LASNPA & WONP-NURT 2017

Report of Contributions

https://indico.global/e/6061

Contribution ID: **6** Type: **Parallel Talk**

Estimation of volumetric dose distribution delivery deviations from dose planned in ^{131}I hyperthyroidism treatment: preliminary results

During more than 60 years of Hyperthyroidism radioiodine treatment has been no general agreement on the applied dose or calculus methodology. The EANM Dosimetry Committee recommend in 2013 an "Standard Operational Procedures for Pre-Therapeutic Dosimetry (SOP)"based on the assessment of the individual ^{131}I uptake and kinetics. To estimate the 3D dose delivery deviations from prescribed dose during patient specific application of this SOP, a computer Matlab application was developed and verified. It was design to execute: radiopharmaceutical curve fitting, cumulated activity calculations, functional thyroid mass estimation, obtain the therapeutic planning activity to warranty the prescribed dose and produce the 3D planning dose map and related dosimetry parameters. 6 patients with 150-400Gy prescribed dose data planning (average 241,67Gy) were analyzed using the developed application. The developed system was verify successfully using a test image phantom and 6 known pharmacokinetics data. The program fitting results were compared with Microcal (TM) Origin (version 6.0), showing not statistical differences ($p < 0.01$). The tridimensional thyroid volume cumulated activity and dose distributions were heterogeneous. 3D dose distribution showed standard deviations between 20.41-108.3Gy (18.01-27.08% of prescribed dose). The differences between maximum and minimum dose value per voxel/MBq were 74-129%, corresponding to 112Gy and 495Gy respectively for the total dose administrated. According to the result, between 50,2% and 71,4% of patient's thyroid will be treat with a dose of DP±20% of planned dose, the rest will be overdose or sub dose.

Conclusions: the 3D treatment planning dose distribution were completely no-homogenous, the significant difference observed should be study in the future more deeply in order to optimized the hyperthyroidism iodine treatment.

Index Terms: optimization, patient's specific treatment, I-131, Hyperthyroidism

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **10** Type: **Poster**

Determination of transmission factors for an ^{85}Kr beta radiation beam using an extrapolation chamber

The ^{85}Kr isotope is a beta-ray emitter (gas) with a half-life of 10.76 years. It is produced in the fission of Uranium and Plutonium. The sources of this isotope are the nuclear tests, the nuclear reactors and the reprocessing of nuclear fuel. In the gas release events around reactors, the ^{85}Kr may represent a major hazard. In beta emitters, in order to evaluate the absorbed dose rate at different tissue depths, it is necessary to determine the transmission factors. In this work, the preliminary results of the determination of transmission factors of the ^{85}Kr source of a BSS2 beta secondary standard are presented. For this purpose, an extrapolation chamber was used. The results obtained are considered acceptable, and they are within the uncertainties, in comparison with the values provided by the source calibration certificate (PTB, Germany). The maximum difference between the results determined in this work and those from the calibration certificate was 3.8%.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **12** Type: **Parallel Talk**

The LUCID-2 detector

Tuesday 24 October 2017 10:30 (30 minutes)

The LUCID-2 detector is the main online and offline luminosity provider of the ATLAS experiment. It provides over 100 different luminosity measurements from different algorithms for each of the 2808 LHC bunches. LUCID was entirely redesigned in preparation for LHC Run 2: both the detector and the electronics were upgraded in order to cope with the challenging conditions expected at the LHC center of mass energy of 13 TeV with only 25 ns bunch-spacing. While LUCID-1 used gas as a Cherenkov medium, the LUCID-2 detector is in a new unique way using the quartz windows of small photomultipliers as the Cherenkov medium. The main challenge for a luminometer is to keep the efficiency constant during years of data-taking. LUCID-2 is using an innovative calibration system based on radioactive 207 Bi sources deposited on the quartz window of the readout photomultipliers. This makes it possible to accurately monitor and control the gain of the photomultipliers so that the detector efficiency can be kept stable at a percent level. A description of the detector and its readout electronics will be given, as well as preliminary results on the ATLAS luminosity measurement and related systematic uncertainties.

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Session Classification: Parallel Sessions - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **13** Type: **Plenary Talk**

Molecular structures in slow nuclear collisions

Friday 27 October 2017 09:00 (30 minutes)

I will report on a quantitative study of the sub-Coulomb fusion of astrophysically important heavy-ion collisions, such as ^{16}O + ^{16}O and ^{12}C + ^{12}C. It is carried out using wave-packet dynamics. The low-energy collision is described in the rotating center-of-mass frame within a nuclear molecular picture [1]. A collective Hamiltonian drives the time propagation of the wave-packet through the collective potential-energy landscape that is calculated with a realistic two-center shell model [2-4]. Among other preliminary results, the theoretical sub-Coulomb fusion resonances for ^{12}C + ^{12}C seem to correspond well with observations. The method appears to be useful for expanding the cross-section predictions towards stellar energies.

1. W. Greiner, J.Y. Park & W. Scheid, in Nuclear Molecules, World Scientific Pub, Singapore, 1995.
2. A. Diaz-Torres & W. Scheid, Nucl. Phys. A 757 (2005) 373.
3. A. Diaz-Torres, L.R. Gasques & M. Wiescher, Phys. Lett. B 652 (2007) 255.
4. A. Diaz-Torres, Phys. Rev. Lett. 101 (2008) 122501.

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Session Classification: Plenary Talks

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **14** Type: **Parallel Talk**

Development of clinically based prediction models using machine learning and Bayesian statistics

The massive development of photon radiation treatment techniques as well as the increase use of Hadron therapy has led to a difficult treatment evaluation since many parameters are in play. At the same time, there has been an increase of cancer clinical data generation in the form of clinical records and imaging data. As a response, biophysical models based on clinical data mining and machine learning are increasingly being developed, with the aim of evaluating clinical effects of radiotherapy treatments.

In this work, the framework for developing generic clinically based models is shown and illustrated with Bayesian statistics neurologic grade prediction models in order to exemplify the type of models that can be developed from a mathematical point of view. The models are based on clinical records of patients who underwent radiotherapy treatment due to glioblastoma which is an aggressive brain cancer. A first model requires as a parameter the neurologic grade of the patient before the treatment then predicts the grade after the treatment. A second, enhanced, model was developed with the aim of making the prediction more realistic and it uses the neurologic grade before the treatment as well, but it additionally depends on the Clinical Target Volume (CTV). Furthermore, with the aid of Bayesian statistic we were able to estimate the uncertainty of the predictions.

These models provide the guidelines for exploration of medical cancer data generated during treatments in order to determine which parameters play an important role in the outcome of clinical effects.

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Presenter: ZAMBRANO-RAMIREZ, Oscar Daniel (Universite Caen Normandie. Laboratoire de Physique Corpusculaire (LPC-Caen). France)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **15** Type: **Parallel Talk**

Methods for Reducing Metal Artifacts in Computed Tomography

Metal artifacts are common in clinical images. Many methods for artifact reduction have been published to overcome this problem. In this work, three well-known methods and a new one were evaluated, compared and enhanced to achieve artifact suppression (linear interpolation (LI), normalized metal artifact reduction (NMAR) and Frequency split metal artifact reduction (FSMAR)). Furthermore, a new method, based on edge-preserving smoothing via L0 Gradient Minimization filter, is presented and compared in results respect the above mentioned methods. Artifacts are caused by metal hips and dental implants. Image quality was evaluated by two experienced radiologists completely blinded to the information about if the image was processed or not to suppress the artifacts. They graded image quality in a five points-scale, where zero is an index of clear artifact presence, and five, a whole artifact suppression. A comparison of the results was carried out. The new method had the best results and it was statistically significant respect to the other tested methods ($p < 0.05$). This new method has a better performance in artifact suppression and tissue feature preservation.

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **16** Type: **Parallel Talk**

Automatic Methods for detecting breast anomalies in digital mammography

Mammography is the gold standard to diagnose breast anomalies at the present; nevertheless, the automatized methods using PC interface are increasing today. They help physicians to give a Breast Imaging Reporting and Data System (BIRADS) classification.
The comparison of some automated methods is presented in this work to detect breast anomalies with good sensibility and specificity on PC, using MATLAB, including glandule reports.
Images from Mini-MIAS database were used. They were improved with some algorithms as median, Laplace, Gaussian or homomorphycal filters, as well as Illumination Correction, Contrast-limited adaptive histogram equalization, and unsharp mask. After that, several methods were tested to segment the breast glandule, micro-calcifications and nodules, fibrous and structural deformations. For segmentation, algorithms based on intensity thresholds, as Multi-class, Three-class, Bi-class and Adaptative Thresholds, and others based on edge detection were tested. Morphological processing was employed to improve quality of images.
Five methods were employed to classify segmented structures: artificial neural network, Bayesian methods, discriminant analysis, Support Vector Machine and KNN with several extraction of image features and descriptors, as entropy, area perimeter and some statistical moments.
Finally, to evaluate the success of the method´s performance, some physicians experienced were able to contour the glandule and detect anomalies to compare results.
The best results were obtained with algorithms as Entropy and multi-class with 4 thresholds.

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **18** Type: **Parallel Talk**

New Clinical and Research Programs in Particle Beam Radiation Therapy: The University of California San Francisco Perspective

The first phase I/II clinical trial involving the application of particle beam radiation therapy (PBRT) with ions heavier than protons up were initiated at the University of California, San Francisco / Lawrence Berkeley National Laboratory (UCSF-LBNL) in 1975 [1–4]. This trial prospectively evaluated tumor responses to PBRT and collected information on the late effects. The last trial extension, submitted to the National Institutes of Health / National Cancer Institute in 1991 by Drs. Castro, Phillips, and others from UCSF-LBNL, was awarded an outstanding score. The main goals of the proposed 5-year extension were: (1) to complete phase II and III trials in selected, specific tumor sites, (eye, paranasal sinuses, skull base, juxtaspinal area, brain, bone, soft tissue, biliary, prostate) and (2) to begin clinical studies with the unique dynamic conformal treatment delivery system available only at LBNL. This would permit 2D-raster scanning to be combined with variable modulation and dynamic collimation, affording a unique opportunity to study the benefits of optimized dose-localization with heavy charged particles.
After tailoring individualized PBRT ion treatments for nearly 2,500 patients over 17 years, the facility at Berkeley Lab was closed by the Department of Energy in 1992, due to budget constraints. Proton beam therapy for uveal melanoma continued at the UCSF-LBNL Crocker Lab, with some noteworthy successes [5]. Following the lead in Berkeley, several other hospital-based heavy ion therapy facilities were developed in Japan, Germany, and Italy [6,7].

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **19** Type: **Parallel Talk**

^{7}Be(p,γ)^{8}B: how EFT and Bayesian analysis can improve a reaction calculation

Monday 23 October 2017 13:30 (25 minutes)

The reaction ^{7}Be(p,γ)^{8}B generates most of the high-energy neutrinos emanating from the pp-fusion chain in our Sun. Over the past twenty years there has been a substantial effort to measure its cross section at center-of-mass energies below 500 keV. One goal of this effort was accurate extrapolation of the astrophysical S-factor to solar energies. I will explain our treatment of this problem (Zhang et al., Phys. Lett. B 751, 535 (2015)), which uses an effective field theory (EFT) for ^{7}Be(p,γ)^{8}B and Bayesian methods to perform the extrapolation. We find a zero-energy S-factor S(0)=21.3±0.7 eV–an uncertainty smaller by a factor of two than previously recommended. This improvement occurs because the EFT encapsulates all plausible low-energy models of the process, and so model selection for this problem can be accomplished in a rigorous and statistically meaningful way.

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Presenter: PHILLIPS, Daniel (Ohio University)

Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **20** Type: **Poster**

Gamma alarm for radiological security

Wednesday 25 October 2017 14:30 (15 minutes)

This paper describes the development of an instrument for Radiological Monitoring and Gamma Alarm (GAMAL01). It monitors the burst of radiation produced during a radioactive accident and triggers an alarm for evacuation in case the radiation exceeds an established threshold. The instrument consists of two sections, analog and digital.

Key words: Geiger Müller counters, data acquisition systems, gamma radiation, radiological protection, dosimetry.

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Session Classification: Poster Session - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **21** Type: **Poster**

Ionizing Radiation Effects in Electronic Devices

Tuesday 24 October 2017 15:00 (15 minutes)

The ionizing radiation absorbed by semiconductor devices can change their properties by modifying the electrical parameters that characterize them and, in the case of memories, processors, can modify the information contained in these devices. In this way, the development of electronic devices resistant to radiation and the qualification of devices confirming that they are more tolerant to the effects of ionizing radiation, require a qualified workforce with the specific knowledge of the physical mechanisms acting on the devices when exposed to the radiation. It is also necessary to know all internationally existing standards for the qualification of devices. Digital systems are often used in space applications to process data, implement control logic, or even store data from sensors. These systems are composed of electronic devices, such as transistors, microcontrollers and microprocessors, which are exposed to ionizing radiation. The use of Field-Programmable Gate Arrays (FGPAs) in aerospace & defense field has become a general consensus among Integrated Circuits (ICs) and embedded system designers. Radiation-hardened electronics used in this domain is regulated under important political and commercial treaties. In order to refrain from these undesired political and commercial barriers COTS FPGAs have been considered as a promising alternative to replace ICs. The development of instrumentation that makes it possible to design new electronic devices, based on new materials and new technologies, as well as knowing how to properly characterize a device, is extremely important for this research area to be self-sufficient in our country. This research project aims to study the effects of ionizing radiation from X-rays, alpha source, protons and heavy ions on electronic devices. The specific objective of the project is to operationalize a system for radiation testing and a methodology for the qualification of electronic devices and components when subjected to radiation doses induced by heavy ions, particles and X-rays. We intend to study the physical phenomena responsible for the effects of radiation and generate training in this strategic area.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **22** Type: **Parallel Talk**

Natural Radiation and Environmental Applications

Tuesday 24 October 2017 10:30 (30 minutes)

Naturally occurring radioactive materials (NORM) are continuous and an unavoidable feature of life on Earth and are present in its crust since its origin. The irradiation of the human body from external terrestrial sources is mainly due to gamma rays coming from natural radionuclides, such as 40K and the elements of the series of 238U and 232Th. These primordial radionuclides present long half-lives, decaying to achieve stability, producing ionizing radiation. It is very important to study radionuclide distribution in soils to understand the radiological implications in relation to the exposure of the human body to ionizing radiation and the knowledge of which components are found in one specific geographic region. Natural background radiation studies are needed to establish reference levels, especially in areas where the risk of radioactive exposure may be higher, and this risk index can be worsened through the soil mineral extraction, generating Technologically Enhanced Naturally Occurring Radioactive Material (TENORM). On the other hand, the secondary effects of natural radiation are also of extreme importance, since the human being feeds on animals and plants, which determine the intake of natural radionuclides. In this work the distribution of natural radiation from Southeastern Brazilian beach sands using gamma-ray spectrometry was studied. In most of the samples studied the dose due to external exposure to gamma-rays, proceeding from natural terrestrial elements, are within the values 0.3 and 1.0 mSv/year, typical range indicated by the United Nations Scientific Committee on the Effects of Atomic Radiation. Gamma-ray technique was used to evaluate the transfer rate of these radionuclides from soil to the plants. Energy-Dispersive X-Ray Spectroscopy (EDS) microanalysis and X-Ray Fluorescence were used also to assist in the sample analysis. The study of natural radiation present in TENORM, plants and food was done. Various chemical processes have been applied in TENORM considering waste samples from extraction of phosphatic rocks, in order to make viable the extraction process and reducing the amount of radioactive waste

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Session Classification: Parallel Sessions - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **23** Type: **Parallel Talk**

Elastic scattering, inelastic excitation and neutron transfer for ^{7}Li+^{120}Sn at energies around the Coulomb barrier

Wednesday 25 October 2017 13:30 (25 minutes)

Experimental angular distributions for the ^{7}Li + ^{120}Sn elastic and inelastic (projectile and target excitations) scattering, and for the neutron stripping reaction, have been obtained at $E_{\rm LAB} = 20$, 22, 24 and 26 MeV, covering an energy range around the Coulomb barrier ($V_B^{\rm (LAB)} \approx 21.4$ MeV). Coupled channel and coupled reaction channel calculations were performed and both describe satisfactorily the experimental data sets. The $\frac{1}{2}^-$ state ^{7}Li inelastic excitation (using a rotational model), as well as the projectile coupling to the continuum (α plus a tritium particle) play a fundamental role on the proper description of elastic, inelastic and transfer channels. Couplings to the one-neutron stripping channel do not significantly affect the theoretical elastic scattering angular distributions. The spectroscopic amplitudes of the transfer channel were obtained through a shell model calculation. The theoretical angular distributions for the one-neutron stripping reaction agreed with the experimental data.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **24** Type: **Parallel Talk**

FAZIA: a new very performant array for heavy ion reactions at Fermi energies

Tuesday 24 October 2017 08:30 (30 minutes)

The FAZIA detector is a new fully digital array based on Silicon(300um)+Silicon(500um)+CsI(Tl)(10cm) telescopes. It is design to study heavy ions collisions in the Fermi energies range using a fully integrated digital electronics. Some details about the construction of this array and about the incredible performance in terms of isotopic separation will be given. Finally, some preliminary results about the isospin physics which can be studied with such powerful tool will be shown.

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Session Classification: Parallel Sessions - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **25** Type: **Parallel Talk**

Shape coexistence phenomena in A∼70 rp-process nuclei within a beyond-mean-field approach

Monday 23 October 2017 13:55 (25 minutes)

Proton-rich nuclei in the A∼70 mass region relevant to the astrophysical *rp-process* manifest exotic structure and dynamics induced by shape coexistence and mixing, competition between like-nucleon and neutron-proton pairing correlations, as well as isospin-symmetry-breaking interactions. Recent results [1-4] concerning the interplay between isospin-symmetry-breaking and shape-coexistence effects on the structure and β-decay properties of N∼Z nuclei obtained within the beyond-mean-field *complex* Excited Vampir variational model will be presented.
Reliable predictions on beyond experimental reach characteristics of these nuclei require realistic description of the experimentally accesible properties. Shape coexistence effects on terrestrial and stellar Fermi and Gamow-Teller β-decay properties of low-lying states and their influence on the effective half-lives of exotic nuclei at the high temperatures of X-ray bursts will be illustrated.

1. A. Petrovici, Phys. Rev. C **91**, 014302 (2015).
2. A. Petrovici and O. Andrei, Eur. Phys. J. A **51**, 133 (2015).
3. A. Petrovici and O. Andrei, Phys. Rev. C **92**, 064305 (2015).
4. A. Petrovici, Phys. Scr. 92, 064003 (2017).

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **26** Type: **Parallel Talk**

Cyclotron production of ^{67}Cu: A new measurement of the ^{68}Zn(p,2p)^{67}Cu, ^{68}Zn(p,2n)^{67}Ga and ^{68}Zn(p,3n)^{66}Ga nuclear cross sections

^{67}Cu is a promising isotope for theranostics, the innovative medical strategy that allows the selection of patients prior treatment and the optimisation of therapy throught a personal dosimetry. The γ-radiation of ^{67}Cu (E = 184.58 keV, I = 48.6%) is suitable for SPECT/CT imaging, while its β-emission (mean E$_{-}$ = 141 keV) and relatively long half-life (61.83 h) permits to follow the slow biodistribution of antibodies, making radioimmuno-therapy its primary application. Since the limiting factor of a widespread use of ^{67}Cu is its availability, the aim of this work is the analysis of ^{67}Cu production by using high-energy and high-intensity cyclotrons, as the one operating at Arronax facility (Nantes, France) and the one recently installed at Legnaro National Laboratories (INFN-LNL, Padova, Italy). The accurate measurement of the ^{68}Zn(p,2p)^{67}Cu cross section in the energy range 35-70 MeV is described in detail, including the realization of enriched ^{68}Zn thin target foils by electrodeposition on silver backing, the stacked-foils target assembly and the radiochemical process to separate Ga from Cu. Indeed, ^{67}Ga (half-life 3.26 d) is co-produced on ^{68}Zn targets via the (p,2n) reaction and presents the same γ-lines as ^{67}Cu, since they both decay into ^{67}Zn. The efficiency of the chemical procedure, is always monitored by using ^{61}Cu and ^{66}Ga radionuclides as tracer isotopes. Results from different irradiation runs show the repeatability of the method and the stability of chemical processing, that can be optimized for massive production with thicker targets. Experimental results on the production of ^{67}Cu, ^{67}Ga and ^{66}Ga are compared with literature data and, if available, with recommended cross sections proposed by the International Atomic Energy Agency (IAEA). Our experimental data are also compared with theoretical estimations obtained by using the TALYS code and different set of parameters (a dedicated talk is also proposed on this topic).

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Presenter: Dr PUPILLO, Gaia (INFN - LNL, Italy.)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **27** Type: **Poster**

Design shielding assessment for a nuclear medicine service

It is recognised worldwide that the security of radioactive materials is very important and that the design of facilities where these sources are used and stored must cater for the implementation of good security measures, including the shielding of some treatment and diagnostic rooms. The radiation protection assessment of a nuclear medicine facility consists of the evaluation of the annual effective dose both to workers occupationally exposed and to members of the public. This assessment take into account the radionuclides involved, the facility features, the working procedures, the expected number of patients per year, the administered activity, the distribution of rooms, the thickness and physical materials of walls, floors and ceilings and so on. The assessment results were compared to the design requirements established by the Cuban regulatory body in order to determine whether or not, the nuclear medicine facility complies with those requirements, both for workers and for members of the public. The evaluation presented is useful for facility designer and for member of regulatory body.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **28** Type: **Plenary Talk**

The Mu2e experiment at Fermilab

Thursday 26 October 2017 10:30 (30 minutes)

The Mu2e Experiment at Fermilab will search for coherent, neutrino-less conversion of negative muons into electrons in the field of an Aluminum nucleus. The dynamics of such charged lepton flavour violating (CLFV) process is well modelled by a two-body decay, resulting in a mono-energetic electron with an energy slightly below the muon rest mass.
If no events are observed in three years of running, Mu2e will set an upper limit on the ratio between the conversion and the capture rates \convrate of $\leq 6 \times 10^{-17}$ (@ 90% C.L.). This will improve the current limit of four order of magnitudes with respect to the previous best experiment.
Mu2e complements and extends the current search for $\mu \rightarrow e\gamma$ decay at MEG as well as the direct searches for new physics at the LHC. This CLFV process probes new physics at a scale inaccessible to direct searches at either present or planned high energy colliders. Observation of a signal will be a clear evidence for new physics beyond the Standard Model.
To search for the muon conversion process, a very intense pulsed beam of negative muons ($\sim 10^{10}\mu/$ sec) is stopped on an Aluminum target inside a very long solenoid where the detector is also located. The Mu2e detector is composed of a straw tube tracker and a CsI crystals electromagnetic calorimeter. An external veto for cosmic rays is surrounding the detector solenoid. In 2016, Mu2e has passed the final approval stage from DOE and has started its construction phase. Data collection is planned for the end of 2021.
An overview of the physics motivations for Mu2e, the current status of the experiment and the required performances and design details of the calorimeter are presented.

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Session Classification: Plenary Talks

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **29** Type: **Parallel Talk**

New results On Proton Tomography from Jefferson Lab

Monday 23 October 2017 13:55 (25 minutes)

Exclusive processes at high momentum transfer, such as Deeply Virtual Compton Scattering (DVCS) access the Generalized Parton Distributions (GPDs) of the nucleon. GPDs offer the exciting possibility of mapping the 3-D internal structure of protons and neutrons by providing a transverse image of the constituents as a function of their longitudinal momentum.
A vigorous experimental program is currently pursued at Jefferson Lab (JLab) to study GPDs through DVCS and meson production. New results from Hall A will be shown and discussed. Special attention will be devoted to the pplicability of the GPD formalism at the moderate values of momentum transfer. In addition, we will report on results for L/T separated pi0 electroproduction cross sections off the proton, the neutron and the deuteron. A large transverse response for both the proton and neutron cases is found, pointing to a possible dominance of higher-twist transversity GPD contributions. For the first time, a flavor decomposition of the u and d quark contributions to the cross section will be shown.
We will conclude with a brief overview of additional DVCS experiments under analysis and planned with the future Upgrade of JLab to 12 GeV.

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Session Classification: Parallel Sessions - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **30** Type: **Parallel Talk**

On the potential of proton dosimetry using Cerenkov radiation in optical fibers

Fiber-coupled scintillators are known to exhibit a nonlinear response to high-LET beams, i.e. ionization quenching. Although corrections may be applied using e.g. Birks'empirical formula such procedures are challenging and may even introduce errors.

Recent studies suggest that Cerenkov light produced in optical fiber cables may be used to circumvent the ionization quenching. The distribution of emitted Cerenkov photons as a function of depth correlates well with the depth-dose profile for electron beams, whereas the agreement is less clear-cut in a proton beam with much fewer charged particles above the Cerenkov energy threshold. Nonetheless, excellent experimental agreements between the Cerenkov radiation and dose distributions have been reported in both electron and proton beams which furthermore motivates this work.

A Geant4 model of the guidance of the Cerenkov photons is in excellent agreement with Cerenkov measurements in an electron beam. The experimentally validated Monte Carlo code is subsequently used to investigate the Cerenkov photon distribution in a proton beam, where the main contribution is from scattered, secondary electrons. Results indicate, that the reported Cerenkov Bragg-peak actually arises from fluorescence.

The Cerenkov light in optical fibers can be used to measure the depth profile of electron beams. The situation is more subtle in proton beams, where hardly any Cerenkov photons are guided to the photomultiplier tube, and the fluorescence signal is orders of magnitude larger.

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Presenter: Mr CHRISTENSEN, Jeppe Brage (Technical University of Denmark)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **31** Type: **Parallel Talk**

Monte Carlo determination of scintillator quenching effect in small radiation fields

Introduction: Fiber-coupled plastic organic scintillator detectors are exceptional for the measurement of the absorbed dose to water in small MV photon beams. This is mostly because of their high degree of water equivalence which results in an almost negligible perturbation of the radiation field. However, these detectors are less ideal when the signal generation and detection is considered. For signal generation it is well known that the light yield per absorbed dose for electrons with energies below approximately 100 keV produces less light than electrons with higher energies, which is the so-called ionization density quenching. Since there are spectral differences when changing from reference field size to small field sizes, the objective of this work is to investigate whether the quenching effect will affect in the same way for the reference field size than for small field sizes.
Materials and Methods: The Birks formalism was used for the determination of the light yield in the scintillators. This formalism was implemented in the Monte Carlo software EGSnrc specifically in its application egs_chamber. A new parameter to quantify the quenching effect was defined as the ratio of the scintillator light yield with quenching and without quenching for every specific field size. The radiation source was a 6MV phase space from the Varian TrueBeam.
Results: The results show that, within the uncertainties, the fluctuation of the quenching effect parameter is negligible regarding the field size.

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **32** Type: **Poster**

Analysis of the radiation effects on some properties of GaAs:Cr and Si sensors exposed to a 22 MeV electron beam

Wednesday 25 October 2017 14:30 (15 minutes)

Nowadays, the experiments related to the High Energy Physics and others fields demand the use of detectors with greater radiation resistance, and the novel material GaAs:Cr had demonstrated excellent radiation hardness compared with other semiconductors. On the basis of the evidences obtained in the JINR experiment with the use of 22 MeV electrons beam generated by the LINAC-800 accelerator, an analysis of the electron radiation effects on GaAs:Cr and Si detectors is presented. The measured I-V characteristics showed a dark current increase with dose, and an asymmetry between the two branches of the behaviors for all detectors. Analyzing the MIP spectra and CCE dose dependence measurements a deterioration process of the detectors collection capacity with the dose increase was found, although the behaviors are somewhat different according to the detector type. The detailed explanation of these effects from the microscopic point of view appears in the text, and are generally linked to the generation of atomic displacement, vacancies and other radiation defects, modifying the energy levels structure of the target material. These changes affect the lifetime and concentration of the charge carriers, and other characteristics of the target material.

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Presenter: Ms TORRES RAMOS, Arianna Grisel (Instituto Superior de Tecnologías y Ciencias Aplicadas (InSTEC))

Session Classification: Poster Session - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **34** Type: **Parallel Talk**

Upgrading a biophysical model to compute radiation-induced indirect damage on a DNA molecule with atomic resolution

The computational approach, also known as computational radiobiology, to study biological effects induced by ionizing radiations on living beings has being commonly used by many research groups in several applications like micro and nanodosimetry, radiotherapy, radiation protection, and space radiation. A group led by Bernal at University of Campinas, Sao Paulo, developed a biophysical model to account for radiation induced direct damage (Bernal et al.[1]). At the moment this model has being extended to account for radiation induced indirect damage. Using liquid water as medium a detailed simulation of physical, pre-chemical and chemical stages of the early DNA damage induced by protons and alpha particles was conducted with Geant4-DNA Monte Carlo simulation toolkit. Two phase-space files were generated, one containing energy deposition events inside the region of interest (ROI), and another one with the position of chemical species produced by water radiolysis from 0.1ps up to 1ns. The information contained in both files was superposed on a genetic material model with atomic-resolution, consisting of several copies of 30-nm chromatin fibers. The B-DNA configuration was used. As a preliminary result the action of the hydroxil radical (·OH) at the deoxy-ribose sugar sites is computed (normally trough hydrogen abstraction). The critical parameter considered for this was the reaction radius, which was calculated from the Smoluchowski's diffusion equation. Single, double, and total strand break yields produced by direct, indirect, and mixed mechanisms are reported.

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **35** Type: **Parallel Talk**

A QCD Lagrangian including renormalizable NLJ terms

Tuesday 24 October 2017 09:00 (30 minutes)

A local and gauge invariant version of QCD Lagrangian is introduced. The model includes Nambu-Jona-Lasinio (NJL) terms within its action in a surprisingly renormalizable form. This occurs thanks to the presence of action terms which at first sight, look as breaking power counting renormalizability. However, those terms also modify the quark propagators, to become more decreasing than the Dirac propagator at large momenta, indicating power counting renormalizability. The approach, can also be interpreted as generalized renormalization procedure for massless QCD. The free propagator, given by the substraction between a massive and a massless Dirac ones, in the Lee-Wick form, suggests that the theory also retains unitarity. The appearance of finite quark masses already in the tree approximation in the scheme is determined by the fact that the new action terms explicitly break chiral invariance. The approach looks as being able to implement the Fritzsch Democratic Symmetry breaking ideas about the quark mass hierarchy. Also, it seems that a link of the theory with the SM can follow after employing the Zimmermann's couplings reduction scheme. The renormalized Feynman diagram expansion of the model is written here and the formula for the degree of divergence of the diagrams is derived. The primitive divergent graphs are identified and the two gloun legs ones are evaluated. The result shows the required gauge invariant transversal structure.

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Session Classification: Parallel Sessions - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **36** Type: **Parallel Talk**

The modeling of reaction cross sections in the production of theranostic radionuclides

Friday 27 October 2017 14:20 (25 minutes)

Recently, a new high-energy (up to 70 MeV) and high-intensity cyclotron has been installed at the INFN-LNL National Laboratories of Legnaro (Padova, Italy). This facility will be soon put in operation and one of its research goals will focus on the production of radioisotopes for medicine and, in particular, theranostics, in the context of the INFN LARAMED initiative.
As research group, we are presently involved in the measurements and modeling of proton-induced nuclear reactions for the production of theranostic isotopes such as 67Cu and 47Sc. A series of measurements have been already performed thanks to a collaboration with the Arronax facility (Nantes, France) and are reported in this very same Symposium by G. Pupillo, L. Mou, et al.
Here we review the theoretical reaction models in a study performed with various codes with the aim to guide, interpret, and support the experiments in the proton-induced reaction measurements. The understanding of reaction cross sections at low-intermediate energies is crucial in this context and requires the knowledge of nuclear models available in different codes, analytical or MonteCarlo, such as EMPIRE, TALYS, FLUKA and others.
The use of nuclear reaction codes is very important to interpret the measurement of production cross-sections and to complete the measurements with estimates of production of contaminants and/or stable isotopes that are difficult to measure, particularly if the measurements have to rely heavily on radiochemical techniques. We will present a general study of different model calculations to simulate isotope production useful in measurements of proton-induced production reactions of the two theranostic radio-isotopes 67Cu and 47Sc.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **37** Type: **Parallel Talk**

Influence of prompt neutron emission on the distribution of charge as a function of the final mass and kinetic energy of fragments from the reaction ^{233}U(nth, f)

Thursday 26 October 2017 15:00 (25 minutes)

Concerning thermal neutron induced fission of uranium 233, using a Monte Carlo simulation, we show how prompt neutron emission from fragments distorts the distribution of charge as a function of final mass and kinetic energy compared with the primary distribution. Since fission discovery, the yield of primary charge (Z), mass (A) and kinetic energy (E), has been one of the objectives of measurements of fragments [1]. However, only the yield of final fragment charge (z), mass (m) and kinetic energy (e), after prompt neutron emission, defined as $Y(z,m,e)$, is accessible in low energy fission [1, 2]. In our Monte Carlo simulation, for each m, we calculate, the average of charge as a function of e. As input for the simulation, we assume that: i) the prompt neutron number (n) decreases linearly with kinetic energy (E), it's equal to the neutron multiplicity (ν) when E is equal to the corresponding average, and it falls to zero at the corresponding maximal value (E_max) [3] and ii) the average of primary fragment charge is proportional to the primary fragment mass (A) and to the charge/mass ratio of fissioning nucleus (92/234). As output of the simulation, we obtain the distribution of final fragment mass (m=A-n), kinetic energy (e=E (1- n/A)) and charge (z=Z). As a result, for a fixed final mass in the region m = 80 - 100, prompt neutron emission produces a negative slope in the curve of average charge as a funtion of e. This result is in agreement with experimental data obtained by Quade et al [1]. Surprisingly, in the region of heavy fragment, contrary to what happens in the mass region m = 80 - 100, the curve of average charge as a funtion of e has a positive slope. In order to compare this results in that heavy mass region, data from experiments with new technologies is expected [2].

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **38** Type: **Poster**

Study of light-particle multiplicities in p + non-fissionable nuclei events in the 0.5 - 2 GeV energy range

Tuesday 24 October 2017 16:00 (15 minutes)

In recent years, the investigation of spallation reactions have caught the attention of scientific community due to their application in the transmutation of nuclear waste by using the Accelerator Driven System (ADS) reactors. Due to the experimental difficulties that nuclear reactions researches face; the study of spallation reaction by using simulation codes is more suitable for generating more complete database for different energy ranges. This work aims to study spallation reactions induced by protons at intermediate energies 0.5 - 2 GeV on non-fissionable nuclei by using the Monte Carlo code: CRISP (Collaboration Rio-Ilhéus-São Paulo). The target nuclei studied were: ^{27}Al, ^{91}Zr, ^{184}W, ^{197}Au and ^{208}Pb, focusing on the last one. Multiplicity of light particles obtained with CRISP was compared with the available experimental data and other Monte Carlo codes involved in the study of spallation reactions, resulting on a quite satisfactory agreement.

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Session Classification: Poster Session - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **39** Type: **Plenary Talk**

Importance of proton drip-line nuclei to nuclear astrophysics

Friday 27 October 2017 09:30 (30 minutes)

Nuclear structure far from stability plays a crucial role in the processes that lead to the formation of the elements. In the specific case of the proton drip-line, its location constrains the path of nucleosynthesis in explosive astrophysical scenarios such as in supernovae and X-ray bursters.
In such scenarios, the density and temperature are so high, that rapid proton capture can occur, and unstable nuclei will be generated up to and beyond the proton drip-line. The path for these reactions depends on the level structure and existence of resonances in proton rich nuclei.
In order to achieve a theoretical understanding of the rapid proton capture (rp) process, the separation energies of proton drip-line nuclei are needed as input in the network calculations.
Direct experiments with unstable nuclei are still challenging, creating an obstacle to our understanding of their structure. However, the observation of proton emission and its theoretical interpretation has made possible to access the nuclear structure properties in the neutron deficient region of the nuclear chart, for nuclei with charges between 50 and 81[1,2]. It has also provided an indirect way to determine separation energies.
Proton radioactivity from nuclei with Z<50 is also of particular interest to estimate the time scale of the (rp) capture path, controlled by the properties of the waiting points isotopes, like for example the nucleus 72Kr, whose properties have not yet been constrained by direct measurements. The knowledge of the proton separation energies, and half-lives of the neighbour nuclei, would allow to establish the most probable path through 72Kr. This can be achieved
analysing the decay properties of Rb isotopes, recently produced at Riken [3].
It is the purpose of this talk to discuss recent developments in the field, and deduce constraints to the astrophysical processes.

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3. H. Suzuhi, et al. to be published.

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Session Classification: Plenary Talks

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **43** Type: **Parallel Talk**

Particle Accelerators to Study Radiation Effects in Electronic Devices

Monday 23 October 2017 14:20 (25 minutes)

Electronic devices are strongly influenced by radiation and the need for radiation tolerant devices is growing for applications in environments with high radiation dose [1]. The effects due to radiation on electronic components are mainly: Total Ionizing Dose (TID), Displacement Damage (DD), and Single Event Effects (SEE). TID is a cumulative effect that changes the characteristics of electronic devices. DD can change the arrangement of the atoms in the lattice, modifying also component electrical properties. SEE can be a transient effect in which free charge, generated by heavy-ions directly into the device, may provoke data corruption or even a permanent device failure. In order to study TID radiation effects in electronic devices subjected to proton beams, is used a 1.7 MV 5SDH Pelletron accelerator of São Paulo University, which can produce proton beams with energies up to 3.0 MeV [2]. In order to study SEE at the 8.0 MV São Paulo University Pelletron accelerator, a new beam line was mounted to test electronic devices with heavy-ion beams [2]. The heavy-ion beam characteristics follow the requirements to test electronic devices for SEE recommended by the European Space Agency (ESA). This setup is being currently used to provoke failures in integrated circuits and to test the performance of redundancy and correction algorithms in FPGAs.

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Authors: MEDINA, N.H. (Instituto de Física da Universidade de São Paulo); ADDED, N. (Instituto de Física da Universidade de São Paulo); AGUIAR, V.A.P. (Instituto de Física da Universidade de São Paulo); MACCHIONE, E.L.A. (Instituto de Física da Universidade de São Paulo); SILVEIRA, M.A.G. (Centro Universitário da FEI, São Bernardo do Campo); DOS SANTOS, R.B.B. (Centro Universitário da FEI, São Bernardo do Campo); GIACOMINI, R. (Centro Universitário da FEI, São Bernardo do Campo); VARGAS, F. (Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre)

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Session Classification: Parallel Sessions - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **44** Type: **Poster**

The extended source efficiency correction to measure norm concentrations using a HPGe detector

Tuesday 24 October 2017 15:15 (15 minutes)

The objective of the experiment is to measure NORM (Naturally Occurring Radioactive Material) in natural samples and calculate their concentrations. For this purpose, experiments detecting the radiation of several gamma-ray calibration sources located at different positions around an HPGe detector were conducted. The efficiency calibration curve for each position was obtained, a piece of information useful to determine the concentration of radionuclides within an extended source. To perform the validation of the results an IAEA reference standard (40K) was placed in different geometries within the volume of a lead shield together with the HPGE detector and the efficiency correction was considered to determine the concentration of radioactive material. The measurement of the 40K concentration was compared with the activity concentration values reported in the calibration certificate of the reference standard. The usefulness of this work is to measure NORM in natural samples to calculate their activity concentration without using the comparison with a reference standard.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **47** Type: **Parallel Talk**

Determination of the ^{6}He nuclear radius from the total reaction cross section

Wednesday 25 October 2017 13:55 (25 minutes)

Nuclear reactions induced by neutron-rich radioactive beams have opened new possibilities for studying nuclei far from stability line [1]. The increase of the reaction cross-sections for neutron rich nuclei compared to the stable nuclei can be attributed to their larger nuclear radii. In order to observe this effect a systematic investigation of total reaction cross sections from elastic scattering measurements using the ^{9}Be target and tightly bound, weakly bound and exotic projectiles have been performed [2]. In particular, the ^{6}He+^{9}Be exotic system shows large values of the reaction cross section compared to reactions induced by stable weakly bound projectiles [1,2]. For this light system, the Coulomb interaction is smaller than nuclear interaction. Thus, the Coulomb breakup of the projectile is expected to have less influence. Another study was carried out to verify the dependence of the observed enhancement as a function of the target mass. The analysis was extended to the ^{6}He scattering on light, medium and heavy mass targets. The results showed a weak, but considerable, enhancement in the total reaction cross section for ^{6}He+^{9}Be system in comparison to ^{6}He scattered on heavy targets [2]. From the total reaction cross sections values, the ^{6}He nuclear interaction radius are extracted using a new method employing a simple geometric relation [3]. A comparison with the radius of the ^{6}He obtained at higher energies is presented.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **48** Type: **Poster**

Study of the ^{8}Li elastic scattering at low energies

Tuesday 24 October 2017 16:00 (15 minutes)

The study of nuclei out of the line of stability has been one of the main fields of research in low energy nuclear physics [1]. Light exotic nuclei such as 6He, 11Be, 11Li, 8B and others are produced in laboratory [2-4] and present new interesting phenomena such as the Borromean structure and the neutron and proton halos [5]. Nuclei like 7Be [6] and 8Li are not so exotic, however, may have much interest in both, nuclear structure and in nuclear astrophysics aspects [7]. The synthesis of heavy elements in stars, has to overcome the mass gaps A=5 and A=8 for which there are no stable elements. For A=8 there are two bound nuclides, 8Li and 8B, which are mirror nuclei, and have half-lifes of arround 800 ms. The presence of these nuclei in stars could affect the nucleosynthesis of heavy elements up to 12C. In addition, nuclear data about nuclei A=8 is very scarce. This work propose measurements of 8Li elastic scattering on several targets: 9Be, 27Al, 58Ni, and 120Sn at laboratory energies from 16 to 32 MeV. Elastic scattering angular distributions at these energies will provide information about the nuclear potential. The interplay between Coulomb and nuclear effects can be investigated, as a function of the target mass. In addition, measurements with the light target 9Be may provide important spectroscopic information of the proton transfer reaction 9Be(8Li,9Be). The measurements will be performed at University of Sao Paulo, using the 8Li beam produced by the RIBRAS (Radioactive Ion Beams in Brasil) facility [8].

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Session Classification: Poster Session - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **50** Type: **Poster**

Thermal-hydraulic study using CFD codes of new nuclear fuel alternatives (UN and UC) for the HPLWR

Wednesday 25 October 2017 14:30 (15 minutes)

The High Performance Light Water Reactor is one of the most promising concepts of the Fourth-Generation reactors. Uranium mono nitride (UN) and Uranium mono carbide (UC) as nuclear fuel alternative for the HPLWR, offer the advantage of high thermal conductivity as compared to UO_2. The use of coating can solve the problems of the reactive nature for UN and UC which arise when these fuels are used in light water thermal reactors. In this paper, a thermal-hydraulic study of the HPLWR fuel assembly, for UO_2, UN and UC, using Computational Fluid Dynamics (CFD) codes was carried out. The use of UN coated with ZrC layers and UC coated with TiN layers and the changes of the fuel thermal conductivity with the porosity were also studied. The radial and axial temperature distributions in the fuels were obtained for all the cases. The maximum temperature values obtained using UN and UC, (coated and uncoated), were lower than those obtained with UO_2. The fuel porosity changes have little influence on the fuel maximum temperature using UN and UC, while using UO_2 the maximum temperature increases in 511 K with a 0.2 % porosity increase.

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Session Classification: Poster Session - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **52** Type: **Plenary Talk**

The Interaction of Neutrons With ^{7}Be: Lack of Standard Nuclear Physics Solution to the "Primordial ^{7}Li Problem"

Friday 27 October 2017 11:00 (30 minutes)

The accurate measurement of the baryon density by WMAP renders Big Bang Nucleosynthesis (BBN) a parameter free theory with only inputs from measurements of the relevant (12 canonical) nuclear reactions. BBN predicts with high accuracy the measured abundance of deuterium, helion and helium relative to hydrogen, but it over-predicts the abundance of 7Li relative to hydrogen by a factor of approximately three and more than three sigma difference from the observed value. This discrepancy was observed early on (more than thirty years ago) and is known as the "Primordial 7Li Problem". Several attempts to reconcile this discrepancy by destroying 7Be with deuterons and helions or a conjectured d + 7Be resonance were ruled out as solutions of the 7Li problem. But the interaction of 7Be with neutrons that are also prevailing during the epoch of BBN, was not directly measured thus far in the BBN window. Also a hitherto unknown n + 7Be narrow resonance in 8Be at energies relevant for the BBN window was not yet ruled out. A worldwide effort for measuring the interaction of neutrons with 7Be is currently underway. We will discuss a measurement in the new neutron facility at the Soreq Applied Research Accelerator Facility (SARAF)
in Israel, that covers the "BBN energy window"with T = 0.5 - 0.8 GK and kT = 43 - 72 keV. We measured a significantly small upper limit on the 7Be(n,a) reaction and the first measurement of the 7Be(n,g1)8Be*(3.03 MeV) reaction (Ea = 1.5 MeV). Our measurement allow us to re-evaluate the so designated "7Be(n,a) reaction rate"first derived by Wagoner in 1969 and still used in BBN calculations. Our evaluated new rate demonstrates that the last possible avenue (of the n + 7Be interaction) for a standard nuclear physics solution of the 7Li problem does not solve the problem. We conclude on lack of standard nuclear physics solution to the "Primordial 7Li problem".

- Work supported by the U.S.-Israel Bi National Science Foundation, Award Number 2012098, and the U.S. Department of Energy, Award Number DE-FG02-94ER40870.

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Session Classification: Plenary Talks

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **53** Type: **Poster**

Assessment of radiological monitoring network well location through back trajectories

Wednesday 25 October 2017 15:15 (15 minutes)

Air quality models are an important tool to assess the responsibility for existing air pollution levels through the evaluation of source-receptor relationships. Back trajectories have frequently been used to identify potential source areas of air pollutants and to clarify their respective contribution at receptor sites.

CALMET/CALPUFF modelling system is well known, and several validation tests were performed until now. This system has a Back Trajectory Analysis Module that creates plots of back trajectories corresponding to user specified air quality events and locations. Each path is initiated for a particular location and starting time. Then the path of some air parcel that impacts that location at that time is mapped back in time to identify potential transport patterns and source regions associated with some air quality event.

In this work, the Back Trajectory Analysis Module of CALMET/CALPUFF system is apply in order to assess the well location of a hypothetical radiological monitoring network around the location of the major potential source of radioactive pollutants to guarantee the detection of a possible accidental spill. In this case study Havana Airport was considered the source. Eight radiological monitoring stations were placed 20km from the source arranged according eight directions (N, NE, E, SE, S, SW, W, NW). The study was conducted during a typical dry season.

As result was obtained that detection is unlikely in two stations (N and S) due to the distance between source and receptor. The remoteness of the source causes three stations (NE, E and SE) to remain blind during the complete season. Only three stations (NW, W and SW) probably will detect radioactivity during the season selected.

The nearness of the radiological monitoring station to the potential source of radioactive pollutants should be taken in account considered to guarantee the detection of a possible accidental spill regardless of the period studied.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **55** Type: **Parallel Talk**

Alpha-transfer Reaction in Combination with Transient Field Technique and DSAM to Measure Magnetic Moments and Life-Times in ^{110}Sn and ^{106}Cd

Tuesday 24 October 2017 13:30 (25 minutes)

Studies on magnetic moments and life-times of exotic nuclei have unveil properties which have leaded to the deeper understanding of the nature and behavior of the nuclear potential. During last years, the alpha-transfer technique has been useful for the study of properties of nuclear species which cannot be created with the current radioactive beam facilities. One of these characteristics, the magnetic moment of short life-time spin-states, had always been a huge challenge because several difficulties such as the alignment of the nuclear spin along a quantum axis. The Transient Field technique allows the measurement of nuclear magnetic moments using the variations of the angular distribution of the emitted gamma-ray radiation, from the state of interest, with a resolution around mrad. In addition to the latter, the Doppler Shift Attenuation Method allows to establish the life-time of excited nuclear states. In this work the measurement of the 2^+ and 4^+ spin-states of the deficient-neutron ^{110}Sn and the life-time of the ^{106}Cd excited spin-sates will be presented, the experimental technique makes use of the alpha-transfer reaction in combination with Transient-field technique and DSAM.

Keywords: Alpha transfer, Transient Field, Coulomb excitation, DSMA, life-time, magnetic moments.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **56** Type: **Poster**

A hybrid linear-discontinuous spectro-nodal method for one-group unidimensional fixed source discrete ordinates problems with isotropic source

Tuesday 24 October 2017 16:00 (15 minutes)

Nowadays, much attention has been given to the problem of obtaining accurate numerical solutions of fixed source discrete ordinates problems. In this work, we described and tested four different numerical methods to solve one-group unidimensional discrete ordinates problems. First, we derived the Diamond Difference (DD) method, next it´s implemented the Linear Discontinuous (LD) and Spectral Green Function (SGF) methods and finally, we obtained the hybrid Linear-Discontinuous Spectro-Nodal (LD-SN) method for discrete ordinates problems. These methods are based on the use of the standard balance equations, which holds in each spatial cell and for each discrete ordinates direction, and consider four different auxiliary equations for the cell-average angular flux. Numerical results of benchmarks are given to illustrate and compare the methods'accuracy. SGF demonstrated be the best method with no spatial truncation errors, follow by LD-SN, LD and DD, respectively. The LD-SN results proved be better than SGF in computational storage and numerical calculation per direction and per iteration.

Keywords: fixed source problems, discrete ordinates, hybrid linear-discontinuous spectro-nodal

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Session Classification: Poster Session - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **57** Type: **Poster**

Thermo-hydraulic study using CFD from the core of a Pebble Bed Reactor (HTR-10)

Tuesday 24 October 2017 16:00 (15 minutes)

Very High Temperature Reactor (VHTR) designs of Generation IV, offer promising performance characteristics; they can provide sustainable energy, improved proliferation resistance, inherent safety, and high temperature heat supply. The 10MW High Temperature Reactor-Test Module (HTR-10) is a pebble bed reactor (PBR). To achieve the commercialization of these reactors in the nuclear industry, it is necessary to take into account very important factors such as safety, because the investigation of their thermo-hydraulic characteristics is a key tool for the design and safe operation of VHTR. Currently the use of codes of Computational Fluid Dynamics (CFD) for the deterministic safety analysis of nuclear reactors have been increased, because it is a tool able to describe in detail the thermal-hydraulic phenomena occurring in the cooling system of the reactor core. In this paper from CFD models (porous and / or realistic) is described with good accuracy the thermal-hydraulic behavior of the reactor core HTR-10 at steady state and the results are compared with a benchmark. The maximum temperature values in the porous medium model were reached at the reactor core outlet, specifically in the central zone. Therefore, the realistic simulation was performed in that region, in order to verify the behavior of the maximum temperature reached by the fuel, which do not exceed the allowable limit for this type of nuclear fuel. The results obtained are consistent with the results presented by other authors using other techniques and simulation models.

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Session Classification: Poster Session - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **58** Type: **Parallel Talk**

Status and prospects of the SoLid neutrino experiment

Tuesday 24 October 2017 11:30 (30 minutes)

The SoLid experiment intends to search for active-to-sterile anti-neutrino oscillation at very short baseline from the SCK•CEN BR2 research reactor (Mol, Belgium). A novel detector approach to measure reactor anti-neutrinos was developed based on an innovative sandwich of composite polyvynil-toluene and ^{6}LiF:ZnS scintillators. The system is highly segmented and read out by a network of wavelength shifting optical fibers and silicon photomultipliers (SiPMs). This detector will have few passive shielding, relying on its volume segmentation and robust neutron identification capabilities to reject the backgrounds components of the experiment and provide a precise measurement.
We will describe the principle of detection and the detector design. Results from the first full scale detector prototype (SM1) measurements will be presented. Particular focus will be made on the current status and the expected results of the SoLid experiment. The SoLid Phase I is planing to start data taking in fall 2017 and will be able to provide important results to clarify the so-called Reactor Antineutrino Anomaly.

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Session Classification: Parallel Sessions - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **61** Type: **Plenary Talk**

Recent Higgs results by the ATLAS experiment and future prospects

Thursday 26 October 2017 08:30 (30 minutes)

Five years ago, particle physicists announced the discovery of the Higgs boson, the last missing ingredient in the Standard Model.
Since then, the enormous wealth of data collected by the ATLAS experiment has allowed us to zoom in on the properties of this fundamental scalar that is linked to electroweak symmetry breaking, a fundamental ingredient in the model that describes the elementary particles. I will present the latest results on its properties like the mass, width, observation of different decay channels and coupling(structure) and discuss their implications in the context of the Standard Model. Because of the special role of the Higgs boson, the precision measurements can be used to look for physics beyond the Standard Model that are expected to show up at the TeV energies the LHC can probe, by looking for inconsistencies between the predicted and observed properties. I will discuss our strategy, the impact current limits have on these models and describe what new Higgs boson decay channels and properties we hope to be able to observe in the current LHC run(s).

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Session Classification: Plenary Talks

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **62** Type: **Parallel Talk**

Radiation-Hard Silicon Detectors and the ATLAS HL-LHC-Upgrade

Monday 23 October 2017 13:30 (25 minutes)

The experiments at the Large Hadron Collider (LHC) at CERN are in need of major detector upgrades to cope with the increased luminosity of the High-Luminosity Upgrade of the LHC. In order to cope with the massive increases in track densities, event rates and radiation damage, the entire Inner Tracker of the ATLAS experiment will be replaced. This presentation outlines the huge challenges of this task, and discusses methods to increase the radiation hardness of silicon particle detectors. An overview of radiation-hard silicon detector technologies will be given.
The technological choices made for the ATLAS Upgrade will be shown and motivated, and the layout and expected performance of the new ATLAS Inner Tracker will be presented.

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Session Classification: Parallel Sessions - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **65** Type: **Poster**

Investigating flattening filter free mode for peripheral lung stereotactic body radiation therapy

Purpose: The flattening filter free (FFF) mode (Elekta) was recently installed at our institution. We investigated FFF planning and delivery for stereotactic peripheral lung treatment as the increased dose rate of FFF mode can reduce the treatment time.
Methods: Ten lung cancer patients with peripheral lesions previously treated with VMAT SBRT were selected to span a range of target sizes and locations. Three additional plans were created for each patient: two 3D conformal plans with 6 MV conventional flattening filter (cFF) and FFF beams, and a VMAT plan with 6 MV FFF. Beam on time was measured for the VMAT plans and estimated for the 3D conformal plans.
Results: FFF VMAT plans met our institutional planning criteria with no or minimal changes to the optimization parameters. The FFF VMAT plans required 5.0 minutes less (median) delivery time (range 2.3 to 10.1 min) compared to cFF VMAT plans. The median effective dose rate for cFF VMAT was 533 MU/min (range 510-562) and for FFF VMAT was 1144 MU/min (range 934-1406) compared to maximum dose rates of 590 MU/min and 1550 MU/min respectively. FFF conformal plans met planning criteria and had an estimated median time savings of 2.5 min (range 2.0-3.3) compared to conformal plans using the cFF beam.
Conclusions: Acceptable peripheral lung SBRT plans can be produced with the FFF beam using both 3D conformal and VMAT techniques. Median time savings of 5.0 and 2.5 minutes for VMAT and 3D conformal plans were achieved compared to using the cFF beam.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **66** Type: **Parallel Talk**

Optimization and experimental characterization of a 3 points plastic scintillator dosimeter

Purpose: This study is devoted to optimize and characterize the response of a multipoint plastic scintillator detector (mPSD) for in vivo dosimetry.

Methods: A 3 points mPSD was constructed and characterized in terms of response to interacting ionizing photons.The detector was composed of BCF-60, BCF-12 and BCF-10 scintillating fibers, separated from each other by segments of clear optical fibers.Some configurations were constructed in order to determine the appropriate scintillator position to the photodetector (distal, center or proximal), as well as their width as function of the scintillation light emitted and spatial resolution.Each scintillator contribution to the total spectrum was determined using lead shielding.For the best configuration, measurements were conducted at 120, 220 kV, 6 MV as well as with an 192Ir HDR Brachytherapy source, and parameters such as SNR, energy and angular dependence were evaluated.

Results: It was determined that BCF-60 should be placed at the distal position, BCF-12 in the center and BCF-10 at proximal position respect to the photodetector.This configuration allowed: to avoid the inter-scintillator excitation, signal self-absorption and optimizing the light transmission through the collecting fiber.For the same scintillator width, it was observed that the scintillation process is more efficient in BCF-10, being the optimal width found 3, 6 and 7 mm for BCF-10,12 and 60 respectively.As expected no energy or angular dependence were observed.SNR analysis demonstrates that up to a source –mPSD distance of 5 cm, our system is sensitive enough to perform HDR brachytherapy dose quantification.

Conclusions: An optimized 3 points mPSD was designed and characterized in this work based on the spectral response at different conditions, constituting a baseline for future applications. Measurements with 192Ir evidenced that this detector could be a promising alternative for in vivo dosimetry in brachytherapy.

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **67** Type: **Poster**

Study of angular dependence in Fiber Optic Dosimetry by Monte Carlo simulations

Real-time dosimetry for radiotherapy with high spatial resolution is a growing research field. Development of new radiotherapy techniques, such as intensity-modulated radiation therapy, stereotactic radiosurgery, and high dose rate brachyterapy among others, require high performance dosimetrics techniques. Even though different kinds of detection systems have been investigated to perform in-vivo dosimetry, most of them do not permit simultaneously spatial resolution, real-time dose assessment and intracavitary measurements.
The so-called fiberoptic dosimetry (FOD) technique has shown to meet most of these requirements mostly needed in radiotherapy [1]. FOD is based on the use of a tiny piece of a scintillation crystal (1mmˆ3 aprox) attached to the end of an optical fiber [1]. The fiber collects the light emitted by the scintillator during irradiation (radioluminescence, RL) and a light detector at the other end of the optical fiber measures its intensity. FOD technique allows for in-vivo and real-time dose assessment, and due to the small size of the detector it not only permit accurate measurements in regions of high dose gradients but also intracavitary measurements [2].
Martinez et al. [3] observed angular dependency of the scintillating signal when cylindrical detectors are employed as usual in this technique.
In the present work, we study the angular response of a YVO_4:Eu^{3+} based FOD probe by using Monte Carlo simulations in order to explain the different attenuation process.
Two geometrical configurations have been studied: 1mm diameter spherically shaped detector, and 2mm length-1mm diameter cylindrical detector. Simulations have been achieved by using PENELOPE employing an hybrid virtual source model based on IAEA phase space data base. In both cases results have been compared with experimental measurements.

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2. Spasic, E., et al., 2011. Intracavitary in vivo dosimetry based on multichannel fibercoupled radioluminescence and optically stimulated luminescence of Al2O3:C. In: IEEE Conference Publication. 2nd International Conference on Advancements in Nuclear Instrumentation Measurement Methods and Their Applications (ANIMMA), pp. 1-6.
3. N Martinez, et al., 2017. Characterization of YVO4:Eu3+ scintillator as detector for Fiber Optic Dosimetry. Radiation Measurements, in press.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **68** Type: **Parallel Talk**

Kicks of magnetized strange quarks stars induced by anisotropic emision of neutrinos

Tuesday 24 October 2017 11:00 (30 minutes)

Beta disintegration is studied in the presence of a magnetic field, which imposes a preferential direction on the emission of neutrinos. It is explored the possibility that this anisotropy in neutrino emission can account for observed Neutron (Quarks) Star velocities (kicks). The conditions under which the anisotropic emission of neutrinos (due to the magnetic field present in the system) causes a "kick" of the compact star are discussed. The matrix element for the beta decay process is computed from first principles taking into account the W boson propagator in presence of a strong magnetic field. The neutrino emissivity is also computed.

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Session Classification: Parallel Sessions - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **70** Type: **Parallel Talk**

Rare Ion Beams in Brazil

Wednesday 25 October 2017 09:30 (30 minutes)

The "Radioactive Ion Beams in Brasil"(RIBRAS) facility is the first device in the Southern Hemisphere to produce unstable secondary beams. It is in operation since 2004 and it consists of two super-conducting solenoids of maximum magnetic field B = 6.5T, coupled to the 8UD-Pelletron tandem Accelerator installed at the University of São Paulo Physics Institute. The radioactive ions produced by in-flight transfer reactions of stable projectiles, are selected and focalized by the solenoids into a scattering chamber. Low energy (3-5 MeV/u) radioactive beams
of ^{6}He, ^{8}Li, ^{7,10}Be, ^{8,12}B are produced currently and used to study elastic, inelastic, and transfer reactions on a variety of light, medium mass and heavy secondary targets. The 2n halo ^{6}He and the 1p halo ^{8}B are particularly interesting to study the role of the halo on the elastic and total reaction cross sections.
Since 2012 RIBRAS can produce purified beams, using both solenoids with a degrader between them. The use of purified beams opens new possibilities, as the resonance scattering studies using inverse kinematics, examples are the (p,p), (p,d), and (p,α) reactions using an ^{8}Li beam hitting thick CH 2 targets to measure their excitation functions. The spectroscopy of the highly excited states of ^{9}Be were studied in this way.
Fusion reactions are also possible with purified beams, we are programming to measure the fusion cross section by activation and off-line gamma-spectroscopy, and also by on-line particle-gamma coincidence. The interest is to study the influence of the 2n-halo structure of ^{6}He on the fusion process. Our Cuban colleague Ivan Padron who spent a year in Sao Paulo put a large (2mx2m) position sensitive neutron detector, also called neutron wall, in operating conditions.
It can be used to measure break-up processes of neutron rich radioactive beams hitting a secondary target.
The installation of RIBRAS has opened many new possibilities to our Pelletron laboratory even approaching the frontiers of nuclear physics, demonstrated by the large number of publications and participations in international conferences.

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Session Classification: Plenary Talks

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **71** Type: **Parallel Talk**

Gamma-ray spectroscopy of the heaviest nuclei at the JAEA-Tokai Tandem laboratory, using ^{249}Cf and ^{254}Es targets

Tuesday 24 October 2017 13:55 (25 minutes)

The spectroscopy of heavy nuclei near the N=152 and N=162 deformed shell gaps provides precious information to improve current predictions of long-lived super-heavy elements in the Island of Stability. Due to deformation, in fact, substates of spherical orbits in the island of stability can be found near the Fermi level in these lighter systems. At the JAEA-Tokai Tandem accelerator, the first in-beam γ-ray spectroscopy of ^{252}Fm (Z=100, N=152) was attempted. ^{252}Fm was produced via the multi-nucleon transfer reaction ^{249}Cf(^{12}C,^{9}Be) respectively at 75 and 77 MeV. The target radioactivity was nearly 150 kBq. The target chamber was surrounded by a new particle-gamma detection setup, comprising an array of Silicon detectors to detect and identify the light reaction ejectiles, and a mixed array of four Germanium and four $LaBr_3$(Ce) detectors, with an absolute photopeak efficiency of nearly 30% at 150 keV. γ-ray transitions from ^{252}Fm were discriminated by the coincident detection of ^{9}Be. The analysis revealed candidate peaks for ^{252}Fm E2 transitions in ground-state rotational band. The implications of this measurement and future plans using a ^{254}Es target will be presented.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **73** Type: **Poster**

New stage on the neutronics and thermal hydraulics analysis of a Small Modular Reactor core

Wednesday 25 October 2017 15:30 (15 minutes)

Building on the success of the large nuclear plants, SMRs offer the potential to expand the use of clean, reliable nuclear energy to a broad range of customers and energy applications. In this work, a model to describe the neutronics parameters of a SMR core that can produce up to 530 MW of thermal power was developed. Using this model, several configurations of fuel enrichment to obtain the most homogeneous distributions of the power inside the fuel assemblies during all the core lifetime were studied. Temperature reactivity coefficients and mass variation of the principal isotopes for the optimized core were calculated. Finally, thermal hydraulics studies of the highest temperature section in the core was performed to obtain the temperature distributions in the fuel, in the moderator and the radial temperature distribution inside the hottest pin of the fuel assembly was obtained.

Authors: CECILIA BETANCOURT, Mariana (InSTEC); Dr ROSALES GARCÍA, Jesús Alberto (InSTEC); ROJAS MAZAIRA, Leorlen (UFPE); Dr GARCÍA HERNÁNDEZ, Carlos (InSTEC); Prof. BRAYNER DE OLIVEIRA LIRA , Carlos (UFPE); Prof. BEZERRA DA SILVA, Jair (UFPE)

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **74** Type: **Poster**

Neutronics Analysis of a Small PWR using TRISO fuel particles with MCNPX

Wednesday 25 October 2017 15:45 (15 minutes)

Tri-structural Isotropic (TRISO) based fuel with SiC matrix can be used in Light Water Reactors (LWRs) for enhancing its safety features in extreme situations. Besides the simplification of the design, the utilization of TRISO fuel particles in PWR technology enhances its integrity by confining the radioactive fission products within fuel itself during the reactor operation. In this work, the preliminary conceptual design of a small PWR core using TRISO fuel was carried out. The neutronic simulation of the core is carry out using MCNPX program version 2.6e. This reactor produces 25MW of thermal power and with approximately 4 years of effective full power years. A multifactorial statistical study about the influence of three parameters in the effective multiplication coefficient value was carried out; particles size, fuel enrichment and packing fraction. The core was optimized in order to obtain in the first load the necessary excess of reactivity to reach the cycle duration. The power distributions in the first load and at the end of the cycle were obtained, with a total maximum power peaking factor of 2.55. The integral effectiveness of the absorber rods and the energetic spectrum in the most important cycle states were calculated.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **75** Type: **Poster**

The association of CT dosimetric quantities with clinical operational factors: basis for specific optimization strategies

The motivation of this analysis was the knowledge of quantitative association between CT dosimetric quantities and operational factors and devise scanner-specific optimization strategies. The measure of indexes of kerma free in air and in standard phantoms (in a Siemens Sensation CT scanner), provided the main data for identification of statistical associations with operational factors and x-ray spectrum estimation. The association between the CT air kerma index free in air at isocenter, and the x-ray-tube potential, corresponds to a power law function with power coefficients of 1.65 –2.80 in average, for different combinations of tube current time product and total collimation. The average kerma quantity for the periphery of the standard CT dosimetry phantom was linearly associated with the CT air kerma index measured at the center of the same phantom. The linear model parameters were 1.05 and 1.91 in average for standard phantoms with diameters of 160 and 320 mm respectively. The was associated linearly with its primary component, the latter estimated by attenuating the computed primary x ray spectrum, with constant total collimation for each case. The equivalent water diameter estimated was into a range of 67 –75 mm and 136 –144 mm among all operational factor combinations for standard phantoms of 160 and 320 mm respectively. This allows gaining insight into its association with dosimetric quantities for optimization purposes. The descriptive analysis of CT dosimetric quantities and its association with clinical operational factors allows gaining insight in the ability to devise model based optimization strategies.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **77** Type: **Poster**

Characterization of a Multichannel Analyzer Implemented with FPGA Board.

Wednesday 25 October 2017 14:30 (15 minutes)

In this work the characterization of a multichannel analyzer conceived in the CEADEN and developed on the basis of an FPGA, is presented. The system consists of 2048 channels; 32 000 counts per channel at most; 4.5ns of sampling time and a dead time of 16ns. A differential non-linearity (DNL) of +3.62 ± 1.56 and a non-integral linearity (INL) of +0.29 ± 0.05, in addition with the increase of the counting rate the channel of the centroid of the peak moves 64 channels as an average towards the left Of the spectrum, while the FWHM of the peaks remains practically constant between 7 and 8 channels. The spectra obtained for radiation sources are in correspondence with the characteristics of each source. In summary these features ensure that this multi-channel analyzer can be used in nuclear spectrometry.

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Session Classification: Poster Session - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **78** Type: **Parallel Talk**

Clustering structure and possible effects in reaction dynamics forming the ^{46}Ti* nuclear system.

Wednesday 25 October 2017 14:20 (25 minutes)

Heavy ion nuclear reaction studies are an important tool to observe and disentangle different and competing mechanisms, which may arise in the different energy regimes. In particular, at relatively low bombarding energy the comparison between pre-equilibrium and thermal emission of light charged particles from hot nuclei is interesting. Indeed, nuclear structure of the interacting partners and reaction dynamics may be strongly correlated, especially at energies close to the Coulomb barrier, and it emerges when some nucleons or clusters of nucleons are emitted or captured [1].
In particular, a major attention has been devoted, in the last years, to the possible observation of cluster structure effects in the competing nuclear reaction mechanisms [2], especially when fast processes are involved.
At this purpose, the four reactions ^{16}O+^{30}Si at 111 MeV, ^{16}O+^{30}Si at 128 MeV, ^{18}O+^{28}Si at 126 MeV and ^{19}F+^{27}Al at 133 MeV have been measured, to study the onset of pre-equilibrium in an energy range where, for central collisions, complete fusion is expected to be the favorite mode. Experimental data were collected, using the GARFIELD+RCo array, fully equipped with digital electronics [3], at Legnaro National Laboratories.
Following the identification of particles and the energy calibration procedures, the complete analysis has been performed on an event-by-event basis. Experimental data are compared to some theoretical predictions: in particular, both dynamical models based on either Stochastic Mean Field (Twingo [5]) or Anti-symmetrized Molecular Dynamics (AMD [4]) and/or fully statistical model (Gemini++ [6]) have been considered. Events generated through these codes are filtered through a software replica of the setup, in order to take into consideration any possible distortions of the distributions due to the finite size of the apparatus.
Differences between the experimental data and the predicted data, which are based on very different physical assumptions, can evidence possible entrance channel effects, which may be due to the cluster nature of the colliding partners.
After a general introduction on the experimental campaign, this contribution will focus on the preliminary results obtained so far.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **79** Type: **Plenary Talk**

The SPES Exotic Beam ISOL Facility: Status of the Project, Technical Challenges, Instrumentation, Scientific Program

Wednesday 25 October 2017 08:30 (30 minutes)

SPES (Selective Production of Exotic Species) is the INFN project for a Nuclear Physics facility with Radioactive Ion Beams (RIBs). It is in advanced construction in Legnaro, with several technological innovations and challenges foreseen, comprehensive of new achievements and improvements.
SPES will provide mostly neutron-rich exotic beams derived by the fission fragments (1013 fiss/s) produced in the interaction of an intense proton beam (200 microA) on a direct UCx target. Several other targets will be developed to provide users a large beam selection. The expected SPES beam intensities, their quality and, eventually, their maximum energies (up to 11 MeV/A for A=130) will permit to perform forefront research in nuclear structure and nuclear dynamics, studying a region of the nuclear chart far from stability. This goal will be reached by coordinating the developments on the accelerator complex and those of up to date experimental set ups.
The schedule of the project is organized so to give low energy beams (1+ species at 40 keV) at the beginning of 2019, while post accelerated beams up to the maximum energies (around 10-11 MeV/n) are foreseen in 2021, after the installation of the newly developed RFQ new injection system for the ALPI post accelerator.
The technical design and the installation phases will be described, followed by the description of some challenging arguments in the Nuclear Physics program to be performed at the Legnaro National Laboratory.

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Session Classification: Plenary Talks

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **80** Type: **Parallel Talk**

The ISOLPHARM project: New production method of high specific activity beta-emitting radionuclides as radiopharmaceutical precursors

At INFN-LNL the SPES facility for the production of radioactive ion beams is constructing. This RIB new facility, besides being operated for nuclear physics studies, may play a pivotal role in the production of medically relevant radionuclides by means of the ISOL (Isotope Separation On-Line) technique.
The production of the radioactive isotopes will be obtained by nuclear reactions induced by 40 MeV protons, accelerated by a cyclotron, that will collide on a multi-foil UCx target in order to dissipate the 8 kW beam power generated by the reaction.
The reaction products will be extracted from the target by evaporation at high temperature (about 2000 ℃), then forced to pass through a transfer tube towards an ionization cavity, where they will be ionized to the 1+ state.
The core of the method is the possibility to obtain pure isobaric beams following mass separation; in this way no isotopic contaminations will be present in the beam and afterwards in the trapping substrate. Only potential isobaric contaminations can affect radiochemical and radionuclide purity, but proper methods can be developed to separate chemically different elements
The goal of the ISOLPHARM project is to provide a feasibility study for an innovative technology for the production of extremely very high specific activity beta emitting radionuclides as radiopharmaceutical precursors. This revolutionary technique will allow to obtain radiopharmaceuticals, impossible in most cases to obtain in the standard production facilities (neutron reactors or cyclotrons), with lower costs with respect to traditional techniques and reduced environmental impact.
The ground-breaking idea of the ISOLPHARM method was granted an International patent (INFN).
The steps to be addressed for the preparation of the radiopharmaceutical are: 1) Trapping of the radionuclide of interest present in the beam by means of the construction and placement of a suitable substrate; 2) Preparation of a medicinal product compatible with the method of administration; 3) Agreement with the requirements of quality guaranteed by compliance with the principles of Good Manufacturing Practice (GMP) in the field of radiopharmaceuticals.

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **81** Type: **Plenary Talk**

Precision measurements of β-energy spectra in nuclear decays

Friday 27 October 2017 10:30 (30 minutes)

Measurements in nuclear β decay played a crucial role in the development of the (V-A) theory of weak interactions, which is embedded in the standard electroweak model (SM). Experiments in β decay offer today a sensitive tool to search for physics beyond the SM, complementary to direct searches performed at high energies.
It has recently been observed that, in searches for new interactions and under very general assumptions, the determination of the so-called "Fierz interference term"in nuclear and neutron decays can potentially compete with searches at the LHC provided the sensitivity reaches a level below 10^{-3} . This is because the Fierz term depends linearly on the exotic couplings whereas the cross sections for the production of new bosons depend quadratically. In nuclear and neutron decays the most direct and sensitive property to extract the Fierz term is the shape of the β energy spectrum. This contribution presents recent precision measurements of β energy spectra in ^{6}He and ^{20}F decays performed at the National Superconducting Cyclotron Laboratory. A new technique that eliminates the very critical instrumental effect of back-scattering of electrons on detectors has been explored. The technique is being tested through the determination of the weak-magnetism contribution which can be accurately predicted in well selected transitions using the principle of Conservation of the Vector Current.

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Session Classification: Plenary Talks

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **84** Type: **Parallel Talk**

Possible effects of clustering structure in the competition between fast emission processes and compound nucleus decay

Wednesday 25 October 2017 15:50 (25 minutes)

In the last decades, a renewed attention to clustering in nuclei has emerged due to the study of weakly bound nuclei at the drip lines [1]. Clusters in nuclear systems can be related to their dynamical formation or their structural presence (pre-formation) in nuclei. While for light nuclei several links between cluster emission and its connection with nuclear structure and dynamics have been pointed out [1,2], this is less obvious when moving towards heavier systems, where the determination of pre-formed clusters within nuclear matter is more complicated and there is still a lack of experimental evidences of such structure effects. An interesting way to investigate the structural properties of medium mass systems is to study, in central collisions, the competition between evaporation and pre-equilibrium light particles emission as a function of entrance channel parameters [2].
An experimental campaign has started at the Legnaro National Laboratories using the GARFIELD + RCo multi-detector system [3] with the aim of confirming alpha clusterization in nuclei by comparing pre-equilibrium emission in terms of energy spectra and multiplicities, for different entrance channel parameters like beam velocity, mass asymmetry and structure of the reacting partners.
In particular, the two systems ^{16}O + ^{65}Cu and ^{19}F + ^{62}Ni, leading to the same compound system ^{81}Rb*, have been studied at the same beam velocity (16 AMeV). Angular distributions and the light charged particles emission spectra in coincidence with evaporation residues have been measured up to very forward angles.
The experimental data have been first compared with the predictions of the Moscow Pre-equilibrium Model (MPM) [4] and then with the statistical model GEMINI++ [5]. A comparison with the dynamical models SMF [6] and AMD [7] has also been done. Recent results of the data analysis will be presented. The analysis is still in progress.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **85** Type: **Poster**

Energetic and structural properties of fullerenes under irradiation processes

Tuesday 24 October 2017 15:30 (15 minutes)

On the basis of the atomic displacement energy (T_d) calculated using the Density Functional Theory with Tight Binding Approximation (DFTB), the cross sections of electron-induced atomic displacement were obtained as a function of the order of the fullerene. Three types of defects commonly induced by radiation (mono-vacancy, di-vacancy and Stone-Wales) were also analyzed, determining their formation energies and the structural changes they produce in the molecule. The results are consistent with the model for the transformation of polyhedral structures to spherical nano-onions under electron irradiation, proposed by Ugarte in 1995.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **86** Type: **Poster**

Method for noise reduction in Computed Tomography images with an approximate bilateral filter

Despite the clear evidence that computed tomography provides very valuable information for diagnosis, there is a potential risk for the use of ionizing radiation. In CT, decreasing the dose of radiation increases the amount of noise in the images; therefore, the noise can hide anatomical details and decrease the detection of injuries. The Bilateral filter, proposed by Tomasi and Manduchi, is able to preserve the edges of the image and to reduce noise in uniform regions. The ability of the BF to reduce noise depends on the function of two sub-factors including spatial distance and intensity weights. In the BF the functions of these weights are exponential. This function has the advantage of reducing the greater amount of noise and better preserving the structural details. The disadvantage is that this noise reduction and detail preservation capability decreases after a certain noise value by reducing filter performance. The advantages of this feature have a very narrow margin and can easily be lost in practical applications where noise variability increases. This affects the performance of the BF causing blurring in the details of the image and a decrease in the ability to reduce noise in the image. In order to be more effective the filtering process in our work, we made a reformulation of the sub-factors of spatial distance and intensity. The function exponential of these sub-factors was approximated to fractional through the MacLaurin serial development. The reformulation, guarantees a better stability in the noise reduction capacity, a better preservation of details in the image when there is an increase in noise variability as well as a reduction in the execution time.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **87** Type: **Poster**

Design of a preamplifier card for the photomultiplier tubes of a Gamma Camera

Wednesday 25 October 2017 14:30 (15 minutes)

The service provided by the Gamma Cameras (GC) in the nuclear medicine departments fails because of their breakdown, generally due to the associated electronics and not to the physical detection components. For this reason, it was decided to develop an electronic system that allows the recovery and optimization of disused GC, starting with the design of the preamplifier for each photomultiplier tube (PMT). The circuit was designed and simulated and the list of components necessary for the construction of the preamplifier was generated, as well as the printed circuit board was designed for its assembly. By simulating the preamplifier this worked in linear mode. This determines that the amplitude of the output signal is proportional to the amount of charge delivered by the detector. This card allows an automatic adjustment of the signals of the PMTs as do the modern GC. Besides, the circuit was designed and simulated for 37 and 75 PMTs, and the printed circuit board was designed for both cases.

Authors: DOMÍNGUEZ MARTÍNEZ, Jorge Luis (InSTEC); OSORIO DELIZ, Juan Francisco (INOR); Prof. RIVERO RAMÍREZ, Doris (InSTEC)

Presenter: DOMÍNGUEZ MARTÍNEZ, Jorge Luis (InSTEC)

Session Classification: Poster Session - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **88** Type: **Parallel Talk**

High-precision mass measurement programme around the N=82 shell closure with the Penning trap mass spectrometer MLLTRAP at ALTO

Thursday 26 October 2017 13:55 (25 minutes)

The international ISOL facility ALTO, located at Orsay in France, provides stable ion beams based on a 15 MV tandem accelerator and neutron-rich radioactive ion beams from the interaction of a γ-flux induced by a 50 MeV 10 μA electron beam in a uranium carbide target. New setups are under preparation to extend the fundamental properties measured at ALTO of ground and excited states of exotic nuclei. As for example, high-precision mass measurements for an accurate determination of the nuclear binding energy. To perform those measurements two devices will be hosted at ALTO: a radiofrequency quadrupole to cool and bunch the continuous radioactive beam and the double penning trap mass spectrometer MLLTRAP, commissioned off-line at the Maier-Leibnitz Laboratory (MLL) in Munich, Germany. The unique ion production at the ALTO facility allows mass measurements in a neutron rich area of major interest around 132Sn. In this context, it is proposed to use neutron-rich silver isotopes (Z = 47, A > 121) to explore the possible weakening of the shell gap for Z < 50 and its impact on the A = 130 r-process elemental abundances. The already well measured masses (A < 121) in the silver isotopic chain will be used for the on-line commissioning. In addition, the development started at MLL on a novel detector-trap for in-trap decay spectroscopy will be carried out at ALTO. It will provide background free spectra via direct in-situ spectroscopy of stored ions. The status and timeline of the novel setup will be presented.

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Session Classification: Parallel Sessions - NUC

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **90** Type: **Poster**

Contribution of nuclear reactions in the production of heavy elements: Analysis in a supernovae environment

Tuesday 24 October 2017 16:00 (15 minutes)

The production of neutron-rich heavy elements takes place via the rapid neutron capture process (r-process). To favour neutron captures over beta decays the astrophysical environment should be explosive like the one found in the core-collapse supernovae. In this work, we focus on the High Entropy Winds (HEW) in Type II supernovae which are one of the more promising sites for the r-process. After the neutron capture rates decrease, due to drop in the neutron density, the remaining nuclides can be highly unstable. After considerable time, these nuclei will decay to stability. The final abundances of elements will depend, besides of neutron capture, on other processes such as beta decay, alpha decay, photo dissociation, alpha capture and beta-delayed neutron emission. The present work evaluates the contribution that these processes have to the final abundances of certain nuclides and studies the dependence of that contribution in the presence of each one of the other processes. For our nucleosynthesis calculations, we used rJava 2.0, software that is able to simulate the physical environment of HEW as well as other r-process sites as the ejecta of neutron star mergers and the ejecta of quarknova.

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Presenter: Mr TRUJILLO, Jose (Universidad de los Andes, Colombia.)

Session Classification: Poster Session - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **91** Type: **Parallel Talk**

Thermodynamical properties of a neutral vector boson gas in a constant magnetic field

Tuesday 24 October 2017 13:30 (25 minutes)

We study the thermodynamical properties of a neutral vector boson gas in a constant magnetic field starting from the spectrum obtained by Proca formalism.
Bose Einstein Condensation (BEC) and magnetization are obtained, for the three and one dimensional cases, in the limit of low temperatures. In three dimensions the gas undergoes a phase transition to a usual BEC in which the critical temperature depends on the magnetic field. Therefore, the condensation is reached not only decreasing the temperature, but also by increasing the field. For the one dimensional gas a diffuse BEC appears. In both, one and three dimensions, the magnetization is a positive quantity and for densities under a critical value the gas can sustain its own magnetic field.
The anisotropic pressures are also considered. The pressure exerted along the field is always positive, but the perpendicular pressure might be negative and the system turns out to be susceptible to suffer, under certain conditions, a transversal magnetic collapse.
The above describe phenomenology is manifested for magnetic fields and densities in the order of those typical of compacts objects. In this regard, a brief discussion of astrophysical implications is presented.

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Session Classification: Parallel Sessions - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **92** Type: **Poster**

The role of aluminiun chloride in the Fischer-Hafner synthesis of technetium and rhenium bisarenes

Wednesday 25 October 2017 16:00 (15 minutes)

Rhenium bis-arenes can be obtained by heating the corresponding potassium perrhenate ($KReO_4$) salt with an arene as a solvent and in the presence of aluminum chloride ($AlCl_3$) and zinc. Variations of this method, originally proposed by Fischer and Hafner, demonstrated that, in some cases, the reaction occurs without using Zn as a reductive agent, but also, that the presence of the Lewis acid is essential. The aim of this work is to study the interactions of $AlCl_3$ with benzene, as well as the reactivity of the system formed afterwards, in order to understand its role in the reaction pathway. Calculations at DFT/M06-2X and MP2 levels using 6-311G(2df,2pd) depicted that the association between $AlCl_3$ and benzene leads to the formation of a charge transfer adduct where the $AlCl_3$ is placed over one of the carbons of benzene. The charge is transfered from the aromatic π system to the Al atom. The analysis of this complex through local reactivity descriptors allowed locating the areas of the benzene's π system more susceptible to react with the Rhenium via electrophilic attack. Meta and orto positions are particularly reactive to that class of attack. Therefore, the initial association with rhenium should occur in these sites. Thus, results show that the formation of the $AlCl_3$-benzene adduct could be an important intermediate in the formation of $[Re(\eta^6\text{-benzene})_2]^+$ complex.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **93** Type: **Parallel Talk**

X-Ray Photoelectron Spectroscopy (XPS) of Carbon nanostructures obtained by underwater arc discharge of graphite electrodes

Wednesday 25 October 2017 13:30 (25 minutes)

Carbon nanostructures, obtained by underwater arc discharge of graphite electrodes, were studied by X-Ray Photoelectron Spectroscopy (XPS). It was observed that the spectra of the samples taken from the floating part of the synthesis products, composed basically by Carbon nano-onions (CNO), present differences with those obtained from the precipitate , which contains a mixture of CNOs and multi-walled Carbon Nanotubes (MWCNT). These differences are related with the presence of atoms of carbon located in orbitals with different degree of hybridization (sp^2-sp^3), which in turn is related to the diverse grade of curvature of the planes of carbon in the nanostructures present in the samples.

The obtained results indicate that XPS can be an important element in the characterization of the products obtained by the above-mentioned method of synthesis.

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Session Classification: Parallel Sessions - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **97** Type: **Parallel Talk**

On gravastars solutions of the Einstein-Klein-Gordon equations in the sense of Colombeau-Egorov's generalized functions

Wednesday 25 October 2017 13:30 (25 minutes)

Spherically symmetric solutions are presented of the equations of motion for a scalar field interacting with gravity (EKG equations) in the Colombeau-Egorov's sense. The scalar fields are confined within the interior region and the exterior fields are purely gravitational and coinciding with the Schwarzschild ones. The solution resembles the so called "gravastars"which had been discussed in the literature. These solutions of the EKG equations open a possibility for the existence of static boson stars. The argumentation is based in defining a one parameter ϵ dependent family of radial dependencies of the metric and the scalar field, being infinitely differentiable. Afterwards, it is argued that in the limit $\epsilon \to 0$, the EKG equations are satisfied in the sense of the generalized functions. The solutions exhibit properties which qualitatively support their physical meaning. For example close to the boundary at the interior, the scalar field energy density pile up towards to the limit surface. On the other hand, also close to the separation surface, but on the outside, the known "non-hair"theorem, clearly indicates that any scalar field perturbation also tends to be attracted to the boundary. The work also suggests the possibility for obtaining a regular gravastar, after using the found singular configuration as a first step in an iterative solution of the quantum EKG equations.

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Session Classification: Parallel Sessions - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **98** Type: **Poster**

Feasibility of using a thyroid probe for ^{131}I intake surveillance of nuclear medicine workers

This research, propose a monitoring procedure of ^{131}I intake of nuclear medicine workers using the thyroid probe of the Nuclear Medicine Department. The Thyroid Counter used is a gamma probe, equipped with a lead shielded NaI(Tl) scintillation detector of 30x30, also was studied the gamma camera Phillips Forte with NaI(Tl) 3/8" pinhole collimator-5mm. The efficiency calibration was performed with a thyroid phantom, simulating the adult thyroid anatomical shape and volume, filled with radioactive solution of known activity of ^{131}I (uncertain activities of 2.24%). The intake and the effective dose estimation were made following the steps suggested in the IDEAS - General Guidelines for the Estimation of the Committed Effective Dose from Incorporation Monitoring Data. The values determined for the efficiency (E) and for the Minimum Detectable Amount (MDA) for probe were of $3.76\text{x}10^{-3}$ ± $1.15\text{x}10^{-4}$ CPS/Bq and 46 Bq for ^{131}I (364 keV), respectively. Meanwhile, for the gamma camera with pinhole were significant higher (E = $1{,}96\text{x}10^{-4}$ ± $9{,}3\text{x}10^{-6}$ CPS/Bq and MDA=85 Bq). The probe system is capable to detect dose as low as 0,004mSv at 24h and 0,02mSv at 2h. A worker monitoring ^{131}I intakes procedure was proposed and established, based on routine screening 2 and 24 hours after to finish "hot lab", "administration routine"of ^{131}I dose to patient, contaminated wastes manipulations, or in case of detected or suspected radionuclide intake. If the contamination is positive, confirmatory monitoring should be developed using the "probe"(and the gamma camera if it is needed for spatial thyroids uptake distribution). The committed equivalent thyroid dose will be evaluated taking into account the real thyroid mass, using the up-taking mass correlated with ultrasound and the real bio-kinetic behavior. The use of probe, for this purpose, produces a significant reduction of uncertain caused by the mass of thyroid, effective half-time and the time of intake. Also, it includes the possibility to block the thyroid uptake during the first 4h of intake, with the reduction of the Committed Effective Dose and Committed Equivalent Dose of the worker.

Index Terms: radiation worker's surveillance, internal contamination, I-131 intake, nuclear medicine workers

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **99** Type: **Parallel Talk**

Development of a method for multielemental determination in water by EDXRF with radioisotopic source of ^{238}Pu

Tuesday 24 October 2017 08:30 (30 minutes)

A method for determination of Cr, Fe, Co, Ni, Cu, Zn, Hg and Pb in waters by Energy Dispersive X Ray Fluorescence (EDXRF) was implemented, using a radioisotopic source of ^{238}Pu. For previous concentration was employed a procedure including a coprecipitation step with ammonium pyrrolidinedithiocarbamate (APDC) as quelant agent, the separation of the phases by filtration, the measurement of filter by EDXRF and quantification by a thin layer absolute method. Sensitivity curves for K and L lines were obtained respectively.

The sensitivity for most elements was greater by an order of magnitude in the case of measurement with a source of ^{238}Pu instead of ^{109}Cd, which means a considerable decrease in measurement times. The influence of the concentration in the precipitation efficiency was evaluated for each element. In all cases the recoveries are close to 100%, for this reason it can be affirmed that the method of determination of the studied elements is quantitative.
Metrological parameters of the method such as trueness, precision, detection limit and uncertainty were calculated. A procedure to calculate the uncertainty of the method was elaborated; the most significant source of uncertainty for the thin layer EDXRF method is associated with the determination of instrumental sensitivities. The error associated with the determination, expressed as expanded uncertainty (in %), varied from 15.4% for low element concentrations (2.5-5 µg/L) to 5.4% for the higher concentration range (20-25 µg/L).

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Session Classification: Parallel Sessions - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **100** Type: **Poster**

Comparison of relative renal function and images through studies with radiopharmaceutical ^{99m}Tc-MAG3 y ^{99m}Tc-DMSA

Relative renal function and differences in the images of kidneys through renal gammagraphy with radiopharmaceutical ^{99m}Tc-MAG3 and ^{99m}Tc-DMSA was compared. For the study a sample of 50 patients was analyzed, in which 75% were children. Images were acquired with a double-headed AnyScan SC gamma camera of MEDISO Company. The renal gammagraphy with ^{99m}Tc-MAG3 was processed as a DMSA study, using the DMSA protocol, taking the sum of first images. Comparison in RRF of left kidney (used as reference) between both studies show a correlation coefficient of 0.996 and a slope value of 1.02±0.01. The images were analyzed by nuclear physicians of ten or more years of experience leading to similar conclusion that sum first images of ^{99m}Tc-MAG3 renography can be informed as a DMSA study, only when in the diagnosis the patient doesn't present ectopic kidneys. This results show that relative renal function obtained in a DMSA study can be obtained through a renography with ^{99m}Tc-MAG3 taking the first images previous to pelvis drainage. In this we can avoid overexposed patients submitted to both studies, avoiding loss of time and guarantee savings of material.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **101** Type: **Parallel Talk**

Decay Spectroscopy Experiments Using the GRIFFIN Spectrometer at TRIUMF

Thursday 26 October 2017 11:30 (30 minutes)

GRIFFIN [1], the Gamma-Ray Infrastructure For Fundamental Investigations of Nuclei is the new decay spectroscopy array located at TRIUMF, Canada's National Laboratory for Nuclear and Particle Physics. GRIFFIN consists of 16 large-volume hyper-pure germanium clover detectors assisted by a custom-built digital data acquisition system, providing 10% efficiency for detecting gamma-rays at 1.3 MeV. A suite of ancillary detector systems can be coupled to GRIFFIN for comprehensive decay spectroscopy experiments with radioactive beams delivered by the TRIUMF-ISAC facility: SCEPTAR [2], an array of plastic scintillators for beta-particle tagging, and PACES [2], an array of five lithium-drifted cooled silicon detectors for high-resolution internal conversion-electron spectroscopy, eight lanthanum bromide scintillators for fast gamma-ray timing measurements [2], and a neutron detector array for the detection of beta-delayed neutron-emitting nuclei called DESCANT, [3]. This versatile experimental set-up allows for the identification of weak branching ratios and firm spin and parity assignments of excited states thorough angular correlation measurements.
Results obtained with the GRIFFIN spectrometer near and far from stability using beta decay of beams of 128–130Cd [4], 46,47K [5,6], 32Na [7], and 118,132In [8,9] will be presented along with a discussion of future opportunities, including the addition of the Compton and background suppression shields in 2018.
The GRIFFIN spectrometer is funded by the Canada Foundation for Innovation, TRIUMF, and the University of Guelph with matching contributions from the British Columbia Knowledge and Development Fund and the Ontario Ministry of Research and Industry. TRIUMF receives federal funding via a contribution agreement through the National Research Council of Canada. This research is supported by the Natural Sciences and Engineering Research Council of Canada.

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Session Classification: Plenary Talks

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **102** Type: **Parallel Talk**

β-decay of ^{77,75}Ni

Monday 23 October 2017 14:20 (25 minutes)

The evolution of the shell structure when moving away from the stability line is discussed in the present contribution. In particular, the effect of the tensor interaction in the appearance and disappearance of magic numbers and the specific case of ^{78}Ni. To contribute to the understanding of the case, the level structure of ^{75,77}Cu was studied in a β-delayed γ-spectroscopy experiment. The β-decay experiment was performed at the Radioactive Ion Beam Factory (RIBF) of the RIKEN Nishina Center. A secondary beam of nuclei in the region of ^{78}Ni was produced by the in-flight fission of ^{238}U projectiles on a ^{9}Be target. After being selected and identified in the BigRIPS fragment separator, the nuclei of interest were implanted in the WAS3ABi active stopper, where the β-decay events were detected. The EURICA array, consisting of 12 germanium cluster detectors, was surrounding the active stopper for the detection of the γ-rays. The level schemes of ^{75,77}Cu are presented together with the results of new shell model calculations.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **103** Type: **Parallel Talk**

Oil samples analysis using X-ray fluorescence

Wednesday 25 October 2017 16:00 (15 minutes)

In this work, several oil samples from different Brazilian basins were investigated using Energy Dispersive X-Ray Fluorescence spectroscopy technique (ED-XRF) aiming to obtain qualitative information about their chemical composition [1,2]. The budget of analyzed samples was composed of twelve oil samples from five distinct oil fields belonging to the Campos Basin of the Esp´ırito Santo and to the Santos Basin, Brazil. The samples were trickled on a thick Kym foil (99.9%) with 2 cm of diameter. The ED-XRF measurements were carried out using a portable device (Amptek XR-100SDD model) [3,4] and the spectra analysis were performed using the WinQxas software. Besides, to enhance the detection of some elements at lower concentrations, Tungsten and Aluminum filters were placed at the exit of the X-ray tube. The preliminary results indicate the presence of S, Cl, K chemical elements and with the use of Al and W filters, identification of Br and Sr at lower concentrations in four oil samples from the Marlim, Pampo and Jubarte fields of the Campos Basin could be also achieved. In addition, the obtained data so far raise the question how these different chemical elements are correlated with the different oil basis especially for those elements present at low concentrations.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **104** Type: **Poster**

Study of Cr-39 detectors

Tuesday 24 October 2017 15:45 (15 minutes)

Every day, the population is exposed to various types of radiation sources. In particular, the radon is the most common radiation present in a gas form. Radon belongs to the radioactive series of uranium and in its decay emits alpha particles of 5.49 MeV. To detect these alpha particles, an effective method very commun is to use Solid State Nuclear Track Detectors (SSNTD). This work propose a comparative study of track diameters using three kinds of CR-39 SSNTDs concerning the chemical etching time. The measurements have been performed exposing the sample plastic detectors to an 241Am radiation source during about 6.5 hours and chemical etched using well known solutions [2-4]. Two different temperatures have been used in this process (70 and 80 °C) and different ranges of time. The diameter of the tracks has been obtained and followed between one chemical etching and other by taking digitalized images with calibration scale of 50μm and using the ImageJ code [5]. The track density have been calculated and the comparative results will be presented.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **105** Type: **Poster**

Correlated background within the SoLid anti-neutrino detector

Tuesday 24 October 2017 15:15 (15 minutes)

The SoLid experiment aims to measure the anti-neutrino energy spectrum 6–9 m from the core of the BR2 nuclear reactor at SCK•CEN in Mol, Belgium. The main goals are to provide a very sensitive search for short-baseline neutrino oscillations and to resolve the reactor neutrino anomaly. The proposed detector technology will be very useful for anti-neutrino detection in other settings as well, such as nuclear safeguard and non-proliferation monitoring of nuclear reactors.
The experiment uses a novel, highly segmented composite scintillator detector. The detector unit is based on 5 cm polyvinyl toluene scintillator cubes, thin neutron sensitive ^{6}LiF:ZnS(Ag) sheets and a reflective Tyvek layer wrapping them for light tight. A first large scale detector prototype based on this technology was deployed at the BR2 reactor by the end of 2014. The main purpose was to study the capability of the detector design to discriminate background. Due to the low overburden and proximity to a nuclear reactor, efficient background reduction is crucial for a successful experiment.
This contribution will be presenting and discussing the advantages of the SoLid detector design for background reduction. The background components studied include atmospheric and spallation neutrons induced by cosmic rays and possible natural radioactivity contamination from the decay chains of ^{238}U and ^{232}Th. The results are based on the data taken with the prototype detector and its full chain GEANT4 based Monte Carlo simulations.

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Session Classification: Poster Session - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **106** Type: **Plenary Talk**

MA-XRF imaging of a 15th century Sicilian painting by Antonello de Saliba

Wednesday 25 October 2017 11:30 (30 minutes)

For the fisrt time, a Saliba's painting was investigated by means analytical technique, MA-XRF (Macro- X-Ray Fluorescence). The LANDIS-X, a novel mobile scanner, allowed to obtain elemental distribution of the pigments allowing better elucidating palette and painting technique.

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Presenter: SANTOS, Hellen C. (São Paulo University)

Session Classification: Plenary Talks

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **108** Type: **Poster**

Color transparecy in vector meson photoproduction

Tuesday 24 October 2017 16:00 (15 minutes)

Employing the Feynman diagrams technique, the GBW model for performing nucleon-dipole interaction and the Regge theory, a new approach for computing in a unique way (perturbative and non-perturbative), the vector meson production has been presented.
The interaction between the color dipole created by the virtual photon and the nucleon is carried out by the exchange of two virtual gluons, which connect the color dipole with the gluonic sea inside of the nucleon trough a three gluonic vertex. The model was
explored in the production of $\rho 0$,ϕ and $J\psi$.

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Session Classification: Poster Session - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **109** Type: **Parallel Talk**

Implementation and application of a method of separation of rare earth elements by ion exchange and subsequent determination by ICP-AES and ICP-MS

Tuesday 24 October 2017 09:00 (30 minutes)

The great interest in rare earth elements (ETR) is due to the many and valuable applications that these elements have in the science and economy of many countries. On the other hand highly sensitive methods are generally required for the determination of these elements in many of the matrices of interest such as geological samples. An alternative is to apply chemical separation procedures, prior to analysis.
In the present work, model experiments were performed to study the ETR separation performance of Cr, Fe, Ni and some elements of the alkaline earth and platinum groups by cation exchange in HCl medium. The final determination in the eluates was carried out by Inductively Coupled Plasma Atomic Emission Spectrometry (EEA-ICP). The elaborated method was used in the ETR analysis in 100 geological samples supplied by the Institute of Geology and Paleontology of MINEM. In the latter case, the determination of ETR was performed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS). An analysis of the obtained results is presented in the work

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Session Classification: Parallel Sessions - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **110** Type: **Parallel Talk**

Elemental analysis of peloids from some Cuban spas using INAA

Tuesday 24 October 2017 09:30 (30 minutes)

Peloids from some Cuban spas (San Diego, Elguea, Santa Lucía, Cajío and Colony) have been studied using Instrumental Neutron Activation Analysis (INAA). Concentrations of 30 major, minor and trace elements in the peloids are reported, including an important group of REE (La, Ce, Nd, Sm. Eu, Gd, Tb, Tm and Yb). No difference is observed for metal contents (including REE) determined for raw and maturated peloids from San Diego spa. Elemental concentrations are compared with other worldwide reported peloids. The iron-normalization using raw (non-matured) mud from San Diego spa as reference material shows that an anthropogenic metal input is present in the Elguea, Cajío and Colony spas. The measured REE contents are in the same order of magnitude as those reported for Earth's upper crust average shales and muds as well as with worldwide reported peloids. However, the behavior of the normalized-to-chondrites REE shows different patterns for Cuban peloids matured with marine and fresh waters, respectively.

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Session Classification: Parallel Sessions - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **111** Type: **Poster**

Radioactivity levels in peloids used in main Cuban spas

Wednesday 25 October 2017 16:00 (15 minutes)

Radioactivity levels in peloids from some Cuban spas (San Diego, Elguea, Santa Lucía and Cajío) have been studied. The radionuclide concentration (in Bq.kg-1 dry weight) varied as follows: ^{226}Ra = 6 –1800, ^{137}Cs = <2 –5, ^{232}Th = 6 –38 and ^{40}K = 47 –365, being comparable to concentrations reported for therapeutic peloids used worldwide. Considering the short exposition times associated with the usual therapeutic practices in Cuban spas, the estimated annual equivalent dose in ^{226}Ra-enriched peloids is well below the accepted equivalent dose values for the skin of peloids-based treatment users. Therefore, radioactivity levels present in peloids from the studied Cuban spas do not represent an impediment for its use with therapeutic purposes.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **112** Type: **Poster**

Commissioning DCAT/VMAT with 6 MV FFF for SRT

Currently at our centre, the stereotactic program uses 6 MV cFF and forward planning techniques: cones for SRS, conformal MLC for SRT. Patients are immobilized with either the non-invasive Aktina stereotactic frame or a thermoplastic mask. Treatment localization is performed with CBCT. We are implementing DCAT and VMAT for SRT with 6 MV FFF to reduce treatment time, treat larger non-spherical lesions, and treat multiple lesions simultaneously. We investigated using different beam geometries, 1 arc, 3 arcs and 5 arcs, for both one and two lesions. Planning was completed in Monaco 5.11 and delivery with Elekta Agility MLC. Fluence measurements were taken with MapCheck and compared to TPS. Absolute dose measurements were acquired with an ion chamber at 4 off axis distances in the Steev phantom and compared to TPS. We selected 3 non-coplanar arcs as the preferred beam geometry. DCAT and VMAT both produced clinically acceptable plans that met our institutional guidelines. DCAT plans had fewer total MU and had higher DTA/dose passing rates and had fewer delivery interrupts. VMAT plans could achieve better OAR sparing when critical structures are near the lesion. Optimization time was similar, as both methods used a 1 mm dose grid. In conclusion, acceptable SRT plans can be produced with 3 non-coplanar arcs and the FFF beam using both DCAT and VMAT techniques.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **113** Type: **Poster**

A surface Coalescence model

Tuesday 24 October 2017 16:00 (15 minutes)

The production of heavy clusters in nuclear reactions is a mechanism that until now is not well understood despite its importance and its wide variety of applications: radiation protection, space and engineering design, medical physics, the design of accelerators and others. According to the Exciton Cascade Model (CEM), there are three possible ways of producing high energy heavy clusters. The first mechanism is through the coalescence of the nucleons produced in the Intra-Nuclear Cascade (INC), the second way is through the pre-equilibrium model, and the last one is the so-called Fermi break-up.
In this work, a new theoretical approach is developed based on the INC model, which allows explaining the formation of light clusters through a first principles coalescence criterion that does not depend directly on experimental parameters and, at the same, can reproduce the experimental data. It is considered a semi-classical Wigner's distribution function in phase space. The calculations have been assessed for the production of deuterons in p-197Au collisions in an energetic range of 2 –10 GeV and the results obtained for the deuteron emission probabilities, and the total cross section is shown and compared with the experimental data.

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Session Classification: Poster Session - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **114** Type: **Parallel Talk**

Systematic CDCC calculations of total fusion for ^{6}Li with targets ^{28}Si, ^{59}Co, ^{96}Zr, ^{144}Sm and ^{209}Bi. Effect of resonance states

Monday 23 October 2017 15:00 (25 minutes)

CDCC calculations of total fusion cross sections for reactions of the weakly bound ^{6}Li with targets ^{28}Si, ^{59}Co, ^{96}Zr, ^{144}Sm and ^{209}Bi at energies around the Coulomb barrier are presented. In the cluster structure frame of ^{6}Li$\rightarrow \alpha + d$, short-range absorption potentials are considered for the interactions between the α and -d fragments with the targets. The effect of resonance states ($l = 2, J^{\pi} = 3^{+}, 2^{+}, 1^{+}$) and non-resonance states of ^{6}Li on fusion is studied by i) omitting resonance states from the full discretized breakup space and ii) by considering only the resonance discretized space. A systematic analysis of the effect on fusion from resonance breakup couplings is carried out from light to heavy target masses.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **115** Type: **Parallel Talk**

The results from the Q-weak experiment measurement of the parity-violating electron-proton scattering

Thursday 26 October 2017 11:00 (30 minutes)

The results of the Q-weak experiment at the Thomas Jefferson National Accelerator Facility are presented. The experiment performed the most precise measurement of the parity-violating electron-proton scattering asymmetry at low momentum transfer, resulting in the first direct determination of the weak charge of the proton (a weak force analog to the electric charge for the electromagnetic force) and the most precise value of the weak mixing (Weinberg) angle, for the first time measured in a semi-leptonic reaction. Since the weak mixing angle is precisely predicted by the Standard model, these results provide new constraints on classes of physics beyond the Standard Model and are complementary to direct searches in the high energy measurements. The requirements of this precise measurement posed technical challenges resulting in the design of a custom apparatus consisting of a triple collimator system, a resistive copper-coil toroidal magnet and eight fused silica Cherenkov detectors, the world's highest power liquid hydrogen target, precision control of helicity-correlated beam properties and beam polarimetry. The detector array absorbed a scattered electron rate of about 7 GHz read out in integrating mode by custom-built modules. Dedicated low-current measurements were undertaken to determine the momentum transfer using sets of drift chambers before and after the toroidal magnet. The technical aspect of the Q-weak experiment will also be presented.

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Session Classification: Plenary Talks

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **116** Type: **Plenary Talk**

Theoretical challenges in double beta decay

Friday 27 October 2017 08:30 (30 minutes)

Double beta decay (DBD) is a nuclear process with the longest lifetime measured until present, which study presents a great interest. Indeed, its possible neutrinoless double beta ($0\nu\beta\beta$) decay mode is a beyond Standard Model (BSM) process whose discovery would clarify if the lepton number is conserved, decide on the neutrinos character (are they Dirac or Majorana particles?) and give a hint on the scale of their absolute masses [1]. Theoretically, the study of $0\nu\beta\beta$ decay involves the accurate computation of the nuclear matrix elements (NME) and phase space factors (PSF), two key quantities entering the lifetimes of this process. In my talk I will make first a short review on the actual challenges to calculate the NME and PSF for DBD [2]-[4]. Then, I will show how from the study of $0\nu\beta\beta$ decay one can constrain BSM parameters related to the neutrino mass and Lorentz violation in weak decays.

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7. S. Stoica, MEDEX'17, May 29 –June 2, 2017, Prague (invit. lecture).

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Session Classification: Plenary Talks

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **117** Type: **Poster**

Spatial distribution and contamination assessment of heavy metals in street dust from Camagüey city (Cuba) using X-ray fluorescence

Wednesday 25 October 2017 16:00 (15 minutes)

Concentrations of various chemical elements in street dusts from Camagüey city were studied by X-ray fluorescence analysis. The mean Cr, Co, Ni, Cu, Zn and Pb contents (in $mg.kg^{-1}$ dry weight) in the urban dust samples were compared with mean concentrations in other cities around the world. Spatial distribution maps indicated the same behaviour for Cr–Ni and Pb–Zn–Cu, whereas the spatial distribution of Co differs from the other heavy metals. The metal-to-iron normalization using Cuban average metal soil contents as background showed that street dusts from Camagüey city are moderately or significantly enriched with Zn-Pb in those areas associated with heavy traffic density and metallurgic plant location. However, the calculation of the potential ecological risk index shows that metal content do not represent a risk for the city´s population.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **118** Type: **Parallel Talk**

Pollution characteristics and human health risks of potentially toxic elements in road dust from the central metropolitan area of Havana city (Cuba) using X-ray fluorescence analysis

Tuesday 24 October 2017 11:30 (30 minutes)

Our study aimed to investigate road dust from relevant locations in Havana city and the associated health risks of potentially toxic elements (PTEs) to humans using X-ray fluorescence analysis. The Geoaccumulation Index, Enrichment Factor and Integral Pollution Index were used to describe pollution characteristics of roadside dust in urban areas associated with traffic and child activities (schools, parks, etc.) from Havana city central metropolitan area (Old Havana, Central Havana, San Miguel del Padrón and Regla municipalities and the Alamar district). Results indicate that industrial roadside dust is contaminated with Pb near high traffic, as well as power and gas station locations, and with Zn and Cu in areas were reconstruction works were performed. The Hazard Quotient (HQ) and Hazard Index (HI) values for all the exposure routes (ingestion, inhalation, and dermal contact) were below the international established limits, except for Pb, Zn and Cu in mentioned areas. The risk of contracting cancer from the studied metals was found to be in safe levels as the RI (carcinogenic risks) values were below the international established limits.

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Session Classification: Parallel Sessions - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **119** Type: **Poster**

X-ray fluorescence analysis of sediments from Mampostón reservoir (Mayabeque, Cuba)

Wednesday 25 October 2017 16:00 (15 minutes)

The objective of the present study was to evaluate the distribution and accumulation of some heavy metals in surface sediments from the Mamposton reservoir (Mayabeque province, Cuba) and its main tributaries (Ganuza and Mamposton rivers and Pedroso dam). Furthermore, it was of great interest to assess their potential risk with regard to human health. Concentrations of Fe, Ni, Cu, Zn and Pb were determined by X-ray Fluorescence Analysis in samples collected in dry and rainy seasons. The results show a significant difference in metal contents in each season. Determined values corresponding to the contamination factor and modified degree of contamination indicate a very low to high degree of contamination effects for the studied sediments. The comparison with sediment quality guidelines reveals that the average concentration of Cu, Zn and Pb in Ganuza river sediments is higher than the established Threshold Effect Levels (TEL) [1]. On the other hand, the Ni content exceeds the established Probable Effect Levels (PEL) [1] in almost every studied location. Based on PEL-Q calculations [2] for Ni, Cu, Zn and Pb, the samples classify as sediments with a medium-low level of contamination in all the studied stations, except for one in the Ganuza River, which classifies as medium-high level of contamination.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **120** Type: **Poster**

MCP-PMT timing at low light intensities whit a DRS4 Evaluation Board

Wednesday 25 October 2017 14:30 (15 minutes)

Positron emission tomography (PET) is one of the most important diagnostic tools in medicine, allowing three-dimensional imaging of functional processes in the body. It is based on a detection of two gamma rays with an energy of 511 keV originating from the point of annihilation of the positron emitted by a radio-labeled agent. By measuring the difference of the arrival times of both annihilation photons it is possible to localize the tracer inside the body. The gamma rays are normally detected by a scintillation detector, which timing accuracy is limited by a photomultiplier and a scintillator. By replacing a photo sensor with a micro channel plate PMT (MCP-PMT) and a scintillator with Cherenkov radiator, it is possible to localize the interaction position to the cm level. In a pioneering experimental study with Cherenkov detectors using PbF_2 crystals and microchannel plate photomultiplier tubes MCP-PMT a time resolution better than 100 ps was achieved. In this work a DRS4 digital ring sampler chip was used to read out single photons output signals from two different MCP-PMTs (Hamamatsu R3809 and Burle 85001) with a sampling rate of 5×10^9 samples/s. The digitized waveforms were analyzed and a comparison between the two detectors timing response was made. The best time resolutions achieved were 161 and 224 ps FWHM for the Hamamatsu and Burle MCP-PMT respectively.

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Session Classification: Poster Session - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **121** Type: **Parallel Talk**

Quantitative techniques in MRI: applications

Magnetic Resonance (MR) Imaging is a powerful noninvasive diagnostic technique based on the interaction of the nuclear spins in the biological medium with external magnetic fields. MR signal is affected by several physical properties or phenomena including nuclear relaxation times (T1, T2, T1rho), nuclear density, magnetic susceptibility, diffusion, perfusion, etc. However, MR images are typically used in qualitative or semi-qualitative way, where the pixel intensity is a relative value weighted in some of these properties. In the last twenty years, the researchers have developed several tools to extract quantitative maps from the MR images with important clinical and research applications.
In this mini-course, we must talk about the main principles involving some quantitative tools: relaxation times, susceptibility, diffusion, chemical shift and perfusion. Medical applications will be reviewed and discussed to illustrate the potential of quantitative imaging.

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Presenter: Dr GARRIDO SALMON, Carlos Ernesto (FFCLRP, University of Sao Paulo)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **122** Type: **Parallel Talk**

Deep nets vs human designed features in medical physics

In medical physics, conventional machine learning uses “hand designed”feature extractors which require great domain expertise. Deep learning has dramatically improved state-of-the-art machine learning in a variety of domains - including speech recognition, visual object recognition, and object detection. Deep learning networks do not need “hand designed”features, but they usually require extremely large data sets. In medical image analysis, large data sets are either unavailable or extremely expensive. In this work we explore the use of convolutional neural networks (CNNs) and transfer learning in a medical physics application with a small dataset (498 images). We compare the results of various CNNs developed without domain knowledge against a system carefully designed by domain experts.

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Presenter: INTERIAN, Yannet (College of Arts & Sciences, University of San Francisco)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **123** Type: **Parallel Talk**

The new systems at Mexico for nuclear reactions measurements at low energies

Tuesday 24 October 2017 11:00 (30 minutes)

During the last 6 year, the infrastructure related with Experimental Nuclear Physics at the Physics Institute, UNAM, has been benefited with an unprecedented injection of resources: four new beam lines were mounted at the CN-Accelerator Van der Graaff of 5.5 MV, which originally had just one. Moreover, a modern Tandetron AMS system of 1 MV was acquired in order to establish this kind of technique for the first time at Mexico. This AMS system is nowadays a National Laboratory called LEMA.
In one of the lines of the Van der Graaff Accelerator was built a permanent windowless Supersonic Gas target (SUGAR), which is been completed with a neutron wall composed of 16 scintillator crystals (MONDE). With this combination will be possible to measure coincidences between charge particles and neutrons and/or gammas.
To complete the AMS system, and additional beam line will be coupled to the accelerator in order to extract intense and pure stable beams at low energy. In addition, the current radioactive beams used for AMS purposes, will be able to be used with an acceptable intensity in order to develop experiments related with the scattering and resonances of ^{13,14}C and ^{26}Al, using light targets.
In this work are presented some of the characteristics of all these new systems: the first data related with the commissioning of the Supersonic Gas Target, where the ^{14}N(d,α)^{12}C was studied, achieving a good resolution for the alpha resonances and proving the good qualities of the entire system; besides, is described the first approximation for the measurements of cross sections for the ^{28}Si(d,α)^{26}Al and ^{25}Mg(p,γ)^{26}Al reactions at low energies, where are used the two accelerators that were mentioned before, the CN-Accelerator to produce the reaction, and the AMS system to measure the concentration of ^{26}Al produced after the irradiation. These ^{26}Al concentrations are directly related with cross sections of a particular reaction energy, whose values are currently interesting for Astrophysics parameters.
This research is been partially supported by PAPIIT-DGAPA-UNAM-Project: IA101616.

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Session Classification: Parallel Sessions - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **125** Type: **Poster**

Plasma dynamic viscosity determined by NMR

A NMR based experimental procedure to determine the dynamic viscosity (η) in Plasma solutionsis presented. An equation relating η and the transversal proton magnetic relaxation time (T_2) is obtained after considering a fast exchange between the free and associated water inside the Plasma Solution, the dominant role of the associated water in proton magnetic relaxation, the characteristic mobility of the plasma proteins and the magnetic field value used in the experiment. Carr-Purcell-Meiboon-Gill pulse sequence was used to measure T_2 in a magnetic resonance console coupled to one homogeneous magnetic system (0,095 T). An η value of 1.66 ± 0.05 mPas was obtained in 27 controls individuals, which statistically match with the value obtained in the same samples using the Oswald viscometer (1.62 ± 0.03 mPas). η was determined in 166 patients with Multiple Myeloma (2.24 ± 0.07 mPas) and 54 with Sickle Cell Disease (1.92 ± 0.05 mPas) showing an statistically significant increase over the control individuals. The results show the utility of this NMR method to estimate dynamic viscosity in Plasma with medical purpose.

Key words: Dynamic viscosity, Transversal relaxation time, Plasma, Multiple Myeloma, Sickle Cell Disease.

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Presenter: LORES GUEVARA, Manuel A. (Centro de Biofísica Médica, Universidad de Oriente, Santiago de Cuba. Cuba.)

Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **127** Type: **Parallel Talk**

Survival of heavy flavored hadrons in a hot medium

Wednesday 25 October 2017 14:20 (25 minutes)

Attenuation of hadrons with open or hidden heavy flavor, produced in relativistic heavy ion collisions, is described within the color-dipole approach. A charmonium propagating through a dense matter can be broken-up by either Debye screening of the binding potential (melting), or due to color-exchange interactions with the surrounding medium (absorption). These two effects are found to have similar magnitudes and both vanish at high transverse momenta of the charmonium. Although hadrons with open heavy flavor, charm and beauty, have been predicted to have a high survival probability, they were found to be strongly suppressed by final state interactions with the created dense medium. While vacuum radiation of high-p_T heavy quarks ceases at a short time scale, production of a heavy flavored hadrons in a dense medium is considerably delayed due to prompt breakup in the medium. This causes a strong suppression of the heavy quark yield in a good accord with available data.

Authors: KOPELIOVICH, Boris (Universidad Técnica Federico Santa María, Chile.); POTASHNIKOVA, Irina (Universidad Técnica Federico Santa María, Chile.); SCHMIDT, Ivan (Universidad Técnica Federico Santa María, Chile.); SIDDIKOV, Marat (Universidad Técnica Federico Santa María, Chile.); NEMCHIK, Jan (Czech Technical University in Prague (CZ) and Institute of Experimental Physics, Kosice (SK))

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Session Classification: Parallel Sessions - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **129** Type: **Parallel Talk**

Recommendations for commissioning IMRT and VMAT into Pinnacle TPS

Methods and results for commissioning and verification of the VMAT delivery chain at NPL are presented. The VMAT parameters for the combination of Pinnacle v9.8 with with Elekta's Mosaiq® v1.6 record and verify system and Synergy and Versa HD linacs are discussed. Commissioning verification and gamma analysis results for three stablished IMRT QA deliveries are presented and compared, based on the use of different 2D/3D dosimetry systems.

Author: SILVESTRE PATALLO, Ileana (National Physical Laboratory, United Kingdom.)

Presenter: SILVESTRE PATALLO, Ileana (National Physical Laboratory, United Kingdom.)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **130** Type: **Poster**

Monte Carlo simulation of radiation transport in the study of hybrid Timepix detectors based on GaAs:Cr

Wednesday 25 October 2017 13:30 (15 minutes)

The chromium - compensated gallium arsenide is attaining a relevant position between the materials devoted to the development and fabrication of radiation detectors. This material shows high resistance to the radiation damage, high effective Z, relative low production cost, possibility to grow large area films, etc. Some results from the study of Timepix hybrid detectors based on GaAs:Cr by using the Monte Carlo modeling of radiation transport are presented in this contribution. The MCNPX, GEANT4, SRIM and MCCM code systems were used for this purpose. In-depth profiles of the energy deposited by the incident radiation within the sensor active volume are included. Similarly the shapes and dimensions of the charge carriers clouds generated by different energy incident photons, in different geometrical conditions, are also obtained and presented. The ranges of two different energy ^{22}Ne ions in GaAs:Cr material and the contributions from each energy loss channel were also determined in the U-400M cyclotron. In addition, the effective displacement cross-sections and the number of displacement per atom produced for each atomic specie are presented when the device is irradiated with electrons and photons at different energies.

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Session Classification: Poster Session - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **131** Type: **Parallel Talk**

Intermediate-energy Coulomb excitation of ^{72}Ni

Friday 27 October 2017 13:30 (25 minutes)

Transition strengths in the Ni isotopes between N=40 and N=50 have been recently subject of extensive experimental and theoretical investigations, aiming to understand whether the tensor forces act to reduce the Z=28 shell closure as the neutron g9/2 orbit is filled towards 78Ni.
The effect of the Z=28 shell gap quenching and its evolution from 68Ni towards 78Ni would be reflected as an enhancement in the quadrupole transition stregths, compared with the seniority scheme predictions for the neutron g9/2 subshell. In 70Ni, the large B(E2) value for the first 2+ excited state obtained by Coulomb excitation was interpreted as an evidence of a large neutron-induced polarization of the proton core. This interpretation was reinforced with a later inelastic proton scattering experiment on 74Ni, in which a large deformation parameter was found, pointing to an enhanced quadrupole collectivity.
In the last year however, a much lower B(E2) value was deduced for 74Ni in a Coulomb excitation experiment. In that work, both experimental and shell-model calculations using the residual LNPS interaction, restores the normal core polarization picture in the neutron rich Ni isotopic chain and suggests that the B(E2) strength predominantly corresponds to neutron excitation.
The known experimental transition strengths by Coulomb excitation are constrained to 70Ni and 74Ni so far.
We report on preliminary results from the Coulomb excitation of 72Ni performed at the Radioactive Isotope Beam Factory at RIKEN, Japan. The BigRIPS fragment separator was used to select and purify a secondary beam of 72Ni at 183 MeV/u. Coulomb excitation of 72Ni was produced by impinging the beam on a 950 mg/cm2 Au target. In order to identify the reaction products after the target, the ZeroDegree spectrometer was used, while the gamma-rays were detected with the 186 NaI(TI) detector array DALI2.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **132** Type: **Poster**

Energy calibration of hybrid GaAs:Cr-based Timepix detector with alpha particles

Wednesday 25 October 2017 14:30 (15 minutes)

The advanced GaAs:Cr material for radiation detection is in the scope of many scientific and technological institutions in the world, as consequences of its proved superior properties and economic advantages. Experiments made at the JINR Dzhelepov Laboratory of Nuclear Problems for the energy calibration of a hybrid GaAs:Cr-based Timepix detector with alpha particles reaffirm that this device is able to register this particle in energy range from 3140 keV to 7687 keV. The mathematical simulation was used to calculate the transmitted energy, making possible the experimental calibration with the use of Mylar as absorbent. By calibrating the detector with characteristic X rays of some target materials and using a two steps fitting procedure was determined the relationship between the photon energies and the registered by the detector TOT counts. The energy calibration with alpha particles was performed according to linear function y = 362.08 + 2.41 x, with R^2 = 0.99, and verified with the measurement of the ^{218}Po line of radon in air.

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Session Classification: Poster Session - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **133** Type: **Poster**

Properties of GaAs:Cr-based pixel detectors

Wednesday 25 October 2017 14:30 (15 minutes)

High resistivity gallium arsenide compensated by chromium has demonstrated a good suitability as a sensor material for hybrid pixel detectors used in X-ray imaging systems with photon energies up to 60 keV. The material is available with thickness up to 1 mm and thanks to its Z number and fully active volume of the sensor high absorption efficiency in this energy region is provided. Although GaAs:Cr-based detectors are mostly designed for X-ray applications, it can be used for charged particle tracks registration, that will be shown.
In this work the results of the GaAs:Cr-based Timepix detectors tests with various particles sources are reported. The energy and spatial resolution, mu-tau distribution over sensor area have been determined. By means of scanning the detector with pencil photon beam generated by synchrotron facility, the geometrical mapping of pixel sensitivity is obtained as well as the energy resolution of a single pixel. The long-term stability of the detector has been evaluated based on the measurements performed over one year. It's well known that the main performance limitation of thick GaAs:Cr-based detectors is caused by readout electronic with relatively small pixels due to the charge sharing effect. But by optimizing the bias voltage it was possible to achieve an FWHM of 2.5 keV at 25 keV in a single photon counting mode. Also the radiation hardness of GaAs:Cr sensors was investigated by means of irradiation with 20 MeV electrons and some results will be presented.

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Session Classification: Poster Session - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **134** Type: **Poster**

Spectral CT with a Timepix detector and a GaAs:Cr sensor: material decomposition

Wednesday 25 October 2017 14:30 (15 minutes)

In recent years, CT has proven itself as a method of nondestructive research in biology, geology, industry, and other fields. However, until recently, the detectors used in CT recorded only the intensity of the radiation, losing information about the energy. The method of dual-energy CT partially corrects this deficiency. With the advent of hybrid matrix detectors with the single photon counting, it became possible to take into account the energy of radiation by comparison with one or more energy thresholds. The ability to use high-Z semiconductors as a sensor makes it possible to increase the efficiency of the detector. This work is devoted to the development of a method of spectral CT with a Timepix detector and a GaAs: Cr sensor. The possibility of material decomposition based on the dependence of the linear attenuation coefficient on energy is demonstrated.

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Presenter: Mr KOZHEVNIKOV, Danila (Joint Institute for Nuclear Research (JINR))

Session Classification: Poster Session - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **135** Type: **Poster**

Study of the charge sharing effect and the energy resolution in a hybrid based on GaAs:Cr Timepix detector

Wednesday 25 October 2017 14:30 (15 minutes)

Among the most modern ionizing radiation detectors, the hybrid based on GaAs:Cr Timepix stands out as one of the most competitive due to its characteristics, such as its high Z and its strong resistance to radiational damage. In addition to their use in high energy physics research, they have been effectively employed in the medical visualization, spatial technologies, geological prospecting, among others advanced fields. The target of this work is a 900 μm GaAs:Cr detector with Timepix read-out technology. Some detector characteristics for three experimental conditions were measured and studied using the X-rays generated by a synchrotron and by an X-ray tube provided with different materials for obtaining the corresponding fluorescence photons. A composite function was used to decompose the differential spectra in to the most important involved contributions. As an additional tool in the investigation, the mathematical modeling of the movement within the detector active volume of the generated by radiation charge carriers was used. The results of the charge-sharing studies showed a noticeable prevalence in the detector of this phenomenon, changing its contribution according to the experiment characteristics. The detector was calibrated for all the planned experiments and the energy resolution of the system was calculated. From the analysis of all obtained results and their comparison with the previously reported in literature data, it was confirmed that the detector has a marked charge-sharing effect between neighboring pixels, seeing its performance more affected as the energy of the incident photons growths.

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Session Classification: Poster Session - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **136** Type: **Parallel Talk**

COMPASS experiment at CERN

Tuesday 24 October 2017 09:30 (30 minutes)

COMPASS is a modern fixed target experiment at a secondary beam of the Super Proton Synchrotron at CERN. The purpose of the experiment is the study of hadron structure and hadron spectroscopy with muon and hadron beams of high intensity. The COMPASS setup is a multipurpose universal spectrometer based on two analysing magnets and equipped with various tracking detectors, electromagnetic and hadron calorimeters, muon filters and Cherenkov detectors for particle identification. COMPASS has an intensive physics programme which includes the following topics: study of nucleon spin structure in semi-inclusive deep inelastic scattering and Drell-Yan process; measurement of the generalized parton distributions for the nucleon in reactions of deeply virtual Compton scattering and deeply virtual meson productions; search for new hadronic states and study of their production mechanisms; test of low-energy QCD models in Primakoff reactions. A physics programme for the period after 2020 is under discussion.

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Presenter: GUSKOV, Alexey (Joint Institute for Nuclear Research (RU))

Session Classification: Parallel Sessions - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **138** Type: **Plenary Talk**

Recent results from the ALICE detector at the LHC

Thursday 26 October 2017 09:00 (30 minutes)

The ALICE experiment at CERN investigates the properties of strongly interacting matter at high temperatures. This talk highlights some of the recent results from the collaboration,presenting key constraints on properties of the QCD matter. A brief description of the ALICE upgrade program is also given.

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Presenter: POLJAK, Nikola (ALICE collaboration)

Session Classification: Plenary Talks

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **141** Type: **Plenary Talk**

Highlights from the CMS Experiment

Thursday 26 October 2017 09:30 (30 minutes)

In the Run-2 of the Large Hadron Collider, CMS is recording an impressive amount of proton-proton collision data at a center of mass energy of 13 TeV. In this talk, we highlight the CMS status in 2017 and some of the latest physics results.

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Session Classification: Plenary Talks

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **142** Type: **Parallel Talk**

The LENOS Project at Laboratori Nazionali di Legnaro of INFN-LNL: a thermal to 70 MeV neutron beam facility

Tuesday 24 October 2017 09:30 (30 minutes)

LENOS (Legnaro NeutrOn Source) project at the LNL-INFN (Italy) is a neutron irradiation facility for nuclear astrophysics studies and data validation for energy and non-energy applications. It is based on a high current low energy RFQ. The facility, will use the 5MeV, 50 mA proton beam of RFQ under test at LNL to produce an unprecedent neutron flux, precisely shaped to a Maxwell-Boltzmann energy distribution. A new method has been proposed to obtain the desired neutron spectra at different stellar energies and a dedicated target, able to sustain a very high specific power, has been developed and tested. We will present the facility, the method used to shape the neutron beam, the results of the high power test of the microchannel water cooled target and the preliminary results of a measurement dedicated to the validation of the proposed method.
Beside the neutron facility based on RFQ, we have currently partially financed an higher neutron energy facility based on the new Cyclotron of 35-70MeV tuneable energy and up to 750uA current. The high energy facility is called NEPHIR and at the moment, is dedicated to the study of Single Event Effect (SEE) on electronic devices. The 70MeV proton beam will produce an atmospheric like neutron spectra up to 70 MeV using a novel technique and novel target: the neutron spectra is constructed by a weighted convolution of neutron spectra coming from different reactions. The target able to use two different materials and thus two different reactions, is a rotating target.
The opportunity to have the tenable energy between 35 and 70 MeV will offer also the opportunity to produce quasi-monochromatic neutron beam, whose applications span from fundamental physics to applied one (within the framework of SEE studies allow the search for threshold effects for instance). Finally, in the long term a pulsing system with about 2 ns time width is planned to allow a neutron Time of Flight facility. In this presentation, the novel method to produce atmospheric neutron spectra, the target design, the calculations for the production of quasi mono-energetic neutron beam with p,Li and p,Be reactions will be presented.

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Session Classification: Parallel Sessions - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **144** Type: **Parallel Talk**

Application of risk analysis methods to radiation medicine

The methodology of Risk Matrices has been used extensively for safety assessments in the risk industry. The method characterized by being systematic and simple, features that allow considering its application in hospitals. The practice of radiotherapy, where fatal accidents have occurred, needs to apply methodologies to anticipate and prevent potential accidents. The Ibero-American Forum of Radiological and Nuclear Regulators (FORO) has adapted and applied this methodology of risk matrices in teletherapy (Co-60 equipment and linear accelerators) and brachytherapy (high and low dose rate).

A large list of possible human error and equipment failure that could trigger accidents was analyzed. The main defenses (interlocks, alarms and procedures) that could prevent, detect, monitor and mitigate potential accidents were identified.

For the practical application of the Risk Matrices methodology, FORO has developed the SEVRRA tool. This allows a generic list of initiator events, barriers and reducers to be adapted to the specific conditions that work in a particular radiotherapy department.

In this way, it is possible to obtain an estimate of the risks in the working conditions of the radiotherapy department that has been evaluated and to propose an action plan to reduce the risks and to prevent the occurrence of accidents in Radiotherapy.

The methodology of Risk Matrices and the SEVRRA tool have been applied in more than 100 Departments of Radiotherapy in Spain and Latin America. In many of them, action plans have been developed to implement safety measures that have made it possible to reduce the risk of accidents.

Currently, FORO works to extend the application of this methodology and the SEVRRA tool to other radiotherapy techniques (IMRT, Radiosurgery, IORT) as well as diagnostic and therapeutic procedures in nuclear medicine.

The work done so far confirms the need for a prospective approach to the prevention of accidents in radiotherapy and is in full accordance with the “Bonn Call for Action No. 7” of the International Conference on Radiation Protection in Medicine developed in German in December 2012.

Author: DUMÉNIGO GONZÁLEZ, Cruz (Sociedad Cubana de Física Médica)

Presenter: DUMÉNIGO GONZÁLEZ, Cruz (Sociedad Cubana de Física Médica)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **145** Type: **Poster**

Analysis of the Higgs field non-minimally coupled to gravity

Tuesday 24 October 2017 15:30 (15 minutes)

Nowadays one of the main problems of Physics is not to know the origin and nature of the acceleration of cosmic expansion during the present and future stages in the evolution of the Universe. The research carried out includes the study of a model based on the Higgs field non-minimally coupled to gravity. Cosmological implications of the Higgs field have been studied for some years, and they have taken more importance after the recent discovery of the Higgs Boson in 2012 at the Large Hadrons Collider in Geneva, Switzerland. Using the dynamical systems technique, we study the possibility that the cosmological Higgs field non-minimally coupled to gravity can lead to the current behavior of the universe. We consider a homogeneous and isotropic flat Friedmann-Robertson-Walker (FRW) metric. We prove that there are two possible late time attractors corresponding to stable de Sitter solutions. These two solutions correspond to late-time accelerated expansion.

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Session Classification: Poster Session - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **146** Type: **Parallel Talk**

Exploring the shell structure of exotic Sn isotopes with an Active Target at SPES: the MagicTin project

Thursday 26 October 2017 15:25 (25 minutes)

With the aim of studying the evolution of nuclear shells in the region of neutron-rich Sn isotopes, the MagicTin project (EU-MSCA 661777) will exploit the capabilities of the ACTAR TPC detector for measuring direct reactions in the Z≥50, A≥132 mass region.
In preparation for these experimental campaigns, to be done at the forthcoming radioactive ion beam facilities like SPES, HIE-ISOLDE or SPIRAL2, several preparatory steps are needed. Indeed, the detection of heavy-ion (Z≥50) induced reactions using an active target represents a challenge itself.
After providing an overview about the use of Active Targets in experiments with Radioactive Ion beams, I will focus on the status of the MagicTin project and its future perspectives.

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Co-author: THE ACTAR TPC COLLABORATION

Presenter: Dr MARCHI, Tommaso (IKS - KU Leuven, Belgium.)

Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **147** Type: **Poster**

Modelling of an Apex Microcollimator coupled with a Precise linear accelerator for radiosurgery treatments

Sophisticated devices are used in Stereotactic Radiosurgery (SRS) for delivering small radiation beams in specific geometries. Computer planning systems are customized with specific dosimetric data corresponding to the specific machine.
At Instituto Nacional de Oncologia y Radiobiologia, an Apex micro multileafs collimator was adopted together with an Elekta Precise linear accelerator for SRS treatments. The system's dosimetric characteristics were measured, according to the manufacturer's recommendations for modelling the beam in a Monaco Treatment Planning System (TPS). The beam production and delivery system is not usual and its measurements are also of interest for small fields dosimetry research.
Measurements were carried out with three dosimetric systems, generally considered as suitable for small fields dosimetry as found in SRS. A Pin Point ionization chamber, a diode and a diamond dosimeter, all from PTW, were used in combination with a 3D water phantom and Mephysto software, also from PTW.
Output Factors, depth dose curves and profiles were measured at different depths. In this work, measurements results and comparisons among them are presented. In order to conform the beam model, the data gathered with the diode was selected. For very small fields was, the chamber's results diverged from those of the other systems, as previously seen in other works.
With this work's results, the Apex radiation beam model could be modeled and the Monaco TPS will have the capacity to calculate SRS treatments. Besides, results from these measurements contribute to the international research project related to small beam dosimetry.

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Presenter: DIAZ MORENO, Rogelio Manuel (Instituto Nacional de Oncología y Radiobiología, Cuba.)

Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **148** Type: **Parallel Talk**

Azimuthal angular correlations in high transverse momentum dijet scenarios.

Tuesday 24 October 2017 13:55 (25 minutes)

Measurements of the azimuthal angle correlation between the two jets with the largest transverse momenta (pt) in inclusive 2-jet topologies, close to the back-to-back configuration, are presented for several regions of the leading jet transverse momentum. The features of the different models considered in the comparisons and their physical impact are discussed.

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Session Classification: Parallel Sessions - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **149** Type: **Poster**

Gamow-Teller β^+ decay properties of A=98 isobars near ^{100}Sn doubly magic core

Tuesday 24 October 2017 16:00 (15 minutes)

In this work, we have realized some spectroscopic calculations in the frame work of the nuclear shell model, in order to estimate the Gamow-teller (GT) β^+ decay of A=98 proton rich isobars in ^{100}Sn mass region near rp-process path. The calculations are carried out by means of Oxbash nuclear structure code, taking into account the monopole effect in the studied mass region. The obtained results are then compared to the available experimental data.

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Session Classification: Poster Session - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **150** Type: **Parallel Talk**

High-resolution gamma-ray spectroscopy at LNL with GALILEO: commissioning campaign and first results

Tuesday 24 October 2017 09:00 (30 minutes)

The Legnaro National Laboratories have a long-standing tradition in gamma-ray spectroscopy. They hosted the most recent HPGe arrays, from GASP, one of the first Compton-shielded large HPGe array to AGATA, the first operational tracking array worldwide.
In this context, a new resident gamma-ray spectrometer GALILEO has been developed. After a 1-y long commissioning campaign, a physics campaign started. In such campaign, GALILEO has been combined with a light-charge particle and a neutron array, EUCLIDES and NEUTRON WALL, respectively, for the investigation of neutron-deficient nuclei. The experiments performed so far aimed mainly at studying the shape coexistence phenomenon in medium-mass and heavy nuclei, the octupole correlations in the Ba region and the isospin symmetry breaking effect in light nuclei. The first results will be reported.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **151** Type: **Parallel Talk**

Exploring the possibility of radiography in emission mode at higher energies: Improving the visualization of the internal structure of paintings

Wednesday 25 October 2017 13:55 (25 minutes)

We demonstrated in previous investigations that the internal structure of paintings can be visualized with conventional radiography in transmission mode when paintings have the proper stratigraphy. Unfortunately, there are many paintings that do not result in useful images. This problem can be solved by using radiography in emission mode. With this technique, the painting is irradiated with high energetic X-rays originating from an X-ray tube operating at 100 keV –320 keV while inside the painting low energetic signals such as photoelectrons or characteristic photons are being generated. These signals escape from the top 10 μm of the painting and are able to illuminate the imaging plate. However, this technique has also some disadvantages. One of them is that it is not able to visualize underlying paintings. In this study, we explored the possibility to enhance the information depth by increasing the energy of the photon source from 100 keV up to 1.3325 MeV (i.e., Co60 source). At the same time, we also studied the impact of the energy on the contrast between pigments and on the lateral resolution. For this, we used mathematical simulation of particle transport in matter to understand the relation between input particle (particle type such as photon, electron or positron and the energy of the particle), the material being irradiated (element from which it is composed, thickness) and the output signal (generated particle types, energy, dispersion). Finally, we will show that it is possible to image paintings using a Co60 source.

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Presenter: Dr SCHALM, Olivier (University of Antwerp & Antwerp Maritime Academy, Belgium.)

Session Classification: Parallel Sessions - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **152** Type: **Poster**

Commissioning of two Sensus SRT-100 50 - 100 kV X-ray unit for skin cancer treatment

This study provides dosimetric data from the commissioning of two Sensus SRT-100 50–100 kV X-ray units. Data collected during the commissioning process included: a) HVL, b) output (dose rate), c) applicator cone factors, and d) profiles. Percentages depth dose were not measured due to lack of resources. Farmer-type chambers (iba-FC65-G), and a thin-window parallel plate ion chamber (PTW-N23342) were used for HVL measurements. Dose rate measurements were made with two thin-window parallel plate ion chamber (PTW-N23342). Dose profiles were measured with EBT3 GafChromic film. The average HVL values for 50, 70, and 100 kV of the two treatment units were found to be 0.52, 1.13, and 2.03 mm Al, respectively when plane parallel chamber were used and 0.55, 1,16 and 1,98 mm Al for farmer types. The HVL's were 2.4%–5% lower when measured with the Farmer chamber, as compared to measurements with the parallel plate chamber, for energies of 50 and 70 kV, that differs to Sheu et all. Dose rates were measured for 50, 70 and 100kV at 15 and 25 cm SSD. The dose rate variation for two units was below 2 %. Applicator factors deviation were also below 2 %. The dose profiles for the 5 cm applicator were nonuniform, especially in the cathode–anode direction. The data obtained shows good stability for this type of machine and the necessity of redundant verification.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **153** Type: **Parallel Talk**

Study of Nucleon-Nucleon Short-Range Correlations, the EMC Effect, and their relation using Backwards-recoiling Protons

Friday 27 October 2017 11:30 (30 minutes)

The EMC effect is the observation that the structure of nucleons in nuclear medium is modified from that in free space. Over 1000 papers were written about the effect, but no explanation is commonly accepted. A linear correlation has recently been observed between the slopes of the EMC universal curve for $0.3 < x_B < 0.7$ in deep-inelastic (DIS) lepton scattering, $d[F_2(A)/F_2(d)]/dx_B$ and $a_2(A/d)$, the per-nucleon inclusive quasi-elastic electron scattering cross-section ratios from SRC in nucleus A to that from deuterium for $1.4 < x_B < 2$. This correlation is surprising because of the vastly different energy and distance scales of EMC and short-range nucleon-nucleon correlations (SRC).

A recent explanation of this correlation is that the modification of $F_2(A)$, the nucleon structure-function in the nuclear medium, depends on the virtuality of the nucleons, which is high for short-range correlated nucleons such that the EMC effect, to a large extent, is related to DIS from highly virtual, short-range correlated nucleon.

We study this hypothesis by detecting EMC events "tagged"by high-momentum ($k_p > k_F$) protons recoiling backward to the momentum transfer, q, which have been shown to be spectators from scattering off their short-range correlated partners.

We shall present and discuss results of inclusive SRC, $a_2(A/d)$, and "normal"EMC $F_2(A)/F_2(d)$, as well as semi-exclusive SRC ("tagged"SRC), and semi-inclusive DIS ("tagged"EMC), $\{\sigma[A(e,e'p_{recoil})X]/A\}/\{\sigma[d(e,e'p_{recoil})X/2]\}$ for their respective X_B ranges.

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Session Classification: Plenary Talks

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **154** Type: **Poster**

Exposed Occupationally Worker Dosimetry at Interventionism Techniques

Very soon is going to work in Cardiological Center of Villa Clara, Cuba, a new brand of X ray Device, (that is X Ray in C Arm), that includes electrophysiology functions, in which the irradiation time might be longer in comparison with Hemodynamic Machines and interventionist cardiology, where take place several procedures of less duration such as angiographies and angioplasties. It is shown the experience results of dose to the doctors of interventionist cardiology, using TLD and RPL detectors, in different parts of the body that demand the radiologic protection. Measurements are mainly made at crystalline, limbs and the whole body. It is taken into account the fact that at the time to perform recordings, the dose to apply must be higher, that is the irradiation of gamma rays is higher at this time. It was used in addition the dosimeter RDS30 and the DCM 3000 in measurements of different regimes of professional work performed with patients. The recorded dose to the interventionist doctors show the great need to keep a permanent and effective surveillance, they are controlled regarding with the kind of procedure, pathologic indication, fluoroscopy time and machine, generating estimation of the patient dose. The doses to the limb of the cardiologic specialist were measured using TLD.
The dose at the crystalline are recorded placing TLD, a Little bigger with its three cells, that it is proposed to improve through an IAEA project. It is also placed a second witness out of the protection media , that is the glasses with lead protection 5 mm equivalent, besides it is informed the dose of thyroids and limbs of the cardiology specialist. The other report of dose is at the heart level of the Doctor under the protection and without protection. In each procedure it is reported the accumulative dose of the performed intervention. It is also reported the average time in minutes of each procedure. Both C Arm devices record a useful information level to the redundant estimates of the likely dose to be received by the doctors and the surveyed patients.
It is confirmed the need of the irreplaceable systematic practice in the preparation in items of radiological protection for all the personal that works at cardiovascular interventionism.

Keywords: TL Dosimeter, Interventionism, Equivalent Dose, Specialist Doctors, Radiological Protection.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **156** Type: **Parallel Talk**

High pt top-jet production at the LHC

Monday 23 October 2017 15:25 (25 minutes)

The production of $t\bar{t}$ pairs at high pT, i.e. the so-called boosted regime, is characterized by two collimated jets which contain most of the particles originating from the top decays. We investigate a scenario with both top quarks decaying hadronically. We attempt a definition of "top jet", by considering the substructure of the selected "fat" jets resulting from the top decay and we study the contamination from QCD events (the background). Theoretical predictions of the differential cross sections as a function of the azimuthal difference between the two top jets, as well as pt distribution of the top jets is presented using the definition of "top jets", on analogies at QCD dijet topologies.

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Session Classification: Parallel Sessions - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **157** Type: **Parallel Talk**

Neutron source based on ^{7}Li(p,n)^{7}Be reaction for Boron Neutron Capture Therapy

Monday 23 October 2017 13:30 (25 minutes)

If Boron Neutron Capture Therapy is to become a practical option, accelerator-based sources of high fluxes of epithermal neutrons are essential. Generation of low energy neutron can be achieved by ^{7}Li(p,n)^{7}Be reaction using accelerator-based neutron source. Much work has been performed on development of high-flux compact proton accelerators, but a doselimiting component remains design of the neutron production target. Specifically, lithium has a low melting point (180°C) and low thermal conductivity (44 W/m°C). In this study, therapeutic gain and tumor dose per target power, as parameters to evaluate the treatment quality, were calculated. Energies near the reaction threshold for deep-seated brain tumors were employed. These calculations were performed with the Monte Carlo N-Particle (MCNP) code. As a result, a good therapeutic gain was obtained with a simple but effective beam shaping assembly. Also, heat transfer evaluations of a lithium target designed were performed by ANSYS software. The target designed show that the peak lithium temperature can be held below 150°C with indalloy flowing by a cooper microchannels plate.

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Session Classification: Parallel Sessions - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **158** Type: **Poster**

Chemical and mineralogical characterization of the cupola slag generated in the “9 de Abril” smelter of Sagua la Grande

Wednesday 25 October 2017 16:00 (15 minutes)

Slags are final by-products involved in the iron and steelmaking process. The general tendency in the foundry workshops in Cuba is to consider slag as a waste material and deposit it in the yards of the workshops or in municipal landfills affecting the environment. Its composition and characteristics depend and vary widely according to the raw material used, the technology employed and the cooling rate once extracted from the furnace. The chemical and mineralogical characterization of slag generated in cupola furnace in the “9 de Abril” smelter of Sagua la Grande has been performed using techniques such as: EDX, XRD and FTIR.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **159** Type: **Parallel Talk**

The role of pairing in heavy-ion induced transfer reactions

Tuesday 24 October 2017 09:30 (30 minutes)

An experimental campaign to study heavy-ion induced one- and two-nucleon transfer reactions has been performed at INFN-Laboratori Nazionali del Sud in Catania (Italy). In particular reactions induced by 18O and 20Ne beams at energies above the Coulomb barrier on different target isotopes have been explored with high resolution (both in energy and angle) and in a quite wide angular range including zero degrees. The aim of this study is two-fold. First of all, the experimental observations and the analysis of the reaction mechanism in two-nucleon transfer reactions in a quantum-mechanical description can give interesting information on the role of the pairing force in populating specific excited states and resonances, such as the so called Giant Pairing Vibration. Moreover, the study of multi-nucleon transfer cross-sections is a crucial aspect for recently proposed research projects involving the use of nuclear reactions of double charge exchange in relation with the physics of neutrinoless double beta decay. The multi-nucleon transfer mechanism could compete with the double meson exchange mechanism in double charge exchange reactions and their role must be understood in order to extract accurate information on the nuclear matrix elements of interest.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **160** Type: **Poster**

Modeling an Elekta Precise linac head using the Monte Carlo code GATE

The Monte Carlo method (MC) has been commonly used in medical physics applications such as radiotherapy, radiation protection and nuclear medicine due to the stochastic nature of radiation and detection processes. In our country, during the last few years, new radiotherapy machines with novel technological advances have been acquired. Among this new equipment, the linear accelerator (linac) has the capability to deliver treatment techniques with high level of complexity. In order to be capable to perform several research activities with a direct impact on the daily clinic our first step was to model the linac head of an Elekta Precise that is commonly used in radiotherapy facilities in Cuba. The MC code employed was GATE, which uses GEANT4 libraries and was adapted for easy implementation in the field of radiotherapy and nuclear medicine. To validate this geometrical model several calculations on a water cube were performed. For each simulations a dose image was obtained. Each dose image was compared with experimental data provided by the medical physics group from the radiotherapy department of the Oncology Institute at Havana using the same beam set up: Source Surface Distance (SSD), Energy, and field sizes of 5x5 cm2, 10x10 cm2, and 20x20 cm2. The uncertainty obtained for each simulation was of 2% for each dose image and the standard deviation with measurements was 3%.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **161** Type: **Parallel Talk**

Chiral effects in gauge theories and the chiral chemical potential

Monday 23 October 2017 14:20 (25 minutes)

We report the generation of a pseudovector electric current having imbalanced chirality in an electron-positron strongly magnetized gas in QED. It propagates along the external applied magnetic field B as a chiral magnetic effect in QED. It is triggered by a perturbative electric field parallel to B, associated to a pseudovector longitudinal mode propagating along B. This mode is associated to the chiral charge density in a massive charged medium in the context of QED. We do not introduce a chiral chemical potential, this term usually used in the literature is not well defined, because the axial charge is not conserved. However, an electromagnetic chemical potential was introduced, but our results remain valid even when it vanishes. A nonzero fermion mass was assumed, which is usually considered vanishing in the literature. In the quantum field theory formalism at finite temperature and density, an anomaly relation for the axial current was found for a medium of massive fermions. It bears some analogy to the Adler-Bell-Jackiw anomaly. We obtain that the pair creation process, due to longitudinal photons (out of light cone), induces an imbalanced chirality and contributes to the chiral current along B. We also discuss about the introduction of a chiral chemical potential in the quantum field theory formalism at finite temperature and density, specifically in the frame of electroweak theory.

Authors: Mr ACOSTA AVALO, Jorge Luis (Instituto Superior de Tecnologías y Ciencias Aplicadas (InSTEC)); Prof. PEREZ ROJAS, Hugo. C (Instituto de Cibernetica, Matemática y Física (ICIMAF))

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Session Classification: Parallel Sessions - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **162** Type: **Parallel Talk**

Elastic scattering of ^{9}Be + ^{80}Se and the breakup threshold anomaly

Monday 23 October 2017 15:50 (25 minutes)

Full angular distributions for the elastic scattering of the ^{9}Be + ^{80}Se system were measured at eleven bombarding energies around the Coulomb barrier namely, 17,18, 19, 20, 21, 22, 23, 24, 25, 30 and 32.8 MeV, in order to investigate the influence of the breakup of the weakly bound ^{9}Be projectile on the reaction mechanisms. The ^{9}Be beams were delivered by the 20 UD tandem accelerator of the TANDAR Laboratory at Buenos Aires. The experimental data have been analyzed in the framework of the optical model using two different potentials: 1) a semi-microscopic double folding potential with normalization factors for the real and imaginary parts, N_R and N_I respectively, as free parameters, and 2) a phenomenological Wood-Saxon potential with six free parameters, namely the depth, radius parameter and diffusivity for the real part (V, r_{0R} and a_R) and the similarly for the imaginary part (W, r_{0I} and a_I). The coupling to the breakup channel, at energies close and below the Coulomb barrier, is reflected as an increase of the imaginary part of the potential as a function of the decreasing bombarding energies, while the real part decreases in strength. The correlation is explained by the dispersion relation, which connects the real and imaginary parts of the nuclear potential. The analysis of the the present experimental data shows that the energy dependence of the two parts of the optical potential indeed presents a behavior consistent with the so called Breakup Threshold Anomaly (BTA). The uncertainties in the study of the parameter´s dependence with energy are studied using the covariance-matrix method [2]. As a conclusion, we will show that the BTA is determined unambiguously, independently of the model chosen for the nuclear potential.

1. M. Hussein, et al. Physical Review C76, 019902(E) (2007)
2. D. Abriola, G. V. Marti and J. E. Testoni, International Conference on Nuclear Data for Science and Technology (ND 2016), September 11-16, 2016

Authors: Dr ABRIOLA, Daniel (Comision Nacional de Energia Atomica, Argentina.); GOLLAN, Fernando (Comision Nacional de Energia Atomica, Argentina.); ARAZI, Andres (Comision Nacional de Energia Atomica, Argentina.); Dr MARTÍ, Guillermo V. (Comision Nacional de Energia Atomica, Argentina.); Dr TESTONI, Jorge E. (Comision Nacional de Energia Atomica, Argentina.)

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **163** Type: **Poster**

Analysis of IMRT calculations and measurements using the TG119 document at the Radiotherapy Center of Suriname (RTCS)

The purpose of this work was to revise how well XiO treatment planning system (TPS 4.80 patch 03) Intensity Modulated Radiation Treatment (IMRT) calculations are delivered by an Elekta Synergy Platform-MLCi2 machine using Task Group 119 (TG119) benchmarked data of the American Association of Physicists in Medicine (AAPM) in order to implement future IMRT treatments at the Radiotherapy Center of Suriname. The approach delivery was steep and shoot and measurements were performed for the four geometries (except C Shape harder) mentioned on the guide document TG119. The photon energy 10MV was also considered. Using the XiO TPS, fixed-beam IMRT treatment plans were constructed based on the structure sets copied to a parallelepipedic phantom which consist of solid water slabs. The plans were delivered to the phantom using the Elekta machine mentioned above and the resulting dose distributions were measured in the coronal plane using EBT3 Gafchromic films. Measured planar dose distributions were analyzed using gamma index with criteria of 3 %/3 mm. Also, point measurements were taken, five times each, using a 0.125 cm3 scanning chamber situated in the same positions recommended. The confidence limit was obtained for both cases film and point measurements for ulterior comparison with the benchmark provided. The results showed that clinical implementation of IMRT only can be justified for simple IMRT calculations, like those developed in prostate´s anatomy, because an increase on complexity of IMRT plans (H&N) could produce important discrepancies between radiation doses calculated and those delivered by the linac.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **164** Type: **Poster**

β^+ decay properties of A=100 isotopes

Tuesday 24 October 2017 16:00 (15 minutes)

The estimation of spectrosopic properties of neutron-deficient nuclei in the A=100 tin mass region is needed for the understanding of the rp-process path and the experimental exploration of the nuclear landscape. In order to evaluate some spectroscopic properties of the Gamow-Teller β^+ decay of neutron deficient tin isotopes of A=100, we have performed shell model calculations by means of Oxbash nuclear structure code. The jj45pn valence space used consists of nine proton and neutron orbitals. The calculations included few valence hole-proton and particle-neutron in $\pi g_{9/2}$ and $\nu g_{7/2}$ orbitals respectively, in ^{100}Sn doubly magic core. Effective interaction deduced from CD-Bonn one is introduced taking into account the nuclear monopole effect in this mass region. The results are then compared with the available experimental data.

Keywords: Nuclear Structure, ^{100}Sn core, Monopole Effect, Oxbash Nuclear structure code, β^+ decay, neutron deficient tin isotopes.

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Session Classification: Poster Session - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **165** Type: **Poster**

Interaction analysis between polyvinylpyrrolidone (pvp) nanogels synthesized by gamma radiation and human neutrophils

Nanogels are extensively studied for diverse biomedical applications. One of the most relevant is the use as drugs nano-carriers for therapeutic purposes, increasing the bioactivity and transport of active components to specific sites or cells. Nanogels-based drug release formulations improve the effectiveness and safety of certain anticancer drugs and radiopharmaceuticals, minimizing its delivery and tumor accumulation problems associated with the existing traditional nuclear medicine agents. In the present work, the interaction of 30 nm Polyvinylpyrrolidone (PVP) nanogels with human neutrophils cells was evaluated. The analysis was performed using Nitroblue Tetrazolium microscopic and colorimetric assay, as an attempt to achieve the more comprehensive view of nanogel interaction with the main cells of the innate immune system. PVP nanogels synthesized by gamma radiation, and titanium oxide nanoparticles exhibited similar cellular activation through the low production of Reactive Oxygen Species (ROS). In contrast, PVP nanogels showed less cellular activation compared to the bacterial peptide fMLP. This result suggests PVP nanogels as good candidates for drug delivery systems.

Keywords: PVP nanogels, neutrophils, Nitroblue Tetrazolium, drug delivery systems

Supported by: ICGEB SMART Fellowship ID# S/CUB15-02

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **166** Type: **Poster**

Pilot testing of the new IAEA/AAPM Small Field Code of Practice

The IAEA is about to publish an IAEA/AAPM protocol for the dosimetry of small photon beams. The present paper inserts into an ongoing IAEA coordinated research project to test the applicability of the new code of practice.
Relative output factors were measured in water (SSD=90cm @10cm depth) for ten field sizes ranging from 0.49 to 11.3 cm of equivalent square. The collimation is made with the tertiary Elekta APEX mMLC attached to an Elekta Precise with flattering filter (WFF) linac of 6 MV beam. Each of the 10 field sizes was measured with the following detectors: Pinpoint 3D (PTW-31016), Non-shielded Diode (PTW-60017) and Microdiamond (PTW-60019).
In order to report the final output factor, measured reading ratios were adjusted with the correction factors from Table 26 of the new protocol. The field sizes were defined using the FWHM in both axes. An excellent agreement is shown for the 3 detectors. The values of the two solid state detectors (60017 and 60019) are very consistent in the whole range of field sizes. For the smallest field measured (0.5 cm) the output factor determined with the pinpoint chamber deviates by 9% respect to the others 2 solid state detectors, this may be explained because the correction factor for the pinpoint for this size was extrapolated from Table 26.
Thus, the applicability of the correction factors suggested in the protocol for these three detectors was demonstrated even for field sizes down to 0.5 cm square size.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **167** Type: **Parallel Talk**

Simulation with GEANT4 of a new imaging Gamma-ray Compton Backscattering device

Tuesday 24 October 2017 13:30 (25 minutes)

A novel imaging device is proposed based on the gamma-backscattering technique described in Refs. [1,2], developed at GSI (Darmstadt, Germany) and modified by the Nuclear Physics Group at National University in Bogotá, which has been successfully tested by observation of concealed objects behind metallic walls, inspection of metallic structures and localization of buried objects [3,4]. The camera comprises essentially a positron source, a backscattering detector and a position detector that determines the direction of correlated 511 keV gamma-rays used to inspect the object. The backscattered gamma-rays are detected with a Compton Camera, following a design presented in Ref. [5], which provides additional information on the position where the scattering process occurs. In order to evaluate the imaging capabilities of the new camera a simulation was developed using the GEANT4 [6] simulation toolkit. In this work, a description and characterization of the new device is presented. Simulated results suggest already methods to improve the position resolution of the camera, which has been applied to study defects presented in corroded metallic structures.

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Session Classification: Parallel Sessions - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **168** Type: **Poster**

Comparison between different Monte Carlo codes in the modeling of an Elekta Precisa linac head

Several Monte Carlo (MC) codes are available for performing radiotherapy dose calculations, with acceptable accuracy. The objective of this work is to analyze the differences in the calculations obtained by different MC codes and their impact on the absorbed dose evaluations. In order to evaluate the possible systematic differences, a comparison was made between different electromagnetic physics packages of the Geant4 application for tomographic emission (GATE) 8 versus Monte Carlo N-Particle eXtended (MCNPX) 2.6 and Gamma electron shower (EGSnrc). To do this, we used a similar geometry for the three codes based on the linear accelerator (linac) head of an Elekta Precise for 6 MV photon beams used in standard therapies. Field sizes of 3 x 3 cm^2, 5 x 5 cm^2, 10 x 10 cm^2, 15 x 15 cm^2 and 20 x 20 cm^2 were considered. The reference values of the percentage depth dose (PDD) and the beam profiles were obtained in the water phantom and in the ionization chamber.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **169** Type: **Parallel Talk**

The physical basis of contemporary dosimetry protocols

In this review lecture, we will explore the physics behind the contemporary codes of practice for dosimetry based on standards of absorbed dose to water, such as the widely used protocols TRS 398 of the IAEA or TG 51 of the AAPM. In particular, we will review the basic concepts of cavity theory and take a pedagogic approach to understanding its role as an essential component of the formalism of these dosimetry protocols.

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **170** Type: **Parallel Talk**

Modern applications of Monte Carlo simulations for patient-specific QA

While pre-treatment VMAT QA is currently a clinical mainstay, there is growing interest in the use of QA methods that are more relevant to the actual patient treatment and are, in fact, capable of providing in vivo dosimetry. To this end, I will present a newly developed methodology for Monte Carlo based VMAT QA, which simultaneously provides the dose deposited in both the patient CT data set and any type of planar detector, such as EPID. By enabling DOSXYZnrc to optionally output a 4D IAEA phase space, it is now possible to collect the particles exiting the patient during a VMAT simulation. This phase space can be used for further synchronized simulations of EPID and/or cone-beam CT dose or images, either globally, incrementally, or per control point, allowing comparisons of the 4D phase space EPID prediction with the actual EPID data acquired with the patient on treatment. In conjunction with the use of daily cone-beam CT data and linac log files, this process provides the capability of monitoring the patient dose delivered during the entire course of treatment.

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **171** Type: **Poster**

Geant4 application for electron beam quality in Intra-Operative Radiotherapy based on simulation of the linear accelerator Novac11

Intra-Operative radiotherapy (IORT) is a very effective technique that has begun to be used in our region. It has proven to be a good alternative as part of the breast conserving surgery. Technical success is based on the administration of high doses to the lesion in a single treatment session of radiotherapy, during the same surgical operation, with multiple clinical advantages that are not exempt of risk and must be evaluated deliberately. In this work, a specific application of Geant4 was created to allow IORT dose calculations to be assessed using Monte Carlo (MC) simulations with acceptable accuracy for dose prediction in complicated treatment plans and also to estimate radiation dispersed in the operating room. The application simulates the irradiation head of the linear accelerator Novac11 in different positions with different types of applicators. The Monte Carlo simulation was preliminarily validated by comparing the simulated dose distributions with the measurements by means of the ionization chamber in a water phantom.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **172** Type: **Parallel Talk**

Exotic light nuclei; The structure of ^{12}C and the mirror states of ^{9}Be | ^{9}B

Tuesday 24 October 2017 11:00 (30 minutes)

Despite all the information we have accumulated during the past decades about the structure of ^{12}C we have not resolved a number of detail, for example, the geometry of its second excited state at 7.65 MeV (0^+), the Hoyle-State, has not yet been solved. Recent results have showed a possible 2^+ resonance between 9-12 MeV that could be related with a collective rotational or vibrational excitation while a resonance at 13.3 MeV is a strong candidate for the corresponding 4^+ excitation. In particular, a most recent measurement in which a new high spin Jπ = 5^- resonance at 22.4 MeV which matches with that predicted ground state rotational band of an oblate equilateral triangle with a D3h symmetry. Symmetry that was observed for the first time in nuclear physics. Through angular correlations it was possible to characterize the 22.4 state in terms of spin and parity.
The structure of A=9 nuclei are relevant in astrophysics and nuclear structure. The measurement of the low-lying excited states in 9B nucleus through the ^{9}Be(^{3}He,t)^{9}B reaction, with the K600 spectrometer in conjunction with a segmented silicon detector array was performed at iThemba LABS facility. Of particular interest was the investigation of the first ½$^+$ state in ^{9}B in order to address discrepancies that currently exist between theoretical models in describing these nuclei.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **173** Type: **Parallel Talk**

Structure Determination and Interactions of Protein Desmoplakin C-terminal by Nuclear Magnetic Resonance Spectrometry and Small Angle X-Ray Scattering

Tuesday 24 October 2017 13:55 (25 minutes)

The tertiary structure and interactions with intermediate filament proteins of the desmoplakin C-terminal, a cytolinker protein related to severe skin diseases and fatal cardiovascular failures, has been determined by the use of two complementary techniques: Nuclear Magnetic Resonance (NMR) and Small Angle X-Ray Scattering (SAXS). NMR spectroscopy provided the atomic structure detail and interactions dynamics information of the desmoplakin linker domain, while SAXS was used to solve the global shape and orientation of the B-linker-C desmoplakin multi-domain. By resolving the ambiguities of the orientations of the individual domains with SAXS it was possible to discriminate between similar structural conformations obtained by NMR. Through the use of these two techniques, we gauged the architecture of the desmoplakin plakin repeat domains B and C in a construct including the linker domain, with the latter offering a pair of basic residues that recognise acidic residues on helical intermediate filament proteins that enhances the desmoplakin binding activity with these proteins.

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Session Classification: Parallel Sessions - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **174** Type: **Parallel Talk**

The NUMEN project: Heavy-Ion Double Charge Exchange reactions towards the 0νββ NME determination

Thursday 26 October 2017 14:20 (25 minutes)

NUMEN proposes cross sections measurements of Heavy-Ion double charge exchange reactions as an innovative tool to access the nuclear matrix elements, entering the expression of the life time of Neutrinoless double beta decay (0νββ). If detected, such a process would give direct evidence to the Majorana-nature of neutrinos, opening a window to physics beyond the standard model.
A key aspect of the project is the use at INFN-Laboratori Nazionali del Sud (LNS) of the Superconducting Cyclotron (CS) for the acceleration of the required high resolution and low emittance heavy-ion beams and of MAGNEX large acceptance magnetic spectrometer for the detection of the ejectiles.
However, a main limitation on the beam current delivered by the accelerator and the maximum rate accepted by the MAGNEX focal plane detector must be sensibly overcome in order to systematically provide accurate numbers to the neutrino physics community in all the studied cases. The upgrade of the LNS facilities, in this view, is part of this project.
First experimental results, obtained at the INFN-Laboratori Nazionali del Sud in Catania using MAGNEX magnetic spectrometer, for the ^{40}Ca(^{18}O,^{18}Ne)^{40}Ar reaction at 270 MeV are shown. The data give encouraging indication on the capability to access quantitative information towards the determination of the Nuclear Matrix Elements for 0νββ decay. Preliminary results, in particular of the reaction ^{116}Cd(^{20}Ne,^{20}O)^{116}Sn at 15 MeV/u, performed at INFN LNS, are reported.

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Session Classification: Parallel Sessions - NUC

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **175** Type: **Poster**

Computational modeling of aqueous homogeneous reactor for medical isotopes production

Wednesday 25 October 2017 14:30 (15 minutes)

Nowadays, the use of Aqueous Homogeneous Reactors (AHR) for the production of medical isotopes, mainly 99Mo, is potentially advantageous because of their low cost, small critical mass, inherent passive safety, and simplified fuel handling, processing and purification characteristics. However, it faces some challenges to be successfully deployed for the production of medical isotopes. This paper summarized the computational modeling efforts carried out by our research group in order to solve some of the identified challenges. The studies carried out included the neutronic and thermal-hydraulic modeling of 75 kWth AHR based on the LEU configuration of the ARGUS reactor. In addition are presented and discussed benchmarking exercises that included neutronic and thermal-hydraulic results of two solution reactors, the SUPO and ARGUS reactors. The computational platform utilized for the neutronic and thermal-hydraulics studies included the utilization of the MCNPX version 2.6e and ANSYS CFX 14 computational codes and two computational clusters in Cuba and Brazil, the InSTEC-IRL cluster and UFPE-DEN-GER cluster. The neutronic studies included the determination of parameters such as critical height, 99Mo and others medical isotopes production. Thermal-hydraulics studies were focused on demonstrating that sufficient cooling capacity exists to prevent fuel overheating. Our group studies and the results obtained contribute to demonstrate the feasibility of using AHR for the production of medical isotopes, however additional studies are necessary to confirm these results and contribute to development and demonstration of their technical, safety, and economic viability.

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Session Classification: Poster Session - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **176** Type: **Parallel Talk**

The EXOTIC project at INFN-LNL

Tuesday 24 October 2017 10:30 (30 minutes)

I will present the low-energy light Radioactive Ion Beam (RIB) in-flight facility EXOTIC [1-4], operational at the INFN-Laboratori Nazionali di Legnaro (INFN-LNL) and the associated experimental set up [5] designed for nuclear physics and nuclear astrophysics experiments. I will present the outline of the experimental program carried out employing the produced RIBs and discuss few selected recent experiments. Finally, I will give the perspectives of the EXOTIC project.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **177** Type: **Parallel Talk**

Preliminary results on Se64 beta decay experiment at RIKEN Nishina Center and Mirror Symmetry

Tuesday 24 October 2017 08:30 (30 minutes)

Spin-isospin excitations can be studied by beta decay and charge exchange reactions in mirror nuclei, shedding light on mirror symmetry, hence we can compare our results on the beta decay of proton-rich nuclei with the results of charge exchange experiments when appropriate targets for the mirror nuclei are available. Accordingly we have performed experiments at GSI and GANIL to study T_z =-1 and T_z =-2 nuclei respectively where it became clear that the study of heavier, more exotic systems, demands beam intensities available only at the RIKEN Nishina Center. In this work we present the first experimental observation of the beta-delayed protons in the decay of the T_z =-2 ^{64}Se.

We have performed an experiment using the fragmentation of a 345 MeV·A ^{78}Kr beam with typical intensity of 200 particle nA on a Be target. The fragments were separated in flight using the BigRIPS separator and implanted in three double-sided Silicon strip detectors (DSSSD) named WASSSABi (60 mm × 40 mm × 1.2 mm, 60 horizontal and 40 vertical strips). The implantation setup was surrounded by the EUROBALL-RIKEN Cluster Array (EURICA). We perform time correlation between the ^{64}Se implantations and beta signals within a single pixel defined as the crossing of one X and one Y strip. In addition, only the strips where the highest energy has been deposited are correlated. The DSSSD detectors were calibrated using an external electron conversion ^{207}Bi source. Due to the fact that the proton emitted is in prompt coincidence with the beta particle, also partially absorbed in the DSSSD detector, shifts in the measured energies are expected. These energy shifts were estimated using the ^{57}Zn and ^{61}Ge beta-delayed proton spectra observed in the same experiment. The ^{57}Zn and ^{61}Ge proton energies were taken from literature. Three proton peaks were observed for ^{64}Se, (1612(10), 2003(13), and 3249(22) keV) and the proton energy errors were estimated from the fit for each proton peak as well as the systematic shift with the proton energies reported in the literature.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **179** Type: **Poster**

Determination of the soil water content using the Neutron Backscattering Technique for explosive devices location

Wednesday 25 October 2017 16:00 (15 minutes)

One of the nuclear techniques that are being investigated by different groups in the field of explosives detection and demining is the thermal Neutron Backscattering Technique (NBT). NBT is based on the fact that the buried target is Hydrogen-rich and therefore if it is in a media with different Hydrogen content and it is exposed to a fast neutron source, the number of backscattered thermal neutrons produced by the moderation process will give us a signal from which we can infer the presence of the Hydrogen-rich target. NBT is used to locate buried Hydrogen-rich objects using a fast neutron source and two ^{3}He neutron detectors. Special problems need to be understood as well as is necessary to study the advantages, disadvantages and limits of the technique in the Colombian case. One of the most important issues that have to be investigated is the soil moisture. The backscattered neutrons intensity was related with the soil water content for farming soil, with and without Hydorgen-rich objects in soil. The experimental results are presented with the purpose of comparing the soil water content as measured by NBT and the gravimetric method. NBT intensity signal changes for both object and soil water content, and the best performance in the data analysis.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **181** Type: **Parallel Talk**

Double-Folding Model Analysis of Fusion Reaction

Wednesday 25 October 2017 15:25 (25 minutes)

Fusion reaction play a critical role in stellar evolution and nucleosynthesis [1]. However, the important fusion reaction still carry large uncertainties at Gamow region due to the low cross sections and, the limited theoretical understanding on the mechanisms related to the fluctuations that occur in the cross section [2]. Recently, we investigated $^{12}C+^{12}C$ system, by making use of the so-called multi-channel folding model [3]. Our formulation, the nucleon-nucleon interaction can be described from the DDM3Y density-dependent potential [4] and it allows the inclusion of elastic and inelastic channels and the fusion cross section. Therefore, from the coupled-channel system, elastic and fusion cross-sections are simultaneously calculated. The explicit inclusion of inelastic channels, the imaginary part of the optical potential are only an absorption contribution of short range [5]. The $^{12}C+^{12}C$ results show that the inclusion of inelastic channels and the presence of the Hoyle state improvement the agreement with experimental data [3]. Our model has been applied to the $^{16}O+^{16}O$ and $^{12}C+^{16}O$ systems, but the inclusion of the inelastic channels did not show a strong contribution in the determination of the astrophysical factor in the region of astrophysical interest.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **182** Type: **Poster**

Charmonium: comparison between potential models

Tuesday 24 October 2017 15:45 (15 minutes)

Heavy quark $c\acute{c}$ has been studied in the non-relativistic framework using interquark potential models of the form of sum of power of the interquark distance. The form of potential is based on phenomenology facts. The proposed potential was solved numerically using a program written on C++. Mass spectra and the expectation value of the radius have been estimated for different quantum mechanical state for $c\acute{c}$ system. The results have been compared with other similar and recent works. The mass spectra obtained is in acceptable agreement with the experimental data for $c\acute{c}$.

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Session Classification: Poster Session - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **184** Type: **Poster**

Study by Monte Carlo method of cross radiation in the bimodal tomographic system ClearPET/XPAD3-CT

A detailed simulation of cross radiation in the PET and CT detectors of the tomographic bimodal system for small animals ClearPET/XPAD3-CT, was made using the Geant4 Monte Carlo code. A positron emitter radioactive point source (FDG-^{18}F) was located in the center of the tomographic system, inside a spherical water phantom. Positron-electron annihilations occurring within the phantom produce gamma photons that arrive both to PET (phoswich) and CT(XPAD3) detectors. Simultaneously X-ray photons from the generator tube, oriented towards the XPAD3 detector are scattered by the phantom, arriving to the phoswich detector. Therefore, we have in both detectors undesired incident radiation coming from the other system. From this study conclude that cross gamma rays contribute about 3.5% of the total intensity in the XPAD3 detector, while cross X rays arriving to the phoswich detector contribute about 3.0% of the total intensity, which is actually reduced to below the noise level, taking into account a Cu filter layer of 0.5mm, which covers these detectors. In this work, it is proposed to optimize the shielding of the system without impairing the efficiency of the detectors

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **185** Type: **Poster**

Thermomechanical behavior of the TRISO fuel under deep burnup and high temperature in the VHTR

Wednesday 25 October 2017 14:15 (15 minutes)

The Generation IV Very High Temperature Reactor (VHTR) is envisioned as an outstanding prototype among the six nuclear systems propose in the Generation IV. The characteristics that highlights this reactor are focused in the low electricity generation costs, short construction periods, in proliferation resistance and physical protection. Nevertheless, it presents essential challenges to be deployed as a sustainable energy taking into consideration the high temperatures (1000℃ in normal operation and up to 1800℃ in accidents conditions) and burnup degrees (150–200 GWd/TonU) achievable in these reactors. One of these key challenges is the nuclear safety which mainly relies on the quality and integrity of the coated fuel particles (TRISO). In this investigation will be studied the thermomechanical behavior of the TRISO fuel in function of the variation of different parameters taking into consideration the deep burnup degrees planned to be reached in the VHTR. The studies performed in this investigation included the evaluation of key parameters in the TRISO such as: release of fission gases and CO, gas pressure, temperature distributions, kernel migration, maximum stress values, and failure probabilities. In order to achieve this goal will be used coupled computational modeling using analytical methods and Monte Carlo and CFD codes such as MCNPX version 2.6e and Ansys version 14.

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Session Classification: Poster Session - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **186** Type: **Poster**

Design, construction and evaluation of a cylindrical phantom for the quality assurance in Computed Tomography

Was designed and produced a cylindrical phantom in PMMA material for evaluate the image quality parameters: spatial resolution, high and low contrast, magnification, uniformity and reproducibility of Hounsfield numbers for Computed Tomography (CT) through the formation of images in the acquisition of tomographic images. The phantom was designed and built under the recommendations of international quality control protocols in CT. Initially its geometry was simulated in GEANT4 and then constructed in axial sections by means laser cutting technology. Subsequently, physical properties such as density, shape and size of each component were established. Internal holes were inserted into the acrylic discs (modules) and filled with selected materials to evaluate the contrast of the image. Metal pieces and wires were incorporated to evaluate the thickness of the tomographic sections. Also within the same module were established objects to determine the spatial resolution of the tomographic system. The Phantom was evaluated in three hospital centers in Tunja city and tomographic axial images were analyzed using a specialized software where were determined Hounsfield numbers of each structure and its tolerance range. Finally, results were intercompared and validated with a phantom Catpham 500 certified, obtaining differences smaller than 5% in the estimation of the densities of materials of reference.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **187** Type: **Poster**

Verification of angular dependence in MOSFET detector

In vivo dosimetry is an essential tool for quality assurance programs, being a procedure commonly performed with thermoluminescent dosimeters (TLDs) or diodes. However, a type of dosimeter that has increasing popularity in recent years is metal-oxide-semiconductor field effect transistor (MOSFET) detector. MOSFET dosimeters fulfill all the necessary characteristics to realize a in vivo dosimetry, since it has small size, good precision and feasibility of measurement, as well as easy handling. Nevertheless, its true differential is to allows reading of the dose in real time, enabling immediate intervention in the correction of physical parameters deviations and anticipation of small anatomical changes in patient during treatment. In order for the MOSFET dosimeter to be better accepted in clinical routine, informations related to its performance should be available frequently. For this reason, this work proposes to verify reproducibility and angular dependence of the standard sensitivity MOSFET dosimeter (TN-502RD-H) for Cs-137 and Co-60 sources. Experimental data were satisfactory and MOSFET dosimeter presented a reproducibility of 3.3% and 2.7% (1 SD) for Cs-137 and Co-60 sources, respectively. In addition, an angular dependence of up to 6.1% and 16.3% for both radioactive sources, respectively. It is conclusive that MOSFET dosimeter TN-502RD-H has satisfactory reproducibility and angular dependence. This means that although precise measurements, special attention must be taken for applications in certain anatomical regions in patient.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **188** Type: **Poster**

Development through in silico experimentation of equations that predict the range of protons and carbon ions in brain and ocular tumors

In this work the study of the Deposited Dose Distributions in depth by Protons and Carbon Ions in different Phantoms, was made with Monte Carlo Method. Initially, a simulation of the interaction of the charged particles (Protons and Carbon Ions) with water was constructed with the Geant4 tool (Fig.1.). The Bragg peaks and Deposited Dose Maps at multiple energies within the therapeutic range were calculated to validation purposes (Fig.2.). Subsequently, the transport of Protons and Heavy Ions on Equivalent Human Tissue and high density materials as bone was studied. Also, the interaction of Protons and Carbon Ions with a human-headed phantom which includes the detailed geometry of the eyes was simulate(Fig.3.). The Bragg Peaks and Deposited Dose Maps were calculated to obtain the equations that predict the range of Protons and Carbon Ions in brain and ocular tumors.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **191** Type: **Poster**

Stopping power cross section of Hf and Pd for protons and alpha particles in the energy range between 0.3 and 2.5 MeV

Tuesday 24 October 2017 16:00 (15 minutes)

Understanding the mechanism of energy loss of charged particles in matter is very important in atomic and nuclear physics given its application in fields such as material and surface science or radiation damage studies. In the last few years, there has been a renewed interest in increasing the accuracy of energy loss and straggling experimental values in order to determine some key parameters included in the theory of stopping power. However, there is still a lack of data about the straggling and the stopping power even for light ions.
In this work we present new data on the stopping power of Hf and Pd for protons and alphas particles in the energy range between 0.3 and 2.5 MeV. These measurements were carried out by using a 2.5 MV Van de Graaff accelerator of the Laboratory of Accelerators and Radiation Technologies (LATR) in C2TN/IST (Lisbon, Portugal). Transmission methodology was used to determine the stopping power cross sections by measuring the energy loss of protons and alphas passing through very thin foils made of Hf and Pd. So far, a good agreement has been found between the obtained results and values reported in literature (SRIM-2013, ICRU49). Additionally, modified Bethe–Bloch theory is being used to extract Pd mean excitation/ionization energy (I) and Barkas effect parameter (b) from the available experimental data.

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Session Classification: Poster Session - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **192** Type: **Parallel Talk**

Advances on applied atomic and nuclear physics at Universidad Tecnológica Metropolitana of Chile (LIATAN laboratory)

Tuesday 24 October 2017 11:30 (30 minutes)

Recently the installation of a Van de Graaff accelerator in the Campus Macul of the Universidad Tecnológica Metropolitana has promoted the formation of the Laboratorio de investigación aplicada con tecnologías atomicas y nucleares (LIATAN). One of the objectives of this scientific laboratory is the development of advanced research mainly in the field of material sciences and environmental sciences using atomic and nuclear technology. This facility is to be considered as a complex laboratory, consisting of facilities that once were operating in other institutions and that will enhance its operation through a project that our University leads.
An essential component of the LIATAN Laboratory is a Van de Graaff electrostatic accelerator. This equipment includes very complex research instruments which are unique in the country since allowing different kind of studies by using IBA techniques[1] such as characterization of surface material samples or to determine trace elements in aerosols samples. On the other hand, a linear electron accelerator will also be installed at the LIATAN laboratory. This accelerator was donated by the National Cancer Institute and it was mainly used for the treatment of tumor diseases and the study of other solid, liquid, gaseous samples. Both facilities are aimed to promote further applied atomic and nuclear research in our country. This talk will describe the main characteristics of the LIATAN facilities and future research prospects.

Acknowledgments: The authors recognize financial support from Dirección de investigación y desarrollo académico (DIDA) of Universidad Tecnológica Metropolitana.

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Session Classification: Parallel Sessions - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **193** Type: **Parallel Talk**

Sentaurus simulation of 3N163 Mosfet to study heavy ions effects

Tuesday 24 October 2017 15:50 (25 minutes)

Semiconductor devices are susceptible to ionization radiation and this kind of event can change their behaviour and electrical properties, causing since a simple current peak on output of the circuit to a logical inversion, each event have your own root cause that can variable from an absorbed radiation dose to a different source of radiation. To deal with these problems is necessary understand the mechanisms behind of each event and use this knowledge to build circuits and semiconductor devices more robust to the radiation. The spatial program and military applications use electronic systems composed of microcontrollers, memories and other parties that can be exposed to radioactive environments in their normally use, a way to handle an unexpected behaviour are needed to avoid accidents. Electronic devices simulation is one of the methods to study the effects of ionizing radiation effects in semiconductor systems. The capability of isolate regions of the device under tests and control the simulation environment bring the possibility of observing the component of an event and understand the mechanisms behind of the event. This research project aims were create a 3D struct to simulate a commercial P-MOSFET (3N163), the effects of a Total Ionization Dose of X-Ray was widely studied and the effects of heavy ions emission is the object of studies in this work to observe the SEE event. The main purpose of the simulations is understanding the results collected to extract the main data and study secondary results that don't was captured in the field experiment.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **194** Type: **Parallel Talk**

Intermediate-energy Coulomb excitation of ^{77}Cu

Friday 27 October 2017 13:55 (25 minutes)

The present experimental study on ^{77}Cu has been carried out at Radioactive Ion Beam Factory of the RIKEN Nishina Center. It will complement the previous study of ^{77}Cu via beta decay of ^{77}Ni where the low-lying states in ^{77}Cu were identified as particle-core excitations through the comparison to the large scale Monte Carlo Shell Model calculations (E. Sahin et al. Phys.Rev.Lett. 118, 242502 (2017)). An almost unique way to characterize the states predicted as collective in the calculations is to measure the transition probabilities, i.e. B(E2) strengths. Hence the following Coulomb excitation experiment was performed to study the collective properties of low-lying states in ^{77}Cu. The characterization of such states and in particular the mixing of both collective and single-particle configurations will provide significant information on the shell structure close to ^{78}Ni. A Coulomb excitation measurement of the states due to the proton-core excitations in the case of ^{77}Cu nucleus will also provide an estimation of the collectivity of the 2^+ state in th even-even ^{76}Ni "core".
Exotic secondary beam particles were produced by induced fission of the ^{238}U beam on a 3 mm thick ^{9}Be target. The uranium beam was accelerated to an energy of 345 MeV/nuclen with an average beam intensity of 20 pnA. Fission products were selected and transported by the BigRIPS fragment separator. Coulomb excitation of the fragments was performed on a 900 mg/cm^2 thick ^{197}Au target, mounted in front of the Zero Degree Spectrometer. The DALI2 NaI array was used to detect de-excitation gamma ray measured in coincidence with beam-like particles identified in the Zero Degree Spectrometer (ZDS). The experimental techniques and results will be discussed in the present contribution.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **196** Type: **Parallel Talk**

Analytical approximations for double Compton backscattering

Thursday 26 October 2017 13:55 (25 minutes)

Gamma-ray Compton backscattering has proven to be of interest for technical applications, one example being an imaging device [1] able of getting the shape of objects behind material obstacles. A big deal of work has been performed in order to characterize the process, which, given the huge mathematical difficulties of an intrinsically random, non-lineal process, numerical simulation is preferred [2]. However, since having an analytical approximation is a powerful prediction and evaluation tool, the analytical path deserves also exploration. An attempt to understand the difference in capacity to backscatter photons by different materials, and for the same material, for different thicknesses and densities produced an analytical expression for the single-backscattered intensity [3].
Obtaining a collective expression for higher scattering orders is a dauting task. A rather ambitious method in that direction uses transport theory to obtain both intensity and spectral shape of the scattered radiation [4]. This method, although offering completeness in the solution is rather difficult to implement in practical cases and simplified approaches might be needed. One example in that direction is the mixed analytical-numerical algorithm in Ref. [5]. Following this approach of incremental theoretical improvement we present a method and several theoretical and numerical results for only-double Compton scattering. These results may prove useful in practice since according to numerical simulations double Compton backscattering events may be responsible in some materials for more than 30% of the total number of multiple scattering events whereas both together, single and double scattering, add up to more than 60% of the total backscattered intensity.

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Session Classification: Parallel Sessions - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **198** Type: **Poster**

Development of a semi-empirical method to determine the efficiency of a gamma radiation detector for point sources

Tuesday 24 October 2017 16:00 (15 minutes)

The gamma spectrometry is the most popular technique for the determination and quantification of the radioactive nuclei present in a radioactive source. In order to obtain the quantification of the radioactive material it is necessary to determine the efficiency of the detector for the energies of the gamma photons emitted from the source.

In the present work we present the theoretical development and the first tests of a new method to calibrate the efficiency of a gamma radiation detector for point sources.

The method consists in the determination of the detector efficiency using a mono-energetic gamma source (such determination must be realized experimentally), which we will be named the reference energy. Using a mono-energetic source is the easiest way to do this. Then from this value we can extrapolate the efficiency to the complete energy range using the physics of first principles of gamma radiation detection theory. Therefore the proposed method corresponds to a semi-empirical method.

In the first work we show the application and the study for the validation of the method using one reference energy (661,65 keV). In this second work we will apply the method using three references energies along the gamma energy range of interest, due to that in the first work the agree between the obtained values by the proposed method and the expected values were worse while the energies were farther of the reference energy.

The reference energies will be: 59,54 keV, 661,65 keV and 1460,65 keV, which are associated to the ^{241}Am, ^{137}Cs and ^{40}K respectively. The second part of the method, the extrapolation from the reference energies to the gamma range, will be done over the energies emitted by ^{152}Eu. All simulations will be done using FLUKA code.

We expect to improve the results obtained by the extrapolation from one energy reference to the complete energy range, with this new proposal considering a set of reference energies and a local extrapolation from these.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **200** Type: **Poster**

Chemical composition of PM10 collected indoor at workshop areas in a factory located in Santa Clara

Wednesday 25 October 2017 16:00 (15 minutes)

The objective of this work was to evaluate the exposure levels to PM10 to which workers are exposed during the working day. Sampling was carried out in two workplace areas of a factory located in Santa Clara city: the iron casting workshop and the unmolding workshop. The factory utilizes as raw materials: iron scrap, ferroalloys, coke, and materials from the own process as pig iron and return sand, which are important sources of the pollutants present in particulate matter. The concentrations of PM10 on the air were determined by gravimetric analysis. The samples were analyzed by Energy Dispersive X-ray Fluorescence (EDXRF) and Ionic Chromatography (IC) for determining the elemental composition and some ions of interest. X-ray Diffraction (XRD) analysis was applied to selected samples in order to identify possible phases of compounds commonly found in this type of industries. The results were compared with the reported in the Cuban Standard NC872:2011 that regulates the harmful substances in the air of the working zone and evaluates the occupational exposure.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **201** Type: **Parallel Talk**

The GFNUN´S Nuclear Innovation: An Innovation Edge Case from a Developing Country Originated in Basic Research

Wednesday 25 October 2017 14:20 (25 minutes)

During the last two decades, the Nuclear Physics Group of National University (GFNUN) has been leading nuclear basic research, generating innovation edge based on its own basic research, training researchers, public servers and society, and building technological transfer. The nuclear Colombian context presents a weakness on strategical nuclear programs and politics based on technical knowledge, low technical formation of decision makers and regulatory supervisors, and low coordination and not assumed responsibility between different governmental dependencies [1]. Colombia is a developing country which economy is highly depending on extractives activities, commodities, agro-industry and tourism. GFNUN is leading three main techniques not only to be applied in the local context but also worldwide which are an innovative methodology to evaluate radioactive materials, and nuclear techniques for corrosion detection and explosives detection for security and defense, and humanitarian demining purposes.
An interesting point as example of the technological evolution is the fact that ate sixth year of developing the demining detection technique, GFNUN found a derived application based on. This is corrosion diagnosis with gamma retrodispersion and explosives detection for security and defense. Now, the corrosion detection technology and explosives detection are starting their third and first year of development, respectively, and the results are promissory but specialized strategies for the technological transfer to the market, potential investors, and a trustworthy royalties system for the researchers are needed; specially in a developing economy context.

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Authors: MARTINEZ SOLARTE, Maria Isabel (Universidad Nacional de Colombia); CRISTANCHO MEJIA, Luis Fernando (Nuclear Physics Group (GFNUN), Universidad Nacional de Colombia, Bogotá.)

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Session Classification: Parallel Sessions - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **202** Type: **Poster**

Simulation of a coaxial HPGe detector using FLUKA code

Tuesday 24 October 2017 16:00 (15 minutes)

The simulation of the spectroscopy systems using MC codes is a common practice in these days. The most popular softwares to do this are MCNP and Geant4 codes. In this work we present the simulation of a gamma spectroscopy system based on a coaxial HPGe detector using FLUKA code. The geometrical characterization of the detector was done from manufacturer information and using the spatial FEP efficiency distribution of the detector for 661.65 keV. The last one was used to determine the dimensions of the inner cavity of the detector, which are not informed by the manufacturer. Due to the differences between the real and simulated response functions, we suppose that these are proportional.
The aims of this work is double. On the one hand, to characterize the detector without the necessity to apply a radiography or any other technique that is not directly associated to a nuclear physics laboratory. And, on the other hand, to validate the simulation of a coaxial HPGe detector using FLUKA code.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **203** Type: **Poster**

Calculation of kinetic parameters of the RECH–1 research nuclear reactor using MCNP and Serpent 2

Wednesday 25 October 2017 14:00 (15 minutes)

In this work we calculated two kinetic parameters of the RECH-1 research nuclear reactor: the effective delayed neutrons fraction, β_{eff}, and the mean neutron generation time Λ using the Monte Carlo codes MCNP6 [1] and Serpent 2 [2] and the neutron cross section library ENDFV.VII.1.
To calculate β_{eff} we used the method proposed by Meulekamp and van der Marck[3]. In this method the effective delayed neutron fraction is estimated as

$\beta_{eff} \sim 1 - \frac{k_p}{k}$,

where k_p is the prompt effective neutron multiplication factor and k is the total effective neutron multiplication factor. To calculate the effective neutron generation time we used the pulsed neutron source method[4]. In this technique a burst of neutrons is injected in a subcritical system and then the decay of the neutron population is observed as a function of time. After the system thermalization and decay of higher flux modes, the fundamental-mode decay constant, α_0 can be measured using the point kinetic approximation. The relation between α_0 and the reactivity, ρ, is obtained from the point kinetics equations:

$\alpha_0 = \frac{\rho - \beta_{eff}}{\Lambda}$.

These calculations will be contrasted with reactor operation experimental campaign results during next year.

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Session Classification: Poster Session - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **204** Type: **Poster**

Incidence of medical physic in prevention of radiological accidents with patients

In radiotherapy and nuclear medicine processes, medical physic have a preponderant participation in the correct administration of prescript doses to a patient, so that if they differ more than a predetermined value to the prescription, become in radiological accident or a mistreatment.
In this paper is exposed a quantitative and qualitative analysis, based on Risk Matrix Method, particularly for external radiotherapy with cobalt radioactive source and nuclear medicine including metabolic therapy with radioactive iodine ^{131}I, and on the functions assigned in Regulatory Safety Guides for both practices to the medical physic in Cuba of the incidence of this professional in prevention and escalation of this sort of accident, playing a roll of barrier and of their frequency and consequences reductor.
As results, it is shown the relevance and need of safety approach, that must prevail for this professional as much in his education as in its daily work and in the education and control of the other personnel in these services as well.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **205** Type: **Poster**

Evaluating the perfomance of PET/CT Gemini TF64 for dynamic 4D PET/CT imaging for radiotherapy treatment planning using the CIRS 008A thorax phantom

The availability of tools for visualize, control, and track patient specific respiratory motion could improve the accuracy in radiation therapy for thorax and abdomen tumor lesion. If smaller treatment fields are used, there is the possibility of target may move out of the treatment field resulting in an under dose to the target and surrounding normal will be exposed.The goal of this work is the evaluation of the tools for dynamic 4D imaging of the PET/CT Phillips Gemini TF64 system installed at INOR for radiotherapy treatment planning of tumors located in thoracic and abdominal cavities which could be influenced by respiratory motion.The performance of PET/CT Philips Gemini TF64 system was previously verified by following the recommendations given in the documents IAEA 1393 and 1557. The CIRS 008A Dynamic Thorax Phantom was used during the tests for simulation of three-dimensional target motion controlled by the CIRS Motion Control Software Model 008PL.The influence of CT acquisition parameters and reconstruction for three simulated respiratory cycles (20bpm/15mm, 10bpm/15mm and 15bpm/25mm) on the gated image quality, geometric accuracy of detection and delineation of moving target with different sizes (10, 20 and 30 mm)were studied. The results using 4D CT and non-gated CT were compared with those obtained using CT acquired without target motion.Three refillable spherical inserts with diameters similar to those used for CT acquisitions were built and adapted to CIRS thorax phantom in order to evaluate the dynamic 4D PET and 4D CT performance of PET/CT Gemini TF 64 system. These in-house made inserts were filled with a Ga-68 radioactive solution(18.5MBq/cc)containing radiologic contrast media. PET/CT acquisition without target motion were used as reference.The effect on SUV measurement for moving target of three types of attenuation correction images used for reconstructions: (a) the free-breathing CT for all PET phases, (b) the average CT for all PET phases and (c) 4D CT for phase-matched attenuation correction were compared. The results obtained matched with those reported in similar experiences using phantoms. Larger targets provide higher registration accuracy than small targets. Different respiratory cycles affect the registration accuracy. Increasing the respiratory amplitude will decrease the accuracy. Nevertheless this is the first experience in our country performing these studies the experiments and their results are the starting point for discussion to establish methodologies for commissioning other imaging systems with 4D imaging tools in Cuba, QC/QA program and acceptance limits.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **206** Type: **Poster**

Cross sections measurements for the $^{13}C(n, \gamma)^{14}C$ and $^{14}N(n, p)^{14}C$ nuclear reactions using the accelerator mass spectrometry technique

Tuesday 24 October 2017 16:00 (15 minutes)

In this work, the cross sections of the nuclear reactions $^{13}C(n, \gamma)^{14}C$ and $^{14}N(n, p)^{14}C$ are experimentally measured using the accelerators mass spectrometry (AMS) technique. To carry out this experiment we use the thermal neutron flux produced by the TRIGA Mark III nuclear reactor located at the National Institute of Nuclear Research (ININ) in Mexico. The concentration of ^{14}C with respect to that of ^{12}C in materials before and after neutron irradiation was determined in the Laboratory of Accelerators Mass Spectrometry (LEMA) of the Institute of Physics of the National Autonomous University of Mexico (UNAM). From the measurements of the relative $^{14}C/^{12}C$ concentration it was possible to determine the corresponding cross sections. This work establishes an experimental protocol for the measurement of cross sections of neutron induced nuclear reactions at thermal energies. The results obtained for the $^{14}N(n, p)^{14}C$ reaction are in good agreement with the values previously reported by other authors. On the other hand, for the $^{13}C(n, \gamma)^{14}C$ reaction, the obtained values differ from those previously reported, which impels us to continue studying this reaction.

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Session Classification: Poster Session - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **207** Type: **Poster**

Towards the measurement of the cross section of the $^{13}C(d,p)^{14}C$ nuclear reaction using AMS

Tuesday 24 October 2017 16:00 (15 minutes)

An experimental protocol to study the total cross section for the $^{13}C(d, p)^{14}C$ nuclear reaction via AMS is being developed for energies in the center-of-mass frame between 100 and 533 keV. We started a series of experiments in which two aluminium cathodes filled with natural-graphite (98.9% 12C, 1.1% 13C) were irradiated at a deuterium energy of 4 MeV at the 6.0 MeV Tandem Van de Graaff Accelerator of the Instituto Nacional de Investigaciones Nucleares (ININ) in Mexico. The number of incident particles was determined using RBS techniques. The relative concentrations of $^{14}C/^{12}C$ were analyzed using AMS at the Laboratorio Nacional de Espectrometría de Masas con Aceleradores (LEMA) of the Universidad Nacional Autónoma de México (UNAM). The relevance of the $^{13}C(d, p)^{14}C$ reaction in the study of compound nucleus formation as well as in some astrophysics scenarios, and the importance of the development of the AMS technique to measure cross sections of nuclear reactions of astrophysical interest in Mexico are also discussed.

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Session Classification: Poster Session - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **208** Type: **Poster**

Testing the intrinsic spatial efficiency method for homogeneous and without matrix sources using MC simulation

Tuesday 24 October 2017 16:00 (15 minutes)

The intrinsic spatial efficiency method is a general and absolute method to determine the efficiency of any extended source. This was experimentally demonstrated and validated only for cylindrical sources and the gamma photons emitted by ^{137}Cs (661,65 keV).
Also, we carried out a research to tested the method for different shapes and sizes. Due to the difficulty that the preparation of sources with any shape represents, the simplest way to do this is by the simulation of the spectroscopy system and the source. We simulated the spectroscopy system and the sources using the FLUKA code. The shapes of the sources were: rings, discs, cylindrical shells, spheres and spherical shells. In such work we only considered gamma photons with an energy of 661.65 keV.
In this work we present a test of the intrinsic spatial efficiency method for sources with the shapes already mentioned and for energies different to 661.65 keV. The gamma energies considered in this new work will be: 59.54 keV (^{241}Am), 351.93 keV (^{214}Pb), 911.19 keV (^{228}Ac), and 1460.65 keV (^{40}K).
Until this moment we have applied the method by simulation for ring sources emitting 1460.65 keV gamma photons, and located coaxially on different positions along the axial axes.
The preliminary results shown an excellent agree between the absolute efficiencies determined by the standard relative method (statistical count) and the intrinsic spatial efficiency method. The relative bias in all cases are lesser than 1.1%.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **209** Type: **Parallel Talk**

Calculation of self-shielding factor for neutron activation experiments using Geant4 and MCNP

Monday 23 October 2017 13:55 (25 minutes)

In this work we calculated the self-shielding factor, G, as a function of the neutron energy, which is important to consider in precise neutron activation experiments.
Twelve samples of pure metallic materials were simulated using the Geant4 Monte Carlo toolkit[1,2] and the MCNP[3] code.
The self-shielding factor is defined as the ratio between the neutron flux inside the sample volume and the flux in the surface of the sample,

$$\mathrm{G} = \left(\int_{E_1}^{E_2} dE\Phi_V\right) \div \left(\int_{E_1}^{E_2} dE\Phi_S\right).$$

We have simulated the behaviour of the self-shielding factor for neutron energies from 10^{-5} eV to 20 MeV. Results obtained by running 10^6 neutron events in MCNP6 using the ENDF-B/VII.1, JEFF 3.2 and TENDL2014 neutron cross section libraries, shows that the self-shielding factor is relevant to include in neutron activation analysis experiments for thermal neutron energies and for sample thickness greater than 10^{-4} m, as seen in the recent calculation of the neutron flux at the RECH-1 nuclear reactor[4].

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3. T. Goorley, et al., Initial MCNP6 Release Overview, Nuclear Technology 180 (2012) 298-315.
4. F. Molina, et al., Energy distribution of the neutron flux measurements at the Chilean Reactor RECH-1 using multi-foil neutron activation and the Expectation Maximization unfolding algorithm, Appl. Radiat. Isot. 129 (2017) 28-34.

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Session Classification: Parallel Sessions - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **210** Type: **Plenary Talk**

First beams at the new RIBs facility at Dubna – ACCULINNA-2

Wednesday 25 October 2017 09:00 (30 minutes)

An significant part of the upgrade of the Dubna Radiactive Ion Beams facility is the replacement of the ACCULINNA fragment separator with a new high acceptance device - the ACCULINNA-2. The project of a new in-flight facility for low energy 30-60 AMeV primary beams with $3 \le Z \le 36$ has been started in 2011. The new device is destined to add considerably to the studies of drip-line nuclei performed with the use of variety of direct reactions known to be distinctive to the 15 –50 AMeV exotic secondary RIBs. An overview of the design, construction and commissioning studies of the ACCULINNA-2 device will be presented.
Secondary beam profiles as well as production rates were measured for 15N (49.7 AMeV) primary beam and Be (2 mm) target. Example dE-ToF identification spectra and calculated beam purity for 6He 31.5 AMeV and 12Be 39.4 AMeV as a main components of secondary beams will be demonstrated. Measured isotope yields agrees with LISE++ simulations. Future upgrades of ACCULINNA 2 setup (zero degree spectrometer, RF-kicker) and prospects of new experiments achievable in next years are presented.

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Session Classification: Plenary Talks

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **211** Type: **Parallel Talk**

Microscopic description of low-lying properties in $^{168-178}$Yb nuclei by the pseudo-SU(3) shell model

Monday 23 October 2017 15:25 (25 minutes)

The rare-earth nuclei have well-known collective properties. The theoretical description of these nuclei represents a challenge to nuclear models, due to the enormous dimensions of the valence space, making the problem unmanageable. This leads us to use symmetry-based models, where it is possible to calculate in a free-truncation environment. In this work we present results for the energy spectrum and the electromagnetic properties in even-even Yb isotopes using the pseudo-SU(3) shell model. The model considers a Nilsson Hamiltonian that additionally includes the quadrupole-quadrupole and pairing interactions, systematically parameterized. The results show that the model considered is a powerful theoretical tool, allowing us to describe the normal parity sector of deformed rare earth nuclei.

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Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **213** Type: **Poster**

Neutronic anisotropy around a radiotherapy treatment field by passive detectors

Wednesday 25 October 2017 13:45 (15 minutes)

Giant-dipole- resonance photoneutrons (GRN) are produced by LINAC 2300 CX operating in the range of 15 MV. During radiotherapy treatment unwanted neutron dose is delivered to patients. To establish the thermal and epithermal photo-neutrons field during radiotherapy treatments Nuclear Track Methodology (NTM). The well tested polyallyldiclogola carbonate (PADC type CR-39 TM on that a thin boron film is deposite to convert neutrons in charged paticles by 10 B(n,α) reaction are employed. The passive device register with efficiency charged particles as a damaged volume these are visible after chemical etching (6N, NaOH, 70 o C) under light transmission microscope (10 x 40).
Tracks of the order of micrometers are visible and their diameters are measure to determine track densities and histogram bars. These provide information on the neutron intensity and energy groups.
Enhancement effects are observed on absorbed dose due to both scattered photo-neutrons and (γ,n) reactions and a relatively good response is observed for mixed radiation field. To solve the difficulty in measuring the photoneutron spectra that is produced from the head of the LINAC due to very intense gamma irradiation, can be used this metodology for stablish the energies of neutrons
and is corroborated by MCNPX the neutron spectra, establishing the additional dose that is attributed to the neutron component.

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Session Classification: Poster Session - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **214** Type: **Poster**

Computational approach of the interaction of gamma radiation coming from neutron capture on biomolecules via GEANT4

Since its discovery in 1935 by J. Chadwick, neutrons have been used in many fields, from power production to medical applications. In particular, G. L. Locher in 1936 came out with the idea of using neutron capture for cancer treatments. Currently the Neutron Capture Therapy (NCT) stands for a binary treatment method that combines a cancer specific Boron (^{10}B) or Gadolinium (^{157}Gd) labeled drug and a neutron beam of a low energy sufficient for neutron capture to take place within the treated tissues. The nuclear reaction that takes places into the cell releases gamma radiation of 0.478 MeV for ^{10}B and 2.2 MeV for ^{157}Gd. In this work we present a GEANT4 study of the interaction of this gamma radiation on bacterial DNA of "staphylococcus aureos".

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **215** Type: **Poster**

Computational approach to the sterilization of the human amniotic membrane using ionizing radiation via GEANT4

In the last decades the use of the Human Amniotic Membrane (HAM) in regenerative and curative medicine has been significantly increased. The sterilization processes of the HAM are crucial for its clinical use. In order to preserve the main biophysical and biochemical properties of HAM, improvements are required in the sterilization procedures, in which some of the valuable HAM's properties are lost. Currently most of HAM's clinical sterilization protocols are based on biochemical processes with antibiotics and glycerol. Recently sterilization studies with ionizing radiation reported up to 25000 Gy radiation sterilization dose to obtain the so-called sterility assurance level. We are considering a simple and valuable approach to the preparation of HAM by antibiotic and glycerol combined with radiation sterilization. In this work we present a GEANT4 study of the interaction of bacterial DNA of "staphylococcus aureos"with two different ionizing radiations.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **217** Type: **Poster**

Computational approach to the interaction of Li coming from neutron capture on biological cells via GEANT4

After the discovery of neutrons, G. L. Locher proposed the idea of using neutron capture for cancer treatment - Neutron Capture Therapy (NCT). This treatment method combines either a Boron (^{10}B) or Gadolinium (^{157}Gd) labeled drug and an epithermal neutron beam suitable for neutron capture to take place within the treated tissues. With a branching ratio of approximately 94%, the ^{10}B nuclear reaction taking place inside the cell releases gamma rays of 0.478 MeV, alpha particles of 1.47 MeV and ^{7}Li ions of 0.64 MeV. Using GEANT4, we present in this work a study of the effects of these final-state particles on biological cells.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **218** Type: **Parallel Talk**

A simulation platform for virtual clinical trials in chest X-ray imaging

Optimization of chest radiography aims to ensure that image quality remains adequate for the clinical tasks undertaken, while patient exposure is kept as low as possible. Establishing good image quality is a complex subject as this is strongly linked to clinical task. Additionally, the evaluation of a large number of system parameters is necessary. While clinical trials offer the gold standard in terms of tasks, realism and observer performance, aspects such as cost, duration and the patient to patient variation are limitations. In contrast, virtual clinical trials (VCT), in which computer simulations are used to model the image acquisition, processing and reading process, constitute a more practical alternative. Anthropomorphic computational phantoms can be used as anatomical models of real patients.

This work describes the creation of a simulation platform for VCT of chest X-rays. A methodology for simulating the imaging chain was developed and validated in terms of image quality and dose using simple homogeneous structures. Radiographic images were generated via Monte Carlo modelling together with ray tracing methods. Measured detector imaging characteristics, given by presampling modulation transfer function (MTF) and the noise power spectrum (NPS) were used to apply realistic degrees of sharpness and noise to the simulated images. This simulation platform has now been extended to include a focused anti-scatter grid. A set of chest anthropomorphic phantoms were created and diverse clinical tasks were added: lung nodules, catheter and rib fractures. Future evaluation will include an observer study, where the generated image dataset will be evaluated by radiologists.

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **219** Type: **Parallel Talk**

Hydrochemical and isotopic characterization of the Mampostón-Jaruco basin

Thursday 26 October 2017 14:20 (25 minutes)

This work presents the results obtained during the hydrochemical and isotopic characterization of the waters of the Mampostón - Jaruco basin in the province of Mayabeque, Cuba. Two sampling campaigns were carried out in different wells drilled in the area, carrying out the collection of hydrochemical data in the field, the analysis of macrocomponents and physico-chemical parameters in the laboratory, isotopic analysis (^{2}H and ^{18}O) and the evaluation of the quality of the analytical data. The interpretation of the results showed that the waters are generally classified as calcium bicarbonate with very similar characteristics between them, suggesting a single origin (recharge). Possible recharge mechanisms involving surface sources in the region were identified.

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Session Classification: Parallel Sessions - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **221** Type: **Parallel Talk**

A Regional Oil Extraction and Consumption Model. Part II: Predicting the declines in regional oil consumption

Tuesday 24 October 2017 11:00 (30 minutes)

In part I of this analysis, the striking similarities of the declining oil production in the North Sea, Indonesia and Mexico were used to model the future maximum possible oil production per annum in all larger countries and regions of the planet from 2015 to 2050.
In part II, the oil export and oil consumption patterns, that were established in recent decades, are combined with the consequences of the forecast declines in regional oil production that were developed in part I of this analysis. The results are quantitative predictions of the maximum possible region-by-region oil consumption during the next 20 years.
The predictions indicate that several of the larger oil consuming and importing countries and regions will be confronted with the economic consequences of the onset of the world's final oil supply crisis as early as 2020. In particular, during the next few years a reduction of the average per capita oil consumption of about 5%/year is predicted for most OECD countries in Western Europe, and slightly smaller reductions, about 2-3%/year, is predicted for all other oil importing countries and regions. The consequences of the predicted oil supply crisis are thoroughly at odds with business-as-usual, never-ending-global-growth predictions of oil production and consumption.

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Session Classification: Parallel Sessions - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **222** Type: **Poster**

Procedure to improve the Quality Management System of the Chemical and Materials Analysis laboratories of CEADEN

Wednesday 25 October 2017 16:00 (15 minutes)

The present work presents a procedure designed for the improvement of the Quality Management System (QMS) implemented in the laboratories of Chemical Analysis and Materials of the CEADEN according to NC ISO / IEC 17025: 2006 in order to allow a stability in time of their status as accredited laboratories. In these laboratories, nuclear and complementary techniques are used in research and scientific and technical services related to the environment, food safety, nuclear safety and security of other technological facilities, among others.
Following a diagnosis of the QMS and identification of the main deficiencies of the last accreditation period, an improvement procedure based on the Plan-Do-Check-Act cycle (PDVA) is applied, which is a methodological tool that can be applied to other testing laboratories of this type that have the status of accredited or that claim to obtain it. Different techniques and tools are used such as expert method, cause - effect diagram, interrelations diagram, interviews, brainstorming, among others.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **223** Type: **Parallel Talk**

A real time pulse processing DAQ for neutron wall modular detector on RIBRAS experiments

Tuesday 24 October 2017 10:30 (30 minutes)

In order to potentiate the experiments with Brazil Radioactive Ion Beam (RIBRAS), new VME (Versa Module Euro Card) Data Acquisition (DAQ) modules characteristics to control, triggering and data acquisition will be described. The DAQ will define to include the Strip Array and Neutron Wall detectors with maximum readout efficiency, no dead time, data selection and event synchronization.
CAEN digitizer modules for VME provide features like zero suppressed readout and overflow suppression. Zero suppression, once enabled, prevents conversion of value which is lower than user defined threshold. Overflow suppression, once enabled, aborts the memorization of data which constitutes an ADC overflow.
Adding FPGAs (field programmable gate array) to data acquisition provides pre- and post-algorithmic processing on data. The hardware elements chosen should have features that make the modules easy to program and handle, while the FPGAs should be reprogrammable when required.
For simplification of the interaction between DAQ elements, provision of standalone working mode for each sub detectors, easy reconfiguration of active sub-detector and easy hardware replacement, the DAQ hardware units are functionally subdivided into hierarchy by logical level along the data stream.

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Session Classification: Parallel Sessions - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **224** Type: **Parallel Talk**

A detector for neutron time of flight spectrometry

Tuesday 24 October 2017 09:00 (30 minutes)

Time of flight neutron spectrometry requires for high detection efficiency. In this work we present a detector which is based on a neutron-gamma converter (^{10}B disk) followed by a gamma detector (BaF_2). The response function to convert time of flight spectrum to energy one was constructed. About four times higher efficiency, compared to an equal thickness ^{6}Li-doped typically-used neutron detector is predicted. The well-known ^{7}Li(p,n)^{7}Be reaction is used to compare the calculated detector response with the measured one. The low energy tail of the neutron spectrum is well reproduced.

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Session Classification: Parallel Sessions - NINST

Track Classification: Nuclear Instrumentation and Facilities

Contribution ID: **226** Type: **Parallel Talk**

MediBoost: a Patient Stratification Tool for Interpretable Decision Making in the Era of Precision Medicine

Machine learning algorithms that are both interpretable and accurate are essential in applications such as medicine where errors can have a dire consequence. Unfortunately, there is currently a tradeoff between accuracy and interpretability among state-of-the-art methods. Decision trees are interpretable and are therefore used extensively throughout medicine for stratifying patients. Current decision tree algorithms, however, are consistently outperformed in accuracy by other, less-interpretable machine learning models, such as ensemble methods. We present MediBoost, a novel framework for constructing decision trees that retain interpretability while having accuracy similar to ensemble methods, and compare MediBoost's performance to that of conventional decision trees and ensemble methods on 13 medical classification problems. MediBoost significantly outperformed current decision tree algorithms in 11 out of 13 problems, giving accuracy comparable to ensemble methods. The resulting trees are of the same type as decision trees used throughout clinical practice but have the advantage of improved accuracy. Our algorithm thus gives the best of both worlds: it grows a single, highly interpretable tree that has the high accuracy of ensemble methods.

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **227** Type: **Poster**

Verification of the external irradiation process for the LF02 automated luminescence reader

Tuesday 24 October 2017 16:00 (15 minutes)

In OSL dating of sediments the application of the single aliquot regenerative (SAR) protocol requires the calibration of each aliquot by giving them a known dose using an internal beta source with a dose rate ranging from 100 to 30 mGy/s. In the case of old samples that have received in natural conditions doses higher than 70 Gy the time employed to equate this dose may be significant. One distinctive feature implemented in the LF02 automated luminescence reader is the possibility of external irradiating the samples without manipulating them. The goal of this process is to reduce the total irradiation time by simultaneously irradiating all the aliquots in a gamma cell facility. The aim of the present work is to establish the conditions and the dose rate of the external irradiation process when using the gamma irradiation facility at CEADEN.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **228** Type: **Poster**

Determination of the natural dose rate in samples of geological interest

Tuesday 24 October 2017 16:00 (15 minutes)

The natural dose rate is one of the physical magnitudes calculated during the process of age determination of geological sediments with the luminescence technique. The dose rate is calculated on the basis of the radioactive content presented in the sediments. Because of the low content of these radioactive isotopes a low background system should be used. In the present work the low background gamma spectrometric system used in the luminescence dating laboratory at CEADEN is described. The construction of a reference material with a similar composition to common sediments is also described. Finally, the radioactive content of quartz rich sediment from Pinar del Rio province and the respective natural dose rate are presented.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **229** Type: **Poster**

Irradiated quartz for beta source calibration

Tuesday 24 October 2017 16:00 (15 minutes)

For luminescence dating to be an accurate absolute dating technique it is very important that we are able to deliver absolutely known radiation doses in the laboratory. This is normally done using a beta source calibrated against an absolutely known reference source or by using a reference luminescence material that has been irradiated in a radiation calibration facility. Here we describe in detail the preparation and luminescence characteristics of a new quartz reference material of the luminescence dating laboratory at CEADEN. A selected sample of quartz extracted from a query in Pinar del Rio province has been treated to extract high pure quartz grains with diameters ranging from 180 to 250 μm. The resulting material was further treated to sensitize and stabilize the luminescence signal prior being irradiated to 5.0±0.3 Gy at the secondary calibration gamma source (related to BIPM) at the CPHR. With this material the dose rate of beta source of the automated luminescence reader LF02 has been calculated to be 0.034±0.002 Gy/s.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **230** Type: **Poster**

The new version of the Sequence-Toolkit software package

Wednesday 25 October 2017 16:00 (15 minutes)

As part of the instrumentation development program of the luminescence dating laboratory at CEADEN a package of open-source software supporting the luminescence measuring process is carried out. The package released under the name of Sequence-Toolkit is routinely used to create and analyze the results of the measuring sequences introduced to the automated luminescence reader LF02. Here we describe the upgrade and the new features introduced in the new version of this package. The modifications are based on the recommendations arising after two years of exploitation of the initial version specially those concerning the speed of the data manipulation and also related to the migration to the new versions of Python and QT programming software.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **231** Type: **Poster**

Age determination of sediments by quartz OSL dating technique

Tuesday 24 October 2017 16:00 (15 minutes)

The age of sediment layers in regions near to the coast in Pinar del Rio province are determined using the quartz photoluminescence method. In some locations the studied layer could be associated with altimetry measurements allowing future analysis of recent tectonic movements. The method for sample collection, preparation and measurement are described. The results analysis indicates variations in the age of formation of these geological structures.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **233** Type: **Parallel Talk**

Application of risk analysis methods to radiation medicine, InSTEC approach

Among the most used methods of risk analysis for medical practices with ionizing radiations are the Risk Matrix and the Failures Modes and Effects Analysis. Two large projects represent these methods. The first corresponds to the Forum of Radiological and Nuclear Regulatory Agencies (FORO-IAEA) and the second to the TG-100, of the American Association of Medical Physicists (AAPM). The SECURE-MR-FMEA program, developed within the framework of the Bonn Call for Action, constitutes a prospective risk analysis system that includes the integrated and coupled management of both methods, with the traditional capabilities published in the representative bibliographies of the same, as well as a series of facilities that automate new types of applications, such as importance, sensitivity, results graphing, data entries, comprehensive documentation and risk monitoring of practices. For the development of these capacities, the experiences of safety analysis applications in nuclear power plants have also been used as a reference. Based on the recognition of the expertise needed to generate the risk patterns of both traditional radiation treatment variants and medical practices with a high degree of technological complexity, the system has included, as references, databases for more than 15 related practices with teletherapy, brachytherapy, diagnostic and therapeutic nuclear medicine, as well as models for the transport and production of radiopharmaceuticals. The system offers capabilities for a variety of applications, including those required in the regulatory arena and for the optimization of quality assurance. The example of risk analysis of stereotactic radiosurgery shows as illustration of the software capabilities.

Keywords: risk analysis, ionizing radiations, cancer treatment, Risk Matrix, SEVRRA, FMEA, TG-100, quality assurance, SECURE-MR.

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **236** Type: **Poster**

Synthesis and characterization of pH and temperature responsible poly(2-hydroxyethyl methacrylate-co-acrylamide) hydrogels by gamma photon irradiation. Doxorubicin release.

Tuesday 24 October 2017 16:00 (15 minutes)

2-hydroxyethyl methacrylate/Acrylamide hydrogels were prepared by simultaneous radiation induced cross-linking copolymerization of acrylamide (AAm), 2-hydroxyethyl methacrylate (HEMA) and water mixtures at a radiation dose of 10 kGy. Hydrogesl were characterized by infrared spectroscopy. Dynamic and equilibrium swelling of hydrogels in water and in buffer solutions were investigated. They were sensitive to pH and temperature. Swelling was non–Fickean and increased with increasing the acrylamide content. Temperature dependence of the equilibrium water uptake of copolymers exhibited a discontinuity around 35°C resulting from the weakening of the hydrogen bonds between the hydroxyl groups of HEMA and the amide groups of AAm . The thermodynamic and network parameters derived from swelling and mechanical measurements are compared and discussed. They exhibit a strong dependence on the AAM content in the hydrogel. The doxorubicin release was governed by copolymer composition, the absorbed dose and their self solubility in water media.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **237** Type: **Plenary Talk**

Multiple techniques for cultural heritage study and the collaboration with the Brazilian museums

Wednesday 25 October 2017 11:00 (30 minutes)

Scientific investigations in the cultural heritage and objects of art are routinely performed in Europe and the United States a few decades ago, in Brazil we are currently increasingly using atomic and nuclear methods for this purpose. Since 2003 the Group of Applied Physics with accelerators of the Institute of Physics of the University of São Paulo has worked with various methodologies for characterization and analysis of cultural objects. The analysis methods include processes of imaging and techniques for elemental and compositional characterization. These methods used together allow the better understanding of the materials and techniques used in the creative process and manufacturing of the objects. In the processes of analysis are used as imaging techniques: Photos with visible light, reflectography Infrared, fluorescence radiation with ultraviolet light, images with tangential light and digitized radiography; that are used to examine and document the artistic and cultural heritage objects. In the determinations of the characteristic materials of the objects present in the collections, we used analyzes for determining the existing elements and chemical compounds in the surface layers of these. The techniques involve ion beam analysis such as Particle Induced X-Ray Emission, Rutherford Backscattering and currently Ion Luminescence. Extending further the possibility of analysis, it has been used the techniques of X-ray Fluorescence and Raman spectroscopy with portable equipment that can be used in museums themselves. The results of these analyzes are providing valuable information about the manufacturing process and provide new information of the objects and all this has allowed a new collaboration with different São Paulo museums such as Pinacoteca, Museum of Contemporary Art (MAC-USP), Paulista Museum, Museum of Archaeology and Ethnology (MAE-USP) and the Institute of Brazilian Studies (IEB-USP). Several works and studies are being carried out systematically in these institutions in different artworks in the museum's collections such as easel paintings, ceramic objects, papers, photos, etc. The information obtained are allowing the formation of a database about materials, pigments and manufacturing techniques of various artists. Particularly in the study of easel paintings the characterization of pigments in parallel with the imaging techniques has allowed to reveal the artist's creative process and has determined the palette used by the artist in one particular work. The purpose of this systematic study is to produce useful information to historians, curators, conservators and restorers for the expansion of knowledge in art history, but also in determining and defining the technical conditions and preservation of the cultural heritage material. The group of applied physics to the study of the historical and artistic heritage objects (NAP-FAEPAH) was formed in the University of São Paulo with collaboration of the different museums and institutions, and several works are been performed and will be presented and discussed.

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Session Classification: Plenary Talks

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **239** Type: **Poster**

Implementation of "S factor methods"for 3D dose planning in ^{131}I hyperthyroidism treatment

The optimization of patient-specific treatment planning of hyperthyroidism with ^{131}I is a desirable goal from medical and radiation protection point of view. The purpose of this work was to develop a software based on MATLAB, capable to handle non-uniform activity distribution at voxel level and made dosimetry calculation using the "S"factor from MIRD methodology, planning the therapeutic activity (TA) to warranty the prescribed treatment dose (DP), using a nuclear medicine multi-technology approach.
To verify the developed tool, the results of 6 patients dose therapy planning with theoretical 1D, theoretical 3D and "S"factors using SPECT and ^{131}I biokinetics were compared (DP between 150-400Gy).
The discrepancy between the two 3D methods concerning to the thyroids average dose among prescribed dose were less than 10%, showing the system capability to proper dosimetry calculation. The 3D dose distribution dissimilarities between "S"factors and theoretical methods took the maximum value of 23% (voxel to voxel dose value / DP), near to the thyroids boundaries tissue. Despite of those difference is inside the typical uncertain range of dose determination methods; the issue should be study deeply using Monte Carlo (MC) approach in order to clarify the voxel dose accuracy of the two methods.
Conclusion: The 3D treatment planned dose distributions were completely no-homogenous, the significant difference observed between voxels should be study in order to optimized the hyperthyroidism iodine treatment.

Index Terms: optimization, patient's specific treatment, I-131, Hyperthyroidism

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **240** Type: **Poster**

Synthesis of polymeric nanogels by gamma radiation: influence of total absorbed dose

Tuesday 24 October 2017 16:00 (15 minutes)

Biomaterials have received a considerable attention over the last 30 years as a means of treating diseases and easing suffering. These materials have found applications in approximately 8000 different kinds of medical devices; even though biomaterials have had a pronounced impact in medical treatment, a need still exists to be able to design and develop better polymer, ceramic, and metal systems. Nowadays, the emergence of micro- and nanoscale science and engineering has provided new avenues for engineering materials with macromolecular and even down to molecular-scale precision, leading to diagnostic and therapeutic technologies that will revolutionize the way health care is administered. Mainly, micro and nanosystems from polymers, such as nanogels, have achieved a great attention in biomedical applications due to they have lots of advantages over conventional systems since they enhance the delivery, extend the bioactivity of the drug, show minimal side effects, demonstrate high-performance characteristics and are more economical.
Several of techniques have been described for the synthesis of nanomaterials from polymers. However, the use of ionizing radiation (γ, e-), to obtain polymeric micro and nanogels are characterized by the possibility of obtaining products with a high degree of purity, which ones are a technological novelty mainly in biomaterial manufacture and therefore in biomedical applications.
The irradiation dose influence on nanogels synthesis by gamma radiation in diluted PVP solutions at a dose ranging from 3 - 22 kGy was performed in this paper. The experiments were performed in absence of oxygen using aqueous PVP solution (0.05 –0.3 %). Crosslinking reactions were carried out at 25 ℃ in a gamma irradiation chamber with a ^{60}Co source (ISOGAMMA LLCo). The Scanning Electron Microscopy (SEM), Attenuate Total Reflection Spectroscopy (ATR), Dynamic Light Scattering (DLS), and Viscosimetry were used as characterization techniques.

Keywords: polymeric nanogels, gamma irradiation, biomaterial.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **241** Type: **Poster**

Methodology for labeling silica sand with ^{99m}Tc for using as solid radiotracer

Tuesday 24 October 2017 16:00 (15 minutes)

For decades, the great economic benefit that represents the use of radiotracers has been recognized by the international industry, however, this technique is still underutilized. The main cause is the lack of timely availability of required radiotracer. Previous studies show the possibility of labeling sediments (with a high content of aluminosilicates) with ^{99m}Tc. This paper aims to develop a methodology for labeling silica sand with ^{99m}Tc for using as solid radiotracer. Labeling the pretreated silica sand and untreated using varying concentrations of stannous fluoride and chloride as reducing agents and different times labeling was performed. The influence of different parameters of the pretreatment of sand in labeling yields obtained was evaluated and the effectiveness of the methods used to reduce $^{99m}TcO_4^-$ ($R_{red\%}$ > 87%) by ascending paper chromatography was proved. Changes in the composition of the silica sand after its pretreatment is able to observe from SEM-EDS techniques. It was possible to establish a methodology for obtaining solid ^{99m}Tc labeled radiotracers in support of silica sand with an estimated preparation time of 4 hours a $R_{ret\%}$ equal to 74% (or a methodology for obtaining solid radiotracers labeling with ^{99m}Tc in support of silica sand with an estimated preparation time and a $R_{ret\%}$ equal to 74%).

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **242** Type: **Poster**

Development of F(ab')$_2$ fragment Monoclonal Antibody h14F7 for radiodiagnostics of tumor positives to N-glicolil-GM3 ganglioside

14F7 is a murine monoclonal antibody that recognizes the ganglioside N-Glycolil GM3 and induces death in tumor cells that overexpress this ligand. Antibody fragments exhibit improved pharmacokinetic properties as compared to whole antibodies. The study was based on two assumptions: first, the h14F7-F(ab')$_2$ does not lose its biological activity; second, labelled with ^{99m}Tc, have a more favorable pharmacokinetic behavior for its use in radiodiagnosis. After pepsin digestion, 10 mg/mL of fragment was obtained with 40 % of recovery. Schwarz method was used for radiolabeling both h14F7 mAb and its F(ab')$_2$ fragment. The quality control was performed by means of paper chromatography, where yields of 99.04 ± 0.27 and 97.21 ± 0.21 %, respectively, were obtained. In vitro studies verified the high stability of ^{99m}Tc-F(ab')$_2$ and ^{99m}Tc-h14F7. Biodistribution of radioimmunoconjugates was evaluated in healthy BALB/c mice and in a tumor model with the administration of equimolar amounts, reflecting lower uptake in non-target organs for ^{99m}Tc-F(ab')$_2$ and scintigraphic images presented a target to non-target ratio due to a faster clearance as demonstrated in pharmacokinetic analysis. ^{99m}Tc-F(ab')$_2$ have good possibilities of being used in radioimmunodiagnosis, with diminished risk of toxic and radiotoxic effects due to the permanence or accumulation of the radiolabeled ligand.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **243** Type: **Poster**

Comissioning of Radiotherapy Treatment Planning Systems: Optimization of the Dosimetric Test of the IAEA TECDOC-1583 guidelines

Background: Independent external audits play an important role in quality assurance in radiation oncology, for this reason the International Atomic Energy Agency (IAEA), in its technical document IAEA-TECDOC-1583, recommends a procedure to establish quality assurance of Radiotherapy Planning System (RTPS) using the IMRT Thorax Phantom (CIRS - 002LFC). The procedure is based on an anatomical test to verify the digitization of contours and the reproducibility of the RTPS and a dosimetric test to check the range of clinical treatment, which consists of eight cases able to simulate clinical situations. This research was focused in optimizing the dosimetric test, keeping tolerance limits and configuration proposed by IAEA.
Methods: This study consisted in correcting the previous mentioned procedure giving the fact that measurements were not done in water cavities, if not in lung, muscle or bone equivalent materials. It was applied for six combination of planning algorithms and high energy photon beams. The CIRS was scanned with a computed tomography (CT) and treatment plans for eight different test cases were planned on local RTPS. The phantom was irradiated following the treatment plans for these test cases and doses in eight specific points were measured with a semiflex ionization chamber.
Results: Differences between the measured and calculated doses were reported by both methodologies. Slightly differences between measurements with and without the correction were appreciably for those tested in bone and lung equivalent materials, being even less in muscle.
Conclusions: This work showed a methodology to optimize the procedure described by the IAEA, bringing the measured dose closer to the planned dose, being these results extensible to advanced techniques quality assurance, such as VIMAT and SRS. It also help us to better understand a more real way to employ the TEC-DOC 1583.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **244** Type: **Parallel Talk**

Origin and residence time of water in the Lima aquifer

Thursday 26 October 2017 13:30 (25 minutes)

Lima, the capital of Peru, and Callao, an urban region, form on of the largest urban centers in South America, with a total population of 10,9 million as of 2017. Three rivers supply water to the capital, however, water for municipal use is mainly taken from the Rimac and Chillon River. The estimated water availability is 148 m^3/person/year, well below the limit of 1000 m^3/person/year Falkermark establishes as of extreme scarcity. Therefore, it is of great importance the identification of water sources for the future.
An experimental study was conducted to analyze Lima´s groundwater origin. Water levels in a well located in Miraflores, near the Pacific Ocean, were observed between 2003 and 2009. A maximum water level was registered three years after the occurrence of a peak in a hydrologic station in Chosica, located approximately 35 km away. Therefore, it was estimated that the residence time, this is the time passing after water infiltrates the ground during a rainfall event, until it reaches the Miraflores well, is three years. Water samples extracted this well were analyzed. The estimated residence time is in agreement with the 3H contents which also indicate that the residence time is three years. In addition, The results obtained in the Miraflores well are also in agreement with the permeability of the valley, which is in the order of $1x10^{-3}$ m/s. The permeability in the alluvial fan, on which Lima is located, is in the order of and 10^{-4} m/s. The storage coefficient is 5% in the valley and 0.2% in the coastal area (INGEMMET, 1988).
In other hand, the relative abundance of 2H and 18O in wells in the Lima aquifer are in agreement with the hypothesis that the aquifer is recharged with water from rainfall events that occur in the highlands at an average elevation of 3000 m.
These results are useful to improve management of water resources for the 10.9 million inhabitants of the coastal city of Lima, whose water supply depends mainly of water flows of the Rimac river and water wells in the Lima aquifer. Optimization of water use is crucial in the present times characterized by climate change. In 2017, for example, due to a critical year of extreme floods, water supply from the Rimac River was interrupted and Lima had to use only water wells for municipal use.

Keywords: Coastal aquifer, Lima, water residence time.
Reference
INGEMMET. 1988. Estudio Geodinámico de la Cuenca del Río Rímac. (Boletín Nº 8b Serie C). Instituto Geológico Minero y Metalúrgico: Lima; 263.

Authors: MONTOYA, Modesto (Universidad Nacional de Ingeniería, Av. Túpac Amaru 210, Rímac, Lima, Peru.); KUROIWA, Julio (Universidad Nacional de Ingeniería, Av. Túpac Amaru 210, Rímac, Lima, Peru.)

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Session Classification: Parallel Sessions - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **245** Type: **Poster**

Radiocarbon marine reservoir effect. Regional offset for the Northwest coast of Cuba

Wednesday 25 October 2017 16:00 (15 minutes)

The regional offset correction ΔR of Marine Reservoir Effect (MRE), crucial for correcting ^{14}C ages calibration for marine influenced samples, was determined for Cuban Northwest coast. Fifteen different locations were studied by ^{14}C dating of pre-bomb known-age marine shells specimens of bivalves and gastropods from the Felipe Poey Museum collection. The distribution of results indicates ΔR values from -46 ± 38 to 140 ± 52 ^{14}C yr and a possible pattern related to the position along the coast and ocean dynamics. We present both mean values for each region and a general ΔR of 28 ± 13 ^{14}C yr for the northwestern coast of Cuba.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **247** Type: **Plenary Talk**

Nuclear physics and astronomical observations of compact objects

Wednesday 25 October 2017 10:30 (30 minutes)

Overarching questions such how and where are the heavy elements synthesized, and what is the mechanism of stellar explosions, like supernovae, have been the subject of study of nuclear astrophysics for the last decades. These puzzles are closely connected to the behavior of matter under extreme density and temperature conditions. Our current understanding relies on simulations, micro-physics input, observations and the connections among them. In this talk, I shall discuss the influence that the nuclear physics input, e.g. weak processes and the nuclear matter Equation of State, has on the above mentioned astrophysical phenomena.

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Session Classification: Plenary Talks

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **248** Type: **Poster**

In Vivo Dosimetry in Total Body Irradiation

Total Body Irradiation (TBI) is a radiotherapy technique that consists of irradiating homogeneously the whole patients body and it is characterized by extended source to surface distances and the use of large irradiation fields. The limitations of the available input data and inherent problems with the calculation procedures make it very difficult to accurately determine the dose distributions in TBI. For these reasons, it is highly recommended to use In Vivo Dosimetry (IVD), to guarantee the quality of TBI treatments as a direct measurement of the delivered dose. An IVD QA system was implemented based on semiconductor diodes and radiochromic films. For the commissioning of the system, both detector types were calibrated independently, using as reference an ionization chamber with a valid certificate in terms of absorbed dose to water (Dw). This guarantees the traceability of the measurements. An assessment was made on the sources of uncertainties. A tolerance level of ±10% was established for the combined contribution of both computational and experimental uncertainties. An experiment was carried out to simulate a clinical TBI procedure to a phantom. In this way, the calibration of the dosimetry system was corroborated. Finally, the IVD system was applied in TBI of three real patients. The discrepancies obtained between the prescribed and measured doses were below the established tolerance level of ±10 %.

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **249** Type: **Parallel Talk**

Basic dosimetry: pathway to solve problems in steep dose radiation fields

Electrons generated by photons during their interaction with matter produce significant ionization through electron-electron Coulomb interactions along their track. The absorbed dose deposited along these tracks is defined as the product of the electron fluence generated and the linear energy transfer, LET, or the restricted mass stopping power averaged over the electron energy spectrum. However, from a standpoint of basic research, in high-ionization density radiation fields, i.e. high LET, where very low-energy electron fluences exist, the physical processes of radiation interaction with matter are not well understood. Besides that, there exists a lack of information about electron cross sections at energy in the sub-keV range and consequently, the determination of the absorbed dose in these radiation fields is challenging. In this talk, I will present some results obtained in the last few years of our research project in basic dosimetry related to steep dose radiation fields and some application in modern radiotherapy. Work partially supported by Royal Society-Newton Advanced Fellowship grant NA150212 and PAPIIT-UNAM grant IN115117.

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **250** Type: **Parallel Talk**

Deflection control study of radiotherapy electron beams

This work presents an integral description of electron beam deflection control as required for novel radiotherapy technique based on convergent photon beam production [1,2]. Conventional radiotherapy is mainly applied by linear accelerators. Although linear accelerators provide dual (electron/photon) radiation beam modalities, both of them are intrinsically produced by a megavoltage electron current. Modern radiotherapy treatment techniques are based on suitable devices inserted or attached to conventional linear accelerators. Thus, precise control of delivered beam becomes a main key issue. Theoretical and Monte Carlo approaches were initially used for designing and optimizing device´s components. Then, dedicated instrumentation was developed for experimental verification of electron beam deflection due to the designed magnets. Both Monte Carlo simulations and experimental results support the reliability of electrodynamics models used to predict megavoltage electron beam control.

1. R. G. Figueroa, M. Valente, Physical characterization of single convergent beam teletherapy CBRT, Physics in Medicine and Biology, 60 (2015) 7191–7206
2. R. G. Figueroa, and M. Valente, Dosimetric and Breemstralung performance of a single convergent beam for teletherapy device , Physica Medica, 32,12 (2016) 1489–1494.

Keywords: Electron beam deflection; Convergent photon beam; Monte Carlo simulation.

Acknowledgments: This study was financed by FONDEF (Chile) project ID15i10337.

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **251** Type: **Poster**

Theoretical and Monte Carlo simulation approaches for X-ray production in different anode geometries

The traditional scheme for X-ray production is based on the well known X-ray tube, an evolution in technology started from the experiments performed by Crookes and finally by X-rays discovery by W. Röntgen in 1895. As known, X-ray tubes are mainly based on the impact of accelerated electron onto high atomic number anodes in order to produce photons by means of Bremsstrahlung and characteristic X-rays. However, spectral and angular distributions of produced photons may not be strictly improved, or even worst, not adequate for specific applications. Actually, one of the main properties of traditional X-ray tubes regards its geometrical divergence, which necessary produces fluence reduction along beam trajectory. This inherent characteristic represents a strong limitation when high concentrated fluence is required, as happens in convergent techniques [1]. This work presents investigations about the effects of the different anode properties in combination with electron beam incidence in order to assess convenient X-ray tube designs to produce X-rays with different purposes, mainly focused on applications requiring photon fluence concentration. Dedicated Monte Carlo subroutines (PENELOPE [2] and FLUKA [3]) were developed aimed at describing interaction processes and X-ray production according to different combination of electron beam incidence and anode physical/geometrical properties. The obtained results confirm that suitable designs are capable of improving photon fluence at certain regions according to specific requirements.

1. Figueroa, F., Valente, M. (2015). Physical characterization of single convergent beam device for teletherapy: theoretical and Monte Carlo approach, Phys. Med. Biol. 60: 7191-206.
2. Salvat, F., Fernández-Varea, J., Sempau, J. (2008). PENELOPE Version 2008, NEA, France.
3. Battistoni, G., Muraro, S., Sala, P.R., Cerutti, F., Ferrari, A., Roesler, S., Fassó, A., Ranft, J. (2007). The FLUKA code: Description and benchmarking, AIP Conf. Proc. 896, 31-49.

Keywords: X-ray production; Convergent photon beam; Monte Carlo simulation.

Acknowledgments: This study was financed by FONDECYT (Chile) project 1171729

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Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **254** Type: **Parallel Talk**

Color reconnection studies in underlying event observables at the LHC

Monday 23 October 2017 15:00 (25 minutes)

Studies of the effects of different color reconnection (CR) choices for three different models implemented in Pythia 8 event generator is shown. Validation plots for the new tunes for the three main Pythia CR model, the MPI-based scheme, the new more QCD-based and the gluon-move model are shown. Four different Rivet validated analysis are presented, the CMS_2011_S9215166 which investigates the agreement of the tunes in the forward region, CMS_2012_PAS_QCD_11_010, which investigates the agreement of the tunes for strange particles, CMS_2015_I1356998 that investigates the agreement of the tunes for diffractive observables and ATLAS_2010_S8894728 which investigates the agreement of the tunes for UE observables.

Authors: RODRIGUEZ RODRIGUEZ, Arturo (Instituto Superior de Tecnologías y Ciencias Aplicadas (InSTEC), Universidad de La Habana, Cuba.); GUNNELLINI, Paolo (Deutsches Elektronen-Synchrotron (DESY), Germany.); GUZMAN MARTINEZ, Fernando (Instituto Superior de Tecnologías y Ciencias Aplicadas (InSTEC), Universidad de La Habana, Cuba.); DOMINGUES DAMIANI, Daniela (Deutsches Elektronen-Synchrotron (DESY), Germany.)

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Session Classification: Parallel Sessions - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **255** Type: **Poster**

Calculation of induced gamma atom displacement in solids considering nonhomogeneous threshold displacement energies

Tuesday 24 October 2017 16:00 (15 minutes)

An extension to the Monte Carlo assisted Classical Method (MCCM) methodology was developed and implemented. The extension allows to calculate the atom displacement per atom (dpa) profiles considering threshold displacement energies which are spatially inhomogeneous. Calculation of the dpa profiles was performed using both, the standard methodology and extended one for gammas of 1.25, 3, 7 and 12 MeV energies for the $BaTiO_3$ ceramic. Significant differences for the oxygen sublattice in all the energy range were found, being these ones the highest ones. In general, the dpa profiles calculated at the same sample deep and energy with the standard MCCM are between one or two orders higher than the ones calculated through the extension.

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Session Classification: Poster Session - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **256** Type: **Poster**

Upgrading algorithm of the Monte Carlo Simulation of Atom Displacements (MCSAD) induced in solids under high fluency electron and gamma irradiation environments

Tuesday 24 October 2017 15:45 (15 minutes)

The Monte Carlo Simulation of Atom Displacement, MCSAD, algorithm and code have been developed and applied in solid materials for the assessment of electron and gamma radiation damage. In the code, single primary knock-on atom (PKA), processes are taken into account in regard to atom displacement (AD) occurrences, which give a well-suited description of radiation damage effects on relative low particle fluency irradiation environments. In addition, target matrix main properties on regard with electron and gamma quanta transport are assumed to remain constant during the radiation transport, it means that, and consequently, material related atom displacement threshold energies and density consequently do not change at different calculation history trails, which supposes a weak radiation damage effects on the target properties. However, under high brightness and fluency irradiation environments, the foregoing MCSAD algorithm and code assumptions are not adequate for describing progressive and intensive radiation damage effects on a given target matrix.

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Session Classification: Poster Session - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **257** Type: **Parallel Talk**

On the effects of magnetic fields and slow rotation in white dwarfs

Wednesday 25 October 2017 13:55 (25 minutes)

We use Hartle's formalism to study the effects of rotation in the structure of magnetized white dwarfs within the framework of general relativity. The inner matter is described by means of an equation of state for electrons under the action of a constant magnetic field, which breaks the SO(3) symmetry and introduces a splitting of the pressure into one parallel and other perpendicular to the magnetic field. Solutions correspond to typical densities of white dwarfs and values of magnetic field below 10^{13}G, considering perpendicular and parallel pressures independently, as if associated to two different equations of state.
Rotation effects obtained accounts for an increase of the maximum mass for both, magnetized and non-magnetized stable configurations, up to about 1.5 M . Further effects studied include the deformation of the stars, which become oblate spheroids and the solutions for other quantities of interest, such as the moment of inertia, quadrupolar momentum and eccentricity. In all cases, rotation effects are dominant with respect to those of the magnetic field.

Authors: ALVEAR TERRERO, D. (Departamento de Física Teórica, Instituto de Cibernética Matemática y Física, Cuba.); MANREZA PARET, D. (Facultad de Física, Universidad de la Habana, Cuba & Instituto de Ciencias Nucleares, Universidad Nacional Autónoma de México, México.); PEREZ MARTINEZ, A. (Departamento de Física Teórica, Instituto de Cibernética Matemática y Física, Cuba.)

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Session Classification: Parallel Sessions - HEP

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **258** Type: **MP Talk**

MR guided radiotherapy: the new standard of care in 10 years time

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Presenter: SANDÍN, C. (Elekta Oncology Ltd., U.K.)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **259** Type: **MP Refresher Course**

Image Guidance in Stereotactic Radiation Treatments

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Presenter: Prof. ROA, Dante (University of California, Irvine, U.S.A.)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **260** Type: **MP Keynote Presentation**

Education, accreditation, and certification in Medical Physics

Author: Prof. PADOVANI, Renato (CoDirector, MSc. Med. Phys ICTP, Italy.)

Presenter: Prof. PADOVANI, Renato (CoDirector, MSc. Med. Phys ICTP, Italy.)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **261** Type: **MP Talk**

Comparison of Education Curriculums between HIC/LMIC for Medical Physics Programs

Author: Prof. AVERY, Stephen (University of Pennsilvania, USA.)

Presenter: Prof. AVERY, Stephen (University of Pennsilvania, USA.)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **262** Type: ***MP Keynote Presentation***

Emerging treatment paradigms and future challenges in radiation oncology

Author: Prof. HUQ, M. S. (UPMC Hillman Cancer Center, USA.)

Presenter: Prof. HUQ, M. S. (UPMC Hillman Cancer Center, USA.)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **263** Type: **MP Refresher Course**

Application of risk analysis methods to radiation medicine: The TG-100 approach

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **264** Type: **MP Talk**

Oligometastases: Imaging, treatment planning and delivery

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **265** Type: **Poster**

Evaluation of the fluoro alkil losartan-derivative as ^{18}F-labeled radiopharmaceutical candidates for cancer diagnosis: theoretical study

There is sufficient information in vitro and in vivo that indicates that AT1 receptor (part of the blood pressure regulated system Renin-Angiotensin) is overexpressed in malignant tumor. The losartan is one of the most studied antagonist of this receptor, for that reason, this study evaluated the fluoro-alkyl losartan-derivatives (^{18}FAL) as potential candidates of ^{18}F-labeled radiopharmaceuticals for cancer diagnosis. Each derivative is obtained by a SN2 reaction. All calculation are performanced in vacuum as first approximation. The stability of these compounds is studied using the Density Functional Theory with the base 6-31G(2d, 2p). Molecular-Docking (MD) is used to estimate the association with this receptor. The functional M06-2X is the best that describes the featuring of these systems. The vibrational frequencies of the members of family ^{18}FAL structures and the bond dissociation energy (BDE) are also calculated. The most stable derivative is ^{18}FML(n=1), followed by ^{18}FPL(n=3) and ^{18}FEL(n=2) (n=CH_2). Atoms in Molecules topological study is done to characterize the bones and weak intramolecular interactions. All the intramolecular interactions are of the Van der Waals type, the fluoroalkyl chain provides additional stability to the molecule, in addition to generating a phenomenon of folding in this derivatives. MD explains the probability of existence of two conformers, one of them orients the phenyl and tetrazol rings in the same way as the natural ligand within the crystallographic structure of AT1 receptor. The amino acids that most contributes to the stability of the ligand-receptor complex are: Arg-167, Ile-288, Trp-84. ^{18}FML is proposed as the best candidate.

1. H. Zhang, et al., Cell, 2015. 161: p. 833–844.
2. J. Kujawski, et al., Molecules, 2015. 20: p. 11875-11890.
3. Álvarez-Ginartea Y. M., et al., Journal of Steroid Biochemistry and Molecular Biology, 2013. 138: p. 348–358.

Authors: MARTÍNEZ LEÓN, A. (Instituto Superior de Tecnologías y Ciencias Aplicadas (InSTEC), Universidad de La Habana, Cuba.); GARCÍA FLEITAS, A. (Instituto Superior de Tecnologías y Ciencias Aplicadas (InSTEC), Universidad de La Habana, Cuba.); RODRÍGUEZ RIERA, Z. (Instituto Superior de Tecnologías y Ciencias Aplicadas (InSTEC), Universidad de La Habana, Cuba.); JÁUREGUI HAZA, U. (Instituto Superior de Tecnologías y Ciencias Aplicadas (InSTEC), Universidad de La Habana, Cuba.); ÁLVAREZ GINARTE, Y. M. (Facultad de Química, Universidad de La Habana, Cuba.)

Presenter: MARTÍNEZ LEÓN, A. (Instituto Superior de Tecnologías y Ciencias Aplicadas (InSTEC), Universidad de La Habana, Cuba.)

Session Classification: Poster Session - MP

Track Classification: Medical Physics

Contribution ID: **270** Type: ***MP Talk***

Safety and Quality in Radiation Therapy

Author: PIPMAN, Y. (AAPM, IOMP, USA.)

Presenter: PIPMAN, Y. (AAPM, IOMP, USA.)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **271** Type: **MP Refresher Course**

Treatment Planning in SBRT/SRS

Author: VENENCIA, D. (Instituto de Radioterapia - Fundacion Marie Curie, Argentina.)

Presenter: VENENCIA, D. (Instituto de Radioterapia - Fundacion Marie Curie, Argentina.)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **273** Type: **MP Talk**

Standardization of Radiomic Feature Extraction for Building Predictive Models in Oncology

Author: MORIN, O. (Department of Radiation Oncology, UCSF, USA.)

Presenter: MORIN, O. (Department of Radiation Oncology, UCSF, USA.)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **274** Type: ***MP Talk***

Advances in brachytherapy dose calculations

Author: BEAULIEU, L. (Department of Physics, Université Laval and CHU de Quebec, Canada.)

Presenter: BEAULIEU, L. (Department of Physics, Université Laval and CHU de Quebec, Canada.)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **275** Type: **MP Talk**

Scintillation applications for in vivo and small field dosimetry

Author: BEAULIEU, L. (Department of Physics, Université Laval and CHU de Quebec, Canada.)

Presenter: BEAULIEU, L. (Department of Physics, Université Laval and CHU de Quebec, Canada.)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **276** Type: ***MP Talk***

Today's technology in Proton Therapy

One of the main challenges of proton therapy today is to produce an equipment that, because of its size and cost, is accessible for general health centers. This way, this therapy will not only be possible in a few centers in developed countries. For this purpose, new equipment has been developed for a single treatment room and equipped with small size cyclotrons with modern technology (including superconducting coil), capable of generating proton beams with energies higher than 200 MeV suitable for the Radiotherapy treatments.
From a clinical point of view, the PBS (Pencil Beam scanning) technique has provided an essential tool to advance in obtaining better dose distributions, allowing the incorporation of the IMPT (intensity-modulated proton therapy) technique that today shows significant advances in clinical dosimetry.
In conjunction with these new technologies are developing techniques of prompt gamma imaging that will allow "in vivo" specific patient quality assurance, whose first results in clinical practice have been presented recently.

Author: BOUREL, V. (Medical Physics Engineering, Favaloro University, Buenos Aires, Argentina.)

Presenter: BOUREL, V. (Medical Physics Engineering, Favaloro University, Buenos Aires, Argentina.)

Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **277** Type: **Poster**

Theoretical evaluation losartan derivatives as ^{18}F-labeled radiopharmaceutical candidates for cancer diagnosis

Wednesday 25 October 2017 16:00 (15 minutes)

The losartan and its fluoro n-ethoxy-methyl-triazole losartan derivatives (FEM, n=0-3) were studied as potential candidates of ^{18}F-labeled radiopharmaceuticals. Each derivate is obtained by the reaction of a terminal alkyne with a substituted azide in presence of Cu(I) catalyst. The stability and association energy of four FEM to the AT1 receptor was evaluated. The Density Functional Theory with the base 6-31G(2d, 2p) was used to evaluate radiotracers stability. In order to determine the functional that provides the best description of FEM, the experimental X-ray diffraction structure of losartan potassium was compared with calculated using different functionals, been the M06-2X the most suitable. The vibrational frequencies of the FEM structures and the bond dissociation energy (BDE) were also calculated. In both, vacuum and water calculations, the stability of compounds decreased following the order: FTEMT(n = 3)>FDEMTL(n = 2)>FMTL (n = 0) > FEMTL(n = 1). When water as implicit solvent was considered in the model, the difference of BDE was only 6kJ/mol. The electron density analysis of atoms in molecules was performed in order to characterize the intramolecular interactions in each FEM derivative. There was an increase of van der Waals type interactions with the increase of the length of the chain, being the FDEMTL the only one with two hydrogen bonds. Molecular Docking study was performed to evaluate the interactions of the four FEM with the receptor. All evaluated derivatives have similar interaction energy with the receptor than losartan. The FMTL derivative can be considered the best candidate as radiotracer.

1. W. Nakanishi, S. Hayashi, and K. Narahara, J. Phys. Chem., 2008. 112: p. 13593-13599.
2. Tsipis A. C., Coordination Chemistry Reviews, 2014. 272: p. 1–29.
3. Álvarez-Ginarte Y. M., et al., Journal of Steroid Biochemistry and Molecular Biology, 2013. 138: p. 348–358.

Authors: GARCÍA FLEITAS, A. (Instituto Superior de Tecnologías y Ciencias Aplicadas (InSTEC), Universidad de La Habana, Cuba.); MARTÍNEZ LEÓN, A. (Instituto Superior de Tecnologías y Ciencias Aplicadas (InSTEC), Universidad de La Habana, Cuba.); ÁLVAREZ GINARTE, Y. M. (Facultad de Química, Universidad de La Habana, Cuba.); RODRÍGUEZ RIERA, Z. (Instituto Superior de Tecnologías y Ciencias Aplicadas (InSTEC), Universidad de La Habana, Cuba.); JÁUREGUI HAZA, U. (Instituto Superior de Tecnologías y Ciencias Aplicadas (InSTEC), Universidad de La Habana, Cuba.)

Presenter: GARCÍA FLEITAS, A. (Instituto Superior de Tecnologías y Ciencias Aplicadas (InSTEC), Universidad de La Habana, Cuba.)

Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **278** Type: **Poster**

Radiolabeling of anti-tumoral peptide for in vivo studies in animal models

Wednesday 25 October 2017 16:00 (15 minutes)

The application of the method of radioactive indicators in research and development of drugs is of great importance for the pharmaceutical industry. Many non-clinical and clinical trials rely on the radiolabelling of the molecules being tested as potential drugs. In the present investigation, a preliminary computational model was developed to obtain the possible structures of the CIGB-300 peptide without radiolabelling and radiolabelling. The radiolabelling with ^{99m}Tc of the antitumor peptide CIGB-300 in its cyclic and non-cyclic forms was studied considering the influence of the peptide mass in the reaction, as well as the influence of the amount of the reducing system. The stability of the radiolabeling was evaluated by mean of cysteine and DTPA challenged and in dilution of serum albumin and fresh human serum. Subsequently, pharmacokinetic evaluation of radiolabeled peptide was performed to verify its tumor uptake in an experimental model in mice and to observe its tissues distribution. Sampling schedule follows a spars data design and the obtained information was processed using the Monolix Suit. Population and individual pharmacokinetic parameters were obtained after selecting the best-fit model. The study was supplemented with scintigraphic images. The results indicate that with only 100 µg of the non-cyclic peptide 98% of radiochemical purity is obtained and is stable, with adequate tumor uptake in the experimental model.

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **279** Type: **Poster**

Fission modes ^{248}Cf, ^{254}Fm and ^{260}No in the reactions ^{22}Ne + ^{232}Th, ^{238}U; ^{16}O+^{238}U, ^{232}Th

Tuesday 24 October 2017 15:30 (15 minutes)

The purpose of this work was to investigate fission modes in the fission of heavy actinides. The experiments have been carried out at the U400 cyclotron at the FLNR JINR (Dubna, Russia) using the double-arm time-of-flight spectrometer CORSET. To investigate the role of closed proton and neutron shells in fission of ^{248}Cf, ^{254}Fm and ^{260}No nuclei at an excitation energy of 40-45 MeV the mass and energy distributions of fission fragments in the reactions ^{16}O+^{232}Th, ^{16}O+^{238}U, ^{22}Ne + ^{232}Th and ^{22}Ne + ^{238}U have been measured. For the compound nucleus ^{260}No* formed in the reaction ^{22}Ne + ^{238}U an increase of fragment yields in the superasymmetric mass region of 52/208 u, that corresponds to the formation of pair of two double magic nuclei ^{48}Ca and ^{208}Pb, were observed. Moreover, for ^{260}No* compound nucleus at the initial excitation energy of 41 MeV the bimodal fission was observed. In this case at the symmetric mass split the both fission fragments was close to the double magic ^{132}Sn. For the compound nuclei ^{248}Cf and ^{254}Fm* formed in the reactions ^{16}O+^{232}Th, ^{16}O+^{238}U and ^{22}Ne + ^{232}Th an increase of fragment yields in the mass region 70/180 u that corresponds to the nuclei ^{70}Ni was observed. It present an interesting case because the initial excitation energy of compound nuclei was around 40-45 MeV whereas typically shell structure starts to break at around 20-30 MeV.

Authors: GIKAL, K. B. (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research, Dubna, Russia.); KOZULIN, E. M. (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research, Dubna, Russia.); ITKIS, I. M. (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research, Dubna, Russia.); ITKIS, M. G. (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research, Dubna, Russia.); KNYAZHEVA, G. N. (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research, Dubna, Russia.); NOVIKOV, K. V. (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research, Dubna, Russia.); PAN, A. N. (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research, Dubna, Russia & Institute of Nuclear Physics, Republic of Kazakhstan.)

Presenter: GIKAL, K. B. (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research, Dubna, Russia.)

Session Classification: Poster Session - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **280** Type: **Parallel Talk short**

Methodology trends on gamma and electron radiation damage simulations studies in solids under high fluency irradiation environments

Thursday 26 October 2017 15:50 (25 minutes)

The present work deals with the numerical simulation of gamma and electron radiation damage processes under high brightness and radiation particle fluency on regard to two new radiation induced atom displacement processes, which concern with both, the Monte Carlo Method based numerical simulation of the occurrence of atom displacement process as a result of gamma and electron interactions and transport in a solid matrix and the atom displacement threshold energies calculations based on Molecular Dynamic methodologies.
The two new radiation damage processes here considered in the framework of high brightness and particle fluency irradiation conditions are: 1) The radiation induced atom displacement processes due to a single primary knockout atom excitation in a defective target crystal matrix increasing its defect concentrations (vacancies, interstitials and Frenkel pairs) as a result of a severe and progressive material radiation damage and 2) The occurrence of atom displacements related to multiple primary knockout atom excitations for the same or different atomic species in an perfect target crystal matrix due to subsequent electron elastic atomic scattering in the same atomic neighborhood during a crystal lattice relaxation time.
In the present work a review of numeral simulation attempts of these two new radiation damage processes are presented, starting from the former developed algorithms and codes for Monte Carlo simulation of atom displacements induced by electron and gamma in irradiated materials and, in addition, the Molecular Dynamics calculations atom displacement threshold energies for defective crystalline materials as well as for the cases of multiple primary knockout atomic excitations.

Authors: CRUZ INCLÁN, C. M. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.); GONZÁLEZ LAZO, E. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.); RODRÍGUEZ RODRÍGUEZ, A. (Instituto Superior de Tecnologías y Ciencias Aplicadas, Cuba.); GUZMÁN MARTÍNEZ, F. (Instituto Superior de Tecnologías y Ciencias Aplicadas, Cuba.); ABREU ALFONSO, Y. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.); PIÑERA HERNÁNDEZ, I. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba & University of Antwerp, Belgium.); LEYVA FABELO, A. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.)

Presenter: CRUZ INCLÁN, C. M. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.)

Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **281** Type: **Poster**

Effects of vacancies on atom displacement threshold energies calculation through Molecular Dynamic Methods in $BaTiO_3$

Tuesday 24 October 2017 15:15 (15 minutes)

Under progressive and intensive radiation damage conditions atom displacement threshold energy, T_d, calculations through Molecular Dynamic Methods must take into the account, in addition to the framework of single recoil atom excitation in an ideal crystalline lattice, multiple excitations and real crystal structures with point defects, in order to reach a better approach to situations emerging from severe and intensive radiation damage impacts on irradiated materials.
At the present work, atom displacement threshold energies evaluations are performed by application of Molecular Dynamics, MD, calculation tools under the assumption that the $BaTiO_3$ tetragonal crystalline structure possesses vacancies. In this context, a 2x2x2 over-dimensioned tetragonal $BaTiO_3$ unit cell was considered containing several primitive ones and owing vacancies on Ba, Ti and O atomic positions under the requirements of electrical charge balance.
On this basis and following a previous report [1,2] on an ideal $BaTiO_3$ tetragonal structure, the present report concern with Ba, Ti and O MD T_d calculation, where the corresponding primary knock-on atom (PKA) defect formation probability functions dependence on the initial excitation energies were calculated at principal crystal directions, and compared with previous one calculated at an ideal $BaTiO_3$ ideal tetrahedral crystal structure.

1. E. Gonzalez, Y. Abreu, C.M. Cruz, I. Piñera, A. Leyva. NIM B 358 (2015) 142-145.
2. E. González, C.M. Cruz, A. Rodríguez, F. Guzmán, Y. Abreu, C.M. Cruz, I. Piñera, A. Leyva. NIM A 865 (2016) 144-147.

Authors: GONZÁLEZ LAZO, E. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.); CRUZ INCLÁN, C. M. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.); RODRÍGUEZ RODRÍGUEZ, A. (Instituto Superior de Tecnologías y Ciencias Aplicadas, Cuba.); GUZMÁN MARTÍNEZ, F. (Instituto Superior de Tecnologías y Ciencias Aplicadas, Cuba.); ABREU ALFONSO, Y. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.); PIÑERA HERNÁNDEZ, I. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba & University of Antwerp, Belgium.); LEYVA FABELO, A. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.)

Presenter: CRUZ INCLÁN, C. M. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.)

Session Classification: Poster Session - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **282** Type: **Poster**

Electron and gamma radiation damage assessments on composite YBCO - Nano/C samples

Tuesday 24 October 2017 15:00 (15 minutes)

Present work deals with the scientific problems and the "states of arts"on regard the knowledge of the physical and structural behaviors of composite materials based on superconducting $YBa_2Cu_3O_7$ (YBCO) and carbon nanostructured compounds (wires and onnions), as well as, their electron and gamma radiation response, which are nominated as YBCO-Nano/C.
Based in the application of radiation transport simulation codes relying on the Monte Carlo Methods, and the Monte Carlo assisted Classical Method (MCCM) an assessment of the radiation damage in terms of displacements per atom (dpa) rate spatial distributions, as well as, of the energy deposition distribution in the composite YBCO-Nano/C is presented.
A simple structural model of the composite YBCO-Nano/C is introduced and justified, where a comparison among the behaviors its different physical properties with the irradiation treatment is discussed.

Authors: VALDÉS ALBUENRES, Jorge Luis (Instituto Superior de Tecnologías y Ciencias Aplicadas, Cuba.); CRUZ INCLÁN, Carlos M. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.); LEYVA FABELO, Antonio (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.); PIÑERA HERNÁNDEZ, Ibrahin (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba & University of Antwerp, Belgium.)

Presenters: VALDÉS ALBUENRES, Jorge Luis (Instituto Superior de Tecnologías y Ciencias Aplicadas, Cuba.); CRUZ INCLÁN, Carlos M. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.)

Session Classification: Poster Session - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **283** Type: **Poster**

The Electrical Point Charges Model: application boundaries for Electrical Field Gradient calculations at nuclei sites in disordered ^{57}Fe doped ZnO matrixes

Tuesday 24 October 2017 16:00 (15 minutes)

Electric Field Gradients (EFG) at Zn and O sites in disordered ^{57}Fe doped ZnO matrixes arising from ^{57}Mn irradiated ZnO samples with wurtzite crystal structure were simulated through DFT atomistic calculations methods. The ZnO disordered crystal defective structures were simulated by means of overdimensioned unit cells (supercell) containing Zn vacancies at different concentrations with a ^{57}Fe atom per supercell. Previous DFT electron density calculation results in these defective crystalline structures reported in [1] were applied.
Electric Point Charge Model (PCM) was also applied to calculate EFG at Zn and O sites in the same ^{57}Fe doped ZnO supercells as before, where Steinheimer antishielding factors γ_∞ values were taken from previously reported ones. A new methodology based on algebraic invariants, as I and D named, of the EFG resulting secular equations for both, DFT and PCM EFG data, were introduced and applied. It was proved that the second degree invariant I is proportional to the electrical quadrupole splitting at ^{57}Fe sites.
It results that a general agreement among Zn and O DFT- and PCM- EFG invariant data statistical distributions was observed, though the best results were achieved at the supercell with higher dimension (3x3x2) and the lowest vacancy concentration, where a good linear correlations among DFT and PCM I and D data were proved and the resulting effective γ_∞ values are very close to the previously reported ones. It was concluded that PCM approach might be applied as an initial numerical assessment for EFG data for high dimensioned supercells.

1. Y. Abreu, et al. Solid State Communications, 185 (2014) 25-29.

Authors: PLACENCIA MONTESINO, Y. (Instituto Superior de Tecnologías y Ciencias Aplicadas, Cuba.); CRUZ INCLÁN, C. M. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.); ABREU ALFONSO, Y. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.); PIÑERA HERNÁNDEZ, I. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba & University of Antwerp, Belgium.); LEYVA FABELO, A. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.)

Presenter: CRUZ INCLÁN, C. M. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.)

Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **284** Type: **Poster**

Development of alternative XRD patterns evaluation methods and their applications for crystalline structure evaluations of ferroelectric $PbZr_{0.53}Ti_{0.47}O_3$ doped with La (1%) ceramics samples under ^{60}Co gamma irradiation

Tuesday 24 October 2017 16:00 (15 minutes)

In previous researches, it has been identified the presence of tetragonal and rhombohedral crystalline phases in ferroelectric ceramic samples of $PbZr_{0.53}Ti_{0.47}O_3$ doped with La (1%) (PLZT) irradiated with ^{60}Co gamma rays, showing their corresponding XRD patterns not conclusive evidences of phase transformations between both phases assisted by gamma irradiation.
The present work concerns with the evaluation of the gamma radiation damage of the irradiated PLZT samples, taking into the account the depleted atom displacement threshold energies due to the presence of point defects in the studied ceramic samples, as has been reported in [1].
It has been crystallographic evaluated, also, XRD reflexions of the non-irradiated PLZT samples, as well as of the irradiated ones by using new research tools of extrinsic and intrinsic nature [2], which are introduced in the present work, according their dependence or not of the choice of a particular crystalline vector basis.
In particular, in the case of the extrinsic methods, it has been established for cubic, tetragonal, orthorhombic and rhombohedral crystalline structures, an important property of the mean square value of the inverse of the interplanar distances taken over those reflexions owing the same value of the sum of square of their Miller Indexes. It results that the former one is proportional to the value of the sum the square Miller Indexes.
On the other hand, new intrinsic evaluation methods were introduced, like the density of reflexion lines and the differences between successive values of the inverse of the interplanar distances.
It results, that all studied PLZT samples (non- gamma irradiated and irradiated ones) comprise two crystalline phases (with tetragonal and rhombohedral structures), where the application of the intrinsic and extrinsic developed methods showed drastic qualitative and quantitative difference among the non-irradiated simple on regard to the irradiated one. The irradiated PLZT XRD patterns showed the presence of two phases with tetragonal and rhombohedral crystalline structures close to the corresponding single-phase reference systems, which are tending to a pseudo – cubic symmetry.

1. E. González, et al. NIM A 865 (2016) 144-147.
2. Eduardo L Mendoza Caballero. BsC. Thesis, InSTEC, Julio/2017.

Authors: MENDOZA CABALLERO, E. L. (Instituto Superior de Tecnologías y Ciencias Aplicadas, Cuba.); CRUZ INCLÁN, C. M. (Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear, Cuba.); RODRÍGUEZ RODRÍGUEZ, A. (Instituto Superior de Tecnologías y Ciencias Aplicadas, Cuba.); DURRUTÍ RODRÍGUEZ, M. D. (Institute of Cibernetics, Mathematics and Physics, ICIMAF, Cuba.)

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Session Classification: Poster Session - NAT

Track Classification: Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security

Contribution ID: **286** Type: **Parallel Talk**

Understanding the origin of the elements using rare isotopes in the laboratory

Thursday 26 October 2017 13:30 (25 minutes)

Nucleosynthetic processes in supernovae and X-ray bursts often involve unstable ions and reactions that are difficult to produce at the relevant energies in rare beam facilities. Recent progress in astronomical observations and the chemical evolution of the Galaxy need to be accompanied with similar progress in understanding the relevant properties of rare isotopes through nuclear physics experiments. I will review the important role that rare isotopes play in understanding stellar explosions, show some examples of recent nuclear physics measurements and give a (very abbreviated) outlook of future nuclear astrophysics studies.

Author: MONTES, Fernando (Michigan State University, USA.)

Presenter: MONTES, Fernando (Michigan State University, USA.)

Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **288** Type: **Parallel Talk**

Study of reactions involving weakly-bound nuclei

Tuesday 24 October 2017 11:30 (30 minutes)

Recently, an experimental campaign was performed at the LAFN (Open Laboratory of Nuclear Physics) of the University of São Paulo. Various angular distributions were obtained at energies around the Coulomb barrier for the ^{7}Li + ^{120}Sn and ^{10,11}B + ^{120}Sn reactions. Besides the elastic scattering, other reaction channels, such as projectile and target-like excitation, and transfer of nucleons, were observed. Details on the experiment, and a theoretical analysis performed within the coupled-channel formalism, will be presented.

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Presenter: GASQUES, Leandro (University of São Paulo, Nuclear Physics Department, Brazil.)

Session Classification: Parallel Sessions - NUC

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **289** Type: **Invited Talk**

Low lying Oscillations of Deformed Nuclei

Monday 23 October 2017 11:00 (55 minutes)

The 1975 Nobel prize in Physics was awarded to Bohr, Mottelson, and Rainwater for the discovery of the connection between nucleon motion and the emergent collective behavior. They described nuclei geometrically as a shape and the oscillations of the nucleus around that shape. In deformed nuclei, they predicted low-lying quadrupole oscillations of the deformed shape with respect to projections on the symmetry axis as "β"and "γ"vibrations.
The "γ"vibration seems to be well characterized and exhibits a systematic behavior across the region of deformed nuclei with typical B(E2; 2+ ɣ $\longrightarrow$ 0+ g.s.) values of a few Weisskopf units (W.u.). The discussion on the "β"vibration however still continues today some forty years later and remains an open challenge to nuclear structure studies to large part to the lack of experimental data on the identification and characterization of 0^+ states. This has been changing recently with the discovery of numerous 0^+ states well below the pairing gap in several isotopes of Sm, Gd, Dy, Er and Hf in the rare earth region. We have been measuring lifetimes of low-lying excited states of $K_\pi = 0^+, 2^+, 4^+$ states in this region of deformation and will present our results along with expected levels of collectivity.
This work was supported by the US National Science Foundation under contract number PHYS-1419765.

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Session Classification: Invited Talks

Track Classification: Nuclear Structure, Nuclear Reactions and Exotic Nuclei

Contribution ID: **290** Type: **Invited Talk**

Nuclear matter and related systems: from the hottest and the coldest places in the universe to the densest

Monday 23 October 2017 10:00 (55 minutes)

Our knowledge of the states of nuclear matter under extreme conditions has advanced significantly in recent years through developments along numerous interrelated paths. This talk will describe this progress by focusing on new understanding of the densest matter in the universe, that deep inside neutron stars. Recent advances driving a better picture of neutron star interiors include observations of heavy neutron stars with masses just twice that of the sun; ongoing observational simultaneous determinations of neutron star masses and radii; an emerging understanding in QCD of how nuclear matter can turn into deconfined quark matter in the interior; and the creation of new states of quantum matter in the laboratory, including quark-gluon plasmas in ultrarelativistic heavy ion collisions, and new Bose and Fermi superfluids in ultracold trapped atomic clouds. The importance of a better understanding of dense nuclear matter is strongly underlined by the observational discovery of gravitational radiation, since merging of neutron stars with black holes or neutron stars will be a principal source of future gravitational radiation events.

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Session Classification: Invited Talks

Track Classification: High Energy Physics, Astrophysics and Cosmology (covering Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)

Contribution ID: **291** Type: **MP Talk**

Promise and Pitfalls of Proton Therapy

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **292** Type: ***MP Talk***

^{18}F-THK for the diagnosis of neurodegenerative diseases

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Session Classification: Parallel Session - MP

Track Classification: Medical Physics

Contribution ID: **293** Type: **Poster**

Dose deposition in small lung lesions: Modifying the PTV for a more robust optimization

In lung cancer, SBRT is used to deliver high doses to a small dense GTV moving into a low-density tissue (margin generating the PTV). If IMRT or VMAT are used to treat such inhomogeneous PTV, a homogeneous dose distribution is achieved generating high photon fluence inside a 3D shell (PTV-GTV). Paradoxically the dose distribution is apparently uniform, but the GTV, which moves into the PTV, will receive a dose that depends on its position. This work studies this phenomenon. Monaco v5.11 (Elekta, SWE) with MC algorithm was used to simulate a SBRT treatment. In a first part, the photon fluence was optimized for the original PTV electron density (EDo) and then used to recalculate the dose on a modified PTV electron density (EDf) in which the mean value of the GTV electron density was forced as the relative electron density of the PTV. In a second part the photon fluence was optimized for PTV EDf and then used for the dose calculation on PTV EDo. In part one, dose increments of 1.6% for D98%, 2.5% for Dmean and 5% for D2% were obtained for PTV-GTV, dose profiles calculated on EDo and EDf, differ up to 6.6% on longitudinal axis along the plan isocenter. A maximum dose difference of 9% of the prescribed dose was obtained between the 3D dose distributions. This means, when the GTV reaches a position inside the PTV, where the photon fluence is optimized for low electron densities, it will receive higher doses than what estimated on the original EDo map. In the second part a reduction of -1.5% for D98%, Dmean and D2% were achieved for PTV-GTV and the maximum difference between dose profiles was -3% for longitudinal axis. The maximum difference between the 3D dose distributions was 6% of the prescribed dose. The GTV is thus irradiated in a more homogeneous way in part two in which the fluence is optimized for its mean electron density everywhere in the PTV. We propose that, in lung small lesions, the PTV must be modified in terms of electron density considering the GTV mobility.

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