Advances in Astroparticle Physics and Cosmology (AAPCOS-2020)

Monday 06 January 2020 - Friday 10 January 2020

Saha Institute of Nuclear Physics

Book of Abstracts

Abstract ID : **2**

Constraints on ultra-light axions from compact binary systems

Content

Ultra light particles (m_a ~ 10^ −21 eV − 10^ −22 eV) with axion-like couplings to other particles can be candidates for fuzzy dark matter (FDM) if the axion decay constant f_a ~ 10^ 17 GeV . If a compact star is immersed in such a low mass axionic potential it develops a long range field outside the star. This axionic field is radiated away when the star is in a binary orbit. The orbital period of compact binaries decay mainly due to the gravitational wave radiation as confirmed first in the Hulse-Taylor binary pulsar. The orbital period can also decay by radiation of other light particles like axions and axion like particles(ALPs). For axionic radiation to take place the orbital frequency of the periodic motion of the binary system should be greater than the mass of the scalar particles which can be radiated which implies that for most of the observed binaries particles with mass m _a
10 ^−19 eV can be radiated which includes FDM particles. In this paper we consider
four compact binary systems: PSR J0348+0432, PSR J0737-3039, PSR J1738+0333, and PSR
B1913+16 (Hulse Taylor Binary) and show that the observations of the time period decays put the bound f_a
O(10^11 GeV)on axion decay constant . This implies that Fuzzy Dark Matter cannot
couple to gluons.

Primary author: Mr PODDAR , Tanmay Kumar (Physical Research Laboratory)

Co-author: Prof. MOHANTY, Subhendra (Physical Research Laboratory)

Presenter: Mr PODDAR , Tanmay Kumar (Physical Research Laboratory)

Abstract ID : **3**

Gravitational waves from phase transition in neutron stars

Content

The detection of gravitational wave (GW) GW170817 along with the electromagnetic counterparts has open up the speculation of the existence of quark matter in neutron stars (NS). There are hints that the collapse of two NS to ultimately a black hole happens via an intermediate step of nuclear to quark phase transition (PT) in them. However, the GW signals coming from a single rotating NS (pulsars) are still beyond the scope of modern GW detectors. However, if there is a phase transition in NS, then the GW signals can get quite intense. In this talk, I will present the prospect of such PT from nuclear matter to quark matter in NS and the possibility of GW signals coming from such PT. The nuclear quark PT is assumed to be a shock-induced PT or to say combustion. Such combustion hints at the existence of a maximum mass in the QS. Such burning is accompanied by a strong GW signal with timescale smaller than GW170817.

Primary author: Dr MALLICK, Ritam (INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH BHOPAL)

Presenter: Dr MALLICK, Ritam (INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH BHOPAL)

Abstract ID : **4**

Study on keV scale sterile neutrino dark matter in an inverse seesaw framework with S_4 flavor symmetry

Content

Searching for the cosmological origin, constituents and the interactions of dark matter is one of the foremost open questions in particle physics and cosmology. There are tremendous number of proposed dark matter candidates among which sterile neutrino is a significant one. With this motivation, we have conducted our study in an inverse seesaw ISS(2,3) framework which leads to a sterile neutrino in keV scale. We have performed numerical analysis in detail which includes the calculation of dark matter mass and mixing with the active neutrinos,decay rates of possible interaction as well as the relic abundance. To strengthen our dark matter model, S_4 flavor symmetry has been incorporated to the construction of the mass matrices involved in the model. We constrain the parameter space of our model with the latest astrophysical and cosmological bounds.

Primary author: Ms GAUTAM, Nayana (Tezpur University, Assam)

Co-author: Dr DAS, Mrinal Kumar (Tezpur University)

Presenter: Ms GAUTAM, Nayana (Tezpur University, Assam)

Abstract ID : **5**

DUNE prospect for leptophobic dark matter

Content

Highly energetic proton or electron beam fixed target experiments give a chance to probe sub-GeV dark matter and associated interactions. In this work we have explore the sensitivity of DUNE to sub-GeV leptophobic dark matter. We study the physics of DUNE experiment for a light fermionic dark matter coupled with the standard model via gauge baryonic vector $U(1)_B$ current that kinetically mixes with ordinary photon. When we have to consider a light baryonic vector mediator undergo into dark matter that can enlarge the sensitivity of DUNE to the baryonic fine structure constant (α_B) in beam dump mode.

Primary authors: NAAZ, Sabeeha (University of Lucknow); Dr SINGH, Jyotsna (University of Lucknow); Dr SINGH, R.B. (University of Lucknow)

Presenters: NAAZ, Sabeeha (University of Lucknow); Dr SINGH, Jyotsna (University of Lucknow)

Abstract ID : **6**

Impact of Cross-Sectional Uncertainties on DUNE Sensitivity due to Nuclear Effects

Content

In neutrino oscillation experiments precise measurement of neutrino oscillation parameters is of prime importance as well as a challenge. To improve the statistics, presently running and proposed experiments are using heavy nuclear targets. These targets introduce nuclear effects and the
quantification of these effects on neutrino oscillation parameters will be decisive in the prediction of neutrino oscillation physics. Limited understanding of neutrino-nucleus interactions and inaccurate reconstruction of neutrino energy causes uncertainty in the cross-section. The error in the determination of cross-section which contributes to systematic error introduces error in the neutrino mixing parameters that are determined by these experiments. In this work we focus on the variation in the predictions of DUNE potential, arising due to systematic uncertainties, using two
different event generators-GENIE and GiBUU. These generators have different and independent cross-section models. To check the DUNE potential with the two generators we have checked the sensitivity studies of DUNE for CP violation, mass hierarchy, and octant degeneracy.

Primary authors: Ms NAGU, Srishti (University of Lucknow); Mr SINGH, Jaydip (University of Lucknow); Dr SINGH, Jyotsna (University of Lucknow); Dr SINGH, R.B. (University of Lucknow)

Presenter: Ms NAGU, Srishti (University of Lucknow)

Abstract ID : **7**

Exchange driven freeze out of dark matter

Content

We introduce a novel mechanism where processes that preserve the number density of the dark sector set the relic density of a thermal particulate dark matter. In a relatively degenerate multipartite dark sector if there is a considerable time lapse between the freeze out of various species then process like the exchange between dark sector constituents can play the pivotal role of driving freeze out and setting dark matter relic density. As a proof of principle, we present simple scalar models with viable dark matter in the GeV scale to demonstrate this phenomenon.

Primary author: MAITY, Tarak Nath (IIT Kharagpur)

Co-author: RAY, Tirtha Sankar (University of Melourne)

Presenter: MAITY, Tarak Nath (IIT Kharagpur)

Abstract ID : **8**

Inertial Frame Dragging Effect in Modified Gravity

Content

In this work, we derive the exact Lense-Thirring~(LT) frequency
for Kerr-MOG black hole~(BH) in scalar-tensor-vector gravity or
modified gravity~(MOG). A detailed study of LT frequency has been done for Kerr-MOG BH in comparison to Kerr BH. The LT frequencies that has been derived could be expressed in terms of BH mass parameter, the angular momentum parameter and the MOG parameter. We compute the LT frequency numerically
as well as visually for various values of θ. We show that the presence of the MOG parameter diminishes the value of LT frequency in comparison to Kerr BH. It could be directly observed from the LT frequency diagram. Extremal cases for this BH have been discussed.

Primary author: Dr PRADHAN, PARTHA PRATIM (HIRALAL MAZUMDAR MEMORIAL COLLEGE FOR WOMEN)

Presenter: Dr PRADHAN, PARTHA PRATIM (HIRALAL MAZUMDAR MEMORIAL COLLEGE FOR WOMEN)

Abstract ID : **9**

The NEWS-G light Dark Matter search experiment: Current status and experiment at SNOLAB

Content

The NEWS-G direct dark matter search experiment employs spherical proportional counters (SPCs) with light noble gases as target media to search for low-mass Dark Matter (DM). The next generation of the experiment is a 140 cm diameter SPC with a new sensor design and improved shielding. This detector is expected to achieve sensitivity to single ionizations, and will profit from sensitivity to nuclear recoils on hydrogen to increase sensitivity to DM particle masses less than 1 GeV/c2. We report on recent results from detector commissioning at the Laboratoire Souterrain de Modane in France, and on progress in installing the detector at the SNOLAB facility in Sudbury, Canada. A novel UV laser calibration technique for the characterization of the SPCs single-electron response is also presented. With a relatively short period of data collection, this detector is expected to set constraints on spin-independent DM scattering down to a DM particle mass of 100 MeV/c2.

Primary author: Mr DURNFORD, Daniel (University of Alberta)

Presenter: Mr DURNFORD, Daniel (University of Alberta)

Abstract ID : **10**

Role of crustal physics in the tidal deformation of a neutron star

Content

In the late inspiral phase, gravitational waves from binary neutron star mergers carry the imprint of the equation of state due to the tidally deformed structure of the components. If the stars contain solid crusts, then their shear modulus can affect the deformability of the star and, thereby, modify the emitted signal. Here, we investigate the effect of realistic equations of state (EOSs) of the crustal matter, with a realistic model for the shear modulus of the stellar crust in a fully general relativistic framework. This allows us to systematically study the deviations that are expected from fluid models. In particular, we use unified EOSs, both relativistic and non-relativistic, in our calculations. We find that realistic EOSs of crusts cause a small correction, of ~1%, in the second Love number. This correction will likely be subdominant to the statistical error expected in LIGO-Virgo observations at their respective advanced design sensitivities, but rival that error in third generation detectors. For completeness, we also study the effect of crustal shear on the magnetic-type Love number and find it to be much smaller.

Primary authors: BISWAS, Bhaskar (IUCAA Pune); NANDI, Rana; CHAR, Prasanta (Inter-University Centre for Astronomy and Astrophysics); Mr BOSE, Sukanta (IUCAA Pune)

Presenter: BISWAS, Bhaskar (IUCAA Pune)

Comments:

This work has been published in Phys. Rev. D on 29th August 2019. DOI:https://doi.org/10.1103/PhysRevD.100.044056

Abstract ID : **11**

The tidal deformability of an anisotropic compact star: Implications of GW170817

Content

We use gravitational wave (GW) and electromagnetic (EM) observations of GW170817 to constrain the extent of pressure anisotropy in it. While it is quite likely that the pressure inside a neutron star is mostly isotropic, certain physical processes or characteristics, such as phase transitions in nuclear matter or the presence of strong magnetic fields, can introduce pressure anisotropy. In this work, we show that anisotropic pressure in neutron stars can reduce their tidal deformability substantially. For the anisotropy-pressure model of Bowers and Liang and a couple of relativistic EOSs – DDHδ and GM1 – we demonstrate that this reduction in spherical neutron stars with masses in the range of 1 to 2 M⊠ can be 23% to 46%. This suggests that certain EOSs that are ruled out by GW170817 observations, under assumptions of pressure isotropy, can become viable if the stars had a significant enough anisotropic pressure component, but do not violate causality. We also show how the inference of the star radius can be used to rule out certain EOSs (such as GM1), even for high anisotropic pressure, because their radii are larger than what the observations find.

Primary authors: BISWAS, Bhaskar (IUCAA Pune); Mr BOSE, Sukanta (IUCAA Pune)

Presenter: BISWAS, Bhaskar (IUCAA Pune)

Comments:

This work has been published in Phys. Rev. D. on 3rd May 2019. DOI:https://doi.org/10.1103/PhysRevD.99.104002

Abstract ID : **12**

Resolution of discrepancy in SFR at Cosmic Noon using Diffuse Supernova Neutrino Background

Content

Multiple astrophysical probes of the star formation rate (SFR) yield widely different inferences of this rate at redshifts greater than 1. While all probes seem to indicate a period of peak star formation known as cosmic noon, the detailed inferences from these probes are in disagreement. The peak indicated by the UV/IR data is significantly lower than the peak indicated by Hα data. The knowledge of the mass range of stars ending with core-collapse supernovae (CC SNe) enables us to estimate SFR using the measurement of CC SNe rate. In this work, the potential of measurement of the diffuse supernova neutrino background (DSNB) at HyperKamiokande to measure CC SNe rate and consequently resolve the discrepancy in the magnitude of the SFR peak, is explored.

The simulation results of the detected neutrino flux at Hyper Kamiokande show that above 10 MeV, it will be able to detect around 450 neutrinos in 20 years, if actual SFR is as indicated by UV+IR, else a higher value of 750 neutrinos. The cutoff of 10 MeV is chosen because, at lower energy ranges, neutrinos due to the DSNB cannot be differentiated from reactor neutrinos. χ^2 test using the simulated detected rate indicates that the hypotheses can be excluded in the absence of background noises. The profile likelihood method is used to include the background in the χ^2 test. The results imply that with the current knowledge of background noises, the hypotheses can not be excluded. However, with improved knowledge of background noises and tighter limits on the uncertainty, the results are improved. The result obtained on repeating the χ^2 test with the assumption that uncertainty in the total background is half the current value, indicates that the hypotheses can be excluded at a 99 percent confidence level.

At present, the knowledge of parameters used to characterize neutrino emission from CC SNe is uncertain. The parameters can be better determined with an improved observation of core-collapse supernova events happening in the nearby universe. Changes in the value of these parameters will affect the results of this paper. Nevertheless, one deduction that remains unchanged is that as the detectors become more significant in volume and the noise rejection or determination capability improves, DSNB measurement will be able to put stringent limits on the parameters involved in the defining equation of global SFR. The improved determination of the SFR equation, in turn, will improve our understanding of cosmic noon.

Primary authors: SINGH, Riya (Indian Institute of Technology Bombay); RENTALA, Vikram (Indian Institute of Technology Bombay)

Presenter: SINGH, Riya (Indian Institute of Technology Bombay)

Abstract ID : **13**

Neutrino Oscillations in Dark Matter

Content

We discuss neutrino oscillations in a medium of dark matter which generalizes the standard matter effect. A general formula is derived to describe the effect of various mediums and their mediators to neutrinos. Neutrinos and anti-neutrinos receive opposite contributions from asymmetric distribution of (dark) matter and anti-matter, and thus it could appear in precision measurement of neutrino or anti-neutrino oscillations. Furthermore, the standard neutrino oscillation can occur from the symmetric dark matter effect even for massless neutrinos.

Primary author: CHUN, Eung Jin (Korea Institute for Advanced Study)

Presenter: CHUN, Eung Jin (Korea Institute for Advanced Study)

Abstract ID : **14**

Binary neutron stars: Einstein's richest laboratory

Content

I will argue that if black holes represent one the most fascinating implications of Einstein's theory of gravity, neutron stars in binary system are arguably its richest laboratory, where gravity blends with astrophysics and particle physics. I will discuss the rapid recent progress made in modelling these systems and show how the inspiral and merger of a binary system of neutron stars is more than a strong source of gravitational waves. Indeed, while the gravitational signal can provide tight constraints on the equation of state for matter at nuclear densities, the formation of a black-hole–torus system can explain much of the phenomenology of short gamma-ray bursts, while the the ejection of matter during the merger can shed light on the chemical enrichment of the universe.

Primary author: REZZOLLA, Luciano (Institute for Theoretical Physics)

Presenter: REZZOLLA, Luciano (Institute for Theoretical Physics)

Abstract ID : **15**

Properties of Binary Components and Remnant in GW170817 using Equations of State in Finite Temperature Field Theory Models

Content

The gross properties of the binary components in neutron star mergers are studied using cold temperature equations of state (EoSs). The tidal properties of the merger components are calculated and the validity of the several EoSs is explored with the given bounds on tidal deformation from the merger event, GW170817. An estimate of the radii of the components with masses within the range 1.1 - 1.6 Solar Masses is also made using an analytical approach. While using zero temperature EoSs for studying the components is rational, finite temperature EoSs must be used for the remnant object in a binary neutron star merger event. Therefore, the thermal effects on the maximum mass, Kepler frequency and moment of inertia of the remnant are investigated using insentropic EoSs.

Primary author: Ms SOMA, Shriya (Frankfurt Institute for Advanced Studies)

Co-author: Prof. BANDYOPADHYAY, Debades (Saha Institute of Nuclear Physics)

Presenter: Ms SOMA, Shriya (Frankfurt Institute for Advanced Studies)

Abstract ID : **17**

H.E.S.S. observation of the Large Magellanic Cloud

Content

The Large Magellanic Cloud (LMC) is a complex satellite galaxy of the Milky Way at a distance of 50 kpc. Despite its large distance, it harbours several interesting targets for gamma-ray observations. H.E.S.S. observations have already lead to the TeV detection 4 exciting pint sources: N 157B - the pulsar wind nebula of the most energetic pulsar yet discovered, N 132D - a radio loud supernova remnant, 30 Dor C superbubble - the largest non-thermal Xray shell and LMC P3 - the first extra-galactic γ-ray binary. With several regions of high mass star formation, extended TeV emission is also expected from the LMC and large scale diffuse emissions at GeV energies have been reported by the Fermi-LAT collaboration.

H.E.S.S. has over 210 hours of exposure time targeted on the LMC, and further observations are ongoing in the search for more point-like and/or extended sources. In this talk, updated results on the known gamma-ray sources as well as upper limits on the non-detected objects will be presented. We will also discuss the efforts and techniques implemented in a search for diffuse emission.

Primary author: Dr SINHA, Atreyee (LUPM, CNRS)

Presenter: Dr SINHA, Atreyee (LUPM, CNRS)

Abstract ID : **18**

Primordial Black Holes and Gravitational Waves at a non-standard pre-BBN epoch

Content

Primordial scalar fluctuations may undergo gravitational collapse in early universe to form primordial black holes (PBH). Abundance of PBH is heavily constrained for the largest observable scales of inflation from the bound on the amplitude of scalar perturbations from CMB surveys. A considerable abundance of PBH to be a potential candidate for cold dark matter is satisfied only when the primordial amplitude of scalar perturbations is quite large ($\sim 10^{-2}$) if PBH formation takes place during radiation epoch (RD). In alternate cosmological histories where additional epochs of arbitrary scalar field domination precede RD, the dynamics of PBH formation and relevant mass ranges can be different leading to lower requirement of primordial power at smaller scales of inflation. Moreover, this alternate history can modify the predictions the gravitational wave (GW) spectrum, specially in the second order of perturbation theory, which can be at the sensitivity range of future GW observations.

Primary author: Dr BHATTACHARYA, Sukannya (Physical Research Laboratory)

Presenter: Dr BHATTACHARYA, Sukannya (Physical Research Laboratory)

Abstract ID : **19**

Production of Dark Matter during Preheating

Content

Standard mechanisms for production of Dark Matter (DM) like Freeze-out requires coupling between DM and Standard Model (SM) particles. However no hint of such interactions in the Direct or Indirect searches makes it interesting to explore production mechanisms requiring no interaction between SM and DM. We find that production of DM from preheating is in general far more than required. We then show that presence of a quartic self interaction term of DM during preheating can suppress the production of DM initially, then an non-relativistic phase of inflaton before it decays to SM and a Cannibalisation mechanism can help to deplete the DM abundance to the right relic abundance.

Primary authors: BERNAL, Nicolás; CHATTERJEE, Arindam; PAUL, Arnab (Indian Statistical Institute, Kolkata)

Presenter: PAUL, Arnab (Indian Statistical Institute, Kolkata)

Abstract ID : **20**

Possibility of neutral Z' portal Dark Matter in the U(1) extended Standard Model

Content

A general $U(1)'$ extension of the Standard Model automatically fits three generations of the right handed neutrinos (RHN) to cancel all the gauge and mixed gauge-gravitational anomalies. Due to the presence of the general $U(1)'$ charges after the anomaly cancellation, the Z'. The $U(1)'$ gauge breaking generates Majorana masses for the right-handed neutrinos. We introduce a Z_2 symmetry to the model and assign an odd parity only for one RHN and hence the odd RHN is stable and can be considered as a potential dark matter (DM) candidate. The neutrino mass generation mechanism works with the other two RHNs which successfully reproduce the neutrino oscillation data. In this case the DM candidate talks to SM candidates through the neutral BSM gauge boson (Z') and as well as with the Higgs boson. We compare our results with the existing bounds from the LHC on the $U(1)'$ coupling. We also briefly show a scenario where such a study could be possible without the inclusion of a Z_2 symmetry.

Primary author: Dr DAS, Arindam (Osaka University)

Presenter: Dr DAS, Arindam (Osaka University)

Comments:

1905.00201 and works in progress.

Abstract ID : **21**

Impact of accretion disk on the gravitational wave-profile emitted from binary merger.

Content

Supermassive black holes in our galactic centers are likely to contain large massive accretion disk. This disk may exert a non-negligible hydrodynamic drag on the compact objects rotating around the central black hole. Hence, the gravitational wave signal emitted from an extreme and intermediate-mass ratio inspirals may be modified due to the modified motion of orbiting companion by the influence of hydrodynamic drag of the disk. In the present work, we investigate this issue using full general relativistic formalism. We wish to estimate precisely the change of the amplitude and frequency of the gravity wave signal due to the effect of the accretion disk and find out the possible error introduced in the estimation of the mass of the central black hole.

Primary authors: Ms CHATTERJEE, Sangita (Jadavpur University); Dr MONDAL, Soumen (Jadavpur University); Dr BASU, Prasad (Cotton University)

Presenter: Ms CHATTERJEE, Sangita (Jadavpur University)

Abstract ID : **22**

A generalized study of accretion processes with relativistic equation of state.

Content

Abstract: We study the hydrodynamics of the accretion process with a temperature dependent adiabatic index. The temperature dependence comes due to a relativistic equation of state which is derived using a relativistic velocity distribution function. The adiabatic index varies smoothly from its non relativistic value (Cp/Cv= gamma = 5/3), to its relativistic value (gamma = 4/3) for a very hot ultra-relativistic gas. This smooth variation of 'gamma' from 5/3 to 4/3 (outer to inner) needs to be taken into account while solving the hydrodynamic equations. In our recent study, we find that except for the region very nearby the compact object, 'gamma' does not change significantly from its non-relativistic value (which was opposite to the previous study) and therefore, the EOS mostly remains non-relativistic in nature. Employing this relativistic equation of state(EOS) (Synge 1957) in which the adiabatic index varies (4/3 to 5/3) from the non relativistic to relativistic regime with temperature we notice that number of the saddle type sonic point reduces to one indicating various interesting results which break many conventional ideas that people usually have in the study of accretion flows.

Primary authors: Dr MONDAL, Soumen (Jadavpur University); Dr BASU, Prasad (Cotton University)

Presenter: Dr MONDAL, Soumen (Jadavpur University)

Abstract ID : **23**

MeV scale model of SIMP dark matter, neutrino mass and leptogenesis

Content

Weakly interacting massive particle (WIMP) is very popular dark matter candidate but non observation in direct detection makes us to think towards other approaches that lead to correct relic density. In WIMP scenario there are 2-> 2 annihilation processes considered for relic contributions. One interesting idea becomes popular recently is Strongly interacting massive particle (SIMP) in which annihilation considered through 3-> 2 or 4-> 2 channels so in this case even strong coupling (effective) ~ 1 can produce relic density observed. Another problem need to be addressed is to explain the observed baryon asymmetry in the universe. One way is to generate it via leptogenesis.
We consider a simple extension of the Standard Model with two singlet scalar fields and three heavy right-handed neutrinos. One of the scalar fields serves as an MeV scale dark matter and its stability is ensured by the introduction of an extra Z 2 symmetry. The second scalar (which is even under the Z 2 symmetry) generates the mass term of the scalar, contributes to the 3 ⟶ 2 annihilation process required for the correct relic density of the dark matter and it also contributes to the leptogenesis. The right-handed neutrinos are responsible for the generation of light neutrino masses through Type-I seesaw mechanism. The decay of the heavy right-handed neutrino can generate the lepton asymmetry which can then be converted to baryon asymmetry through sphaleron transitions.

Based on: arXiv:1908.00909

Primary authors: Dr SRIVASTAVA, TRIPURARI (PRL, Ahmedabad); Prof. MOHANTY, Subhendra (Physical Research Laboratory); Dr PATRA, Ayon (PRL, Ahmedabad)

Presenter: Dr SRIVASTAVA, TRIPURARI (PRL, Ahmedabad)

Abstract ID : **24**

Broadband Spectral Energy Distributions of 3C 273

Content

The flat spectrum radio quasars (FSRQ) are blazars exhibiting prominent emission lines in their optical spectra. This suggests the presence of broad emission line regions in these sources. The broadband spectral energy distribution (SED) of one of the brightest gamma-ray sources in the Fermi-LAT energy band, 3C 273 (z=0.158), will be discussed using simultaneous data from Swift and Fermi satellites. Two high flux states and one quiescent state of the source are modeled using one zone leptonic and hadronic emission models. The preliminary modeling of broadband SEDs of few epochs of 3C 273 will be presented.

Primary author: Ms PATEL, Sonal R. (IIT Kharagpur, University of Mumbai)

Co-authors: BOSE, Debanjan (Sungkyunkwan University); Prof. GUPTA, Nayantara (Raman Research Institute)

Presenter: Ms PATEL, Sonal R. (IIT Kharagpur, University of Mumbai)

Abstract ID : **25**

Disk-Jet connection in blazars: a semi-analytic framework

Content

X-ray variability from disk/corona-dominated systems, such as black hole X-ray binaries (BHXRBs) and Seyfert galaxies are known to show broken power-law power spectral densities (PSD), with the break timescale correlated with black hole mass. Hence the PSD break is expected to be linked to the properties of the accretion flow. Recent high temporal resolution X-ray observations of high synchrotron peaked (HSP) blazar, Mrk 421, has confirmed, for the first time, a broken power-law PSD for a purely jet dominated system. Disk-jet connection has previously been explored by, for example, correlating the time of sharp decline in disk/corona luminosity and subsequent ejection of new radio blobs down the jet. However, the recent observation of similar break timescale in Mrk 421 light curve may imply a more direct link between the variability of the disk and that of blazar jets. We construct a semi-analytic model for the time variability of blazar non-thermal emission to investigate the possible relation between the characteristic timescales in the disk and jet. We find both the PSD of the jet and the disk variability may have broken power-law shapes but the break timescales are not necessarily correlated. The break in the jet seems to be primarily related to the interval between large amplitude flares while the break timescale for disk PSD may reflect the viscous timescale in the disk. We are now extending our model to a broader parameter space for a physically motivated and more realistic reconstruction of blazar lightcurves, which we shall use to thoroughly explore different possibilities for disk-jet connection and comparison with observed multi-wavelength data.

Primary authors: Mr MUKHERJEE, Sagnick (Presidency University); MITRA, Kaustav (Yale University); Prof. CHATTERJEE, Ritaban (Presidency University)

Co-authors: Mr MAJUMDER, Anwesh (Anton Pannekoek Institute of Astronomy); Mr ROY CHOWDHURY, Agniva (University of Maryland, Baltimore County)

Presenter: MITRA, Kaustav (Yale University)

Abstract ID : **27**

Fusion interaction of light hypernuclei and its astrophysical importance

Content

A hypernucleus is a bound nucleus consisting at least one strange hyperon like Λ, Σ, Ξ, Ω etc. in addition to protons and neutrons. These nuclei constitute a fantastic laboratory for studying significant events in particle physics as well as nuclear-astrophysics since they constitute dense nuclear matter in compact stars having masses in the range 2-3 MΘ.Nuclear fusion reactions in the low energy regime (from few eV to several KeV) are not only relevant in stellar energy production or primordial nucleosynthesis, it may also provide new insights for strange star.In the low energy regime Nuclear fusion reactions can be explained successfully by the phenomenon of quantum mechanical tunneling through an effective well-barrier combination with dominance of Coulomb interaction in the barrier component. We will investigate the possibility of formation of different hypernuclei through absorption of different hyperon by 3He and also by other target in the nuclear plasma environment in dense nuclear media, in terms of absorption cross-section (σ). To achieve the goal we introduced a phenomenological complex potential in our calculation.In this contribution, we will investigate fusion reaction cross-section and barrier width for the different hypernuclei systems and discuss possible origins for the different behavior of fusion excitation functions for these systems.Results and plot for different fusion reactions will be presented at conference.

Primary authors: Mr MAHAMADUN HASAN, Mahamadun (ALIAH UNIVERSITY); Dr MD.ABDUL KHAN, Abdul (ALIAH UNIVERSITY); Mr MURSHID ALAM, Murshid (ALIAH UNIVERSITY); Mr SHAMIM HAQUE MONDAL, Shamim (ALIAH UNIVERSITY)

Presenter: Mr SHAMIM HAQUE MONDAL, Shamim (ALIAH UNIVERSITY)

Abstract ID : **28**

Synchrotron radiation from dark matter annihilation in few newly discovered dwarf spheroidal galaxies

Content

Dwarf spheroidal galaxies are dark matter (DM) dominated in nature. Hence they are good targets for indirect detection of DM. Due to high density of DM in the dwarf galaxies the possibility of annihiation of DM particle is possible in these galaxies. The electromagnetic signals originating from DM annihilations, can span the whole electromagnetic wavelength spectrum. The Electrons originating from the annihilation processes will be able to give synchrotron radiation in the presence of the magnetic field of the dSphs. In our study we focus on the synchrotron signal from few newly discovered dwarf galaxies (Horologium I, Tucana II, Draco II, Reticulum II etc.). Taking the diffusion of electrons in these galaxies into account, we study the synchrotron signals from these galaxies. We also study the sensitivity of the Square-Kilometer-Array (SKA) telescope towards the signals from these galaxies.

Primary author: Dr DAS, Kasinath (IACS, Kolkata)

Co-authors: Ms BHATTACHARJEE, Pooja (Bose Institute, Kolkata); Prof. CHOUDHURY, Debajyoti (University of Delhi); Prof. GHOSH, Dilip Kumar (IACS, Kolkata); Prof. MAJUMDAR, Pratik (SINP, Kolkata)

Presenter: Dr DAS, Kasinath (IACS, Kolkata)

Abstract ID : **29**

Analysis of Fermi-LAT data from Tucana-II: possible constraints on the Dark Matter models with an intriguing hint of a signal

Content

Tucana-II (Tuc-II), a recently discovered Ultra Faint Dwarf Spheroidal galaxy, has a high mass to light ratio as well as a large line-of-sight stellar velocity dispersion, thus making it an ideal candidate for an indirect dark matter (DM) search. We have analyzed nine years of γ-ray data obtained from the Fermi-LAT instrument from the direction of Tuc-II. A very weak significant γ-ray excess (2.2σ) over the background of Tuc-II has been detected from the location of this galaxy. We have observed that this excess of γ-ray emission from the of location Tuc-II rises with longer periods of data. For $b\bar{b}$ annihilation channel the test statistics (TS) value peaks at DM mass $\sim$ 14 GeV and for $\tau^+\tau^-$ annihilation channel it peaks at DM mass 4 GeV. We then estimated 95% confidence level upper limit of the possible velocity weighted self-annihilation cross-section of WIMPs within Tuc-II by fitting the observed γ-ray flux with spectra expected for DM annihilation. We have also compared our results with the cross-sections obtained in various popular theoretical models of the WIMPs to find that our results impose reasonable tight constraints on the parameter spaces of those DM models.

Primary authors: Mrs BHATTACHARJEE, Pooja (Bose Institute); Mr MAJUMDAR, Pratik (Saha Institute of Nuclear Physics); Mr BISWAS, Sayan (Raman Research Institute); Mr JOARDER, Partha sarathi (Bose Institute)

Presenter: Mrs BHATTACHARJEE, Pooja (Bose Institute)

Abstract ID : **30**

Implications of JLA data for k–essence model of dark energy with given equation of state

Content

We investigated implications of recently released 'Joint Light-curve Analysis' (JLA) supernova Ia (SNe Ia) data for dark energy models with time varying equation of state of dark energy, usually expressed as w(z) in terms of variation with corresponding redshift z. From a comprehensive analysis of the JLA data, we obtain the observational constraints on the different functional forms of w(z), corresponding to different varying dark energy models often considered in literature, \textit{viz.} CPL, JBP, BA and Logarithmic models. The constraints are expressed in terms of parameters (wa,wb) appearing in the chosen functional form for w(z), corresponding to each of the above mentioned models. Realising dark energy with varying equation of state in terms of a homogeneous scalar field ϕ, with its dynamics driven by a k–essence Lagrangian L=VF(X) with a constant potential V and a dynamical term F(X) with $X=(1/2)\nabla\mu\phi\nabla\mu\phi$ we reconstructed form of the function F(X). This reconstruction has been performed for different varying dark energy models at best-fit values of parameters (wa,wb) obtained from analysis of JLA data. In the context of k–essence model, we also investigate the variation of adiabatic sound speed squared, c2s(z), and obtained the domains in (wa,wb) parameter space corresponding to the physical bound c2s>0 implying stability of density perturbations.

Primary author: Mr CHATTERJEE, Anirban (Ramakrishna Mission Vivekananda Educational and Research Institute)

Co-author: Prof. BANDYOPADHYAY, Abhijit (Ramakrishna Mission Vivekananda Educational and ResearchInstitute)

Presenter: Mr CHATTERJEE, Anirban (Ramakrishna Mission Vivekananda Educational and Research Institute)

Comments:

Accepted for publication in European Physical Journal Plus

Abstract ID : **35**

Constraining the equation of state of neutron stars using GW170817

Content

The first detection of gravitational waves from binary neutron star merger event GW170817 is providing important new constraints on the nuclear equation of state at high density. The tidal deformability bound of GW170817 combined with the observed 2-solar mass neutron star poses serious challenge to theoretical formulations of realistic equation of state (EOS). In this talk I shall discuss our recent study where we analyzed a fully comprehensive set of relativistic nuclear mean-field theories by confronting with the observational bounds and the measured neutron-skin thickness. We found that only 3 models out of 269 can withstand these bounds. However, if hadron to quark phase transition is allowed inside neutron star core, several EOSs were found to be consistent with all the measured bounds. We also obtained an upper limit on the radius of a 1.4-solar mass neutron star to be R < 12.9 km.

Primary author: Dr NANDI, Rana (Tata Institute of Fundamental Research)

Presenter: Dr NANDI, Rana (Tata Institute of Fundamental Research)

Abstract ID : **36**

The Future of Gravitational Wave Detection

Content

Over the coming decade, the world-wide network of GW detectors will explore the nearby universe and yield a treasure trove of information about the physics of neutron stars and black holes. In order to go beyond our current understanding of general relativity and high density nuclear physics, we will need to commission the new LIGO-India detector in eastern Maharashtra, and invent new measurement techniques to go beyond the usual limits of thermodynamic fluctuations and Poisson statistics in the photon counting.

Primary author: Prof. ADHIKARI, Rana (Caltech, USA)

Presenter: Prof. ADHIKARI, Rana (Caltech, USA)

Abstract ID : **38**

Hadronic phase in heavy ion collisions via Saha equation

Content

Saha ionization equation constrains thermodynamic properties of hot gas where dissociation and recombination reactions are in equilibrium. That is assumed to be the case in expanding hadronic fireball created in heavy ion collisions. There, during the last stages of expansion when total chemical equilibrium is lost, loosely bound unstable particle species tend to dissolve and recombine in the hot hadronic medium. Assuming balance between those two effects one arrives to formalism similar to Saha equation. It was shown [1] that light (anti-)(hyper-)nuclei in heavy ion collisions at LHC are well described by the Saha equation. This brings up the analogy between nucleosynthesis in the early universe after the Big Bang and in "Little Bangs" created in heavy ion collisions. In the same way the resonance production can be treated in the framework of thermal model with an evolution between chemical and kinetic freeze-outs [2], where the decays and recombinations of resonances balance each other. During this phase the yields of many short-lived resonances are suppressed at $T = T_{\rm kin} < T_{\rm ch}$. A fit of $T_{\rm kin}$ allows to describe the abundances of both, the stable hadrons and the short-lived resonances, like ρ^0 and K^{*0}, as measured by the ALICE collaboration at LHC. This allows to extract $T_{\rm kin}$ from the measured hadron and resonance yields alone.

Primary author: Dr MOTORNENKO, Anton (Frankfurt Institute for Advanced Studies)

Presenter: Dr MOTORNENKO, Anton (Frankfurt Institute for Advanced Studies)

Abstract ID : **39**

Cosmic nucleosynthesis in supernovae and kilonovae

Content

Supernova explosions represent the primary pathway to forming the majority of heavy elements in the universe. In the canonical framework of supernova nucleosynthesis, Type Ia supernovae are responsible for enriching the interstellar medium with Fe group elements, while core-collapse supernovae lead to the production of large amounts of intermediate mass elements (such as oxygen and calcium). Yet, substantial progress has been made in recent years on understanding the origin of peculiar transients and their role in the chemical enrichment of the universe. Ongoing transient surveys are now systematically discovering and characterizing faint and fast evolving transients that were missed in previous transient surveys due to a combination of survey cadence and strategy. Examples include Calcium rich transients that appear to play a substantial role in enriching the intergalactic medium with Ca. Similarly, the discovery and characterization of the first kilonova associated with GW170817 has shed important light into the origin of the heaviest r-process elements in the universe. In this talk, I will summarize recent progress in our understanding of these phenomena and how large scale systematic supernova discovery and classification is enabling us to pin down the progenitors and rates of these events, and their role in the chemical enrichment of the universe.

Primary author: Mr DE, Kishalay (Caltech)

Presenter: Mr DE, Kishalay (Caltech)

Abstract ID : **40**

Plasma flow around compact objects

Content

Matter around compact objects like black holes and around neutron star is affected by very strong gravity. In fact even at a distance 105 Schwarzschild radii away from the central object the temperature can be estimated to be greater than few X10 5 K. Therefore, by following Saha ionization equation one can consider most of the matter to be fully ionized plasma. In this talk we discuss how such hot plasma behaves around compact objects by discussing some basic theoretical issues as well as checking the conjectures through numerical simulation.

Primary author: Prof. CHATTOPADHYAY, Indranil (ARIES)

Presenter: Prof. CHATTOPADHYAY, Indranil (ARIES)

Abstract ID : **41**

Cosmology meets Condensed Matter Physics

Content

In this work, our prime focus is to study the one to one correspondence between the conduction phenomena in electrical wires with impurity and the scattering events responsible for particle production during stochastic inflation and reheating implemented under a closed quantum mechanical system in early universe cosmology. In this connection, we also present a derivation of quantum corrected version of the Fokker–Planck equation without dissipation and its fourth-order corrected analytical solution for the probability distribution profile responsible for studying the dynamical features of the particle creation events in the stochastic inflation and reheating stage of the universe. It is explicitly shown from our computation that quantum corrected Fokker–Planck equation describes the particle creation phenomena better for Dirac delta type of scatterer. In this connection, we additionally discuss Itô, Stratonovich prescription and the explicit role of finite temperature effective potential for solving the probability distribution profile. Furthermore, we extend our discussion of particle production phenomena to describe the quantum description of randomness involved in the dynamics. We also present computation to derive the expression for the measure of the stochastic nonlinearity (randomness or chaos) arising in the stochastic inflation and reheating epoch of the universe, often described by Lyapunov Exponent. Apart from that, we quantify the quantum chaos arising in a closed system by a more strong measure, commonly known as Spectral Form Factor using the principles of random matrix theory (RMT). Finally, we discuss the role of out of time order correlation function (OTOC) to describe quantum chaos in early universe cosmology.

Primary author: Dr CHOUDHURY, Sayantan (MPI for Gravitational Physics, Potsdam)

Presenter: Dr CHOUDHURY, Sayantan (MPI for Gravitational Physics, Potsdam)

Abstract ID : **42**

Status of Hyper Kamiokande Experiment

Content

Hyper-Kamiokande is a multi-purpose next generation neutrino experiment. Hyper-K will be located deep underground, 650 m below Mt. Nijuugo-yama. The detector is a two-layered cylindrical shape ultra-pure water tank, with its height of 60 m and diameter of 74 m. The inner detector will be surrounded by 40,000 photosensors to detect water Cherenkov radiation due to the charged particles. It will serve as a far detector of a long baseline neutrino experiment for the J-PARC neutrino beam, with the main focus the determination of CP violation, and will also be a detector capable of observing - far beyond the sensitivity of the Super-Kamiokande detector - proton decay, atmospheric neutrinos, and neutrinos from astronomical sources. In this presentation I will present a highlight of HyperK science goals. Also discuss in briefly about WCTE (Water Cherenkov Test Experiment) scheduled to be held at CERN soon.

Primary author: Dr BOSE, Debanjan (IIT Kharagpur)

Presenter: Dr BOSE, Debanjan (IIT Kharagpur)

Abstract ID : **43**

Transient black hole X-ray binaries

Content

Most black hole X-ray binaries are transient sources, and hence require a special planning to observe them in the desired spectral and timing states. I will discuss how the AstroSat continuum and line X-ray spectra of two such sources, 4U 1630-47 and MAXI J1535-571, were used to constrain black hole mass and spin, and other system parameters. We will discuss, while this was possible because of prompt AstroSat ToO observations, future instruments, which will be able to observe such sources repetitively, flexibly and with a quicker response, particularly in coordination with other observatories, will yield better results.

Primary author: Prof. BHATTACHARYYA, Sudip (Tata Institute of Fundamental Research, Mumbai)

Presenter: Prof. BHATTACHARYYA, Sudip (Tata Institute of Fundamental Research, Mumbai)

Abstract ID : **44**

Effective Quantum Theory of Black Hole Horizons

Content

We shall develop an effective quantum theory of black hole horizons using only the local horizon geometry. On the covariant phase space of the Holst action admitting Weak Isolated Horizon as an inner boundary, we construct Hamiltonian charges corresponding to Lorentz symmetries. We show that horizon area is the Hamiltonian charge corresponding to Lorentz boosts as well as that of Lorentz rotation which acts on 2-sphere cross-sections of the horizon. Using this expression of area as a generator of Lorentz rotation, and the fact that quantum states residing on the horizon cross-sections carry a representation of $ISO(2)$, we derive the spectrum of area operator on the horizon. The eigenstates of this area operator are shown to be labeled by integers or half integers. The entropy is obtained completely in terms of these \emph{area quanta} residing on the horizon. The formalism is also extended to non-minimally coupled scalar fields, where the area operator gets modified due to the value of the scalar field on the horizon.

Primary author: Prof. CHATTERJEE, Ayan (Central University of Himachal Pradesh)

Presenter: Prof. CHATTERJEE, Ayan (Central University of Himachal Pradesh)

Abstract ID : **45**

Cosmology with standard sirens

Content

TBD

Primary author: Dr GHOSH, Archisman (Leiden University, Netherlands)

Presenter: Dr GHOSH, Archisman (Leiden University, Netherlands)

Abstract ID : **46**

A multi-wavelength study of Markarian 421 during the 2015-16 campaign

Content

Blazar Markarian 421 (Mrk421) is one of the brightest extragalactic very high energy (VHE, E>100GeV) gamma-ray sources regularly monitored with multi-wavelength (MWL) instruments. We present ~60 hours of observation of Mrk421 during 2015 and 2016 conducted with the Major Atmospheric Gamma Imaging Cherenkov (MAGIC) Telescopes along with the observations from the other MWL instruments. During 2016, Mrk421 showed a historical low activity in X-rays and VHE gamma-rays. We aim to characterize the MWL variability in this intermediate- and low-flux states observed during the 2015-16 campaign in light of previously published MWL data. We present a detailed variability study in MWL and multi-year context using hardness-ratio analysis and fractional variability (F-var) along with the correlation study through the flux-flux correlation and discrete correlation function (DCF). An estimate of the typical state of Mrk421 in radio-VHE gamma-rays will be presented using the multi-year data.

Primary author: BANERJEE, Biswajit (Saha Institute of Nuclear Physics)

Co-authors: Prof. PANEQUE, David (Max Planck Institute for Physics, Munich); Dr TERZIĆ, Tomislav (University of Rijeka); Prof. MAJUMDAR, Pratik (SINP, Kolkata)

Presenter: BANERJEE, Biswajit (Saha Institute of Nuclear Physics)

Abstract ID : **47**

A new probe to Leptogenesis

Content

We present a study of leptogenesis in non-standard cosmology considering a fast expanding Universe due to an additional scalar field. The Hubble expansion rate is modified by the newly added scalar field, which can change the abundance of lepton asymmetry resulted in the leptogenesis mechanism. We report a significant deviation from the standard unflavored leptogenesis scenario can be achieved in presence of the scalar field φ that dominates the energy budget of the early Universe.

Primary author: Dr DUTTA BANIK, AMIT (CCNU, INST. PART. PHYS.)

Presenter: Dr DUTTA BANIK, AMIT (CCNU, INST. PART. PHYS.)

Abstract ID : **49**

An analysis of heavy dark matter decaying into IceCube PeV neutrinos

Content

We consider a superheavy dark matter (SHDM) decaying into ultrahigh energy (UHE) neutrinos that may account for upgoing muon neutrino events ($\sim$ PeV energy region) detected by IceCube. From our analysis of the best fit values of the two parameters namely the mass of the superheavy dark matter and its decay lifetime are obtained. The theoretical astrophysical flux is also included in the analysis. We find that while the neutrino events in the energy range $\sim$ 60 TeV- $\sim$ 120 TeV appears to have astrophysical origin, the events in the energy range $\sim$ 1.2×10^5 GeV - $\sim$ 5×10^7 GeV can be well described from the superheavy dark matter decay hypothesis. The theoretical fluxes are computed by adopting the procedure, where the DGLAP numerical evolutions of QCD cascades as well as electroweak corrections are included for evolving the decay process of the superheavy dark matter. We also find that the higher energy regime higher than the energy range $\sim 1.2 \times 10^5$ GeV - $\sim 5 \times 10^6$ GeV can be addressed only when the leptonic decay channel is considered.

Primary author: Ms PANDEY, MADHURIMA (Saha Institute of Nuclear Physics)

Presenter: Ms PANDEY, MADHURIMA (Saha Institute of Nuclear Physics)

Abstract ID : **50**

Thermal ionisation: creation and creator

Content

Today, most physicists and astrophysicists encounter the Saha equation as a relatively straightforward application of standard atomic and statistical physics. When the theory of thermal ionisation was born in Kolkata a century ago, none of the ingredients, we now take for granted were well established, and there were many false leads. This forces us to ask how and why a young physics lecturer in Kolkata made this breakthrough in understanding stellar spectra - then a mystery to the worldwide community. A close reading of the original papers and other sources gives us some answers, without decreasing the sense of wonder. I conclude this exercise in retrospection with some possible lessons for our current pedagogy and research.

Primary author: Prof. NITYANANDA, Rajaram (Azim Premji University, Bengaluru)

Presenter: Prof. NITYANANDA, Rajaram (Azim Premji University, Bengaluru)

Abstract ID : **51**

Search for Dark Matter with NEWS-G Experiment

Content

The NEWS-G direct dark matter search experiment is using spherical proportional counters (SPC) with light noble gases as Ne, He, H to explore very low mass WIMPs parameter space. First results obtained with a SPC prototype operated with Ne gas at the Laboratoire Souterrain de Modane (LSM) have already placed NEWS-G as a leader in the search for low-mass WIMPs. Recent and planned improvements for the next phase of the experiment will be presented, including the reduction of the background levels, detector performances and stability, and detector characterization. The next generation detector will consist of a larger volume 140 cm diameter SPC to be operated at SNOLAB with H and He gas. The use of lighter targets, improved thresholds and detector performance and with a significant reduction of the background levels will allow for unprecedented sensitivity to sub-GeV WIMPs down to 0.1 GeV. The current and future stages of the NEWS-G experiment in the context of the global dark matter search will also be discussed.

Primary author: Prof. PIRO, Marie-Cécile (University of Alberta)

Presenter: Prof. PIRO, Marie-Cécile (University of Alberta)

Abstract ID : **52**

γ-Rays from Dark Matter Annihilation in Milky Way Satellite Galaxies: An Analysis with Particle Dark Matter Models for 45 Dwarf Spheroidals

Content

This has been suggested that the dwarf satellite galaxies in the Milky Way may contain substantial amount of dark matter in them. These dark matters may undergo self-annihilation to produce γ-rays. The satellite borne γ-rays telescope such as Fermi-LAT reported the detection of γ-rays from around 45 Dwarf Spheroidals (dSphs) of Milky Way. In this work, we consider a particle dark matter model and after studying its phenomenology, we calculate the γ-ray fluxes of each of these 45 dSphs and compare our results with the upper bounds of mass vs annihilation cross-sections of dark matter provided by the Fermi-LAT collaboration. We calculate these fluxes by considering different dark matter density profiles and make a comparison of the results. We also repeat our analysis with another dark matter candidate namely Kaluza-Klein dark matter inspired by extra-imensional models. We make a critical comparison between the results obtained for each of these models vis-à-vis the observational results.

Primary author: Mr HALDER, Ashadul (St. Xavier's College, Kolkata)

Co-authors: Prof. BANERJEE, Shibaji (St. Xavier's College, Kolkata); Ms PANDEY, Madhurima (Saha Institute of Nuclear Physics); Prof. MAJUMDAR, Debasish (Saha Institute of Nuclear Physics)

Presenter: Mr HALDER, Ashadul (St. Xavier's College, Kolkata)

Abstract ID : **53**

Meghnad Saha and Astrophysics in India

Content

Meghnad Saha's work on thermal ionisation is widely recognised as one of the fundamental bases of Astrophysics, particularly for its application to the understanding of stellar spectra, and to various other branches of Astrophysics and Cosmology. I will briefly review its impact on Astrophysics, and discuss Saha's thoughts on ultraviolet and space-based astronomy, and his contribution to post-independence Astronomy and Astrophysics in India.

Primary author: Prof. RAYCHAUDHURY, Somak (IUCAA, Pune)

Presenter: Prof. RAYCHAUDHURY, Somak (IUCAA, Pune)

Abstract ID : **54**

Ultra light dark matter and how to detect them with binary pulsars

Content

Dark matter which is ultra-light $m \sim 10^{-21} eV$ can form dark matter which does not collapse at scales smaller than dwarf galaxies due to quantum pressure. Such ULDM can solve some problems of cold dark matter-like core cusp problem, missing satellite galaxies etc. I will discuss how if such dark matter particles exist, they will be emitted from binary pulsars and can be detected through binary pulsar timings.

Primary author: Prof. MOHANTY, Subhendra (Physical Research Laboratory)

Presenter: Prof. MOHANTY, Subhendra (Physical Research Laboratory)

Abstract ID : **55**

A new sensitivity goal for neutrinoless double beta decay experiments

Content

In presence of non-standard interactions (NSI) the solar neutrino problem admits a degenerate solution with the solar mixing angle in the second octant, This is known as the Dark-LMA solution. We discuss the implications of this for neutrino-less doublebeta decay (0νββ). We show that while the predictions for the effective mass governing 0νββ remains unchanged for the inverted mass scheme, that for normal ordering becomes higher for the Dark-LMA parameter space and moves into the "desert region" between the two. This sets a new goal for sensitvity reach for the next generation experiments if no signal is found for the inverted ordering by the future neutrino-less doublebeta decay experiments.

Primary author: Prof. GOSWAMI, Srubabati (Physical Research Laboraotory)

Presenter: Prof. GOSWAMI, Srubabati (Physical Research Laboraotory)

Abstract ID : **56**

GRB observations

Content

Gamma-ray bursts (GRBs) are the most luminous explosions in the Universe. Their nature has been well studied using enormous amounts of GRB data in a broad range of the electromagnetic spectrum, from radio frequencies up to GeV energies. However, several theoretical studies had been predicting TeV emission as well, but it could not be detected for a long time. The MAGIC collaboration had been continuously improving its stereoscopic telescope system in order to detect GRBs. Its light-weight structure and automatic repositioning system allow to quickly point the telescopes towards any location in the sky within 30 seconds after a GRB alert is received. Also, the developments of observations at large zenith angles or under moonlight greatly extended the duty cycle of the telescopes, increasing MAGIC's capabilities in GRBs follow-up. On January 14th, 2019, for the first time since its operation started 15 years ago, the MAGIC telescopes have undoubtedly detected a very high energy gamma-ray emission up to TeV energies from GRB 190114C. With a preliminary significance of over 20 sigma in the first 20 minutes of observation, this very strong detection started a wide campaign of multi-wavelength follow-up observations ranging from radio to infrared, optical, UV, X-ray and gamma-ray. In this contribution, the data results such as light curve and time-resolved spectral energy distributions will be shown. Also, the theoretical interpretations of these results will be briefly discussed.

Primary author: Dr SUDA, Yusuke (MPI for Physics, Munich)

Presenter: Dr SUDA, Yusuke (MPI for Physics, Munich)

Abstract ID : **57**

On Meghnad's magnetic monopoles, Stringy dyons and Gravitational waves

Content

Meghnad Saha, in 1936, had given an altogether different argument for the quantization of the product qg in the case of a magnetic monopole, with magnetic charge g, interacting with a particle having electric charge q by utilizing the fact that the classical angular momentum of the electromagnetic field for such a system is proportional to qg/c and that quantum angular momentum must always be quantized. We extend Saha's argument to a dyon interacting with another dyon. Furthermore, we estimate the power radiated because of such dyon-dyon interactions by calculating the loss of energy due to emission of both gravitational waves as well as electromagnetic radiation. The possibility of detecting such systems using gravitational wave detectors is reflected upon. Finally, we consider a new class of transient radio-sources recently discovered called fast radio bursts to investigate whether such phenomena could arise from cosmic dyon-dyon interactions.

Primary author: Prof. DASGUPTA, Patrick (University of Delhi)

Presenter: Prof. DASGUPTA, Patrick (University of Delhi)

Abstract ID : **58**

TBD

Content

TBD

Primary author: Prof. SIGL, Günter (University of Hamburg)

Presenter: Prof. SIGL, Günter (University of Hamburg)

Comments:

Skype Talk

Abstract ID : **59**

Evidence for anisotropy of cosmic acceleration?

Content

Observations reveal a bulk (non-Hubble) flow in our local Universe which is faster and extends to longer scales than is expected around a typical observer in the standard ΛCDM cosmology. The deceleration parameter of the Hubble expansion rate inferred from local observations is then expected to show a scale-dependent dipolar modulation. By analysing the public JLA catalogue of 740 Type Ia supernovae we find that it is indeed essentially a dipole, rejecting isotropy at 3.9σ, which is aligned with the CMB dipole, while the monopole component is ~50 times smaller and consistent with zero at 1.4σ. Thus the cosmic acceleration deduced from supernovae may just be an artefact of our being non-Copernican observers, rather than evidence for a dominant component of dark energy in the Universe.

Primary author: Prof. SARKAR, Subir (University of Oxford (GB))

Presenter: Prof. SARKAR, Subir (University of Oxford (GB))

Abstract ID : **60**

Cosmology/Inflation

Content

TBD

Primary author: Dr PAL, Supratik (Indian Statistical Institute, Kolkata)

Presenter: Dr PAL, Supratik (Indian Statistical Institute, Kolkata)

Abstract ID : **61**

Bounds on graviton mass using galaxy clusters

Content

Although galaxy clusters have been proved to be wonderful laboratories for testing a whole zoo of modified theories of gravity, which dispense with dark energy as well as with dark matter, until recently there have been no works on obtaining limits on graviton mass, after the first paper on this subject way back in 1974. To fill the lacuna, we present recent bounds on graviton mass from three different kinds of galaxy cluster observations. The first uses multi-wavelength X-ray and lensing data from Abell 1689. The second limit (which is the most sensitive) comes from stacked galaxy cluster catalog from SPT-SZ, SDSS redMaPPer and Pl anck SZ. Finally, we present limits on graviton mass using 12 relaxed galaxy cluster from Chandra for which detailed temperature and density profiles are available. Our limits from these measurements range from 10^{-29} to 10^{-31} eV and are about two orders of magnitude more stringent than the first ever bounds obtained.

Primary author: Dr DESAI, Shantanu (IIT Hyderabad)

Presenter: Dr DESAI, Shantanu (IIT Hyderabad)

Abstract ID : **62**

Understanding gravity through a better understanding of its densest objects

Content

I will show how the gravitational probing of compact objects, sometimes in association with their other multi-messenger sightings, whenever available, can not only reveal their composition (e.g., the equation of state) or test the no-hair theorem, but also unravel the nature of gravity itself (e.g., the number of dimensions of the spacetime these objects live in).

Primary author: Prof. BOSE, Sukanta (IUCAA, Pune)

Presenter: Prof. BOSE, Sukanta (IUCAA, Pune)

Abstract ID : **63**

Probing the highest energy emission from gamma-ray pulsars

Content

Recent advances in gamma-ray astronomy have provided a renewed impetus to pulsar research. Explaining the high-energy emission is critical to understanding the pulsar mechanism, since pulsars convert a significant fraction of their rotational energy into gamma-ray photons. The Large Area Telescope (LAT), on the Fermi satellite, has been scanning the gamma-ray sky since 2008, from 100 MeV to over 100 GeV. In this talk I will review what we have learned from Fermi about the highest energy emission from pulsars and how ground-based gamma-ray observatories, such as MAGIC, working in conjunction with Fermi, can help extend our knowledge in the very high energy regime.

Primary author: Prof. SAZ PARKINSON, Pablo (The University of Hong Kong)

Presenter: Prof. SAZ PARKINSON, Pablo (The University of Hong Kong)

Abstract ID : **64**

The QCD equation of state at finite density from heavy ion

Content

In this talk I will present the first calculation of the QCD phase structure and thermodynamics which is shown to be consistent with lattice QCD results at small barychemical potential as well as nuclear matter properties and known constraints from compact star observations[1,2]. In this context I will discuss the most relevant properties and constraints which should be satisfied by any model which attempts to predict the QCD phase structure. Furthermore, I will discuss how nuclear interactions may strongly influence the measured baryon number fluctuations in nuclear collisions at low beam energies [1]. Finally, I will also address similarities and differences between the matter created in heavy ion collisions and in mergers of compact stars and how both can be described in a unified framework [3].

[1] A.Mukherjee, JS and S.Schramm, Phys. Rev. C 96, no. 2, 025205 (2017)
[2] A.Mukherjee, S.Schramm, JS and V. Dexheimer, arXiv:1706.09191
[nucl-th].(accepted for pulication in Atronomy & Astrophysics)
[3] M.Hanauske, JS et al., J. Phys. Conf. Ser. 878, no. 1, 012031 (2017).

Primary author: Dr STEINHEIMER, Jan (Frankfurt Institute for Advanced Studies)

Presenter: Dr STEINHEIMER, Jan (Frankfurt Institute for Advanced Studies)

Abstract ID : **65**

Stability analysis and universality relations of a differentially rotating, hot, hypermassive Neutron Star

Content

The stability of the merger remnant depends crucially on the underlying Equation of State (EoS) as well as the differential rotation velocity profile of the Neutron Stars (NS). Thus it provides a method to probe the nature of dense matter in NS cores, which is still a mystery, as the nature of dense matter beyond saturation density is not accessible to terrestrial experiments. The recent detection of NS merger event GW170817 has opened up a new window to the universe. Post-merger searches by the LIGO-VIRGO collaboration did not find evidence for GW from the remnant. One probable outcome is a differentially-rotating hot hypermassive neutron star. We consider the most realistic solutions of differentially rotating class "A" stars, which always have a mass-shedding limit. For this we consider zero-temperature as well as finite entropy EoSs based on the phenomenological Relativistic Mean Field (RMF) with density-dependent coefficients. We constructed relativistic equilibrium sequences of differentially rotating NSs and calculate the extra mass supported by the rotating star compared to the static star. We also generate equilibrium sequences with different degrees of differential rotation. For constant angular momentum sequences the onset of the secular instability is then marked by the "Turning point" criterion i.e. the maximum of the gravitational masses as a function of central density. We also investigate whether the presence of strangeness affects the universality relations and find the existence of two families of curves of hot and cold stars for a differentially rotating star. We examine the universality with a range of differential rotation parameters as well.

Primary author: Dr BANIK, Sarmistha (BITS Pilani, Hyderabad)

Presenter: Dr BANIK, Sarmistha (BITS Pilani, Hyderabad)

Abstract ID : **66**

Probing the Cosmic dawn with the 21 cm-line

Content

A period of major changes in the Universe took place between ~0.2 and ~ 2 billion years after the big bang at the time when the first galaxies and supermassive black holes were forming. The onset of first sources of light which marked the end of the '*dark ages*' and changed the IGM thermal state is often termed as '*cosmic dawn*'. Subsequent period when the neutral hydrogen (HI) was ionized is popularly known as the *epoch of reionization* (EoR). Unfortunately, these landmark events remain largely unexplored. Radio interferometric observations of redshifted HI 21-cm radiation are considered to constitute the most promising tool to probe the reionization epoch.

In my presentation, I shall discuss recent experimental efforts and various observational strategies being/will be adopted by ongoing or upcoming radio interferometric experiments. Next I shall focus on statistical quantities that will be measured by these experiments and present results from recent simulations. We shall then discuss about methods for detecting reionizing sources (e.g galaxies, quasars) individually. Finally, we shall discuss about the most ambitious upcoming project i.e, the SKA and some related activities being carried out in India.

Primary author: Dr DATTA, Kanan K. (Presidency University, Kolkata)

Presenter: Dr DATTA, Kanan K. (Presidency University, Kolkata)

Abstract ID : **67**

Observations from uGMRT and implication in Sensitive Cosmological Studies in the pre-SKA era

Content

Redshifted 21cm signal is an important probe for early universe near the Epoch of Reionization, Cosmic Dawn, and Dark Ages. Study of these epochs form key science projects for the SKA, HERA, MWA and LOFAR. However, bright foregrounds and systematics pose major challenges in detection of the cosmological HI signal from Pre-EoR (< 150 MHz) and post-EoR (> 300 MHz) era. We present here our best estimate of the upper limit on the Post-EoR 21cm power spectrum. We have used most of the state-of-the-art wide-field, wide-band direction-dependent calibration/imaging algorithms in CASA/SPAM for the data analysis. The final results are used to characterize the nature of foregrounds both in the spectral domain as well as the spatial domain. We use the power spectrum of the foregrounds to characterize the nature of point sources and diffuse foregrounds. Once the foregrounds are characterized, they can be used to extract the signal from similar datasets in lower frequencies corresponding to the redshifted 21cm signal. Here, we also present the signal extraction mechanism using Artificial Neural Network. We will present the initial results from the 21cm power spectrum estimation from Post-EoR epochs using ANN. This has been very successful in our past Global 21cm signal studies. Here, we present the recent application on real observations. Here, we show that uGMRT has great potential to study these deep fields and sensitive cosmological observations in the pre-SKA era and perhaps beyond.

Primary author: Dr DUTTA, Abhirup (IIT Indore)

Presenter: Dr DUTTA, Abhirup (IIT Indore)

Abstract ID : **68**

SuperCDMS SNOLAB

Content

In an effort to understand the composition of the Universe, SuperCDMS SNOLAB experiment will aim to directly detect low-mass (≤10 GeV/c2) dark matter. By measuring ionization and phonon signals using a combination of cryogenic detectors operated with two different voltage conditions (HV and low voltage iZIP) and two target materials (germanium and silicon) we maximize the low-mass reach. The science reach of the detectors show an improvement of 2-3 orders of magnitude beyond current results from SuperCDMS Soudan in cross section, and an order of magnitude in mass, due to improved detector design and a cleaner experimental site. This talk will discuss calibration techniques, backgrounds studies, the current status and projected sensitivity of the SuperCDMS SNOLAB experiment.

Primary author: IYER, Vijay (NISER, Bhubaneswar)

Presenter: IYER, Vijay (NISER, Bhubaneswar)

Abstract ID : **70**

Unification with vector-like fermion dark matter and possible signatures

Content

TBD

Primary author: Dr SAHU, Narendra (IIT Hyderabad)

Presenter: Dr SAHU, Narendra (IIT Hyderabad)

Abstract ID : **71**

Effect of Dark Matter on Neutron Star Cooling

Content

We propose a dark-matter (DM) admixed density-dependent equation of state where the fermioinc DM interacts with the nucleons via Higgs portal. Presence of DM can hardly influence the particle distribution inside neutron star (NS) but can significantly affect the structure as well as equation of state (EOS) of NS. Introduction of DM inside NS softens the equation of state. We explored the effect of variation of DM mass and DM fermi momentum on the NS EOS. Moreover, DM-Higgs coupling is constrained using dark matter direct detection experiments. Then, we studied cooling of normal NSs using APR and DD2 EOSs and DM admixed NSs using dark-matter modified DD2 with varying DM mass and fermi momentum. We have done our analysis by considering different NS masses. Also DM mass and DM fermi momentum are varied for fixed NS mass and DM-Higgs coupling. We calculated the variations of luminosity and temperature of NS with time for all EOSs considered in our work and then compared our calculations with the observed astronomical cooling data of three pulsars namely PSR B0656+14, Geminga and PSR B1055-52. It is found that APR EOS agrees well with the pulsar data for lighter and medium mass NSs but cooling is very fast for heavier NS. For DM admixed DD2 EOS, we found that in case of medium and heavier mass NSs, all chosen DM masses and fermi momenta agree well with the observational data but for lower mass NSs, all DM fermi momenta and high DM masses barely agree with the observations. Furthermore, only lower DM mass agrees with observations in case of lighter NSs. Cooling becomes faster as compared to normal NSs in case of increasing DM mass and fermi momenta. It is infered from the calculations that if low mass super cold NSs are observed in future that may support the fact that heavier WIMP can be present inside neutron stars.

Primary authors: Mr BHAT, Sajad Ahmad (Saha Institute of Nuclear Physics); Mr PAUL, Avik (Saha Institute of Nuclear Physics)

Presenter: Mr BHAT, Sajad Ahmad (Saha Institute of Nuclear Physics)

Abstract ID : **72**

A Search for Dark Matter using PICO Bubble Chambers

Content

The PICO collaboration has been developing ever larger detectors for the direct detection of dark matter using the superheated bubble chamber technology. The use of C_3F_8 has led to world leading results for spin-dependent dark matter interactions on the proton. The results from PICO 60 will be reviewed and the current status of a new installation, PICO 40 will be presented. A planned next generation detector, PICO 500, will have an order of magnitude larger active mass and significantly reduced backgrounds. In addition, a new understanding of the detector response to electron recoils will allow the detector to be optimized for lower threshold running. The future dark matter search program with the PICO bubble chambers and lower threshold capability will be presented.

Primary author: Prof. NOBLE, Tony (SNOLAB, Canada)

Presenter: Prof. NOBLE, Tony (SNOLAB, Canada)

Comments:

Skype Talk

Abstract ID : **73**

The first image of a black hole

Content

I will briefly discuss how the first image of a black hole was obtained by the EHT collaboration. In particular, I will describe the theoretical aspects that have allowed us to model the dynamics of the plasma accreting onto the black hole and how such dynamics was used to generate synthetic black-hole images. I will also illustrate how the comparison between the theoretical images and the observations has allowed us to deduce the presence of a black hole in M87 and to extract information about its properties. Finally, I will describe the lessons we have learned about strong-field gravity and alternatives to black holes.

Primary author: Prof. REZZOLLA, Luciano (Institute for Theoretical Physics)

Presenter: Prof. REZZOLLA, Luciano (Institute for Theoretical Physics)

Comments:

Evening Talk

Abstract ID : **74**

Cosmology with low-redshift observations: No signal for new physics

Content

We analyze various low-redshift cosmological data from Type-Ia supernova, baryon acoustic oscillations, time-delay measurements using strong-lensing, H(z) measurements using cosmic chronometers and growth measurements from large scale structure observations for ΛCDM and some different dark energy models. By calculating the Bayesian evidence for different dark energy models, we find out that the ΛCDM still gives the best fit to the data with H0=70.3-1.35+1.36 Km/s/Mpc (at 1σ). This value is in ⊠2σ tension with various low and high redshift measurements for H0 including SH0ES, Planck-2018 and the recent results from H0LiCOW-XIII. The derived constraint on S8=σ8Ωm0/0.3 from our analysis is S8=0.76-0.03+0.03, fully consistent with direct measurement of S8 by KiDS+VIKING-450+DES1 survey. We hence conclude that the ΛCDM model with parameter constraints obtained in this work is consistent with different early and late Universe observations within 2σ. We therefore, do not find any compelling reason to go beyond concordance ΛCDM model.

Primary authors: Prof. DUTTA, Koushik (Saha Institute of Nuclear Physics); ROY, Anirban (SISSA, Italy); ., Ruchika (CTP, JMI, New Delhi); Prof. SEN, Anjan Ananda (CTP, JMI, New Delhi); Prof. SHEIKH-JABBARI, M. M. (Institute for Research in Fundamental Sciences (IPM), Tehran)

Presenter: Prof. SEN, Anjan Ananda (CTP, JMI, New Delhi)

Abstract ID : **75**

Meghnad Saha: A spectacular journey from Astronomy to Astrophysics, Ad astra per aspera et per ludum

Content

Saha Ionisation equation opened the door of astronomy to astrophysics and eventually to Astroparticle physics. After a brief introduction of Saha equation I shall go over is the microsecond old universe and discuss the relics of cosmic phase transition from quarks to hadrons. The flux tube model used in this analysis is reminiscent of the spirit of Saha equation.

A novel idea, using the analogy of the stopping of Hawking radiation, the survival of quark nuggets after "little inflation" a discussed.

Massive Astronomical Compact Objects (MACHO) are discussed in detail. The possibility of MACHOs being black holes, or rather primordial black holes is also discussed. The binaries of Quark Nuggets (QN) and the possibility of binary turning to black holes with the evolution of the universe is also discussed. Deductibility of gravitational waves with the recently used experimental tools LIGO/ VIRGO/ SKA will be presented.

Primary author: Prof. SINHA, Bikash (Variable Energy Cyclotron Centre, Kolkata, India)

Presenter: Prof. SINHA, Bikash (Variable Energy Cyclotron Centre, Kolkata, India)

Comments:

Keynote Address