Trabajos Fin del Master ofrecidas por el grupo de IEM - CSIC

Study of exotic nuclei with GRIFFIN Bruno Olaizola IEM-CSIC bruno.olaizola@cern.ch	**The GRIFFIN array at TRIUMF, Canada**, is currently the state-of-the-art spectrometer, with one of the highest gamma-ray efficiencies and a suit of ancillary detector that allows for in-depth decay experiments. It is routinely used to study the structure of some of the most exotic isotopes with extreme neutron-to-proton ratios. **What are you going to do?** The master research project will consist of the data analysis of recent GRIFFIN experiments. You will analyze the beta decay of exotic nuclei and build their level schemes, making use of different nuclear physics techniques, such as angular correlations or conversion electron spectroscopy. **What are you going to learn?** During this work, you will familiarize yourself with GRIFFIN and TRIUMF, a world-leading laboratory. You will also learn to use powerful analysis tools like ROOT, the most commonly used software in the nuclear and particle physics field. Finally, you will gain in-depth knowledge about nuclear structure far from stability and a wide range of nuclear physics detectors, able to detect gamma rays or charged particles.
Beta decay experiments at ISOLDE, CERN Bruncsico Olaizola IEM-CSIC bruno.olaizola@cern.ch Andrés Illana GFN-UCM andres.illana@cern.ch	**The ISOLDE laboratory** pioneered the development of radioactive beams, and it is still considered a world-class laboratory in nuclear physics. One of its experimental lines is the ISOLDE Decay Station (IDS), which is the permanent setup to conduct decay experiments of exotic nuclei, with a special focus on beta decay. The CSIC and UCM groups routinely use IDS to unravel the nuclear structure of isotopes far from the Valley of Stability. **What are you going to do?** The master research project will consist of the data analysis of recent IDS experiments. You will analyze the beta decay of exotic nuclei, building their level schemes and measuring the lifetime of excited state in the picoseconds (10^{-12} s) range. **What are you going to learn?** During this work, you will familiarize yourself with the fundamental aspects of decays experiments at IDS, and with the ISOLDE facility at CERN. You will also learn how to use powerful analysis tools like ROOT, the most popular software in the nuclear and particle physics field. Finally, you will gain in-depth knowledge about nuclear structure far from stability and a wide range of nuclear experimental techniques.

Monte Carlo Simulations for Nuclear Reactions of astrophysical interest. Mª José García Borge Vicente García Távora IEM-CSIC. mj.borge@csic.es vicente.garcia@csic.es	Throughout this academic year we plan to perform a series of studies of reactions of astrophysical interest, 7Li(3He,p)9Be (scheduled for October 17-19) and 10B(d,alpha)8Be in the **tandem accelerator of 5 MV of the CMAM-UAM (Madrid).** **What are you going to do?** The master research work will consist of the study of the optimum energy to realise the experiments, performing simulations to obtain the best setup configuration, and analyzing the data obtained from the simulations. A comparison of the simulations with the real data obtained is also aimed. **What are you going to learn?** During this work, you will learn to use some physical and kinematics calculators like LISE++. You will also perform simulations of the experimental setup using GEANT4, and you will learn advanced data analysis techniques mainly using C++ and python. All those programs and technique are used nowadays to perform real Nuclear Physics experiments from the top-tier facilities like CERN to the smaller ones like CMAM.
Experimental study of Nuclear Reactions of astrophysical interest. Olof Tengblad Vicente García Távora IEM-CSIC olof.tengblad@csic.es vicente.garcia@csic.es	Throughout this academic year, we plan to perform a series of studies of reactions of astrophysical interest, 7Li(3He,p)9Be (scheduled for October 17-19) and 10B(d,alpha)8Be in the **tandem accelerator of 5 MV of the CMAM-UAM (Madrid**). **What are you going to do?** The research work of the master will consist of the study of the electronics and DAQ (data acquisition system), which represents one of the things that students are most afraid of when they have to face for first time a real experiment. The student will also participate in the experiment and analyze the data obtained. **What are you going to learn?** During this work, you will learn about the main electronics and stuff that are used nowadays for real experiments developed in top-tier facilities like CERN and also in the smaller ones like CMAM. You are going to learn also how to use some physical and kinematics calculators like LISE++ and advanced data analysis techniques mainly using C++ and python.

Development of a machine learning discriminator for improving the 3ΛH signal in HypHI Phase 0 experiment Christophe Rappold, Samuel Escrig López, IEM-CSIC christophe.rappold@csic.es samuel.escrig@csic.es	In the previous experiment of the HypHI collaboration, the Phase 0 experiment, the light hypernuclei 3ΛH and 4ΛH were observed in the collision of 6Li+12C at 2AGeV. The goal of the proposed TFM is to use of machine learning techniques for improving the signal-to-background ratio of 3ΛH experimental signal. **What are you going to do?** The work for the TFM will consist to use the different machine learning framework for tabular dataset to improve the analysis of the experimental data of the HypHI Phase 0 experiment. The experimental data and Monte-Carlo simulations will be used for creating, teaching and evaluating the different ML algorithms. **What are you going to learn? Y**ou will learn to use the ROOT and GEANT4 frameworks applied to an already performed experiment of high energy nuclear physics. You will learn advanced data analysis techniques mainly using C++ and python. You will learn about machine learning techniques and how to use them adequately. You learn about the hypernuclear physics and the structure of the observed light hypernuclei.
Efficiency study of the particle identification in the HypHI Phase 0 and WASA-FRS experiments. Christophe Rappold, Samuel Escrig López, IEM-CSIC christophe.rappold@csic.es samuel.escrig@csic.es	In the experiments of the HypHI collaboration, the phase 0 experiment and the **WASA-FRS experiment@FAIR**, light hadron were measured. A new particle identification algorithm is in development based on statistical method. Efficiciency study must be carry out and the experimental yield ratio of identified hadron will be estimated. **What are you going to do?** The research work will consist of studying the efficiency of the particle identification algorithm on the GEANT4 simulations of the Phase 0 and of the WASA-FRS experiments. Once the differential efficiency of algorithm as function of the physical observable is defined, the yield ratio of the different identified hadron in the minimum bias dataset of the Phase 0 experiment will be estimated. **What are you going to learn?** During this work, you will learn about advanced data analysis techniques of the particle identification mainly using ROOT framework and C++. Those techniques are the base of the analysis in high energy nuclear and particle physics. You will then learn how to applied knowledge from GEANT4 simulations on to the analysis of experimental data to extract physical observable such as yield ratio of measured particle species, and how to relate those observable to the understanding of nuclear collisions.