



ERASMUS MUNDUS JOINT MASTER IN NUCLEAR PHYSICS

Academic Year 2026/2027

MASTER THESIS PROPOSAL

TITLE: Geant4 simulations for decay spectroscopy at IDS-CERN

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UNIVERSITY/RESEARCH CENTER: IEM-CSIC, Madrid, Spain

ABSTRACT

Monte Carlo simulations are an essential tool for the design and interpretation of modern nuclear-physics experiments. In this project, the student will develop Geant4 simulations of beta-decay experiments at the ISOLDE Decay Station (IDS) at CERN. The work will include detector modelling, studies of gamma-ray detection efficiencies and gamma–gamma angular correlations, and the simulation of realistic decay schemes. Tools will also be developed to extract nuclear data from ENSDF and incorporate them automatically into the simulations. The thesis will be carried out at IEM-CSIC in Madrid, in connection with ongoing experimental activities at ISOLDE.

What are you going to do? You will develop and run Geant4 simulations of experiments performed at IDS. You will model the relevant detector systems, study detector response and efficiencies, simulate gamma-ray cascades and angular correlations, and compare simulated observables with experimental data when available. You will also develop an automated workflow, using C++ and/or Python, to retrieve nuclear level and decay information from ENSDF and use it as input for the simulations.

What are you going to learn? You will gain practical experience with Geant4 and Monte Carlo methods, detector modelling, gamma-ray spectroscopy and nuclear decay data. You will also develop programming and data-analysis skills and become familiar with the experimental environment of ISOLDE and IDS. These skills are directly applicable to experimental nuclear physics and related areas involving radiation detection and simulation.

<https://isolde.web.cern.ch/>
<https://isolde-ids.web.cern.ch/>
<https://geant4.web.cern.ch/>





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Academic Year 2026/2027

MASTER THESIS PROPOSAL

TITLE: Beta-decay study of exotic nuclei with GRIFFIN, TRIUMF

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ABSTRACT

The GRIFFIN array at TRIUMF, Canada, is currently the state-of-the-art decay spectrometer, with one of the highest gamma-ray efficiencies and a suite 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. The thesis will be carried out at IEM-CSIC in Madrid, in connection with ongoing experimental activities at TRIUMF.

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, conversion electron spectroscopy or ultra-fast timing techniques.

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.

<https://triumf.ca/>

<https://griffin.triumf.ca/>

<https://root.cern/>



ERASMUS MUNDUS JOINT MASTER IN NUCLEAR PHYSICS

Academic Year 2026/2027

MASTER THESIS PROPOSAL

TITLE: In-beam gamma spectroscopy in the northeast region of ^{80}Zr

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ABSTRACT

(just few lines 5-10 explaining briefly the idea of the proposed work and the place where it will be developed).

The mass region above ^{80}Zr ($Z = N = 40$) has gained much attention during the last two decades due to the recent theoretical and experimental works published. Nuclei in this region can exhibit a transition from collective behaviour to spherical configuration. The latest results show a clear competition of the shape coexistence with triaxiality for nuclei above ^{80}Zr . However, there is a deficit of experimental information in this region. With this aim, we performed an experiment at the University of Jyväskylä (JYU). The purpose of this master thesis is to analyse part of the data collected in this experiment. In particular, the student will need to calibrate the setup and to investigate the different reaction channels of a fusion-evaporation $^{54}\text{Fe}(^{40}\text{Ar}, \text{xnp})$ reaction used for studying this region of the nuclear chart.



ERASMUS MUNDUS JOINT MASTER IN NUCLEAR PHYSICS

Academic Year 2026/2027

MASTER THESIS PROPOSAL

TITLE: Characterization of the vacuum and electronics components of the SUGAR-MAD windowless jet target and its commissioning with charge particle detection systems.

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ABSTRACT

(just few lines 5-10 explaining briefly the idea of the proposed work and the place where it will be developed).

As part of the “focal plane elements” duties for the ISRS European Project, coordinated by IEM-CSIC, a number of different devices were acquired. One of the main elements to be characterized is the SUGAR-MAD system (SUpersonic Gas jet tARget of MADrid), a device thought to produce a very pure and thin gas target, ideal for low energy facilities and astrophysical measurements. The first stage of the SUGAR-MAD construction is been started, and it will consist in the characterization of the 8 vacuum stations (turbo-molecular pumps, rotary screw pumps and roots pumps) and their associated electronic controllers. The proposal Master Research will be related to such characterization as well as, the simulation of the fluxes to arrive to supersonic gas fluxes and a number of radioactive sources and beam tests using a silicon strip detection system along to SUGAR-MAD at the Spanish accelerators (CMAM, Madrid and/or CMAM, Madrid). The student will also be involved in the different research measurements of the Local Group.