ERASMUS MUNDUS MASTER IN NUCLEAR PHYSICS
Academic Year 2022/2023

MASTER THESIS PROPOSAL

TITLE: Analysis of the energy imparted by protons to microscopic sites in water with Monte Carlo simulations

SUPERVISOR(S): Miguel Antonio CORTÉS GIRALDO

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UNIVERSITY/RESEARCH CENTER: Universidad de Sevilla

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

Microdosimetry provides a theoretical framework to determine the properties of the spatial distribution of energy deposition by a charged particle track at microscopic scale, with which radiobiological effects of ionizing radiation can be estimated. Our group has developed a Monte Carlo code with Geant4-DNA to carry out track-structure calculations of proton track segments to calculate dose-averaged liner energy transfer (LETd) values from microdosimetry quantities. The aim of this project is to model the energy imparted to sites as function of its diameter and chord length. The candidate will develop the project at the University of Seville (Spain), and will collaborate with the Proton Therapy Center at the Massachusetts General Hospital and Harvard Medical School (Boston, MA, USA). Knowledge on the Geant4 toolkit and C++ is highly recommended.

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Academic Year 2022/2023

MASTER THESIS PROPOSAL

TITLE: Geant4 benchmark against ICRU Report 90 – A verification test for charged particle transport.

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UNIVERSITY/RESEARCH CENTER: Universidad de Sevilla

ABSTRACT
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The International Commission on Radiation Units and Measurements (ICRU) released the Report no. 90 in 2016, revising key data for the transport modeling of charged particles within the scope of radiotherapy physics. Namely, tables with new values of stopping power and range were published for electrons, positrons, protons, alphas and carbon ions in liquid water, air, and graphite. The aim of this project is to develop a Geant4 application with the goal of providing the Geant4 Collaboration with an updated testing case of the code. The project will be developed at the University of Seville (Spain). Knowledge on the Geant4 toolkit and C++ is highly recommended.

ERASMUS MUNDUS MASTER IN NUCLEAR PHYSICS
Academic Year 2022/2023

MASTER THESIS PROPOSAL

TITLE: Characterization of a nuclear reactions spectrometer

SUPERVISOR(S): Marcos Aurelio Gonzalez Alvarez and Juan Pablo Fernández

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UNIVERSITY/RESEARCH CENTER: University of Seville

ABSTRACT

The laboratory ALOHA (Applied Laboratory On Heavy-ion Analysis) of the Department of Atomic, Molecular and Nuclear Physics (University of Seville) count on two current developments on nuclear reactions spectrometers:

i) MARS (*Modular Apparatus for nuclear Reactions Spectrometry*) and
ii) VENUS (*VME Electronics for NUclear Signals processing*).

The main goal of this project is to characterize the spectrometers response. We analyze last generation detectors, electronics and acquisition systems responses (in terms of sensitivity, resolution, efficiency, signal to noise ratio, spectral response, among others) under irradiation using different radioactive sources (cosmic rays, alpha, beta and/or gamma). Results are permanently exchanged with companies in order to evolve in nuclear instrumentation development.

NucPhys Erasmus Mundus Master Degree
Master Thesis Proposals 2022-2023

University of Sevilla
Fusion Group

Título: Fast-ion orbit tomography in the ASDEX Upgrade tokamak

Tutores: J. Galdon(jgaldon@us.es), A. Jansen van Vuuren (avanvuuren@us.es)

Resumen: In tokamak fusion experiments, measuring the 6D-fast-ion distribution function is important. Unfortunately, the different diagnostics are only sensitive to small volumes of the full fast-ion phase-space. In this work, the orbit tomography technique will be applied to scintillator-based fast-ion loss detectors. This will allow the integration of the measurement from multiple detectors into a common framework, for the determination of the fast-ion loss distribution.

Título: Development of a Thomson Scattering system for the SMART tokamak

Tutores: M. Garcia Muñoz (mgm@us.es) and Eleonora Viezzer (eviezzer@us.es)

The Thomson Scattering system is one of the basic diagnostics in a tokamak and provides measurements of the electron density and temperature. In this work, a feasibility study for the Thomson Scattering diagnostic will be carried out for the SMART tokamak of the University of Seville, taking into account the predicted background plasma profiles expected.

Título: Development of a Soft X-Ray system for the SMART tokamak

Tutores: M. Garcia Muñoz (mgm@us.es) and Eleonora Viezzer (eviezzer@us.es)

Abstract: Soft X-Ray emissions are commonly used in tokamaks to directly measure, or infer, some important plasma parameters such as electron temperature, radiated power as well as for the localization of magnetohydrodynamic (MHD) fluctuations through tomographic reconstructions. In this work a feasibility study for a multi lines-of-sight SXR system for the SMART tokamak will be carried out. This work should end with a proposal for a SXR setup for the SMART tokamak.

Título: Development of a Wall Conditioning system for the SMART tokamak

Tutores: M. Garcia Muñoz (mgm@us.es) and Eleonora Viezzer (eviezzer@us.es)

Abstract: Wall conditioning is key to improve the plasma performance in a magnetically confined fusion reactor as impurities released from the wall can cool down the plasma until its colapse. Several methods are typically used to condition the reactor wall, and, among others, in this work

glow discharges and boronisation will be explored as main wall conditioning methods for the SMART tokamak.

Título: Stability analysis of SMART equilibria using MARS-F

Tutores: M. Garcia Muñoz (mgm@us.es) and Eleonora Viezzer (eviezzer@us.es)

Abstract: The main goal of the SMART tokamak is to explore the prospects of Negative Triangularity shaped plasmas for a future fusion power plant (FPP) based on spherical tokamaks. Although NT plasmas offer some attractive features for a future FPP, they are also typically more prone to magnetohydrodynamic (MHD) fluctuations. In this work, the MHD code MARSF will be used to explore the stability of SMART plasmas with positive vs negative triangularity.

ERASMUS MUNDUS MASTER IN NUCLEAR PHYSICS
Academic Year 2022/2023

MASTER THESIS PROPOSAL

TITLE: Measurement of (alpha,n) reactions at the CNA HISPANOS facility of interest for underground dark matter experiments

SUPERVISOR(S): Carlos GUERRERO

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UNIVERSITY/RESEARCH CENTER: Universidad de Sevilla
Centro Nacional de Aceleradores (CNA)

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

Neutrons are a significant source of background in underground dark matter experiments. These neutrons are produced via (alpha,n) reactions, with alphas being of natural origin from the structural and surrounding materials. At the CNA HISPANOS neutron beam line, in the context of the Spanish MANY Collaboration, we will set-up a system that allows measuring (a,n) reaction yields by both activation and neutron time-of-flight. The thesis work will consist on the preparation and characterization of gamma and neutron detectors, realization of the (a,n) experiments, data analysis and comparison to previous data for validation.

An additional information that might be of interest to the candidates is that a new PhD position is expected to be open by Summer 2023 for a thesis related to the exploitation of the CNA HISPANOS facility.