ERASMUS MUNDUS MASTER IN NUCLEAR PHYSICS
Academic Year 2023/2024

MASTER THESIS PROPOSAL

TITLE: **Evaluation of the beam dose in FLASH protontheraphy using Ion Beam Techniques**

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UNIVERSITY/RESEARCH CENTER:University of Sevilla / Centro Nacional de Aceleradores

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

Protontheraphy (PT) is a kind of radiation theraphy that uses protons, instead of energetic photons, to treat cancer. In conventional PT the dose to the patient is usually delivered in tens of fractions of 2 Gy, with typical dose average rates of 0.1 Gy/s. Alternatively, in FLASH-PT ultra-high average dose rates, larger than 40 Gy/s, are used. The extreme instantaneous dose rates used in some FLASH-PT modalities cause that most of the common active dosimetry techniques fail to provide an accurate measurement.
I
n this work we want to evaluate the use of Ion Beam Analytical techniques, such as Rutherford Backscattering Spectrometry (RBS) or Particle Induced X-Ray Emission (PIXE) as a tool for the control of the dose during the FLASH-PT iradiation.

The experiments will be carried out at the 3 MV Tandem Accelerator of the Centro Nacional de Aceleradores (CNA) in Sevilla.

Candidates should have good background in nuclear instrumentation and radiation detectors.

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Academic Year 2023/2024

MASTER THESIS PROPOSAL

TITLE: Development and experimental validation of the neutron imaging capability of the dual Gamma-Neutron vision (GN-Vision)

SUPERVISOR(S): Jorge Lerendegui Marco and Carlos Guerrero

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UNIVERSITY/RESEARCH CENTER: Instituto de Física Corpuscular, IFIC (CSIC-UV) / USE

ABSTRACT

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

This thesis project deals with the development of GN-Vision, a novel dual g-ray and neutron imaging system, which aims at simultaneously obtaining information about the spatial origin of g-ray and neutron sources [1]. The proposed gamma-neutron imaging device could be used for medical applications, in particular for range verification and dose monitoring in hadrontherapy. Moreover, neutron and g-ray imaging devices are also of prime interest nuclear safety and security applications.

The GN-Vision device, designed as an evolution of the predecessor i-TED detector [2], is based on two position sensitive detection planes and exploits the Compton imaging technique for the imaging of g-rays. In addition, spatial distributions of epithermal and thermal-neutron sources are reconstructed by using a passive neutron pin-hole collimator attached to the first detection plane, which is able to discriminate neutrons and g-rays.

In this context, this thesis work will focus on the experimental development of the neutron imaging capability of GN-Vision in the IFIC lab. The work will include the experimental studies to achieve position sensitivity for g-ray and neutron sources in the CLYC-6 detector, the characterization and optimization of the neutron imaging performance and, last, the experimental proof-of-concept in a neutron beam facility such as CNA or CMAM. Besides the experimental work, the student will also gain experience on Monte Carlo simulations with Geant4.

[1].- J. Lerendegui et al., EPJ Tech. a Inst. (accepted) https://doi.org/10.48550/arXiv.2207.09781
[2].- V. Babiano et al., Nucl. Inst. Methods. A, 953, 163228 (2020). https://doi.org/10.1016/j.nima.2019.163228

ERASMUS MUNDUS MASTER IN NUCLEAR PHYSICS
Academic Year 2023/2024

MASTER THESIS PROPOSAL

TITLE: Physical and biological aspects of radioactive embolization for cancer therapy

SUPERVISOR(S): Miguel Cortés-Giraldo (Universidad de Sevilla)
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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).

Transarterial radioembolization (TARE) is a well-extended technique to treat inoperable hepatic cancers. Usually, microspheres labeled with the β-emitter ^{90}Y are delivered and stuck into the tumor vasculature, provoking a double effect. On the one hand, the tumor supply of nutrients is cut off by blocking the vessels, and on the other hand, ionizing radiation is delivered to the tumor cells. An interesting alternative is to consider other radioactive emitters, including the more biologically effective α-particles, to study the potential implications of diverse emissions in the vasculature and, overall, in the tumor viability. This project will employ Monte Carlo simulations to compare the physical aspects of each modality and their biological and clinical implications.

*All Master Thesis' projects with A. Bertolet are entitled for only one single vacancy.

ERASMUS MUNDUS MASTER IN NUCLEAR PHYSICS
Academic Year 2023/2024

MASTER THESIS PROPOSAL

TITLE: The relation between microdosimetry and DNA damage for carbon ion therapy *

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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).

Carbon ion therapy (CIT) is a type of cancer treatment that uses high linear energy transfer (LET) ion beams, which have a high relative biological effectiveness (RBE) compared to low LET radiation, to kill cancer cells with high precision. Microdosimetry allows capturing the local energy deposition pattern, which can be related to the complexity of damage induced to DNA, and, ultimately, higher RBE. In this project, we will use the Monte Carlo (MC) package TOPAS-nBio to calculate microdosimetric distributions for carbon ions of different energies and compare the results to experimental measurements and the results of radiobiological experiments published in the literature.

*All Master Thesis' projects with A. Bertolet are entitled for only one single vacancy.