MAPFIS essay PhD topics

Topic 1: Participation in the DRIM-PET project

Supervisor: João Filipe Veloso, Universidade de Aveiro

Positron Emission Tomography is the best example of contribution of medical imaging systems to clinical research. In the case of research-dedicated PET scanners for small animal imaging, size adequacy is essential, since, for instance, a rat's heart is more than 100 times smaller than the human heart.

This work will be part of the DRIM-PET project running at Aveiro University to develop a small PET scanner with depth-of-interaction (DOI) capability, important to improve spatial resolution. The system combines scintillator-photodetector cells with a new DOI determination method, based on light guides (optical fibers) with silicon photomultiplier readout (SiPM). The method requires small number of components to obtain DOI; therefore, it allows producing a high-performance PET system at acceptable cost.

Experimental and simulation studies will be performed by the student to determine system's optimized parameters, with the aim of building a prototype to be tested and characterized for its interest as new PET scanner for pre-clinical research in Nuclear Medicine.

The work will carried out at:

DRIM labs – Deteção da Radiação e Imagiologia Médica of I3N, University of Aveiro

Topic 2: Portable MPGD based x-ray detector

Supervisor: João Filipe Veloso, Universidade de Aveiro

MicroPatterned Gaseous Detectors (MPGDs) have been widely used in all the High Energy Physics (HEP) experiments running at Large Hadron Collider and have strongly contributed for the outstanding last-year achievement, the measurement of a particle with the same characteristics as predicted for the Highs Particle. MPGDs can be combined in different geometries and present high gains ($\sim10^6$) and position resolutions in the tens micro scale.

MPGDs are being developed within an international collaboration, CERN-RD51 "Micropatterned Gas Detectors Technologies", where the supervisor group is a member. The main development is devoted to large sensitive areas for High Energy, but at the same time, very interesting applications have been implemented, such as in X-ray detection, astrophysics, photon detection, medical imaging, security, etc.

The proposed topic will run within the RD51 collaboration and aims for the development of a position-sensitive portable sealed MPGD based detector, where all the electronic components, high voltage and readout electronics are incorporated. Also, a small, low-consumption, gas purification system will be developed, in order to keep the gas "clean" and ensuring an high level of portability. For good detection efficiency, required for the envisaging applications (e.g., x-ray detection, medical imaging, x-ray fluorescence imaging, industrial), the use of heavy noble gases is mandatory.

The work will carried out at:

DRIM labs – Deteção da Radiação e Imagiologia Médica of I3N, University of Aveiro

CERN - Gaseous Detectors Group, CERN, Switzerland.