Two-years postdoctoral fellowship at LPSC (Grenoble, France): Development of a TOF-based Prompt Gamma detector for real-time monitoring in Proton therapy

Project description

A very high ballistic precision and optimal tumour coverage may be in principle achieved with proton therapy, but uncertainties in patient tissue composition, physiological movements or transient modification of the anatomy may lead to significant errors in treatment delivery.

In order to fully exploit the potential of this technique, we are currently developing a novel system for real-time control of particle therapy, based on TOF-resolved (Time-Of-Flight) Prompt Gamma (PG) imaging with 100 ps time resolution, namely TIARA (Tof Imaging ARrAy). The system will consist of a set of small size, ultra-fast pixel detectors (~1cm^3) fixed on a rigid support surrounding the irradiated volume to achieve 3D coverage. Each pixel will consist in a monolithic Cherenkov radiator read-out by one or more Silicon Photomultipliers [1]. TIARA will be read in time coincidence with a fast beam monitor. The TOF between the beam monitor and the TIARA pixels, together with TIARA pixels' positions constrain the PG vertex coordinates allowing a 3D reconstruction of the ion range in real-time and with a millimetric precision at pencil beam level [2].

This multidisciplinary project has recently been funded by the French National Institute of Health and Medical Research (INSERM) for a duration of three years. Physicists, engineers, mathematicians and clinical medical physicists from three French institutes (two CNRS labs, LPSC[1] and CPPM[2] and the CAL[3] proton therapy centre) will contribute to the development and test of the TIARA detector and to the conception of a dedicated image reconstruction algorithm.

Job description

The current position is based in Grenoble, at the CNRS Laboratory of Subatomic Physics and Cosmology (LPSC). We are looking for a highly motivate candidate to take charge of the TIARA detector development from pixel R&D to prototype assembly and test. The experimental activities will be carried out with gamma, electron and neutrons sources at LPSC. Regular beam tests at the CAL proton therapy centre are planned to evaluate the detector response under clinical irradiation conditions (phantom studies). The successful candidate will collaborate with electronic engineers at LPSC and CPPM to set-up and test TIARA acquisition system and software. She/he will be responsible for the data analysis of beam test campaigns and she/he will participate to the redaction of papers and reports.

Candidate profile

- PhD in physics/medical physics or equivalent, with a focus on particle detector development;
- Extended knowledge of radiation detection physics (gamma-rays, charged particles);
- Good knowledge of signal treatment and data acquisition techniques;
- Previous experience with Silicon Photomultipliers and/or scintillators;
- Data analysis with scientific software (python and/or ROOT);
- Experience in Monte-Carlo simulation (Geant4, GATE…) would be appreciated;
- Good written and oral English skills;
- Ability to work in a collaborative environment.

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[1] Laboratoire de Physique Subatomique et Cosmologie, Grenoble, France.
[2] Centre de Physique des Particules de Marseille, Marseille, France.
[3] Centre Antoine Lacassagne, Nice, France.

Start date: Spring 2021, negotiable.
Term of contract: 12 months (renewable for additional 12 months).
Contract: Full-time.
Salary: Approximately 2648 euros per month (gross salary), according to French public service grids.
Experience: Less than 2 years of postdoctoral experience.

To apply, please send a CV and an application letter to Sara Marcatili: sara.marcatili@lpsc.in2p3.fr

References:

1) S. Marcatili et al., 2019, A 100 ps TOF detection system for on-line range monitoring in hadrontherapy, *2019 IEEE NSS-MIC Conference Record, 26 Oct.-2 Nov. 2019 Manchester, UK*. https://arxiv.org/abs/2001.04222
2) M. Jacquet et al., 2020, A Time-Of-Flight-Based Reconstruction for Real-Time Prompt-Gamma Imaging in Protontherapy. https://arxiv.org/abs/2012.09275