

Postdoc position for the development of next-generation high pressure TPCs with optical readout

IGFAE (Galician Institute for High Energy Physics)

The University of Santiago de Compostela, founded in 1495, is the oldest University in Galicia and one of the oldest, continuously running, universities in the world. It has over 40000 students and 2000 professors and researchers.

IGFAE, founded in 1999, is a Spanish Excellence Research Center, member of the SOMMa, the league of Severo Ochoa Centers and María de Maeztu Units to promote Spanish Excellence in research and to enhance its social impact at national and international levels. It is a joint research center of the University of Santiago de Compostela and the Autonomous Government of Galicia. The Institute performs frontier research in High Energy Particle Physics, Nuclear Physics, Astroparticle Physics and related areas, both theoretical and experimental.

One of the research programs of IGFAE relates to *Dark Matter and the Nature of the neutrinos*. The Institute is involved in the detector construction, operation and physics analysis of the NEXT experiment (conceived to determine the neutrino mass scale). In a broader context, it develops technology for next-generation optical time projections chambers, targeting nuclear and WIMP-based dark matter experiments, neutrino physics, as well as applied research. This position is supported by the IGNITE initiative of IGFAE, focused centrally on technological developments aimed at the introduction of a fluorescence-based T_0 -scheme for the High Pressure Near Detector of DUNE.

Subject description

The Deep Underground Neutrino Experiment (DUNE) is a next-generation neutrino oscillation experiment at Fermi National Accelerator laboratory (Fermilab), in the US. Designed, as customary, with a suite of Near and Far Detectors. It is conceived as the ultimate neutrino oscillation experiment, with ability to extract the CP-phase of the neutrino-mixing matrix and determine the neutrino-mass hierarchy. Its huge Far Detector (40kton) is a neutrino observatory by itself, with a parallel program in astrophysical and solar neutrinos, and beyond standard model (BSM) processes like the measurement of the proton decay. Its Near Detector (ND), sitting close to the neutrino beam, needs to provide a neutrino flux estimate with an accuracy close to 1%, and has a parallel program in precision neutrino physics and BSM physics as well. One of the detector elements of this detector suite is a high-pressure argon time projection chamber (TPC), placed inside a magnetic field. This TPC, that relies on avalanche multiplication, aims at developing an unprecedented technological feat in this readout configuration: the determination of the interaction time of the event. Enabling a self-triggering capability, with a T_0 obtained through gas fluorescence, will be deeply transformational: besides natural applications outside the scope of this project, it would allow i) immunity with respect to uncorrelated backgrounds, ii) fiducialization of the event, iii) improved vertex assignment for neutral-current interactions, and even, although much more challenging, iv) providing Particle ID for elastic scatterings with nuclei.

This postdoctoral project will be focused on the experimental study and technical demonstration of the possibility of obtaining primary scintillation in an avalanche-mode TPC, potentially allowing for self-triggering capability, for the first time. The postdoc researcher will work in a strong international collaboration, headquartered at Fermilab, with participation from the Universities of Texas Arlington, Univ. Valencia, Univ. Coimbra and Univ. Aveiro. Partners are members of the NEXT collaboration as well, therefore synergies in particular with this experiment but also with other Optical TPC applications, will be naturally explored during the development of the project.

Job duties

The postdoctoral researcher will work on different experimental approaches devoted to finding a scintillating gas compatible with good avalanche multiplication in a TPC, for which scintillation in the UV, visible and IR ranges will be explored. He or she will have at his/her disposal the new facilities deployed at the recently refurbished gaseous

detector lab of IGFAE, focused on the study of the scintillation in gaseous detectors, for pressures up to 10 atm. The lab allows VUV-IR wideband photo-spectroscopy, with high control on the gas purity, that are essential assets for the project. Complementary to the project is the modeling of the scintillation process, for which use will be made (when necessary) of the simulation packages Garfield++ (secondary scintillation) and Degrad (primary scintillation), together with an additional software package developed at the Institute. These will need to be adapted to the cases under study to allow, in particular, the inclusion of transfer reactions between excited species. The main aim of this project is to elaborate a solid technical proposal by 2020-2021, that could be included in the upcoming Technical Design Report of the DUNE ND-collaboration.

The postdoctoral researcher will integrate him or herself in the research activities currently ongoing within the group and the Institute, in particular NEXT and other related OTPC projects. She will be assigned at least one PhD student and one technician will be at her disposal. Managerial as well as leading roles are expected, within the already established consortium.

Requirements

- PhD in Particle Physics.
- Previous postdoctoral experience in the development of gaseous detectors for particle physics.
- Previous postdoctoral experience in the field of rare event searches: neutrino, dark matter physics, rare nuclear physics reactions...
- Good oral and written proficiency in English.
- Availability for travelling.

Special attention is paid to the following:

- Ability to work both independently and within a team, and to formulate and tackle research problems.
- Written and oral communication skills.

Terms of employment

This is a 1.5 (+0.5y) year position, subject to hiring conditions according to the University of Santiago de Compostela bylaws.

Instructions on how to apply

Applications shall be written in English and include a cover letter stating the reasons why the applicant is interested in the position and in what way the research project corresponds to his or her interests and educational background. The application must also contain a CV, and other documents to be considered (e.g., letters of recommendation), and should be sent to Diego.Gonzalez.Diaz@usc.es.

IGFAE welcomes applicants with diverse backgrounds and experiences and encourages gender equality.

Opening of call: 1-October-2019

Deadline for application: 15-November-2019

Data of start: as soon as possible after the closing date, normally not later than 1-January-2020.

More information: <https://igfae.usc.es/igfae/>