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PROPOSAL – POST-DOCTORAL JOB OFFER

Introduction

The neutrino group of Laboratoire de l'Accélérateur Linéaire in Orsay is opening a 2-year post-doctoral position funded by ANR (16-CE31-0018-03) to work on the SoLid experiment which is under construction. The SoLid experiment is a very short baseline (5.5-10 m) reactor anti-neutrino experiment looking for sterile neutrinos in the eV mass scale, close to BR2 research reactor in Mol, Belgium.

SoLid experiment

The SoLid experiment will investigate the possible existence of sterile neutrinos to explain the reactor anti-neutrino anomaly that emerged after the re-evaluation of the anti-neutrino spectra and reactor flux for the θ_{13} experiments. Anti-neutrinos are detected through inverse beta decay reaction (IBD) where a positron and a neutron are produced. The 5 cm cubic detector cells are arranged in a 3D matrix of 16x16 per planes, with the scintillation light being read out by orthogonal wavelength shifting fibers and SiPMs. The combination of 2 scintillators provides a clear signature of the anti-neutrino events. First, PVT scintillator cubes serve as neutrino target, detect the positron and measure its energy as the prompt signal. The second scintillator is a ^{6}LiF:ZnS(Ag) layer that will absorb the neutron after its thermalization in the detector. This delayed signal has a characteristic light emission signature to distinguish it from the PVT signal. The fine segmentation allows a topological reconstruction of the delayed coincidences signing an anti-neutrino interaction and is extremely powerful to reject the backgrounds which are huge at shallow depth close to a nuclear reactor. In addition the detector will be installed at BR2 research reactor in Belgium where the background conditions are very favorable compared to other reactors. The site also offers the closest position possible for a very sensitive measurement. Furthermore a precise characterization of the ^{235}U anti-neutrino energy spectrum and flux with comparison to the predicted spectrum will allow a better understanding of the distortion observed in the current neutrino-reactor experiments.

A 288 kg prototype made of 2304 cubes, named SM1, has been constructed in 2014 and deployed at BR2 in early 2015. Few days of reactor ON, about 2 months of reactor OFF and several calibration data have been taken. This measurement campaign allowed to demonstrate the technology principle, the neutron identification and the strong background rejections capabilities. Results have been presented at Neutrino and ICHEP 2016 conferences and an article is under preparation. The next step called phase 1 of SoLid has been funded and is now under construction. More than 1.6 t detector (50 planes) with improved light collection, better neutron efficiency and thicker shielding will start taking data by spring 2017.

The international SoLid collaboration consists of about 50 physicists and involves institutes from Belgium, France, UK and USA. The French collaboration gathers 4 laboratories : LAL, LPC-Caen, LPC-Clermont-Ferrand and Subatech.

LAL group and activities

The LAL Laboratory is under the joint supervision of the Université Paris-Sud and the Institut National de Physique Nucléaire et de Physique des Particules (IN2P3) of the CNRS. The laboratory is situated in Orsay, 40 min from Paris by train.

The SoLid group of LAL is constituted of 3 CNRS researchers and 1 University assistant professor. A PhD student also started in 2015 and will defend in 2018. Several bachelor and master students are participating to the group research activities.

The LAL group plays a major role in the positron energy measurement both from an hardware point of view (plastic scintillator test bench development) and a reconstruction point of view. Indeed, the LAL group has the responsibility to coordinate the electromagnetic signal measurements in the collaboration. In addition, the LAL group is also involved in the IBD search and background studies for the SM1 prototype and the phase 1 of SoLid.

Description of the position

Since the SoLid phase 1 detector is under construction, the successful candidate will participate to the assembly work at Gent University where the detector is being assembled. The detector planes are then directly commissioned and qualified cube per cube with electron, gamma and neutron sources before going to BR2. This work will help the construction effort and allow the post-doc to acquire a good knowledge of the detector technology and start some characterization and reconstruction works.

The candidate is expected to take a leading role on the EM signal reconstruction and analysis in the collaboration. He will also carry out anti-neutrino and backgrounds data analysis and simulation studies. The post-doc will present his work and SoLid results (well expected by the community) at major particle or neutrino physics conferences and participate to the publications.

The post-doc could also to take part in the supervision of Bachelor and Master students internships and possibly of PhD.

Application

A recent PhD in experimental particle, nuclear or astroparticle physics is required. Experience in detector technology, event reconstruction, calibrations, data analysis and Geant4 simulations would be appreciated.

Candidates should send a curriculum vitae, a covering letter, a research statement and ask for at least 2 recommendation letters to be sent by e-mail (asking for confirmation receipt) to :

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mail: bongrand@lal.in2p3.fr

The review of applications will start at the publication of the offer and will continue until the position is filled preferably by the end of 2016.