Open PhD position: Measurement of the weak mixing angle $\sin^2\theta_W$ by coherent elastic neutrino-nucleus scattering with the RICOCHET experiment

Location: Laboratoire de Physique Subatomique et Cosmologie (LPSC) & Institut Laue Langevin (ILL) – Grenoble

PhD college: Université Grenoble-Alpes – Doctoral school of Physics

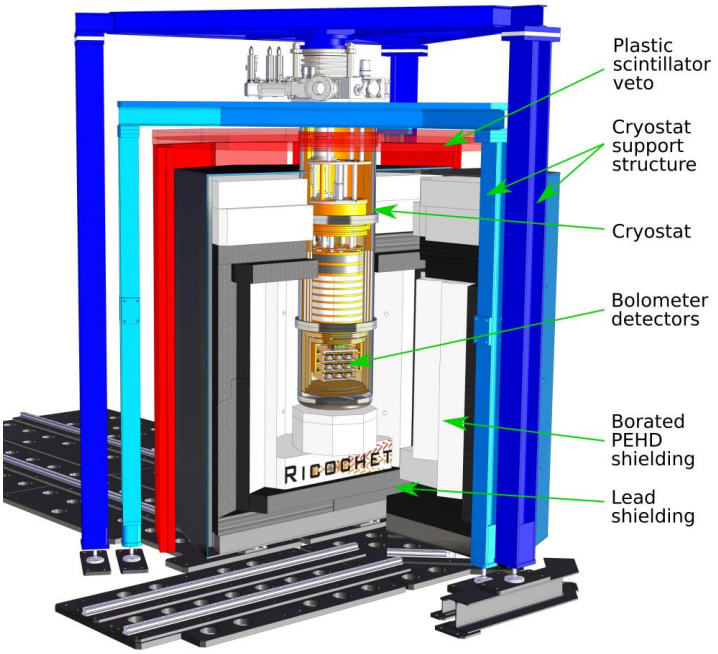
RICOCHET Collaboration: IJCLab, IP2I, Institut Néel, LPSC, MIT, Wisconsin U., Northwestern U., Amherst U., JINR

Local Team: Guillaume Chemin (PhD student - LPSC), Corinne Goy (LPSC), Jacob Lamblin (LPSC), Jean-Sébastien Réal (LPSC), Silvia Scorza (LPSC), Torsten Soldner (ILL), Anne Stutz (LPSC)

After the observation of neutrino oscillations, the physics of neutrinos remains a source of discoveries and conceals a potential for new measurements: predicted in 1974, the process of coherent elastic scattering of neutrinos on nuclei (CEvNS) was discovered experimentally only in 2017 by the COHERENT experiment. RICOCHET will perform this measurement for the first time at very low energy ($E_\nu \sim 4$ MeV) where the coherence phenomenon is maximal: a % precision measurement of the cross-section is expected. This gives access to several important quantities, in particular the weak mixing angle $\sin^2\theta_W$. Only a few measurements of the weak mixing angle exist at low momentum transfer; in particular, only one measurement, coming from the parity violation measurements in atoms, exists in the range accessible to RICOCHET.

RICOCHET [arXiv:2111.06745] will exploit anti-neutrinos produced by the research nuclear reactor of the Institut Laue Langevin in Grenoble. It will use an array of germanium crystals and of super-conducting zinc crystals to detect the small nuclear recoils produced by CEvNS. These crystals are operated at a temperature of 10 mK, enabling the low energy detection threshold required by the low energy of the neutrinos. The objective is to reach a threshold of 50 eV with 10 eV resolution for the nuclear recoils.

The installation of the cryostat with the germanium detectors is planned for the end of 2023. The zinc crystals will be introduced at a later stage in the experiment. The RICOCHET collaboration is aiming for a cumulative 300 days of reactor-on data until 2026.



Layout of the RICOCHET experiment.

The PhD project, with a total duration of 3 years, aims at measuring $\sin^2\theta_W$ with the RICOCHET data recorded up to 2026. The PhD student will participate in all phases of the experiment: installation, operation, data analysis and interpretation of the results. The thesis involves experimental work as well as simulations (Geant4) and data analysis (Root, C++). It takes place in Grenoble in collaboration between the Institut Laue Langevin and the Laboratoire de Physique Subatomique & Cosmologie. The RICOCHET collaboration has about 90 members from Europe and the USA.

Applications (including brief motivation letter, CV, Bachelor/Master certificate or score excerpt, short abstract of master thesis, and a contact person for a reference) should be send to Corinne Goy (corinne.goy@lpsc.in2p3.fr), Jacob Lamblin (jacob.lamblin@lpsc.in2p3.fr) and Torsten Soldner (soldner@ill.fr).

Deadline: 2 Juin 2023