Ecole Doctorale des Sciences Fondamentales

Title of the thesis: Search for antineutrino disappearance with the SoLid detector.

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Summary :

The SoLid experiment aims at searching for antineutrinos disappearance shortly after their production. The antineutrinos are produced at the Belgian nuclear reactor BR2 (dedicated to experimental nuclear researches) out of the fission of the nuclear reactor fuel, which is mostly made of ^{235}U. The antineutrinos are detected in the coincidence of a neutron capture and a positron emission, the two particles being issued from the scattering of the antineutrino on a proton of the detector, known as inverse beta decay (IBD) process. The detection technology is novel for this field of Physics. The neutron is captured in ZNS scintillating layers doped with ^{6}Li attached to PVT scintillating cubes of 5 cm side aimed at detecting the positron particle. The scintillating light in both cases is captured by wavelength shifting fibres and read out by SiPM devices.

The Clermont group joined the SoLid collaboration in January 2017. It has contributions both about the instrument and the Physics analyses. The instrumental activities concern the development of environmental sensors monitoring temperature, pressure and humidity in the container hosting the experiment, the study of the air-borne Radon-induced background and contributions to the Data Acquisition System. The successful candidate is expected to devote a part of her / his time to contribute to these activities. SoLid is a small experiment and provide the student the opportunity to master all steps of an ambitious experiment in Physics.

The heart of the PhD. subject is however directed towards Physics analyses. We have developed a strategy for topological analyses of the IBD signal that has still to be validated on simulation samples and reactor off data. The first Physics goal will be the precise measurement of the antineutrino energy spectrum out of the fission products of ^{235}U. The next stage is the final target of the experiment about the antineutrino oscillations. All of these Physics developments will be conducted in close collaboration with the members of the SoLid experiment.

The successful candidate is required to master one programming language and have at least an initial knowledge in C++ language and root software, to have a basic knowledge of detector Physics and to own a good command of the English language.