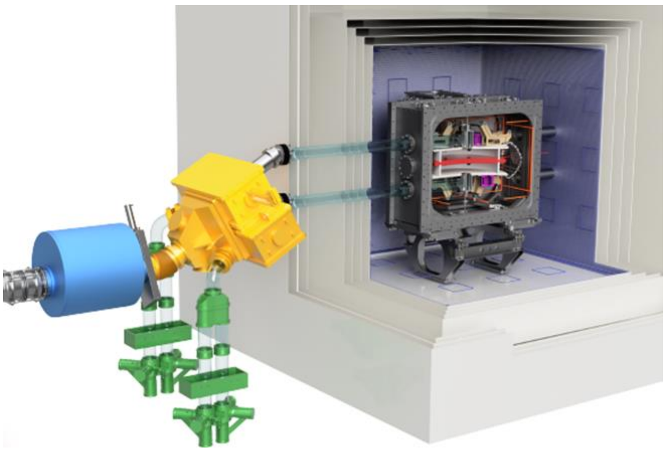
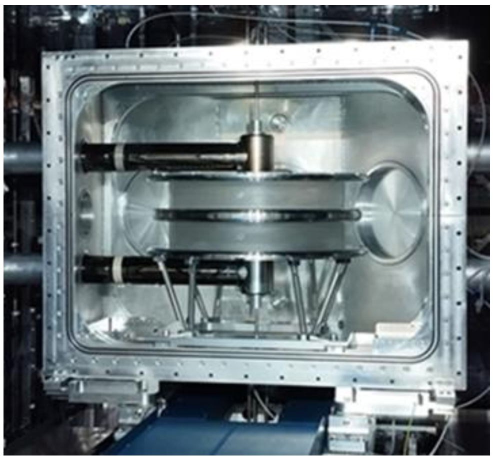
Title: *The measurement of the electric dipole moment of the neutron*.

Advisor: Lefort Thomas at the Laboratoire de Physique Corpusculaire (LPC).

PhD subject:
The search for electric dipole moment (EDM) of particles probes physics beyond the standard model. It is performed worldwide on elementary particles or composite systems (electron, neutron, Hg and so on …). One of the main motivations is the current lack of CP violating mechanisms. These mechanisms are needed to account for the appearance of matter in our Universe [1]. In the early Universe, matter and antimatter should have been equally produced. Today, there is only a tiny amount of antimatter. Why the antimatter disappears from our Universe is not understood. The discovery of an EDM would reveal new hints towards the understanding of this mystery.
The LPC Caen is involved in an experiment at Paul Scherrer Institute (PSI) in Switzerland aiming at measuring the neutron EDM [2]. The experiment is carried out with ultra-cold neutrons at PSI (see left figure below). These neutrons are of great interest since they can be stored for a few minutes in vessels (see the right picture below). During their (long) storage, their intrinsic properties, like the EDM, can be studied.
At PSI, a new spectrometer was built and is nearly operational. A sensitivity improvement of one order of magnitude is expected with respect to the best worldwide measurement performed so far [3]. Among several tasks, the LPC Caen was in charge of the development of the neutron detectors and the analysers of the neutron polarisation. The spectrometer commissioning is ongoing and a first data taking period is planned for 2025 and 2026.

Left: scheme of the n2EDM experiment, right: picture of the neutron precession chamber.

The PhD period (2025-2028) is ideal. The two first years will be dedicated to data taking. The candidate will participate to the analysis of the first collected data. Given the current sensitivity achieved today a new limit is expected. Specific topics related to neutron detection and spin analysis will be addressed during the thesis (data blinding, systematic effects and so on). He (she) will have to travel to Switzerland (where a long stay of a few months can be foreseen). He (she) will also be involved in the maintenance of the detectors and spin analysing system.

Expected skills of the candidate:

- Numerical methods and data analysis, knowledge of statistical methods.
- Knowledgeable in experimental methods in nuclear or particle physics
- Programming (C++/python/others)

For further information, contact T. Lefort: 00.33.2.31.45.24.12, lefort@lpccaen.in2p3.fr.

[1] Violation of CP invariance, C asymmetry, and baryon asymmetry of the universe", ZhETF Pis'ma *(1967*).
[2] The design of the n2EDM experiment, Eur. Phys. J. C. (2021).
[3] Measurement of the permanent EDM of the neutron, PRL 124 (2020).