Internship offer – Year 2020-2021

Internship level: M2

Duration: 4 months

Possible PhD follow up: Yes

Proposed PhD funding type: PhD School PHAST

Supervisor: Antonio Uras

Phone: +33 47 24 31429

Email: antonio.uras@cern.ch

Address: IP2I Lyon – Bureau 205
Domaine Scientifique de la Doua – Bât. Paul Dirac
4 rue Enrico Fermi – 69622 Villeurbanne Cedex - France

Mentoring team: ALICE

Research field: Particle physics

Internship title: Testing the Standard Model in ultra-peripheral heavy-ion collisions: study of the performances of the ALICE-3 detector for the measurement of the tau (g-2) and the search for axion-like particles.

Work description: A number of outstanding experimental and theoretical observations point to an incompleteness of the standard model (SM). The high-energy hadronic collisions provided by the LHC are currently the best environment for searches of a large variety of beyond SM (BSM) physics signals. In this context, heavy-ion collisions are typically disfavored with respect to proton-proton collisions due to the reduced luminosity and the lower per-nucleon collision energy. However, ultra-peripheral heavy-ion collisions (UPC), quasi-elastic processes where the impact parameter is much greater than the ion radius, could provide better conditions for searches of specific BSM searches. In UPCs, the ions remain (largely) intact, and there is a large rapidity gap between any produced particle and the beam-line with very little detector activity: this clean environment, along with the huge Z^4 enhanced signal rate, can in principle be exploited for searches of BSM particle coupling predominantly to photons, or precision measurements of electromagnetic couplings of SM particles.

The proposed internship will focus on the study of the performance of the ALICE-3 detector (proposed to replace the current ALICE detector beyond 2030 at the CERN LHC) for the search of axion-like particles and the measurement of the anomalous magnetic moment (g-2) of the tau lepton, exploiting the clean environment and the large photon-photon cross-section available in UPC of Pb nuclei at the CERN LHC. The required work will include a review of the physics processes responsible for the proposed measurements, as well as a discussion of the main particle detection techniques and particle reconstruction algorithms, and will mainly consist in an activity of Monte Carlo simulations and interpretation of results.