Search for the coherent neutrinoless transition of a muon to an electron in a muonic atom with the COMET experiment at J-Parc

Master 2 Research Internship at Laboratory of Physics of Clermont (LPC)
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Several experiments are looking for Beyond the Standard Model signals through charged lepton flavour violation (cLFV) searches. Being forbidden in the Standard Model (SM), and strongly suppressed in minimal SM extensions capable of accounting for neutrino oscillation data, cLFV is a particularly powerful probe for New Physics.

The neutrinoless muon-electron conversion of a muonic atom ($\mu^- + (A, Z) \rightarrow e^- + (A,Z)$) was already used to put bounds on cLFV (7×10^{-13} presently). The muonic atoms are created by capturing muons at rest in a standard atom. Since the limit on neutrinoless muon-electron conversion is very stringent already, the way to further improve it is to create as many muonic atoms as possible by using very intense beams of low energy muons. The upcoming experiment COMET (COherent Muon to Electron Transition) at the Japan Proton Accelerator Research Complex (J-PARC) is expected to push it by four orders of magnitude by taking advantage of the highest intensity muon beam in the world.

To preserve the expected sensitivity of COMET to the neutrinoless muon-electron conversion, the detector needs to be protected from the background induced by atmospheric muons by a subdetector called Cosmic Ray Veto (CRV). One of the CRV components needs to operate in a very high radiation environment and is made out of Glass Resistive Plate Chambers (GRPCs).

The LPC group is responsible for defining the GRPC-CRV design through Monte Carlo simulations and validating the performance of GRPC-prototypes in a testbench at LPC and in dedicated testbeams. The M2 candidate will work on the implementation of the GRPC-CRV into COMET Geant-4 simulation and analysis framework called ICEDUST and on the testing of prototypes in the cosmic testbench.

Since one of the options for the GRPC readout is the Front-End Electronics developed at IP2I for the CMS Muon Chambers, the M2 candidate is expected to spend significant time at IP2I Lyon.

In addition to the usual academic requirements (good understanding of particle and detector physics, basics of C++ coding and analysis techniques), a good command of (scientific) English is required since the internship will be performed in close interaction with COMET collaborators from KEK (Japan), Monash University (Australia) and Imperial College London (UK).

A successful Master 2 Internship can be followed by a summer internship at KEK and a PhD on cLFV search within the COMET group at LPC.