Two internship positions are proposed at the Padova Division of the Italian National Istitute of Nuclear Physics (INFN):

Subject 1: Optimization of calorimeter of a muon collider experiment

Studies for the design of a future particle collider employing muons are focusing on the possible layout of a detector, which should effectively reconstruct decays of Higgs bosons and search for new physics at high energy in muon-muon collisions. In this context, the design of the calorimeter is crucial for the detection of photons emitted by Higgs boson decays. The student would participate to the study of how different geometries of the detection elements affect the discrimination of real photons from background due to the decay of muons in the beam. Knowledge of C++ and/or python is useful for this work.

Subject 2: Development of an innovative tomography technique using muon k capture

Tomography employing muons (from cosmic rays or otherwise) is used for industrial and research applications ranging from archaeology to geology, border control, industrial process control, nuclear plants. Usually muons are tracked before and after a volume of interest, and the composition of the latter is inferred by the scattering of the particles; or by detection of the absorption of muons in the material. A novel idea is to exploit the capture of negative muons inside atoms, where they interact with protons emitting a neutron with a lifetime different from that of ordinary muon decay. This opens the way to precise inference on the atomic species where the process takes place, as the lifetime is strongly dependent on the atomic Z. The student would develop aspects of the simulation of the process and the reconstruction of the image of unknown volumes from information on the direction and lifetime of detected particles. Basic knowledge of C++ is needed for this work.

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