

Search for physics beyond the standard model at the LHC and FCC using effective field theory

Scientific context

The CMS experiment at the Large Hadron Collider operates at the energy frontier, with a broad research programme searching for evidence of new massive particles predicted in extensions of the standard model (SM). However, if these new states are beyond the direct energy reach of the LHC, a different approach is needed. Using the framework of *effective field theory* (EFT), it is possible to systematically study how new physics leads to deviations from SM predictions in the energy regime accessible. The EFT introduces a set of higher dimensional operators to the SM Lagrangian that parameterise all possible beyond-the-SM interactions. The challenge is that the number of operators is large: nearly 2500 at the lowest order, meaning we need a large set of measurements to probe them all. The Future Circular Collider (FCC) is proposed to be built at CERN in the next decades, and will offer unprecedented precision for Higgs boson and other electroweak measurements in the EFT framework.

Internship project

The goal of the project is to study how measurements from the LHC (probing high energies) and FCC (for electroweak precision) can be combined in a global EFT fit, to provide complementary sensitivity to a wider range of beyond-the-SM effects than either could alone. The student will develop a lightweight fitting framework for this task, in which a wide set of current and predicted future measurements can be combined. From this they will be able to determine how many EFT operators we are sensitive to. The focus will then be on mapping EFT operator constraints to specific beyond-the-SM theories, e.g. supersymmetry, to understand how our indirect constraints with the EFT compare with direct searches for new heavy particles.

Host team at the Laboratoire Leprince-Ringuet

The CMS group at LLR is a founding member of the CMS Collaboration. It has designed, built, and is responsible for the operation of the L1 trigger for the electromagnetic calorimeter (ECAL). It has also designed the calorimeter mechanics and contributed to the front-end readout electronics. It has major involvement in particle reconstruction and identification with the e/gamma and tau Physics Object Groups, and contributed to the development of the Particle Flow event reconstruction. It is among the leading protagonists within the CMS collaboration in diboson, multiboson and Higgs physics, as well as in heavy ions physics.

Other information

This internship is intended for students at the M2 level. Experience of coding in Python is desirable.



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