Hunting for new physics through measurements of the Higgs boson with the CMS experiment

The Higgs boson was discovered by the CMS and ATLAS experiments at the CERN Large Hadron Collider (LHC) in 2012. As the most recently-observed particle in the standard model (SM) of particle physics, understanding the properties of this particle is an important part of the physics programme at the LHC. At the same time, direct searches for new particles not predicted in the SM are continuing in parallel. However, those searches have so far not yielded direct evidence of new particles. It is therefore possible that the new physics that we are looking for is much heavier than can be produced at the LHC. If that is the case, the only way in which we can learn about the presence of possible new particles is through precise measurements of SM particles. The third run of the LHC is currently ongoing, with collisions taking place at a record centre-of-mass energy of 13.6 TeV. The data that are being collected will allow us to probe the properties fo the Higgs boson, and the SM, in more detail than ever before.

The goal of this project will be to develop an analysis strategy for measuring the Higgs boson and other SM particles such as W or Z bosons simultaneously, with the aim to constrain the possible presence of new physics in the context of the framework of effective field theories. The student will simulate samples of signal events (Higgs boson as well as other particles) using Monte Carlo event generators, and try to optimize the sensitivity to the possible presence of new physics, by minimizing the presence of background events. Novel analysis techniques can be tested in this process.

In case the project is followed by a PhD thesis, the student would be able to continue working on a similar topic within the CMS group at LLR, where proton-proton collision data collected during the current run of the LHC would be analyzed.

LLR is a founding member of the CMS experiment, and many of the activities of the CMS group at the laboratory focus on studies of the Higgs boson, in the ZZ, bb, and di-tau lepton final states. Additionally, members of the group have expertise in multiboson measurements.

For more information, interested candidates should e-mail Adinda de Wit (**adinda.dewit@cern.ch**)