

A window to new physics through Higgs boson measurements with the CMS experiment at the LHC

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. The Higgs boson can be produced through different mechanisms and can decay into different final states. All of these production and decay combinations are thus studied at the LHC, usually in individual analyses. However, to get a full picture of the characteristics of the Higgs boson, we need to consider all these analyses jointly to perform what we call combined Higgs boson measurements.

These combined measurements provide the best possible precision on the properties of the Higgs boson, and are additionally interpreted in new physics scenarios, for example in the context of the framework of effective field theories (EFT). In such a framework we set constraints on parameters that describe the possible contribution from new physics interactions. This is a powerful framework that can highlight possible deviations from the SM, but that, in the presence of such deviations, does not indicate which specific new physics model is responsible for the deviations.

The goal of this project is to study the extent to which the combined Higgs boson measurements from the CMS Collaboration can constrain specific new physics models, by reparameterizing the EFT constraints that have already been set. As the statistical model for the combined Higgs boson measurements is highly computationally intensive, a simplified statistical model will be set up for this. As part of the project, it would also be possible, depending on the student's interest, to study the best way to construct this model, which could have implications for future combined Higgs boson measurements at the LHC.

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

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 and direct searches for heavy new particles.

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