# « Search for Super Symmetry in the Higgs sector »

The first years of the LHC data have lead the discovery of the Higgs boson with properties very close to those predicted for a Higgs boson of the Standard Model (SM). At the same time numerous searches for physics beyond the Standard Model (BSM) have been performed, particular for Super Symmetry (SUSY), the most popular and best-motivated possible extension of the SM. No supersymmetric particle has been discovered so far and the possible mass scale for such particles seems now to be well above one TeV.
Besides the existence of new particles Super Symmetry predicts a significant modification of the Higgs sector: The simplest realization, the Minimal Supersymmetric Standard Model (MSSM), adds one neutral CP-even Higgs boson, one CP-odd Higgs boson and a pair of charged Higgs bosons to the Standard Model Higgs. In other extensions, for example the Next to Minimal Supersymmetric Standard Model (NMSSM), there will be more neutral bosons, three neutral scalars and two neutral pseudo-scalars. As a consequence it will be possible to study Higgs-Higgs interactions by decays of one type of Higgs boson to another one, giving new and often spectacular signatures.
The next Run of the LHC with high luminosity at a centre of mass energy of 13 TeV will allow probing these extensions of the Higgs sector in different search channels and analysis strategies. This will be the central subject of the thesis proposed here. The thesis will be preceded by a Master thesis / Internship in the context of the Master Subatomic and Astroparticle Physics in Strasbourg.
Both the master thesis (internship) and the PhD thesis will be carried out at the IPHC, Strasbourg within the CMS experiment at the LHC.

The Master thesis (stage M2) will concentrate on a phenomenological feasibility study (Monte-Carlo simulation level) of one (or two) possible search channels for a non-standard model Higgs boson and determine their experimental challenges like for example lepton (tau) identification and evaluate the discovery potential.

The PhD thesis will apply the ideas of the phenomenological study on the new LHC data at 13 TeV: A data analysis strategy and the corresponding analysis programmes will be developed in the context of the CMS collaboration, especially within the Higgs-working groups. Close contacts with theoretical physicists in France (GDR Terascale) and in Germany (KIT), specialists of the NMSSM, are foreseen in order to work towards a discovery of Super Symmetry in the Higgs sector or place strong limits on parts of the SUSY parameter space within the framework of the NMSSM or for SUSY in general.

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