Search for charge-parity (CP) violation in Higgs decays to two tau leptons

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In 2012, the ATLAS and CMS experiments at the LHC discovered a new particle [1,2,3], whose properties are in good agreement with those predicted for the Higgs boson within the Standard Model (SM). Beside many other measurements, the measurement of its CP state draws a particular attention. Any deviation from a purely scalar state would be a clear sign for new physics beyond the SM. In contrary, a confirmation of a purely scalar state would allow to exclude new physics models such as several supersymmetry models.

Measurements of the Higgs CP state have been performed by ATLAS and CMS in different Higgs production channels. Additionally, the CMS experiment has performed, for the first time, the measurement of the CP state in the Higgs to two τ-leptons decay using the data collected in the Run2 of the LHC [4]. The IPHC group has contributed to this analysis with the analysis of the τ -lepton reconstructed from three charged pions. For that, the so-called "polarimetric vector method" has been developed to build a proxy for the CP state.

The Run3 data taking of the LHC will start in July 2022. This thesis will be performed within the Higgs to τ-leptons CP measurement analysis. The new data as well as further developments on discriminating observables and analysis techniques will help to significantly increase the precision of this measurement. A fraction of the time would further be devoted to the work on the tracking detector upgrade of the CMS experiment for the High-Luminosity-LHC. The IPHC group is strongly involved in the design and construction of one part of this detector.

Further information: http://www.iphc.cnrs.fr/-CMS-.html

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