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Complementing constraints of the Higgs potential shape with triple-Higgs searches at the LHC

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The discovery of the Higgs boson in 2012 was a triumph for the Standard Model (SM) of particle physics and the mechanism of electroweak symmetry breaking. An essential ingredient to this mechanism is the Higgs field potential, which is introduced ad-hoc and assumed to be Mexican-hat shaped in the SM, but cannot be derived from first principles. It is therefore important to probe this shape experimentally. Current measurements of single Higgs boson production only probe the area around minimum of the potential. To determine its exact shape, measurements of processes involving self-couplings of N Higgs bosons (H^N) are needed. While there is an extensive existing research programme to extract the triple Higgs coupling (HHH) from di-Higgs production, little attention is currently given to the quartic Higgs coupling (HHHH) which can be extracted from searches for triple Higgs production. In this talk, we will demonstrate how experimental searches for triple Higgs production can complement the ongoing di-Higgs programme. Starting from the sensitivities of both search types to the HHH and HHHH coupling we estimate experimental precision for upcoming LHC runs to arrive at a first projection for LHC era measurements.

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