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The more the merrier: searching for Higgs boson twins and triplets with ATLAS

An intriguing property of the Higgs field is its ability to interact with itself. Experimentally, the trilinear (triple-Higgs vertex) and quartic (quadruple-Higgs vertex) self-interactions can be probed in proton-proton collisions at the LHC that result in two or three Higgs bosons. These rare and hard-to-identify processes not only provide unique access to the full shape of the Higgs potential and the mechanism of electroweak symmetry breaking in the early universe but could also be sensitive to new phenomena not predicted in Standard Model. Existing searches for Higgs-boson pair production, which itself has not been observed yet, are already able to constrain the trilinear self-coupling. The observation of Higgs boson pair production is a key goal of the LHC scientific programme.

The even rarer process of tri-Higgs production could provide complementary information on the trilinear coupling and unique constraints on the quartic coupling but has not been explored in the LHC searches published to date.

In this project, we will explore experimental techniques to efficiently identify collision events with three Higgs bosons and to discriminate them against the huge background from other processes using multivariate techniques. A particular focus will be placed on the reconstruction and identification of Higgs boson decays to b-quarks in events with high jet multiplicities, building on approaches developed for di-Higgs searches.

Group

FH-ATLAS

Project Category

B1. Physics Data Analysis and Performance (software-oriented)

Special Qualifications

Python or C++ (required); advanced PP lectures or ML courses/experiences are desirable but not strictly required

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