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HIPPO —HIggs Pairs and POtential

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Picoseconds after the Big Bang, the Universe experienced a phase transition into a state of lower energy, in which nearly all fundamental particles became massive by interacting with the Higgs field. About 13.8 billion years later, the 2013 Nobel Prize in physics was awarded to Englert and Higgs for discovering this mass-generating mechanism, confirmed by the observation of a spin-0 neutral boson with a mass of 125 GeV by ATLAS and CMS at the Large Hadron Collider (LHC) in 2012. The shape of the Higgs potential and the Higgs boson self-coupling are among the most important open questions in particle physics: establishing and measuring Higgs boson pair (HH) production is central to the LHC physics program, both as the experimental signature of the Higgs boson self-coupling and as a sensitive probe of several BSM scenarios. The Higgs boson self-coupling is also strongly related to cosmology and the aforementioned phase transition in the early Universe, which may have given rise to gravitational waves that appear as a background today. We are therefore at a historic junction, where a single measurement in the terrestrial LHC experiments can shed light on the early Universe and its behaviour as a whole. A dozen particle physicists in Sweden recently formed the HIPPO project to coherently tackle these questions. Via regular meetings, the corresponding research topics progress along two inter-connected tracks, one theoretical and one experimental, which exploit the interplay between directly probing the Higgs boson self-coupling and BSM physics at colliders and indirectly probing the phase transition in the early Universe through the gravitational-wave background. An application to the Wallenberg foundation is currently in preparation, aiming at injecting funding resources into the project and creating a world-leading research environment across four academic nodes in Lund, Stockholm and Uppsala.

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