Separation of HH and HZ Final States Using Spin Correlation

Celine Stauch
LMU Munich

The Standard Model of particle physics performs well when describing fundamental physics at a small scale. However, it is unable to account for some observed phenomena, which leads to the conclusion that the current model needs to be extended. The investigation of the Higgs boson and di-Higgs production processes offers opportunities to improve the understanding of nature further. Di-Higgs processes are immensely rare and there is a large amount of background processes which make the measurement of these processes very difficult. A prominent background for the di-Higgs production is the production of a Higgs and Z boson. These processes are kinematically very similar since the two bosons have comparable masses and both processes have close cross sections in proton-proton collisions. However, the Higgs boson is a scalar particle while the Z boson has a spin of 1. The spin of the Z boson transfers to the final state particle and ultimately impacts their direction.
To investigate the impact of the particle spin on the final states, a method based on the Ellis-Karliner angle is applied. This observable was originally used on a three-jet system consisting of massless partons and will be modified for massive particles. For this purpose, two approaches are tested on generator level simulation data. Further, methods of improving the jet selection are investigated. These selection methods show that a precise jet selection is necessary to be able to distinguish between Higgs and Z bosons using spin correlations. The results suggest that the use of a modified Ellis-Karliner angle provides an observable which is applicable for the separation of the investigated di-Higgs processes from the specified background process.