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Optimizing the Higgs self-coupling measurement at ILC and C^3

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Measuring the Higgs self-coupling is a key target for future colliders and is enabled by double Higgs production. An important question is how the precision of this measurement improves with higher center-of-mass collision energy. In this work, we study the ZHH process at center-of-mass energies of 500, 550, and 600 GeV, simulated with the ILD detector concept from the International Linear Collider (ILC) using the DD4HEP toolkit. The accurate reconstruction of ZHH events under realistic detector conditions requires the use of advanced algorithms to fully utilize the initial-state kinematics, including e.g. kinematic fitting, matrix element-inferred likelihoods and jet clustering with graph neural networks (GNNs). This is the first study of the dependence of the self-coupling precision on the choice of center-of-mass energy and it demonstrates the importance of optimizing the center-of-mass energy for increased sensitivity on the self-coupling. The requirements that the Higgs self-coupling measurement puts on the choice of center-of-mass energy will be evaluated as this is important for shaping the landscape of future colliders such as ILC or Cool Copper Collider (C^3). It also highlights the reusability of the ILC detector concept and Key4HEP-based analyses for new collider concepts.

Primary author: BLIEWERT, Bryan (FTX (FTX-SLB))

Co-authors: LIST, Jenny (FTX (FTX-SLB)); TORNDAL, Julie (FTX (FTX-SLB)); NTOUNIS, Dimitris (Stanford University & SLAC National Accelerator Laboratory); VERNIERI, Caterina (SLAC); TIAN, Junping (University of Tokyo)

Presenter: BLIEWERT, Bryan (FTX (FTX-SLB))

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