Contribution ID: **59** Type: **not specified**

Accuracy Complements Energy: Impact of Electroweak Precision Tests on the Higgs Self-Coupling at FCC-ee

Thursday 5 June 2025 16:00 (15 minutes)

A Tera-Z factory, such as FCC-ee or CEPC, will have indirect sensitivity to heavy new physics up to the tens of TeV scale through higher-order loop contributions to precision measurements at the Z-pole. These provide complementary sensitivity to potential deviations from the Standard Model typically thought to best be constrained at leading order at higher energies above the Z-pole, leading to improved projected sensitivities for models such as the real singlet scalar, weakly interacting massive particles or the custodial quadruplet. The entanglement between the Z-pole and higher energy runs has a profound impact on the extraction of a bound on the Higgs Self-Coupling at FCC-ee, which is probed at next-to-leading order (NLO) via Single Higgs production. We determine the FCC-ee sensitivity to Higgs self-coupling modifications $\delta\kappa_\lambda$ within the SMEFT framework, including for the first time flavour, LEP, LHC, and FCC-ee observables in a global analysis with all leading NLO effects via one-loop renormalisation group evolution, as well as incorporating finite NLO contributions to electroweak precision and ZH observables. We find that, under reasonable assumptions, FCC-ee sensitivity to $\delta\kappa_\lambda$ can exceed that of the HL-LHC.

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Session Classification: Future Colliders