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Physics with the XFEL Compton $\gamma\gamma$ Collider (XCC) Higgs Factory

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The XFEL Compton $\gamma\gamma$ Collider (XCC) Higgs factory concept is an alternative to $e+e$ colliders which could possibly: (1) begin operation on an earlier time scale due to its lower cost and smaller footprint, and (2) provide comparable Higgs coupling measurements, with some unique advantages. With the XCC, 62.8 GeV electron beams collide with 1 keV X-ray free electron laser (XFEL) beams at points 60 μm upstream of the $e-e$ interaction point to produce tightly focused colliding beams of 62.5 GeV photons. The Higgs boson production rate is 80,000 Higgs bosons per 107 seconds at 4 MW total beam power. For the triple Higgs coupling measurement, the $\gamma\gamma$ center-of-mass energy can be upgraded to 380 GeV, where the rate for $\gamma\gamma \rightarrow \text{HH}$ is twice the rate for $e+e- \rightarrow \text{ZHH}$ at $\sqrt{s}=550$ GeV. The Higgs physics potential of the XCC is discussed, with emphasis on its unique challenges and opportunities. The measurement of the Higgs self-coupling measurement is also reviewed where, due to the simpler final state (HH vs. ZHH), the improvement in Higgs self-coupling sensitivity at the XCC could extend beyond its $1/\sqrt{2}$ statistical advantage.

Primary author: PESKIN, Michael (SLAC)

Presenter: BARKLOW, Timothy (SLAC)

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