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H \rightarrow tau⁺,tau⁻ CP Violation Analysis for SiD

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The matter-antimatter asymmetry of the universe may result at least partially from CP violation. CP violation in mesons and neutrinos is too small to account for matter-antimatter asymmetry, motivating a search for CP violation in the Higgs sector. We present a study of the potential measurement of CP symmetry of the Higgs boson at the International Linear Collider (ILC) by the SiD experiment. We study the H \rightarrow tau⁺,tau⁻ channel, which is particularly useful for CP analysis of leptonic Higgs decays because of its high branching ratio and the ease of extracting CP-sensitive statistics from tau decay products. Our method uses a double neural network system which takes energy and multiplicity statistics as inputs to tag tau events and their decay paths. We use CP-sensitivity-based event weighting methods to avoid strict cuts and make use of tau⁺ \rightarrow pi⁺, pi⁺-pi⁰, l⁺, pi⁺-2pi⁰, pi⁻+2pi⁺ decay modes. We focus on ZH, Z \rightarrow e⁺e⁻, mu⁺mu⁻ events for simplicity. Our workflow performs very well against the dominant four-fermion background and yields strong preliminary mixing angle precision estimates. These results could help improve the precision of Higgs CP violation measurements at the ILC.

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