



Contribution ID: 183

Type: Oral presentation (in person)

Searching for heavy neutral leptons through exotic Higgs decays at the ILC

Wednesday 10 July 2024 11:40 (20 minutes)

In this study we investigate the feasibility of detecting heavy neutral leptons (N_d) through exotic Higgs decays at the proposed International Linear Collider (ILC), specifically in the channel of $e^+e^- \rightarrow qq H$ with $H \rightarrow \nu N_d \rightarrow \nu l W \rightarrow \nu l qq$. Analyses based on full detector simulations of the ILD are performed at the center-of-mass energy of 250 GeV for two different beam polarization schemes with a total integrated luminosity of 2 ab^{-1} . A range of heavy neutral lepton masses between the Z boson and Higgs boson masses are studied. The 2σ significance reach for the joint branching ratio of $BR(H \rightarrow \nu N_d) \cdot BR(N_d \rightarrow l W)$ is about 0.1%, nearly independent of the heavy neutral lepton masses, while the 5σ discovery is possible at a branching ratio of 0.3%. Interpreting these results in terms of constraints on the mixing parameters $|\varepsilon_{id}|^2$ between SM neutrinos and the heavy neutral lepton, it is expected to have a factor of 10 improvement from current constraints.

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Session Classification: BSM, Global Interpretations

Track Classification: Physics and Detector: BSM, Global Interpretations