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Photon-Photon Processes at the ILC and BSM signatures with small mass differences

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In supersymmetric extensions of the Standard Model,higgsino-like charginos and neutralinos are preferred to have masses of the order of the elecktroweak scale by naturalness arguments. Light higgsinos are also well motivated from a top-down perspective. Such light $\tilde{\chi}_1^{\pm}$, $\tilde{\chi}_1^0$ and $\tilde{\chi}_2^0$ states can be almost mass degenerate. In this talk the analysis of two benchmark points which exhibits mass difference of O [GeV] in the higgsino sector is presented. Due to their mass degeneracy it is very difficult to observe the decay of such higgsinos at hadron colliders. ILC being an e^+e^- collider has the prospect of providing very clean physics environment to observe or exclude such scenarios. However, in addition to the desired $e^+e^- \rightarrow \tilde{\chi}^+\tilde{\chi}^-$ processes, parasitic collisions of real and virtual photons radiated off the e^+e^- beams occur at the rates depending on the center of mass energy (250 GeV - 1 TeV) and other beam parameters. For instance, at a centre of mass energy 500 GeV the expectation value is about 1.05 $\gamma\gamma$ events per bunch crossing. In the given higgsino scenarios, visible decay products have low transverse momenta due to their small mass differences. This so called $\gamma\gamma$ overlay has a very similar topology to our signal event which makes the removal of overlay very challenging. The standard methods to remove $\gamma\gamma$ background e.g k_t algorithm method remains inadequate. This talk presents a proposed solution namely a newly developed track grouping algorithm which is based on the concept of displaced signal and $\gamma\gamma \rightarrow$ low p_T hadron overlay vertices. By applying the track grouping algorithm to separate $\gamma\gamma \rightarrow$ low p_T hadron tracks from the higgsino decay tracks, an analysis has been performed using the full detector simulation for the International Large Detector (ILD). The results from the analysis and a comparison with the previous study which was performed without the inclusion of $\gamma\gamma \rightarrow$ low p_T hadron events is made to understand the impact of the overlay on the higgsino analysis.

Time Zone

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