Contribution ID: **90** Type: **not specified**

Long-Lived Sleptons at a 100 TeV Proton Collider (and the LHC)

Monday, 24 August 2015 17:10 (20 minutes)

This talk, based on arXiv:1505.02996, focuses on collider searches for long-lived charged particles (LLCPs), i.e., charged particles which are observed stable in the detectors.
Their discovery will be extremely exciting and give significant implication for both particle physics and cosmology.

We studied expected sensitivity of such searches at a future proton collider with $\sqrt{s}$=100 TeV with an integrated luminosity of 3000 fb^{-1}.
Adopting the charged slepton as the benchmark candidate of LLCP, we found that a 100 TeV collider has a potential to exclude $m_{\rm slepton}$<3.2-4.0 TeV at 3000 fb^{-1}.
This reach fully covers the neutralino dark matter with slepton-neutralino co-annihilation, and partly does the possible parameter region of SuperWIMP scenario.

Through this work, we noticed two novel features of 100 TeV hadron colliders that affects the search.
Firstly, in a 100 TeV hadron collider, radiative energy loss (bremsstrahlung etc.) from muons can be observed.
That is, some muons will be so energetic that lose their energy also via radiative process in the detectors.
It allowed us to distinguish LLCP from muons to reject 34% of background events.

Secondly, we found that, in 100 TeV collider, we should treat momentum resolution carefully.
Momentum resolution in trackers are often approximated as $\Delta p \propto p$, but for much larger p, it scales as $\Delta p \propto p^2$.
With this careful consideration, we found that the mass resolution of LLCPs is significantly deteriorated.

I would like to introduce the two feature to the audience (i.e., usefulness of muon radiative energy loss, and importance of careful treatment of momentum resolution), because they are not specific in LLCP searches, but will important for future discussion of both detector design and collider phenomenology.

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Session Classification: SUSY Expt. and Phenomenology

Track Classification: Supersymmetry Phenomenology and Experiment