Contribution ID: **65**   Type: **Oral**

Detecting hidden sector dark matter at HL-LHC and HE-LHC via long-lived stau decays

Thursday, 23 May 2019 17:30 (15 minutes)

We investigate a class of models where the supergravity model with the standard model gauge group is extended by a hidden sector $U(1)_X$ gauge group and where the lightest supersymmetric particle is the neutralino in the hidden sector. We investigate this possibility in a class of models where the stau is the lightest supersymmetric particle in the MSSM sector and the next-to-lightest supersymmetric particle of the $U(1)_X$-extended SUGRA model. In this case the stau will decay into the neutralino of the hidden sector. For the case when the mass gap between the stau and the hidden sector neutralino is small and the mixing between the $U(1)_Y$ and $U(1)_X$ is also small, the stau can decay into the hidden sector neutralino and a tau which may be reconstructed as a displaced track coming from a high p_T track of the charged stau. Simulations for this possibility are carried out for HL-LHC and HE-LHC. The discovery of such a displaced track from a stau will indicate the presence of hidden sector dark matter.

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Session Classification: Supersymmetry: Models, Phenomenology and Experimental Results

Track Classification: Supersymmetry: Models, Phenomenology and Experimental Results