Contribution ID: **149** Type: **parallel talk**

Radiative Natural SUSY

Tuesday, 7 May 2013 17:30 (15 minutes)

Models of natural supersymmetry seek to solve the little hierarchy problem by positing a spectrum of light higgsinos <˜ 200-300 GeV and light top squarks <˜ 600 GeV along with very heavy squarks and TeV-scale gluinos. Such models have low electroweak fine-tuning and satisfy the LHC constraints. However, in the context of the MSSM, they predict too low a value of m(h), are frequently in conflict with the measured b\to s\gamma branching fraction and the relic density of thermally produced higgsino-like WIMPs falls well below dark matter (DM) measurements. We propose "radiative natural SUSY" (RNS) which can be realized within the MSSM (avoiding the addition of extra exotic matter) and which maintains features such as gauge coupling unification and radiative electroweak symmetry breaking. The RNS model can be generated from SUSY GUT type models with non-universal Higgs masses (NUHM). Allowing for high scale soft SUSY breaking Higgs mass m_{H_u}> m_0 leads to automatic cancellations during renormalization group (RG) running, and to radiatively-induced low fine-tuning at the electroweak scale. Coupled with large mixing in the top squark sector, RNS allows for fine-tuning at the 3-10% level with TeV-scale top squarks and a 125 GeV light Higgs scalar h. The model allows for at least a partial solution to the SUSY flavor, CP and gravitino problems since first/second generation scalars (and the gravitino) may exist in the 10-30 TeV regime. We outline some possible signatures for RNS at the LHC and at a linear eˆ+eˆ- collider. If the strong CP problem is solved by the Peccei-Quinn mechanism, then RNS naturally accommodates mixed axion-higgsino cold dark matter, where the light higgsino-like WIMPS - which in this case make up only a fraction of the measured relic abundance - should be detectable at upcoming WIMP detectors.

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Session Classification: Higgs IV