Contribution ID: **576**   Type: **parallel talk**

Bayesian analysis and naturalness of (Next-to-)Minimal Supersymmetric Models

Monday 7 May 2018 18:15 (15 minutes)

In non-minimal supersymmetric (SUSY) models, additional tree-level contributions to the Higgs mass provide a possible solution to the little hierarchy problem of the minimal supersymmetric standard model (MSSM). This has generated increased interest in models such as the next-to-MSSM (NMSSM), on the grounds that they may be more natural than the MSSM. However, traditional measures of fine-tuning do not provide a well-defined method for making such comparisons, since the outcome depends heavily on the particular definition of fine-tuning chosen. We contrast the results of applying such measures to the constrained MSSM and a semi-constrained NMSSM with those obtained using so-called naturalness priors. The latter arise automatically in the context of a Bayesian analysis quantifying the plausibility that a given model reproduces the weak scale. Consequently, these naturalness priors have a well-defined probabilistic interpretation, and allow naturalness to be rigorously grounded in Bayesian statistics. We find that results based on naturalness priors agree qualitatively with the traditional measures of fine-tuning used, and illustrate how naturalness priors can provide valuable insight into the hierarchy problem.

Summary

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Session Classification: SUSY II