University of Notre Dame

Doctoral Thesis Defense

Abstract

A SINGLET EXTENSION OF THE

MINIMAL SUPERSYMMETRIC STANDARD MODEL

TOWARDS A MORE NATURAL SOLUTION TO THE

LITTLE HIERARCHY PROBLEM

by

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In this work, I present a generalization of the Next-to-Minimal Supersymmetric Standard Model (NMSSM), with an explicit μ-term and a supersymmetric mass for the singlet superfield, as a route to alleviating the little hierarchy problem of the Minimal Supersymmetric Standard Model (MSSM). I analyze two limiting cases of the model, characterized by the size of the supersymmetric mass for the singlet superfield. The small and large limits of this mass parameter are studied, and I find that I can generate masses for the lightest neutral Higgs boson up to 140 GeV with top squarks below the TeV scale, all couplings perturbative up to the gauge unification scale, and with no need to fine tune parameters in the scalar potential.

This model, which I call the S-MSSM is also embedded in a gauge-mediated supersymmetry breaking scheme. I find that even with a minimal embedding of the S-MSSM into a gauge mediated scheme, the mass for the lightest Higgs boson can easily be above 114 GeV, while keeping the top squarks below the TeV scale.

Furthermore, I also study the forward-backward asymmetry in the $t\bar{t}$ system within the framework of the S-MSSM. For this purpose, non-renormalizable couplings between the first and third generation of quarks to scalars are introduced. The two limiting cases of the S-MSSM, characterized by the size of the supersymmetric mass for the singlet superfield is analyzed, and I find that in the region of small singlet supersymmetric mass a large asymmetry can be obtained while being consistent with constraints arising from flavor physics, quark masses and top quark decays.

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Place: Nieuwland Science Hall 202

Department: Physics
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