



Search for Supersymmetry (bRPV)

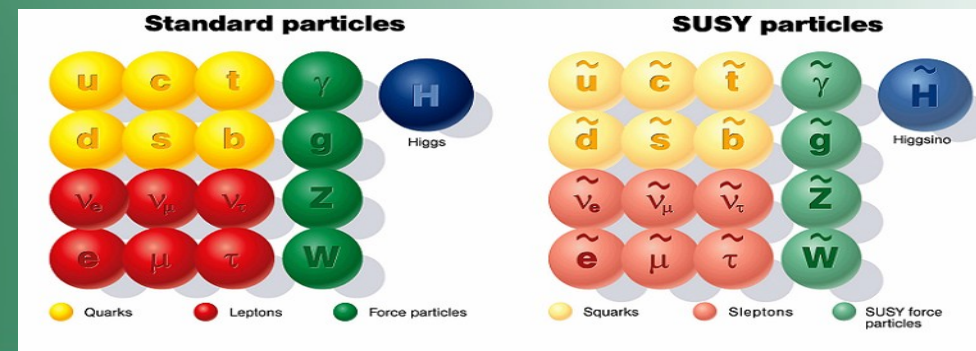
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Supersymmetry

=>SUSY is an extension of the SM that try to solve it's problems
all SM particles have SUSY-partners with
spin difference of $\pm 1/2$

- Theoretical motivations
 - Higgs mass stabilization against loop corrections (fine-tuning problem)
 - Unification of gauge couplings at single scale
 - Dark matter candidate:
Lightest supersymmetric particle (LSP) is stable



R-parity

$$\text{R-parity: } R = (-1)^{3(B-L)+2s} \rightarrow R = \begin{cases} +1, \text{ SM particles} \\ -1, \text{ superpartners} \end{cases}$$

Theoretical models

- There is many SUSY models the Simplest is MinimalSupersymmetricSM (MSSM) has > 100 parameters
 - different models
 - Gravity mediated (SUGRA)
 - Gauge mediated (GMSB)
 - Minimal Supersymmetric Standard Model (MSSM)
 - ...
 - GUT scale unification → few free parameters

R-Parity Violation (RPV)

Most of the scenarios considered within SUSY assume the conservation of R-parity

This assumption can be safely relaxed if one of number baryon or lepton is assumed to be violated

R-Parity Violation (RPV)

R-parity conservation hinted but not required by proton stability

L-number violating terms

$$W_{Rp} = \lambda_{ijk} \hat{L}_i \hat{L}_j \hat{E}_k^C + \lambda'_{ijk} \hat{L}_i \hat{Q}_j \hat{D}_k^C + \underbrace{\epsilon_i \hat{L}_i \hat{H}_u}_{\text{bilinear terms}} + \underbrace{\lambda''_{ijk} \hat{U}_i^C \hat{D}_j^C \hat{D}_k^C}_{\text{B-number violating terms}}$$

bilinear terms

B-number violating terms

SUSY is broken in a hidden sector

Gauge-mediated supersymmetry breaking

In GMSB models , SUSY breaking is propagated to the visible sector via SM-like $SU(3) \times SU(2) \times U(1)$

Advantage of the models relative to the minimal supergravity and anomaly-mediated SUSY breaking models is that scalars with the same gauge quantum numbers, but different flavors, have identical soft SUSY breaking masses

The Gravitino (\tilde{G}) is the LSP (in general $m(\tilde{G}) \ll 1$ keV), which escapes detection, leading to missing Energie

Gauge-mediated supersymmetry breaking

In large part of the GMSB parameter space the NLSP is the Neutralinos (mixtures of gaugino and higgsino)

This NLSP decays to a Gravitino and either a γ , Z, or h.

-If Neutralino is a bino-like, so the main decays is :

$$\tilde{\chi}_1^0 \rightarrow \gamma \tilde{G}$$

-If Neutralino is a higgsino-like, the main decays is :

$$\tilde{\chi}_1^0 \rightarrow H \tilde{G}$$

Bilinear RPV: theoretical motivation

Bilinear RPV

Connexion with neutralino Physics

EW symmetry is broken by Higgs and sneutrino vev's
neutrinos mix with neutralinos $\rightarrow 7 \times 7$ mixing matrix
a “low-scale” seesaw mechanism renders neutrinos
massive

Bilinear RPV: signatures in colliders

- bRPV couplings can be embedded in any supersymmetric scenario:
 - MSSM, SUGRA, AMSB, ...
- Almost same event as in RPC SUSY except that (N)LSP decays at end of SUSY cascade
- Common features among SUSY scenarios
 - LSP lifetime may be long ($c\tau \sim 1 - 100$ mm)
→ search for displaced vertices
 - many **leptons** and **taus** in final state
→ **1-**, **2-** or **multilepton** analyses relevant
 - large **MET** due to copious neutrino production
→ conventional MET-based searches applicable to bRPV SUSY

Bilinear RPV (bRPV)

In our choice of bilinear R-parity violating (bRPV) model considered here:

- The LSP is the Neutralino
- The bRPV terms are embedded in (mSUGRA) model
- The bRPV introduces nine additional parameters the free parameters in R-parity conserving

Z+missE analysis

THANK YOU