Collider phenomenology in supersymmetric models

Jong Soo Kim · TU Dortmund · Theoretische Physik III/IV

Terascale physics at the LHC

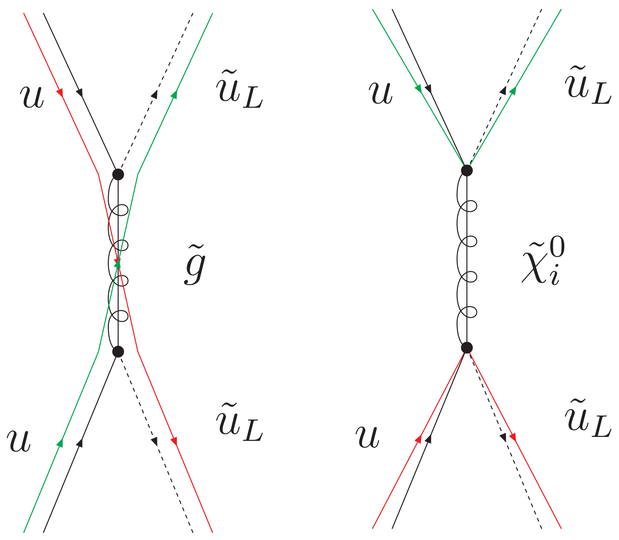
- first experimental evidence for physics beyond the Standard Model (SM) was found in the neutrino sector
- SM must be extended
- supersymmetry (SUSY) is the most promising candidate for a possible extension of the SM
- SUSY is falsifiable at the Large Hadron Collider (LHC)
- with the start of the LHC imminent, I have been interested in working on LHC collider phenomenology

Research interests

- Collider Phenomenology
  - rapidity gap signatures in supersymmetric events
  - collider signatures of heavy longliving particles
  - supersymmetric discovery channels
  - CP asymmetries at the LHC
- Model Building
  - neutrino physics
  - CP violation

Electroweak contributions to squark pair production

S. Bornhauser, M. Drees, H. K. Dreiner, J. S. Kim, published in Phys.Rev.D76:095020,2007



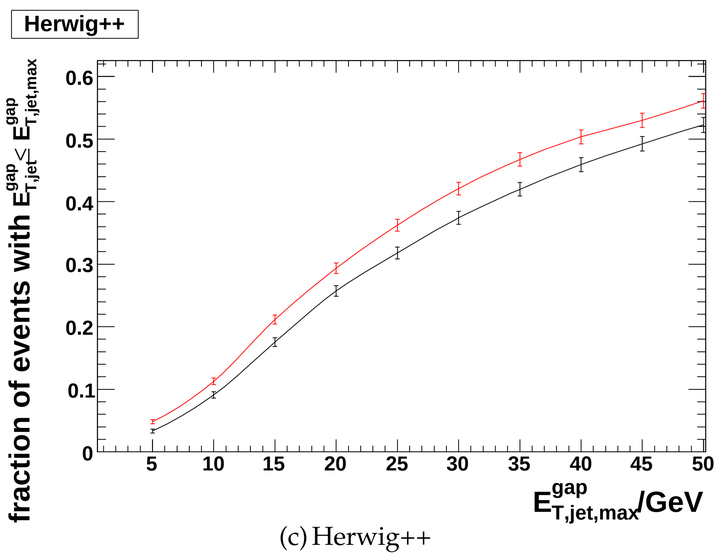
(a) color connected (b) not color connected

- squark pair production is one of the most important production channels
- even heavy squarks have large production cross section, i.e. thousands of squarks will be produced at the LHC
- we computed the electroweak (EW) contributions at leading order
- the pure QCD cross section is enhanced up to 50%
- EW can give rise to rapidity gap events

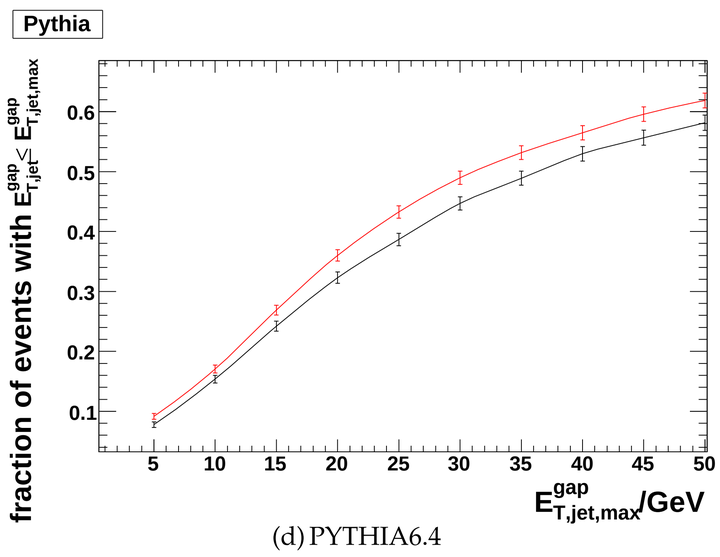
Rapidity gap events in squark pair production at the LHC

S. Bornhauser, M. Drees, H. K. Dreiner, J. S. Kim, published in Phys.Rev.D80:095007,2009

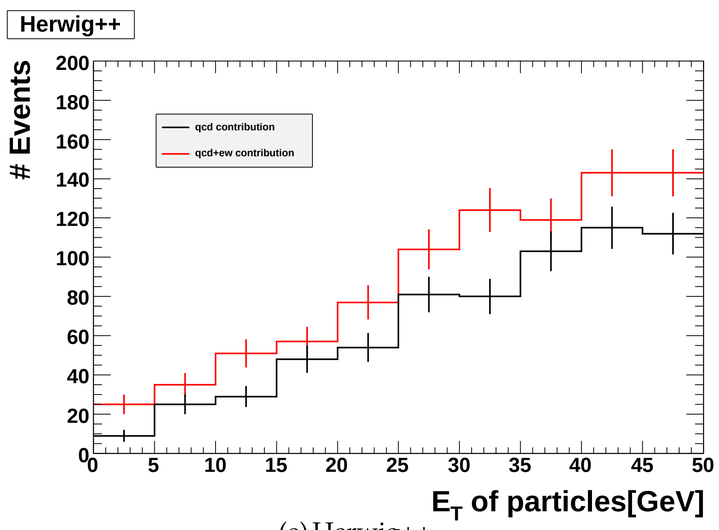
- exchange of EW gauginos in the t- and u-channel allows squark pair production without color exhange
- we investigated the potential for detection of rapidity gap events
- we found statistically significant evidence for a color singlet exchange contribution



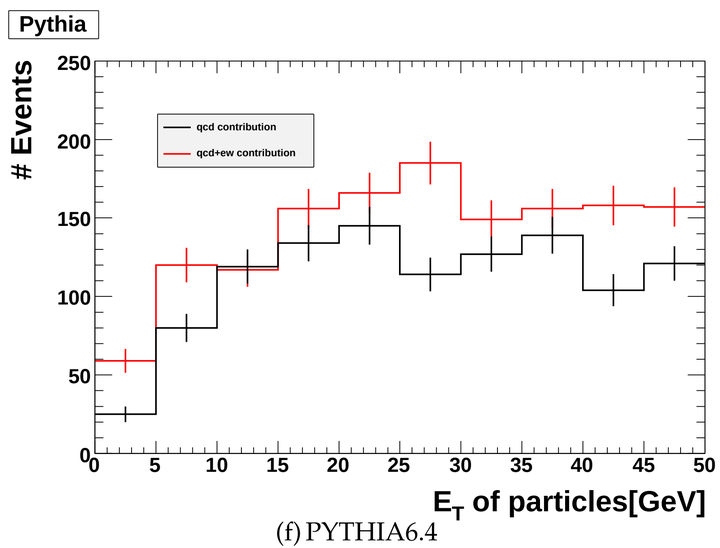
(c) Herwig++



(d) PYTHIA6.4



(e) Herwig++



(f) PYTHIA6.4

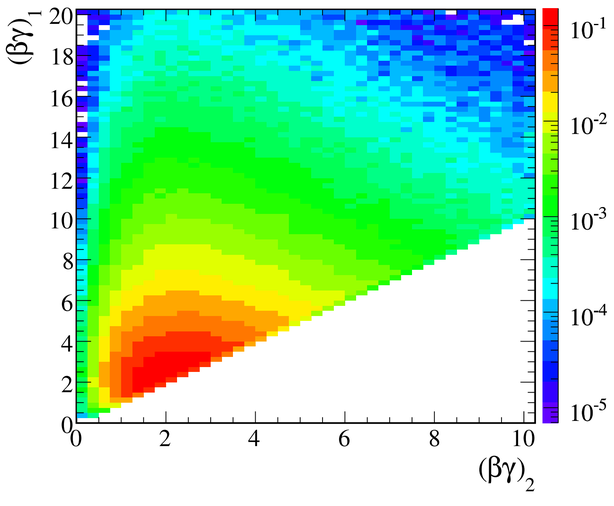
Collider signatures of minimal flavor mixing from stop decay length measurements

G. Hiller, J. S. Kim, H. Sedello

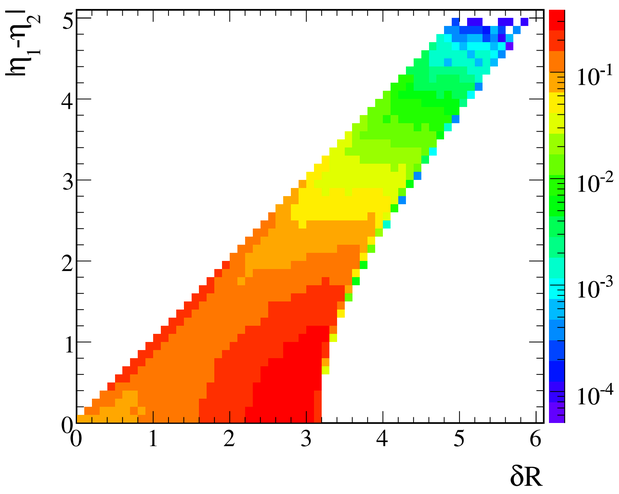
e-Print: arXiv:0910.2124, submitted to PRD

- in minimal flavor violation (MFV), flavor violation is completely determined by SM Yukawa couplings
- in general, squarks of third generation decay into same generation
- if these decays are forbidden kinematically, stop decay is suppressed by small flavor mixing couplings
- consider tree-level FCNC two body stop decay $\tilde{t}_1 \to \tilde{\chi}_1^0 c$:
- small couplings in MFV and small mass splitting $m_{\tilde{t}_1} - m_{\tilde{\chi}_1^0} \approx 5$ GeV supress width
- picosecond lifetime possible!
- consider same sign stop pair production through $pp \to \tilde{g}\tilde{g} \to \tilde{t}_1^* \tilde{t}_1^* tt$

Are the stops boosted sufficiently?



Are they separated spatially?



Charm transverse impact parameter