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Searches for supersymmetry using the M_{T2} variable in hadronic events produced in pp collisions at 8 TeV

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Abstract: Searches for supersymmetry (SUSY) are performed using a sample of hadronic events produced in 8 TeV pp collisions at the CERN LHC. The searches are based on the M_{T2} variable, which is a measure of the transverse momentum imbalance in an event. The data were collected with the CMS detector and correspond to an integrated luminosity of 19.5 fb^{-1}. Two related searches are performed. The first is an inclusive search based on signal regions defined by the value of the M_{T2} variable, the hadronic energy in the event, the jet multiplicity, and the number of jets identified as originating from bottom quarks. The second is a search for a mass peak corresponding to a Higgs boson decaying to a bottom quark-antiquark pair, where the Higgs boson is produced as a decay product of a SUSY particle. For both searches, the principal backgrounds are evaluated with data control samples. No significant excess over the expected number of background events is observed, and exclusion limits on various SUSY models are derived.

Keywords: Supersymmetry, Hadron-Hadron Scattering

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Simplified model	Limit on parent particle mass at $m_{\widetilde{\chi}_1^0} = 0$	Best limit on LSP mass	Limit on mass splitting
Direct squark production			
Single light squark	$m_{\widetilde{q}} > 520\,\text{GeV}$	$m_{\widetilde{\chi}_1^0} > 120\,\text{GeV}$	$\Delta m(\widetilde{q}, \widetilde{\chi}_1^0) < 200\,\text{GeV}$
8 degenerate light squarks	$m_{\widetilde{q}} > 875\,\text{GeV}$	$m_{\widetilde{\chi}_1^0} > 325\,\text{GeV}$	$\Delta m(\widetilde{q}, \widetilde{\chi}_1^0) < 50\,\text{GeV}$
Bottom squark	$m_{\widetilde{b}} > 640\,\text{GeV}$	$m_{\widetilde{\chi}_1^0} > 275\,\text{GeV}$	$\Delta m(\widetilde{b}, \widetilde{\chi}_1^0) < 10\,\text{GeV}$
Top squark			
$m_{\widetilde{t}} > m_t + m_{\widetilde{\chi}_1^0}$	$m_{\widetilde{t}} > 450\,\text{GeV}$	$m_{\widetilde{\chi}_1^0} > 60\,\text{GeV}$	$\Delta m(\widetilde{t}, \widetilde{\chi}_1^0) < 230\,\text{GeV}$
$m_{\widetilde{t}} < m_t + m_{\widetilde{\chi}_1^0}$	$m_{\widetilde{t}} > 175\,\text{GeV}$	$m_{\widetilde{\chi}_1^0} > 60\,\text{GeV}$	$\Delta m(\widetilde{t}, \widetilde{\chi}_1^0) < 90\,\text{GeV}$
Direct gluino production			
$\widetilde{g} \to q\bar{q}\widetilde{\chi}_1^0$	$m_{\widetilde{g}} > 1225\,\text{GeV}$	$m_{\widetilde{\chi}_1^0} > 510\,\text{GeV}$	$\Delta m(\widetilde{g}, \widetilde{\chi}_1^0) < 25\,\text{GeV}$
$\widetilde{g} \to b\bar{b}\widetilde{\chi}_1^0$	$m_{\widetilde{g}} > 1300\,\text{GeV}$	$m_{\widetilde{\chi}_1^0} > 740\,\text{GeV}$	$\Delta m(\widetilde{g}, \widetilde{\chi}_1^0) < 50\,\text{GeV}$
$\widetilde{g} \to t\bar{t}\widetilde{\chi}_1^0$	$m_{\widetilde{g}} > 1225\,\text{GeV}$	$m_{\widetilde{\chi}_1^0} > 450\,\text{GeV}$	$\Delta m(\widetilde{g}, \widetilde{\chi}_1^0) < 225\,\text{GeV}$
$\widetilde{g}_1 \to q\bar{q}\widetilde{\chi}_2^0$, $\widetilde{\chi}_2^0 \to h\widetilde{\chi}_1^0$, $\widetilde{g}_2 \to qq'\widetilde{\chi}_1^\pm$, $\chi_1^\pm \to W^\pm\widetilde{\chi}_1^0$	$m_{\widetilde{g}} > 825\,\text{GeV}$	$m_{\widetilde{\chi}_1^0} > 410\,\text{GeV}$	$\Delta m(\widetilde{g}, \widetilde{\chi}_1^0) < 225\,\text{GeV}$
cMSSM/mSUGRA model	Mass limit for $m_{\widetilde{q}} = m_{\widetilde{g}}$	Gluino mass limit	Squark mass limit
	$m_{\widetilde{g},\widetilde{q}} > 1550\,\text{GeV}$	$m_{\widetilde{g}} > 1150\,\text{GeV}$	$m_{\widetilde{q}} > 1450\,\text{GeV}$

Table 5. Summary of observed mass limits (at 95% CL) for different SUSY simplified models and for the cMSSM/mSUGRA model. The limits quoted are the observed limits using the signal cross section minus one standard deviation (σ_{theory}) of its uncertainty. For the simplified models, the limit on the mass of the parent particle is quoted for $m_{\widetilde{\chi}_1^0} = 0$, while for the LSP the best limit on its mass is quoted. The best limit on the mass splitting between the parent particle mass and the LSP mass is also given. Finally, the absolute limits on the squark and gluino masses are quoted for the cMSSM/mSUGRA model.

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