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CMS-SUS-12-011

Search for new physics in the multijet and missing
transverse momentum final state in proton-proton
collisions at $\sqrt{s} = 7 \text{ TeV}$

The CMS Collaboration

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A Supplemental Material: Baseline and search event selections

The event selection starts from a baseline selection. Events passing the baseline selection are then divided into 14 exclusive search regions. The baseline selection requirements after trigger are:

- at least three jets with $p_T > 50$ GeV and $|\eta| < 2.5$;
- $H_T > 500$ GeV;
- $\cancel{H}_T > 200$ GeV;
- $|\Delta\phi(J_n, \vec{\cancel{H}}_T)| > 0.5$ rad, $n = 1, 2$ and $|\Delta\phi(J_3, \vec{\cancel{H}}_T)| > 0.3$ rad, where $\Delta\phi$ is the azimuthal angle difference between jet axis J_n and the $\vec{\cancel{H}}_T$ direction for the three highest- p_T jets in the event;
- no isolated muons or electrons in the event;
 - muons and electrons are required to have $p_T \geq 10$ GeV and a good quality track that is matched to the primary vertex within $200 \mu\text{m}$ transversely and 1 cm longitudinally;
 - they are required to be isolated, with a relative isolation variable, defined as $\left[\sum^{\Delta R < 0.3} p_T^{\text{charged hadron}} + \sum^{\Delta R < 0.3} p_T^{\text{neutral hadron}} + \sum^{\Delta R < 0.3} p_T^{\text{photons}} \right] / p_T$, smaller than 0.2, where $p_T^{\text{charged hadron}}$, $p_T^{\text{neutral hadron}}$, and p_T^{photons} are, respectively, the transverse momenta of charged hadrons, neutral hadrons, and photons, as reconstructed by the particle-flow algorithm, within a distance $\Delta R = 0.3$ in η - ϕ space of the lepton;
 - muons are required to have $|\eta| < 2.4$, whereas electrons should have $|\eta| < 2.5$ excluding the barrel-endcap transition region $1.44 < |\eta| < 1.57$;
- jets with $p_T > 30$ GeV have an electromagnetic p_T fraction less than 0.95 and a neutral hadron p_T fraction less than 0.90.

Events passing the baseline selection are divided into 14 search regions:

- for the H_T bins of 500–800 and 800–1000 GeV, \cancel{H}_T is binned into 200–350, 350–500, 500–600, and >600 GeV;
- for the H_T bin of 1000–1200 GeV, \cancel{H}_T is binned into 200–350, 350–500, and >500 GeV;
- for the H_T bin of 1200–1400 GeV, \cancel{H}_T is binned into 200–350 GeV and >350 GeV;
- for the H_T bin of $H_T > 1400$ GeV, $\cancel{H}_T > 200$ GeV.

References

- [1] CDF Collaboration, “Inclusive Search for Squark and Gluino Production in $p\bar{p}$ Collisions at $\sqrt{s} = 1.96$ TeV”, *Phys. Rev. Lett.* **102** (2009) 121801, doi:10.1103/PhysRevLett.102.121801, arXiv:0811.2512.
- [2] D0 Collaboration, “Search for squarks and gluinos in events with jets and missing transverse energy using 2.1 fb^{-1} of $p\bar{p}$ collision data at $\sqrt{s} = 1.96$ TeV”, *Phys. Lett. B* **660** (2008) 449, doi:10.1016/j.physletb.2008.01.042, arXiv:0712.3805.
- [3] ALEPH, DELPHI, L3 and OPAL Collaborations, “Joint SUSY Working Group”, (2002). LEPSUSYWG/02-06-2.

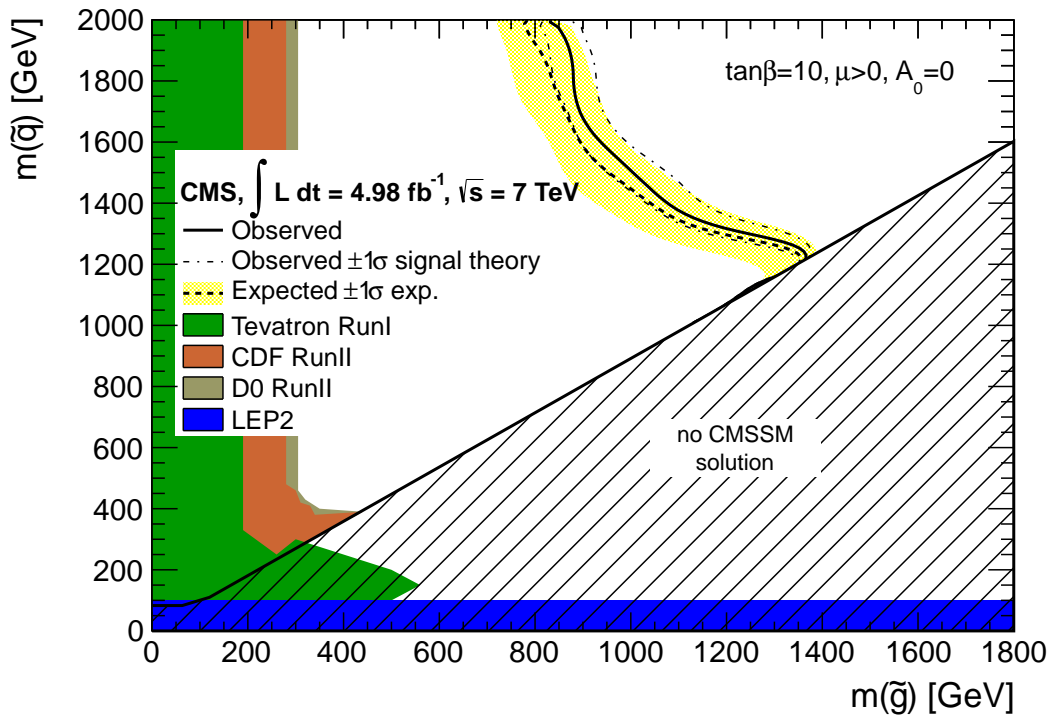


Figure 1: The observed and expected 95% CL lower limits in the CMSSM $(m(\tilde{g}), m(\tilde{q}))$ plane, for $\tan\beta = 10, \mu > 0$, and $A_0 = 0$. The yellow-shaded region shows the $\pm 1\sigma$ variation in the expected limit, while the dot-dashed curves show the variation in the observed limit when the signal cross section is varied by its theoretical uncertainties. The limits from earlier searches by other experiments [1–3] are also shown. Comparisons with earlier searches are shown for illustrative purpose only, as they are derived with different models or parameter choices.

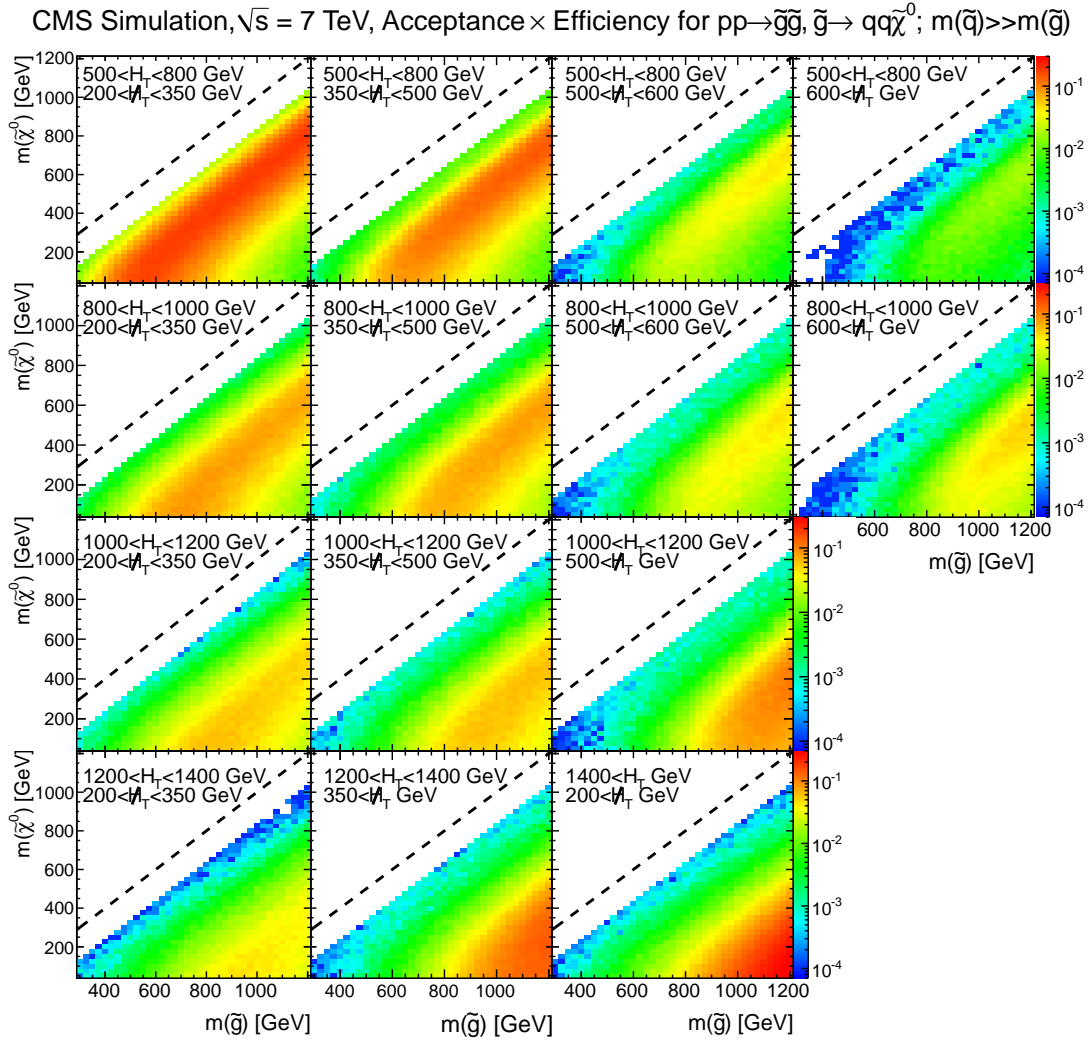


Figure 2: The acceptance times efficiency of the 14 search regions for the simplified model of $\tilde{g}\tilde{g}$ ($\tilde{g} \rightarrow qq\tilde{\chi}^0$) production in the $(m(\tilde{g}), m(\tilde{\chi}^0))$ plane. Empty points are due to the low acceptance times efficiency where no simulated signal events pass the search selection.

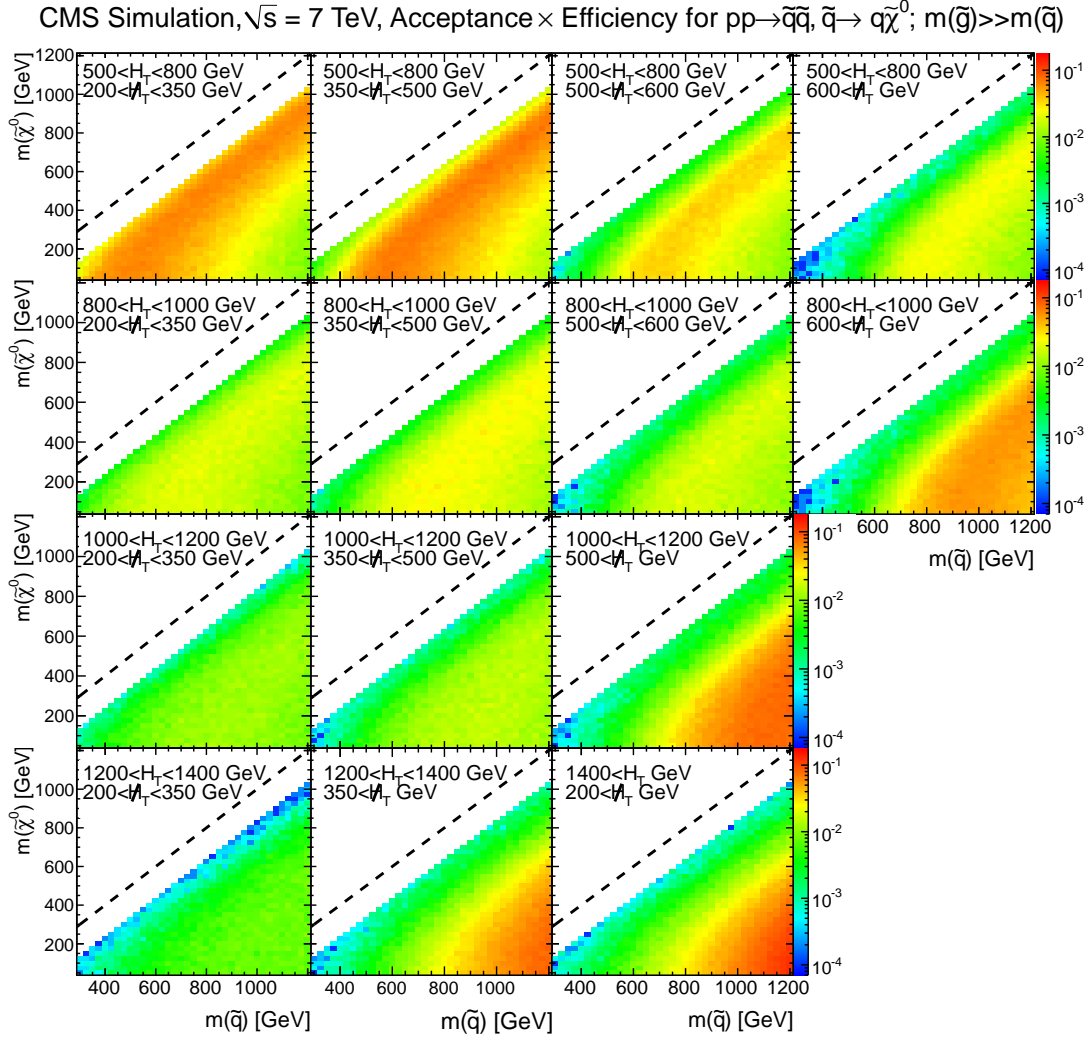


Figure 3: The acceptance times efficiency of the 14 search regions for the simplified model of $\tilde{q}\tilde{q}$ ($\tilde{q} \rightarrow q\tilde{\chi}^0$) production in the $(m(\tilde{q}), m(\tilde{\chi}^0))$ plane. Empty points are due to the low acceptance times efficiency where no simulated signal events pass the search selection.