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Supplemental Material for : Search for physics beyond the standard model in events with a Z boson, jets, and missing transverse energy in pp collisions at $\sqrt{s} = 7$ TeV

The CMS Collaboration

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A Additional Interpretation of the Results

In this appendix we interpret our results in the context of two additional SMS topologies. The first topology is the same as discussed in Sec. 7, in which the LSP is the lightest neutralino, but with a different choice of the $\widetilde{\chi}_2^0$ mass parameter, $x = 0.75$, so that the $\widetilde{\chi}_2^0$ is closer in mass to the gluino than to the LSP. The second is a topology inspired by gauge-mediated SUSY-breaking (GMSB) models, in which the LSP is a light gravitino (mass $\lesssim 1$ keV), which is treated here as massless. In this scenario, we consider gluino pair-production where each gluino decays to a pair of jets and the lightest neutralino $\widetilde{\chi}_1^0$, which itself decays to a Z boson and the gravitino ($\tilde{G}$) LSP, as shown in Fig. 1. If the $\widetilde{\chi}_1^0$ is mostly bino then the decay $\widetilde{\chi}_1^0 \to \gamma\, \tilde{G}$ dominates, while the decay $\widetilde{\chi}_1^0 \to \mathrm{Z}\, \tilde{G}$ can become favored if the $\widetilde{\chi}_1^0$ is mostly wino or higgsino. The parameters of this model are the masses of the gluino and of the lightest neutralino $\widetilde{\chi}_1^0$.

Results for the neutralino LSP scenario are presented in Fig. 2 (JZB analysis) and Fig. 3 (MET analysis). Results for the gravitino LSP scenario are presented in Fig. 4 (JZB analysis) and Fig. 5 (MET analysis).

The JZB search relies on the correlation between the Z boson and the $E_{\mathrm{T}}^{\mathrm{miss}}$ directions, which leads to an asymmetry in the JZB distribution. The sensitivity of this search is thus reduced in mass spectra that lead to symmetric JZB, as can be the case in the GMSB-inspired scenario in the region of parameter space that is evident, e.g., in Fig. 4.

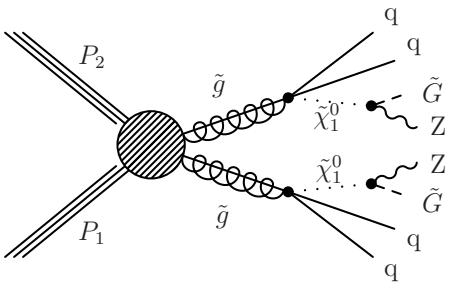

Figure 1: Simplified model for the production of two gluinos decaying into two Z bosons, two gravitinos, and jets.

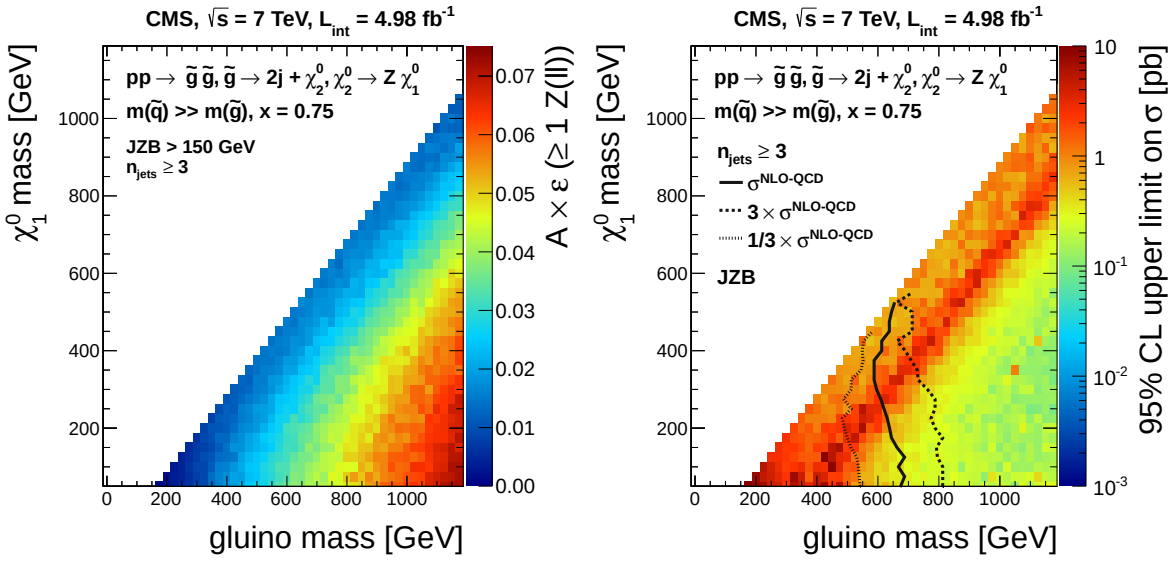

Figure 2: Limits on the SMS topology with neutralino LSP ($x = 0.75$), based on the JZB method: (left) signal efficiency times acceptance normalized to the number of events with at least one $Z \to \ell\ell$ decay for the JZB $>$ 150 GeV region; (right) 95% CL upper limits on the total gluino pair-production cross section. The region to the left of the solid contour is excluded assuming that the gluino pair-production cross section is $\sigma^{\text{NLO-QCD}}$, and that the branching fraction to this SMS topology is 100%. The dotted and dashed contours indicate the excluded region when the cross section is varied by a factor of three. The signal contribution to the control regions is taken into account.

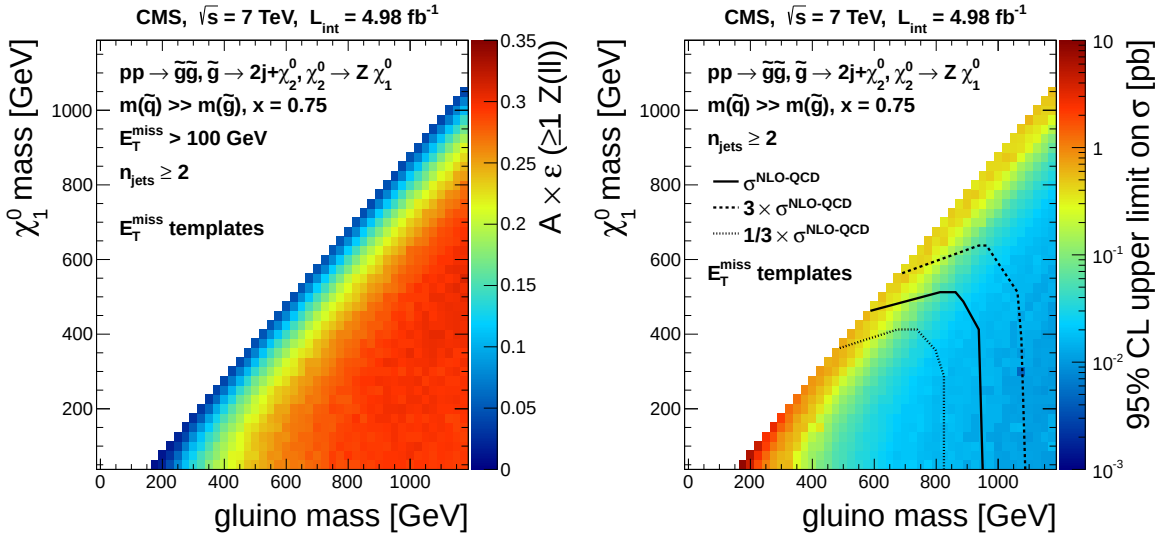

Figure 3: Limits on the SMS topology with neutralino LSP ($x = 0.75$), based on the $E_{\text{T}}^{\text{miss}}$ template method: (left) signal efficiency times acceptance normalized to the number of events with at least one $Z \to \ell\ell$ decay for the $E_{\text{T}}^{\text{miss}} > 100$ GeV region; (right) 95% CL upper limits on the total gluino pair-production cross section. The region to the left of the solid contour is excluded assuming that the gluino pair-production cross section is $\sigma^{\text{NLO-QCD}}$, and that the branching fraction to this SMS topology is 100%. The dotted and dashed contours indicate the excluded region when the cross section is varied by a factor of three. The signal contribution to the control regions is negligible.

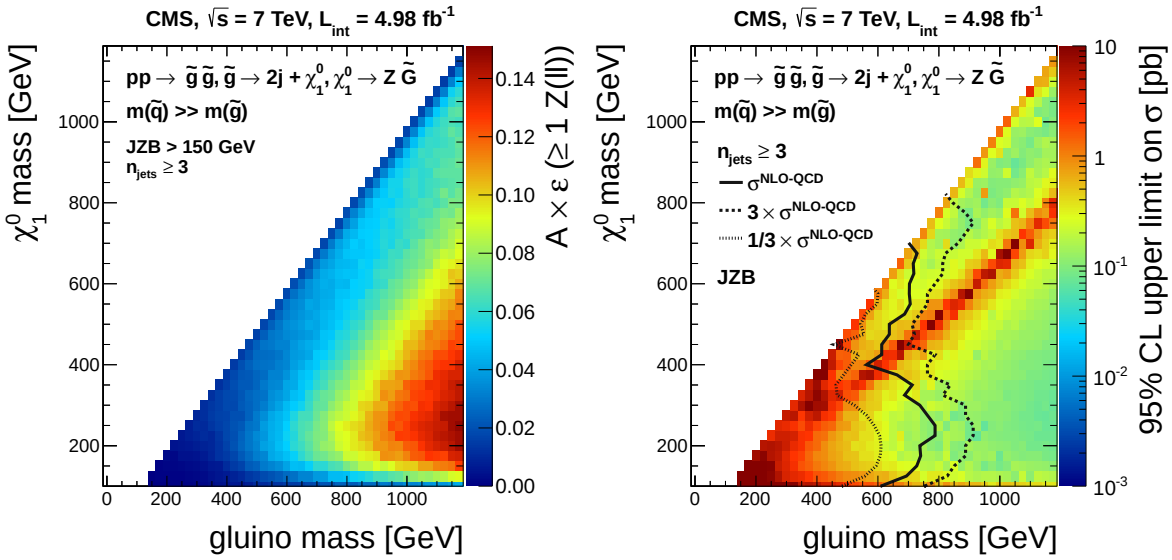

Figure 4: Limits on the SMS topology with gravitino LSP, based on the JZB method: (left) signal efficiency times acceptance normalized to the number of events with at least one $Z \to \ell\ell$ decay for the JZB > 150 GeV region; (right) 95% CL upper limits on the total gluino pair-production cross section. The region to the left of the solid contour is excluded assuming that the gluino pair-production cross section is $\sigma^{\text{NLO-QCD}}$, and that the branching fraction to this SMS topology is 100%. The dotted and dashed contours indicate the excluded region when the cross section is varied by a factor of three. The signal contribution to the control regions is taken into account.

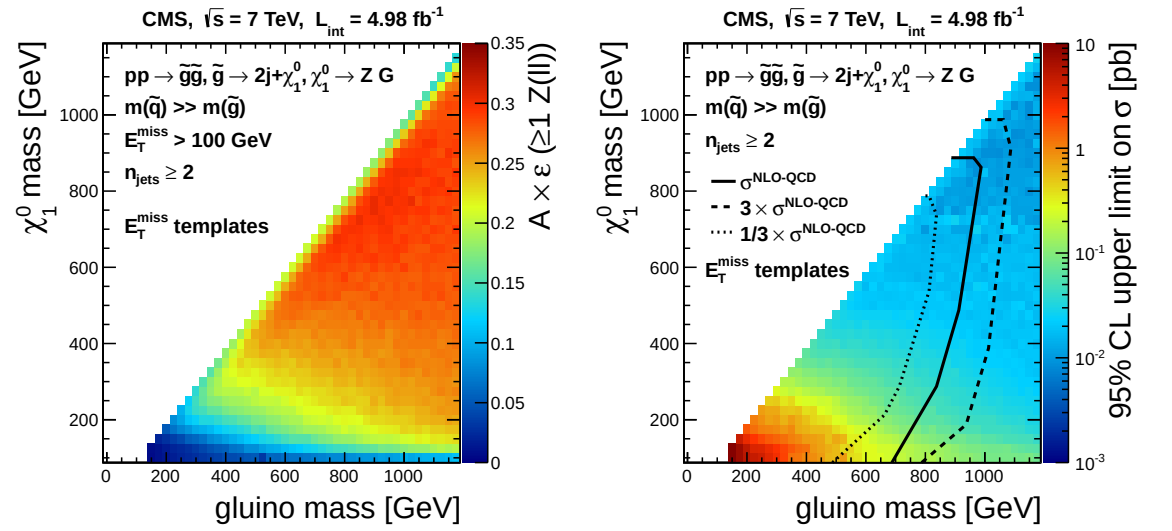

Figure 5: Limits on the SMS topology with gravitino LSP, based on the $E_{\mathrm{T}}^{\mathrm{miss}}$ template method: (left) signal efficiency times acceptance normalized to the number of events with at least one $Z \to \ell\ell$ decay for the $E_{\mathrm{T}}^{\mathrm{miss}} > 100$ GeV region; (right) 95% CL upper limits on the total gluino pair-production cross section. The region to the left of the solid contour is excluded assuming that the gluino pair-production cross section is $\sigma^{\text{NLO-QCD}}$, and that the branching fraction to this SMS topology is 100%. The dotted and dashed contours indicate the excluded region when the cross section is varied by a factor of three. The signal contribution to the control regions is negligible.