

Erratum: Visible collider signals of natural quirks **[Phys. Rev. D 111, 115021 (2025)]**

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In our original work, the constraint in Eq. (3.4) was not imposed on our plots. We present several figures updated to show only the physically meaningful parameter space. These new plots are in terms of the total mass M and $\tan \beta$, which are related to the mass splitting Δ by

$$\Delta = \frac{m_W^2}{M} \cos 2\beta = \frac{m_W^2}{M} \frac{1 - t_\beta^2}{1 + t_\beta^2}, \quad (3.4)$$

where $t_\beta \equiv \tan \beta$. We consider $0.1 \leq t_\beta \leq 10$, which effectively covers all allowed Δ for a given M . A few other minor corrections are also noted. Overall, we find that our qualitative results still hold.

Equation (2.12) should read

$$\mathcal{L} = \frac{\alpha'}{6\pi} \left(\frac{y^2}{\mu^2} \right) |H|^2 G_{\mu\nu}^{(a)} G^{(a)\mu\nu} = \frac{\alpha'}{6\pi} \left(\frac{y^2}{\mu^2} \right) v h G_{\mu\nu}^{(a)} G^{(a)\mu\nu} + \mathcal{O}(h^2) \quad (2.12)$$

and (2.14) should be

$$\frac{y^2}{\mu^2} = \frac{c_g}{2v^2}. \quad (2.14)$$

The useful upper bound for c_g given immediately after Eq. (2.14) should now be $c_g = 1/16$. Figure 1 reflects these changes as an update to Fig. 1 in the original work.

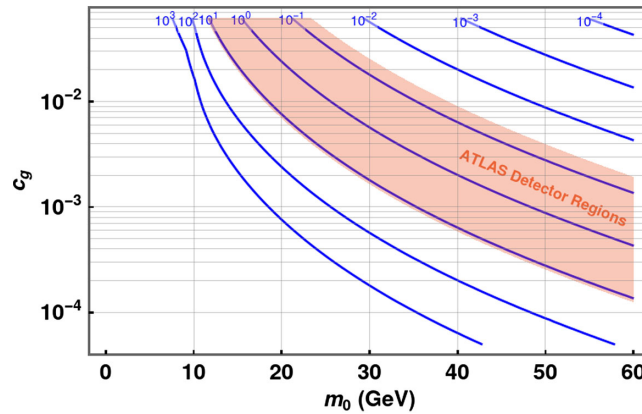


FIG. 1. Decay length in meters of the lightest glueball state, $J^{PC} = 0^{++}$. This decay length is plotted as a function of the glueball mass, m_0 , and the coupling parameter, c_g , which characterizes the coupling between the hidden gluon field and the SM Higgs. The red region indicates detector regions in the ATLAS experiment that are sensitive to displaced vertices.

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All equations with Δ remain correct in the original work, though the large M behavior of Eq. (3.11) is clearer when $\cos 2\beta$ is used:

$$\frac{\Gamma_{WZ}}{\Gamma_{W\gamma}} = \frac{s_W^2 \beta_{WZ}}{c_W^2 \beta_{W\gamma}} \left[1 + \frac{c_W^2 \cos^2 2\beta}{8s_W^4 (Q_u + Q_d)^2} \right] + \mathcal{O}\left(\frac{1}{M^2}\right). \quad (3.11)$$

Figure 4 from the original work is updated to the present Fig. 4. The qualitative shape is the same, but the BR for WZ asymptotes to $\sim 85\%$ at large M and $t_\beta \approx 1$.

Figure 5 from the original work should be replaced by Fig. 5. Additionally, Fig. 5(b) was updated to show the 13 TeV production curves scaled by semileptonic BRs for the gauge bosons, which are larger than the leptonic BR scaling shown in the original work. This update demonstrates that the WZ resonance searches still do not provide additional bounds.

Figure 6 from the original work is updated to this Fig. 6. The ATLAS 8 TeV search effectively excludes $M \lesssim 325(350)$ GeV for $t_\beta < 1(> 1)$.

Figures 8–10 in the original work are updated to Figs. 8–10 shown below. We use new values of m_0 and c_g based on Fig. 1 to show the parameter combinations with the maximum number of events passing cuts in the three detector subsystems. We also found a few minor bugs in the simulation code: a small error in calculating the missing transverse momentum and a small mistake regarding the Muon Spectrometer (MS) vertex reconstruction efficiencies. After fixing both of these, we find minimal differences in the final results. However, in presenting our final results here, we reduced the number of events constituting a “discovery” from five events to three events, similar to the FCC-ee analysis of [78].

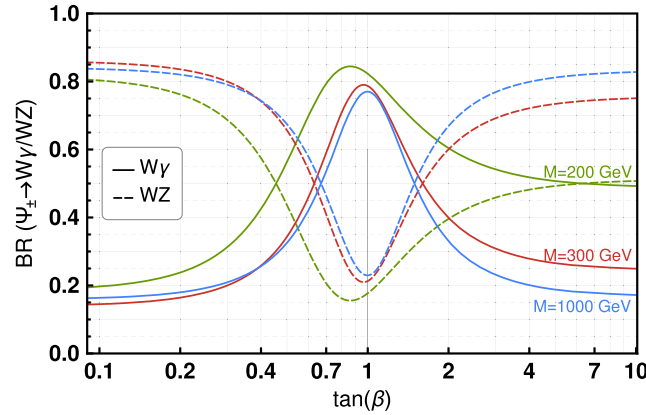


FIG. 4. Branching ratios (BRs) for a charged bound state $\Psi_\pm$ decaying into $W\gamma/WZ$ as a function of t_β for various total masses (M). The $W\gamma$ signal dominates $t_\beta \approx 1$, but turns over as t_β moves away from 1. As M increases, the turnover point moves away from extreme t_β .

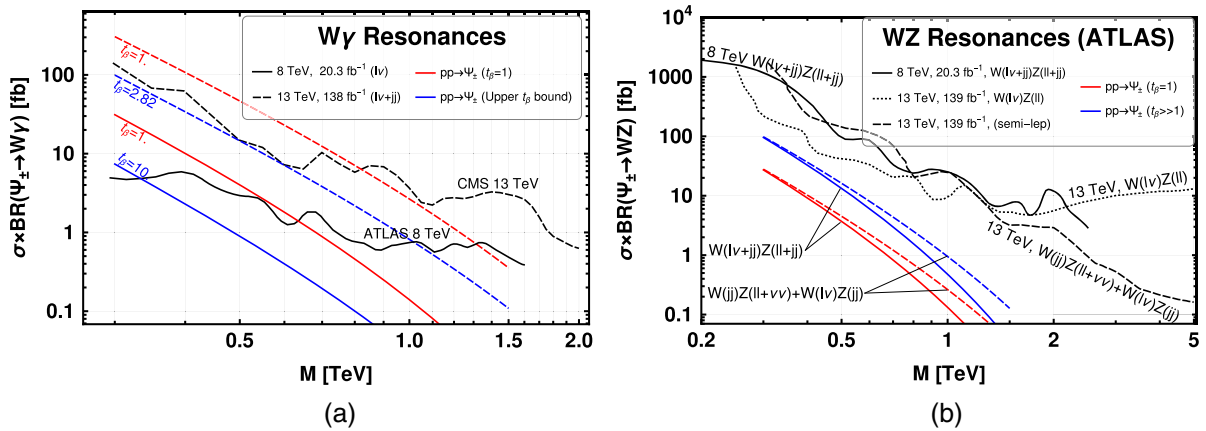


FIG. 5. Application of LHC diboson resonance searches to charged bound state $\Psi_\pm$ production and decay. (a) $W\gamma$ resonance searches lead to experimental bounds on squirk masses. See Fig. 6 for bounds in the (M, t_β) parameter space. (b) Current WZ resonance searches provide no additional experimental bounds, even at extreme values $t_\beta = 0.1, 10$.

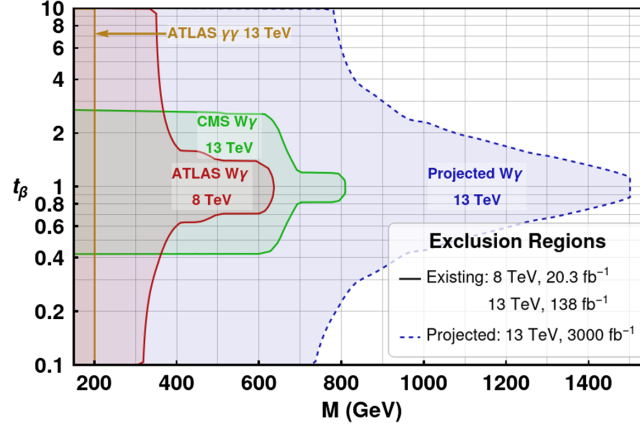


FIG. 6. Direct experimental bounds on our simple squark model as a function of t_β and the total mass M . Excluded regions from completed $\gamma\gamma$ and $W\gamma$ searches are bounded by a solid line. The blue region with dashed boundary shows the projected sensitivity for 3000 fb^{-1} of integrated luminosity with collider energy $\sqrt{s} = 13$ TeV.

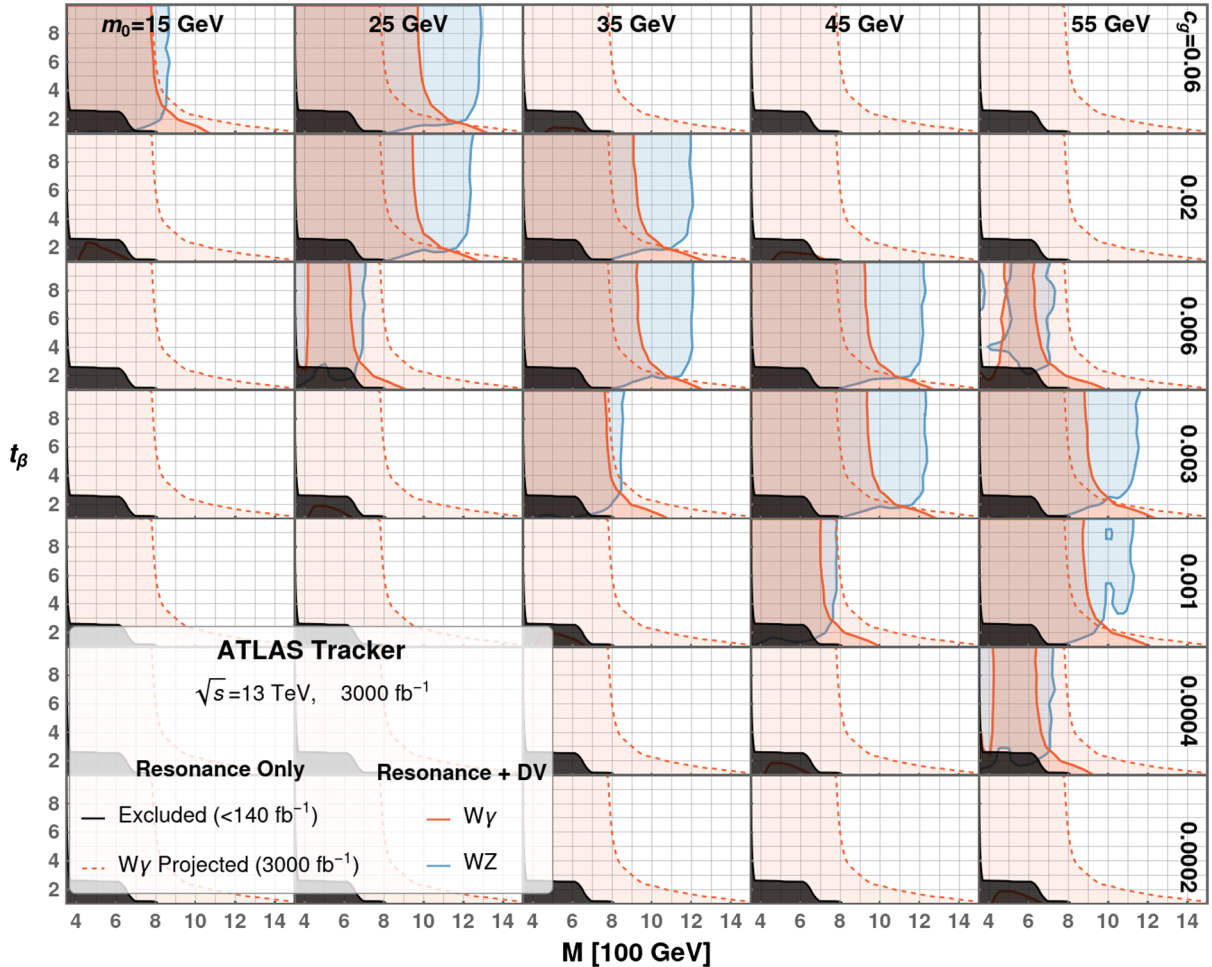


FIG. 8. Resonance only and simulated R + DV sensitivity regions in M and t_β inside the ATLAS tracker at $\sqrt{s} = 13$ TeV and 3000 fb^{-1} for various (c_g, m_0) . Exclusion regions in black are due to $W\gamma$ resonance searches by ATLAS [44] and CMS [46]. Dashed orange curves show the projected reach of $W\gamma$ resonance searches. Simulated discovery regions in orange (blue) indicate three or more events at a given (M, t_β) with a 0^{++} hidden sector glueball decay within the tracker and a $W^\pm\gamma$ ($W^\pm Z$) decay which passes the appropriate cuts, found in Appendix (A 6) in the original work.

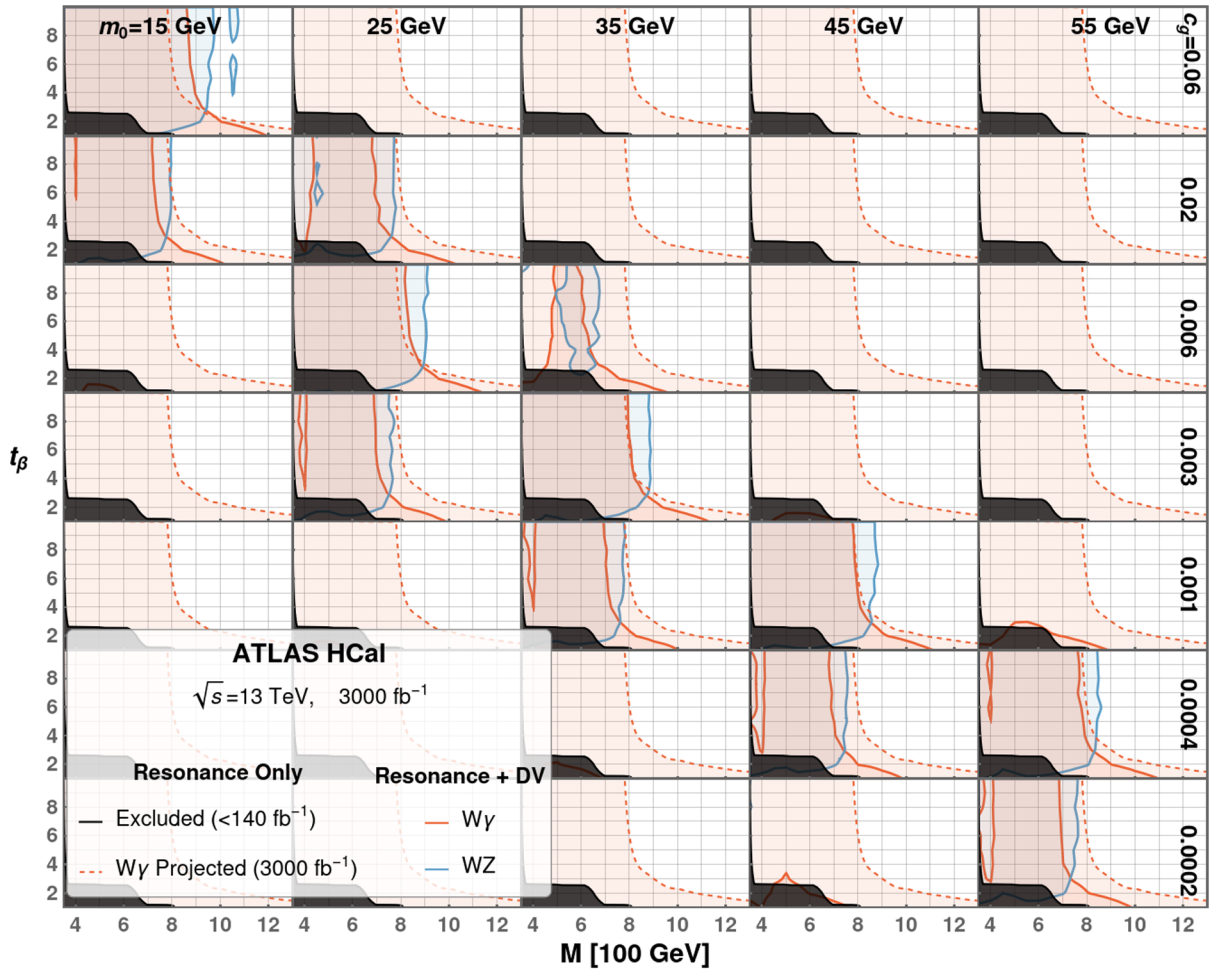


FIG. 9. Resonance only and simulated R + DV sensitivity regions inside the ATLAS hadronic calorimeter at $\sqrt{s} = 13$ TeV and 3000 fb^{-1} given various parameter combinations (c_g, m_0). See the caption to Fig. 8 for descriptions of various regions.

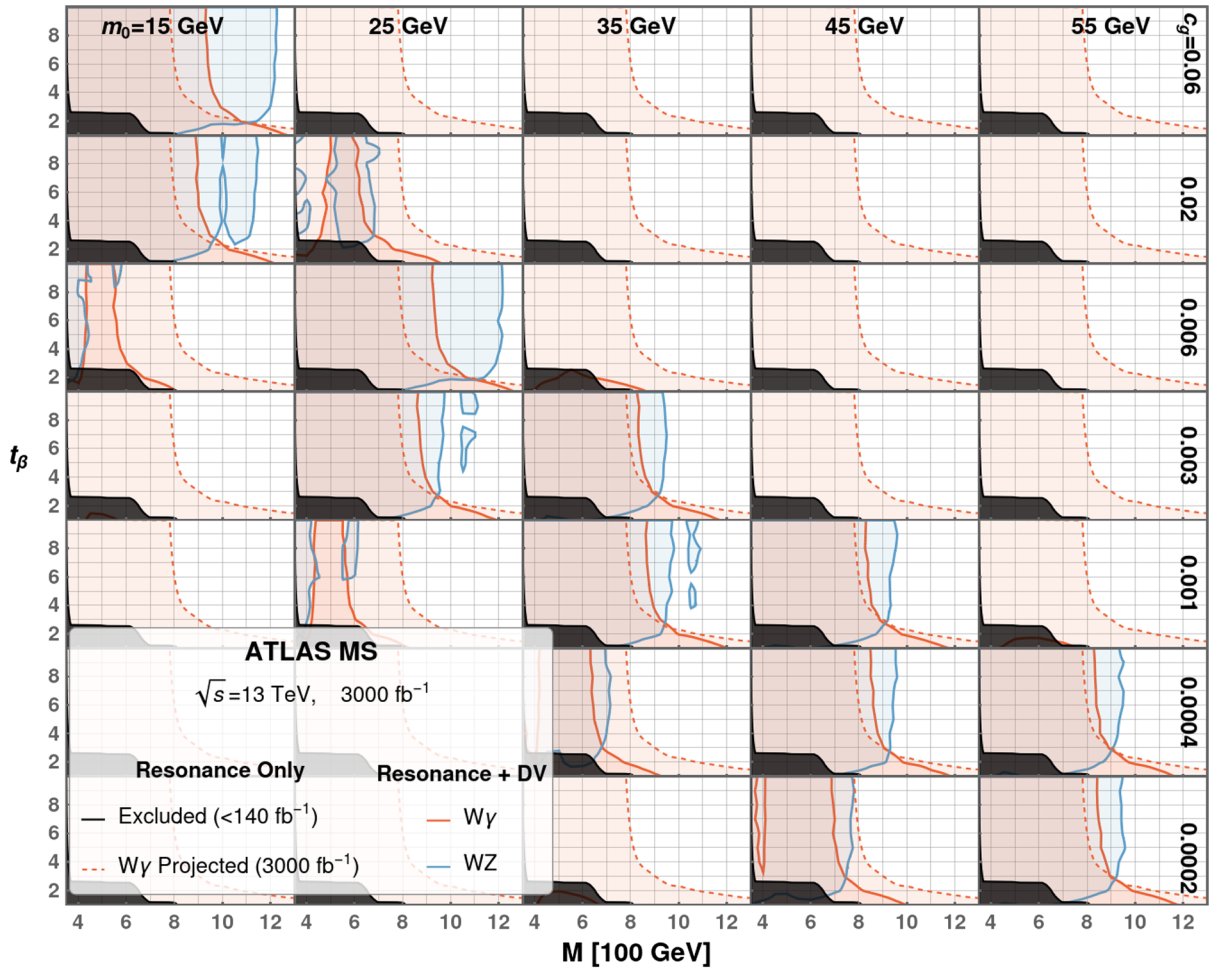


FIG. 10. Resonance only and simulated R + DV sensitivity regions inside the ATLAS muon spectrometer at $\sqrt{s} = 13$ TeV and 3000 fb^{-1} given various parameter combinations (c_g, m_0). See the caption to Fig. 8 for descriptions of various regions.

[78] CMS Collaboration, Search for a resonance decaying to a W boson and a photon in proton-proton collisions at $\sqrt{s} = 13$ TeV using leptonic W boson decays, *J. High Energy Phys.* **09** (2024) 186.