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Color-octet scalars in Dirac gaugino models with broken R symmetry

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We present a phenomenological investigation of color-octet scalars (sgluons) in supersymmetric models with Dirac gaugino masses that feature an explicitly broken R symmetry (R-broken models). We have constructed such models by augmenting minimal R-symmetric models with a set of supersymmetric and softly supersymmetry-breaking operators that explicitly break R symmetry. We have found new features that appear as a result of R symmetry breaking, including enhancements to extant decay rates, novel tree- and loop-level decays, and improved cross sections of single sgluon production. We have also explored constraints on these models from the Large Hadron Collider. We find that, in general, R symmetry breaking quantitatively affects existing limits on color-octet scalars, closing loopholes for light CP-odd (pseudoscalar) sgluons while perhaps opening one for a light CP-even (scalar) particle. Altogether, scenarios with broken R symmetry and two sgluons at or below the TeV scale can be accommodated by existing searches.

Summary

One of the more striking predictions of minimal models with Dirac gauginos (R-symmetric models) is the appearance of color-octet scalars (sgluons). These particles, which could be produced copiously at the LHC, have been studied at length, but to date a comprehensive account of their gauge-invariant interactions has not been produced. This is because there are many gauge-invariant operators relevant to sgluon phenomenology that are forbidden by R symmetry. We have constructed models with Dirac gaugino masses and adjoint scalars that feature such a set of operators. In this presentation we describe these models, highlight the most important effects of R symmetry breaking, and discuss collider constraints on the sgluons in these scenarios.

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