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Constraints on Light Dark Matter from Single-Photon Decays of Heavy Quarkonium

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We investigate constraints on the interactions of light dark matter with Standard Model quarks in a framework with effective contact operators mediating the decay of heavy flavor bound state quarkonium to dark matter and a photon. When considered in combination with decays to purely invisible final states, constraints from heavy quarkonium decays at high intensity electron-positron colliders can complement missing energy searches at high energy colliders and provide sensitivity to dark matter masses difficult to probe at direct and indirect detection experiments. We calculate the approximate limits on the branching fraction for $Y(1S)$ decays to dark matter and a photon. Given the approximate limits on the branching fractions for all dimension 6 or lower contact operators, we present the corresponding limits on the interaction strength for each operator and the inferred limits on dark matter-nucleon scattering. Complementary constraints on dark matter annihilation from gamma-ray searches from dwarf spheroidal galaxies are also considered.

Summary

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