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Sharp spectral features from light dark matter decay via gravity portals

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So far, all evidence for the existence of dark matter is based on its gravitational interactions with the observable sector, and its precise particle nature remains mysterious. However, even if dark matter is stable against decay in flat spacetime, as commonly assumed in the literature, the presence of nonminimal couplings to gravity of the dark matter field can spoil this stability in curved spacetime, with potentially remarkable phenomenological implications. More specifically, a scalar dark matter candidate with a mass in the MeV-GeV region, destabilized through a linear coupling to the Ricci scalar, can decay into electron-positron pairs and photons. This has implications for both the thermal history of the Universe and the present-day gamma-ray spectrum observed at Earth. Observations of the cosmic microwave background by the Planck satellite and of the extragalactic isotropic gamma-ray background by COMPTEL, EGRET and Fermi LAT can be used to constrain the size of the nonminimal coupling parameter.

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