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Nonrelativistic vector dark matter nonminimally coupled to gravity

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Vector dark matter (VDM) is a good candidate of dark matter with rich phenomenology. In this work, we study nonminimal couplings to gravity for VDM in the wave regime, where the particle mass is below 30eV . In the nonrelativistic limit, the nonminimal coupling with the lowest mass dimension leads to effective self-interactions that affect the mass-radius relation of vector solitons, growth of linear perturbations during structure formation, and the speed of gravitational waves (GWs). Based on current limits on the GW speed, we constrain the dark matter mass and nonminimal coupling strength to be within the range $-2 \times 10^{46} \text{eV}^{-2} < \xi_2/\text{m}^2 < 2 \times 10^{49} \text{eV}^{-2}$.

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