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Dark matter as bound states in asymptotically safe quantum gravity

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Many dark matter models become unviable when embedded into the framework of asymptotically safe quantum gravity. In this work, we investigate dark matter arising as bound states of fundamental fermions in the strongly-coupled regime of a gauge theory. Modeling the self-interactions of dark baryons via the effective-range approach, we perform a multi-scale analysis in which we combine phenomenological constraints with the theoretical requirements imposed by consistent embedding into asymptotically safe quantum gravity. We find a regime in parameter space that is compatible with all constraints, indicating that this theory may account for dark matter while being ultraviolet complete and predictive. Additionally, we discover a generic feature: kinetic mixing between visible and dark photons is dynamically driven towards tiny values within the ultraviolet complete setting; a crucial condition to prevent an overabundance of dark matter produced via the kinetic mixing portal in the freeze-in mechanism.

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