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Phenomenology: Enlightening Cold Dark Matter's darkest side via a non-minimal coupling

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The cold dark matter (CDM) paradigm has proven to be relatively successful on cosmological scales, but struggles in fully describing the observed phenomenology on (sub)galactic scales. In this picture, two long-standing issues are the well-known cusp-core controversy and the existence of several tight scaling laws between dark and baryonic quantities, whose explanation is not trivial in the CDM framework. In this talk, I will entail the possibility that CDM could be dynamically non-minimally coupled to gravity, and how such effect has the potential to solve these issues in a single shot. After outlining the theoretical foundations of the model, I will proceed in discussing quantitative astrophysical results achieved in Gandolfi et al. 2021 and Gandolfi et al. 2022 exploiting this non- minimally coupled DM model. The key findings of our analysis are that a) this model can develop cored dark matter profiles whit a shape closely following out to several core scale radii the phenomenological Burkert profile, b) it can accurately fit the rotation curves of different kinds of local spiral galaxies and c) it can consistently reproduce the Radial Acceleration Relation, one of the most general relations characterizing the dark-baryonic interplay.

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