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Long-Range Dark Matter Self-Interactions in FIRE Simulations

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In this talk, I present the first results from a new suite of Feedback in Realistic Environments (FIRE) simulations in which the dark matter is subject to a long-range self-interaction. This self-interaction takes the form of an attractive Yukawa potential parametrized by the strength of the force and its screening length, which we simulate on kiloparsec to megaparsec scales. We simulate galaxies on mass scales ranging from classical dwarfs to Milky Way-mass galaxies. The addition of a long-range dark matter self-interaction has dramatic effects on the formation of galaxies and their host halos: relative to ΛCDM, structure formation occurs at a higher redshift, and both central halos and subhalos can be more compact than their CDM counterparts. These features suggest that long-range dark matter self-interactions may alleviate several tensions in ΛCDM cosmology, such as the rotation curve diversity problem (in which some observed galaxy rotation curves are cuspier than rotation curves predicted by simulations with CDM). While past work has sought to constrain long-range dark matter self-interactions on cosmological scales, we present galaxy-scale constraints from comparisons between these simulations and observational data.

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