

# Dark Matter and Stars: Multi-Messenger Probes of Dark Matter and Modified Gravity

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## Nonlinear Cosmological probes of gravity theories beyond General Relativity

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Several modifications to general relativity have been proposed with the aim to explain the nature of dark energy and the accelerated expansion of the Universe. In this talk I will review the present status of modified theories of gravity in the light of astrophysical probes of gravity in the weak-field regime, ranging from stars to cosmological scales. I begin by setting the scene for how theories beyond General Relativity are expected to behave in the different astrophysical systems, as well as their cosmological signatures. With these in hand, I present a range of observational tests with an eye to using the current and next generation of observations for tests of gravity. In particular, I will show how physical observables of the non-linear regime of structure formation are promising probes to constraining theoretical models in the nonlinear dynamics of galaxies, clusters and large scale structure.

**Primary author:** MOTA, David F.

**Presenter:** MOTA, David F.