Cosmology with nonlocal gravity

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Even though a fundamental Lagrangian is considered to be local, quantum loops of massless particles give rise to nonlocal effective field equations. Inspired by this fact, several classes of nonlocal gravity models have been proposed in an attempt to describe observed cosmic motions without invoking the hypothetical substances, dark energy and/or dark matter. I will focus on two classes of nonlocal models replacing dark energy, one proposed by Deser and Woodard and the other by Maggiore and Mancarella. I will review how they generate the current cosmic acceleration without dark energy and mainly present cosmological perturbations and structure formation for the Deser-Woodard model and compare how it differs from the one for the Maggiore-Mancarella model. I will also briefly discuss the issues concerning nonlocal gravity such as degrees of freedom and stability, and the gravitational energy-momentum flux due to an isolated system. Very recently, the original version of the Deser-Woodard model has been ruled out by solar system constraints. However, the new version expects to share most features regarding cosmological evolutions with the old one, for which more detailed analysis needs to be done.