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Cosmology based on f(R) gravity with O(1) eV sterile neutrino

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Abstract

© 2015 IOP Publishing Ltd and Sissa Medialab srl. We address the cosmological role of an additional (1) eV sterile neutrino in modified gravity models. We confront the present cosmological data with predictions of the FLRW cosmological model based on a variant of f(R) modified gravity proposed by one of the authors previously. This viable cosmological model which deviation from general relativity with a cosmological constant Λ decreases as R^{-2n} for large, but not too large values of the Ricci scalar R (while no Λ is introduced by hand at small R) provides an alternative explanation of present dark energy and the accelerated expansion of the Universe (the case n=2 is considered in the paper). Various up-to-date cosmological data sets exploited include measurements of the cosmic microwave background (CMB) anisotropy, the CMB lensing potential, the baryon acoustic oscillations (BAO), the cluster mass function and the Hubble constant. We find that the CMB+BAO constraints strongly restrict the sum of neutrino masses from above. This excludes values of the model parameter λ~ 1 for which distinctive cosmological features of the model are mostly pronounced as compared to the ΛCDM model, since then free streaming damping of perturbations due to neutrino rest masses is not sufficient to compensate their extra growth occurring in f(R) modified gravity. Thus, in the gravity sector we obtain λ>8.2 (2σ) with the account of systematic uncertainties in galaxy cluster mass function measurements and λ>9.4 (2σ) without them. At the same time in the latter case we find for the sterile neutrino mass 0.47 eV < mν, sterile < 1 eV (2σ) assuming that the sterile neutrinos are thermalized and the active neutrinos are massless, not significantly larger than in the standard ΛCDM with the same data set: 0.45 eV < mν, sterile < 0.92 eV (2σ). However, a possible discovery of a sterile neutrino with the mass mν, sterile ≈ 1.5 eV motivated by various anomalies in neutrino oscillation experiments would favor cosmology based on f(R) gravity rather than the ΛCDM model.

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Keywords

Galaxy clusters, modified gravity, Neutrino masses from cosmology