PUBLISHED: 2 MARCH 2017 | VOLUME: 1 | ARTICLE NUMBER: 0081

research highlights

COSMOLOGICAL SIMULATIONS

Beyond the standard muddle

Mon. Not. R. Astron. Soc. (in the press); preprint at https://arxiv.org/abs/1702.00676 (2017)

If neutrinos have mass, the standard model of particle physics and the 'standard' Λ cold dark matter cosmological model would need revision. To discriminate between cosmological models, Mauro Roncarelli and co-workers run hydrodynamical simulations for both massless and massive neutrinos with four different mass sums for the three neutrino flavours. Compared with South Pole Telescope data on galaxy clusters, their results are consistent with massless neutrinos. More interestingly, their analysis favours a rapid reionization scenario, and provides an upper limit to patchy (non-homogeneous) reionization models.

Specifically, they study the kinematic Sunyaev–Zel'dovich (kSZ), or Ostriker–Vishniac, effect, which is the non-thermal Doppler shift of the cosmic microwave background (CMB) photons after interacting with high-energy electrons in the intergalactic medium. This effect leads to temperature fluctuations of the CMB. Their simulations using different cosmologies are fed into a model for the kSZ effect due to large-scale structure after reionization. Measurements of the kSZ effect can be used to disentangle different cosmological parameters, and possibly rule out exotic models such as quintessence or modified gravity. But massive neutrinos would suppress the kSZ effect — slowing down the growth of large-scale structure and complicating the interpretation of kSZ analyses. ❐

May Chiao