Contribution ID: **40** Type: **not specified**

Void spin distribution as a powerful probe of σ8

Tuesday, 8 July 2025 17:40 (20 minutes)

We present a numerical proof of the concept that the void spin distributions can provide a tight constraint on the amplitude of matter density fluctuation on the scaleof 8 h inverse Mpc (σ8) without being severely deteriorated by the degeneracies of σ8 with cold dark matter density parameter multiplied by the dimensionless Hubble parameter square (Ωcdmh^2), total neutrino mass (Mν) and dark energy equation of state (w). Applying the Void-Finder algorithm to a total of 15 AbacusSummit N-body simulations of 15 different cosmological models , we identify the giant voids and measure the magnitudes of rescaled specific angular momenta of point-like void halos as their spins. The 15 cosmologies include the Planck ΛCDM and 14 non-Planck models, each of which differs among one another only in one of {σ8, Ωcdmh^2, Mν, w}. We determine the probability density distribution of void spins for each model and for the first time find it to be well approximated by the generalized Gamma distribution with two characteristic parameters, k and θ. It turns out that the best-fit values of k and θ exhibit very sensitive dependence only on σ8, being almost insensitive to Ωcdmh^2, Mν and w. This exclusive σ8-dependence of the void spin distributions is confirmed to be robust against the variation of the mass and number cuts of void halos. We also test an observational feasibility of estimating the void spins from real data on the galaxy redshifts.

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Session Classification: Parallel 1