

Reheating the Universe Once More - The Dissipation of Acoustic Waves as a Novel Probe of Primordial Inhomogeneities on Even Smaller Scales

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We provide a simple but robust bound on the primordial curvature perturbation in the range $10^4/\text{Mpc} < k < 10^5/\text{Mpc}$, which has not been constrained so far unlike low wavenumber modes. Perturbations on these scales dissipate the energy of their acoustic oscillations by the Silk damping after primordial nucleosynthesis but before the redshift $z \sim 2 \times 10^6$ and reheat the photon bath without invoking CMB distortions. This acoustic reheating results in the decrease of the baryon-photon ratio. By combining independent measurements probing the nucleosynthesis era and around the recombination epoch, we find an upper bound on the amplitude of the curvature perturbation over the above wavenumber range as $\mathcal{P}_\zeta < 0.02$. Implications for super massive black holes are also discussed.

References:

[1] T.Nakama, T.Suyama and J.Yokoyama, arXiv:1403.5407[astro-ph.CO]