Angular Power Spectrum of the 21 cm Signal from the Dark Ages: Sensitivity to Cosmological Parameters

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Abstract

The 21 cm line of neutral hydrogen provides a powerful observational window into the early Universe, particularly during the Dark Ages (redshifts $z \sim 30-200$), before the emergence of the first luminous objects. In this work, presented a theoretical study of the angular power spectrum C_{ℓ} of 21 cm brightness temperature fluctuations and its dependence on key cosmological parameters.

Described a linear perturbation framework that accounts for density inhomogeneities, peculiar velocities (redshift-space distortions). By modeling the 3D power spectrum of the 21 cm signal and projecting it into angular multipole space, could be investigated the sensitivity of C_{ℓ} to variations in parameters such as the total matter density Ω_m , baryon fraction Ω_b , Hubble constant H_0 , and the fluctuation amplitude σ_8 .

Results show that the 21 cm angular power spectrum is sensitive to these parameters, especially at high multipoles where small-scale information is preserved. This highlights the potential of future radio interferometric observations—such as those by the Square Kilometre Array (SKA)—to provide competitive constraints on the cosmological model.

References

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