

Constraining dark matter with 21-cm signals from the Cosmic Dawn

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The nature of dark matter (DM) has played a critical role in the formation of the first luminous objects of the universe. A distinguishing characteristic of DM models is their small-scale density fluctuations, which would have affected the abundance of minihalos and the first galaxies, and can be probed through features in the global evolution and spatial fluctuations of the 21-cm signals from neutral hydrogen at cosmic dawn.

In this talk, I'll first briefly review the effects of DM on the 21-cm signals from cosmic dawn, and the challenges from parameter degeneracies between particle physics and the unknown astrophysics in the early universe. Then I'll focus on two novel probes, i. e. the velocity acoustic oscillations on the 21-cm power spectrum, and the 21-cm absorption lines against higher-redshift background sources at cosmic dawn, known collectively as the 21-cm forest. In particular, the 21-cm forest are proposed to simultaneously probe the small-scale structures governed by the dark matter particle mass and the early heating history regulated by the formation of first galaxies. By measuring the 1-D power spectrum of the 21-cm forest on high-redshift quasar spectra, the upcoming Square Kilometre Array will be able to shed light on the nature of both the dark matter and the first galaxies.

Presenter: XU, Yidong (NAOC)

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