



A fundamental step towards the cosmological 21 cm signal

The expansion history and the nature of dark energy are of fundamental importance for understanding the universe. Among various dark energy probes are included the type Ia supernovae (SNe Ia), baryon acoustic oscillations (BAO), cosmic microwave background (CMB), weak lensing, and galaxy clusters. Compared with the conventional optical BAO measurement that requires millions of galaxy spectra, the newly developed 21 cm intensity mapping (IM) technique enables efficient measurements of large-scale structures inaccessible to any other known techniques, while providing precise BAO scales and tight constraints on the expansion history of the universe [1].

The cross-correlation between the 21 cm intensity and optical galaxies was first detected in 2010 [2]. Due to the bright foreground orders of magnitude higher than the cosmological signal as well as the greater calibration accuracy required, the auto-correlation of the 21 cm IM is yet to be detected, which is one of the primary goals for many newly built and upcoming radio telescopes, including the China-led Tianlai radio array. Recently, the Tianlai collaboration group [3] published their first report on the basic system performance and some preliminary data analysis of the cylinder pathfinder array. With years of close international collaboration, they have realized the access to detailed information on testing some key technologies, from the hardware design to data processing pipeline, demonstrating a system generally in an expected state. Although the 21 cm auto-correlation signal is still buried in the system noise, this work represents a fundamental step towards detecting the cosmological 21 cm signal, which may be a valuable input to the 21 cm IM experiments and 21 cm cosmology.

It should be noted that the Tianlai array is also a pathfinder for the future Square Kilometre Array [4], the largest radio array in the coming decade. With accumulation of practical experience and development of the full-scale array, Tianlai will take its critical role in detecting the 21 cm BAO signals, and help answer the question of what dark energy is.

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