

Probing cosmology & astrophysics with 21cm forest

Date 10:00 - 11:00, November 7 (Friday), 2025

Place 1131, Building 9 (Zoom ID: 881 5903 1592)

Speaker

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Abstract

Understanding the formation of the first stars, galaxies, and black holes is a central goal of cosmology. A promising probe is the “21 cm forest”—faint absorption features imprinted by neutral hydrogen on radio signals before and during reionization. Unlike galaxy surveys or the CMB, the 21 cm forest traces the intergalactic medium (IGM), the emergence of the first luminous objects, and key physics such as dark matter properties and IGM heating.

This talk will outline how the 21 cm forest opens a new window on the universe’s first billion years, highlighting its scientific promise, challenges, and future prospects with next-generation facilities like the Square Kilometre Array (SKA). I will also present our recent work applying advanced techniques, including the Wavelet Scattering Transform (WST), to extract physical insights from simulated 21 cm signals. Together, these advances show how the 21 cm forest can serve as a powerful bridge between astrophysics, cosmology, and fundamental physics.

Biography

Dr. Hayato Shimabukuro is an Associate Professor at the Southwest Institute of Astronomy (SWIFAR), Yunnan University. He earned his Ph.D. in astronomy from Nagoya University and held postdoctoral positions at the Paris Observatory and Tsinghua University before joining SWIFAR. His research focuses on theoretical cosmology, particularly probing the early universe with the 21 cm line. He has pioneered methods to extract cosmological information from 21 cm signals, including higher-order statistics, machine-learning approaches, and the 21 cm forest to study small-scale structure, dark matter, and the thermal history of the IGM.

He is active in international collaborations, including the SKA Epoch of Reionization and Cosmic Dawn working groups, and is also dedicated to science communication, having authored several popular astronomy books. (Outside research, he enjoys Yunnan’s mushroom cuisine and local rice noodles.)