

X13a DREAMS: Deep Reconnaissance of Early Assemblies with Metal-poor Star formation

Kimihiko Nakajima (NAOJ/Kanazawa), Masami Ouchi (NAOJ/U. Tokyo), Yuichi Harikane, Yoshiaki Ono, Yi Xu, Hiroya Umeda (U. Tokyo), Yuki Isobe (Cambridge), Yechi Zhang (Caltech), Moka Nishigaki (SOKENDAI/NAOJ)

The formation of primordial stars and galaxies in the early universe has long been a challenge for observational astronomy, which has been revolutionized by the capabilities of JWST. A breakthrough study by Vanzella et al. (2023) utilized JWST/NIRSpec IFU observations to analyze a highly magnified ($> \times 100$) Lyman-alpha emitting arc at $z = 6.6$, hinting at the presence of a low-mass ($< 1000 M_{\text{sun}}$), low-metallicity stellar cluster within the arc. This study raises the exciting possibility of detecting Population III stars within this system.

To further investigate this object and explore pristine star formation, we secured 63 hours of JWST/NIRSpec observations in Cycle 3 (ID 4750, PI Nakajima), successfully conducted in November 2024. In this talk, we will introduce the program, Deep Reconnaissance of Early Assemblies with Metal-poor Star formation (DREAMS), designed to study this system in unprecedented detail. Our primary objective is to detect the HeII 1640 emission line using deep, medium-resolution spectroscopy, providing a diagnostic for ongoing Population III star formation. In addition to the primary target, DREAMS leverages NIRSpec's MOS capabilities to conduct uniquely deep spectroscopy of other high-redshift, low-mass objects in the lensing cluster MACS J0416. Findings from these additional targets will be presented in this talk.