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Uncovering Early Galaxy Formation with JWST: A Modeling Perspective

Time: 14:00-15:00, 17 December (Tuesday), Shanghai time

Venue: N600 (TDLI)

Host: Ying Zu (祖颖)

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Abstract:

The James Webb Space Telescope (JWST) is transforming our understanding on galaxy formation and evolution, revealing distant galaxies deep into the epoch of reionization and red sources that were simply unknown pre-JWST. In this talk, I will discuss two key areas, with a focus on the challenges in modeling the spectral energy distributions in the JWST era. First, a central science goal of JWST is finding the first galaxies, which often requires modeling of photometric data to select candidates for spectroscopic follow-up. I will show the modeling work that turns the nearby cluster A2744 to one of deepest views of our universe, as part of the UNCOVER survey. The resulting rich, public dataset, reveals stellar populations across $0.2 < z < 13$, and helps to lead to the discovery of the surprisingly large galaxies at $z > 12$. I will also briefly discuss how this exquisite dataset is poised to redefine our census of galaxy populations. Second, the optical/IR sensitivity of JWST has led to the discovery of compact red sources, initially interpreted as apparently massive galaxies at $z > 7$. This interpretation yields a strongly accelerated time line compared to standard models of galaxy growth. Yet, major uncertainties remain about their nature due to the limited photometric data. I will present detailed studies of these so-far mysterious "little red dots", enabled by the spectroscopic data from the RUBIES program. Remarkably, we find clear signatures of evolved stellar populations, the formation histories of which extend hundreds of millions of years into the past in galaxies only 600–800 Myr after the big bang. Confoundingly, some of them exhibit broad Balmer emission lines, suggesting that dust-reddened AGNs contribute to, or even dominate, the spectral energy distributions red-ward of \sim rest $0.6\mu\text{m}$. I will explore potential origins and evolutionary tracks, from the cores of massive galaxies to low-mass galaxies with over-massive black holes, and conclude with remaining puzzles and possible future directions to form a complete physical picture of these intriguing systems.

Biography:

Dr. Bingjie Wang is an Assistant Research Professor at the Pennsylvania State University. Wang received her Ph.D. from the Johns Hopkins University in 2021. She has been at the forefront of JWST's discovery of the early universe, finding some of the most distant galaxies and also the earliest old stars in the young universe. Her research focuses on developing sophisticated models to interpret the light from galaxies and their central black holes, bridging observations with theories of galaxy formation and evolution.

