TDLI Astronomy Seminar

Title: Galaxy sizes and compactness during the epoch of reionization

Time: 14:00-15:00, 26 February (Wednesday), Shanghai time

Host: Xianzhong Zheng

Location: N601

Pedro Cataldi

(IAFE)

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Meeting ID: 253103842 (no password）

Abstract:

JWST data analysis has shown an unexpected population of red galaxies and high masses of M∗ > 10^10Msun with extremely small effective radii at z≳ 6. Considering the surprising results of the high redshift size-mass / luminosity relation consistently found both in observation and various simulations at high redshift, this work aims to understand the mechanisms that produce these unexpected trends. This study investigates the physical transition of galaxy gas and stellar components during early cosmic epochs at redshift z≳ 5, using the FirstLight (FL) cosmological simulation suite. This suite comprises 300 high-resolution zoom-ins and accurately depicts the reionization of the large-scale intergalactic medium while resolving galaxy properties. We find that the half-mas stellar radius for simulated galaxies shows a positive relation with stellar mass at M∗ < 10^9Msun, followed by a general trend of decrease afterwards. After galaxies reach a benchmark stellar mass, M∗ ≈ 10^8.5Msun, a reduction in galaxy size is predominantly observed, during which galaxies undergo a phase of rapid compaction and gas depletion. Early Universe simulated galaxies transitioned to a rapid and bursty SFR phase with the following formation of a subpopulation of compact massive galaxies. We identify the compaction of high stellar masses galaxies as a consequence of both, the phase state of the primordial gas at early cosmic epochs (with low metallicity, cold cooling streams, and extremely low cooling rates) and the deepens of the gravity well potential, which favours the infalling of star-forming gas toward the galaxy centre.

Biography:

Dr. Pedro Cataldi currently is working as a postdoc in Numerical Astrophysics at the Institute of Astronomy and Space Physics in Buenos Aires, Argentina, focusing on solving challenging problems in cosmology, feedback processes and galaxy formation theory. He is broadly interested in all aspects of astronomy and cosmology and particularly in galaxy formation and galaxy clustering. He is currently working on studies of the assembly bias and galaxy clustering in numerical simulations in comparison with the upcoming LSST surveys, as well as on the formation of galaxies during the Epoch of Reionization. Dr. Pedro Cataldi completed his PhD in Physics from Buenos Aires University, supervised by both Dr. Susana Pedrosa and Dr. Susana Landau. He worked on alternative cosmological models (f(R) cosmology), baryonics physics and dark matter halo evolution while implementing a numerical approach and with financial support from the CONICET PhD fellowship (2017) and LACEGAL-RISE (2020) from the European Union. He is also a member of the Dark Energy Science Collaboration (DESC) and a collaborator of the FlatIron Institute in New York City.