Yingjie Peng (University of Cambridge, postdoc)

Roberto Maiolino (University of Cambridge)

Presentation Requested: oral
Category: Cosmic Star Formation History
Question: How does the star formation rate density evolve over all redshifts, especially at z > 2? Is there agreement between the measurements from ALMA, JVLA, Herschel, HST, and other instruments? Can the SFR density be dissected showing what is contributing to it at different redshifts or how might we go beyond measuring this relationship. What are the state of the art simulations and how do the observations compare to them?

The two-phase galaxy evolution and the origin of the cosmic sSFR-History

The specific SFR (sSFR) is one of the most fundamental properties of the galaxies, which depicts the star-formation main sequence and directly governs the cosmic star-formation history and stellar mass assembly history of the galaxy population. We will first discuss the evolution of the key properties of star forming galaxies within the typical gas regulator model or bathtub-model, such as the gas mass, SFR, stellar mass, sSFR, gas fraction and metallicity. We show that the predicted sSFR from the gas regulator model is in good agreement with the predictions from typical Semi-Analytic Models, but both are fundamentally different from the observed sSFR history. This clearly implies that some key process is missing in both typical SAMs and gas regulator model. We show that the observed sSFR history requires a minimum gas accretion timescale of t_{acc} $0.3Gyr^{-1}$ that put a limit on the specific gas accretion of all galaxies. As a consequence of the t_{acc} , the galaxy evolution will naturally be separated into two distinct evolutionary phase with the transition redshift around z 2. With the t_{acc}, the gas regulator model is able to produce perfectly the observed sSFR-history. We will also discuss that the equilibrium timescale, which is determined by the product of star-formation efficiency and mass-loading factor, is the central parameter in control of the evolution of all key galaxy properties, as well as the scatters in most of the key scaling relations, such as the stellar mass-SFR relation and mass-metallicity relation.