An History of Galaxy Migrations over the Stellar Mass-SFR Plane from the COSMOS-Web Survey

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Abstract:

This presentation explores the multifaceted dynamics of galaxy evolution using the star formation rate (SFR)-stellar mass (M*) plane as a foundational framework. We investigate the evolutionary trajectories of galaxies examining their recent Star Formation History (SFH) and positions on the M*-SFR plane. Our analysis spans the examination of galaxies' past positions over the last million to billion years, and compares them to their recently observed ones, this accompanied by measurements of their respective angles and magnitudes of displacement, thus revealing the intricate dynamics of galaxy migrations.

Employing the angle and magnitude of displacement over the M_*-SFR plane as key metrics, we aim to unravel the underlying mechanisms governing the galaxy evolution up to redshift 4. Leveraging the rich dataset provided by the COSMOS-Web survey and physical parameters derived from the SED-fitting code CIGALE, we incorporate non-parametric star formation histories (SFHs) to capture the evolution of galaxies. An extensive validation study employing data from the Horizon AGN hydrodynamic simulation (Laigle et al. 2019; Dubois et al. 2014) is present as well, with the aim to rigorously assess the accuracy and reliability of the SED-fitting CIGALEs derived parameters.

The results of this study demonstrate a strong correlation between the angle of displacement across the SFR-M* plane and the recent SFHs. Galaxies exhibit negative angles corresponding to declining SFHs and positive angles associated with rising SFHs. Further analysis of the angle distributions over the SFR-M* plane reveals a notable shift in the star forming region, with a transitioning from rising SFHs at high redshifts to declining ones at lower redshifts, consistent with trends observed in the SFRD plot. Additionally, the starburst region exhibits a prevalence of highly positive angles, indicative of fast-rising SFHs, while highly negative angles align with galaxies experiencing fast declines in SFHs, populating the so-called read-ded sequence. Moreover, examination of galaxy displacement along the star forming region reveals no significant absolute displacement, suggesting a novel approach to studying and interpreting the galaxy main sequence.

FInally a discussion on how this new approach on the study of the different regions of the SR-M* plane will take place to shed light on the known mechanisms governing the different regions across the SFR-stellar mass plane. By discerning the distribution of angles and different displacements along with their trajectories of migration, we expect to provide valuable insights into the underlying dynamics and physical processes governing the galaxy's evolution.