Seminarium Astrofizyczne
wtorek 28.11.2023 godz. 12:30
ul. Pasteura 7, sala 404

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Dario Colombo
(Angelander-Institute for Astronomy (AIfA))

The EDGE-CALIFA survey: unveiling the star formation quenching mechanisms in the local Universe

Understanding how galaxies cease to form stars represents an outstanding challenge for all galaxy evolution theories. The ``star formation quenching" can be related to a complex interplay of phenomena such as the AGN activity, the influence of large-scale dynamics, or the environment in which galaxies live in. All this information is available from the Integral Field Unit (IFU) CALIFA survey (Sanchez et al. 2016) which provides kpc-resolved measurements of stellar population and ionized gas emission lines for a representative sample of local Universe galaxies. However, disentangling the dominant quenching mechanisms is impossible without knowledge of the conditions of the molecular gas, the raw fuel of star formation. With this aim, we are assembling the Extragalactic Database for Galaxy Evolution (EDGE, Bolatto et al. 2017) which, to date, consists of a homogenized CO line dataset for more than 650 CALIFA targets observed with the APEX, CARMA, and ACA telescopes. Through the EDGE-CALIFA dataset, we have noticed that galaxies at different stages of their evolution show approximately similar molecular gas quantities and that the star formation efficiency (SFE) in the remaining cold gas reservoir is what modulates their retirement, with lower efficiencies corresponding to more quiescent galaxies (Colombo et al. 2020). Causes for the altered SFE (compared to the average value in star-forming disks) are diverse and span from the influence of bar and merger (Utomo et al. 2017, Chown et al. 2019) to the incremented shear (Colombo et al. 2018), and the presence of bulge (Villanueva et al. 2021). Nevertheless, the molecular gas appears really reduced in the regions influenced by the AGN activity (Ellison et al. 2020). Through the combination of integrated and kpc-resolved CO measurements provided by EDGE, we have observed that star formation fundamental relations are equivalent whether measured integrating across the whole galaxy or on kpc-scale. This implies that the main physical processes that regulate star-formation operate on kpc-scale. Nevertheless, galaxy interactions, galactic-wide outflows, and the ignition of an AGN do influence star formation, but they do not seem to have a direct effect galaxy-wide (Sanchez et al. 2021). Additionally, on kpc-scale, SFR in galaxies appears modulated by the hydrostatic mid-plane pressure (Barrera-Ballesteros et al. 2021) which indicates that SFR is self-regulated by momentum injection from supernovae explosions.

Serdecznie zapraszam,
Giuliano Lorenzon, on behalf of the SOC