Resolving the Rise and Fall of Star Formation in Galaxies
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The Extragalactic Database for Galaxy Evolution (EDGE)

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Abstract. The EDGE-CALIFA collaboration has obtained resolved IFU and CO spectroscopy for 126 nearby galaxies, selected from the CALIFA main sample. We have assembled the spatially resolved products of the survey into Astropy-compatible pixel tables that reduce the oversampling in the original FITS images and facilitate comparison of pixels across different images. By joining these pixel tables to lower dimensional tables that provide profiles, integrated spectra, or global properties, it is possible to investigate the dependence of star formation rate on both local and global conditions. In this short video talk I provide an overview of EDGE, with examples of the use of the database to conduct analysis and generate plots.

Keywords. Galaxy evolution, Interstellar molecules, Star formation, Galaxy photometry

1. Introduction

The EDGE-CALIFA Survey has observed 126 galaxies from the CALIFA sample (Sánchez et al. 2016a) in CO(1–0) emission with the CARMA interferometer (Bolatto et al. 2017) and at optical wavelengths (3745–7500Å) with the PPAK-PMAS integral field spectrograph (IFS) on the 3.5m Calar Alto telescope. In this video talk we have provided an overview of the Python-based `edge_pydb` database which provides access to the sampled image data, as well as integrated properties and 1-D profiles. The images include moment maps derived from the CO(1–0) cubes as well as analysis products (e.g. intensities of strong emission lines) obtained from the IFS cubes using the Pipe3D analysis suite (Sánchez et al. 2016b). We also provide a number of higher-level analysis products, such as the star formation rate surface density based on extinction-corrected Hα emission.

2. Data Access and Examples

The database consists of a number of Astropy (Astropy Collaboration et al. 2022) compatible tables and a Python package (`edge_pydb`) which assists with exploration of the data as well as documenting the process by which the database was constructed. A number of sample iPython notebooks are provided to help users get started with the package. The Python package is freely distributed on Github and PyPI, and is largely based on Astropy. It includes the image data for one galaxy, NGC 4047. The full set

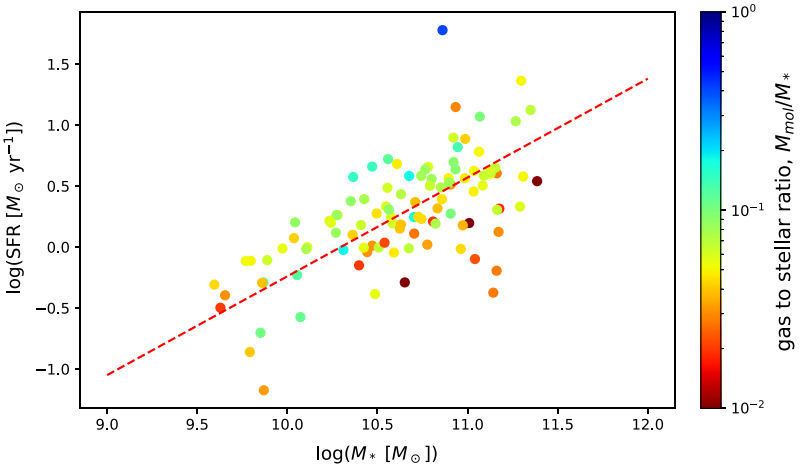

Figure 1. Integrated SFR vs. stellar mass for the EDGE-CALIFA galaxies observed with CARMA. Points are color coded by the ratio of molecular gas to stellar mass. The fiducial locus of the main sequence from Cano-Díaz et al. (2016) is shown as the dashed red line. To first order, the vertical offset from the main sequence is determined by molecular gas content.

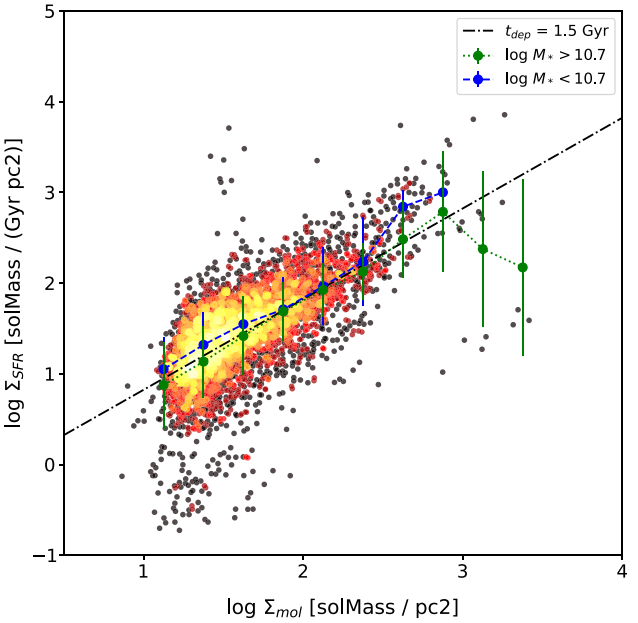

Figure 2. SFR surface density (based on extinction-corrected Hα emission) vs. molecular gas surface density for individual pixels within the EDGE database. Solid blue and green points represent binned averages for the pixels in low mass and high mass galaxies respectively. Overall the data show consistency with a common depletion time of 1.5 Gyr across the sample.

of tables for the 125 galaxies observed with CARMA (omitting one galaxy where the CALIFA data were of poor quality) is expected to be released in 2023 and will be discoverable through the Github site. We encourage interested users to contact us before the release to test out the database for their science.

The database includes sample scripts for plotting global properties of the sample, displaying scatter plots of the mass-metallicity and Kennicutt-Schmidt relations, and

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converting the tabulated pixel data back into images for visualizing the different data columns.

3. Science Applications

The EDGE-CALIFA data have already been used in a number of publications exploring the links between molecular gas and star formation across the galaxy population (e.g., Bolatto et al. 2017; Utomo et al. 2017; Colombo et al. 2018; Dey et al. 2019). Figure 1 shows an example of plotting the global data tables, producing a main-sequence plot color coded by molecular to stellar mass ratio. Figure 2 shows an example of plotting the image data, showing that the resolved Kennicutt-Schmidt (rKS) relation appears largely insensitive to the mass of the host galaxy in the parameter space covered by the survey. The code to generate these and other plots are included in the sample notebooks on Github.

The EDGE data architecture is easily extended to other surveys and will be used in future EDGE-CALIFA programs that extend the CARMA-observed sample using CO data from other millimeter-wave observatories (e.g., APEX, ALMA, GBT, LMT). Feedback from users is encouraged to facilitate future improvements in the database.

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