The EDGE-CALIFA survey: Variations in the Molecular Gas Depletion Time in Local Galaxies

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ABSTRACT

We present results from the EDGE survey, a spatially resolved CO(1–0) follow-up to CALIFA, an optical Integral Field Unit (IFU) survey of local galaxies. By combining the data products of EDGE and CALIFA, we study the variation of molecular gas depletion time ($\tau_{\rm dep}$) on kiloparsec scales in 52 galaxies. We divide each galaxy into two parts: the center, defined as the region within $0.1\ R_{25}$, and the disk, defined as the region between 0.1 and $0.7\ R_{25}$. We find that 13 galaxies show a shorter $\tau_{\rm dep}$ (~ 1 Gyr) in the center relative to the disk ($\tau_{\rm dep} \sim 2.4$ Gyrs), which means the central region in those galaxies is more efficient at forming stars per unit molecular gas mass. This finding implies that the centers with shorter $\tau_{\rm dep}$ resemble the intermediate regime between galactic disks and starburst galaxies. Furthermore, the central drop in $\tau_{\rm dep}$ is correlated with a central increase in the stellar surface density, suggesting that a shorter $\tau_{\rm dep}$ is associated with molecular gas compression by the stellar gravitational potential. We argue that varying the CO-to-H_2 conversion factor only exaggerates the central drop of $\tau_{\rm dep}$.

Keywords: galaxies: star formation — galaxies: structure — ISM: molecules — ISM: abundances.

ABSTRACT

- CALIFAサンプル(近傍銀河の面分光)をCO(1-0)で追観測
- kpcスケールでのt_{dep}(=$\Sigma_{gas}/\Sigma_{SFR}$)を調べた
- t_{dep}は 1Gyr@中心 < 2.4Gyr@disk部

SAMPLE

- 0.005 < z < 0.03
- SF銀河
- inclination < 75deg → 52天体

- CARMAでCO(1-0)を取得(beam 4.5”x4.5”)
- galactic α_{CO} = 4.4

以下のように定義

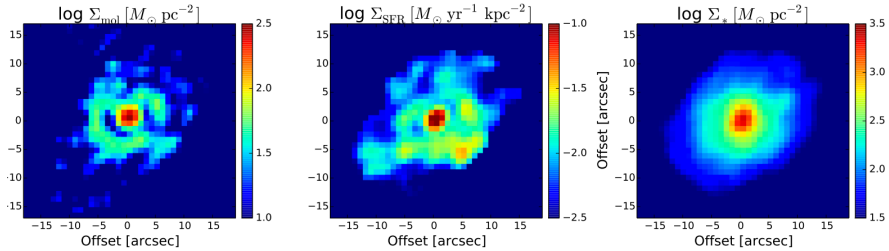
center : r < $0.1R_{25}$

disk : $0.1R_{25}$ < r < $0.7R_{25}$

R_{25} : 25mag/arcsec^2@B band

R25 = 4.6±0.8 l_* (l_* = scale length)

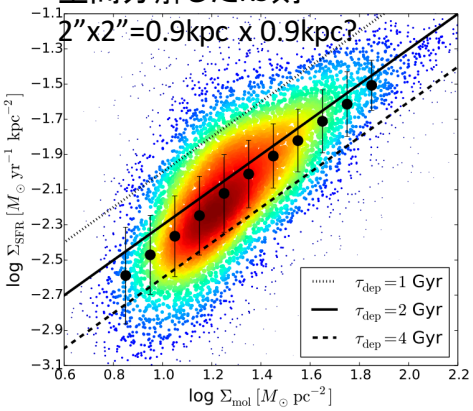
- Σ_{SFR} : extinction corrected Hα
- gas metallicity : O3N2(Marino+16)
- stellar age, Σ_* : pix-to-pix SED fit (Pipe3D, Sanchez+16)

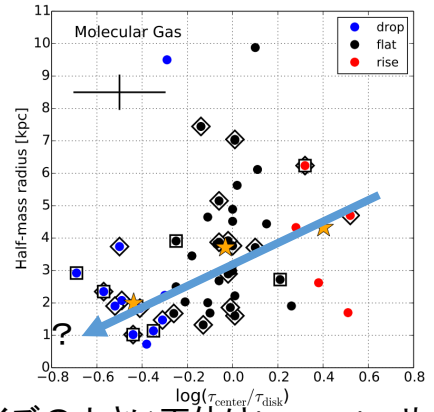


データの一例(NGC2253)

空間分解したKS則

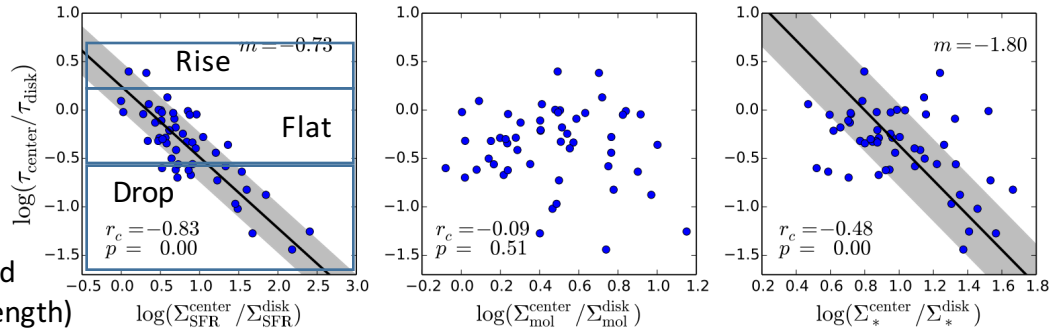
2”x2”=0.9kpc x 0.9kpc?



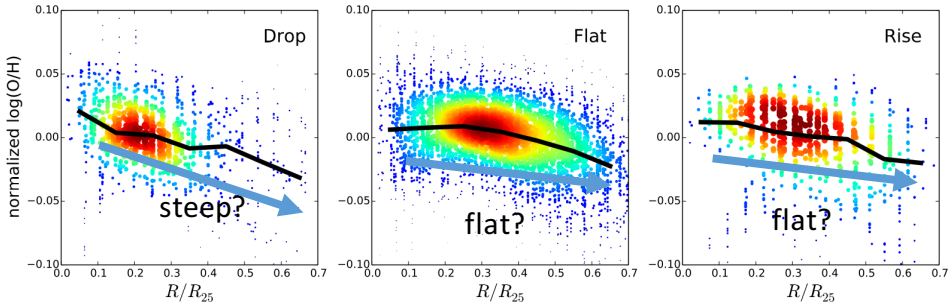


サイズの小さい天体はinteractionやbarの寄与がある。

それらによりSFEが高められている？



中心部でtdepが低下するのは、Σ_{SFR}とΣ_*の増加の影響が大きい



中心部でtdepが低下している銀河(Drop)では、metallicity gradientもsteep

← 効率の良い星形成活動で金属量がenhanceされる

しかし、gasの金属量はSFHの影響も受けるので、よく分からない

TAOでPaαの強みを活かしたLIRGの観測をするのであれば、ALMAの観測につなげるためにもASTEとかでCOの予備データが欲しい