The EDGE-CALIFA survey: the influence of galactic rotation on the molecular depletion time across the Hubble sequence

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ABSTRACT

We present a kpc-scale analysis of the relationship between the molecular depletion time ($\tau_{\rm dep}^{\rm mol}$) and the orbital time ($\tau_{\rm orb}$) across the field of 39 face-on local galaxies, selected from the EDGE-CALIFA sample. We find that, on average, 5% of the available molecular gas is converted into stars per orbital time, or $\tau_{\rm dep}^{\rm mol} \sim 20\ \tau_{\rm orb}$. The resolved relation shows a scatter of ~ 0.5 dex. The scatter is ascribable to galaxies of different morphologies that follow different $\tau_{\rm dep}^{\rm mol}-\tau_{\rm orb}$ relations which decrease in steepness from early- to late-types. The morphologies appear to be linked with the star formation rate surface density, the molecular depletion time, and the orbital time, but they do not correlate with the molecular gas content of the galaxies in our sample. We speculate that in our molecular gas rich, early-type galaxies, the morphological quenching (in particular the disc stabilization via shear), rather than the absence of molecular gas, is the main factor responsible for their current inefficient star formation.

Key words: ISM: molecules – galaxies: star formation – galaxies: structure – galaxies: kinematics and dynamics – galaxies: evolution

- CALIFA : SDSS銀河の可視IFUサーベイ
- EDGE : CALIFA銀河のCO1-0 follow-up
- kpc-scaleのdepletion timeはorbital timeで説明できるか？

Fig. 3

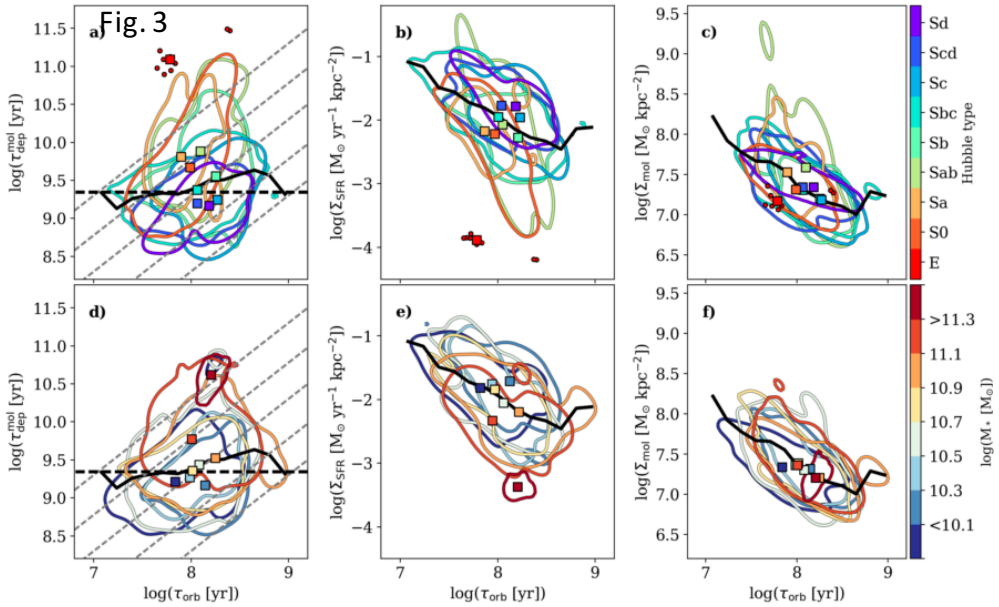
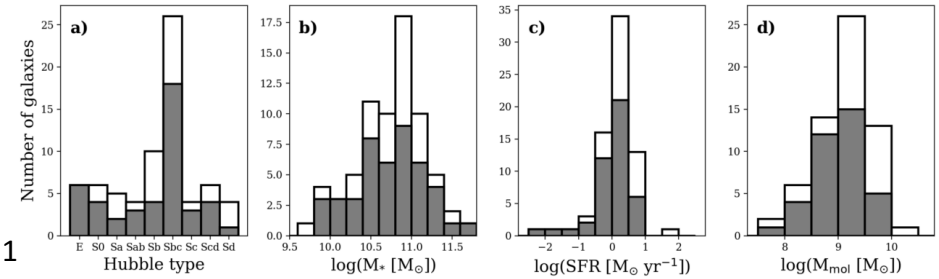
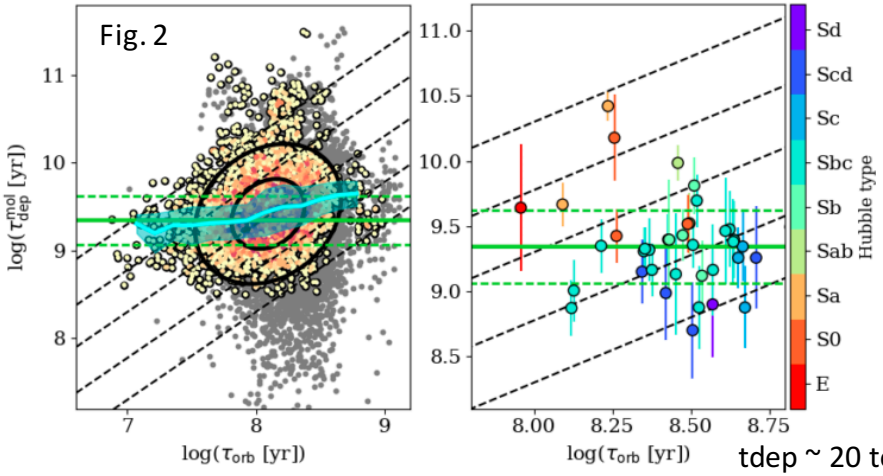


Fig. 1



a: Hubble type毎に異なるtdep-torb関係がある。
b: Hubble type毎に異なるΣSFR-torb関係がある
c: Σmol-torbはHubble typeとは無相関
d-f: 銀河の質量も無相関

Fig. 2



$$A = 0.5\left(\frac{V_c}{R_{\rm gal}} - \frac{dV_c}{dR_{\rm gal}}\right) = \frac{\pi}{\tau_{\rm orb}}(1-\beta),$$

A: オールト定数。shearの強さ。
solid body => A=0
flat rotation => A = π/torb

shearが強いと、星形成率面密度は低下し、tdepも短い
= morphological quench

tdep ~ 20 torb, 0.5dexの分散

Fig. 6