

A panchromatic spatially-resolved analysis of nearby galaxies: sub-kpc scale Main Sequence in grand-design spirals

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ABSTRACT

We analyse the spatially resolved relation between stellar mass (M_*) and star formation rate (SFR) in disk galaxies (i.e. the Main Sequence, MS). The studied sample includes eight nearby face-on grand-design spirals, e.g. the descendant of high-redshift, rotationally-supported star-forming galaxies. We exploit photometric information over 23 bands, from the UV to the far-IR, from the publicly available DustPedia database to build spatially resolved maps of stellar mass and star formation rates on sub-galactic scales of 0.5-1.5 kpc, by performing a spectral energy distribution fitting procedure that accounts for both the observed and the obscured star formation processes, over a wide range of internal galaxy environments (bulges, spiral arms, outskirts). With more than 30 thousands physical cells, we have derived a conservative definition of the local spatially resolved MS per unit area for disks, $\log(\Sigma_{SFR})=0.82\log(\Sigma_*)-8.69$. This is consistent with the bulk of recent results based on optical IFU, using the $H\alpha$ line emission as a SFR tracer. Our work extends the analysis at lower sensitivities in both M_* and SFR surface densities, up to a factor ~ 10 . The self consistency of the MS relation over different spatial scales, from sub-galactic to galactic, as well as with a rescaled correlation obtained for high redshift galaxies, clearly proves its universality.

論文のポイント

- 複数のサーベイデータを用いてpanchromaticなrSFMSを2種類のスケールで作成したこと
- 様々な他論文との比較

サンプル

- DustPediaから大規模螺旋構造を持つSFGを抽出 (Hubble stage index Tが2~8、かつ $D_{25} > 6'$ 、かつ $i < 40^\circ$ 、かつ22 Mpc以内)
- 正確なSED fittingを行うため、最低でも20個のバンドで観測されているもの
- 最終的に8個の天体に絞られた
 - $10^{10} - 10^{11} M_\odot$
 - $1 - 4 M_\odot \text{yr}^{-1}$

手法

- 最もSPFの悪いSPIRE 350に合わせた
- $8'' \times 8''$ (SPIRE 350のpixel scale)、 $1.5 \text{ kpc} \times 1.5 \text{ kpc}$ (典型的な物理スケール)の2種類
- pixel単位とintegrated photometryからSED fittingを行った

図4

- 左上 : SFR
- 左下 : stellar mass
- 右上 : MSからの距離
- 右下 : rSFMS plot

Fig. 4

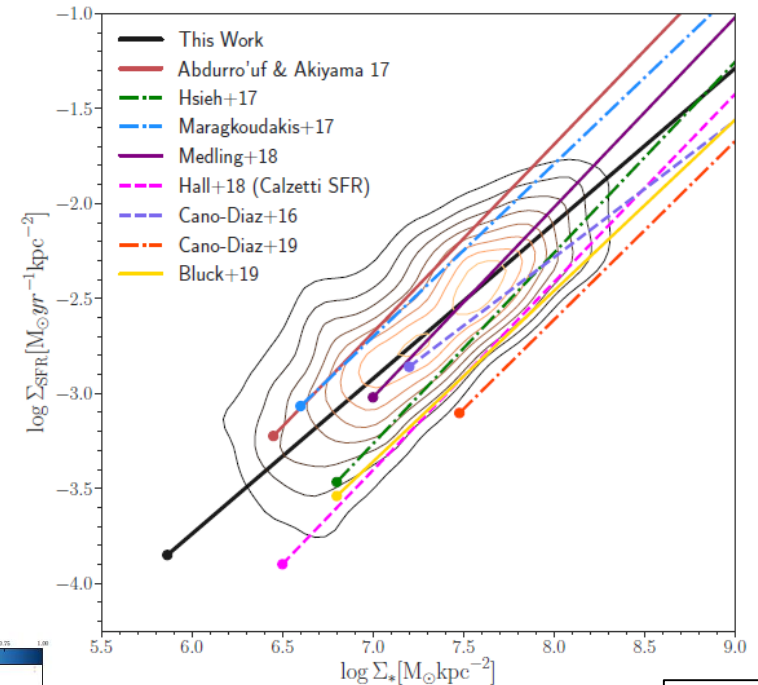
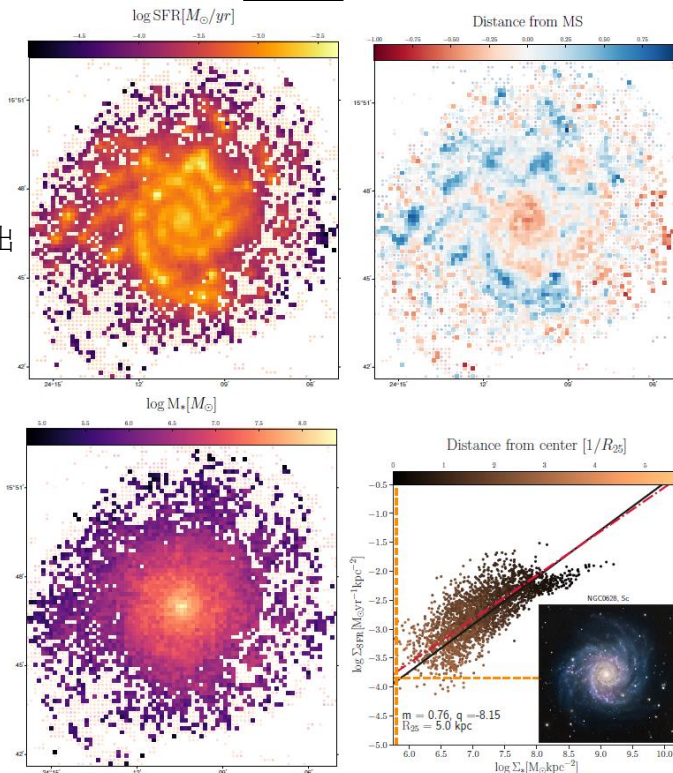


Fig. 8

Table 2. Summary of the slopes quoted in the text, with associated SFR tracer.

Reference	Slope	SFR tracer
Cano-Díaz et al. (2016)	0.72	$H\alpha$
Abdurro'uf & Akiyama (2017)	0.99	SED fitting
Hsieh et al. (2017)	1.00	$H\alpha$
Maragkoudakis et al. (2017)	0.91	$3.6 \mu\text{m}$ or $8.0 \mu\text{m}$
Hall et al. (2018)	0.99	$H\alpha + 24\mu\text{m}$
Medling et al. (2018)	1.00	$H\alpha$
Cano-Díaz et al. (2019)	0.94	$H\alpha$
Bluck et al. (2019)	0.90	$H\alpha$
This Work	0.82	SED fitting

- 8個の銀河を考える上では0.82の傾きがあり、スケールが変わっても不変
- この手法では $H\alpha$ 輝線やBalmer decrementに基づく方法よりも小さなSFR、stellar mass(outermost regionsまで)を考えることができる
- サンプル数を増やす必要あり