# Detection of the self-regulation of star formation in galaxy discs

J. Zaragoza-Cardiel et al. 2019   arXiv : 1906.01641

ABSTRACT

Stellar feedback has a notable influence on the formation and evolution of galaxies. However, direct observational evidence is scarce. We have performed stellar population analysis using MUSE optical spectra of the spiral galaxy NGC 628 and find that current maximum star formation in spatially resolved regions is regulated according to the level of star formation in the recent past. We propose a model based on the self-regulator or "bathtub" models, but for spatially resolved regions of the galaxy. We name it the "resolved self-regulator model" and show that the predictions of this model are in agreement with the presented observations. We observe star formation self-regulation and estimate the mass-loading factor, $\eta = 2.5 \pm 0.5$, consistent with values predicted by galaxy formation models. The method described here will help provide better constraints on those models.
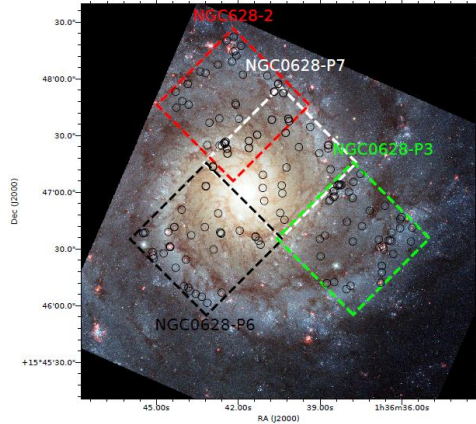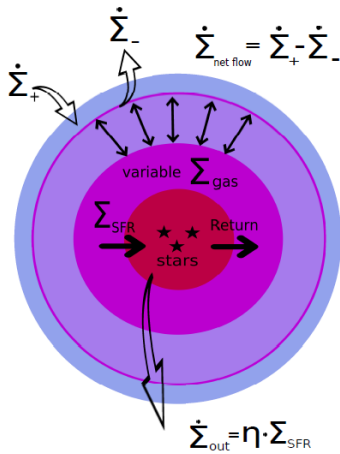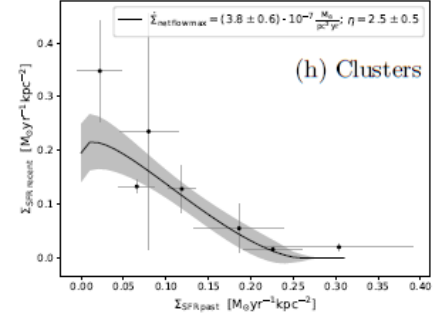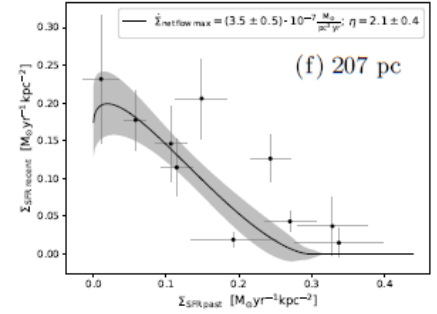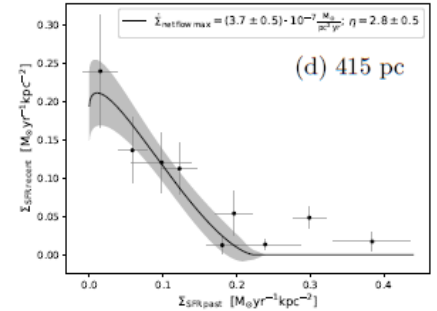
- recent SFR(20 Myr)対past SFR(570 Myr)の図
- 両者とも低い部分に点が集中

- net flowが増加→recent SFRも増加

- ηは領域の大きさによらず不変
- localな星形成領域の典型

- max recent SFRはpast SFRに抑制されている

9領域

36領域

144領域
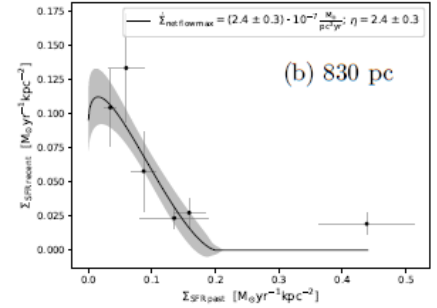
$$\dot{M}_{\mathrm{gas}} = \dot{M}_{\mathrm{in}} - \mathrm{SFR}(1 - R + \eta)$$

$$\dot{M}_{\mathrm{out}} = \eta \mathrm{SFR}$$

$$\dot{\Sigma}_{\mathrm{gas}} = \dot{\Sigma}_{\mathrm{net\,flow}} - \Sigma_{\mathrm{SFR}}(1 - R + \eta)$$

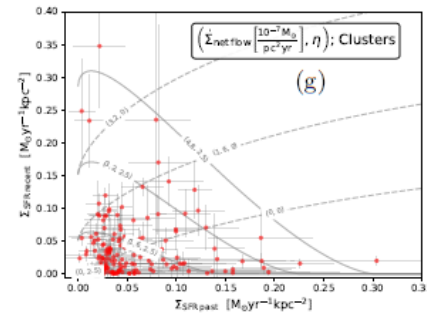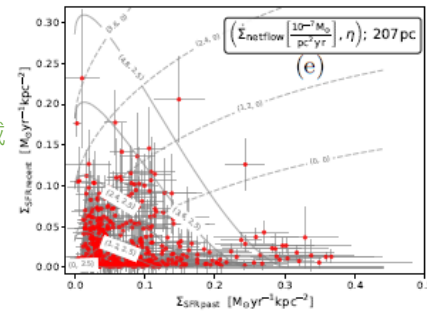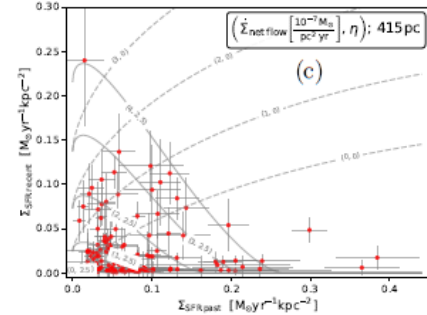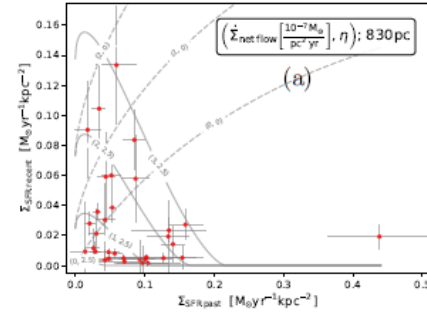$$\dot{\Sigma}_{\mathrm{out}} = \eta \Sigma_{\mathrm{SFR}}$$

$$\overline{\Sigma}_{\mathrm{SFR\,recent}} =$$
$$A \left\{ \left[\dot{\overline{\Sigma}}_{\mathrm{net\,flow}} - \overline{\Sigma}_{\mathrm{SFR\,past}}(1 - R + \eta) \right] \Delta t + \left[\frac{\overline{\Sigma}_{\mathrm{SFR\,past}}}{A} \right]^{\frac{1}{N}} \right\}^{N}$$

$\dot{\Sigma}_{\mathrm{net\,flow}} = \dot{\Sigma}_{+} - \dot{\Sigma}_{-}$

$\dot{\Sigma}_{\mathrm{out}} = \eta \cdot \Sigma_{\mathrm{SFR}}$

(a) 830 pc
(b) 830 pc $\dot{\Sigma}_{\mathrm{net\,flow\,max}} = (2.4 \pm 0.3) \cdot 10^{-7} \frac{M_\odot}{\mathrm{pc}^2\mathrm{yr}}; \eta = 2.4 \pm 0.3$
(c) 415 pc
(d) 415 pc $\dot{\Sigma}_{\mathrm{net\,flow\,max}} = (3.7 \pm 0.5) \cdot 10^{-7} \frac{M_\odot}{\mathrm{pc}^2\mathrm{yr}}; \eta = 2.8 \pm 0.5$
(e) 207 pc
(f) 207 pc $\dot{\Sigma}_{\mathrm{net\,flow\,max}} = (3.5 \pm 0.5) \cdot 10^{-7} \frac{M_\odot}{\mathrm{pc}^2\mathrm{yr}}; \eta = 2.1 \pm 0.4$
(g) Clusters
(h) Clusters $\dot{\Sigma}_{\mathrm{net\,flow\,max}} = (3.8 \pm 0.6) \cdot 10^{-7} \frac{M_\odot}{\mathrm{pc}^2\mathrm{yr}}; \eta = 2.5 \pm 0.5$