Self-Regulated Star Formation Via UV-Dependent Phase Transitions in the ISM: Application to SO and Infrared-Luminous Galaxies.

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Self-Regulated star formation on large scale is an attractive notion in the study of galaxy evolution. Here we are interested in a self-regulating mechanism based on the sensitivity of the warm gas condensation on the UV interstellar radiation field (Parravano 1989). In this model the star formation rate (SFR) is assumed to be self-regulated in such a way that it maintains Pmax approximately equal to the interstellar warm gas pressure. Here, Pmax is the pressure in the marginal state of stability for the transition warm gas $--$ > small clouds. Due to the dependence of Pmax on the gas density, gas composition, and dust content, the resulting self-regulated star formation rate also depends on this parameters. In term of global galactic parameters the self-regulated SFR (ψ_{pp}) can be expressed (Parravano 1989)

$$\psi_{pp} = 1.0510^{-6} 10^{-Po/2P1} \frac{10^{P3([Xi/H]-[Xi/H]o)/2P1} M_{HI}^{1/2P1} T_d^2}{d_1^{P2/2P1} \sqrt{d_1/d_2}} \qquad (1)$$

We are interested in determining how widely applicable is equation (1). Here we take two samples of galaxy types, each representing extrema of the ISM and star formation: lenticulars (SOs), the morphologically earliest type within which stars are currently forming, and very infrared luminous galaxies, which are often interpreted as undergoing a galaxy-wide period of enhanced stellar creation. Data for the SO galaxies were taken from Thronson et al. (1989) and for the luminous systems, we use Young et al. (1989).

Comparison between the observed average SFR ($\psi_{IRB} = 2.06^{-9}\sqrt{L_{IR} L_B}$) and the rate predicted by the model (ψ_{pp}, eq.1) show that only galaxies with $L_B \simeq M_{HI}$ adjust well to the hypothesis $\psi_{IRB} \simeq \psi_{pp}$. Nevertheless, for the whole sample, the ratio of the theoretically predicted SFR from the observed one, ψ_{IRB}/ψ_{pp}, is strongly correlated to the ratio L_B/M_{HI}. Due to the lack of observational data of the UV-luminosity (L_{UV}), it has been assumed that $L_{UV} \propto L_B$. Consequently, we interpret this deviation merely as the increasing contribution of old stars to the blue light for galaxies of earlier morphological types. It is enough to assume that $L_{UV}/L_B \propto M_g/M_*$ to recover a good correlation between ψ_{IRB} and ψ_{pp}. We conclude that the rates of star formation ranging over four orders of magnitude in both lethargic lenticulars (SO) galaxies and Infrared-luminous galaxies can be satisfactorily fit under the assumption that within the ISM the condition $Pmax \simeq P_g$ is fulfilled.

References: Parravano, A.,1989, Ap. J., **347**, 812; Thronson, H.A. et al..1989, Ap. J., **344**, 747; Young,J.S. et al. 1989, Ap. J. Suppl., **70**, 699

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