Gas density and star formation in the rarified regions of discs of normal and LSB galaxies

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We calculated the radial profiles of the azimuthally averaged midplane gas volume density ρ_g for 11 high surface brightness (HSB) spiral galaxies, 7 low surface brightness (LSB) galaxies and 3 S0 galaxies assuming their gaseous layers to be in the equilibrium state in the plane of marginally stable stellar discs. We compared the surface star formation rate (Σ_{SFR}) and star formation efficiency ($SFE=\Sigma_{SFR}/\Sigma_{gas}$) with ρ_g and stellar surface density Σ_s assuming the latter to be proportional to disc surface brightness. Both HSB and LSB galaxies follow a single sequence $\Sigma_{SFR}-\rho_{g}$ and $SFE-\Sigma_s$ or $SFE-\rho_s$. It means that the conditions of star formation are similar in the outer discs of normal spiral galaxies and in the inner regions of LSB galaxies if their stellar discs have similar densities. The relationship between SFE and ρ_s is close to the law SFE $\sim \rho_s^{1/2}$ expected in the theoretical model of self-regulated star formation proposed by Ostriker et al.\cite{OstrikerAll10}. The alternative explanation is to propose that SFE is proportional to a frequency of vertical oscillation of gas clouds around the disc midplane. In the most rarified regions of LSB galaxies the efficiency of star formation is nearly independent on gas and stellar disc densities being higher in the mean than it is expected from the extrapolation of the power law fit for HSB sample galaxies. Evidently in these regions with extremely low ρ_{g} SFE depends on local density fluctuations rather than on the azimuthally averaged disc parameters.

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