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# A comparison of star formation history between NGC 300 and M33

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**Abstract.** NGC 300 is a near-optical twin of the Local Group galaxy M33, which are benchmarks for understanding late-type spiral galaxies. They are two bulgeless and low-mass spiral galaxies in different environments. In order to explore the common properties and differences between the two nearby low-mass systems, we first use the simple chemical evolution model to explore the star formation history (SFH) of NGC300 and M33, and then compare the feasible model predicted SFH of NGC 300 with that of M33. Through comparing the SFHs between them, it can be found that the mean stellar age of NGC 300 is older than that of M33, there is a recent lack of primordial gas infall onto the disk of NGC 300, recent star formation along the disk of NGC 300 is less active than that of M33, and the local environment may play a key role in the secular evolution of a galaxy.

**Keywords.** galaxies: evolution, galaxies: spiral, galaxies: individual: NGC 300 and M33

## 1. Introduction

Motivated by the result of Guglielmo *et al.* (2015) that the average star formation history (SFH) of a galaxy depends on its stellar mass, but galaxies of a given stellar mass have different SFHs depending on their environments. NGC 300 is a near-optical twin to the Local Group galaxy M33 in Hubble type and mass, and they are two bulgeless, low-mass pure-disk galaxies. Although they are similar in appearance, M33 has a disk break at ∼8 kpc, while NGC 300 has a pure exponential disk out to ∼14 kpc. Furthermore, an HI bridge exists between M33 and M31, indicating that they interacted with each other in the past. Compared to M33, NGC 300 is a relatively isolated system. The aforementioned differences indicate that they may experience different evolutionary histories, therefore it is necessary to study and compare the SFH of NGC 300 with that of M33.

## 2. Model

Simple chemical evolution models for NGC 300 (Kang *et al.* 2016) and M33 (Kang *et al.* 2012) are constructed to build a bridge between their SFHs and their observed properties. Here we briefly introduce the main ingredients and basic assumptions of the models. Their disks are assumed to grow up gradually by continuous infall of primordial gas ($X = 0.7571, Y_{\rm p} = 0.2429, Z = 0$) from their halos. To describe the rate at which stars are forming from the cold gas, the molecular-hydrogen-correlated star formation

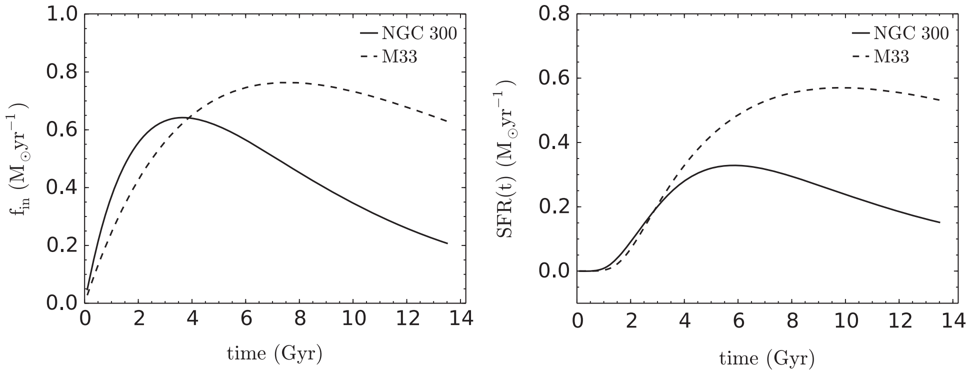


**Figure 1.** The feasible model predicted time evolution of gas infall rate (left) and star formation rate (right) for NGC 300 (solid) and for M33 (dashed).

law is adopted in the models (Leroy *et al.* 2008). Since NGC 300 and M33 are low-mass galaxies, the gas-outflow process is also considered in the models, and the gas outflow rate is assumed to be proportional to star formation rate (SFR). Both instantaneous recycling assumption and instantaneous mixing of the interstellar medium with stellar ejecta are also assumed in the models.

## 3. Result

Investigations of the feasible models for NGC 300 and M33 are in Kang *et al.* (2016) and Kang *et al.* (2012), respectively. The left panel and the right panel of Figure 1 respectively plots the feasible model predicted time evolution of gas infall rate and SFR. It can be seen from the left panel of Figure 1 that the gas infall rate of NGC 300 is gradually increasing with time and reaches its peak at about 10 Gyr ago, and then slowly drops down, while that of M33 achieves its peak around 6 Gyr ago and then gradually falls. Moreover, the gas infall rate of NGC 300 increases and falls faster than that of M33, and the present-day gas infall rate of NGC 300 is much lower than that of M33. On the other hand, the right panel of Figure 1 reveals that the SFR of NGC 300 is lower than that of M33 after $z \sim 2$, and the difference between them increases with time and reaches the maximum at the present time. Furthermore, the feasible model predicted values of present-day SFR are $0.51\,M_\odot yr^{-1}$ for M33 and $0.18\,M_\odot yr^{-1}$ for NGC 300, which are in good agreement with the observed data for them. All these indicate that, compared to M33, less gas infall and weaker star formation occurred recently in the disk of NGC 300. Our results show that, even though NGC 300 and M33 have similar stellar mass and morphology, they have experienced different SFHs due to their environmental differences (See Kang *et al.* 2016 for more details).


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