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CHEMICAL EVOLUTION MODEL OF M33

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We present a chemical evolution model (CEM) of M33 and we find that M33, which is smaller than both M31 and MW, shows a lower gas infall rate, SFR efficiency, and IMF $\mathcal{M}_{\rm up}$. Therefore the CEMs for large spiral galaxies (Carigi et al. 2005; Meneses-Goytia et al. 2011) can be scaled to a smaller galaxy.

M33 is a type Sc galaxy with a baryonic mass of 8.4×10^9 $M_\odot$. It is the third largest member spiral of the Local Group, it is about three times smaller than the Milky Way and six times smaller than M31.

The CEM of M33 presented in this paper uses an inside-out scenario of galaxy formation with a dual-infall, similar to the one considered in MW model by Carigi et al. (2005). We used: (a) the time scale for the gas infall rate by Marcon-Uchida et al. (2010), (b) the SFR by Kennicutt (1998), (c) the IMF by Kroupa et al. (1993) between 0.1 $M_\odot$ to $\mathcal{M}_{\rm up}$, and (d) Z-dependent stellar yields by Karakas (2010), Kobayashi et al. (2006), and Nomoto et al. (1997) for low-intermediate mass stars, massive stars, and SNIa, respectively.

Our CEM was built to reproduce the mass surface density of gas ($\Sigma_{\rm gas}$) and O/H values in the galactic disk (see Figure 1). The HI+H2 observational data by Gratier et al. (2010) were corrected with contributions of He and heavy elements. A very good agreement for $r \leq 6$ kpc was obtained assuming a star formation eficiency of 0.04. The increase of $\Sigma_{\rm gas}$ for $r > 6$ kpc cannot be explained by an inside-out model. Similar behavior has been observed in other spiral galaxies, and its explanation is still an open problem (Vlajic 2010).

The O/H values determined for collisionally excited lines by Rosolowsky & Simon (2008) were corrected adding 0.23 dex and 0.12 dex due to temperature variations (t^2) in HII regions by Peimbert et al. (2007), and considering dust depletion by Peimbert & Peimbert (2010), respectively. The modeled O/H gradient, $12 + \log(\text{O/H}) = -0.022 \times r$ (kpc) $+ 8.73$, is in good agreement with the observed, $12 + \log(\text{O/H}) = -(0.027 \pm 0.012) \times r$ (kpc) $+ (8.71 \pm 0.07)$, when we assume $\mathcal{M}_{\rm up} = 50$ $M_\odot$ in the IMF. In Figure 1 we also plotted the predicted SFR, which shows an excellent fit to observations.

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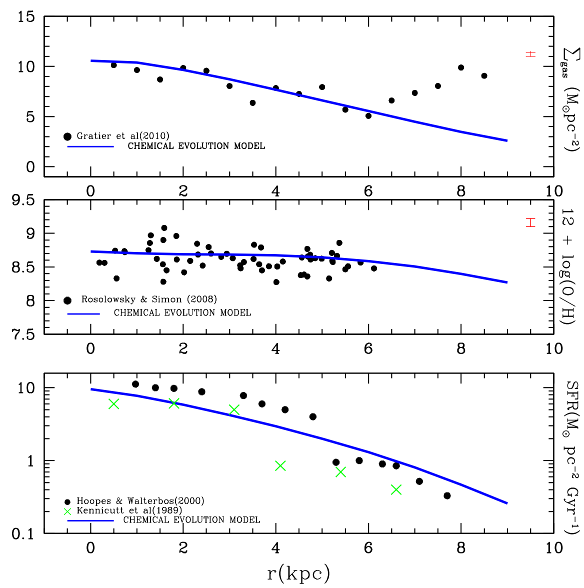

Fig. 1. Radial distribution in the galactic disk of: the gas mass surface density (top), O/H values from HII regions (middle), star formation rate (bottom). The blue solid line is the model result at the present time of 13 Gyr. The black circles are observational data, HI and H2 by Gratier et al. (2010), with He and Z contributions (top), abundances by Rosolowsky & Simon (2008) corrected by t^2 and dust depletion (middle), and SFR by Hoopes & Walterbos (2000), green crosses, SFR by Kennicutt (1989) (bottom).

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