Abstract

The nature of the Type Ia supernovae (SNIa) progenitors remains still uncertain. This is a major issue for galaxy evolution models since chemical and energetic feedback play a major role in the overall stellar evolution. SNII events occur following a distribution of explosion times which is known as the Delay Time Distribution (DTD). It is suggested that different progenitor scenarios will create particular chemical abundance patterns in their host galaxies. We explore this point and implement 5 different DTDs in SPH galaxy simulations dominated by a rapid quenching of the star formation, displaying the majority of the stars concentrated in the bulge component. We find that not every DTD is able to reproduce simultaneously the observed SNIa rates of spiral/late-type galaxies, the [O/Fe] ratios shown displayed by the Milky Way and the observed correlation between the specific SNIa rate and the specific star formation rate. Our results suggest that SNIa observations in galaxies with very low and very high specific star formation rates can help to impose more stringent constraints on the DTDs and therefore on SNIa progenitors.

Methodology & Results

We estimate the rate of SNIa using the formulation of Matteucci & Renzini (2003) (see the Methodology & Results section) by using the population of stars in each galaxy to determine the mass of SNIa progenitors. The SNIa rate is calculated as the sum of the number of SNIa per galaxy times the life-time of the progenitors. Since the life-time of the progenitors depends on their mass, we calculate the mass of SNIa progenitors using the IMF and the SFR of the galaxy. We then calculate the rate of SNIa using the DTDs implemented in the simulation. The DTDs are implemented as follows: Single Degenerate (SD, cyan), Double Degenerate (DD, purple), Power Law (PL, yellow), Single Degenerate-3 (SD-3, blue), and Single Degenerate-2 (SD-2, green). We also consider the SD scenario with a low mass cut-off of 0.6 M⊙ (SD-Low, black).

Conclusions

We present the results of galaxy simulations performed with DeLfs SPH (Muñoz-Darias et al. 2015, Li et al. 2011, Scannapieco et al. 2006), NuStar SPH (Chiosi et al. 2015), and NuHybrid SPH (Jordan et al. 2015). We explore the performance of 5 different DTDs in galaxies with isolated dark matter halos of mass 10^12 M⊙. We find that not all DTDs are able to reproduce the observed SNIa rates of spiral/late-type galaxies, the [O/Fe] ratios shown displayed by the Milky Way and the observed correlation between the specific SNIa rate and the specific star formation rate. Our results suggest that SNIa observations in galaxies with very low and very high specific star formation rates can help to impose more stringent constraints on the DTDs and therefore on SNIa progenitors.