High-mass X-ray Binaries: Illuminating the Passage from Massive Binaries to Merging Compact Objects
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Emission-line diagnostics of core-collapse supernova host HII regions including interacting binary population

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Abstract. Considering as many as 70% of massive stars interact with a binary companion (Sana *et al.* 2012, 2014), we created a new model of the optical nebular emission of HII regions by combining the results of the Binary Population and Spectral Synthesis (BPASS, Eldridge, Stanway *et al.* 2017) code with the photoionization code (CLOUDY). This is discussed more in detail in Xiao *et al.* 2018a. Then we use this model to explore a variety of emission-line diagnostics of CCSN host HII regions from the PMAS/PPAK Integral-field Supernova hosts COmpilation (PISCO, Galbany *et al.* 2018). We determine the age, metallicity and gas parameters for H II regions associated with CCSNe, contrasting the above variables to distribution type II and type Ibc SNe. We find their nebular emission and CCSN progenitor types are largely determined by past and ongoing binary interactions, for example mass loss, mass gain and stellar mergers. However we note these two types SNe have little preference in their host environment metallicity measured by oxygen abundance or in progenitor initial mass, except that at lower metallicities supernovae are more likely to be of type II. The BPASS and nebular emission models are available from bpass.auckland.ac.nz and warwick.ac.uk/bpass.

Keywords. binaries:general, supernovae:general, HII regions.

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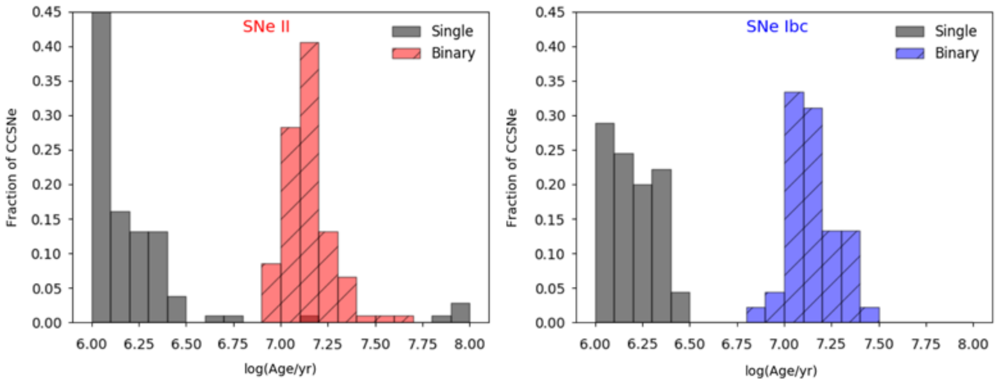

Figure 1. The fraction of CCSN number as a function of age derived from best-fitting models accounting for ionizing photon leakage. The left panel show the fraction distribution for type II SNe and the right panel for type Ibc SNe, with the black bars are from single-star models and the coloured bars from binary-star models. The binary-star models, that allow for ionizing photon loss, provide a more realistic age compared to the constraints of detected SN progenitors (Smartt 2015; Eldridge et al. 2013). We also find that type II and type Ibc SNe arise from progenitor stars of similar age, mostly from 7 to 45 Myr, which corresponds to stars with masses $< 20 M_{\odot}$. (The figure taken from Xiao *et al.* 2018b)

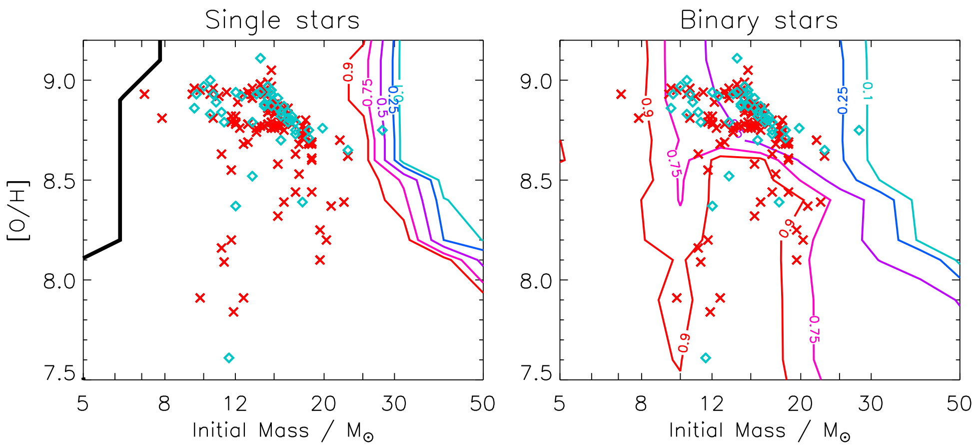

Figure 2. The predicted number count ratio of SN type as a function of initial mass and metallicity, compared to observational data (type II in red crosses, type Ibc in blue diamonds) from the best-fitting models accounting for ionizing photon loss. The contours are annotated with the fraction of supernovae that are type II at that contour. The thick black line represents the minimum initial mass for SNe to occur. The binary-star models provide a much improved prediction of the type II to Ibc ratio as a function of progenitor mass and metallicity than single-star models. (The figure taken from Xiao *et al.* 2018b)

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