

Stripped-envelope supernova rates and host-galaxy properties

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Abstract. The progenitors of stripped-envelope supernovae (SNe Ibc) remain to be conclusively identified, but correlations between SN rates and host-galaxy properties can constrain progenitor models. Here, we present one result from a re-analysis of the rates from the Lick Observatory Supernova Search. Galaxies with stellar masses $\lesssim 10^{10} M_{\odot}$ are less efficient at producing SNe Ibc than more massive galaxies. Any progenitor scenario must seek to explain this new observation.

Keywords. supernovae: general, surveys, galaxies: fundamental parameters

Core-collapse supernovae (CC SNe) are broadly divided into SNe II and SNe Ibc (also known as stripped-envelope SNe; see, e.g., Modjaz *et al.* 2014). The progenitors of the latter have yet to be unambiguously identified (Eldridge *et al.* 2013). Knowledge of the progenitors will impact various field of astrophysics, from the explosion processes of these stars, through galaxy evolution and cosmic nucleosynthesis. In past works (e.g., Graur & Maoz 2013, Graur *et al.* 2015), we have shown that correlating SN rates with

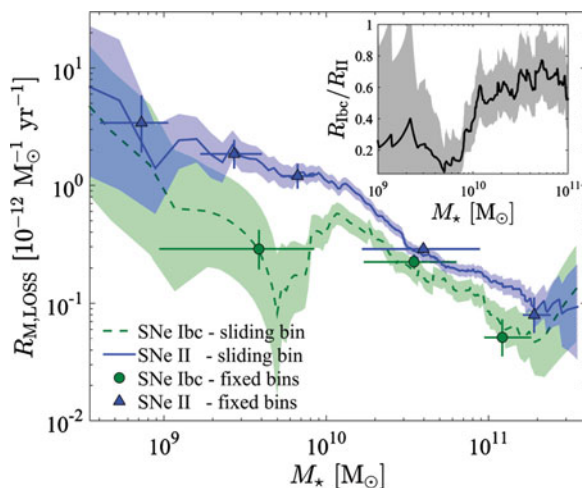


Figure 1. Mass-normalized CC SN rates versus galaxy stellar mass, measured in sliding (curves) and fixed (symbols) bins. The shaded patches are the 68% Poisson uncertainties of the rates as measured with the sliding bin. The inset shows the ratio between the SN Ibc and SN II rates. In galaxies less massive than $\sim 10^{10} M_{\odot}$, the SN Ibc rates plateau and are deficient relative to the SN II rates.

various host-galaxy properties can constrain progenitor scenarios, by, e.g., recovering the delay-time distribution of SNe Ia. A fraction of the Lick Observatory Supernova Search (LOSS; Leaman *et al.* 2011, Li *et al.* 2011a,b) SN host galaxies have Sloan Digital Sky Survey spectra, from which various galaxy properties were extracted. We have used this fraction of LOSS SNe to re-measure CC SN rates and test for correlations with different galaxy properties. In Fig. 1, we show CC SN rates as a function of galaxy stellar mass, M_* , from which it appears that while in galaxies with $M_* \gtrsim 10^{10} M_\odot$ the rates of SNe Ibc track those of SNe II, in less-massive galaxies the SN Ibc rates are deficient relative to the SN II rates. This deficiency hints that some physical process(es) related to the progenitors of SNe Ibc is hindering their production in galaxies less massive than $\sim 10^{10} M_\odot$. Any SN Ibc progenitor model must reproduce these rates and explain this deficiency.

References

- Eldridge, J. J., Fraser, M., Smartt, S. J., Maund, J. R., & Crockett, R. M. 2013, *MNRAS*, 436, 774
- Graur, O. & Maoz, D. 2013, *MNRAS*, 430, 1746
- Graur, O., Bianco, F. B., & Modjaz, M. 2015, *MNRAS*, 450, 905
- Leaman, J., Li, W., Chornock, R., & Filippenko, A. V. 2011, *MNRAS*, 412, 1419
- Li, W., Leaman, J., Chornock, R., Filippenko, A. V., Poznanski, D., Ganeshalingam, M., Wang, X., Modjaz, M., Jha, S., Foley, R. J., & Smith, N. 2011a, *MNRAS*, 412, 1441
- Li, W., Chornock, R., Leaman, J., Filippenko, A. V., Poznanski, D., Wang, X., Ganeshalingam, M., & Mannucci, F. 2011b, *MNRAS*, 412, 1473
- Modjaz, M., Blondin, S., Kirshner, R. P., Matheson, T., Berlind, P., Bianco, F. B., Calkins, M. L., Challis, P., Garnavich, P., Hicken, M., Jha, S., Liu, Y. Q., & Marion, G. H. 2014, *AJ*, 147, 99