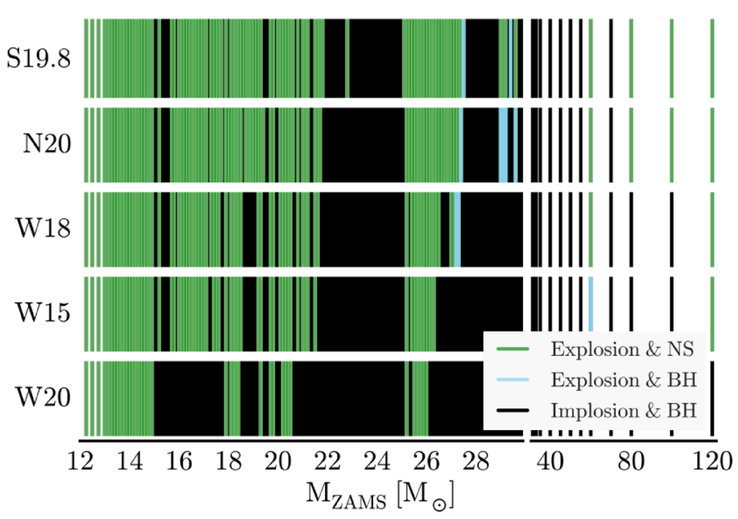
The Effects of Metallicity on the LMC Core-Collapse Progenitor Mass Distribution

Sonja Panjkov[1 2] , Katie Auchettl[1 2 3]

1 School of Physics, The University of Melbourne, Australia 2 OzGrav, University of Melbourne, Australia 3 Department of Astronomy and Astrophysics, University of California, Santa Cruz, USA

1.

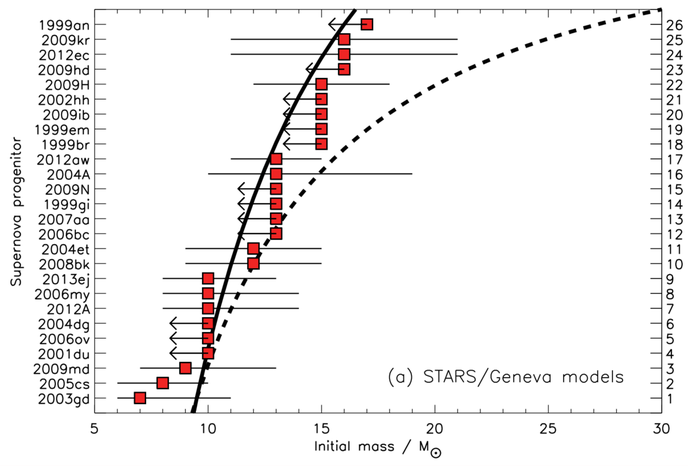
Models predict observable Core-Collapse Supernovae (CCSNe) up to 120 $M_\odot$ ...



CC explosion outcomes for SN1987A using 5 different models. Observable SNe are predicted for high mass stars. [1]

2.

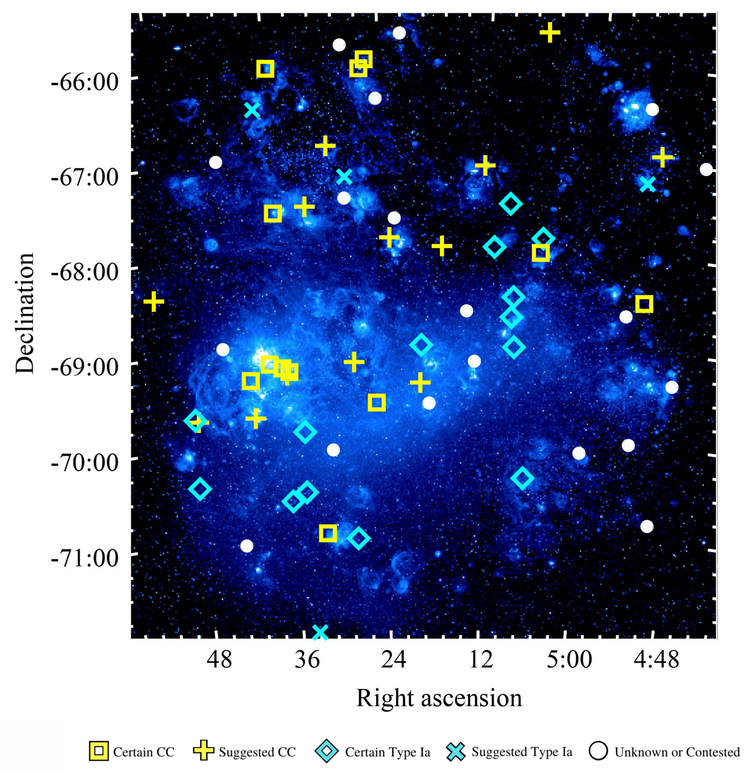
...but progenitors identified in pre-SN images show a deficit of high mass stars (M >18$M_\odot$).



The Initial Mass of CCSN progenitors identified from pre-explosion images. The curves are the cumulative Initial Mass Functions (IMFs) for different maximum masses. [2]

3.

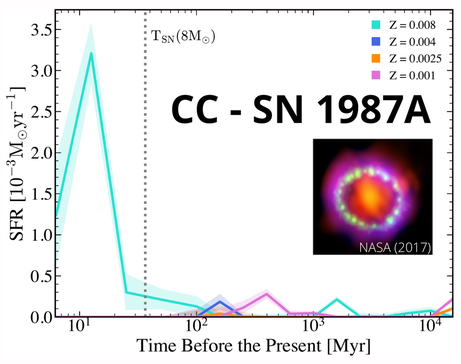
Luckily, information about the SN progenitors is encoded in the Star Formation Histories (SFHs) of the 78 LMC Supernova Remnants (SNRs).

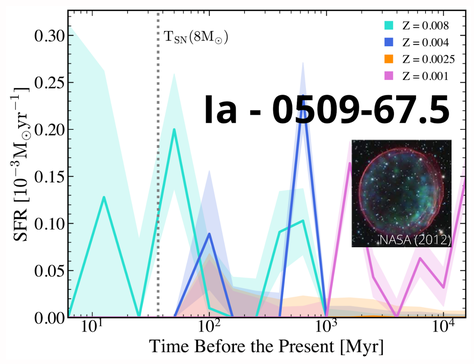


Hα map of the LMC marking the location and literature classifications of the LMC SNRs.

4.

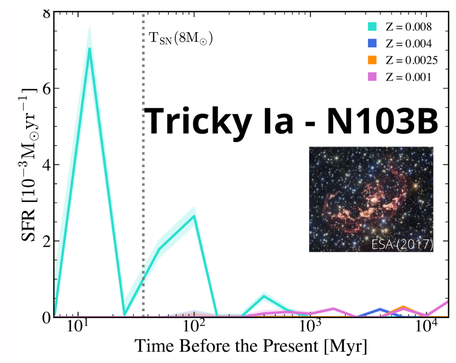
First, we extract the local SFH for each LMC SNR from the maps of Harris & Zaritsky (2009).





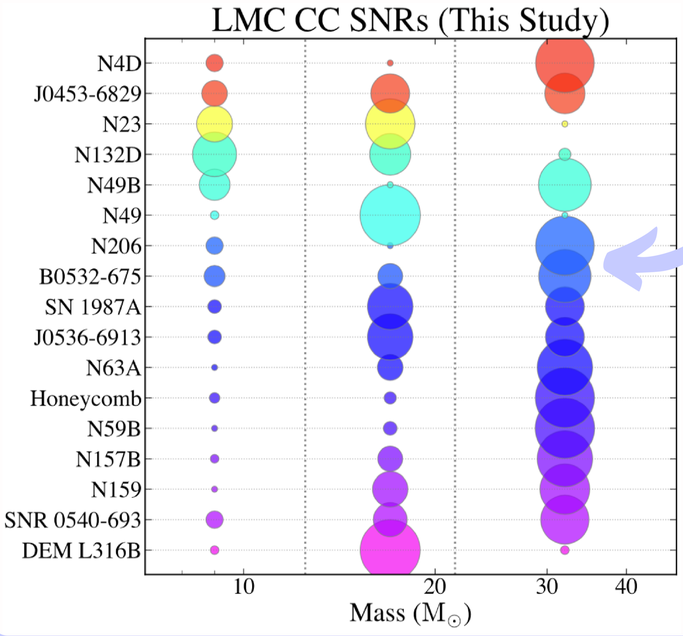
In general, CC SNRs show recent, vigorous star formation (SF) while Type Ia SNRs tend to be found in quiescent environments.

However, some Type Ia SNRs also show strong, recent SF, like N103B (right). Thus, we also consider independent properties, like X-ray line emission, when classifying SNRs.



5.

For the CC SNRs, we can relate bursts of SF to stellar lifetime and hence to progenitor mass, allowing us to calculate the progenitor mass distribution.

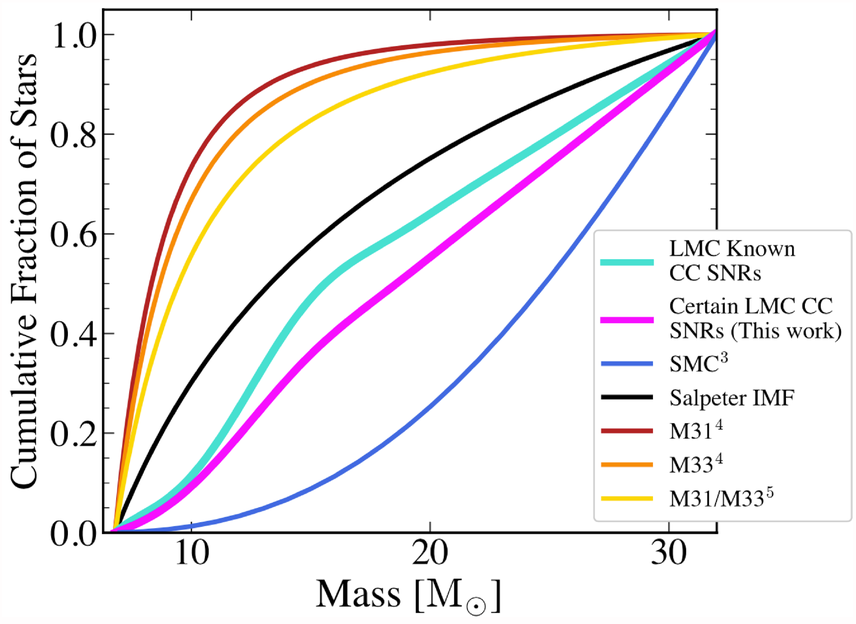


Evidence for high-mass CC (M>18$M_\odot$) progenitors, in line with theoretical predictions!

The LMC CC progenitor mass distribution assuming a single star population. The size of the circles indicates the likelihood of a given progenitor mass range.

6.

From this, we can determine the CC progenitor IMF for the LMC.



The LMC IMF is consistent with a Salpeter IMF, but predicts fewer massive stars than in the low-metallicity SMC. This is likely due to higher rates of rotation and decreased mass loss in metal-poor environments, leading to more massive progenitors.

srpanjkov@student.unimelb.edu.au
@spacey_sonja
sonjapanjkov.github.io

References

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