Progenitor Mass Distribution for Core Collapse Supernova Remnants

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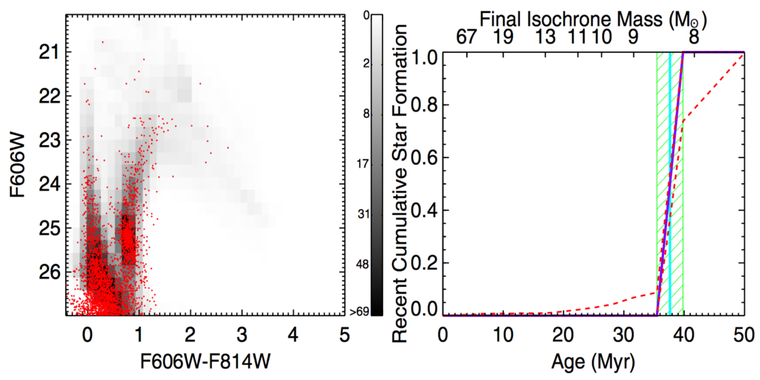
Age-dating nearby stellar populations: one way to constrain the progenitor masses of CCSN

- Theory predicts that single stars above ~ 8 $M_\odot$ collapses, but in general we don't know **which ones actually explode**?
- It is difficult to constrain these stars: only ~ 70 supernova (SN) progenitor have direct images
- By age-dating the surrounding stellar populations in the vicinity of the SN explosion we can infer the progenitor mass associated with that age



(Jennings et al. 2014)

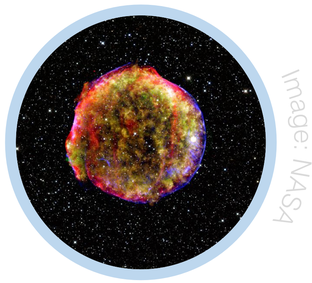
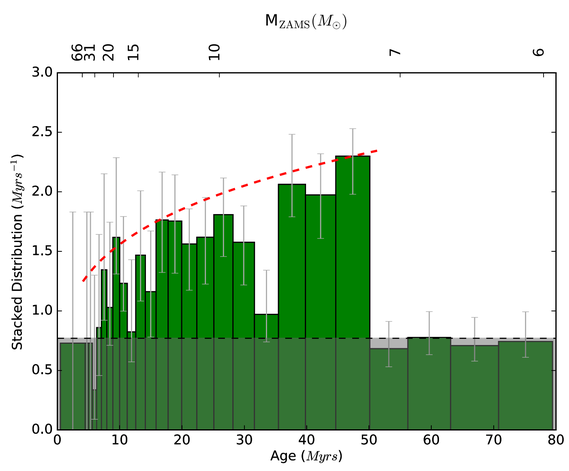


Image: NASA

Supernova remnants (SNRs) as SN tracers, since **they are detectable for ~ 10^4 yr.** Hence, we have the potential to find hundreds of progenitor masses

- Age distribution for 94 SNRs in M31 and M33 galaxies. This image clearly shows a minimum age, maximum age, and slope of the distribution.

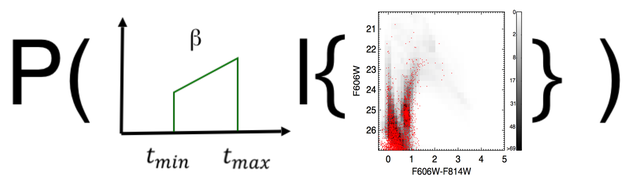


(Díaz-Rodríguez et al. 2018)

Our primary goal is to constrain which stars explode and constrain the predictions of core-collapse SN

Infer progenitor mass distribution from star formation histories (SFHs)

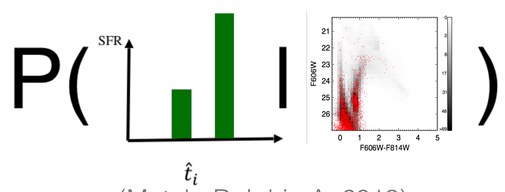
Goal: Calculate the progenitor mass distribution (t_{min}, t_{max}, β) given the observed color-magnitude diagrams (CMD) for the regions surrounding the SNRs or SNe



(Díaz-Rodríguez et al. 2019 in prep)

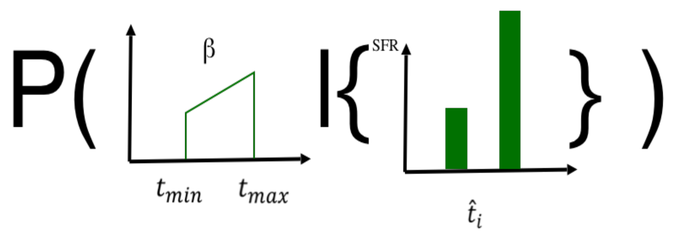
How:

- We first derive the SFH from the color-magnitude diagram for each field using Match

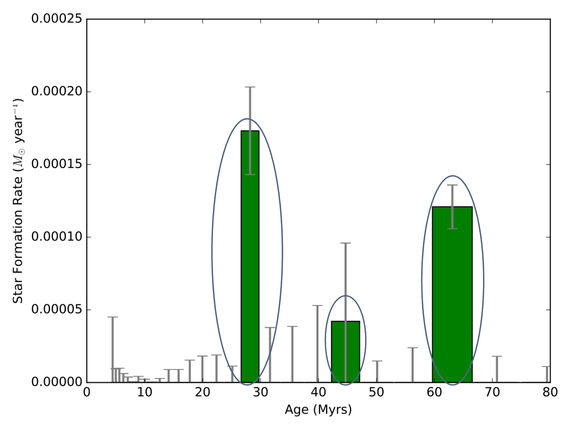


(Match, Dolphin A. 2013)

- In Díaz-Rodríguez et al. 2018 we infer the progenitor mass distribution given a set of SFHs

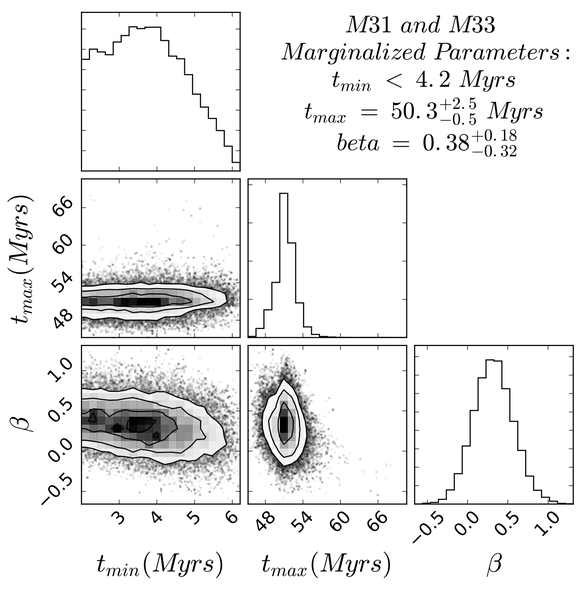


(Díaz-Rodríguez et al. 2018)



- The next phase, is to connect the previous two steps into one so that we may infer the progenitor mass distribution given a set of CMDs (see Goal) (Díaz-Rodríguez et al. 2019 in prep)
  - Includes Monte Carlo test of this whole process

Tighter constraints for the minimum mass, maximum mass, and slope of the mass distribution

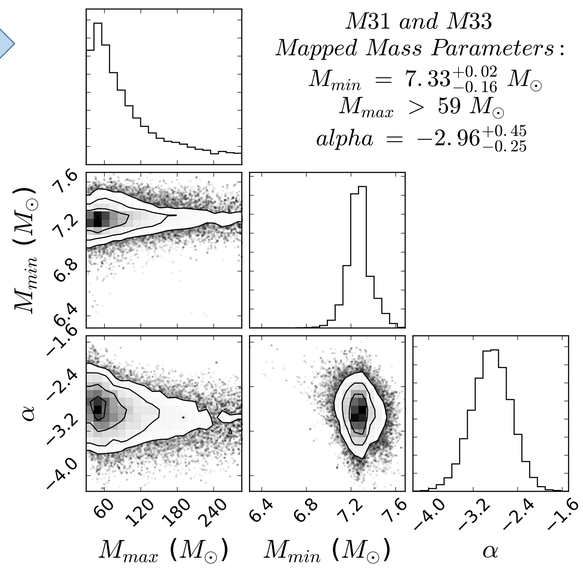


Bayesian inference for 94 SNRs in M31 and M33 (Díaz-Rodríguez et al. 2018)

Assumptions in our mapping

- Single star evolution (Padova Models)
- Specific metallicity (solar)
- Specific parameters such as overshoot

$$M_{min} = 7.33^{+0.02}_{-0.16}\ M_\odot$$
$$M_{max} > 59\ M_\odot$$
$$alpha = -2.96^{+0.45}_{-0.25}$$



Future:

- Infer progenitor mass distribution for ~300 of SNRs in M83
- Compare distribution with CCSNe simulations
- Include binary effects on the model