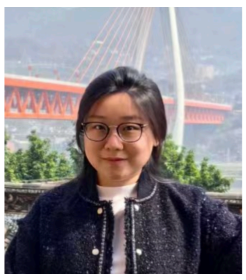
Unveiling the interacting binary origin of Type IIP supernova*



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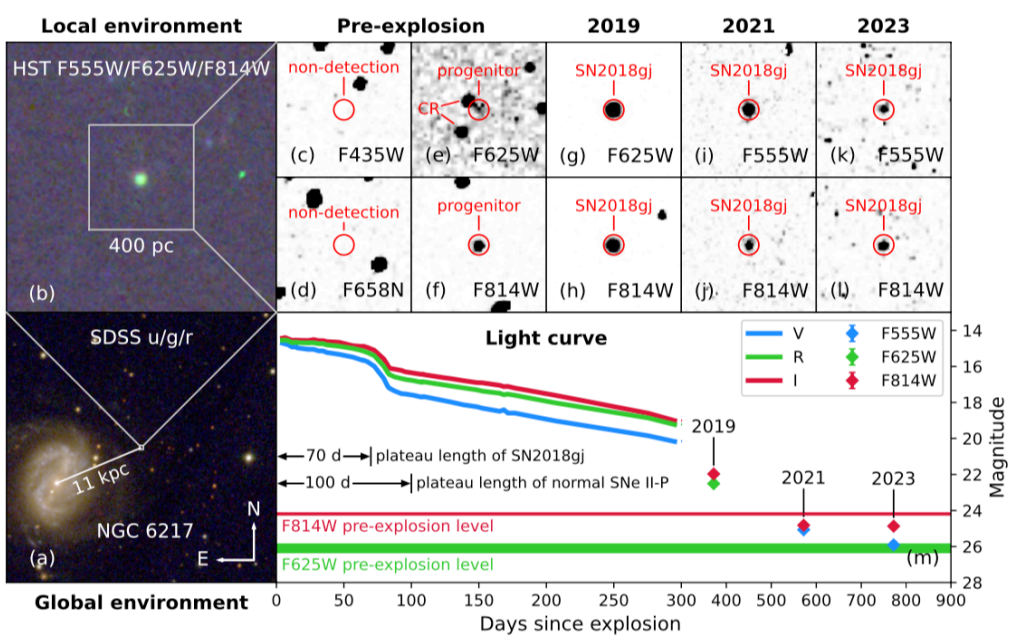
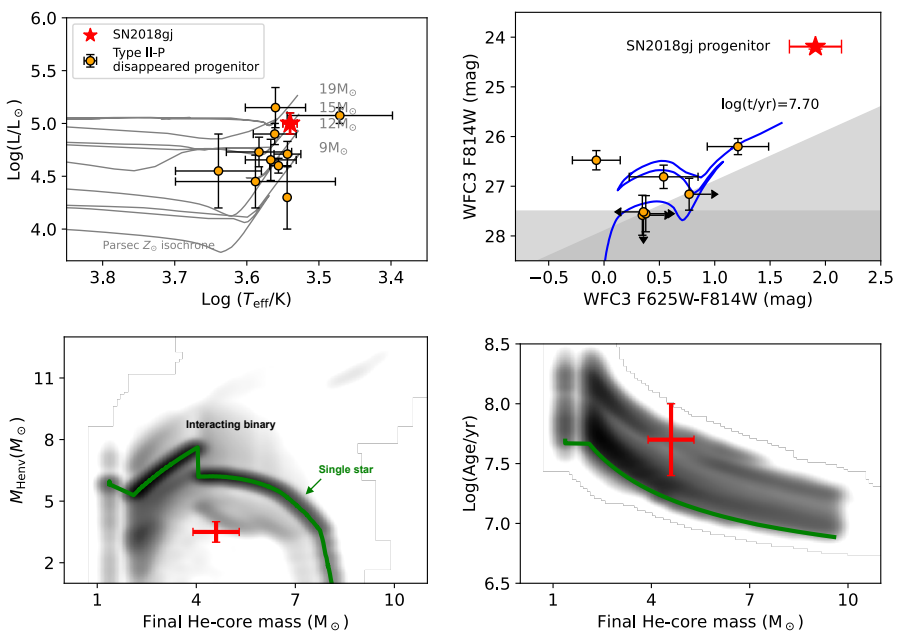
Motivation

SNe IIP is the most common subclass of CCSNe (>50%)[1]. They exhibit strong H features in spectra and have a plateau phase in light curves powered by H recombination. They display a rich observational **diversity**[2,3], such as the plateau length, peak luminosity and expansion velocity. It has been well established that red supergiant (RSG) stars are the **direct progenitors** of SNe IIP[4]. **For a long time, they have been considered as single stars with initial masses of 8–17 $M_{\odot}$. Only recently, is it realized in theory that the RSG progenitors of SNe IIP may also have experienced significant binary interaction**[5,6]. It has been suggested that interacting binaries may account for up to 1/3–1/2 of SNe IIP and different progenitor structures (observed diversity). However, **big challenge** of identifying the interacting binary origin of SNe IIP is that the progenitor appears as an apparently similar RSG before core collapse for both single and binary channels, and channel containing a survived companion only accounts for <5%[5]. We aim to conduct a comprehensive survey of the SNe IIP progenitors and identify the interacting binary origin based on multiple observational evidences and provide simulations of the binary evolution.

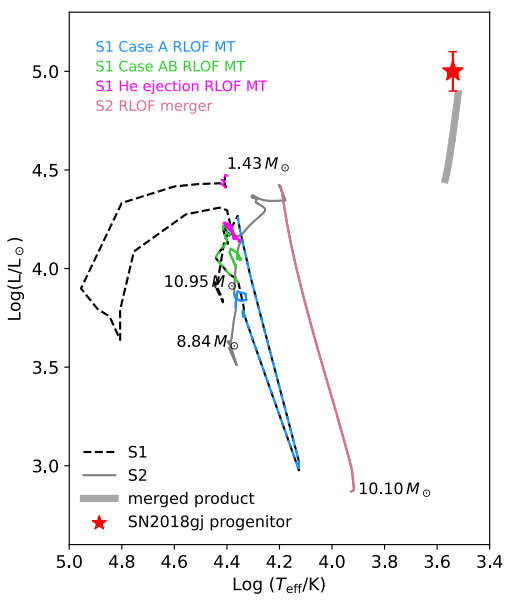
The unique case: SN 2018gj

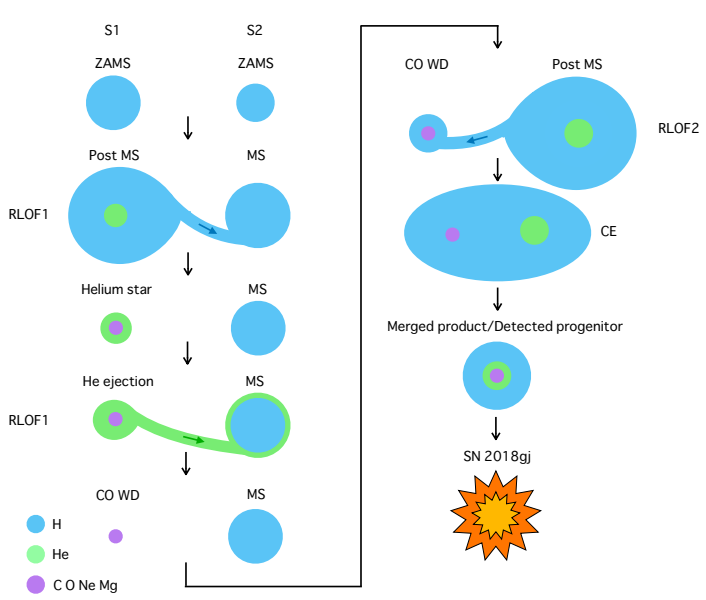




- **Environment**: very sparse region without obvious signs of recent star formation
- **Direct detection**: resembles a RSG with $M_{\rm ini} \sim 15 M_{\odot}$
- **Light curve**: significantly stripped H envelope
- **Single star origin can not explain the old environment, luminous progenitor, short plateau length together.**

Interacting Binary Channel





- WD+HB produces progenitor with non-standard (larger) core to envelope mass ratio.
- **Less massive stars produce SNe IIP that only single massive stars can generate.**
- Simulations are performed with POSYDON population synthesis code.

SNe IIP sample

- Extensive search of progenitors on pre-explosion HST images
- Inspection of possible late-time images of known progenitors
- Consist of ~20 SNe IIP progenitors
- 11 SNe IIP progenitors have indeed exploded (genuine progenitors)
- Estimation of probabilities of interacting binary origin

Reference:
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* Niu et al. to be submitted