N II as a Diagnostic for Supernova Progenitor Mass

MODELLING SUPERNOVA SPECTRA

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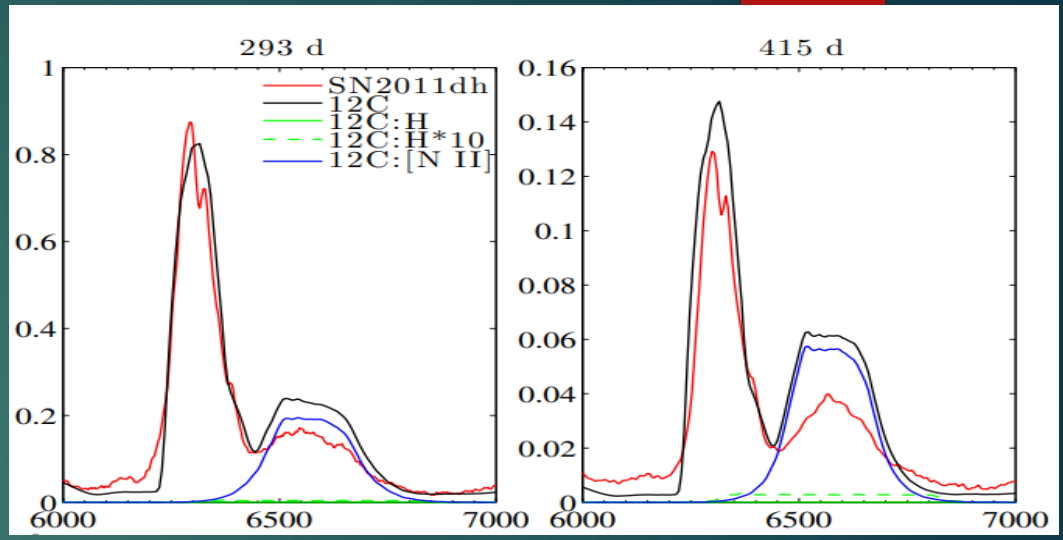
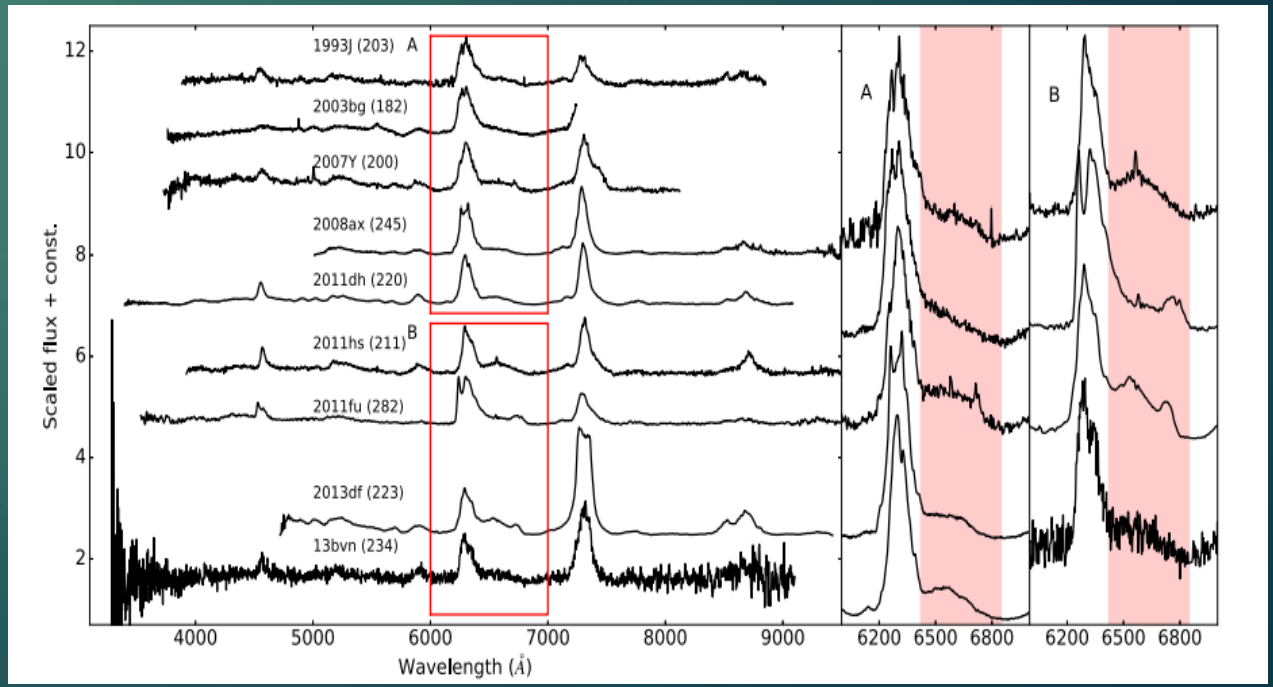
NII feature around 6550 Å

- Feature centred on 6550 Å present in multiple IIb/Ib spectra at ~200 days
- Differing strengths per SN
- Initially thought to be hydrogen
- Found to very likely be caused by NII doublet at 6548, 6583 Å

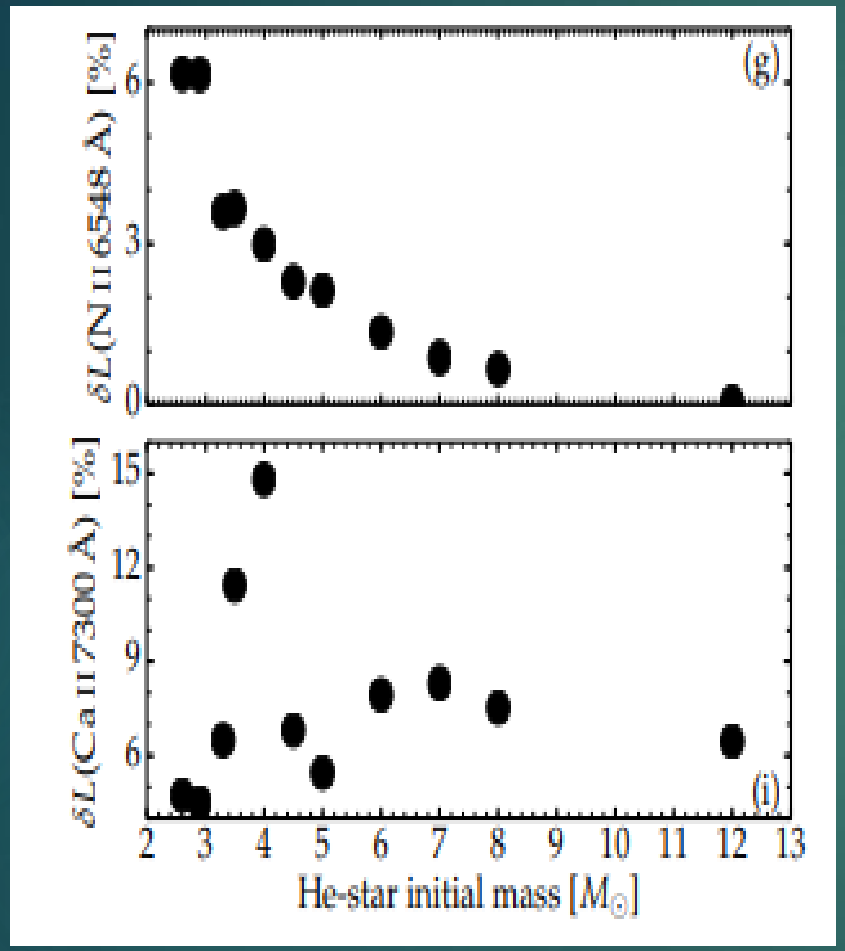


Jerkstrand et al., 2015

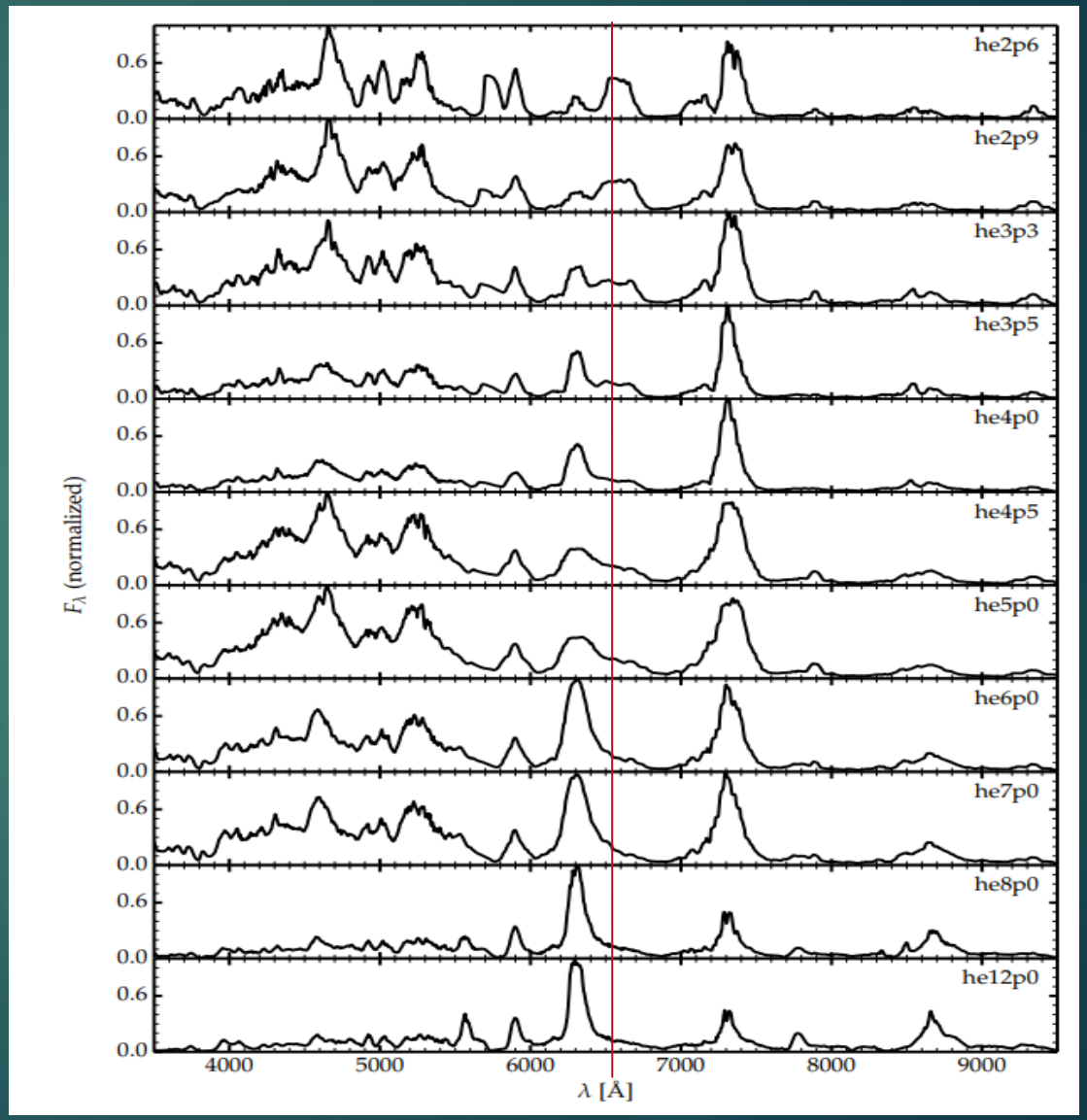


Fang & Maeda, 2018

Usecase: Potential As a diagnostic

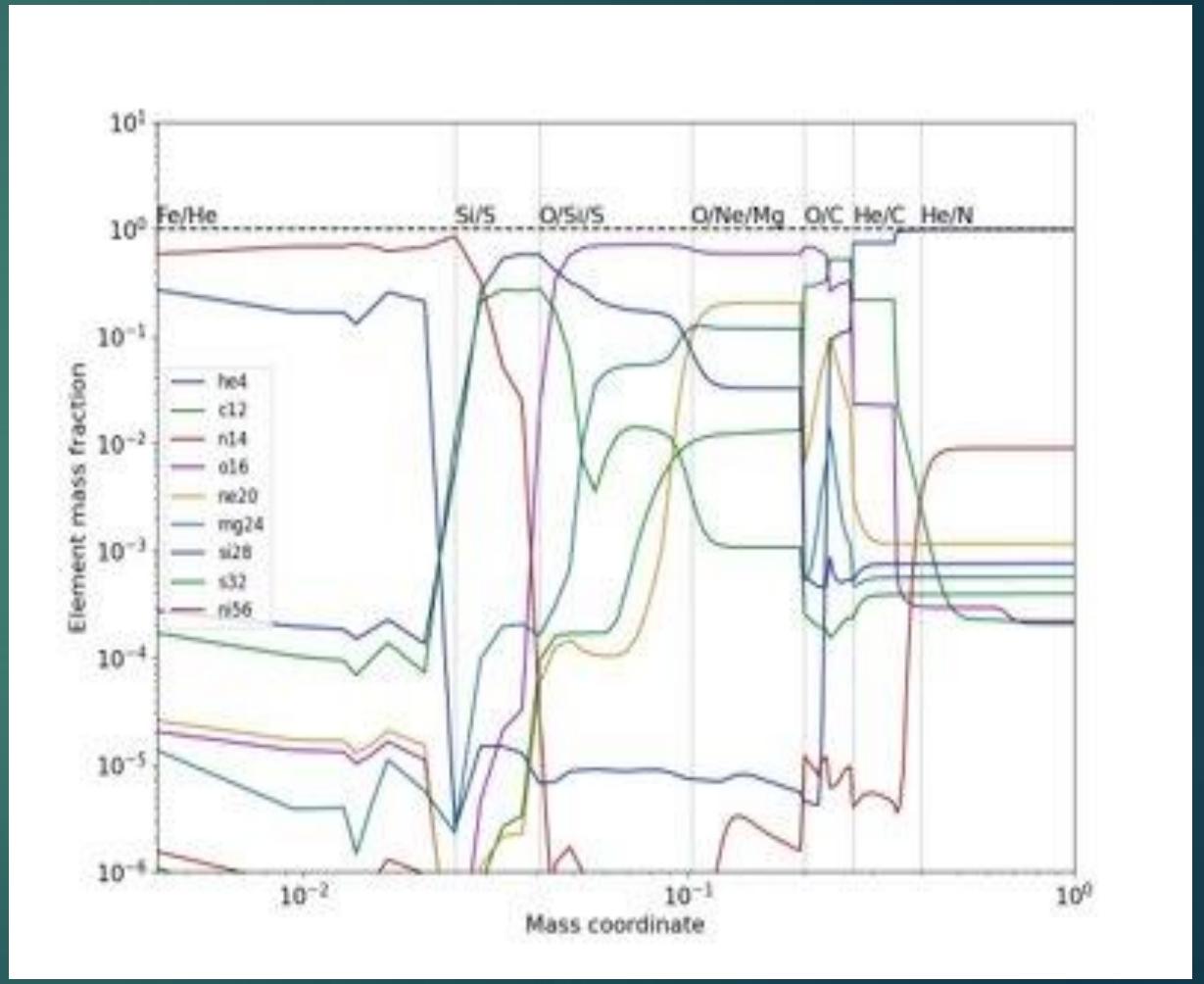


Dessart et al., 2021



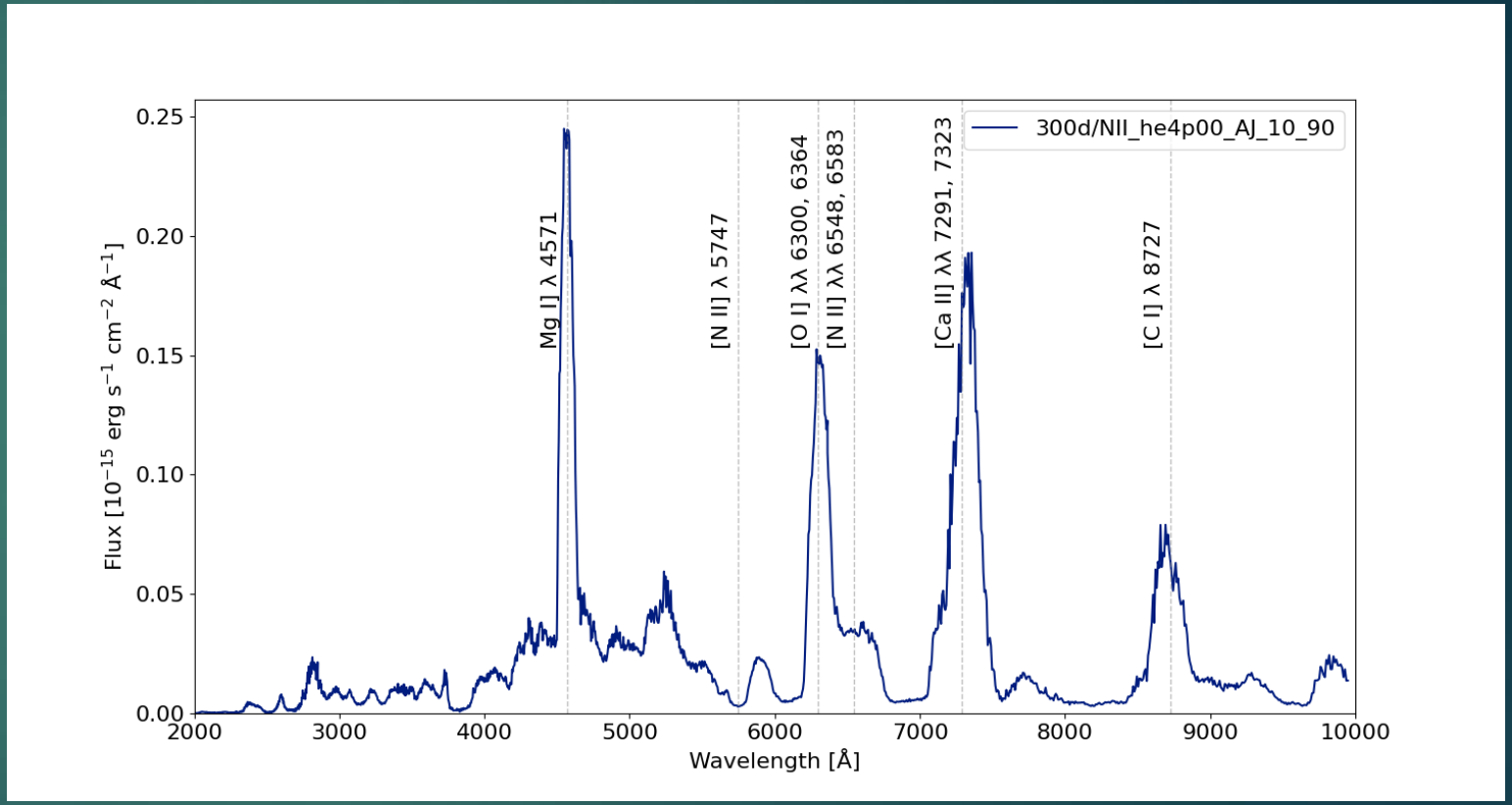
Usecase: Tracer of He/N zone

- In the current theory, type Ib and Ic differ due to presence of He/N zone
- However, potential surpression of He-emission makes this not certain (e.g. Williamson et al., 2021)
- The nitrogen emission is a tracer for a He/N zone, providing additional constraints to our theory



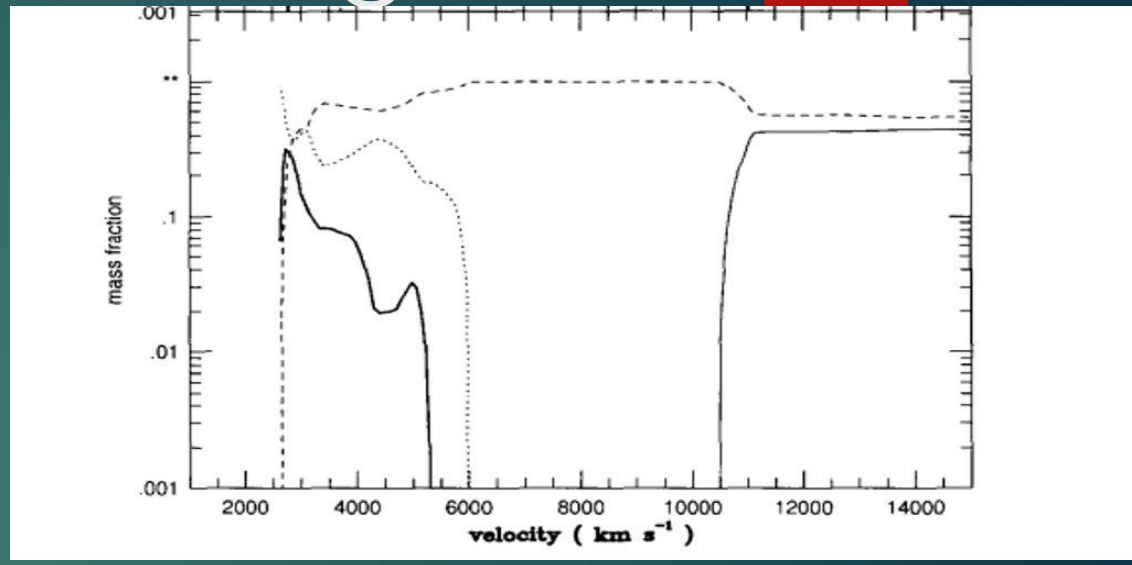
My Project: Model the N II Emission

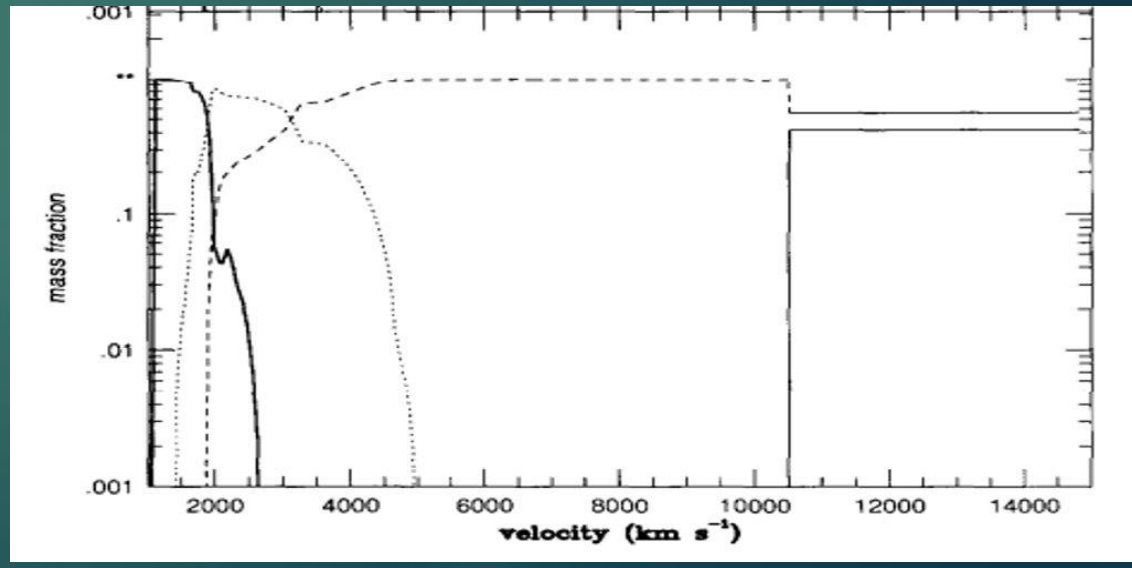
- Use as input model the Helium core preginotrs from Woosley et al., 2019
- Evolve their spectra using SUMO NLTE code (Jerkstrand et al., 2011)
- Track N II evolution through time
- Compare the results to observed SNe spectra



My Project: The Effect of Mixing

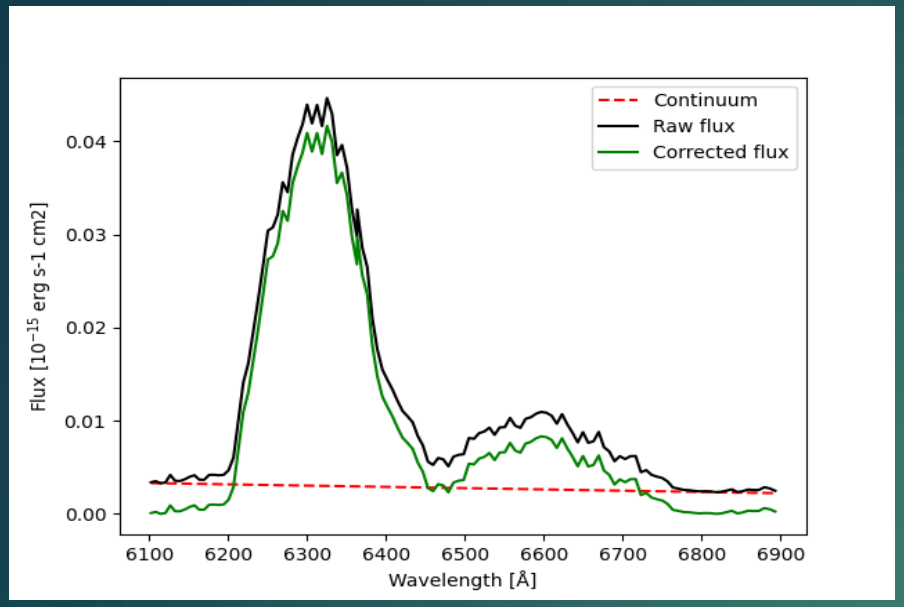
- During explosion, SN ejecta get mixed to varying degrees
- Multiple sets of 2D-simulations show that lower mass means more mixing
- Test effect of different mixing strengths by parametrising this in models

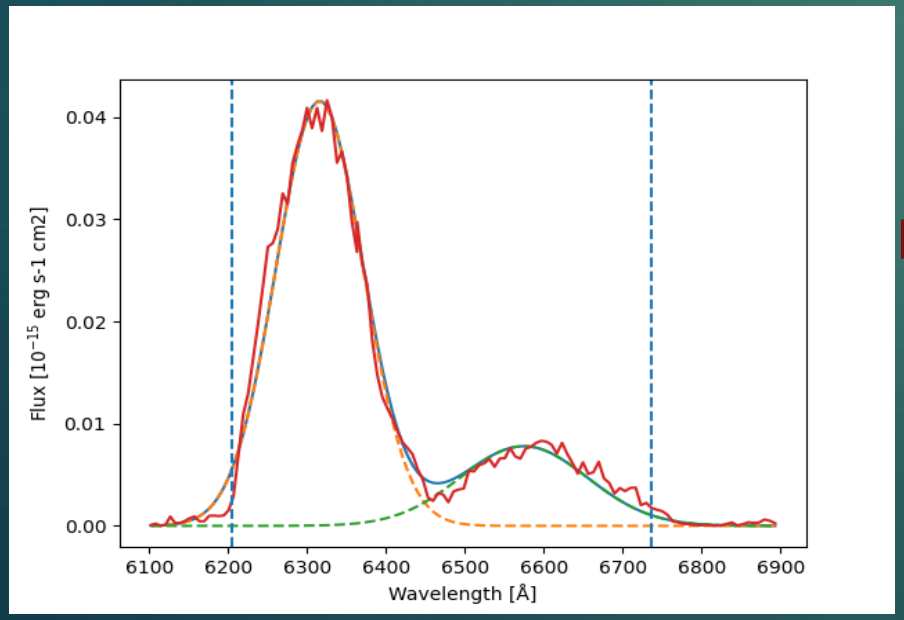


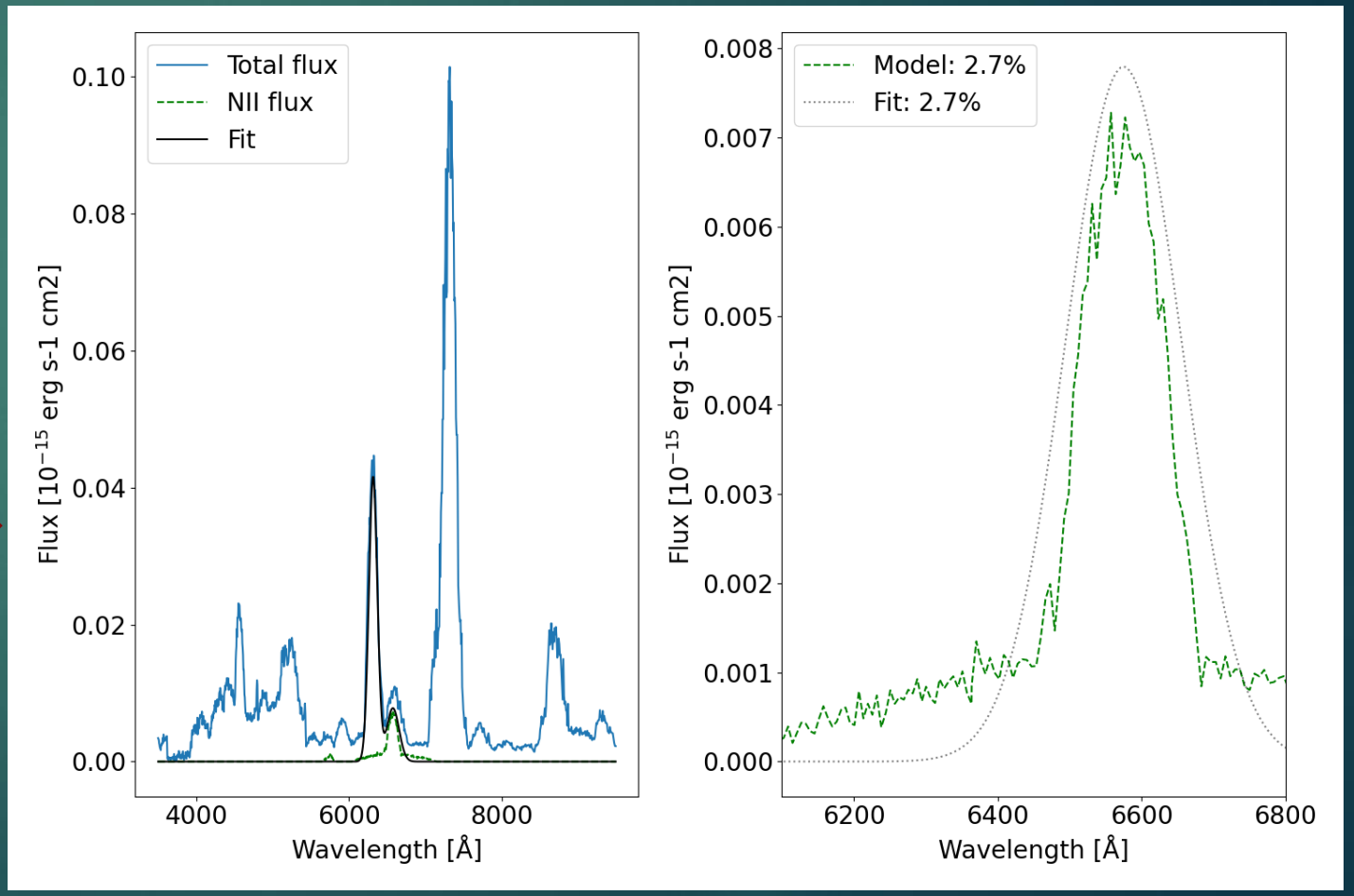


Nomoto et al., 1995

Fit a double Gaussian to obtain Fractional Line Luminosity

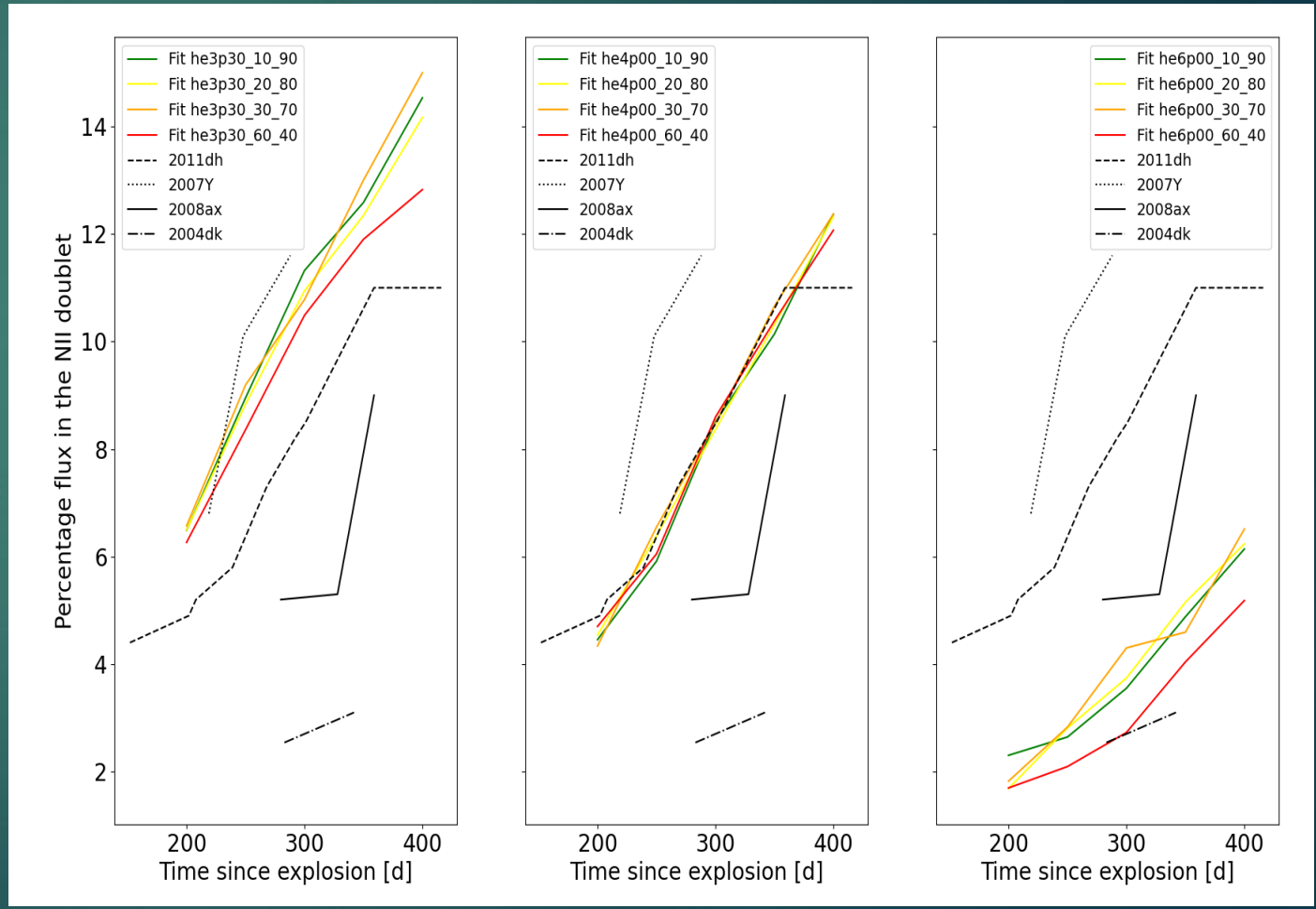




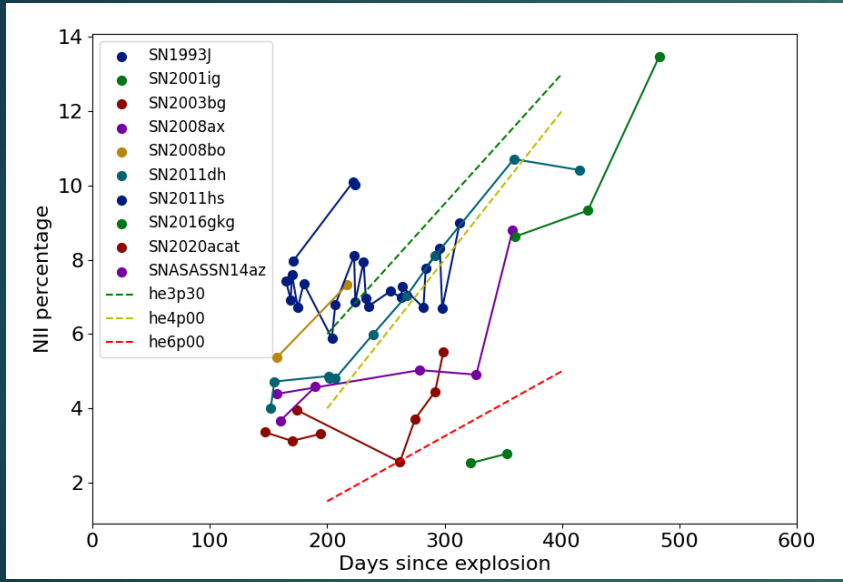


Preliminary Results: Mixing not as important?

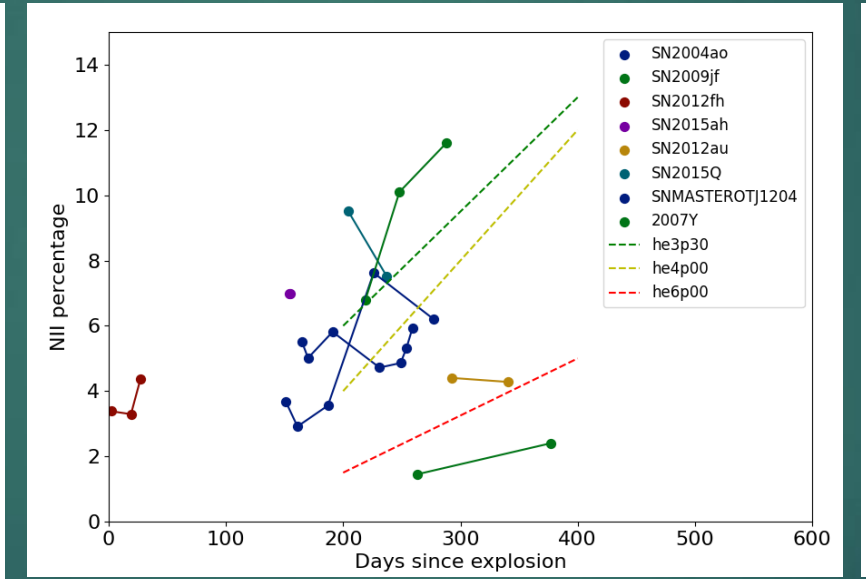
- Find Mass to be the dominant factor for N II percentage
- Correspondence with Nomoto's group finds that mixing percentage is most likely at 0-10% level
- Ni56 does simply not get mixed well enough with N14



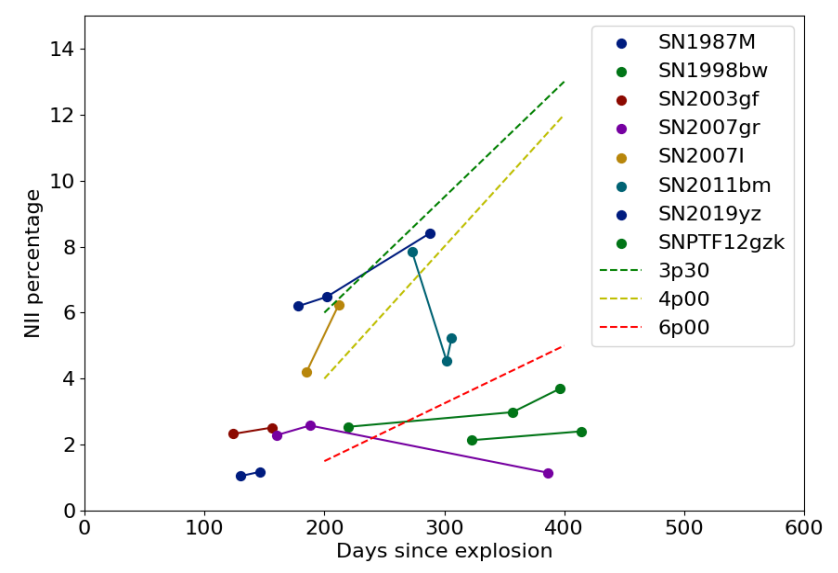
Preliminary Results: Comparing with Observations



Type IIb



Type Ib



Type Ic