מכון ויצמן למדע
WEIZMANN INSTITUTE OF SCIENCE

ZTF
SPRING MEETING 2022

Flash spectroscopy and the environment of massive stars :

What we can learn from the first week of a Core Collapse Supernova.

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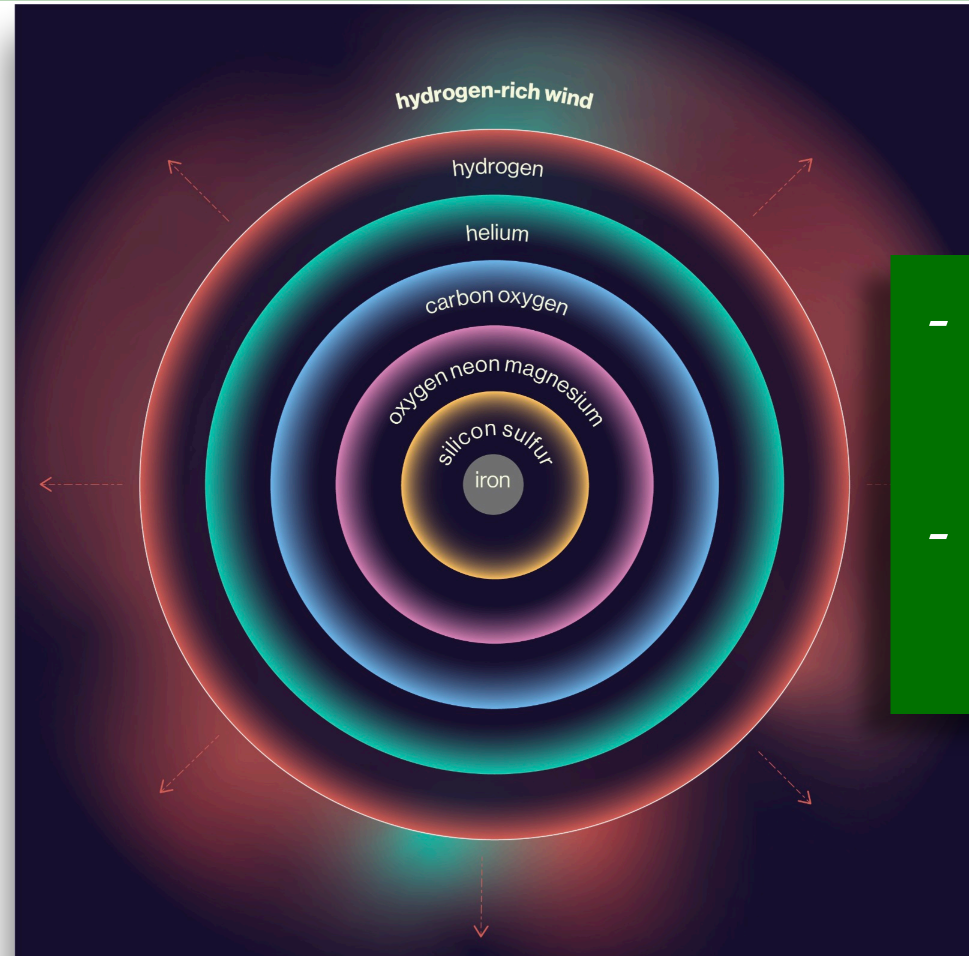
11/05/2022

Massive stars and the circumstances of their death

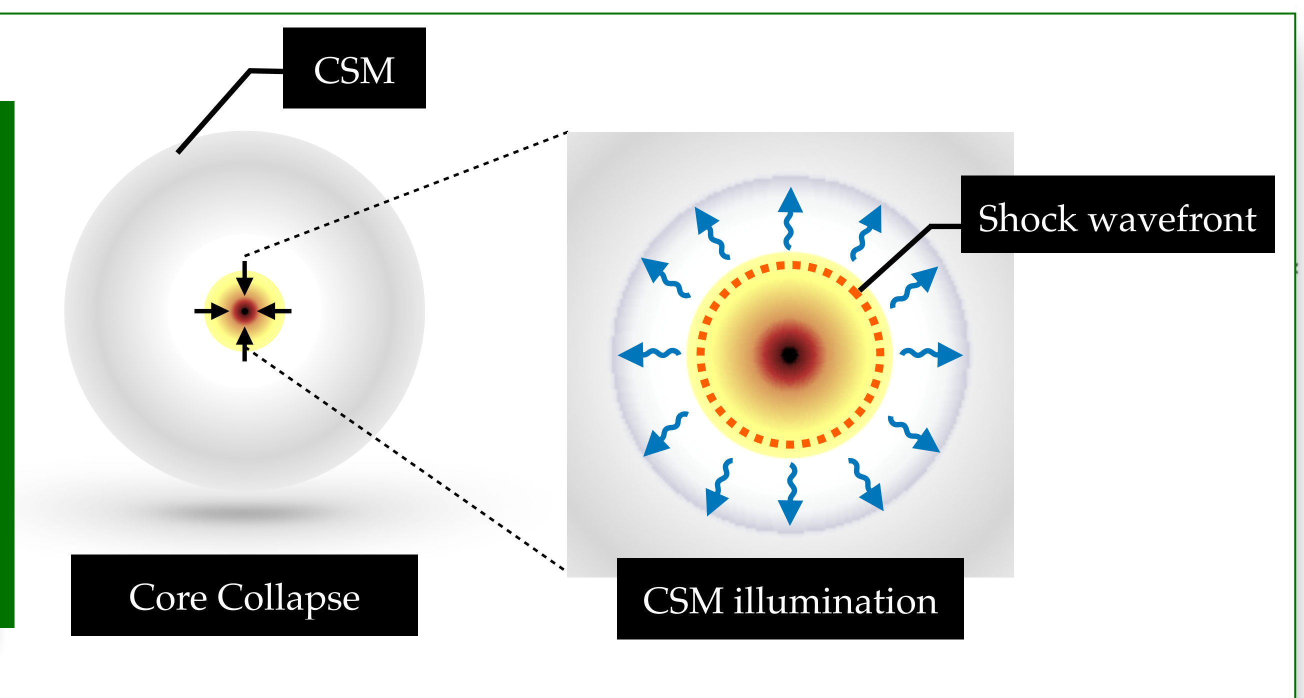


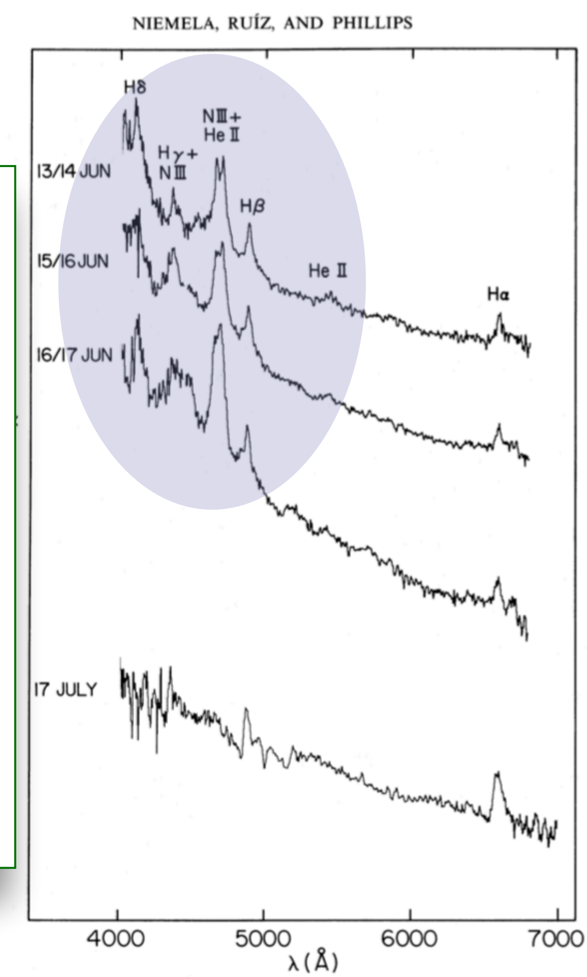
- Massive stars experience mass loss throughout their lives, at a rather low rate ($< 10^4 M_\odot/y$)

- Towards the end of their life, some will experience stronger outbursts (precursors) , creating a denser yet confined circumstellar material nebula

- After the core collapse, the shock break out energy flashes the CSM

- The CSM is revealed: transient emission lines appear at early time.





Flashers Vs. Non Flashers

Observational questions

How common are flash features?

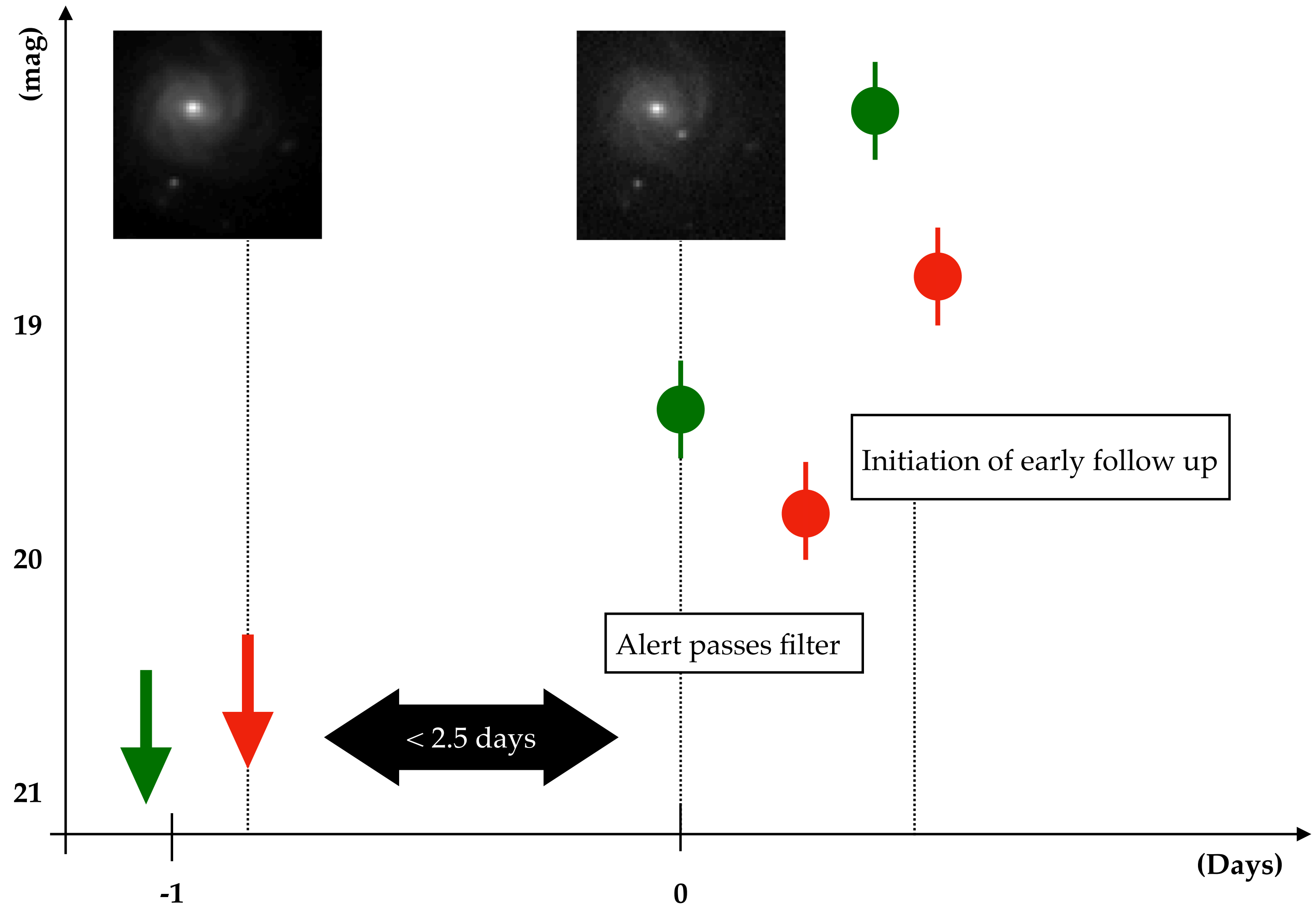
How different are flashers' LC from non flashers?

Physical questions

How common is elevated mass loss in CCSNe progenitors?

Does a nearby, confined CSM contributes to the powering of the early LC?

The Zwicky Transient Facility survey and the Infant SNe experiment



We routinely catch supernovae within **less than two days** from explosion.

Our strategy combines the use of alert filtering system, daily human scanning, and rapid early follow-up.

We aim towards a sample with <2 d from EED spectroscopic follow up.

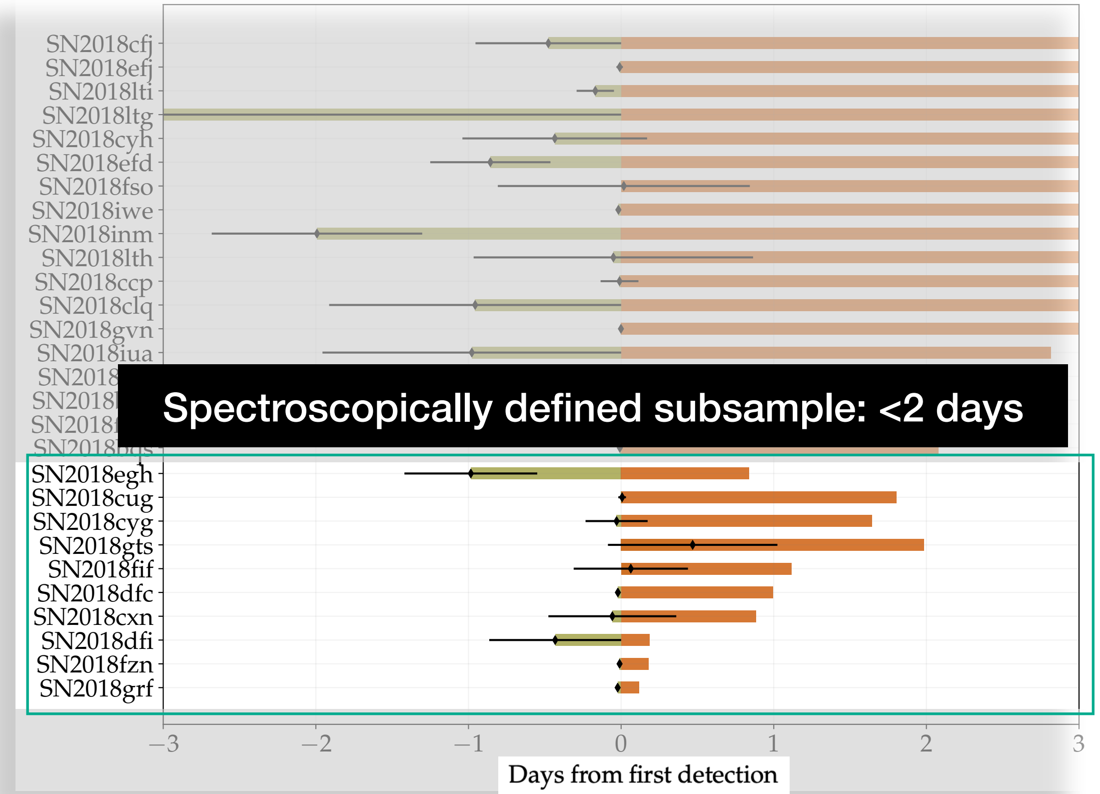
How common are flash ionisation features ? - ZTF 1st year (2018)

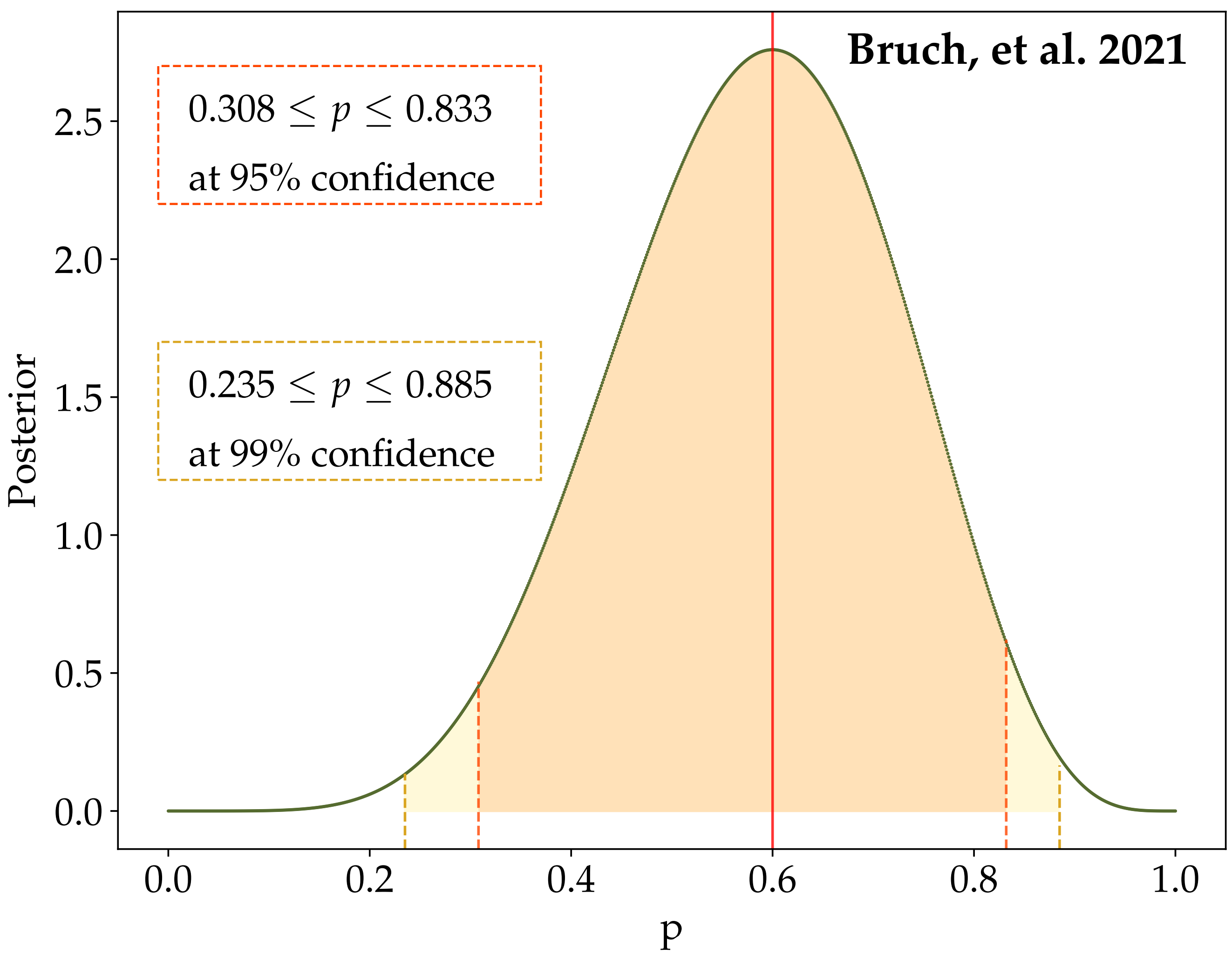
We base our identification of flash features on the presence of **narrow emission He II line**.

28 Infant SNe II (out of ~300 classified SNe II)

10 with spectrum <2 d from explosion

6 Flashers, 2 dubious, 2 Non-Flashers





The majority of SNe II progenitors are embedded in CSM, which implies that **a large fraction experiences elevated mass loss prior to explosion.**

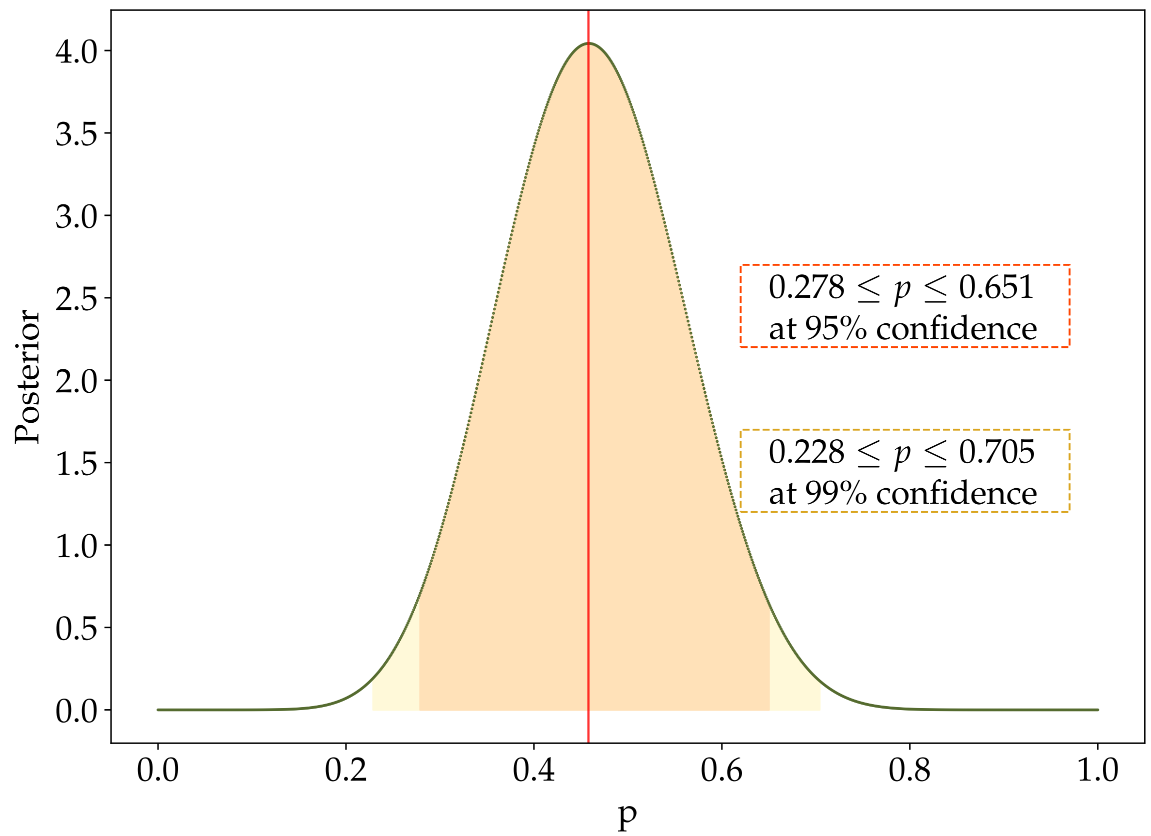
Bruch et al. (in prep) 2022

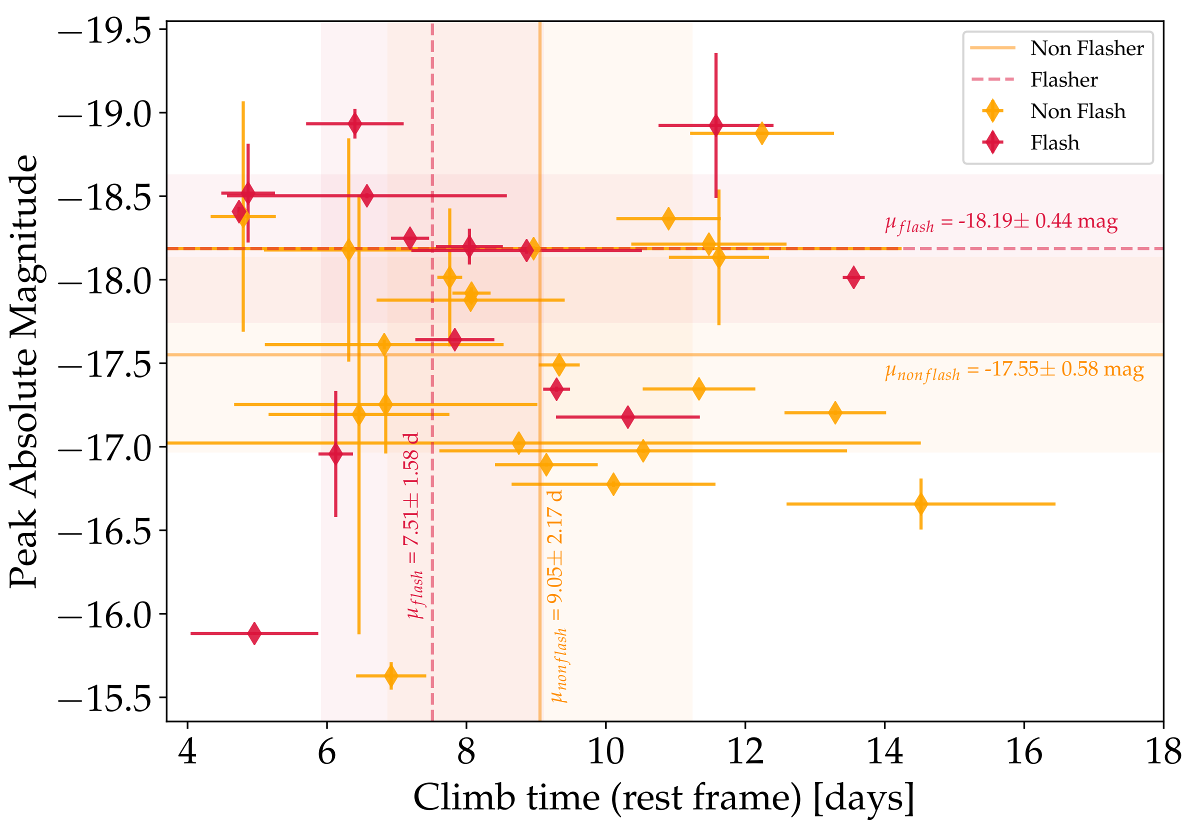
148 Infant SNe (II-IIn-IIb)

123 Standard SNe II

24 SSNeII with spectrum <2 d from explosion

11 Flashers, 13 Non Flashers



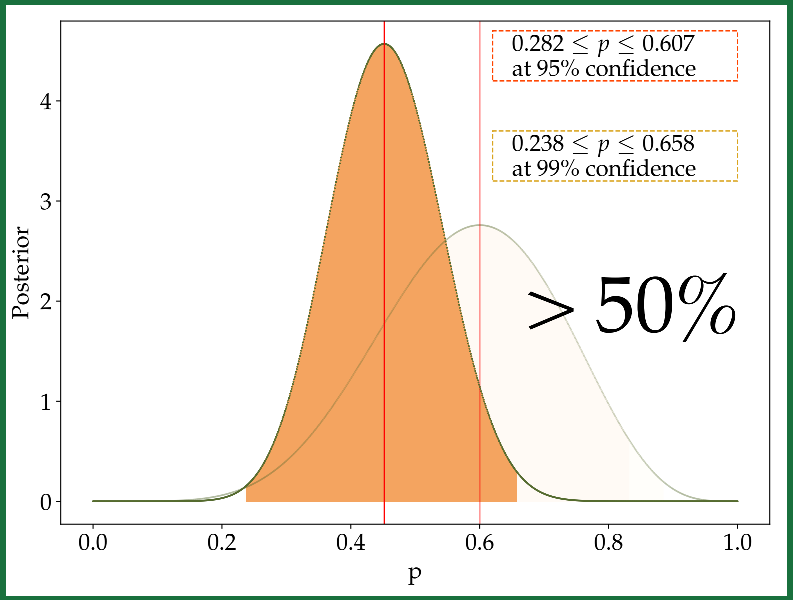


There is no obvious difference between flashers and non flashers in the LC behaviour.

Conclusions

Flash features are common

Massive stars experience elevated mass loss prior to explosion, as a common scenario



Flash features do not extra-power the early LC

Flash features result from a different regime of CSM interaction than Type Xn?