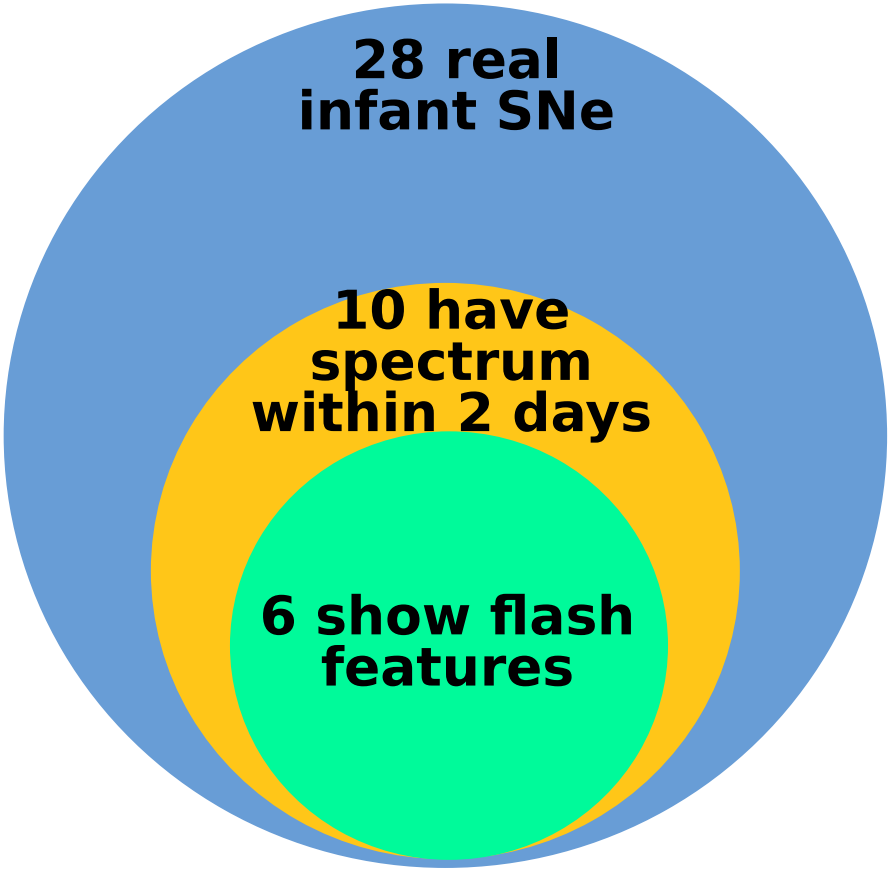
ZTF projects at WIS

ZTF collaboration meeting
October 21st 2020

Infant SNe – 2018 sample (Rachel)

- flash-ionization features (narrow, highly-ionized emission lines) observed in early spectra of many Type II SNe
- likely emitted by CSM that was ionized during SN shock breakout

- dedicated ZTF program
- “real infant SNe”: Type II, non-detection within 2.5 days and rise by at least 0.5 mag
- within 2 days of SN explosion: **>30% of SNe II have flash features** (31-83% at 95% confidence level)
- Bruch et al. 2020, submitted to ApJ

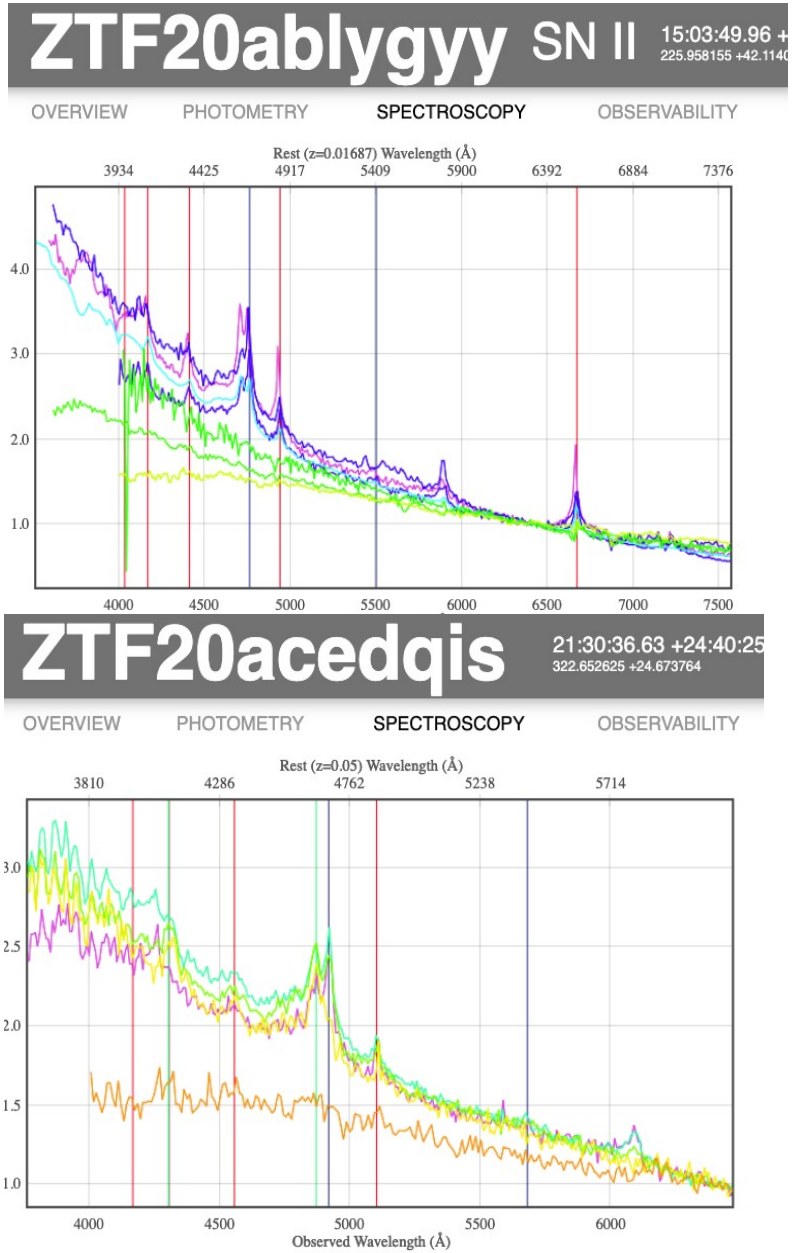


→ many Type II progenitors are surrounded by CSM when they explode

Infant SNe – The full sample (Rachel)

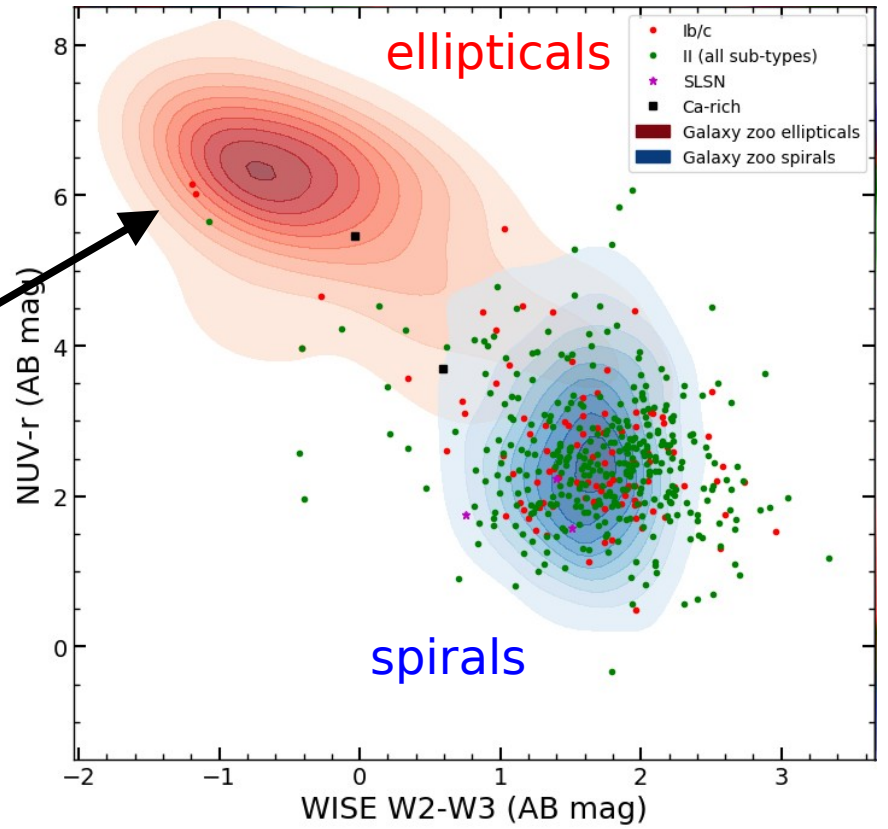
- so far 105 infant SNe (39 have spectrum within 2 days), 34 flasher
- excellent spectral sequence allows detailed analysis of some SNe

- Questions that larger sample might answer:
  - Does interaction increase SN luminosity at early times?
  - Do flash features correlate with SN properties, such as peak brightness or temperature?
  - For how long are flash features observed?



CCSNe in elliptical galaxies (Ido)

- MIR/NUV-r color cuts can discriminate well between galaxy types (at low z)
- 3 CCSNe from the bright transient survey sample in ellipticals (~1%)
  - ZTF18aailcgs (Ic)
  - ZTF20abkiarz (Ic?)
  - ZTF18abscyjj (II, in the outskirts)
- Residual star formation or different progenitor channels?



Updated shock-cooling model (Ido)

- new model: interpolating between planar and spherical phase (Morag et al, in prep.) → avoids non-physical models
- changes for UV observations in the first days after explosion

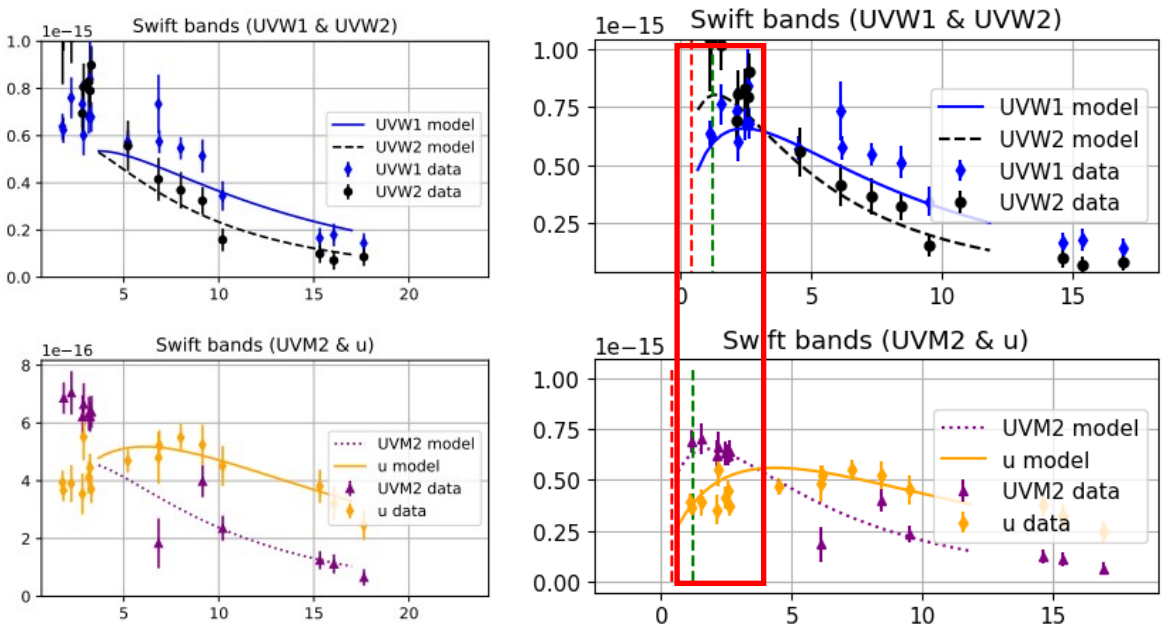
- Strong impact on fits (e.g. SN2018fif):
  - **old model**: progenitor radius of 1150 R_{sun} (larger than most RSG stars)
  - **new model**: 750 R_{sun} (consistent with detected RSGs)

  → early UV data important to constrains progenitor radius

- challenges fitting new model to some objects

old model
(Sapir & Waxman 2016)

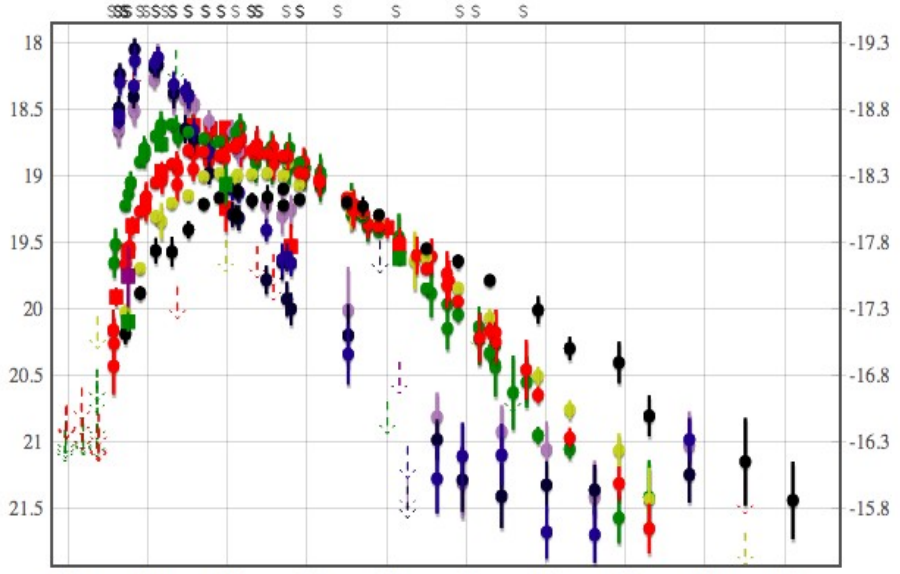
new model
(Morag et al. in prep.)

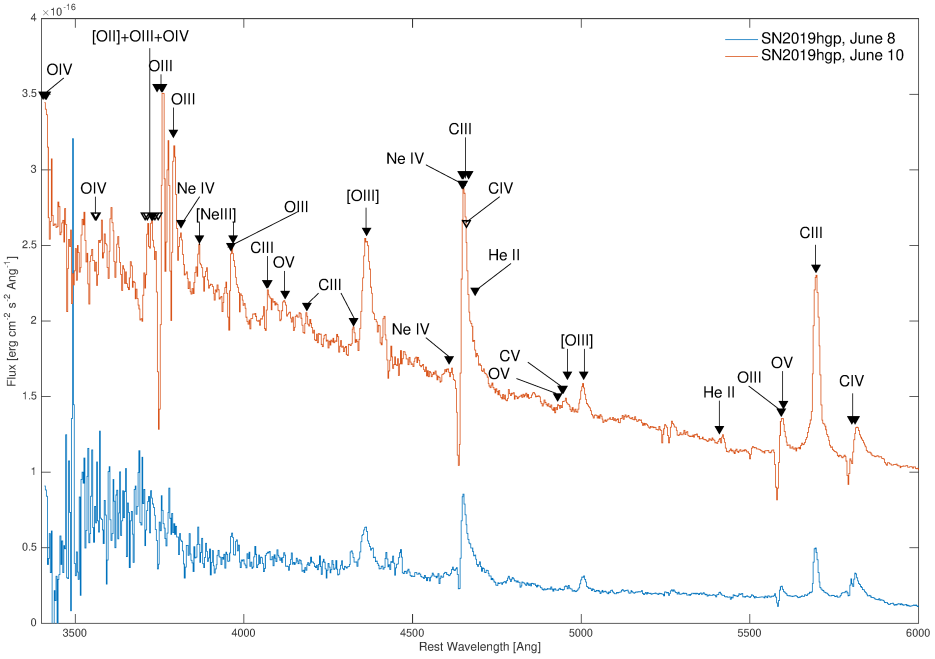


Soumagnac et al. (2019)

SN2019hgp - explosion of a WC Wolf-Rayet Star (Avishay)

- Identified shortly after explosion with superb photometric and spectroscopic follow-up
- Rapid rise similar to Rapidly evolving transients (RETs) and SNe Ibn
- Early spectra dominated by emission lines from ionized C, O, Ne
- Explosion occurred within expanding wind of velocity >1500 km/s
- Data suggest at least some RETs arise from explosions of W-R stars: **SNe Ibn from WN stars, and events like SN 2019hgp ("Icn") from WC stars**
- manuscript in preparation



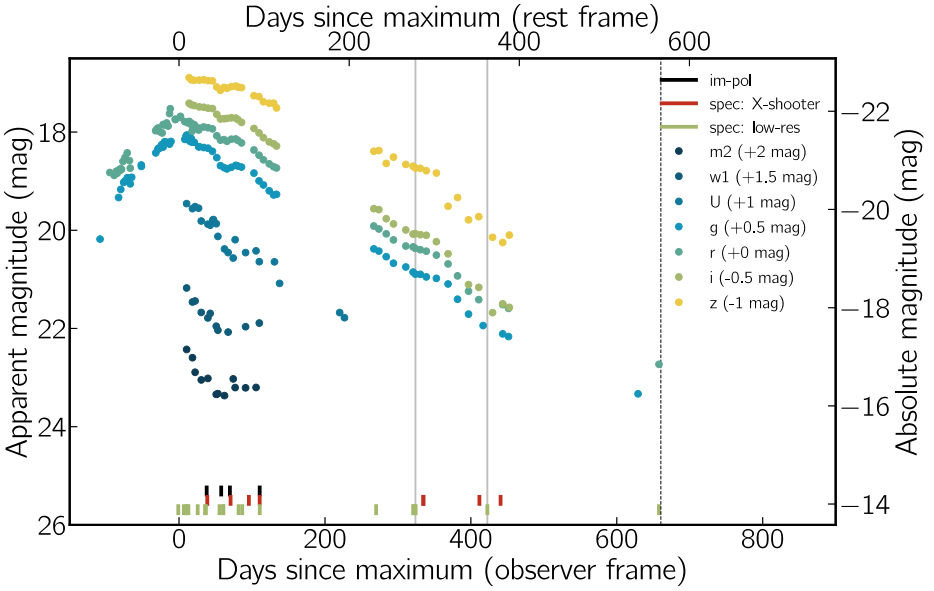


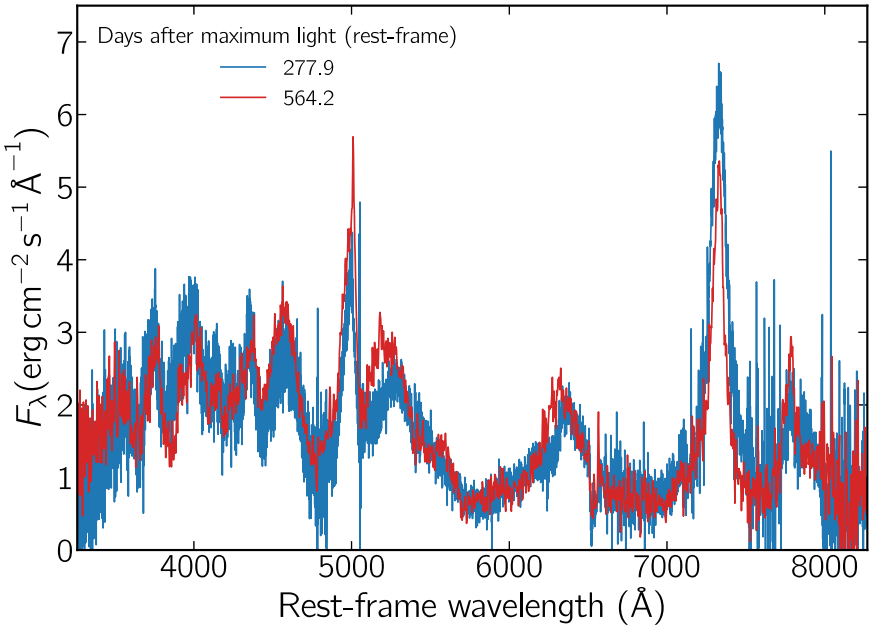
The extreme SLSN SN2018ibb (Steve)

- SLSN-I with rise time of >100 days
- Decline of ~0.9 mag/100 days (nickel powered?)
- Ejecta velocity of 7000 km/s, line width of 1500 km/s
- Absorption lines indicate eruptive mass-loss shortly before explosion
- At 560 days after maximum, we still probe only the outer ejecta

  → Extreme properties even for SLSNe!

- Is SN2018ibb **pair-instability SN** in the nearby Universe? Or, even a local example of **population-III-like explosion**?

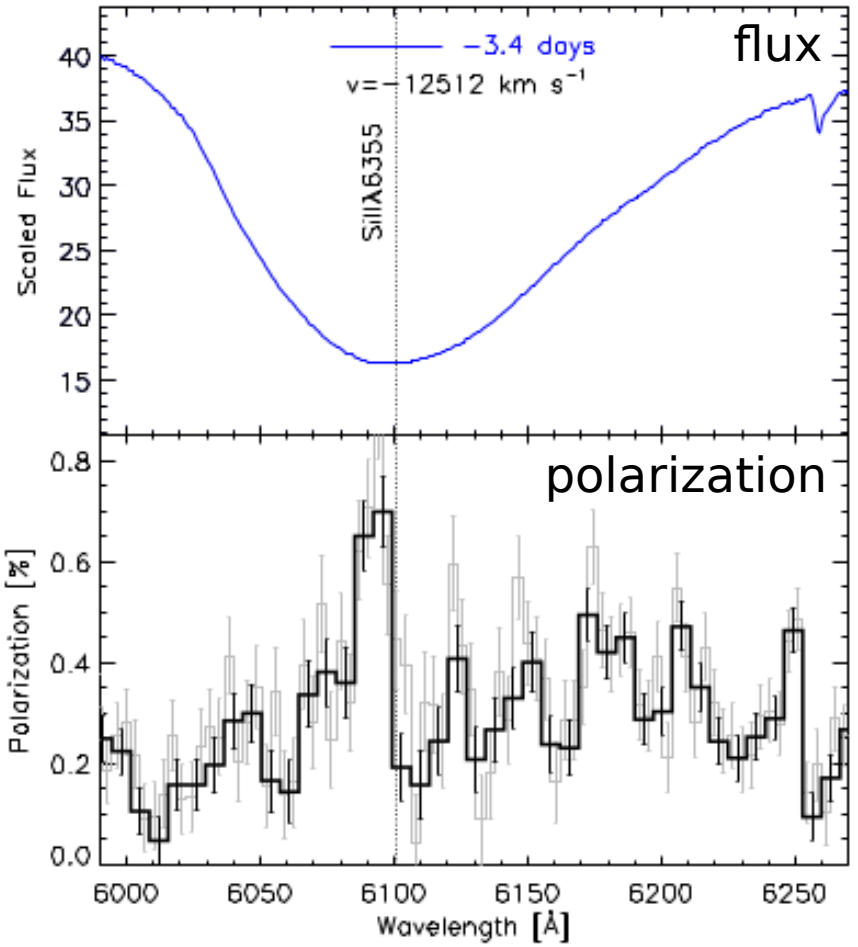




Polarimetry of young SNe (Yi)

- polarization caused by asymmetries
  - ejecta asymmetric
    → continuum polarization
  - chemical asymmetry in ejecta
    → line polarization
- complex polarization structure in silicon feature of young Ia

VLT Specpol of the Type Ia SN2020ue – Yang et al. in prep.

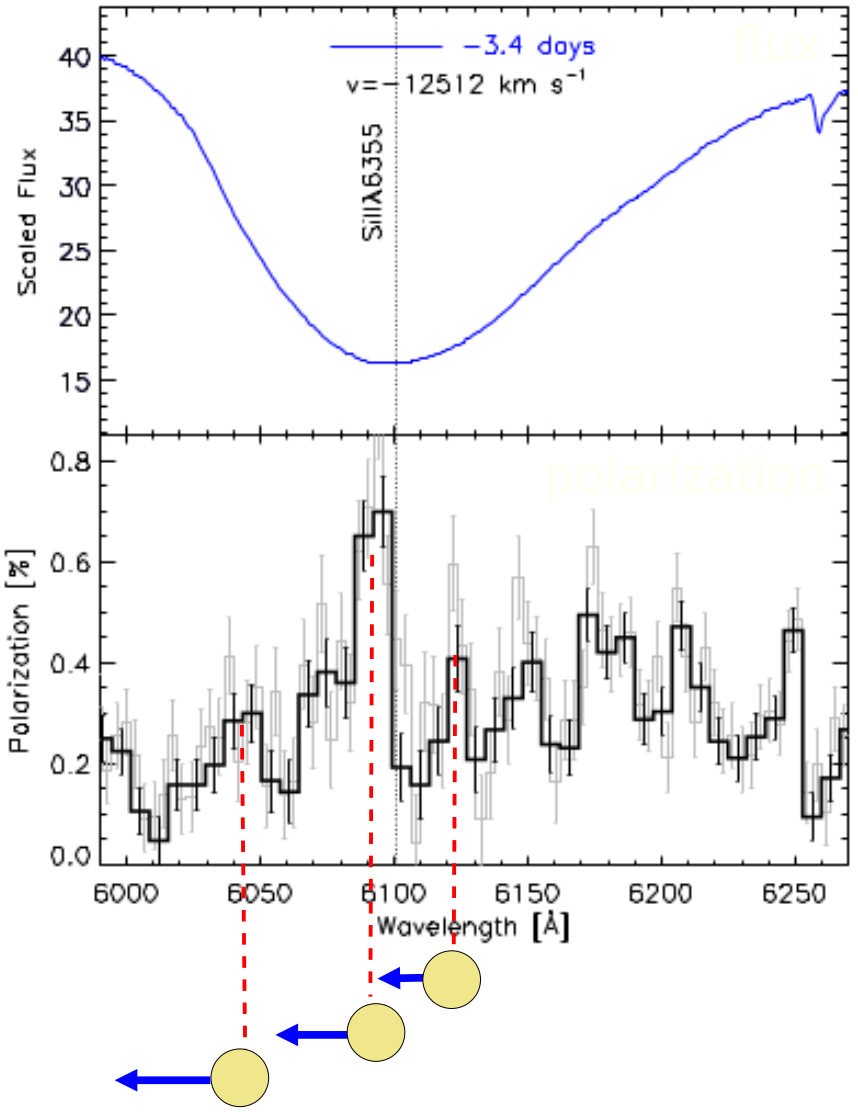


Polarimetry of young SNe (Yi)

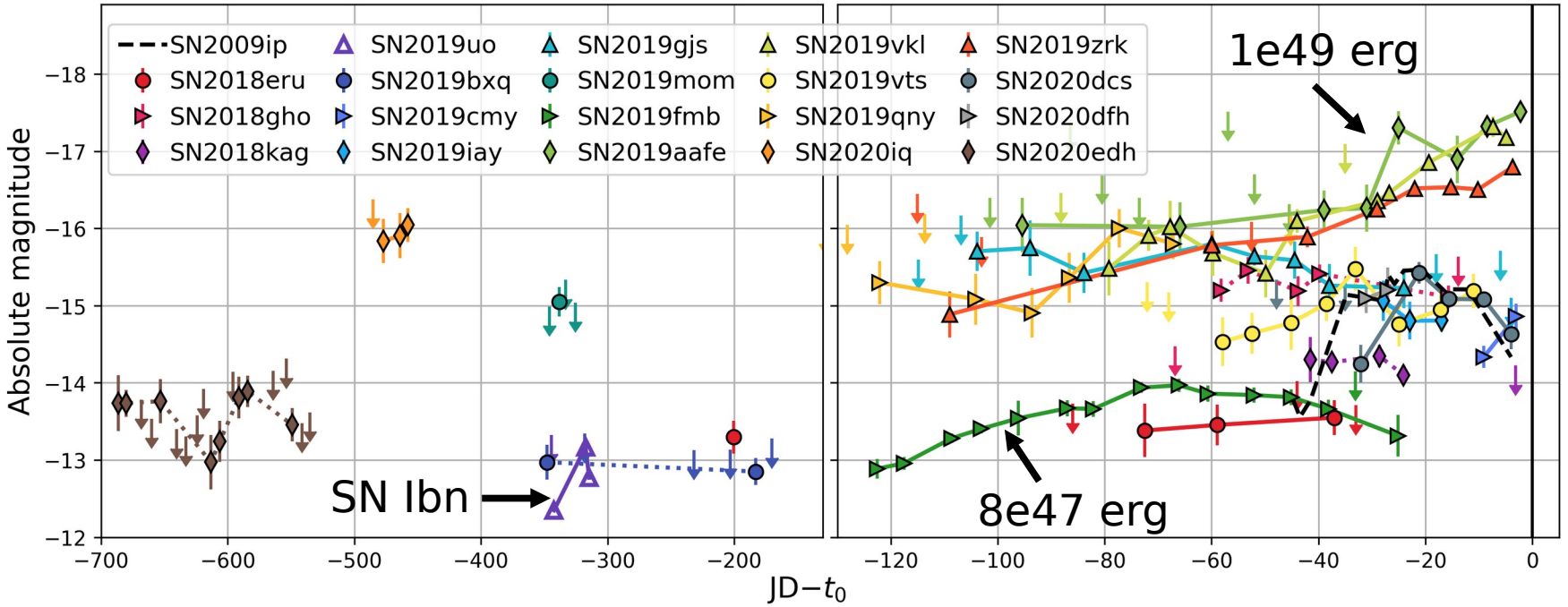
- polarization caused by asymmetries
  - ejecta asymmetric
    → continuum polarization
  - chemical asymmetry in ejecta
    → line polarization
- complex polarization structure in silicon feature of young Ia

  → **blobs of silicon** in ejecta are blueshifted according to their velocity
- peaks change with time as different blobs become visible when we can see deeper into ejecta
- measure polarization of flash SNe to find out whether or not their CSM is spherical

VLT Specpol of the Type Ia SN2020ue – Yang et al. in prep.



Stellar outbursts prior to interacting SNe (Nora)



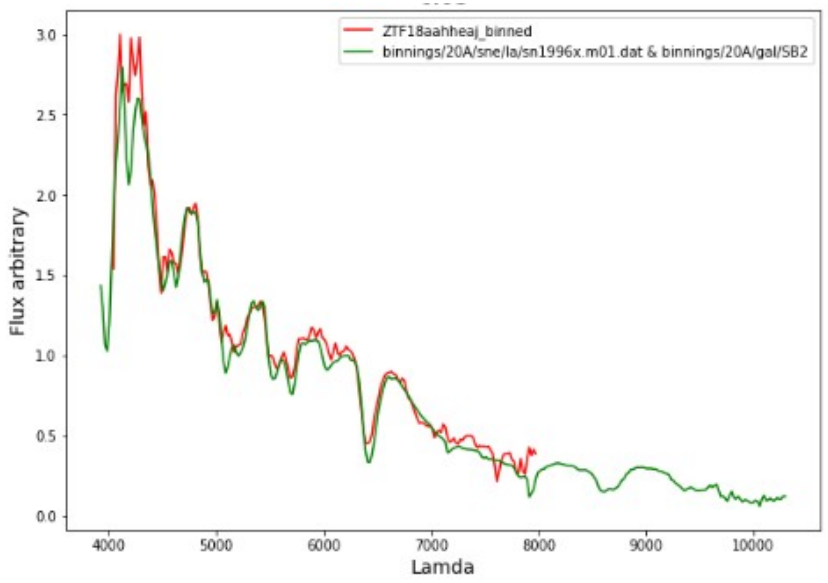
- search for stellar flares prior to 200 interaction-powered SNe
- bright, long-lasting precursors detected in 100 days before SN
- Type IIn: precursors brighter than -13th mag observed 25% of the time in final 3 months; rate at earlier times only 5%
- energetic outbursts require ejection of >1M_{sun}, if interaction-powered
- Shiode & Quataert (2014): turbulent Ne and O burning phases launch precursors – but observed precursors are 100 times brighter

More projects

Python SuperFit (Sam)

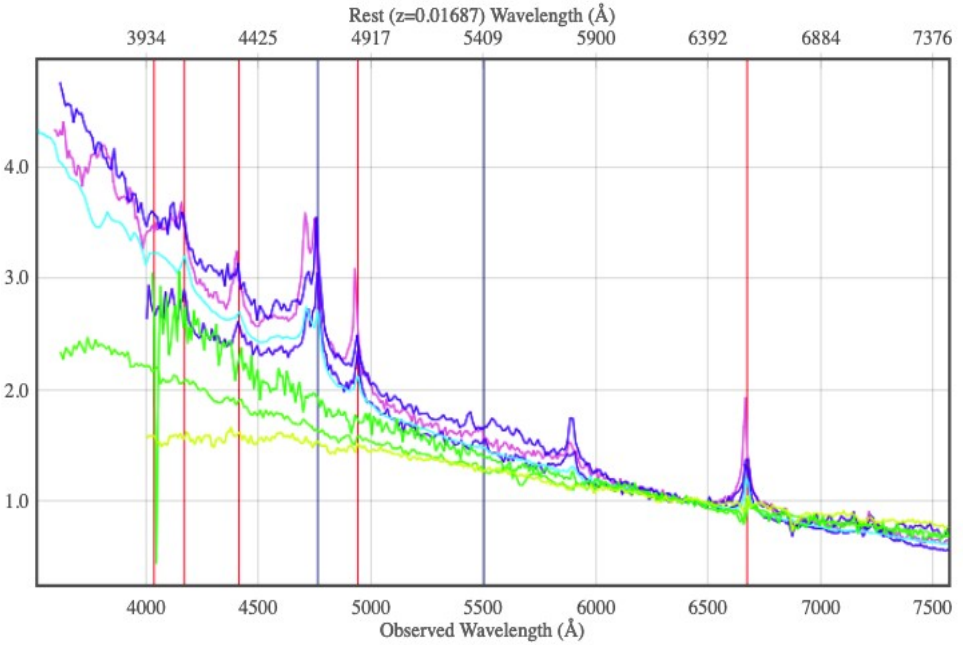
github link

- in python, faster
- updated templates with higher resolution and more SN classes
- gui planned



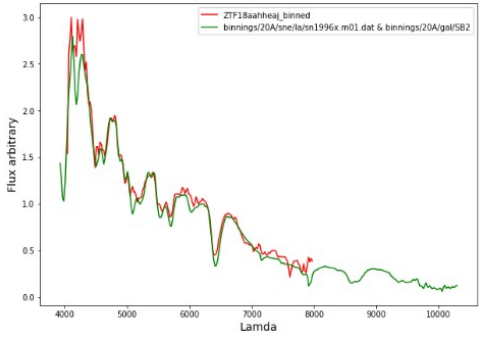
SN2020pni/ZTF20ablygyy (Erez)

- nearby Type II with flash features
- very good data will allow detailed study

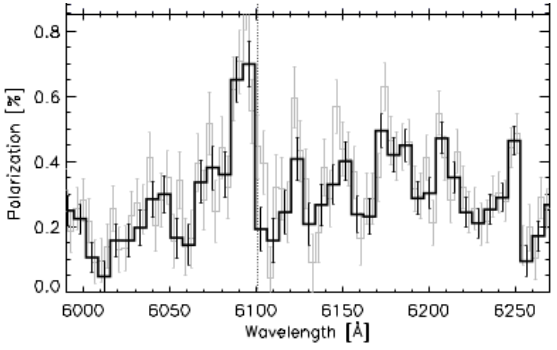


Summary

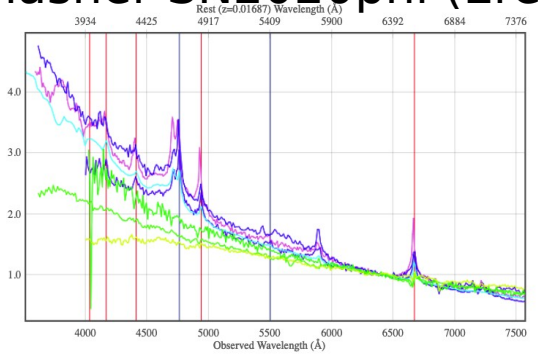
Python SuperFit (Sam)



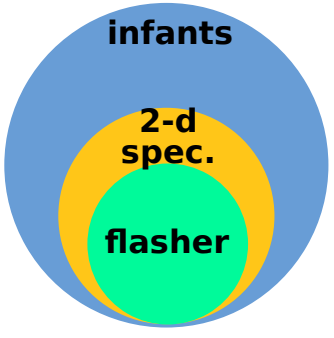
Polarimetry (Yi)



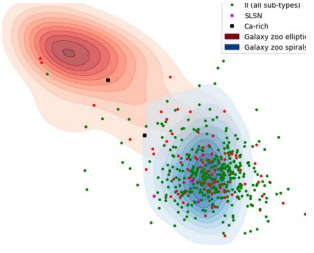
flasher SN2020pni (Erez)



Infant SNe (Rachel)

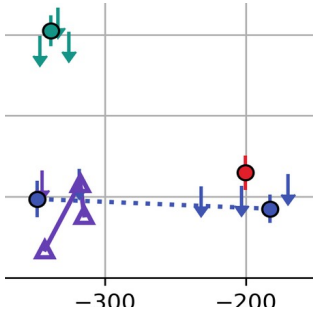


CCSNe in elliptical galaxies (Ido)

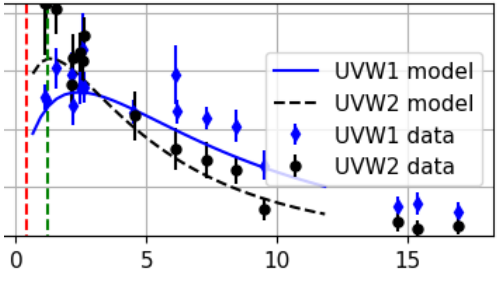


extreme SLSN SN2018ibb (Steve)

Precursor searches (Nora)



Shock-cooling models (Ido)



Type “Icn” SN2019hgp (Avishay)