ULTRASAT אולטראסאט
Ultraviolet Transient Astronomy Satellite

CCSNe properties from observations with ULTRASAT

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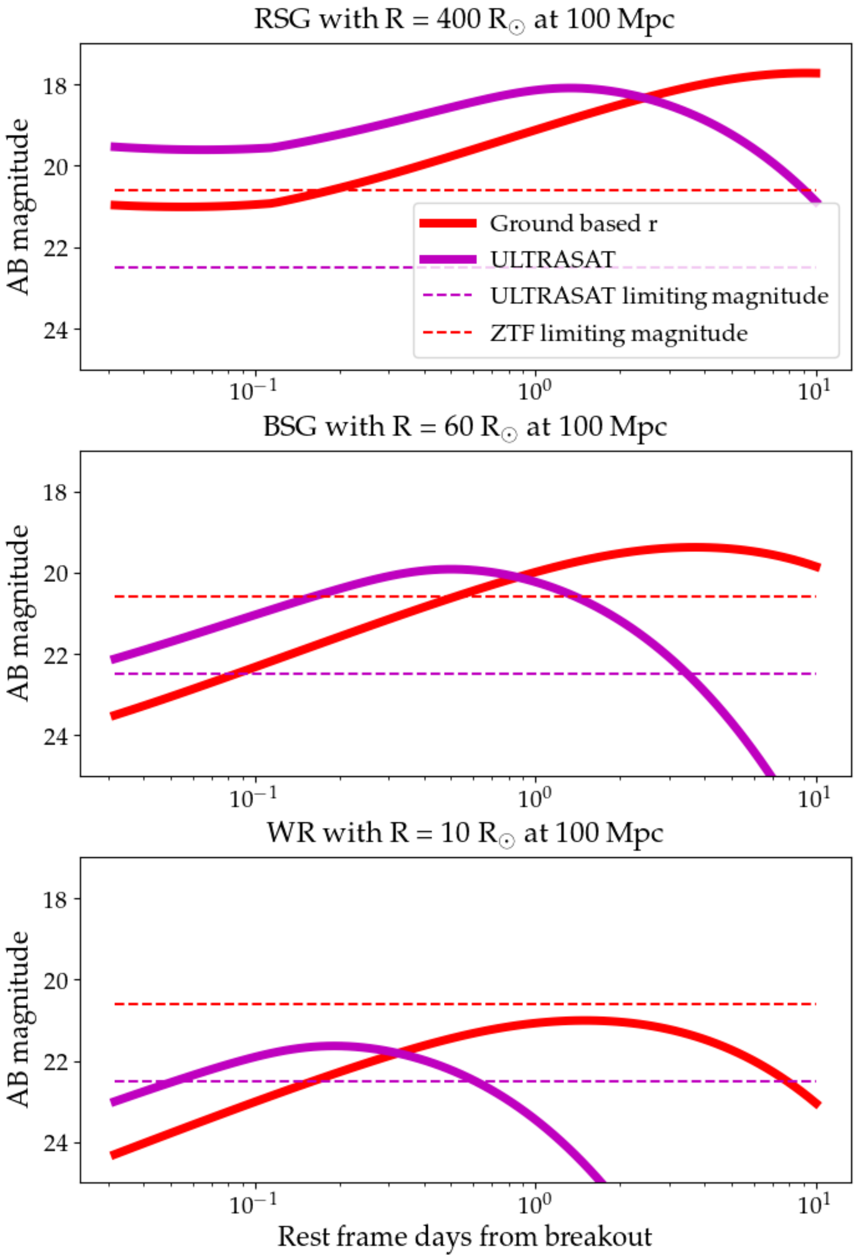
Shock-cooling emission

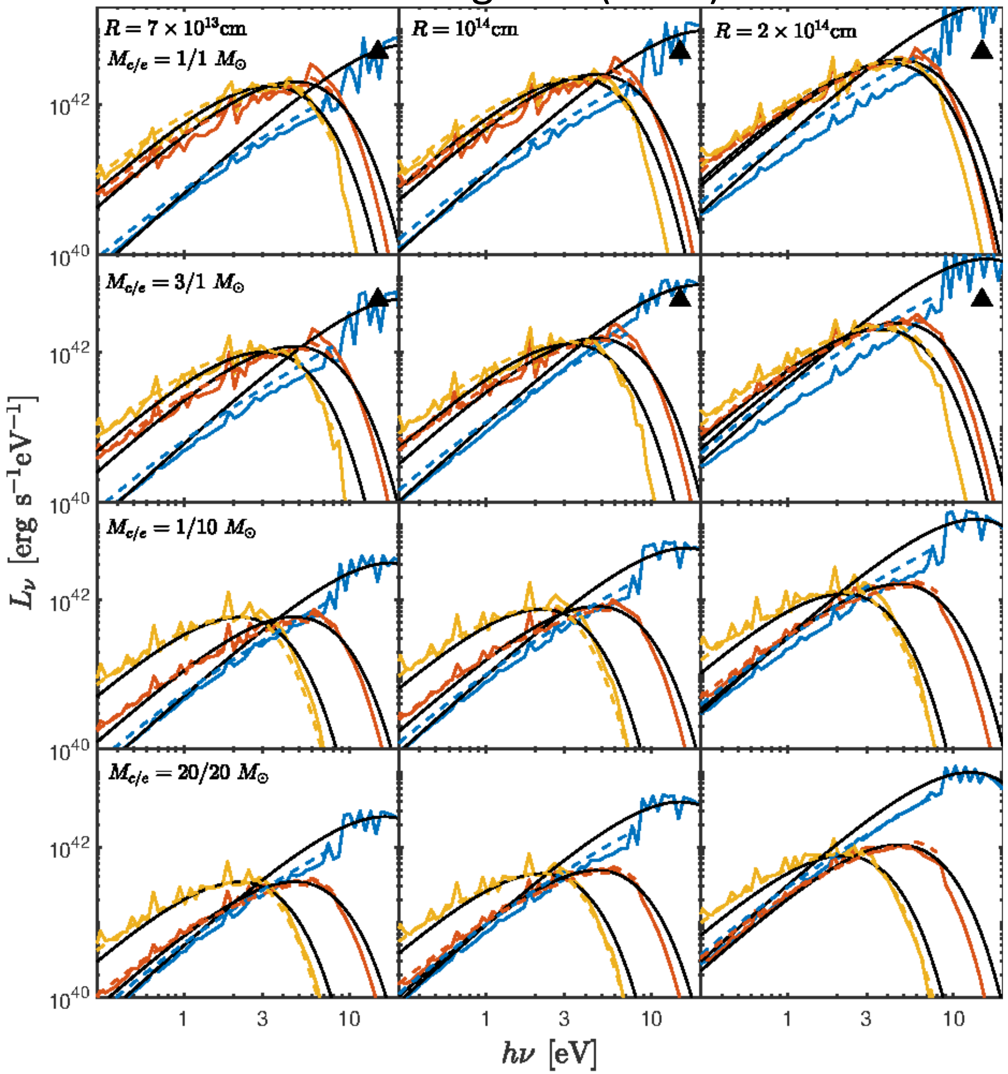
- The **early (< few days)** light curves of SNe II can constrain progenitor radius
- BSG/WR stars – faster and fainter (< 1 day)
- ULTRASAT is ideally suited for collecting the right dataset (LSST is too slow, ZTF and others too shallow)



Models are now geared for ULTRASAT

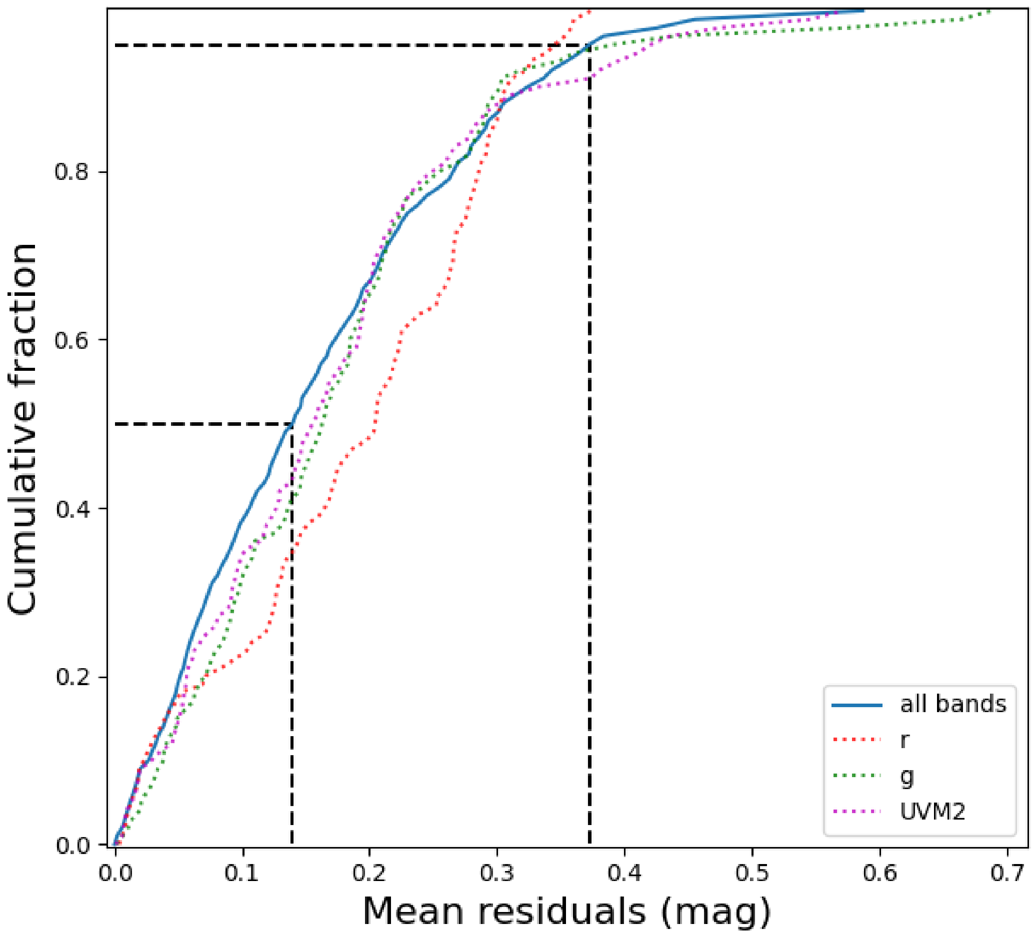
- Morag et al (2023) account for the planar to spherical evolution – early times
- ~20% accuracy in flux
- Proper treatment of UV line blanketing and emission
- Allows for fitting extinction to high precision

Morag et al (2023)



Shock cooling fitting

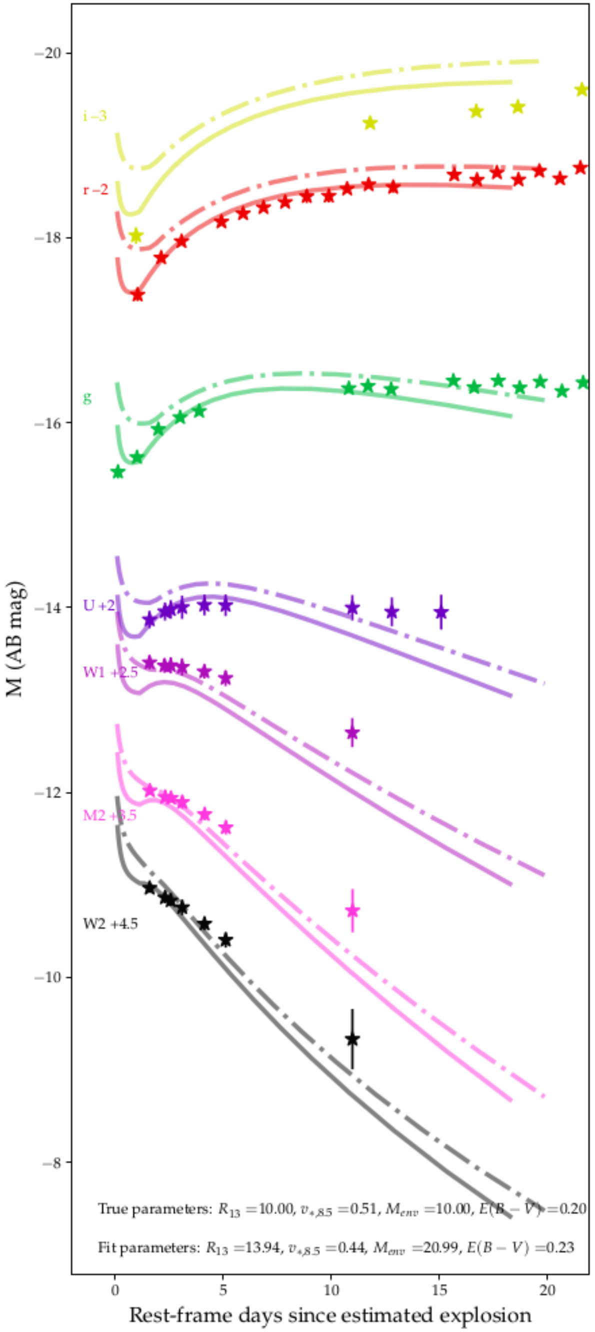
- ~20% accuracy in flux
- Many complications when fitting:
  - Validity domain
  - Correlated residuals
  - Deviations from blackbody
- We treat these effects
- We test our method against hydrodynamical simulations



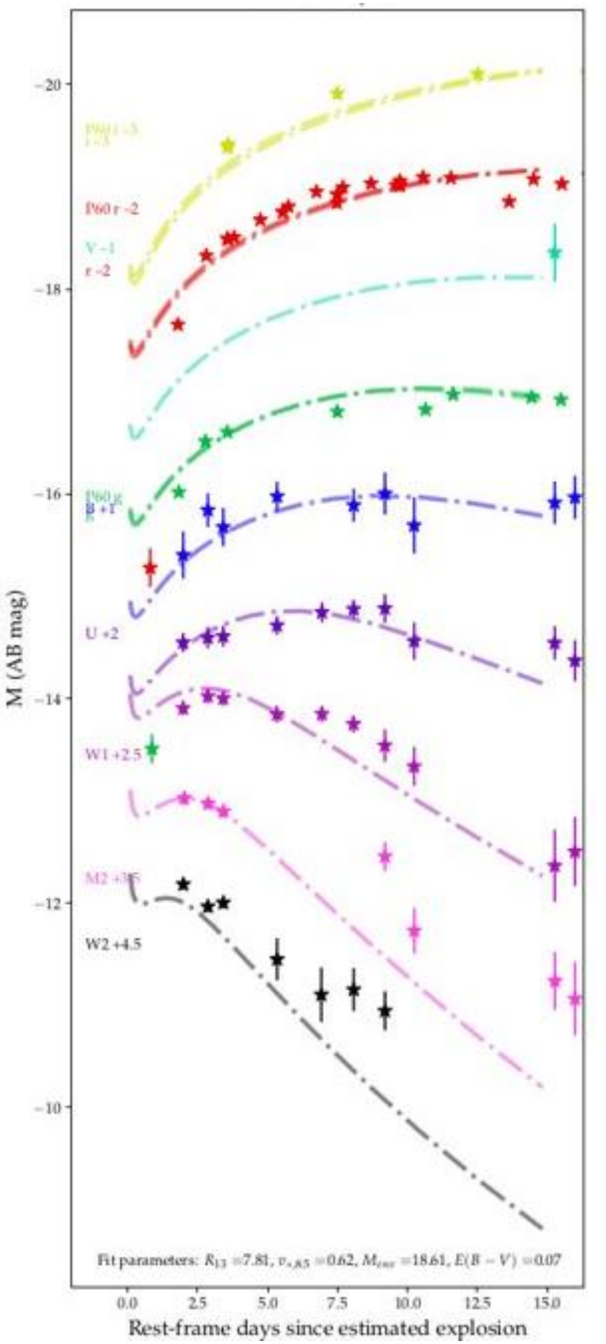
A method to recover true parameters

- We developed a method to fit SN light curves
- We fit synthetic light curves from 24 MG simulations with analytic models

MG Simulation



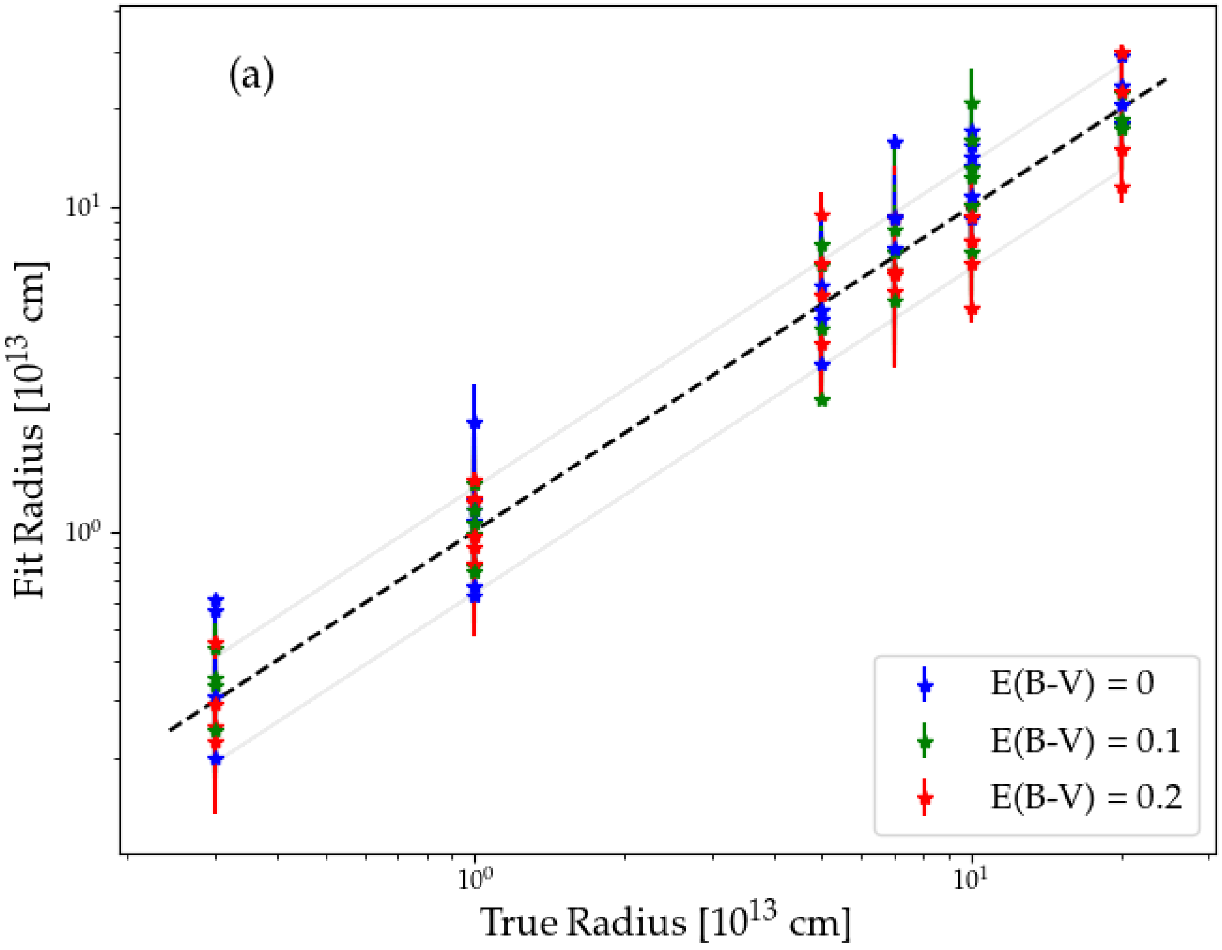
SN2018fif (Soumagnac et al)



A method to recover true parameters

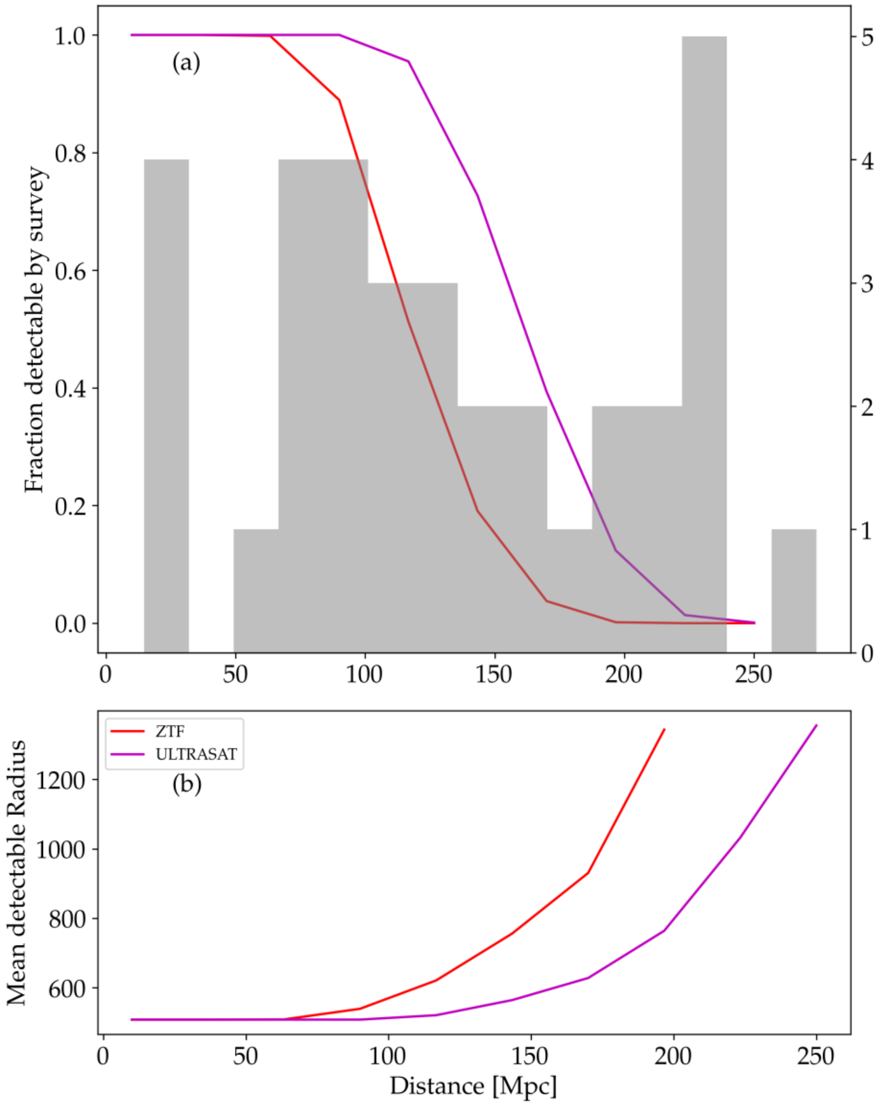
Irani et al. , in prep

- We developed a method to fit SN light curves
- We fit synthetic light curves from 24 MG simulations with analytic models
- We demonstrate parameter recovery is possible over the entire parameter space (R = 1e12 – 1e14 cm)



An important volume correction

- We simulate the observed fraction of RSG observable as SNe based on
  the observed LMC+SMC population
- Luminosity bias requires volume correction at d>70 Mpc.

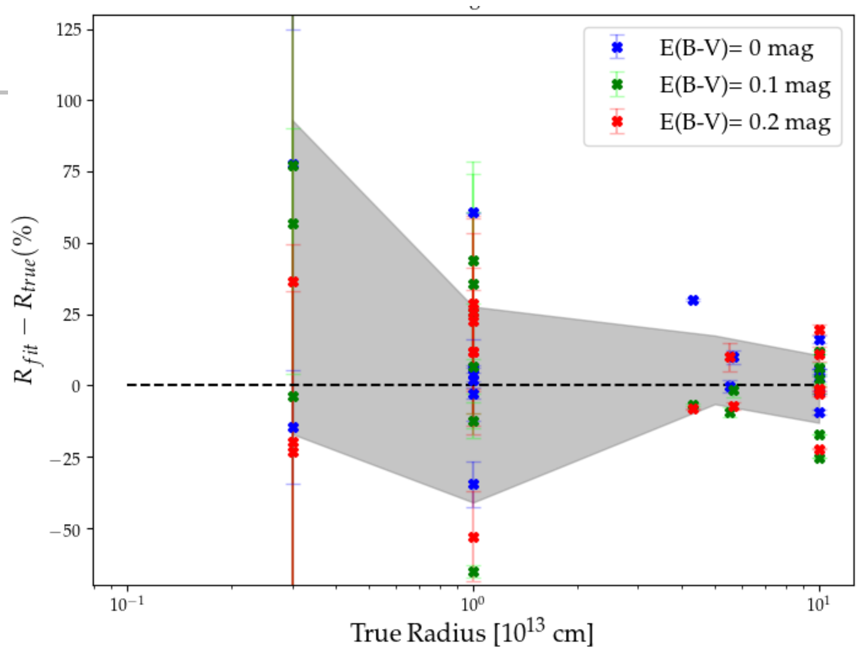


Irani et al. , in prep

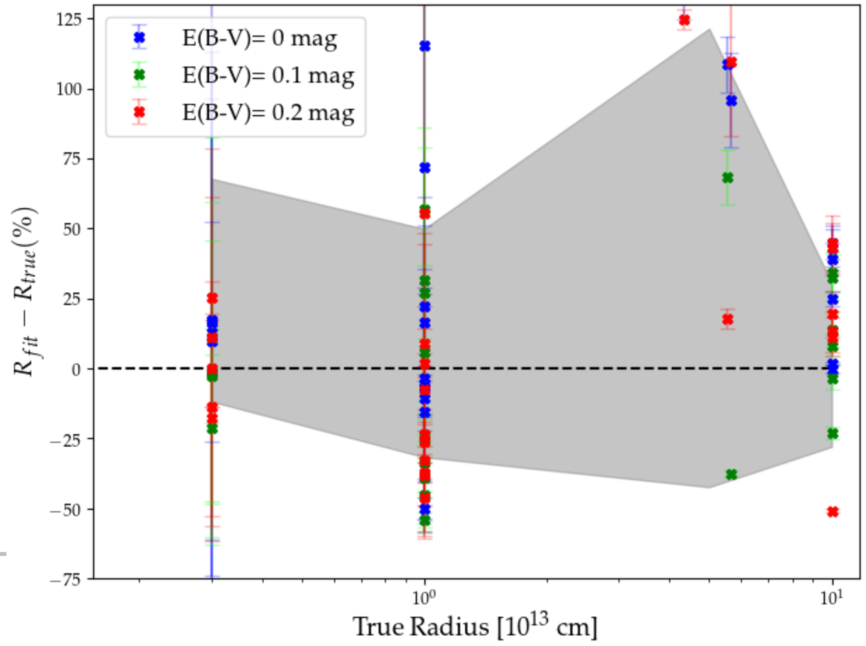
Sampling effects

Comparing ULTRASAT-like observing strategy to a ZTF-like observing strategy:

- Better constraining of the parameters
- Many more SNe with appropriate datasets
- Less observing bias



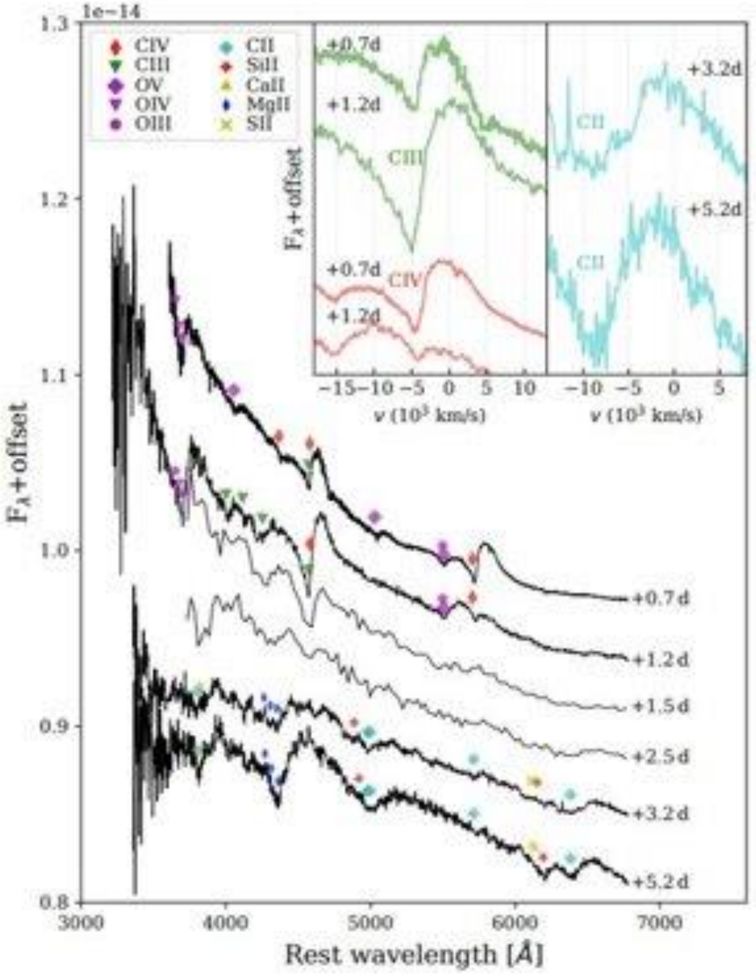
ULTRASAT +ground based



ZTF+SWIFT

Early peaks & CSM interaction

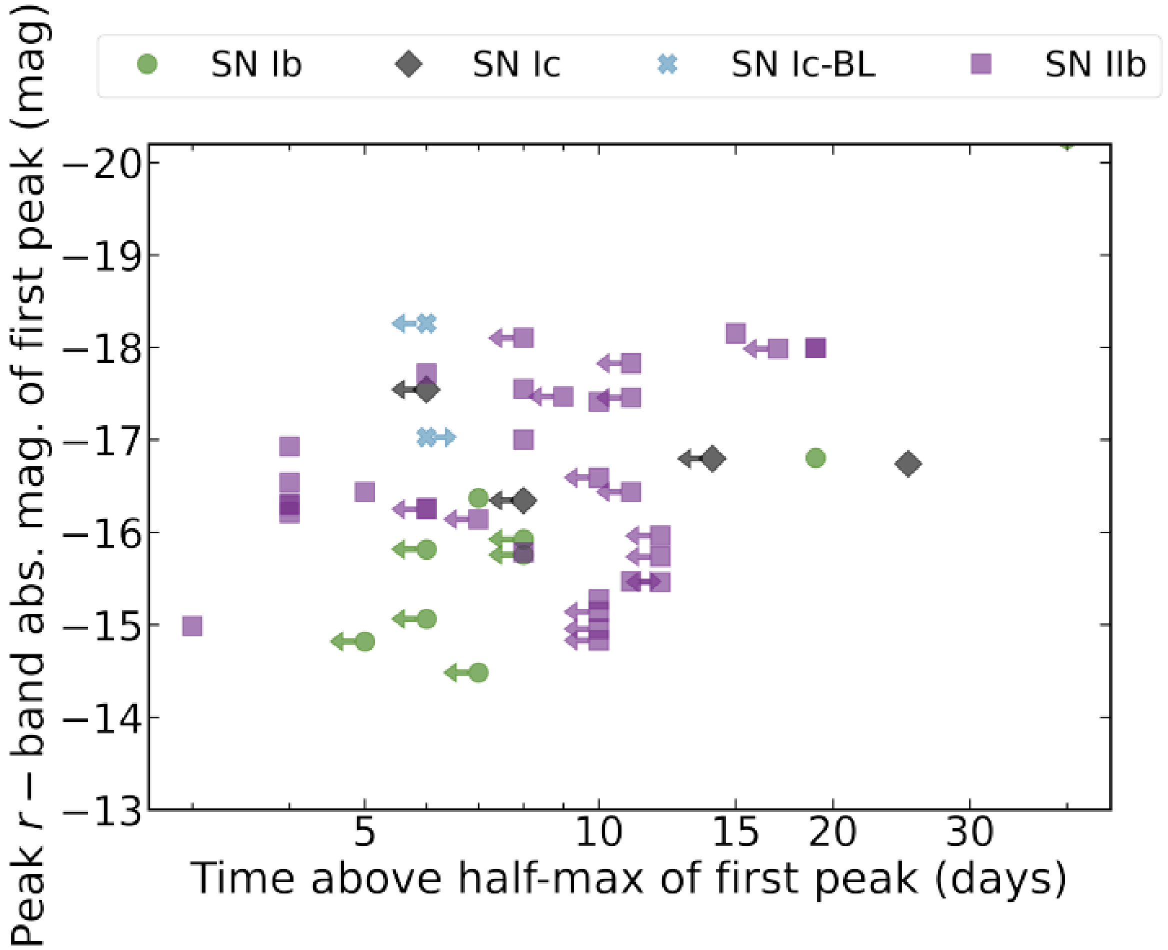
SN 2022oqm (Irani et al 2022)



- 2022oqm – first peak contemporal with narrow emission features

Type I CCSNe with elevated UV emission

- Many SNe Ib/c have early UV-emission excess
- 3%-9% of Ibc have peaks observable by ZTF; Das et al 2023
- Typically - little data during first peak



Early peaks & CSM interactior

- 2022oqm – first peak contemporal with narrow emission features
- Fast evolution explained by fast temperature evolution, as seen in other SNe Ibc

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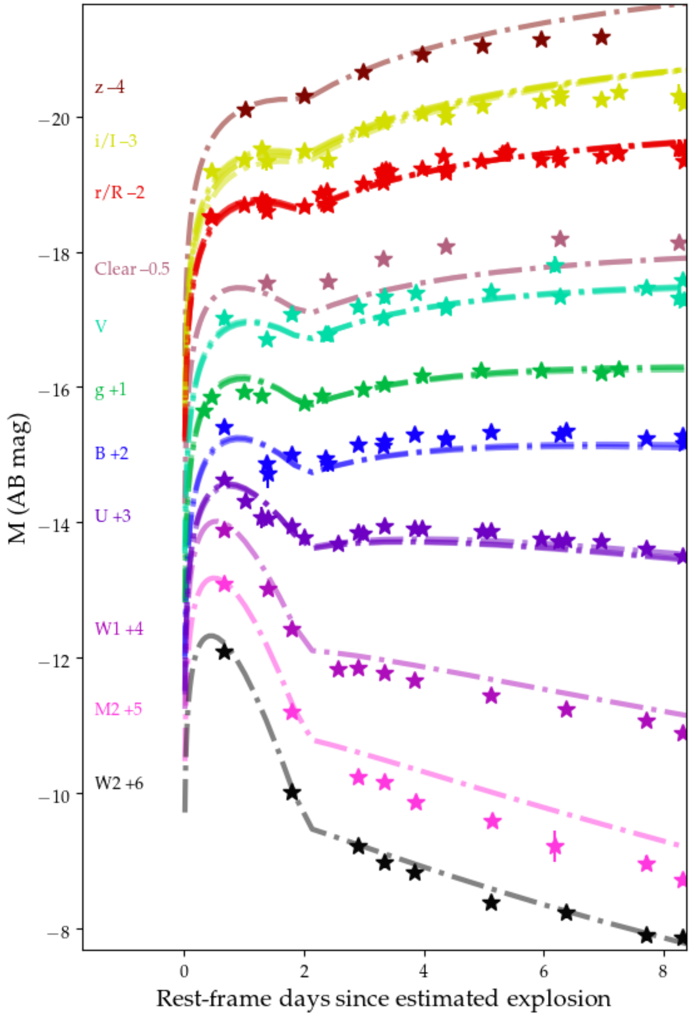

Early peaks & CSM interaction

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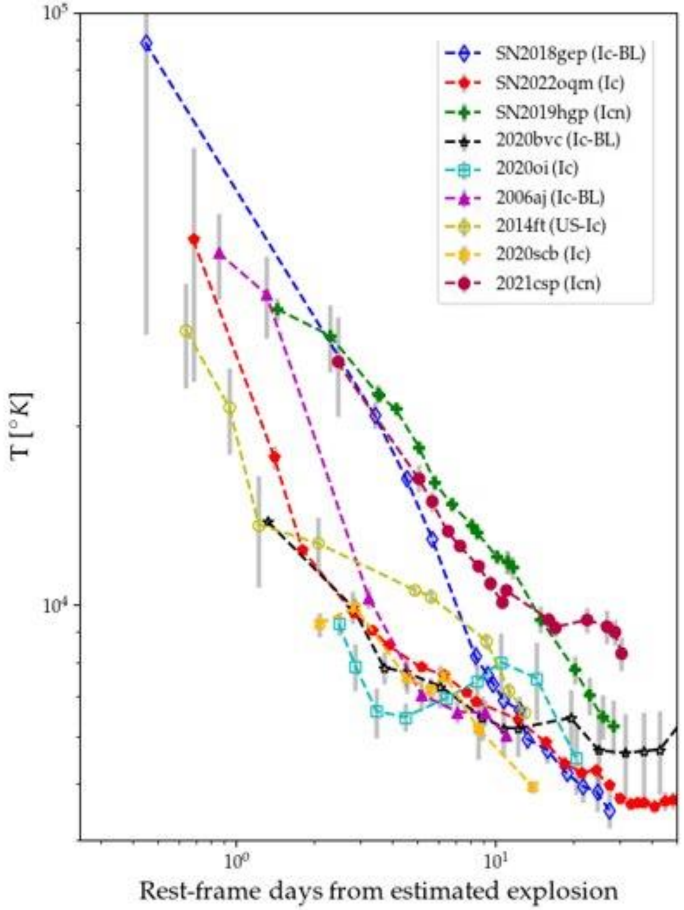


- 2022oqm – first peak associated with narrow emission features from CSM
- Fast evolution explained by fast temperature evolution, as seen in other SNe Ibc with CSM

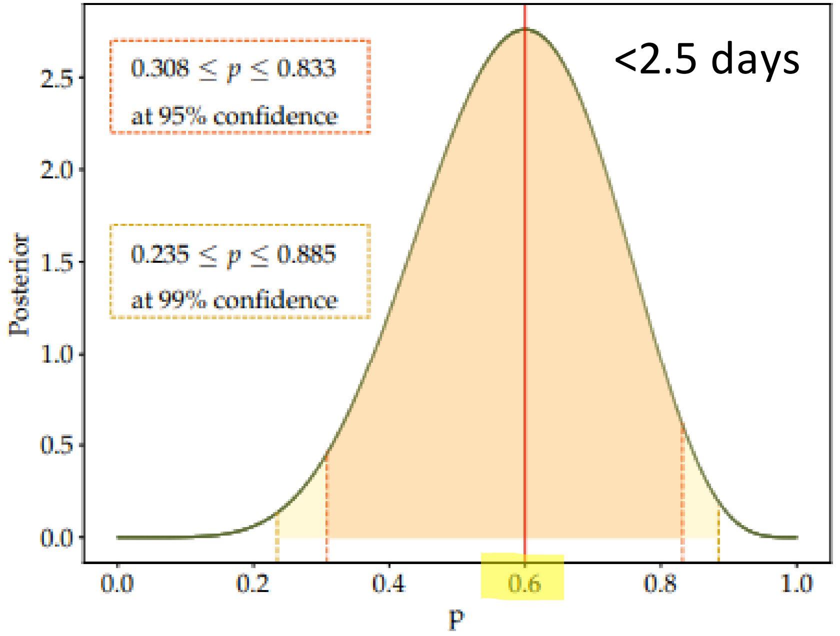
the fraction of SNe Ibc with CSM

- In SNe II, earlier observations increase the chance of observing the CSM
- We are likely catching the bright and slow end of the Ibc CSM distribution

Khazov et al. (2016)

Table 3
Event Fractions

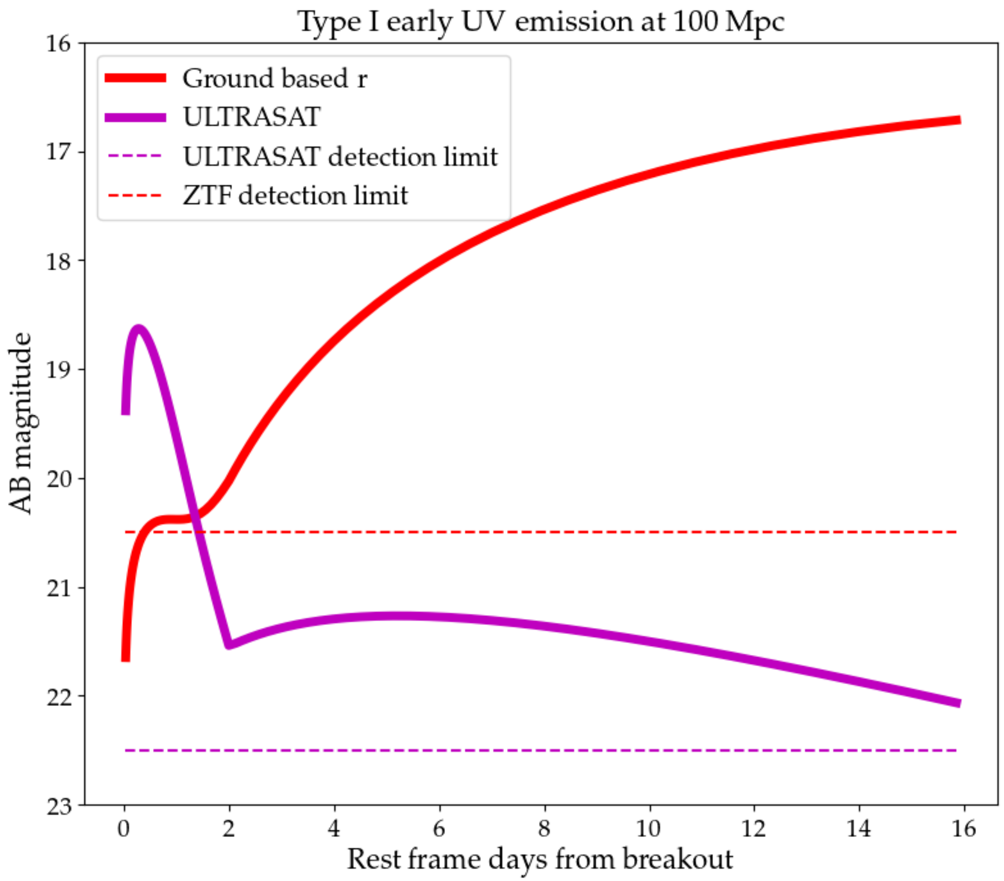
Days from Explosion	Sample Size	FI	BF
9	84	14%	32%
5	55	18%	33%
2	11	18%	54%



Bruch et al. (2020)

SNe Ibc with ULTRASAT

- ULTRASAT will be sensitive to shorter and weaker UV emission
- Enabling early spectroscopy
- Towards characterizing the CSM properties of SNe Ib/c



Summary

- We can recover progenitor parameters from the shock-cooling phase of CCSNe
  - RSG
  - BSG &WR
- ULTRASAT will be ideal for mapping the CSM properties of SNe Ib/c

Read our paper on SN 2022oqm!