Working group 1: Transient Stellar Explosions

Group lead: A. Gal-Yam

Group members

Members (now including US PIs):

- Gal-Yam (WIS; Lead), Ofek (WIS), Waxman (WIS), Kowalski (DESY), Maoz (TAU), Arcavi (TAU), Horesh (HUJI), Pe'er (BIU), Guetta (Ariel), Kushnir (WIS), Buhler (DESY), Soumagnac (BIU), Perets (Technion), Yaron (WIS), Sand (Arizona), Ho (Cornell), Zabludoff (Arizona)
- Associates: Nordin (HU), Ohm (DESY), Morag (WIS), Sadeh (WIS), Shenhar (WIS), Wasserman (WIS), Guttman (WIS), Irani (WIS), Zimmerman (WIS)

Welcome!

Key papers

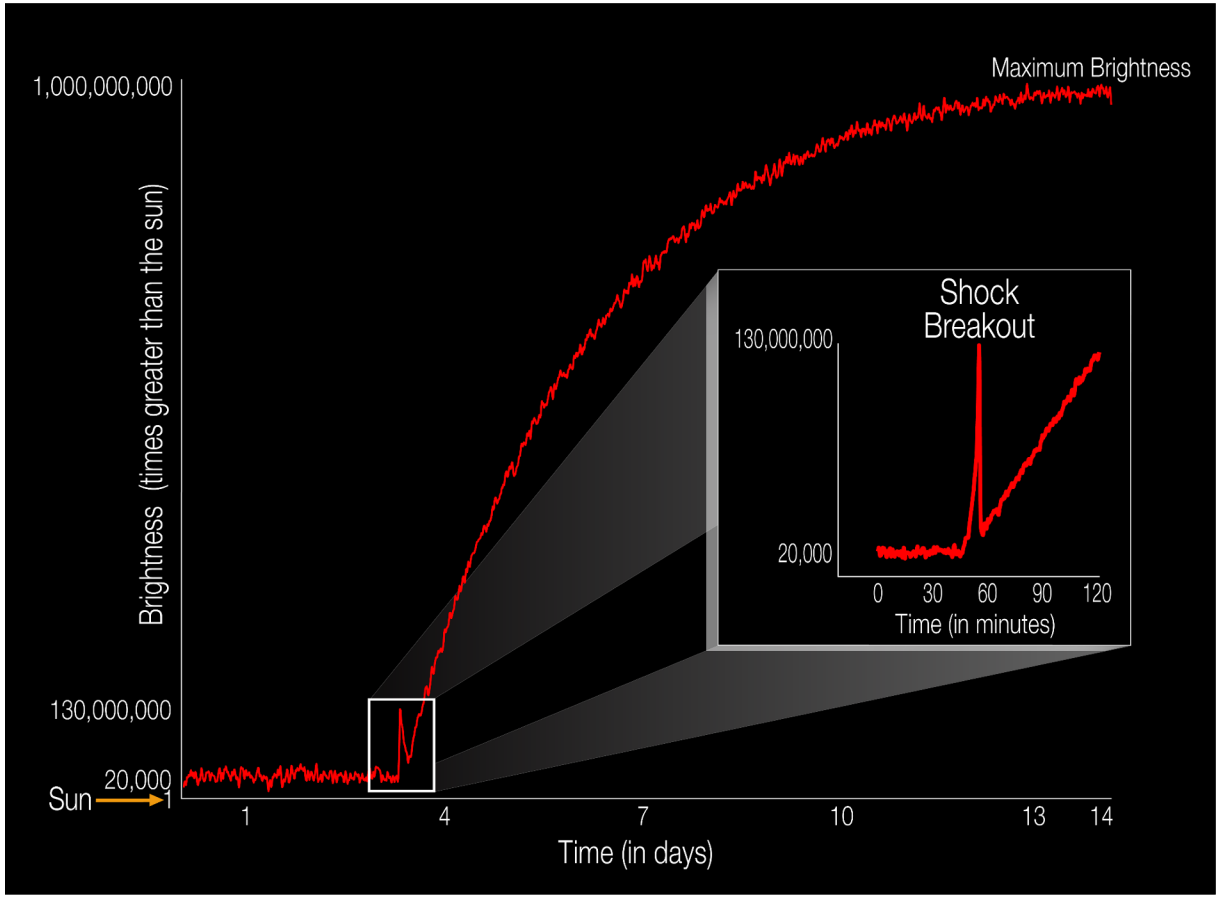
Topic	WG1 Key paper	Leads
Supernova shock breakout (SB)	First detections of SB flares	Gal-Yam
	Detection or limits of SB from Ib/c and exotic explosions	Gal-Yam
	SB/SC search and limits using coadded images	Ofek
Supernova progenitor studies	Analysis of sample of the year-1 CC SN sample to determine progenitor properties from shock cooling models	Gal-Yam
	Analysis of the full sample of CC SNe from the main mission (years 1-3)	TBD
	Nearby SN: precursors search and progenitors variability	Ofek
Radio and mm studies	Comparison of progenitor constraints and mass loss history derived from UV/visible and radio/mm data	Horesh
	Mass loss history as a function of progenitor star type and size	Horesh
	Very rapid mm observations of SNe – search for early mm emission and its connection to UV parameters	Horesh
Theory	Comprehensive modelling of typical supernova explosions observed at infancy	Waxman
	Theoretical modelling of first shock-breakout events discovered	Waxman
Rapid transients	Short duration (~1 day) transients, low luminosity transients (e.g., AIC)	Ofek
Other SN studies	Bolometric study of SNe IIn	Ofek
	Bolometric study of SNe for which SB signal has been detected	Kushnir

Cadence: all about the shock breakout

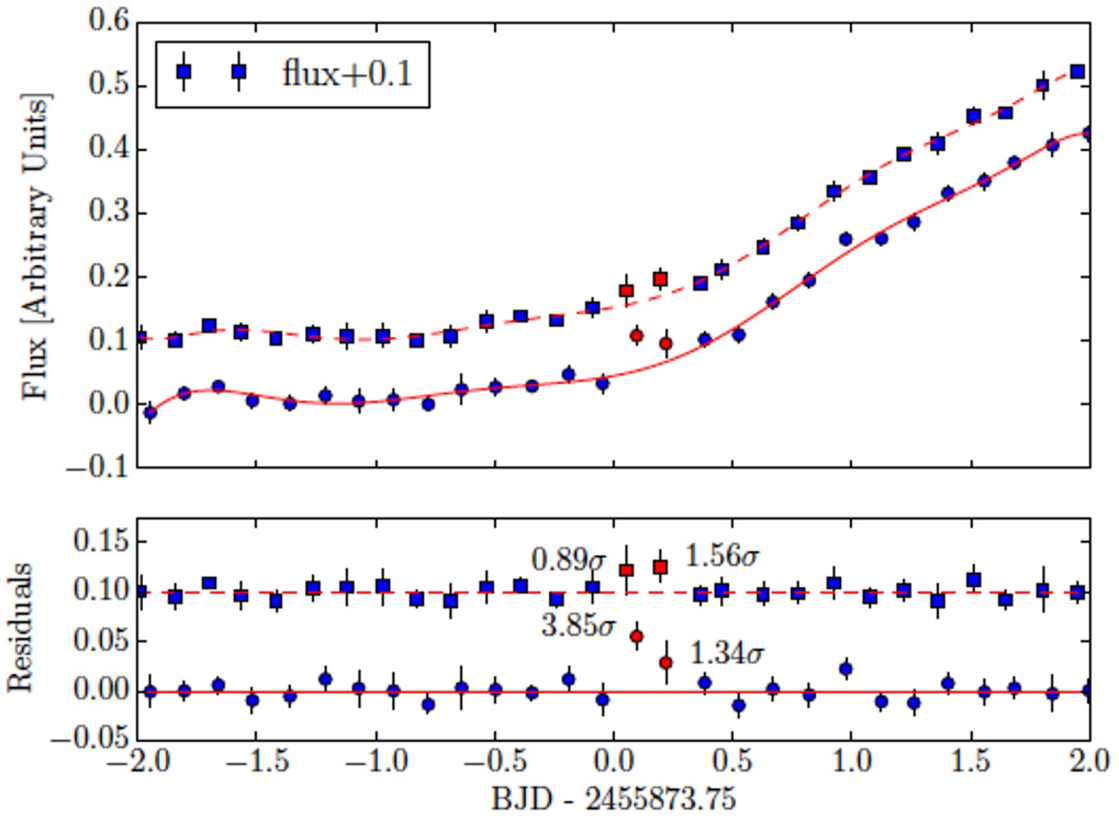
- SB flares have not been convincingly measured for CC SNe.
- Kepler: signal is inconclusive at best
- GALEX, Swift (08D) - UV is mostly SC (not SB)
- 16gkg - rapid rise seen may or may not be SB.

ULTRASAT needed to make solid detections of SB flares, need cadence of minutes to resolve flare evolution

A comment about shock breakout



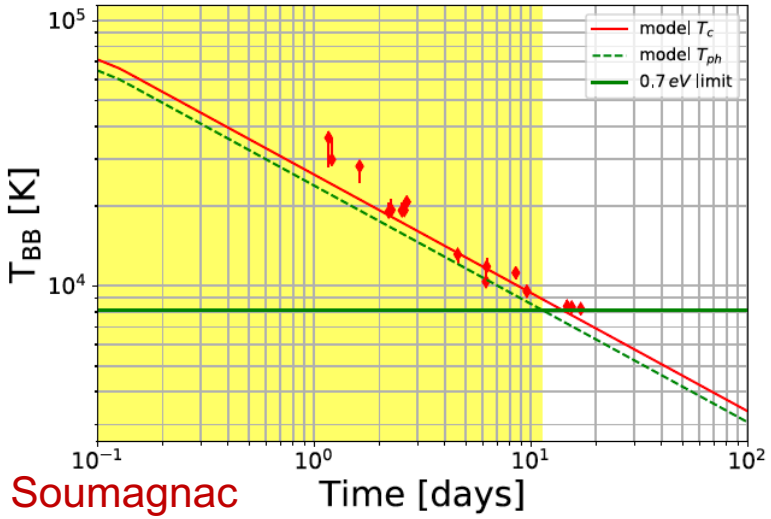
NASA PR (not real Kepler data!)



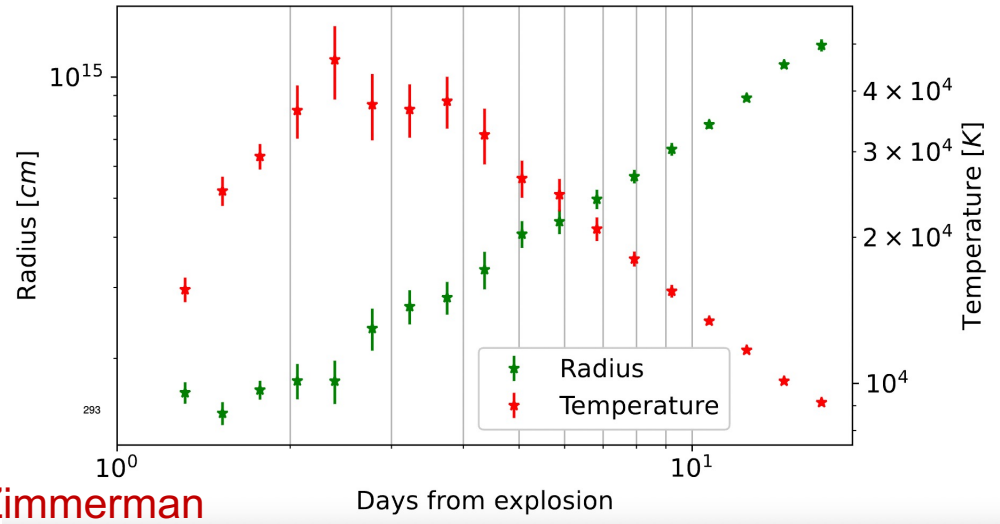
Real data, showing effect of binning (Rubin & Gal-Yam 2017)

Emerging understanding of early SN emission

- Two “modes” now commonly seen: cooling and rising/heating
- Cooling events are well-fit by predictions of shock-cooling models (common)
- “Heating” events (2020pni, 2022oqm, 2023ixf) do not fit shock cooling; early emission likely result of an extended shock breakout.



Soumagnac



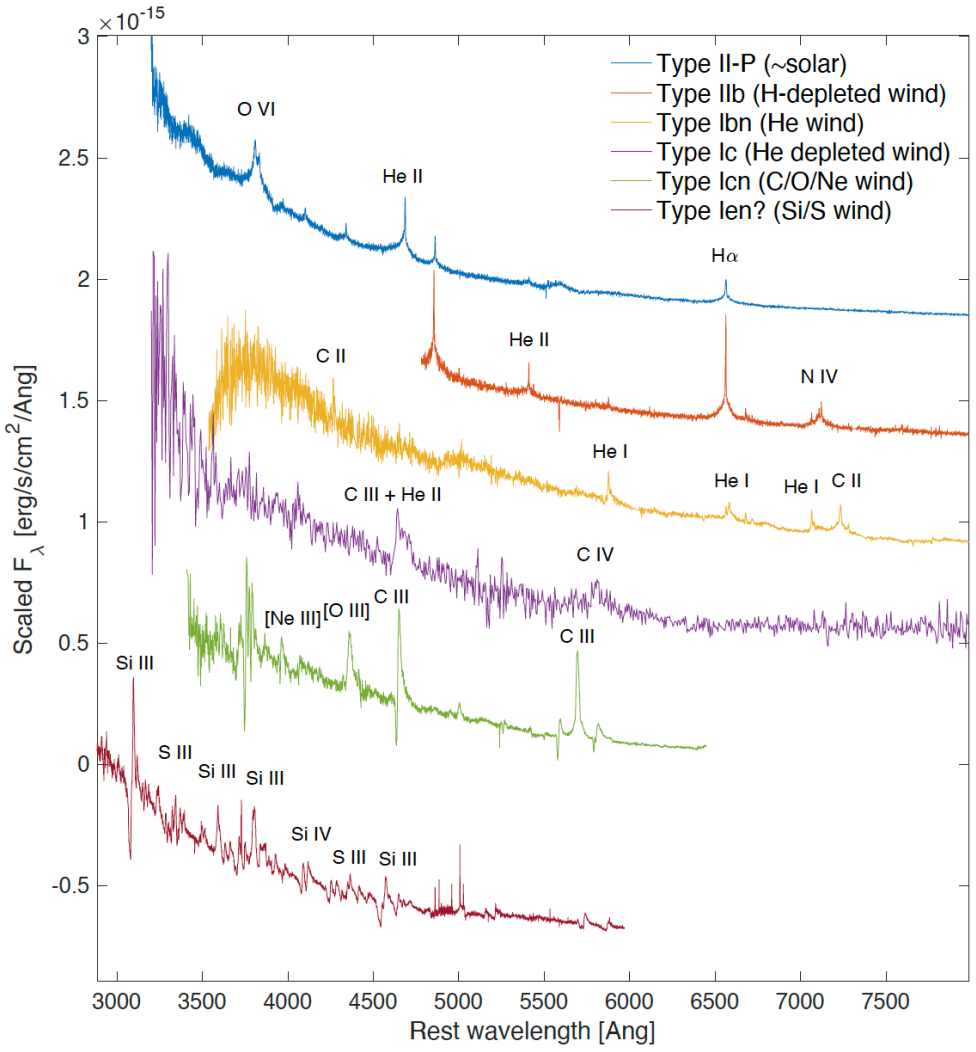
Zimmerman

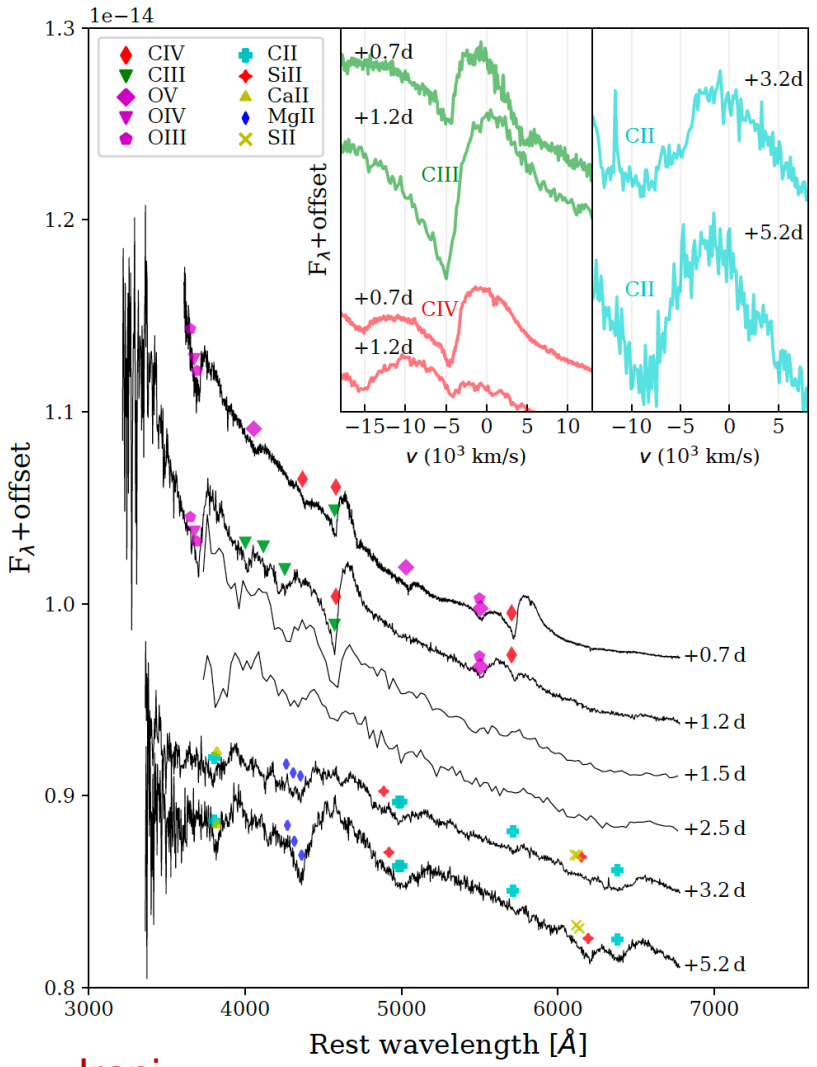
Recent lessons learned

- Type Ib/Ic supernovae also have early UV bumps (at least some; Das)
- At least is some cases this is also due to CSM interaction (Irani)

- 2023ixf: an experiment in “not having UV” due to Swift saturation.
- Attempt to replace by U band (e.g., recent Hiramatsu paper)
- Our work with HST-based UV shows U-band results are significantly off (e.g., in bolometric luminosity)
- Demonstrating critical need of ULTRASAT (confirming simulations by e.g., Rubin)

Spectroscopy at early times





Irani

Informed predictions for ULTRASAT

- Large discovery space on short timescales (<1 day, especially <1 hour)
- Shock breakout likely, other possible effects
- Extended shock breakout (days) – common but not the majority, surveys biased in favor
- UV data critical to properly measure physical parameters, in particular in complex situations (e.g., CSM, non-standard shock breakouts)
- Spectroscopic follow-up strongly motivated
- All CC supernovae classes are relevant

ULTRASAT has significant role to play!