SOXS Science WG#8 – Core Collapse SNe

Gal-Yam et al. 2014, Nature

Avishay Gal-Yam, Giuliano Pignata

For WG8

I. Arcavi

Working group members

Gal-Yam (WIS; head), Pignata (Chile; Deputy)

Benetti, Turatto, Pastorello, Cappellaro, Elias-Rosa, Tartaglia, Tomasella (INAF-OAPd), Botticella (INAF-OACn), Smartt (QUB), Izzo, Della Valle (INAF-OANa), Anderson (MAS), Kuncarayakti, Mattila, Kotak, Kankare, Guyierrez, Nagao (Turku), Stritzinger (Aarhus), Strotjohann (WIS)

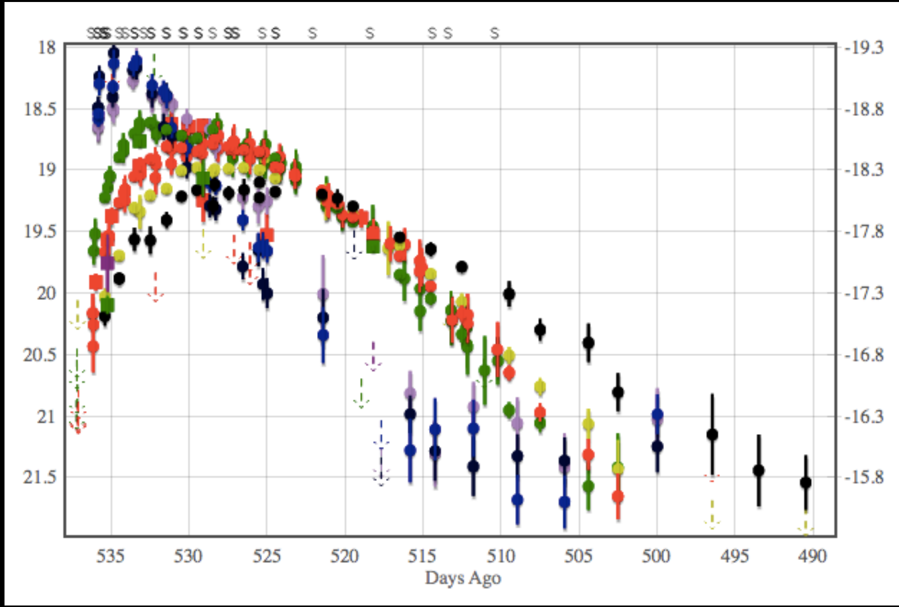
Main Science Goals

- To create a legacy data that will be a benchmark for future study of massive star explosions
- To make best use of most powerful and novel features of SOXS (resolution, IR)
- To serve as broad a community within the SOXS consortium as possible

Practical considerations

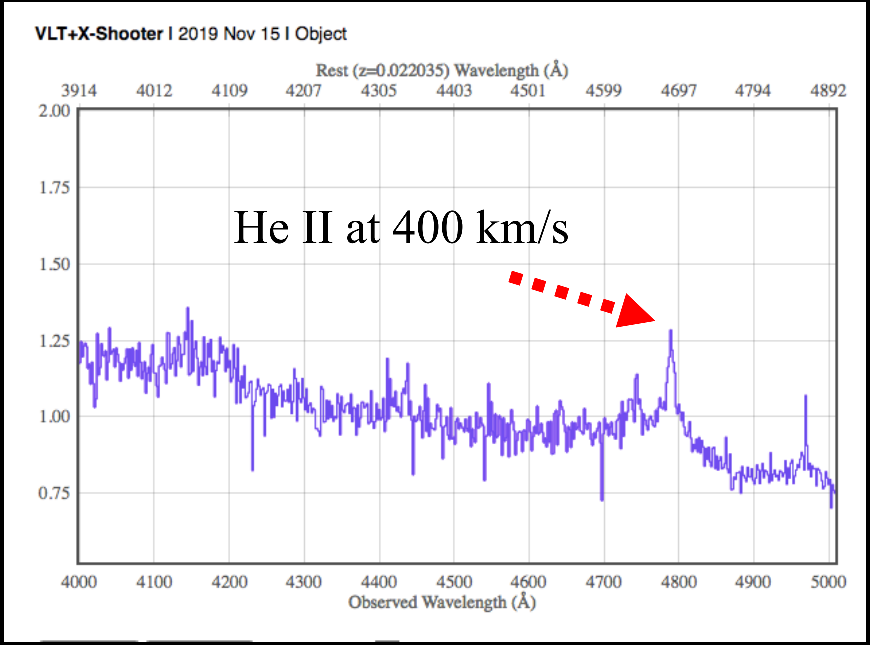
- High impact results come from nearby events
- Events detected close to explosions provide complete and informative data sets

Goal: collect a set of benchmark objects observed “from start to finish”



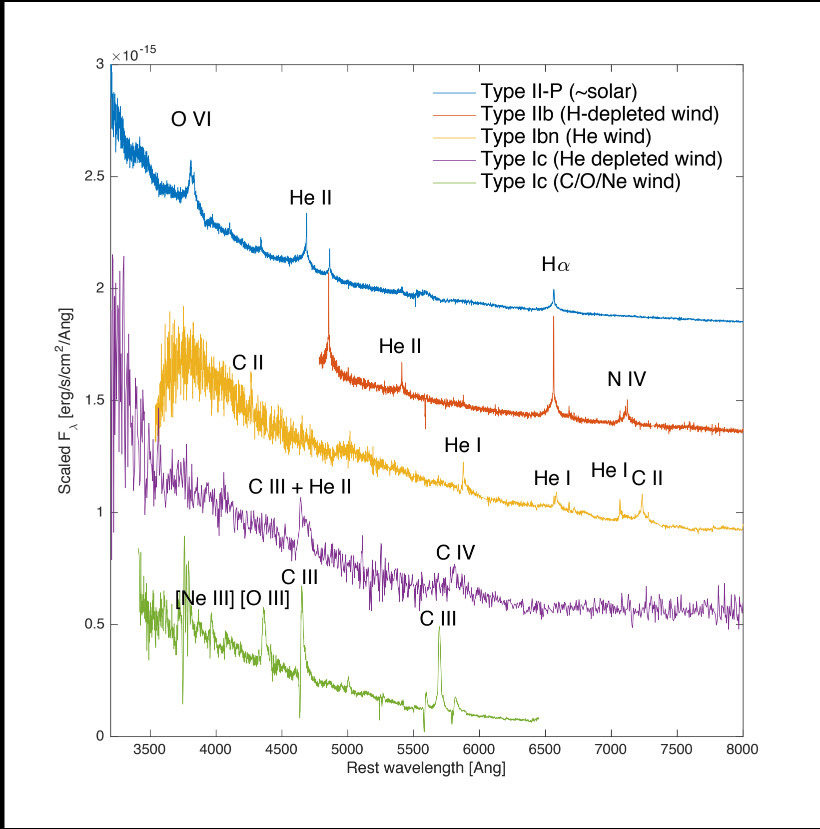
Power of SOXS

- Infant core-collapse supernova explosions show transient "flash" emission lines
- This is common (60% at day 2 measured by Bruch et al. 2020)
- SOXS resolution can chart pre-explosion CSM speed: key to understand how and why stars explode



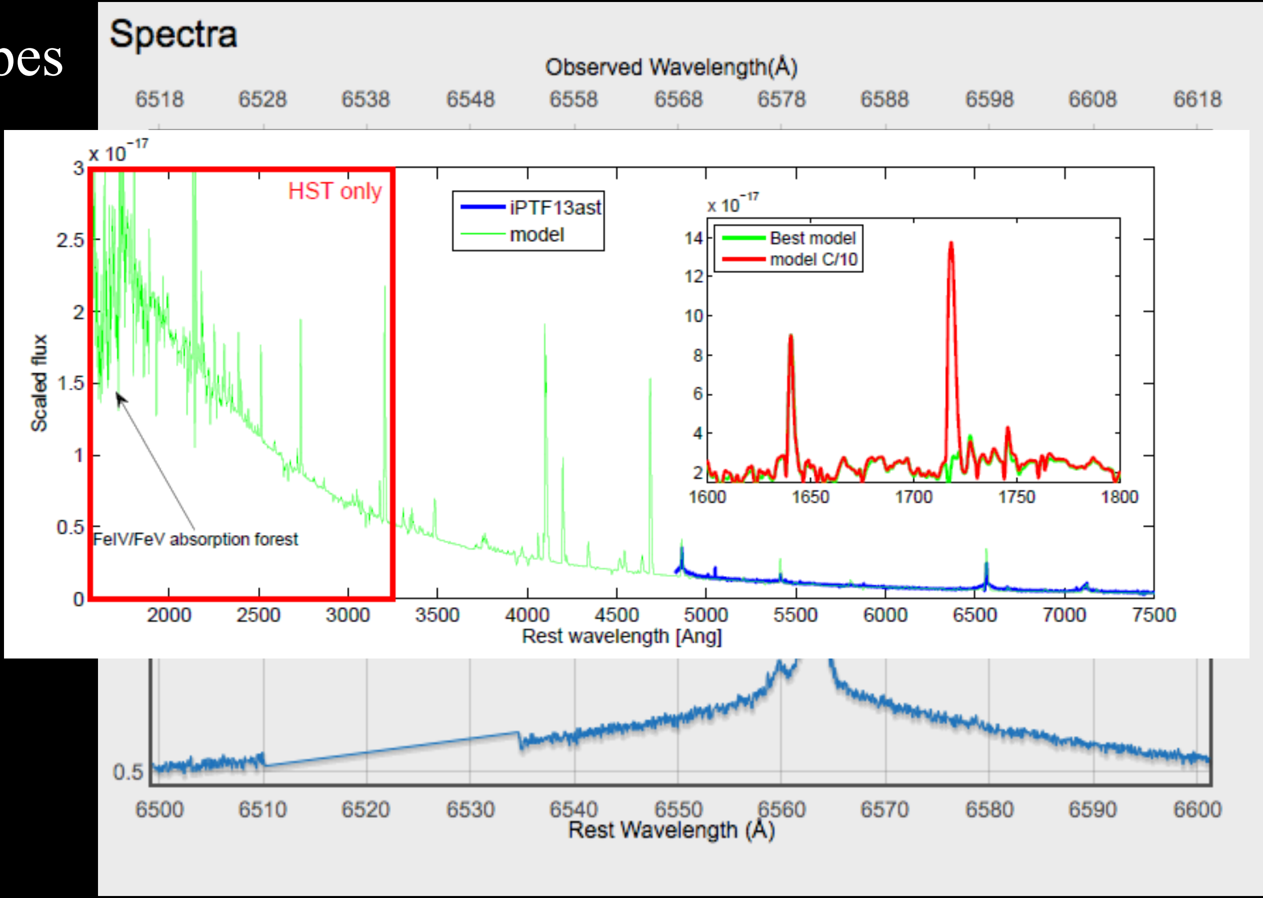
Power of SOXS sample

- Important to understand all types
- Broad coverage would be very informative
- For nearby events, nebular spectra would be also possible

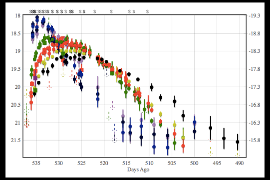


Profiles of narrow lines

- For early SNe of all types
- For SNe IIn, Ibn
- Broad wavelength coverage would be interesting
- CSM/ISM absorption lines (Na, Ca)
- Search for the next surprise…



Major key program: CC SN benchmarks



- Select all nearby (<50 Mpc) SNe detected early (within <3 days of explosion)
- Made possible by all-sky high cadence surveys (ASASSN, ATLAS, ZTF, in future ULTRASAT)
- Answer numerous WG member goals

✓ Infant SNe and shock breakout

✓ SNe with precursors

✓ SNe with detected progenitors

✓ EC-SN candidates (faint II)

✓ Nearby 87A-like events

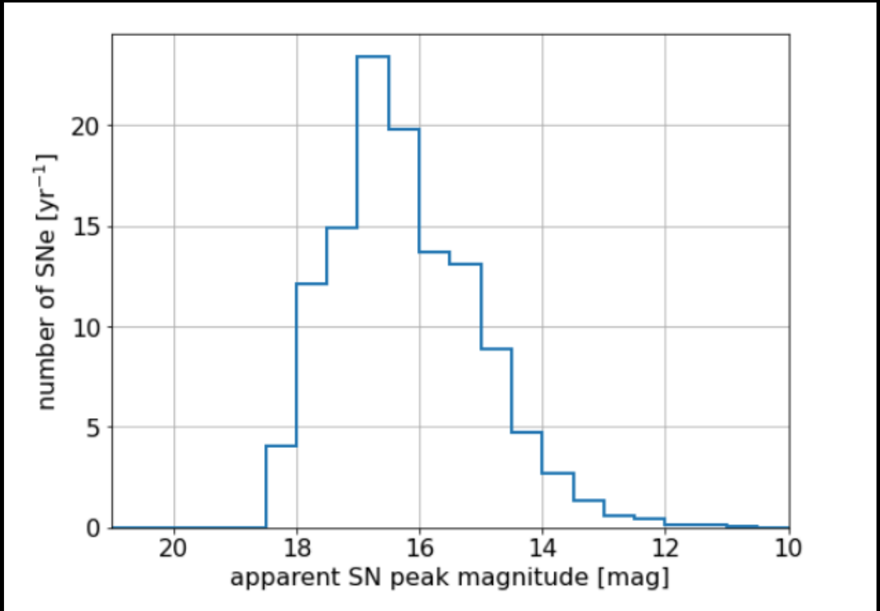
✓ Nearby SNe IIn

Additional science programs

- Infant SNe from ULTRASAT (starting late 2024)
- SNe Ib/c with CSM
- SNe Ic-BL to z=0.1
- SNe in LIRG
- Long-lasting Type II

Number of benchmark targets

- Based on recent ZTF/RCF: 120 CC SNe within 50 Mpc brighter than 20 mag (all sky)
- About ½ (60 events) well observed from south, and about ½ of those found early (i.e., not near the sun) – 30 events per year. About 60% SNe II, 30% Ib/c, 10% rare events (IIn, IIb, Ibn, Ic-BL, 87A etc).



Peak magnitude distribution (Strottjohann)

Initial time request estimate

- 120h per semester for benchmark key program, pending more accurate estimates (30 targets, 8 spectra per object = 4h, preliminary)
- Up to 15h for specialized programs
- Reserve 5h for special and surprising events

- Can reconsider benchmark program after year 2

Time allocation (very preliminary)

- 60h WIS
- 50h INAF
- 20h Chile (MAS)
- >5h Finland
- 5h QUB

Thanks