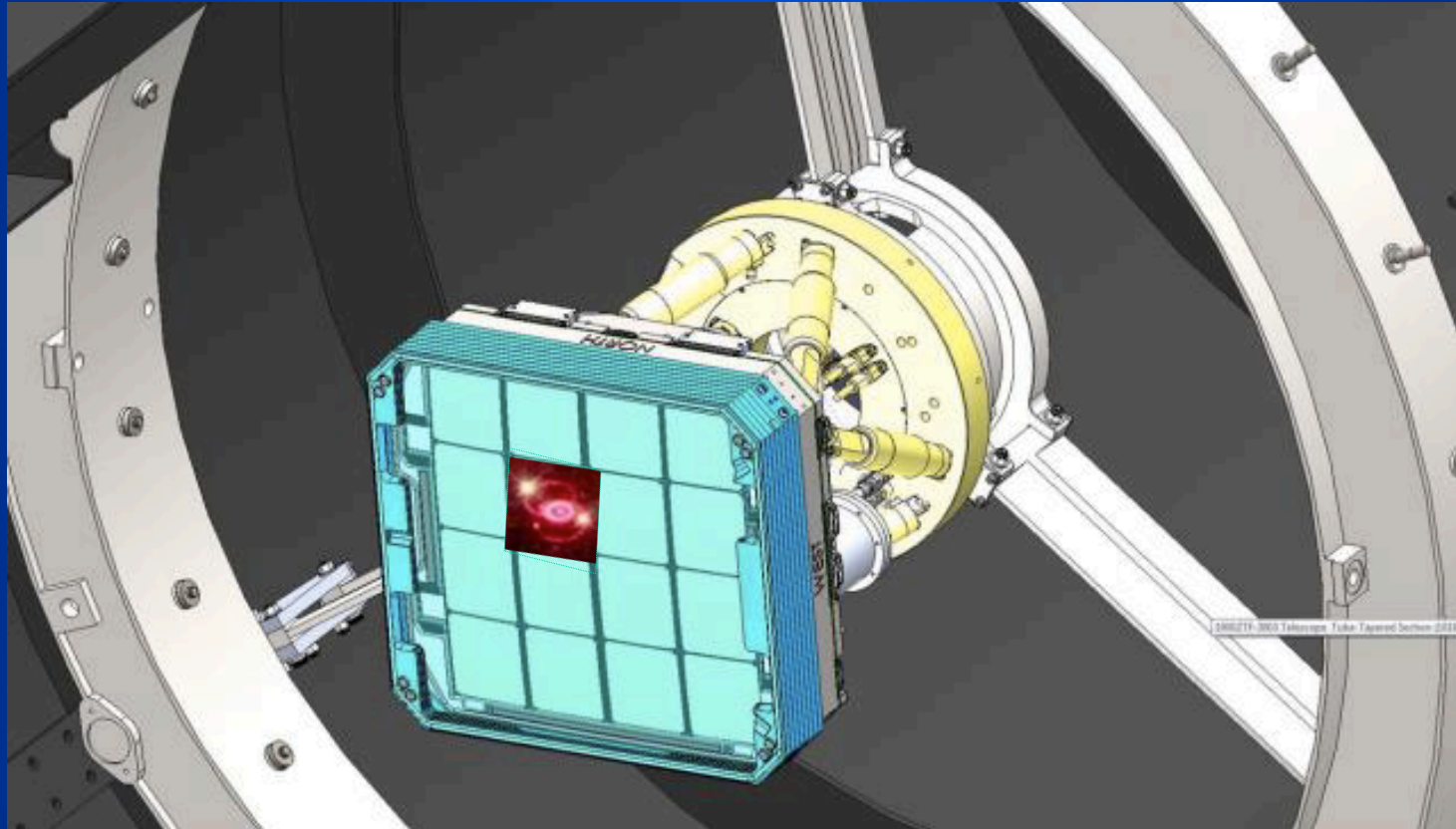


Core-collapse science with ZTF



Avishay Gal-Yam

Weizmann Institute Of Science

ZTF meeting 2016, Maryland

ZTF is going to revolutionize SN science



SN studies should start at day 1, routinely

The WIS SN group



Main areas of activity

- Young SN spectroscopy (“Flash”)
- Type II_n SNe
- Photometry of young CC SNe at optical+UV (ULTRASAT)
- CC SN samples (mainly working on PTF SNe II)
- Host galaxies of SNe from PTF
- Some unique cases
- SLSNe (w/ Lunnan, Yan, Quimby, Perley)
- Databases, rapid alert system (TNS), methodology

ZTF: Total numbers

Use “month of wonder” (August 2010) to estimate numbers

Assume:

ZTF is 10 times more efficient than PTF

50% of time will be used for a few-day near-all-sky cadence

Expected SN numbers:

Total CC: 115 (including ~10 SLSN)

Types: 65 II, 20 Ib/c, 5 Iib, 15 IIn, 10 SLSN

Of those 10 events at $<17\text{mag}$, 15 at <18 , 40 at <19 and 50 at <20

(so 65 within easy reach of SEDM at peak)

ZTF should produce many hundreds of classified CC SNe per year

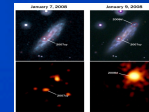
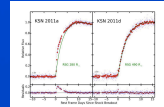
ZTF: young SN numbers

- iPTF is capable of finding at least 1 “day 1” SN per month at normal weather and reasonable cadence choice
- A conservative estimate for ZTF is therefore a “day 1” SN every week. Probably we should have more.
- Number of CC SNe and Ia should be about equal.
- Exotic events (e.g., SLSNe) should happen more than once a year.

Now

It is now prime time to think about transient science at day 1

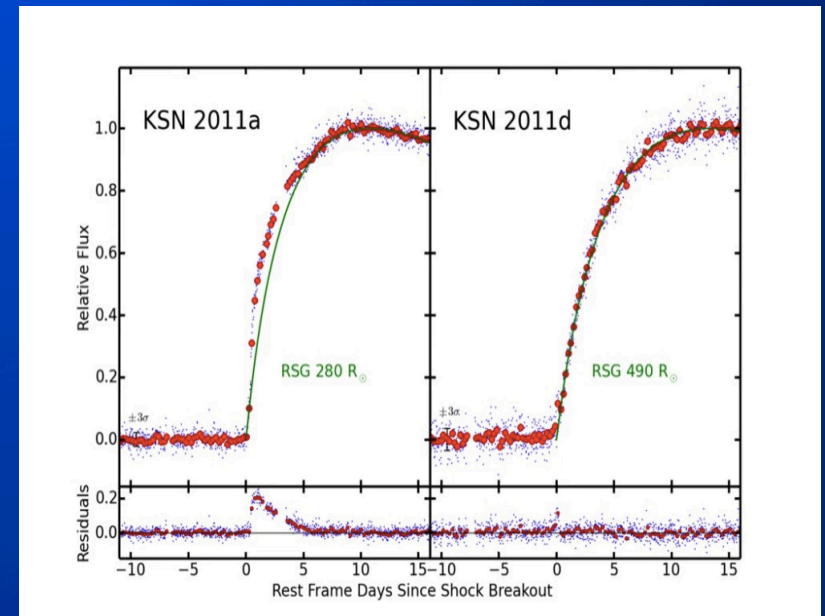
- Shock breakout/cooling
- Multiwavelength
- World networks
- Neutrino and GW coincidence
- Flash spectroscopy
- ...



Shock breakout/cooling

We can conduct experiments competitive with Kepler (1hr cadence)

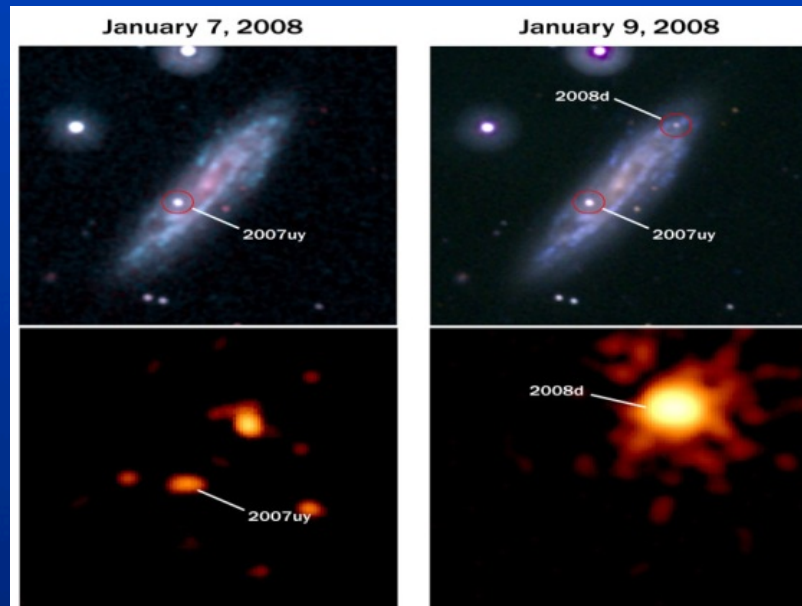
- UV (Swift) is key
- Need rapid response t
- Secure multi-band, spectra



Multi-wavelength

Swift is Key

Are there other relevant missions?

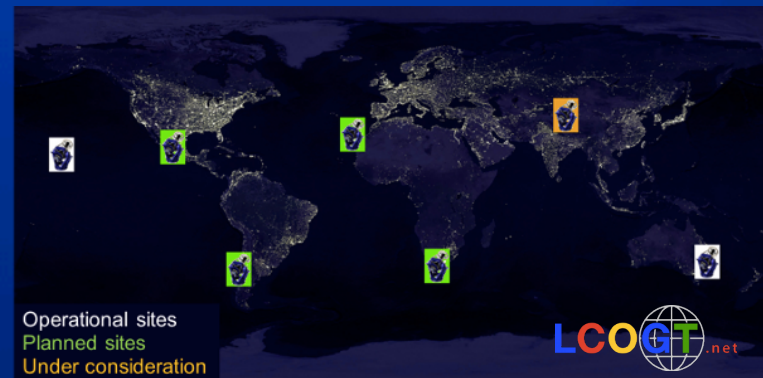


World networks

ZTF-LCOGT is a natural combination

Can we continue to work together as well as we did?

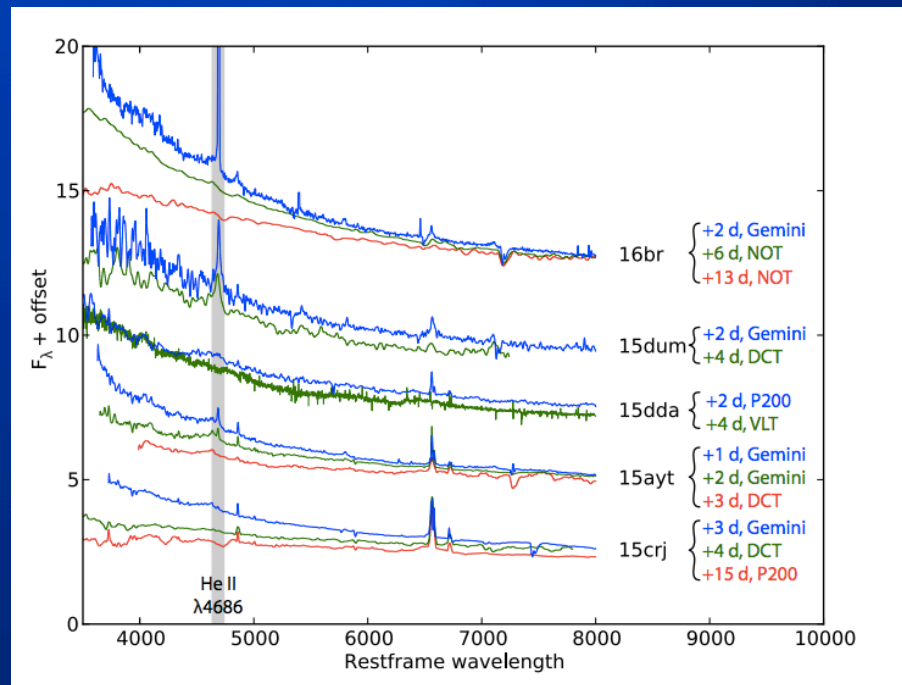
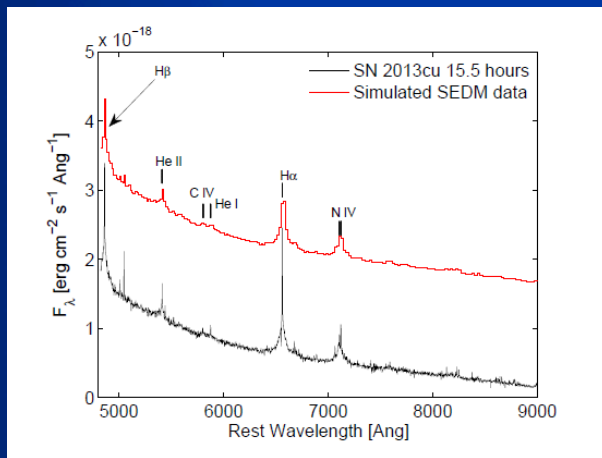
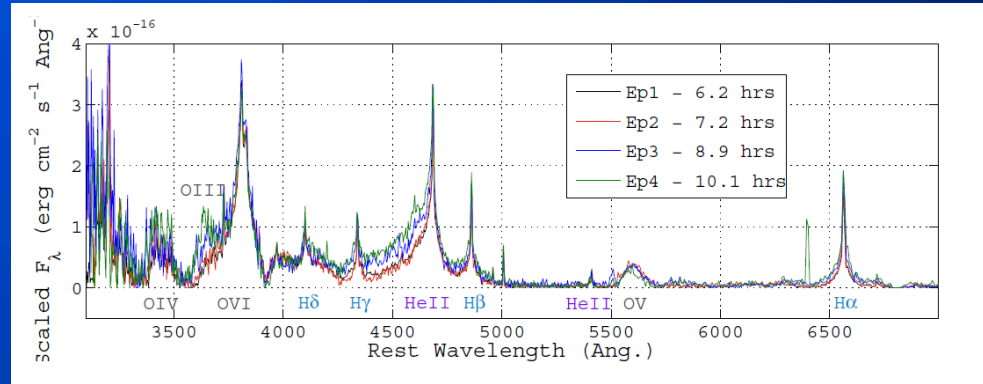
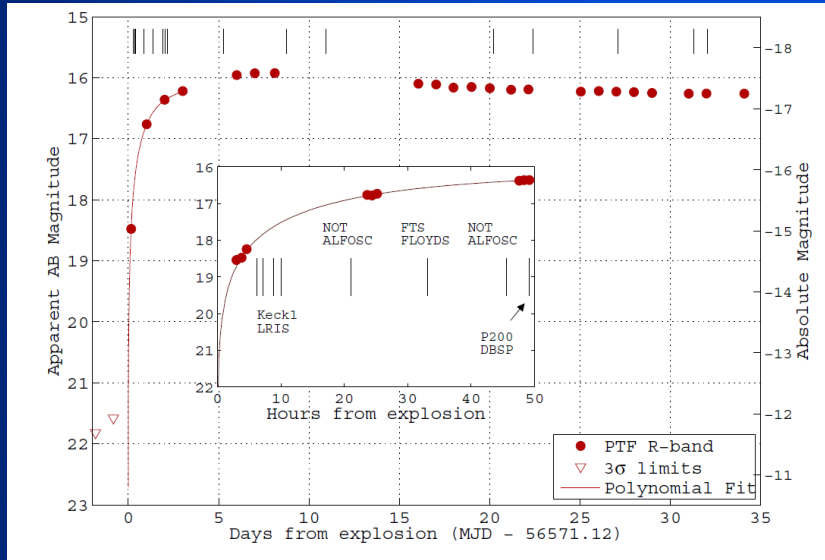
Need efficient hand-over to follow-up telescopes (Marshal)



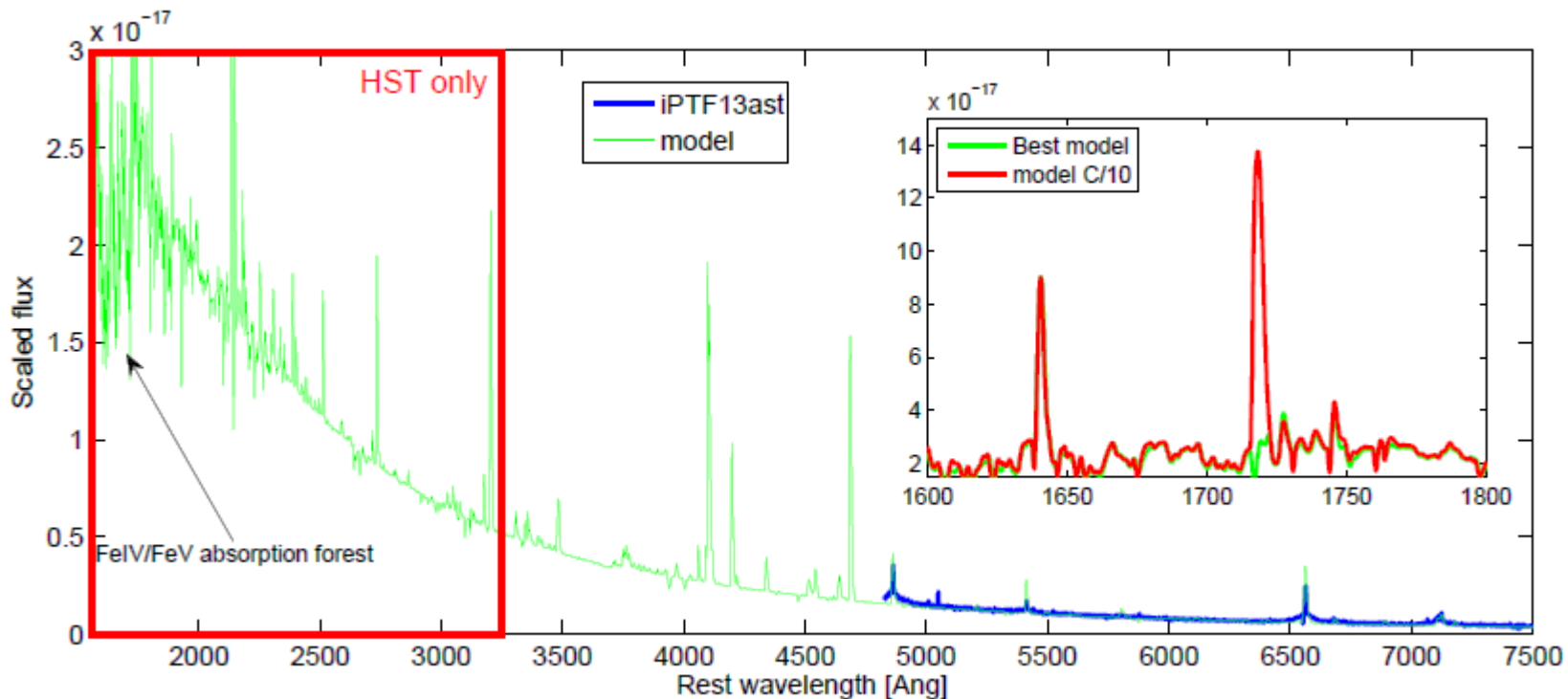
Non-EM

LIGO and IceCube joint work (both prompt and long-term – stacking, cross-correlation studies)

Flash spectroscopy with ZTF



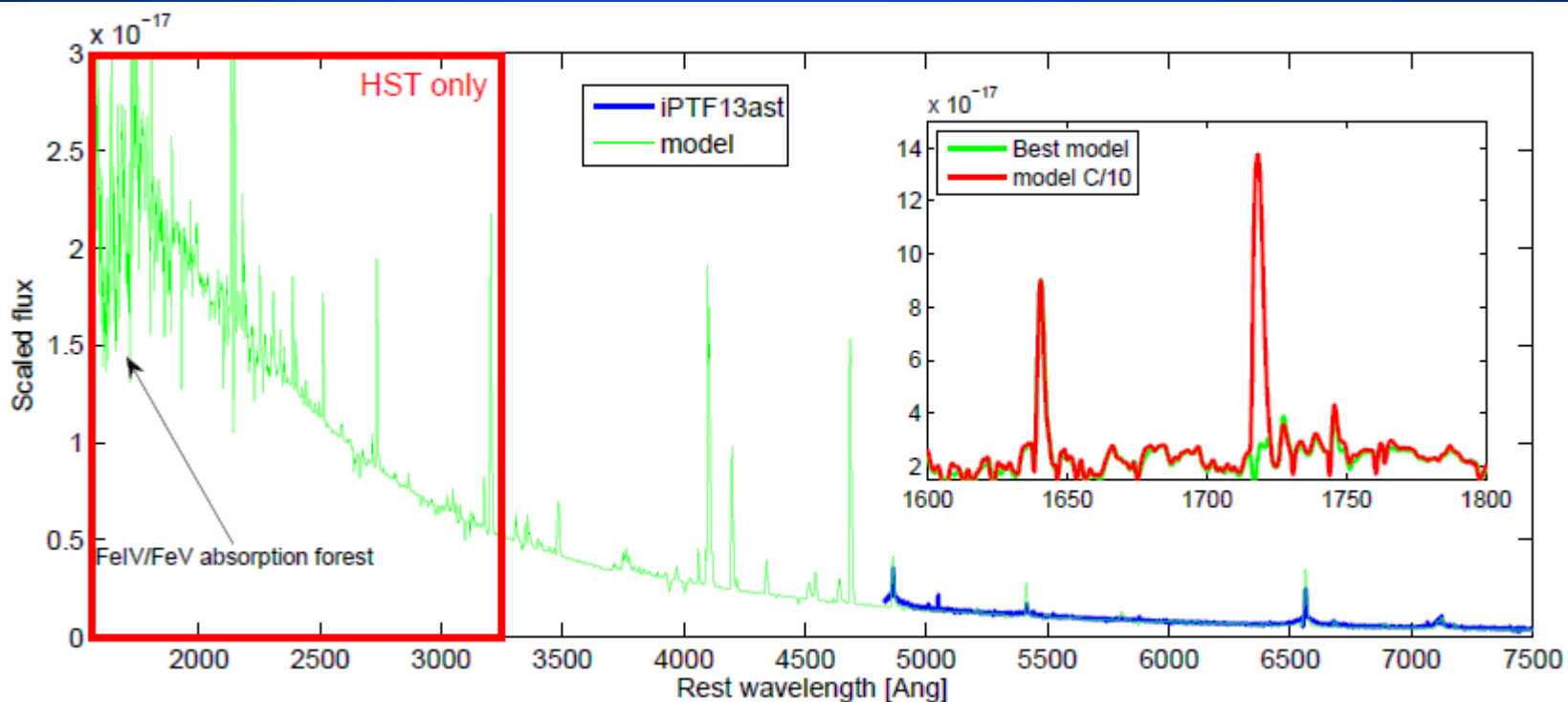
HST UV is a very attractive place to go to



ZTF Flash science

- Classify any SN progenitor with CSM, W-R/Ib/c would be a key new area
- Easily done to >100 Mpc, potential is >100 SN/y
- Characterize pre-explosion evolution via mass loss during during terminal year
- Big clue to explosion question

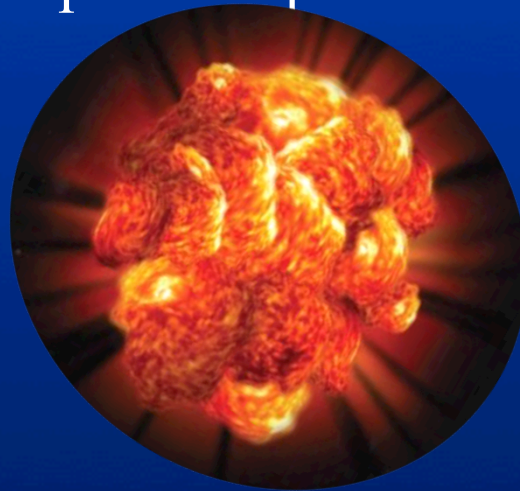
HST UV is a very attractive place to go to



Take home message

ZTF offers very rich CC SN science

- Focus on early times but,
- Big opportunity for massive sample studies, SEDM is Key
- Rates! The key is pre-planning and discipline: enforce a magnitude cut on SEDM follow-up; regard this as prime experiment (e.g., Swift).



Thanks

The Palomar Transient Factory (PTF) found some SNe very early

