Superluminous Supernovae at High-z with WFIRST

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This talk

• What do we know about low-z SLSNe?
• How can this help us to plan for WFIRST observations?
  – diversity of light curves, spectra and hosts
  – Serve as template library (LC and SED)
  – Start planning: observation, data reduction, SLSN identification, follow-up
What is a SLSN: 10x brighter, 5x longer, UV bright

Gal-yam et al. 2012, Quimby et al. 2011

Credit: Quimby
Interesting explosion physics

- Likely massive progenitors in low-z environment.
- e+e- pair instability (>130Msun)
- Fast spin, high magnetic field NS (magnetar)
- Interaction with dense CSM
Palomar Transient Factory – an efficient machine for discovering low-z SLSNe

The PTF camera field of view

92 MPix
1.0 arcsec sampling
R=21 in 60 seconds

Fov: 7 sq. deg
Palomar 48”, operating since 2009.

At $z \sim 0.2$, SLSNe are very rare, $200/\text{Gpc}^3/\text{yr}$, $\sim 0.3\%$ SNIa. (i)PTF has found $\sim 50$ SLSNe, the largest sample.
Diversities of SLSN Light Curves

- Slow SLSN-I
- Fast SLSN-I

Nicholl et al. MNRAS 2015;452:3869-3893
Double-peaked LC

Nicholl et al. 2015 ApJ
Building SLSN spectral Library, SED (t, source)

PTF 09cnd at z=0.258 (phase:−18)

Variations of SLSN spectra

Typical, SLSN-I

Slow evolving, SLSN-I, PISN?

Yan et al. 2015 ApJ
Diversity of host galaxies: SLSN-I hosts are mostly dwarfs

Leloudas et al. 2015, MNRAS
Future work

• Identification --- Light curve – very slow evolution because of time dilation
• Need to coadd images – in what cadence? Special processing software
• Spectra --- will be difficult from ground. JWST or WFIRST grism follow-up (GO program)
• Z>5 SLSN host galaxies --- low-mass relative to MF at z>5? Might not be true. Unknown.