



The Palomar Transient Factory – Various Results

Dovi Poznanski (UC Berkeley & LBNL)
+ Peter Nugent (LBNL) + many others





PTF (2009-2013)

- CFH12k camera on the Palomar 48" telescope
 - 7.8 sq deg field of view, 1" pixels
 - 60s exposures with 15-20s readout in r, g and H-alpha
 - Improvements to telescope (seeing, tracking, scheduling)
 - Running since January 2009
- 2 Cadences (Mar. - Nov.)
 - Nightly (35% of time) on nearby galaxies and clusters (g/r)
 - Every 5 nights (65% of time) on SDSS fields with minimum coverage of 2500 sq deg. (r) to 20th mag 10-sigma
 - H-alpha during bright time (full +/-2 days)

Nov-Feb, minute cadences on select fields.





PTF Science

PTF Key Projects	
Various SNe	Dwarf novae
Transients in nearby galaxies	Core collapse SNe
RR Lyrae	Solar system objects
CVs	AGN
AM CVn	Blazars
Galactic dynamics	LIGO & Neutrino transients
Flare stars	Hostless transients
Nearby star kinematics	Orphan GRB afterglows
Rotation in clusters	Eclipsing stars and planets
Tidal events	H-alpha 1/2 sky survey

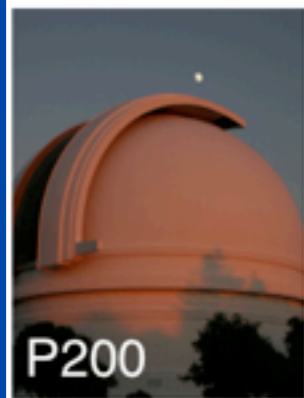
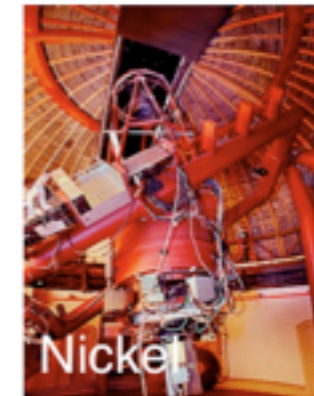
The power of PTF resides in its diverse science goals
and follow-up.

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PTF Science

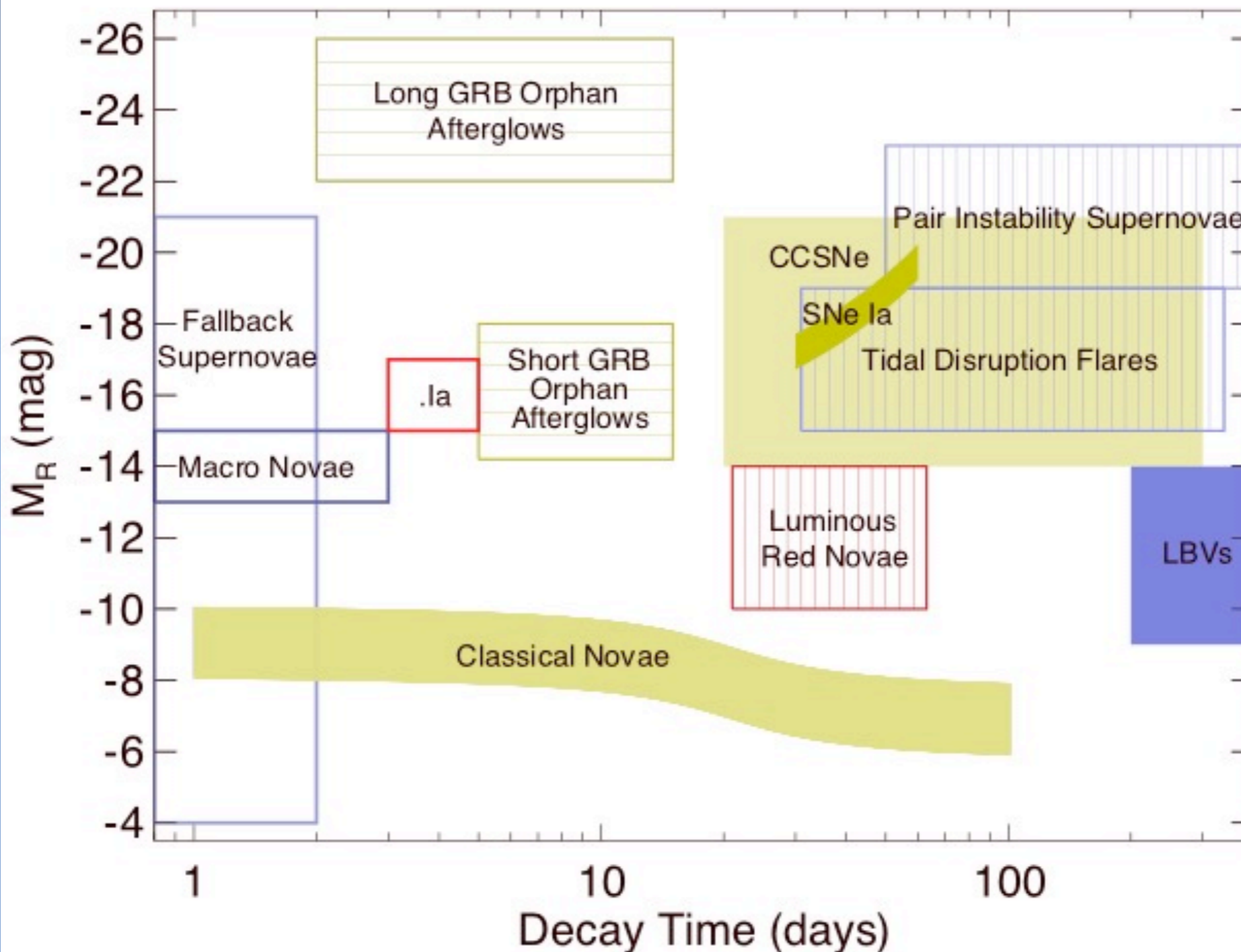
▼► Detected transients will be followed up using a wide variety of optical and IR, photometric and spectroscopic followup facilities.



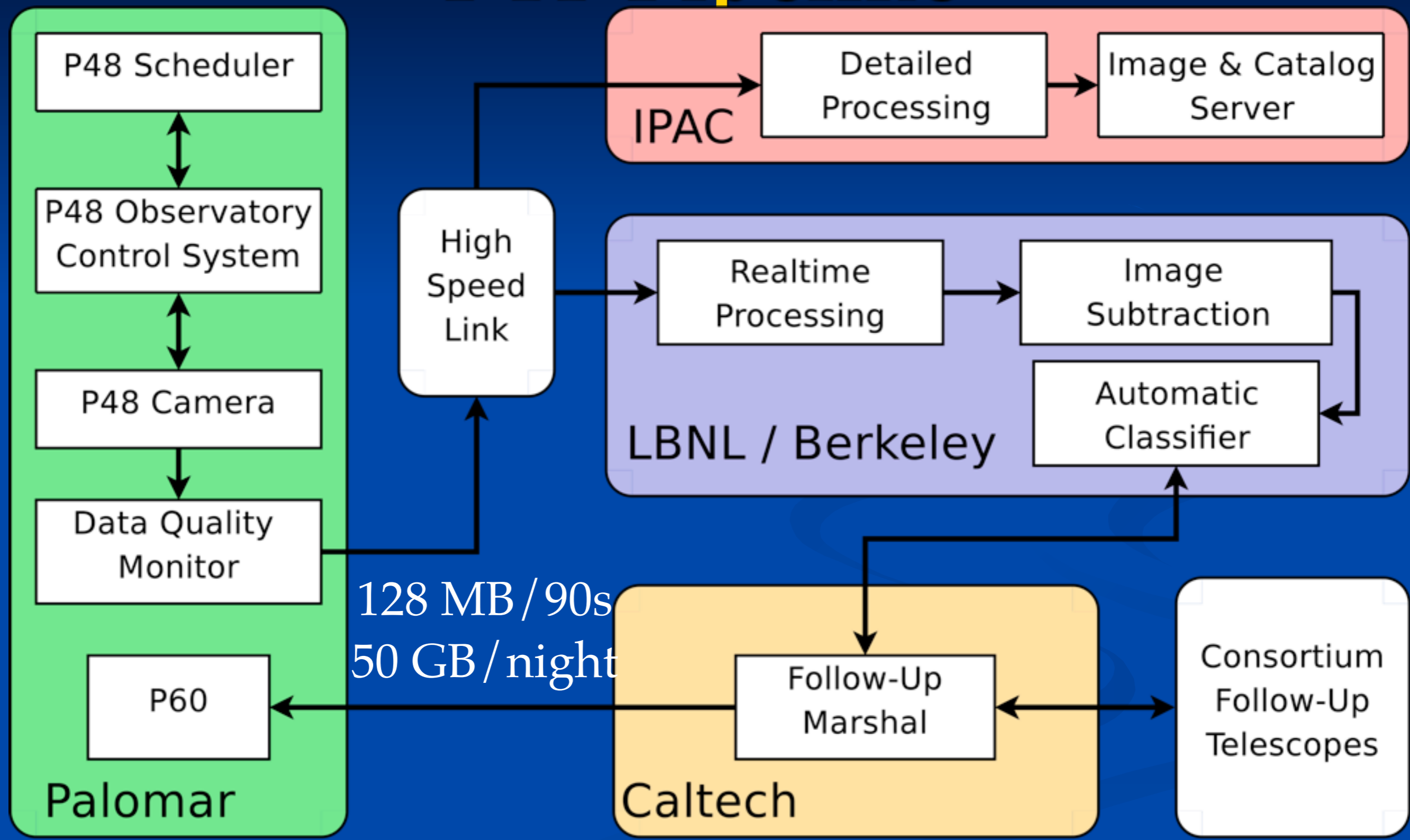
The power of PTF resides in its diverse science goals and follow-up.

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Phase-Space

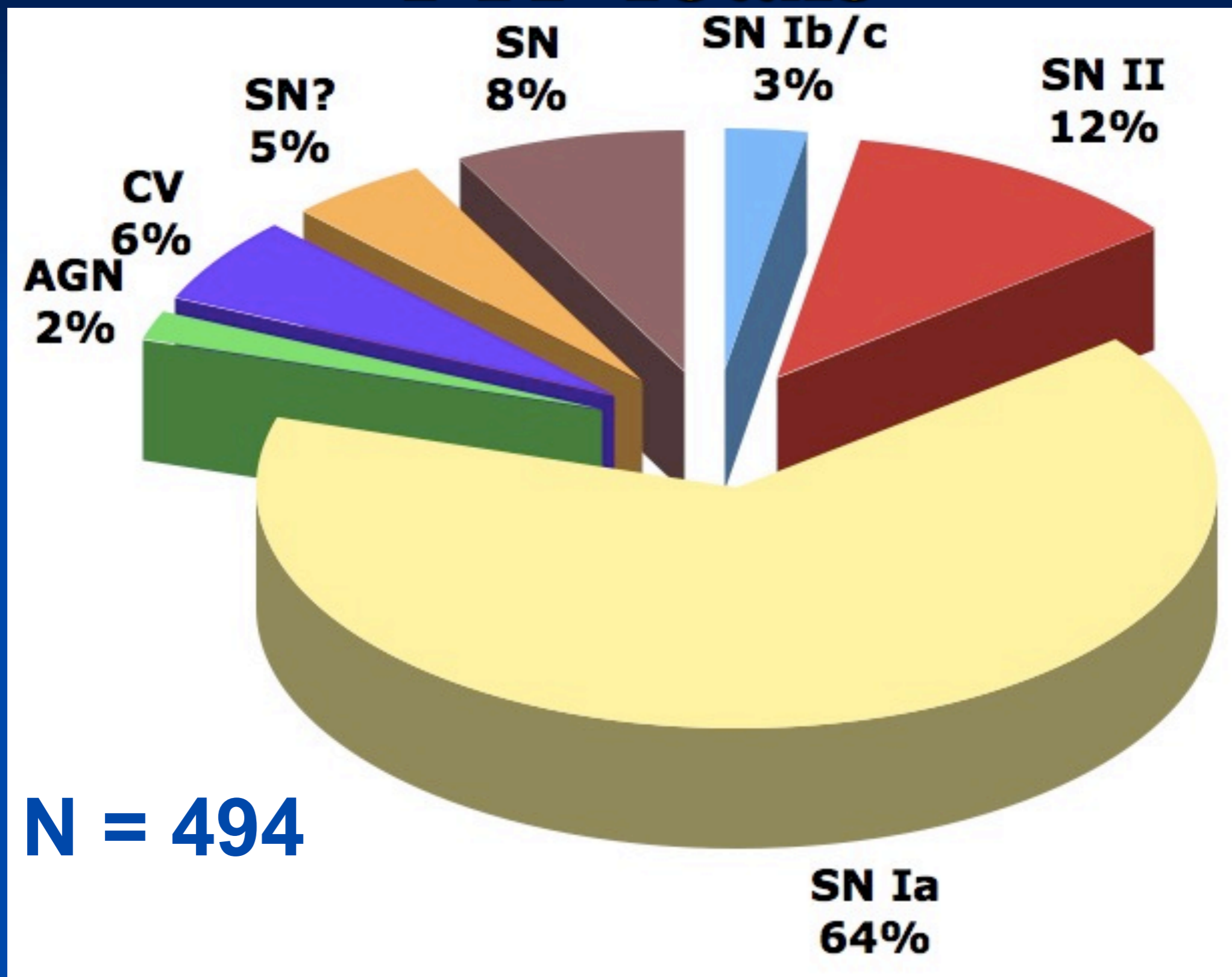


PTF Pipeline

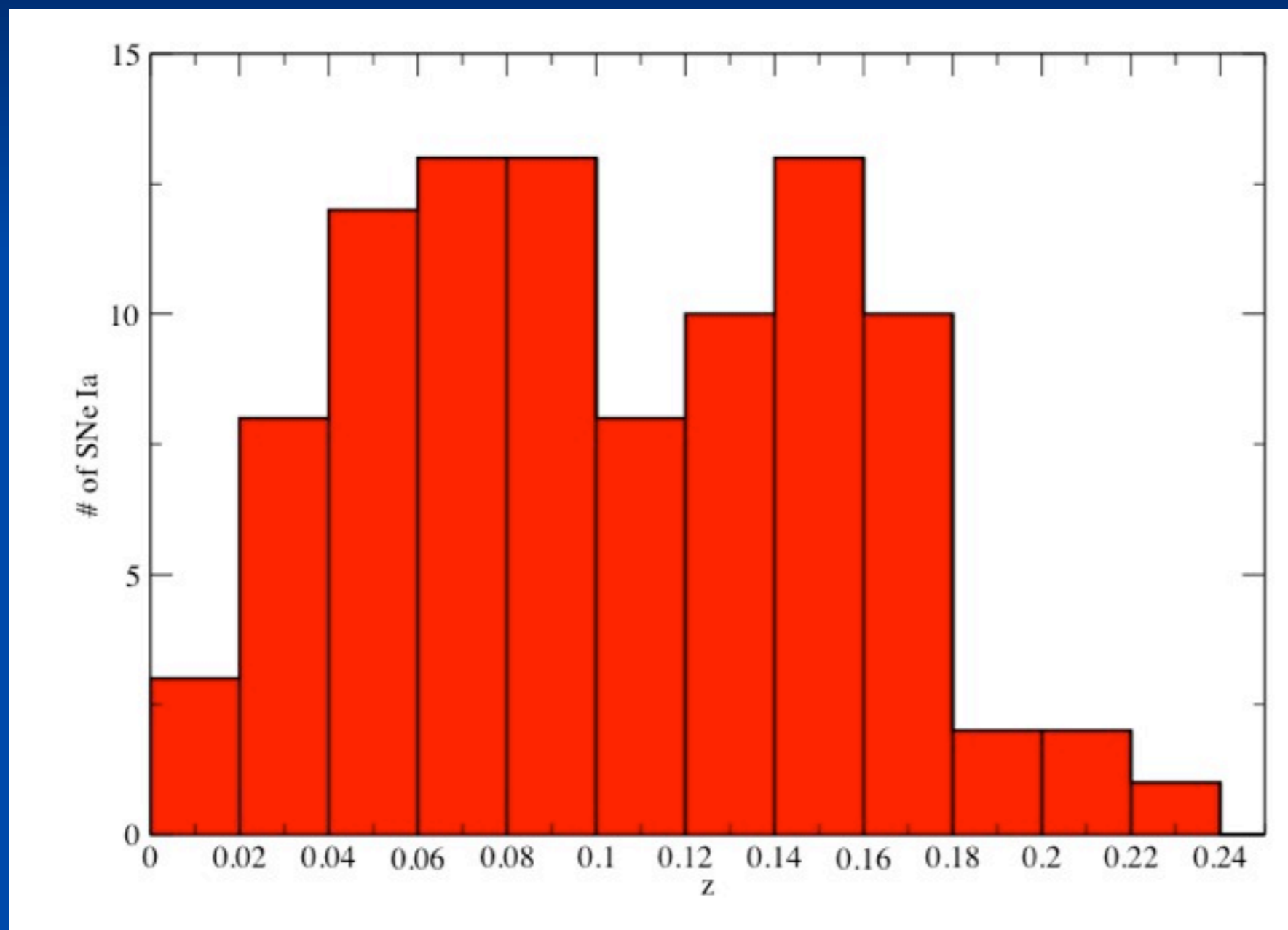


128 MB / 90s
50 GB / night

PTF Totals

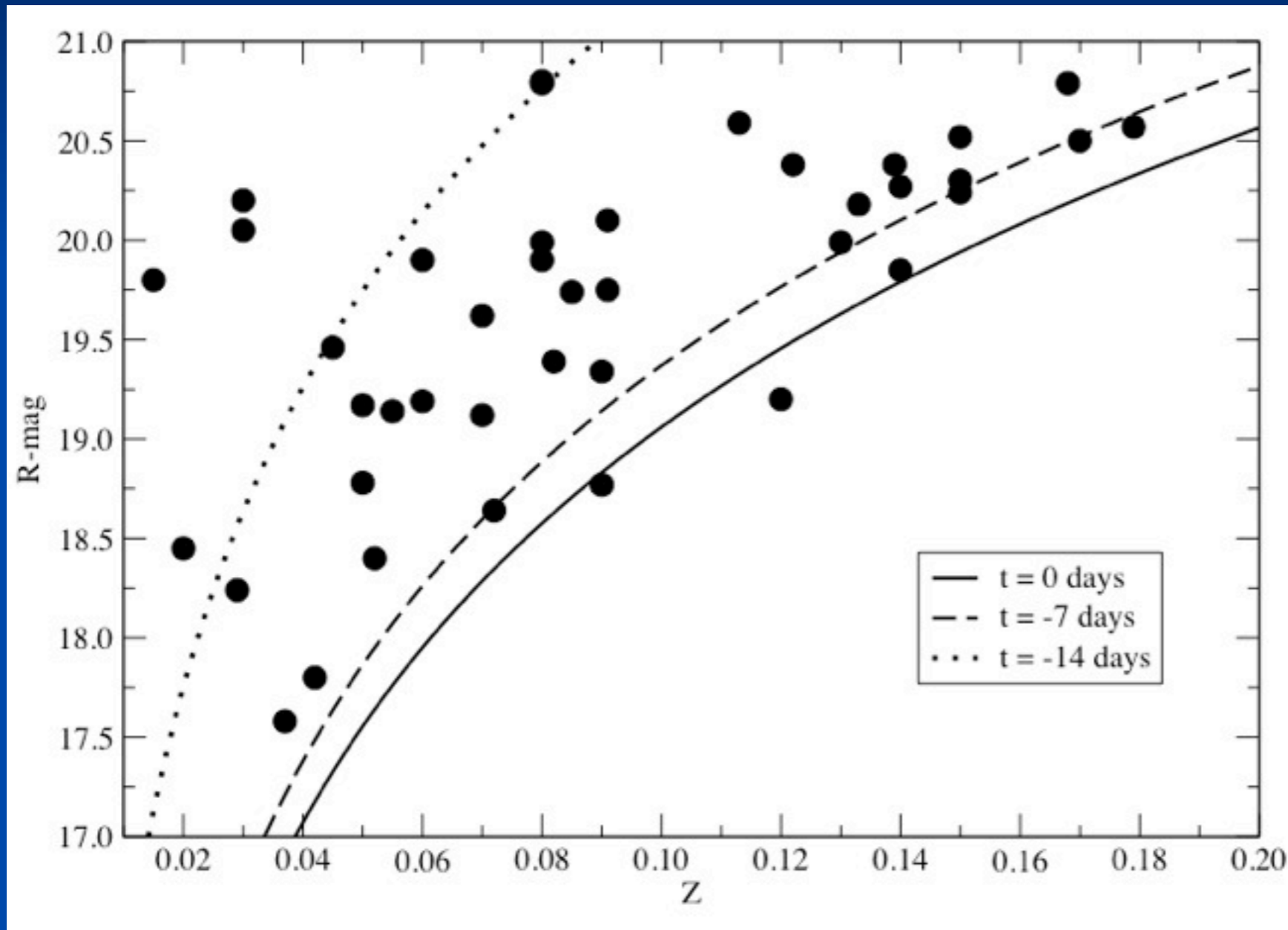


PTF SNe Ia



Redshift histogram is about what you would expect given that we want to find them early with $z < 0.1$.

PTF SNe Ia



This plot shows the brightness at max, $t=-7$ and $t=-14$ for normal SNe Ia vs. the R-mag at discovery for 40 SNe Ia found in July - August 2009. Most are caught very early.

SN Ia Program

PTF09dsy
[53.342100](#)
[-4.998677](#)

[Finding Chart](#)
[Scanning Page](#)

[Check NED](#)
[Check SIMBAD](#)
[Get DSS Image](#)
[Check Skyview](#)

SN Ia

[spectroscopic follow-up 1/1 done](#)

r = 15.8 (3.9 d)

[photometric follow-up 13/5000 done](#)

We have spectroscopically identified 305 SNe Ia since Mar. 2009. When we have rolled, we catch the SNe 2 weeks before peak brightness with $z < 0.1$ and we have found the SNe in a full range of host galaxies as shown here.

SN Ia Program

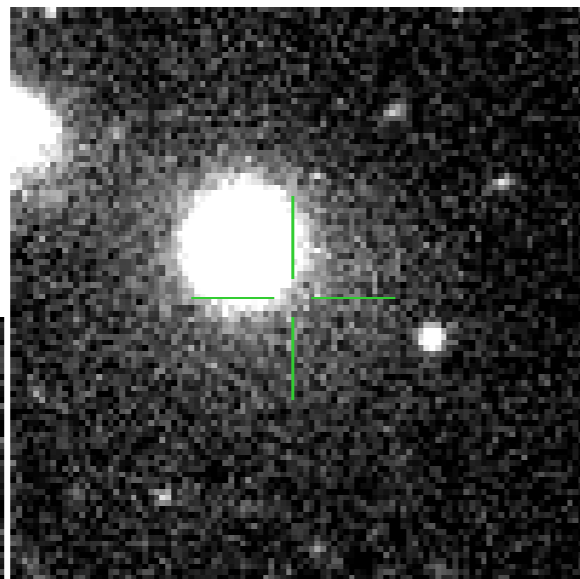
We have spectroscopically identified 305 SNe Ia since Mar. 2009. When we have rolled, we catch the SNe 2 weeks before peak brightness with $z < 0.1$ and we have found the SNe in a full range of host galaxies as shown here.

PTF09dnp

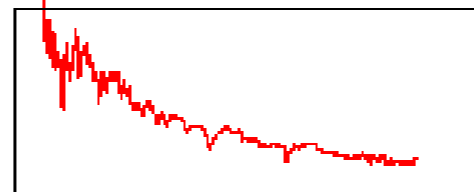
229.851529
+49.498980

Finding Chart

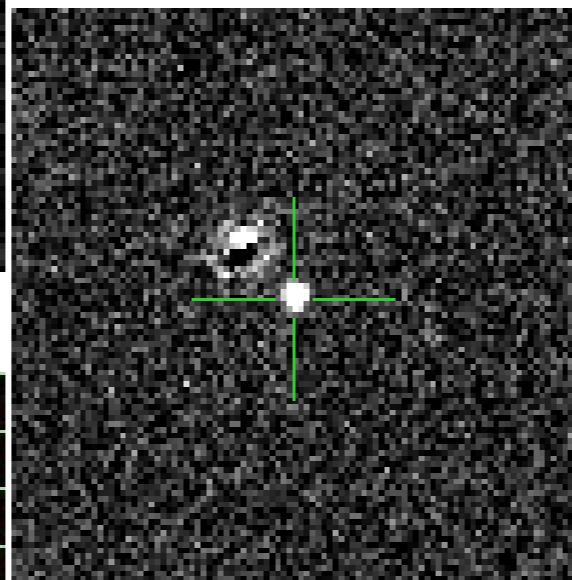
Scanning Page



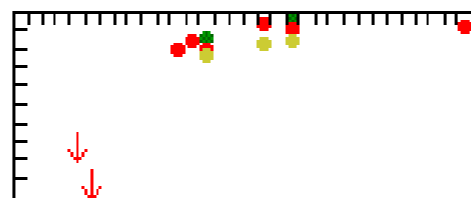
SN Ia



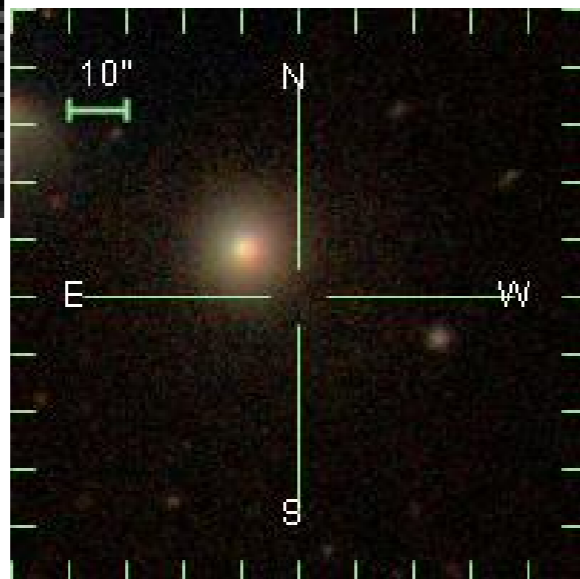
no spec fup scheduled



r = 16.9 (10.1 d)



photometric follow-up 7/3000 done



Check NED

Check SIMBAD

Get DSS Image

Check Skyview

SN Ia Program

We have spectroscopically identified 305 SNe Ia since Mar. 2009. When we have rolled, we catch the SNe 2 weeks before peak brightness with $z < 0.1$ and we have found the SNe in a full range of host galaxies as shown here.

PTF09bai

230.098128
+26.424681

[Finding Chart](#)

[Scanning Page](#)

[Check NED](#)

[Check SIMBAD](#)

[Get DSS Image](#)

[Check Skyview](#)

SN Ia +58.4d

[no spec fup scheduled](#)

$r > 20.7$ (49.0 d)

[photometric follow-up 3/3 done](#)

SN Ia Program

We have spectroscopically identified 305 SNe Ia since Mar. 2009. When we have rolled, we catch the SNe 2 weeks before peak brightness with $z < 0.1$ and we have found the SNe in a full range of host galaxies as shown here.

PTF09awt

236.761734
+40.689086

[Finding Chart](#)

[Scanning Page](#)

[Check NED](#)

[Check SIMBAD](#)

[Get DSS Image](#)

[Check Skyview](#)

SN Ia +63.4d

[no spec fup scheduled](#)

r = 19.1 (36.1 d)

[photometric follow-up 5/3 done](#)

HST UV Program

7 Incredibly early Type Ia supernovae sent to the Hubble Space telescope.

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3 New Supernova Discoveries/Classifications

ATel #2174; [Peter Nugent \(Lawrence Berkeley National Laboratory\)](#), [Mark Sullivan \(University of Oxford\)](#) & [D. Andrew Howell \(LCOGT\)](#)
 on 25 Aug 2009; 12:48 UT
 Distributed as an Instant Email Notice (Supernovae)
 Password Certification: Peter Nugent (penugent@lbl.gov)

Subjects: Optical, Request for Observations

The Type Ia supernova science working group of the Palomar Transient Factory (ATel #1964) reports the discovery of three nearby supernova. Confirmation spectra were carried out using the Palomar Hale telescope on a classification of the spectra were carried out using Superfit quite young, STIS/UV spectroscopic observations on the the ToO program "Verifying the Utility of Type Ia Supernovae and Dispersion in the Ultraviolet Spectra" (PI: R. Ellis) follow-up of these sources at all wavelengths.

Name	RA	Dec
PTF09dn1	17:23:41.804	+30:29:49.5
PTF09dlc	21:46:30.103	+06:25:09.2
PTF09dnp	15:19:24.432	+49:29:56.4

- Related**
- 2174 [3 New Supernova Discoveries/Classifications](#)
 - 2067 [Erratum to ATel#2055](#)
 - 2055 [Palomar Transient Factory : Discovery, Photometric and Spectroscopic Follow Up Of Fifteen Optical Transients](#)
 - 2043 [Confirmation of CRTS Supernovae](#)
 - 2037 [Palomar Transient Factory Discovers a Possible super-Chandrasekhar Type Ia Supernova](#)
 - 2009 [Confirmation of CRTS Supernovae in Intrinsically Faint Galaxies](#)

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2 New Supernova Discoveries/Classifications

ATel #2255; [Peter Nugent \(Lawrence Berkeley National Laboratory\)](#), [Mark Sullivan \(University of Oxford\)](#) & [D. Andrew Howell \(LCOGT/UCSB\)](#)
 on 23 Oct 2009; 22:44 UT
 Distributed as an Instant Email Notice (Supernovae)
 Password Certification: Peter Nugent (penugent@lbl.gov)

Subjects: Optical, Ultra-Violet, Novae, Supernovae

The Type Ia supernova science working group of the Palomar Transient Factory (ATEL#2174) reports the discovery of two nearby supernova, PTF09fox and PTF09foz. Confirmation spectra were taken with DEIMOS on the Keck II telescope by K. Chiu and with GMOS on the Gemini-South telescope by D.A. Howell on October 21 UT, respectively. Classification of the spectra were carried out using Superfit (Howell et al. 2005). As both supernovae are prior to maximum light, STIS/UV spectroscopic observations on the Hubble Space Telescope were triggered by the ToO program "Verifying the Utility of Type Ia Supernovae as Cosmological Probes: Evolution and Dispersion in the Ultraviolet Spectra" (PI: R. Ellis). We strongly encourage additional follow-up of these sources at all wavelengths.

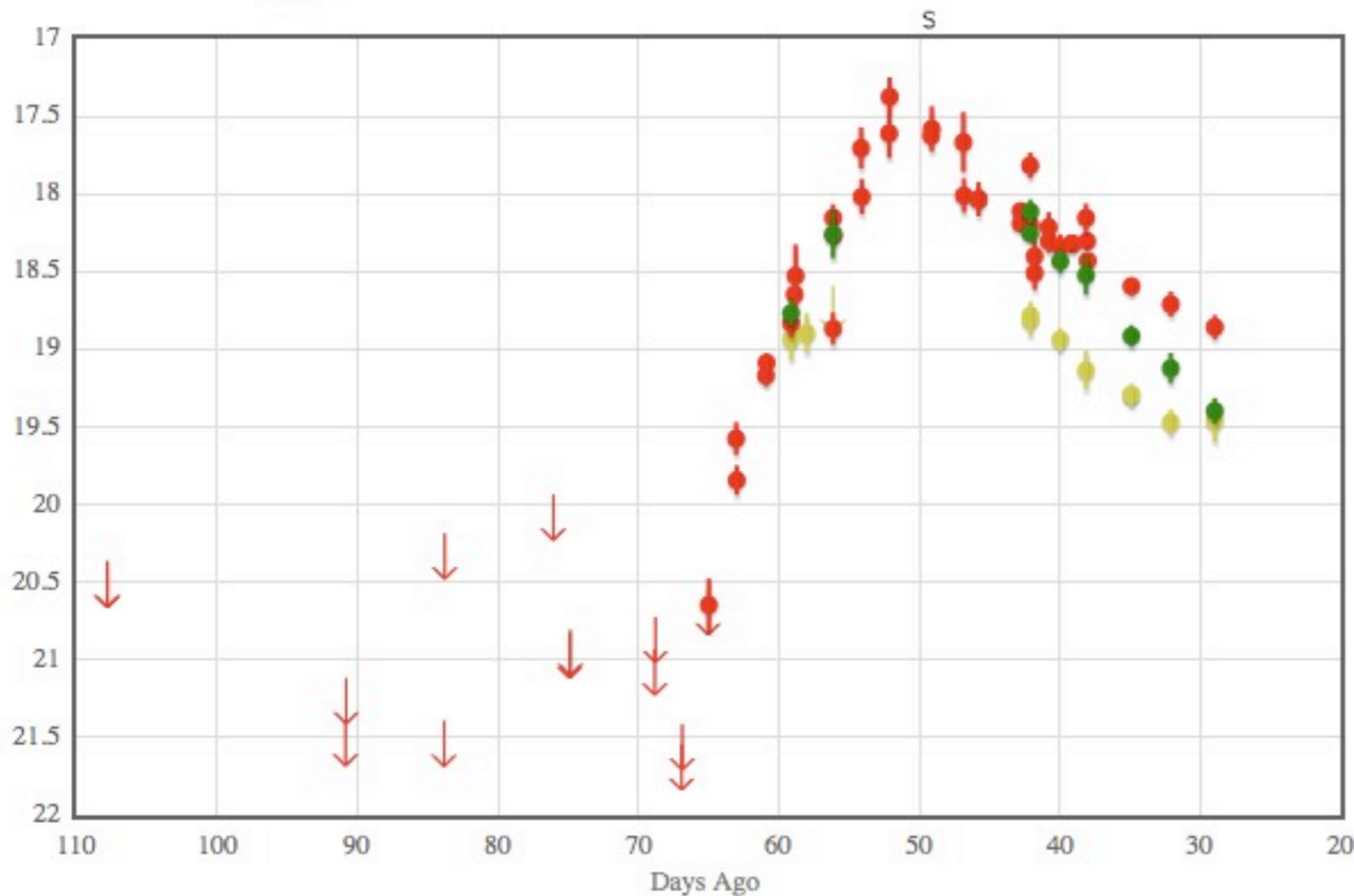
Name	RA	Dec	z	phase	disc	mag (R-band)
PTF09fox	23:20:48.009	+32:30:08.60	0.07	-7	Oct 19.6	18.8
PTF09foz	00:42:11.719	-09:52:52.47	0.05	-8	Oct 19.8	18.8

- Related**
- 2255 [2 New Supernova Discoveries/Classifications](#)
 - 2174 [3 New Supernova Discoveries/Classifications](#)
 - 2055 [Palomar Transient Factory : Discovery, Photometric and Spectroscopic Follow Up Of Fifteen Optical Transients](#)
 - 2037 [Palomar Transient Factory Discovers a Possible super-Chandrasekhar Type Ia Supernova](#)
 - 2005 [Palomar Transient Factory: Discovery and Follow-Up of 25 Transients](#)
 - 1983 [Palomar Transient Factory Discovers and Classifies Eleven Optical Transients](#)
 - 1964 [Supernova Discovery from the Palomar Transient Factory](#)



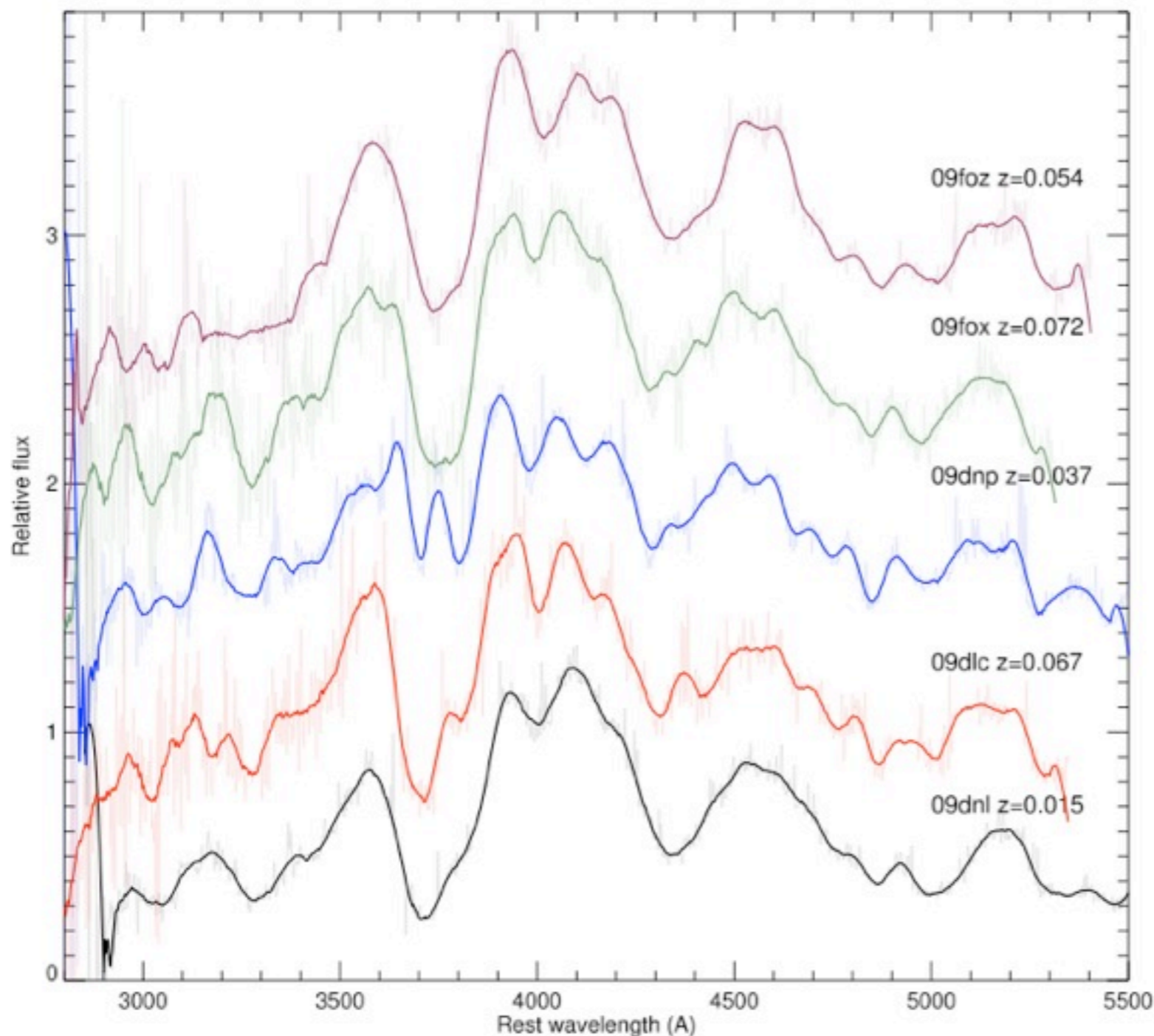
HST UV Program

Light Curve for PTF 10duz



During the dynamic cadence mode (30% of the time) we can find the SNe within a couple of days after explosion.

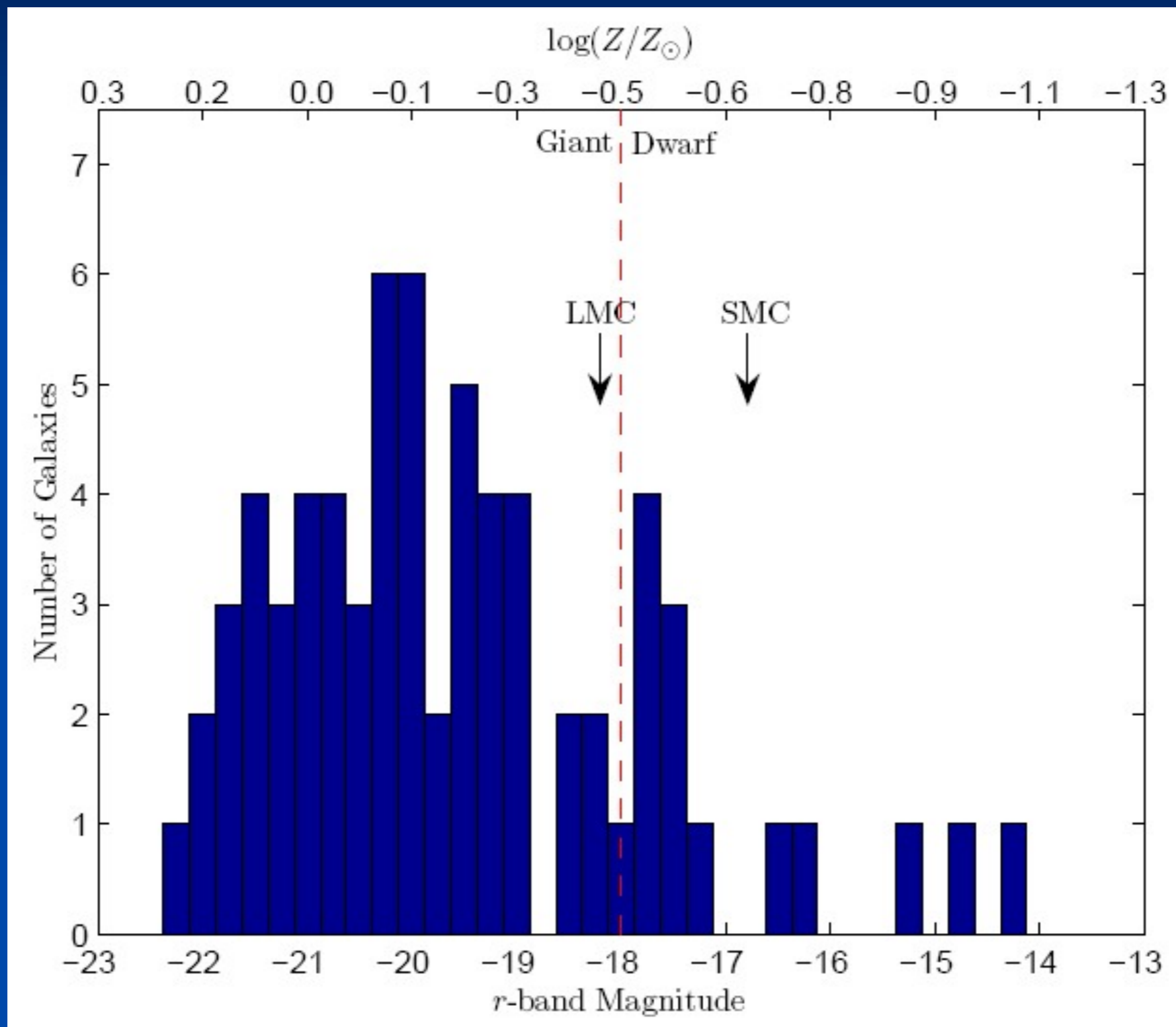
HST UV Program



7 Incredibly early Type Ia supernovae sent to the Hubble Space telescope. Must find them by *Thursday* morning with $t=-11$ to get them to HST by maximum light.

All within 2 days of peak when HST observed them with STIS.

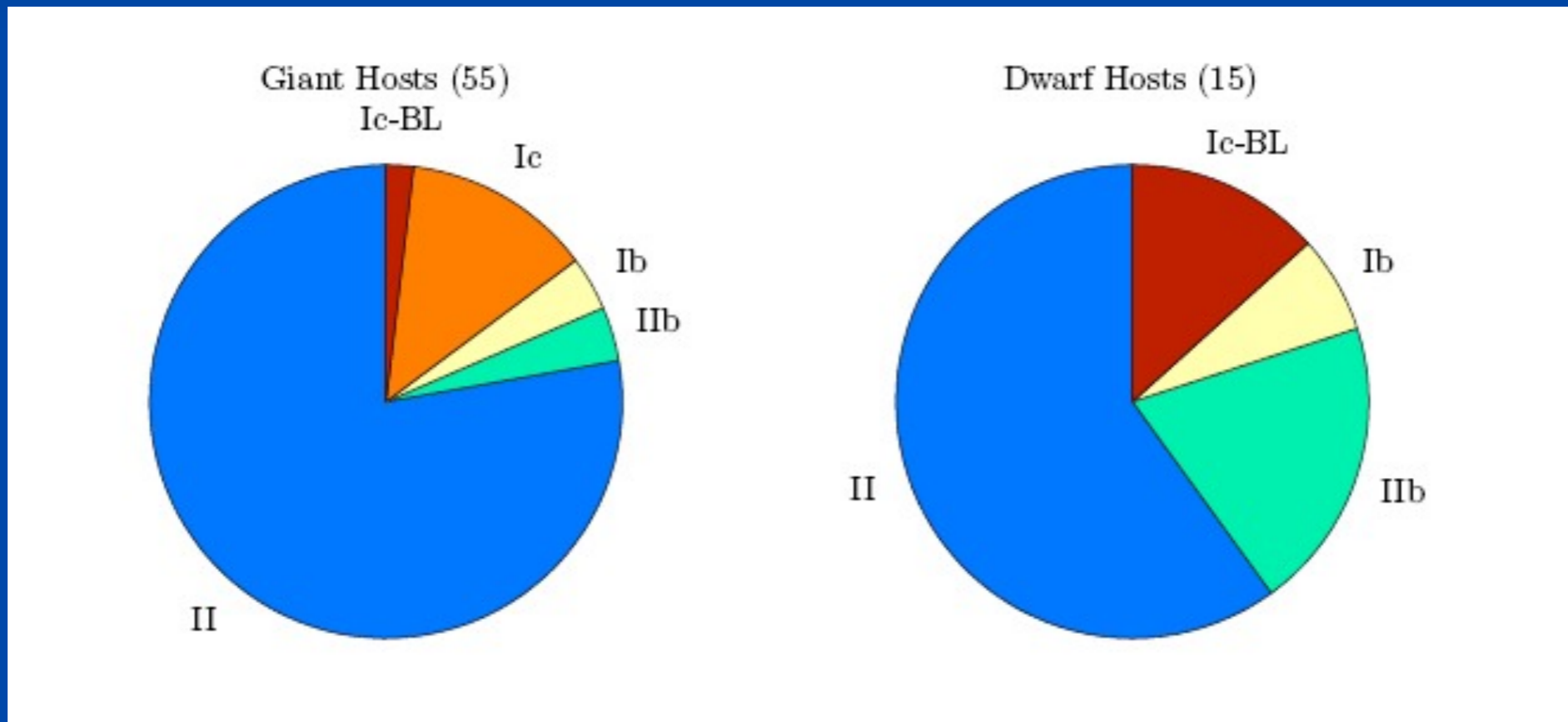
Lots of CC SNe in dwarf-galaxy



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CC SNe in dwarf galaxies ARE different

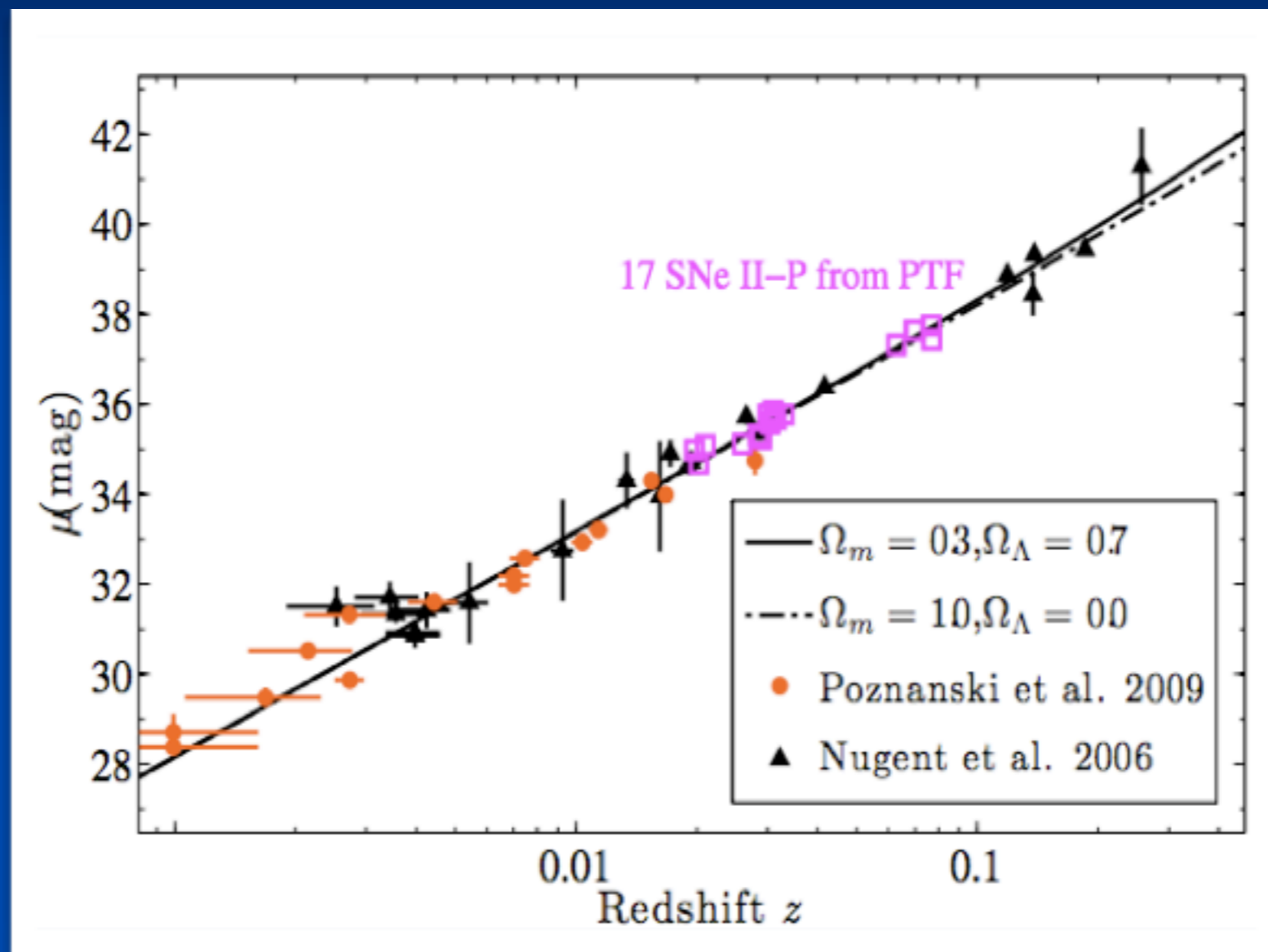
Despite small number statistics:



SNe in dwarf galaxies ARE different

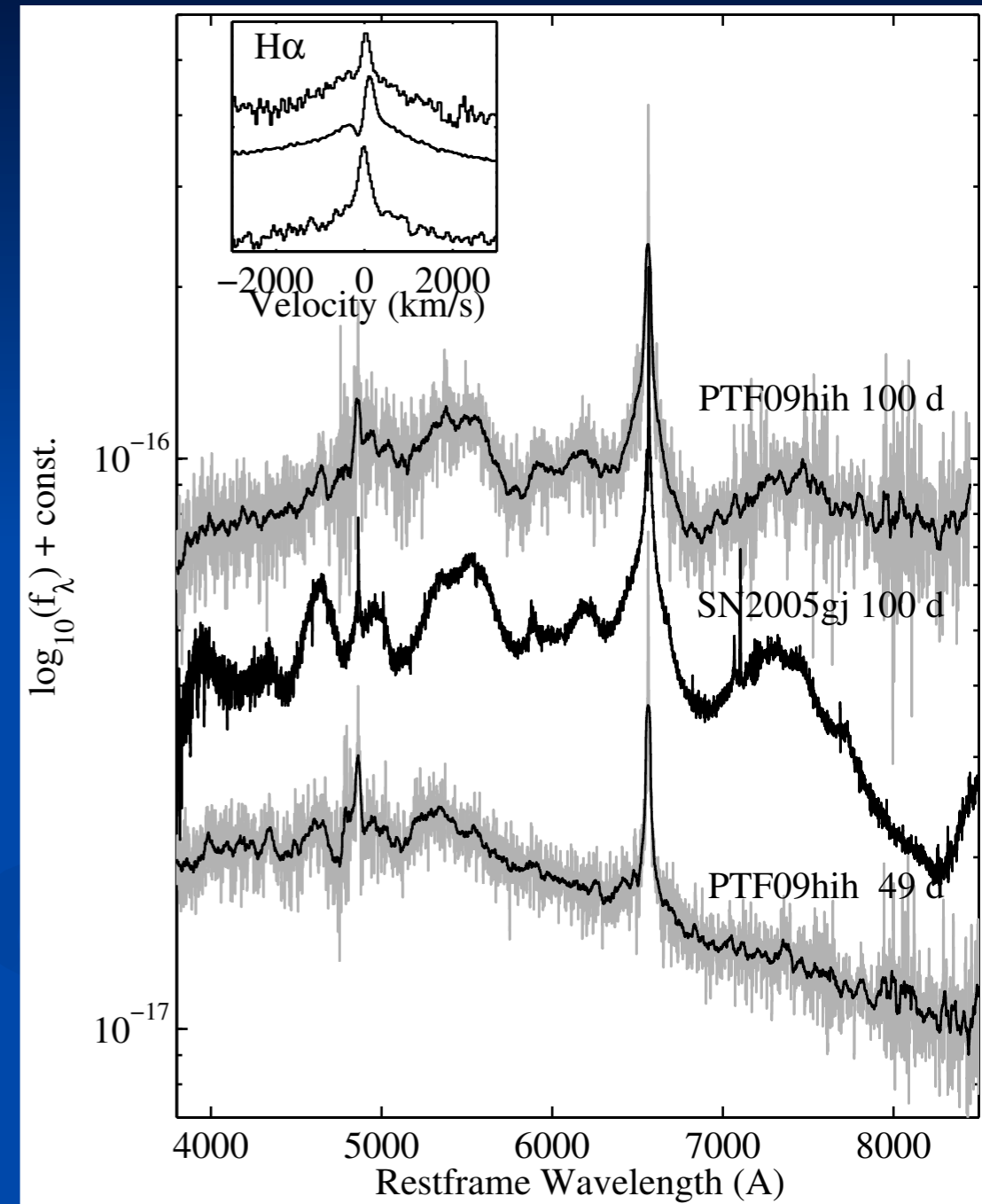
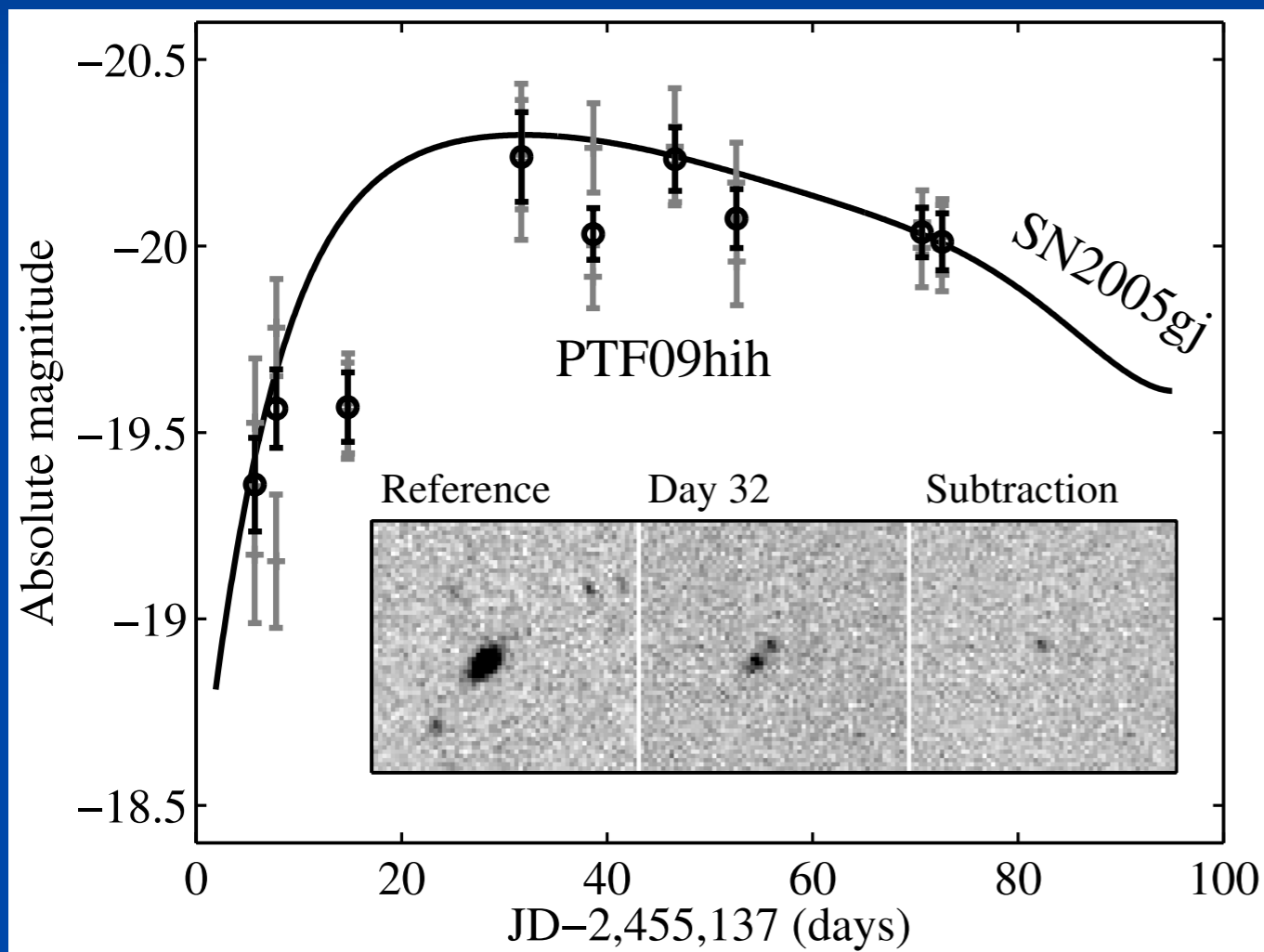
- No “regular” SNe Ic in dwarfs
- Excess of SNe Ic-BL and SNe IIb in dwarfs (> 95% significance)
- Where are all the II's?

IIP Cosmology

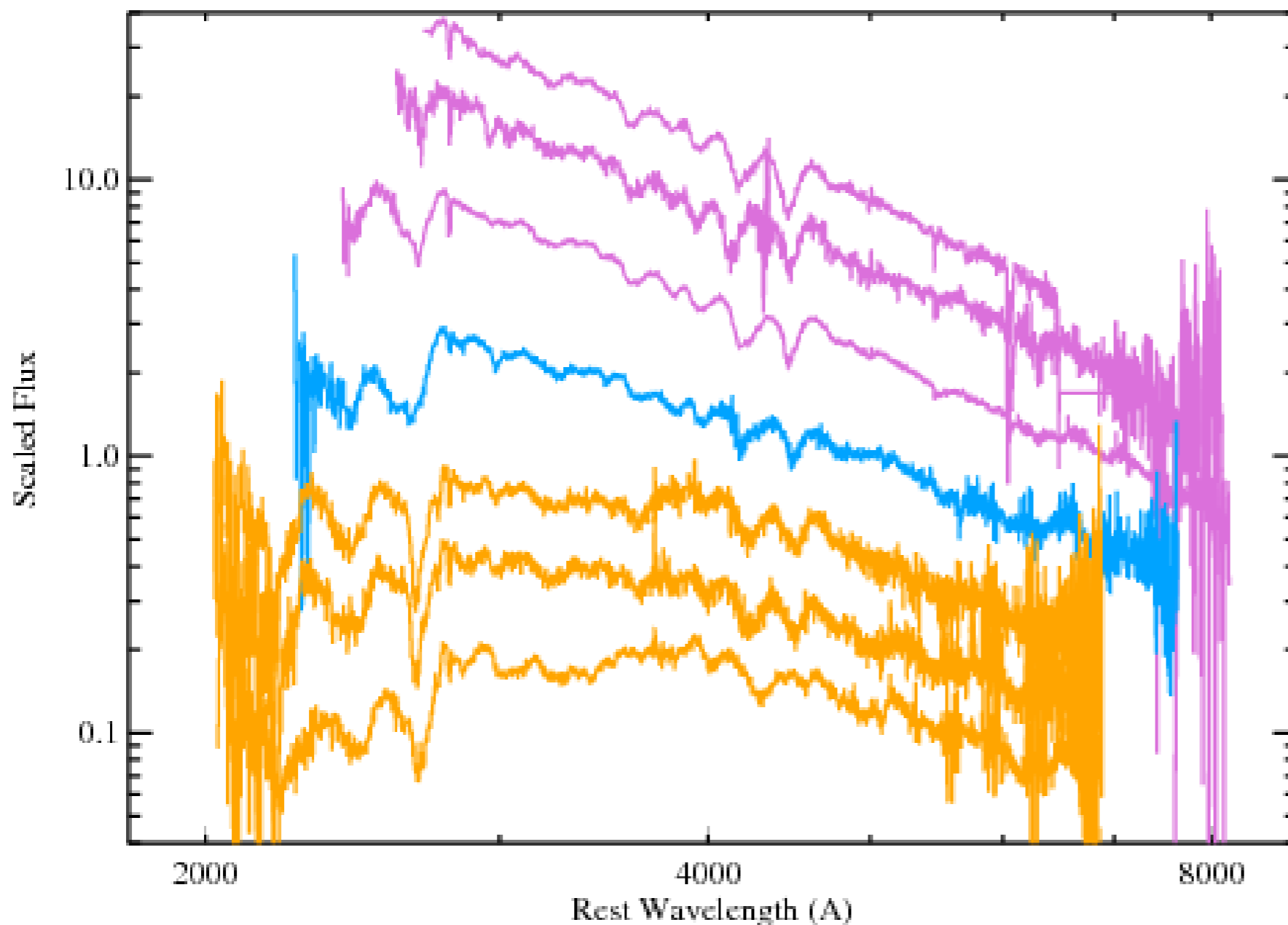


- Photometry - piggy-back on core-collapse project.
- Spectroscopy - dedicated time with Keck + proposed Gemini + random.

PTF09hih - 2002ic/ 2005gj analog



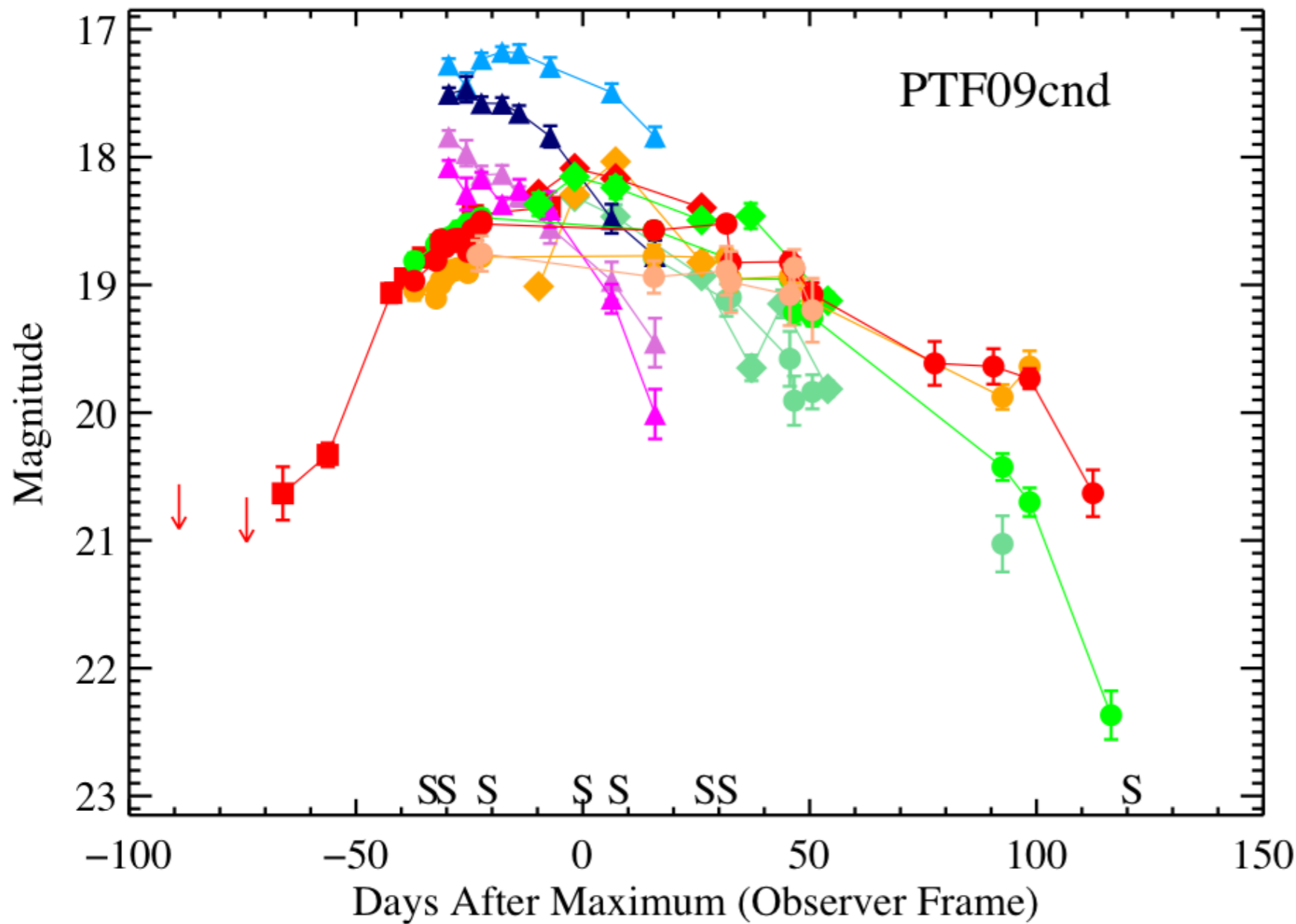
The Bright!



Spectra of the PTF LSNe. From top to bottom: PTF09cnd, PTF09cwl, PTF09atu. In each group, the spectra are shown in phase order, earliest to latest (top to bottom).

The absorption features can be fit by SYNAPPS and are shown to be OII, CaII, Mg II and possibly SiIII.

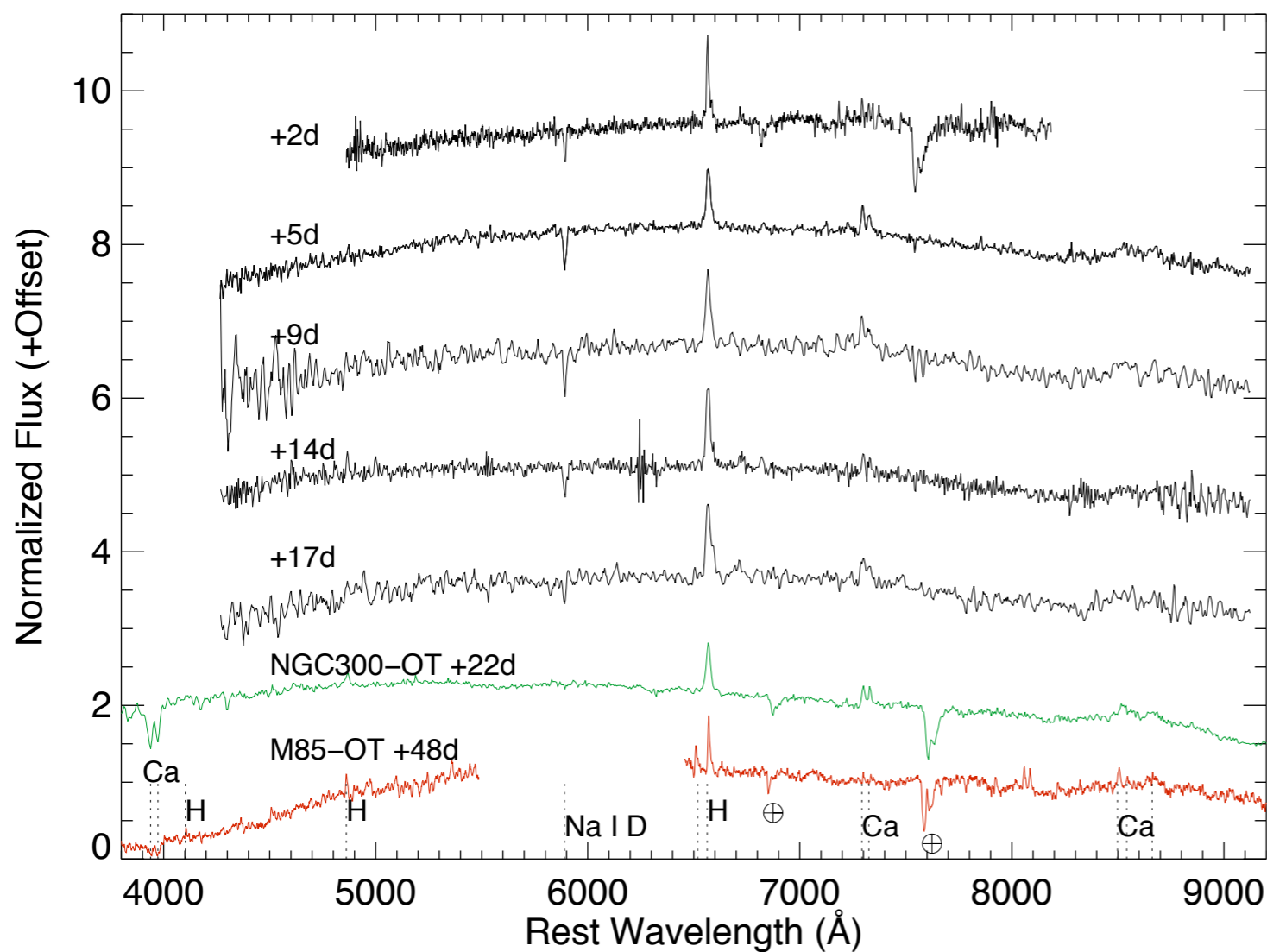
The Bright!



Light curve of PTF09cnd, the best observed of the three and the only one with Swift light curves. From roughly top to bottom: U (sky blue), UVW1 (navy blue), UVM2 (orchid), UVW2 (magenta), g (green), R (red), r (red), B (aqua), I (orange), z (beige).

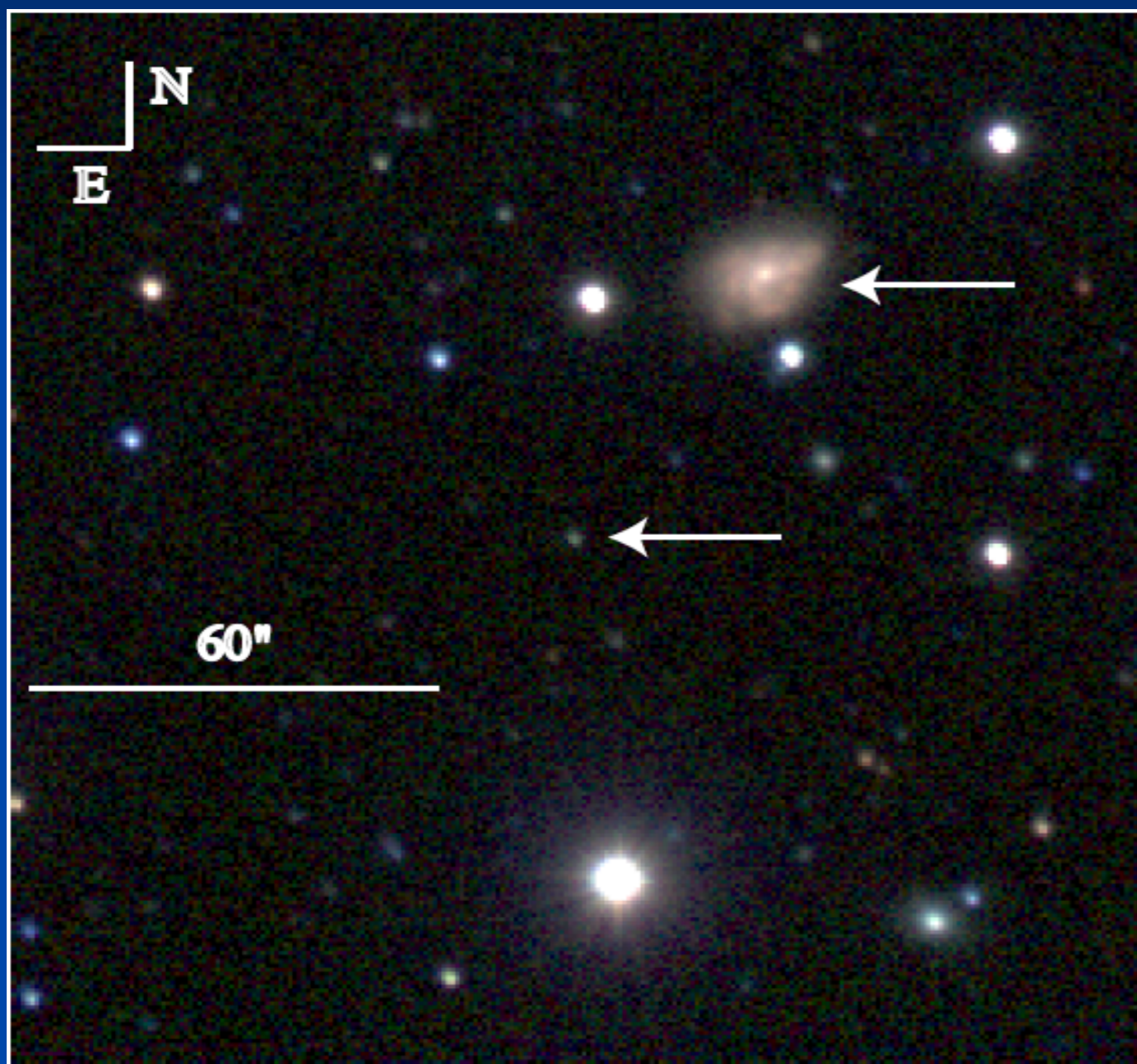
Given its redshift, it peaks at $V=-23$ and stays within a factor of 2 of this for almost 100 days!!!

The faint I... 09fqs



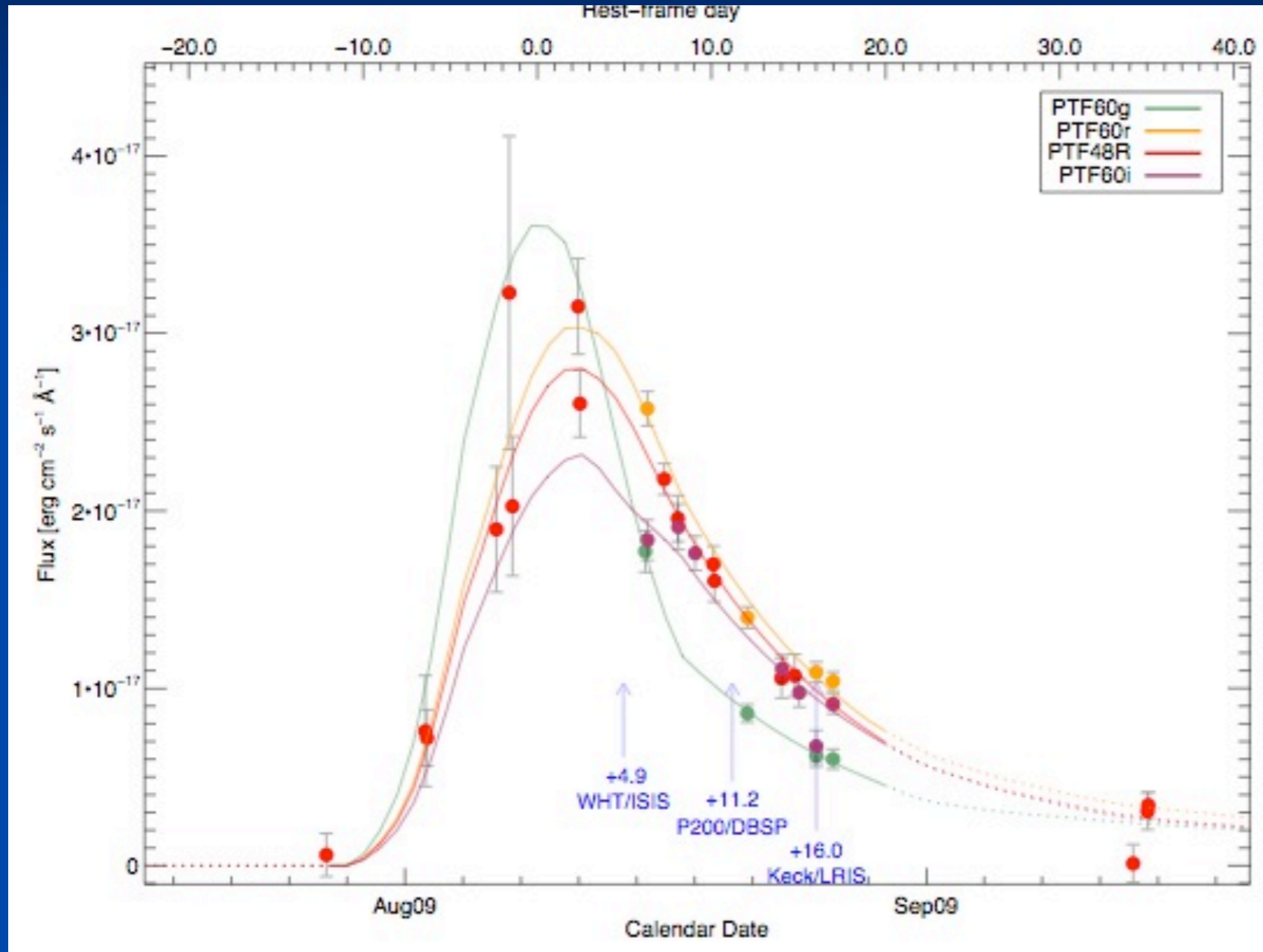
Similar to various optical transients discovered recently

The faint II... 09dav



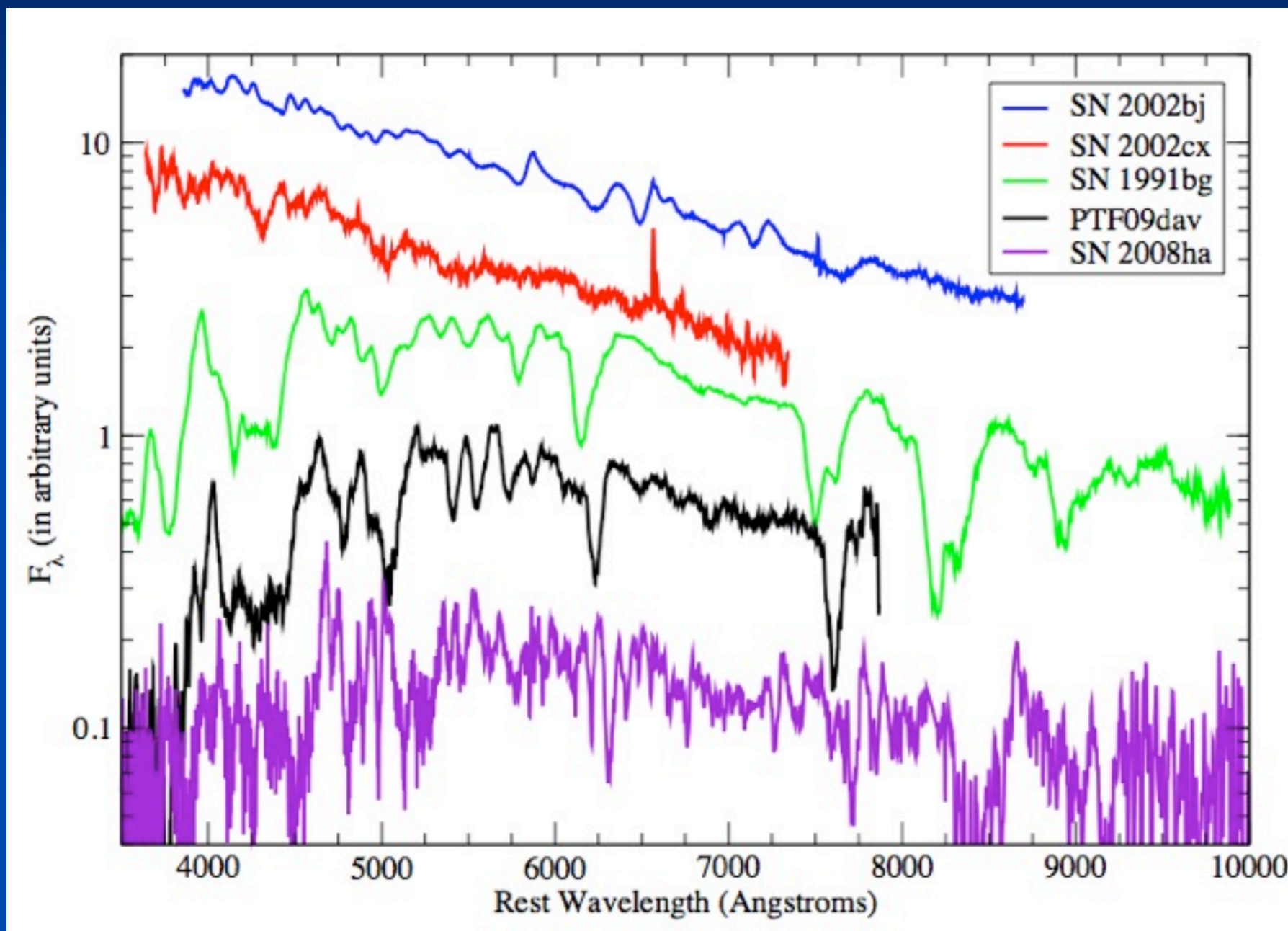
PTF09dav was found 40 kpc away from the nearest potential host galaxy. There is nothing at the position of the SN to $R=-13$ given its redshift.

The faint II... 09dav



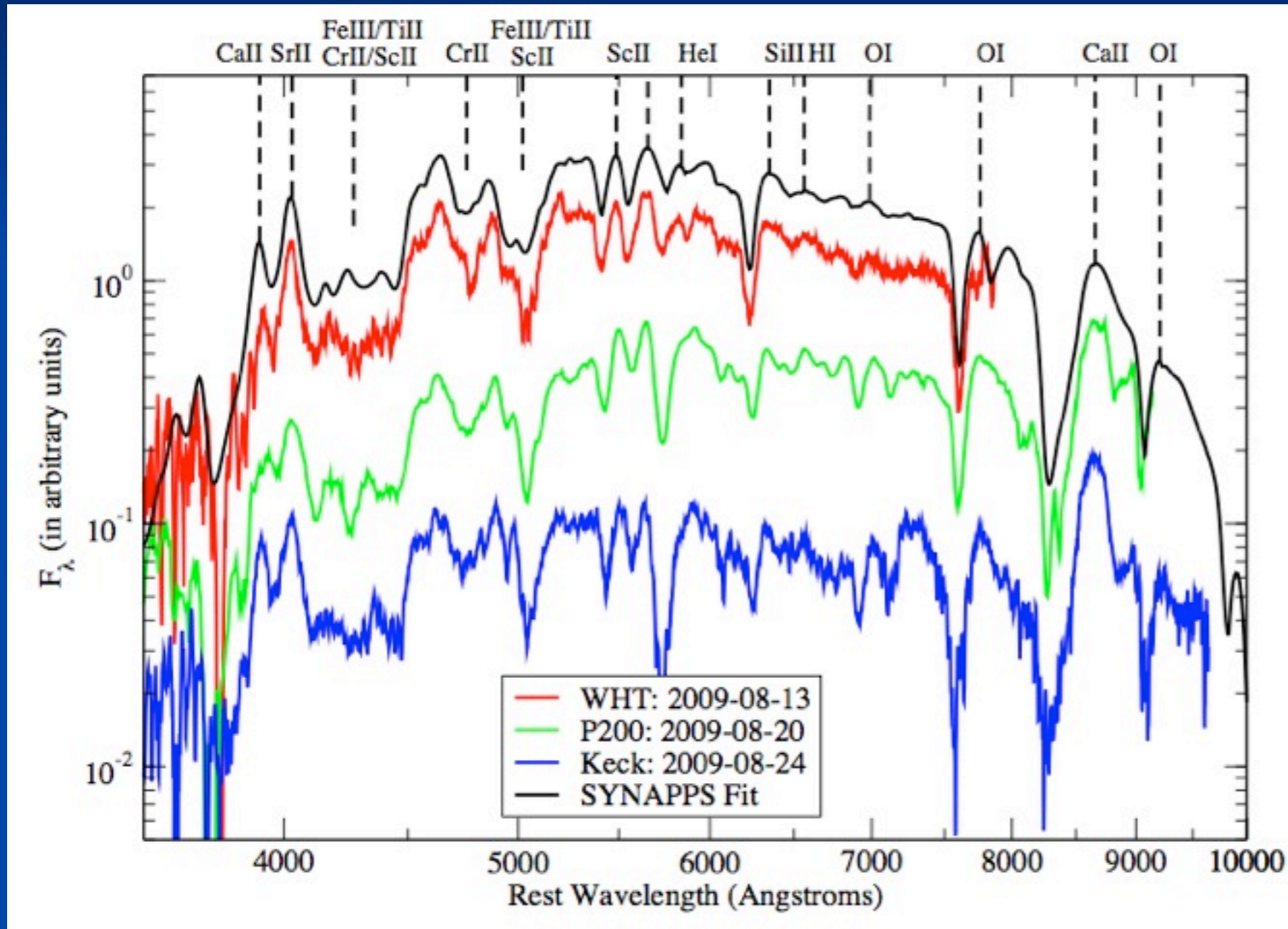
PTF09dav peaks at $R=-15.7$, 6 times fainter than the most subluminescent SN Ia, and its width was 3/4 smaller than SN 1991bg.

The faint II... 09day



The spectrum is most similar to subluminous SNe Ia and does not compare well with other faint/fast SNe.

The faint II... 09day



The SYNAPPS fit positively identifies Sc, which has not been observed in Type I SNe to date. This is the “W” feature near ~5500 Ang, *not* SII. Velocities go from 6,000 to 5,000 km/s over the 3 epochs of spectra.