BigBOSS Workshop: Transients

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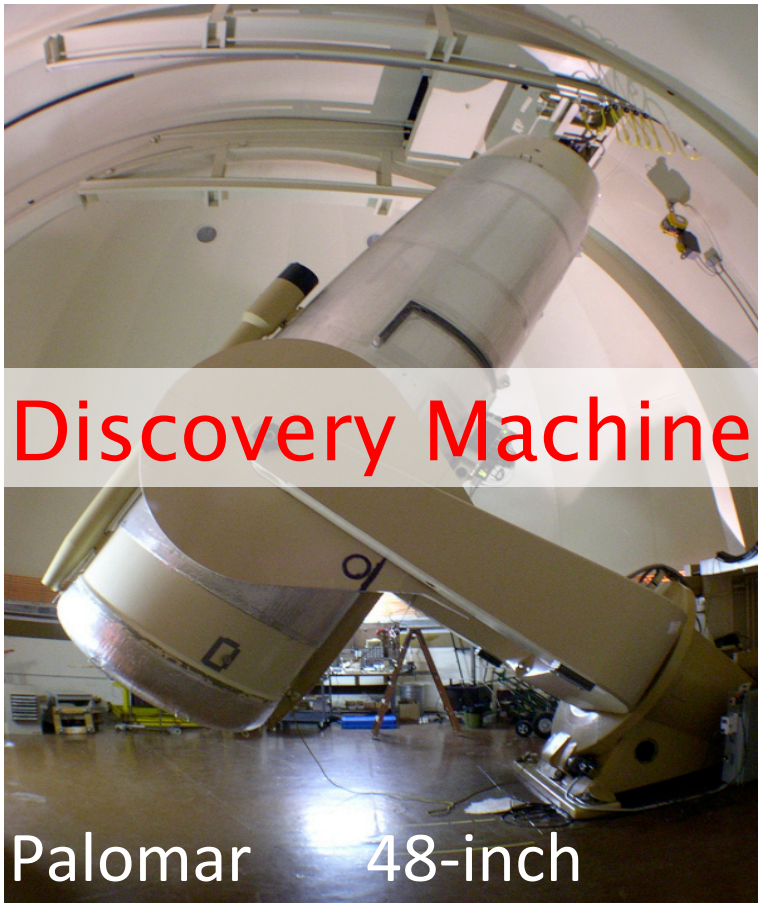
On behalf of the Palomar Transient Factory
September 13, 2011

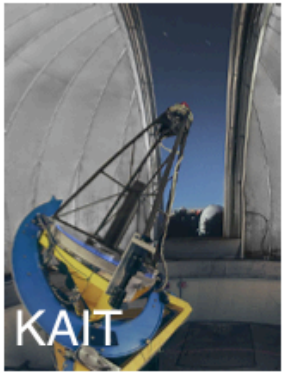
Palomar Transient Factory

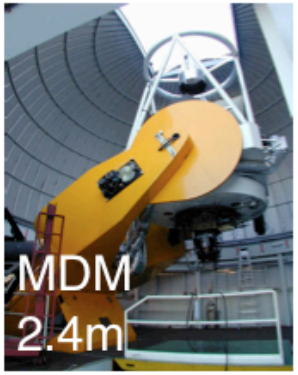
A wide-angle, high cadence survey dedicated to systematically chart the transient sky.

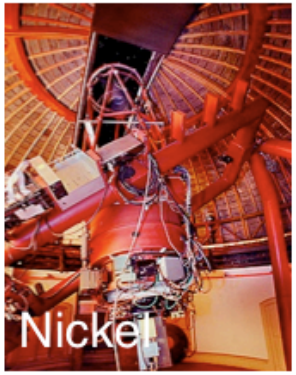


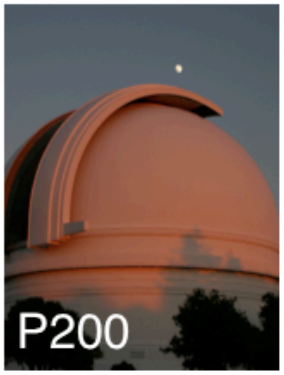
Discovery Machine + Classification Engine

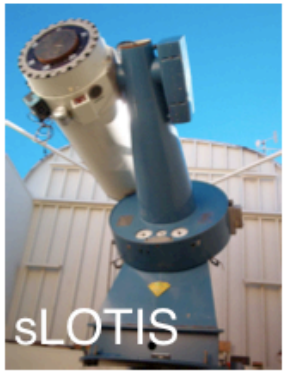
PTF follow-up telescopes



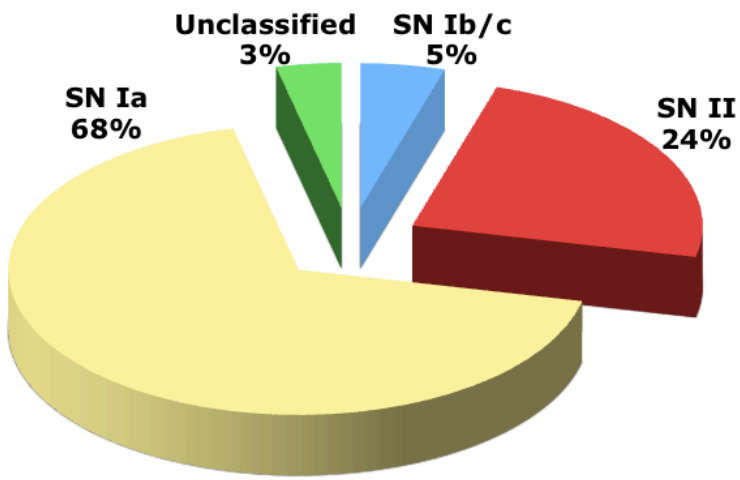








Spectroscopy is Currency: 1296 Transients + 30 Papers

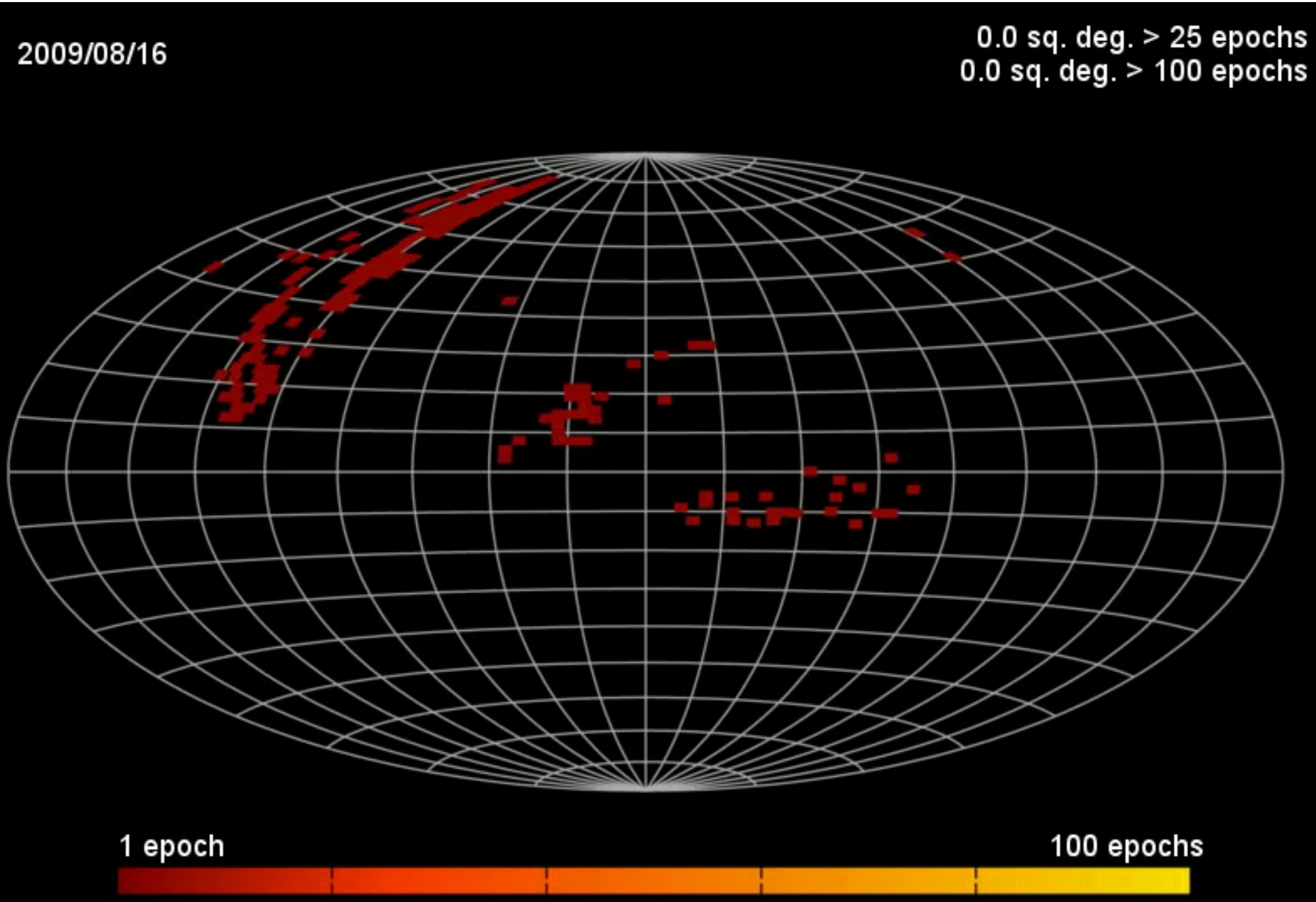


1296 Spectroscopically Confirmed Extagalactic PTF Transients

18. The Palomar Transient Factory: System Overview, Performance and First Results (PASP)
19. Exploring the Optical Transient Sky with the Palomar Transient Factory (PASP)
20. The 12Kx8K CCD mosaic camera for the Palomar Transient Factory (SPIE)

And 10 more….

1. PTF11eon/SN2011dh: Discovery of a Type IIb Supernova from a Compact Progenitor in the Nearby Galaxy M51 (ApJL)
2. The Subluminous and Peculiar Type Ia Supernova PTF 09dav;
3. An extremely luminous panchromatic outburst from the nucleus of a distant galaxy (ApJ)
4. PTF10iya: A short-lived, luminous flare from the nuclear region of a star-forming galaxy (MNRAS)
5. PTF 10bzf (SN 2010ah): a broad-line Ic supernova discovered by the Palomar Transient Factory (ApJ)
6. Real-Time Detection and Rapid Multiwavelength Follow-up Observations of a Highly Subluminous Type II-P Supernova from the Palomar Transient Factory Survey (ApJL)
7. The Extreme Hosts of Extreme Supernovae (ApJ)
8. Evidence for an FU Orionis Outburst from a Classical T Tauri Star (ApJ)
9. PTF10nvg: An Outbursting Class I Protostar in the Pelican/North American Nebula (AJ)
10. Hubble Space Telescope Studies of Nearby Type Ia Supernovae: The Mean Maximum Light Ultraviolet Spectrum and its Dispersions (ApJ)
11. Galaxy Zoo Supernovae (MNRAS)
12. Rapidly Decaying Supernova 2010X: A Candidate ".Ia" Explosion (ApJL)
13. Supernova PTF 09uj: A Possible Shock Breakout from a Dense Circumstellar Wind (ApJ)
14. The Palomar Transient Factory Survey Camera: 1st Year Performance and Results (SPIE)
15. PTF10fqs: A Luminous Red Nova in the Spiral Galaxy Messier 99 (ApJ)
16. Core-Collapse Supernovae from the Palomar Transient Factory: Indications for a Different Population in Dwarf Galaxies (ApJ)
17. Mysterious transients unmasked as the bright blue death throes of massive stars (Nature)


2009/08/16
0.0 sq. deg. > 25 epochs
0.0 sq. deg. > 100 epochs
1 epoch
100 epochs

Science Case for Transients

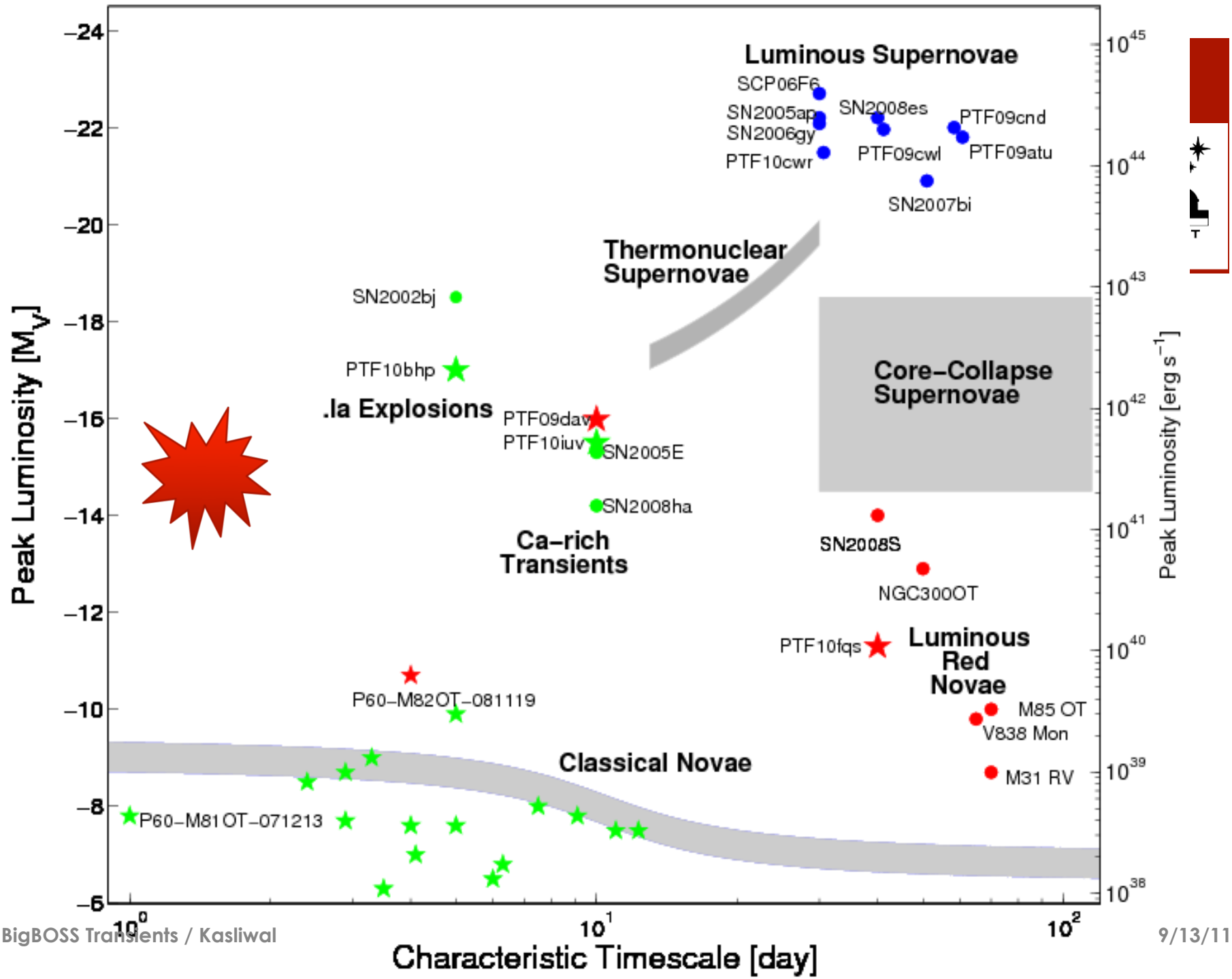
PALOMAR TRANSIENT FACTORY

I. Before the Transient
- A Nearby Galaxy Catalog – host redshifts matter

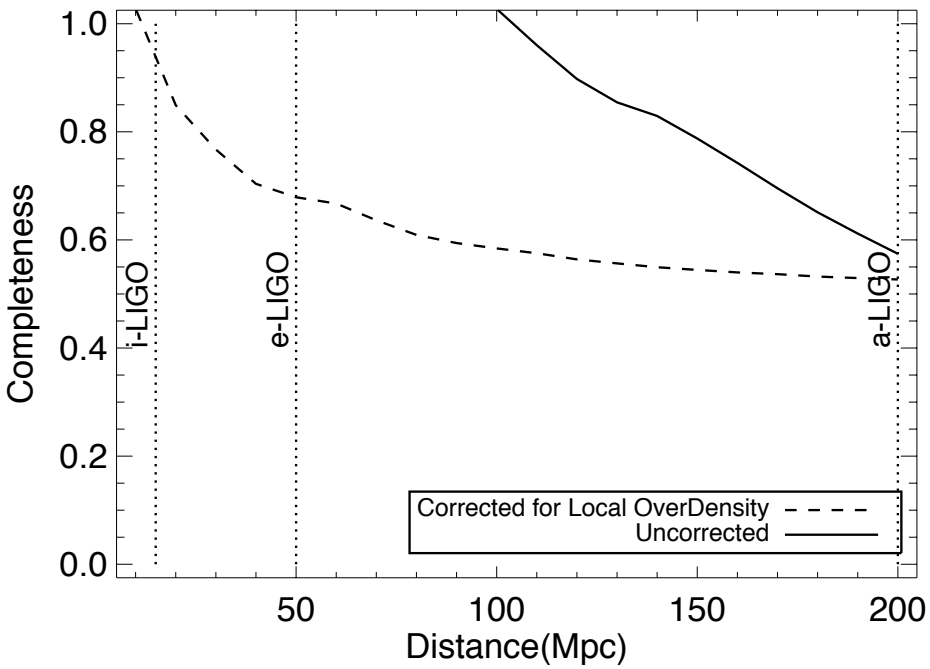
II. During the Transient
- Prompt spectroscopy – Advanced LIGO

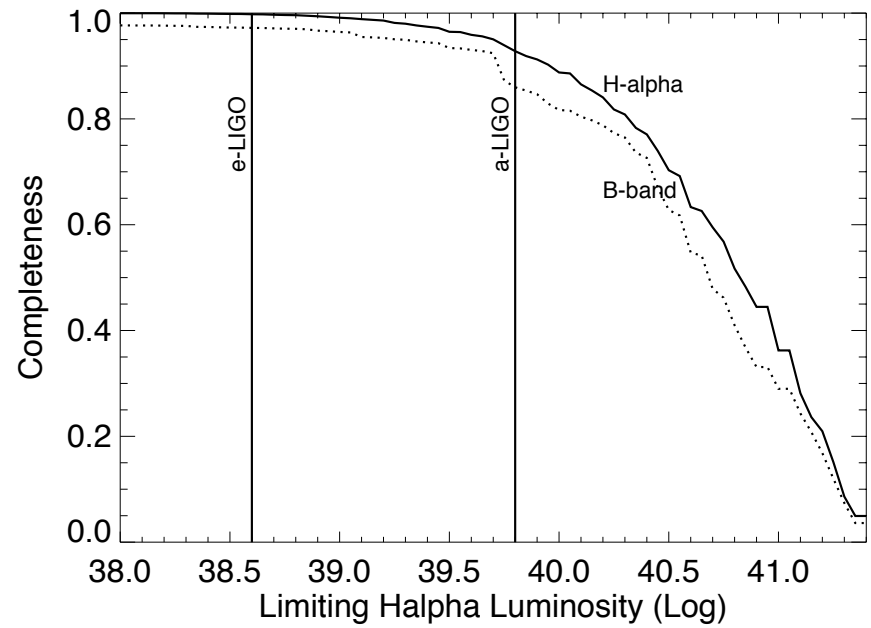
III. After the Transient: Environments, Redshifts, Quiescence
- Quasars Variability-Luminosity Relationship
- Metallicities right at the location of the event
- Galactic Variables, Strong H-alpha emitters/absorbers
- M31/M33 Variables

IV. Time-Domain Spectroscopy


Luminous Supernovae
SCP06F6
SN2005ap
SN2006gy
SN2008es
PTF09cnd
PTF10cwr
PTF09cwl
PTF09atu
SN2007bi
Thermonuclear Supernovae
SN2002bj
PTF10bhp
.Ia Explosions
PTF09dav
PTF10iuv
SN2005E
SN2008ha
Ca–rich Transients
Core–Collapse Supernovae
SN2008S
NGC300OT
PTF10fqs
Luminous Red Novae
M85 OT
V838 Mon
M31 RV
P60–M82OT–081119
Classical Novae
P60–M81OT–071213
Peak Luminosity [M_V]
Peak Luminosity [erg s^{-1}]
Characteristic Timescale [day]
−24
−22
−20
−18
−16
−14
−12
−10
−8
−6
10^{45}
10^{44}
10^{43}
10^{42}
10^{41}
10^{40}
10^{39}
10^{38}
10^{0}
10^{1}
10^{2}

I. Before the Transient: A 200Mpc Galaxy Catalog





95% complete catalog requires 300,000 galaxies i.e. limiting mag of B<20

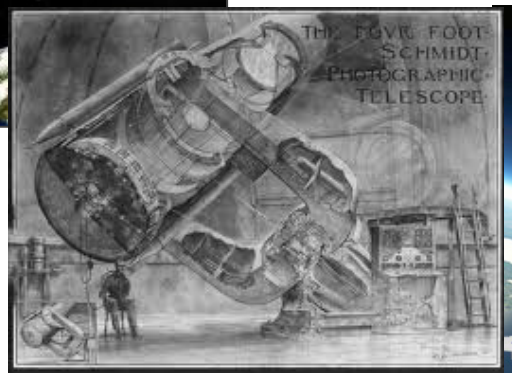
Step 1. Narrowband survey with PTF.

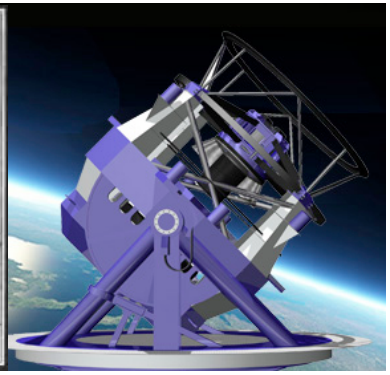
Step 2. BIGBOSS spectra of H-alpha candidates

II. During the Transient: Only where FoV is necessary

Gravity Waves, TeV Neutrinos & Gamma Rays

Optical Follow-Up





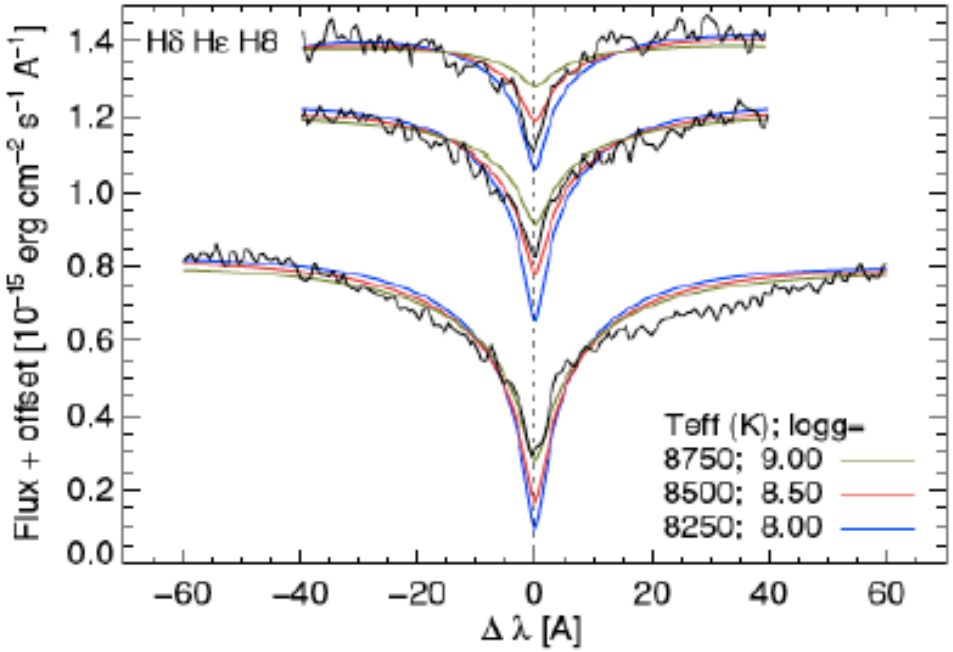
BIGBOSS & Target of Opportunity
How quickly can the fibers be re-positioned to a new field?
How flexible is the scheduling? Known footprint of fields?

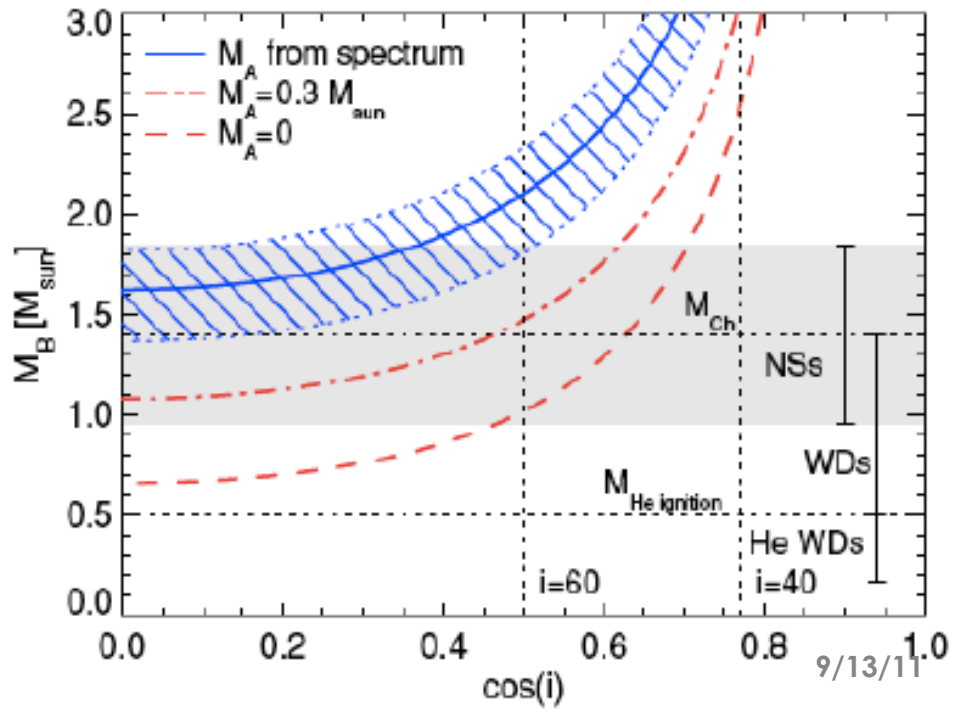
III. After the Transient: Systematic follow-up

- Quasar Variability-Luminosity Relationship
- Supernovae Host Properties esp. Metallicity
- M31 Variability Characterization & background quasars
- Galactic Variables: Systematic Follow-up
  - ~3% of sources are variable. ~50-500 per sq deg
  - Compact Binaries: ~10 per sq deg WD-dM binaries, ~1 per sq deg for Cataclysmic Variables, ~0.2 detached WD-WD binaries
  - RR Lyrae to map Galactic structure
- Strong H-alpha emitters or absorbers

IV. Time Resolved Spectroscopy

- SWARMS (Carles Badenes)
  - Backyard neutron star or black hole?
  - What is the rate of white dwarf mergers as a function of their mass?
  - Can white dwarf mergers result in Type Ia supernovae?
  - The Zoo of Compact Binaries
  - What is the binarity fraction given a stellar type?
- BIGBOSS
  - Separating and calibrating each sub-exposure
  - Cadence of sub-exposures:
    - few min, few hours, few day, few month, few years





Summary of BigBOSS requirements

PALOMAR TRANSIENT FACTORY

I. List of candidate nearby galaxies (~5-10 per field)

II. Need flexibility in scheduling and rapid pointing of fibers

III. List of known transients and variables

IV. Need proper calibration of each sub-exposure

V. Cadence of sub-exposures: minutes, hours, days, months, years

VI. Co-ordinate sky coverage of BigBOSS with that of transient surveys