Berkeley SuperNova Ia Program (BSNIP): 20 Years of Photometry and Spectroscopy of Over 500 Type Ia Supernovae

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Advisor: Alex Filippenko

GSPS
24 April 2009
Berkeley SuperNova Ia Program (BSNIP): Photometry and Spectroscopy of ~Bajillion Type Ia Supernovae

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Outline

• SN Basics: A Refresher
• Statistics & Demographics of the Sample
• SNDB - Data Management and Storage
• Past and Future Analysis of SNe Ia Spectra
• To Do List for BSNIP I
Why should we care about SNe?
(I ask myself this everyday…)

• Test models/theories of:
  – Stellar evolution
  – Massive stars
  – WDs
  – Explosion physics
  – Nucleosynthesis

• Trigger star formation.

• Disburse elements.

• Track expansion history of Universe.
Type Ia Supernova

White Dwarf

Companion Star

Transferring gas
Type II Supernova

Core of a Red Supergiant

- Iron
- Silicon, Sulfur
- Oxygen, Neon, Magnesium
- Carbon, Oxygen
- Helium
- Hydrogen
Stripped Core-Collapse Supernovae

Type II

H

He,...

Type Ib

He

C,O,...

Type Ic

C,O

O,Ne,Mg,...
SN 2001X (type II) vs. days since discovery

SN 2003fa (type Ia) vs. days since discovery
SNe Ia Light Curves

M. Ganeshalingam

LBL (http://www.lbl.gov/Science-Articles/Archive/sabl/2005/October/04-supernovae.html)
Berkeley SN Ia Program (BSNIP)

• Who?
  – Me & Foley & Thea & Cnock (spectral data and analysis)
  – Mo & Weidong (photometric data and analysis)
  – Jesse Leaman & Weidong (SN rates)
  – Postdocs (paper-writing machines)
  – Undergrads (grunt work)
  – Alex & Foley (thinking about the Big Picture)

• What?
• When?
• Where?
• Why?
BSNIP

• Who?
• What?
  – 11 years of photometry from KAIT
  – A few years of photometry from the 1m at Lick
  – 20 years of spectra from the 3m at Lick
  – 14 years of spectra from Keck
  – Consistent data reduction by a select few people
  – More info about the dataset later
• When?
• Where?
• Why?
BSNIP

• Who?
• What?
• When?
  – SN Rates: Jesse’s thesis (to be submitted soon)
  – LCs: Mo’s thesis (drafts are circulating)
  – LC Analysis: Mo’s thesis (being written)
  – Spectra: My thesis (parts written, still working)
  – Spectral Analysis: My thesis (background reading and coding have begun)
• Where?
• Why?
BSNIP

• Who?
• What?
• When?
• Where?
  – People: Mostly at Berkeley, some former Alex students at various other places.
  – Telescopes: KAIT, Lick 1m, Lick 3m, Keck, HST, IUE
  – SNe: IN SPACE!!!!!!
• Why?
BSNIP

• Who?
• What?
• When?
• Where?
• Why?
  – A great, self-consistent, huge dataset of SNe Ia photometry and spectroscopy.
  – The data should go public!
  – We will be able to do statistically significant analysis of SNe Ia progenitors, hosts, nucleosynthesis yields, cosmology, other sciencey stuff.
Statistics & Demographics

- 1457 spectra of 597 objects
- Average 2.4 spectra/object (median 1.0)
Redshifts

Mean: 0.0249
Min: 0.00149
Median: 0.0219
Max: 0.0949
Ages

- Mean age 31.9 day (median 15.9)
- 27 older than 180 days past max
- **125 spectra within 3 days of max**
Spectra AND Photometry

- 933 spectra of 293 objects with a Date of Max.
- 852 spectra of 251 objects with a full set of LC parameters (and can thus be used for cosmology).
Random Stats

• Average wavelength range: 3400-10000 Å
  – This is wider than most other groups’ SNe Ia spectra

• Alex has observed 337 nights for this project (over 22 yrs → 15.3 nights/yr)
  – I’ve done 57 nights (over 3.5 yrs → 16.3 nights/yr)
Data Management & Storage

• We have a lot of data. :-)  
• It was very unorganized before I came to town. :-/
• I organized it. :-)  
• It was hard and took a lot of time and effort. :-(  
• Now the data is organized! :-D
SN Database (SNDB)

- Uses the popular open-source software stack known as LAMP:
  - Linux OS
  - Apache webserver
  - MySQL relational database management system
  - PHP server-side scripting language

- Lives on the hercules computer in Campbell

- Ways to access the SNDB:
  - Terminal
  - PHPMyAdmin
  - My nifty search pages (public and private)
past and future analysis of SNe Ia spectra

Hachinger, et al. 2006
past and future analysis of SNe Ia spectra

Hachinger, et al. 2006
To Do List for BSNIP I

- Finish Reducing Data - Thea, Cnock
- Missing/Wrong Data in SNDB - Me, UGs
- Host galaxy redshifts - Thea
- Host galaxy photometry - Mo, Foley
- Filtered LCs - Mo
- Unfiltered LCs - Me, Mo, Xiaofeng, Robin Mostardi
- Spectrophotometry - Me, Mo, Foley, Thea
- Classification - Me, Foley
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To Do List for BSNIP I

• Make a table of spectral information for each object - Me
• Make a shload of plots of spectra and statistics/demographics - Me
• Do a tiny bit of analysis - Me, Foley
• Write paper (without tipping our hat) - Me, Foley

• BSNIP II: Do a ton of analysis and write a lot - Me
The End