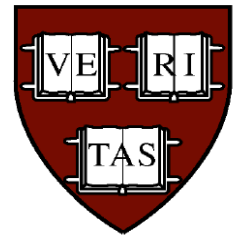


Spectroscopic Clues about Luminosities of Type Ia Supernovae

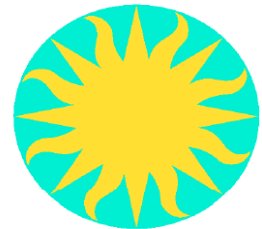
Tom Matheson



R. Kirshner, S. Blondin, S. Jha,
P. Garnavich, P. Challis



KITP
March 22, 2007



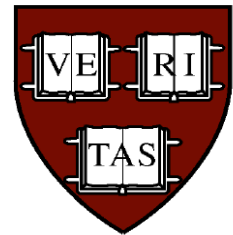


Spectroscopic Clues about Luminosities of Type Ia Supernovae

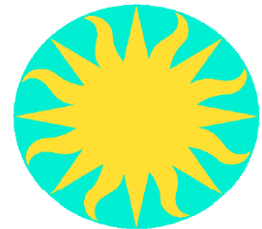
Tom Matheson



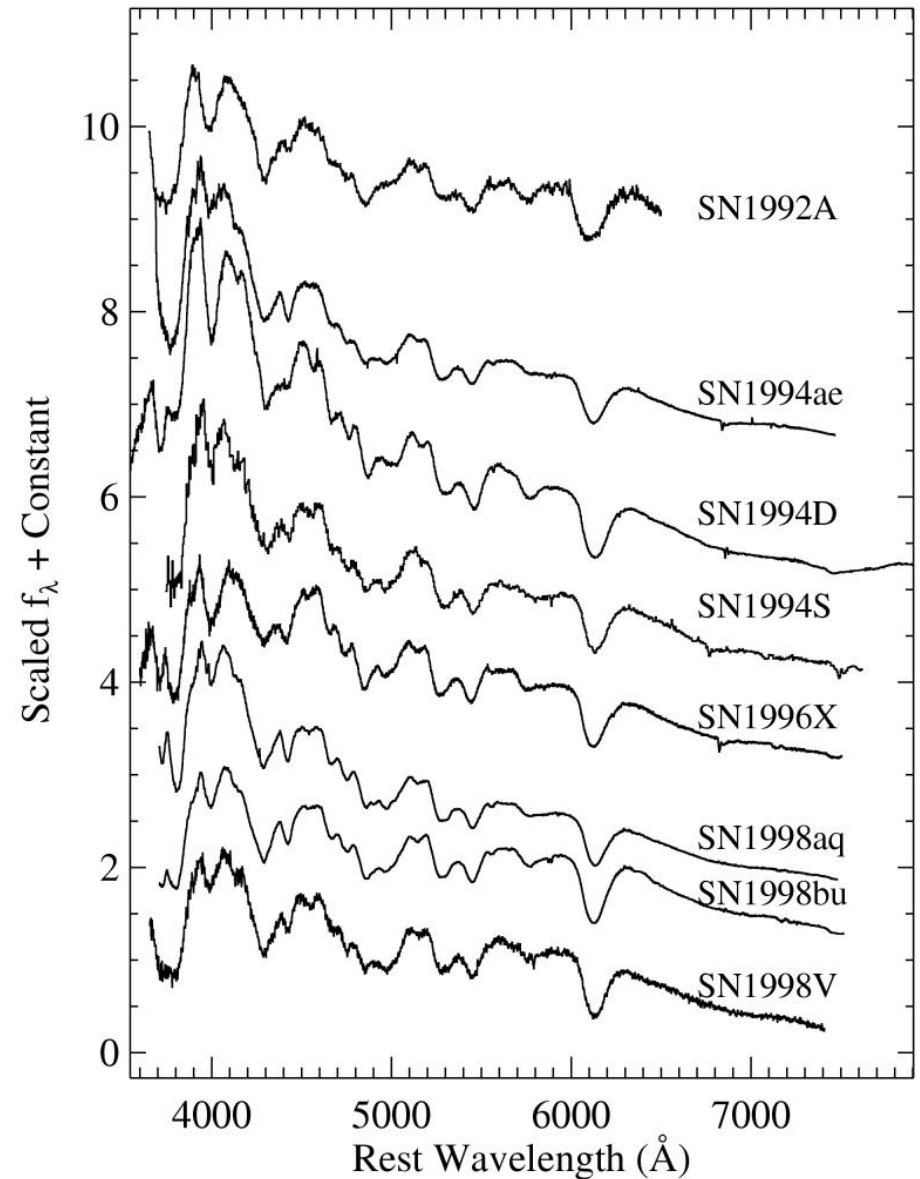
R. Kirshner, S. Blondin, S. Jha,
P. Garnavich, P. Challis



KITP
March 22, 2007



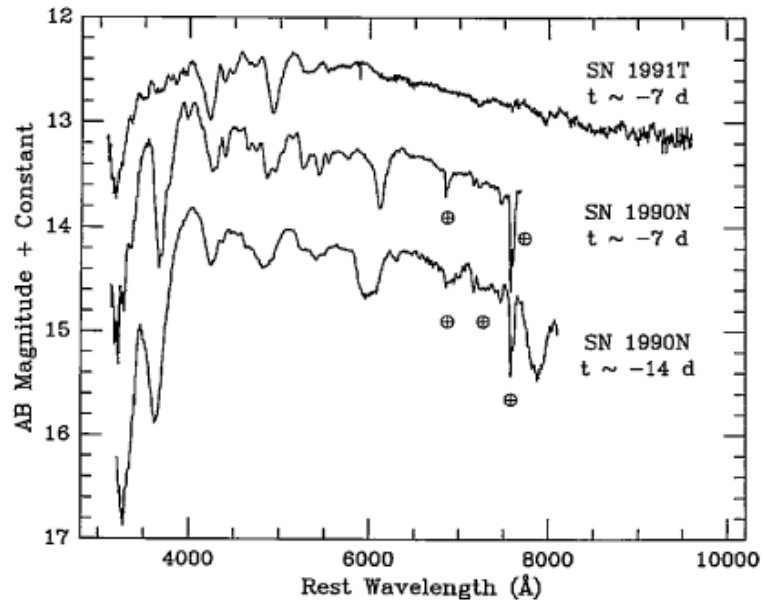
Once upon a time
all Type Ia SNe
were alike



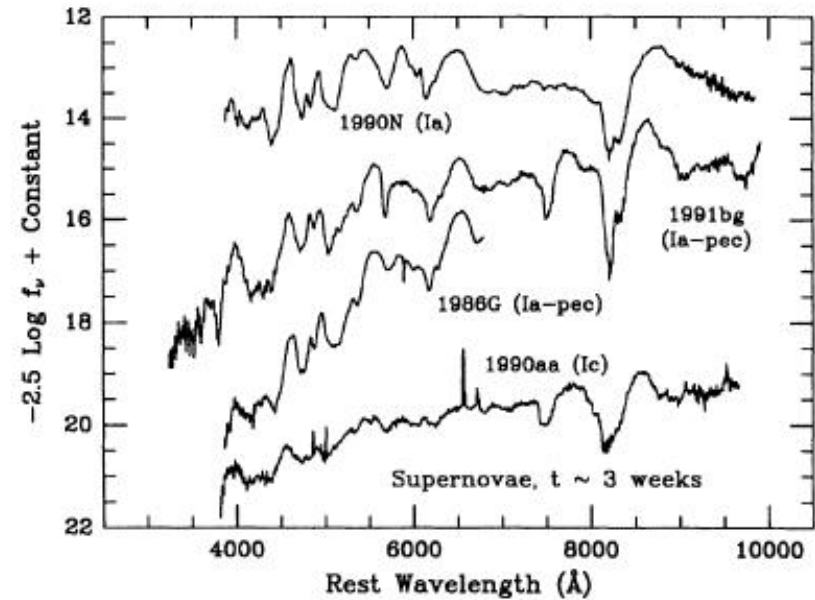
d) Similarities in the Spectra of Type I Supernovae

It has often been suggested that spectra of Type I supernovae show remarkable similarities. We have available excellent data to investigate this question. With reference to SN 1972e in NGC 5253, it can be seen from figures 6 and 7 that the spectrum

SN 1991T and SN 1991bg

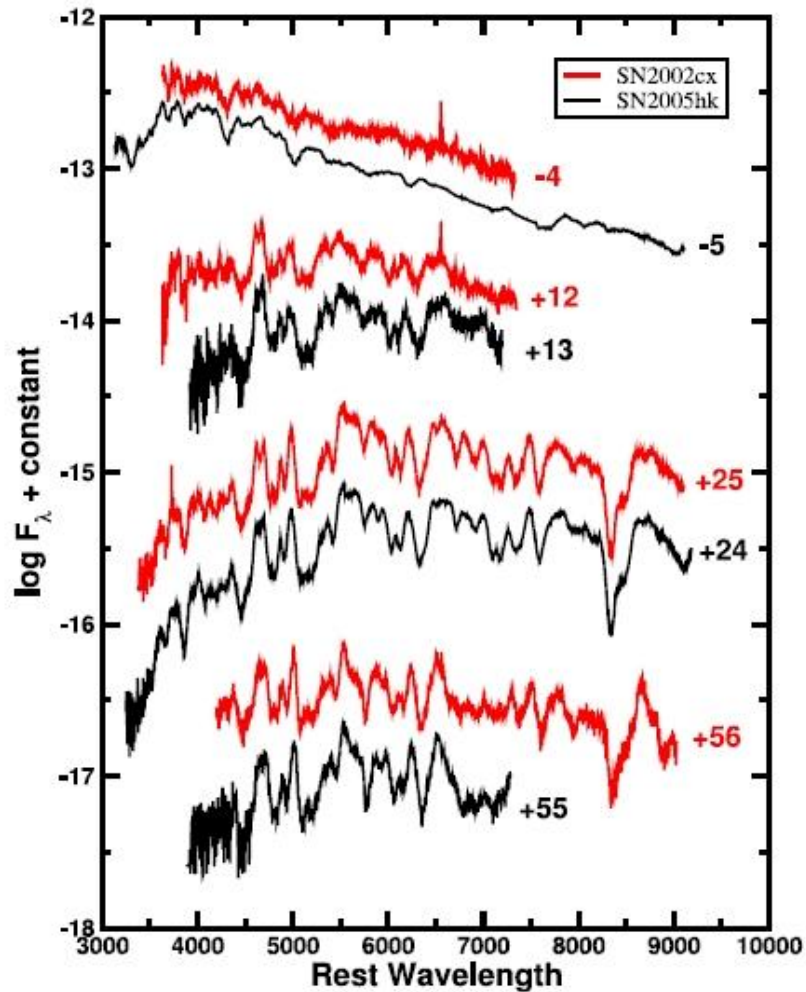


Filippenko et al. 1992
Phillips et al. 1992

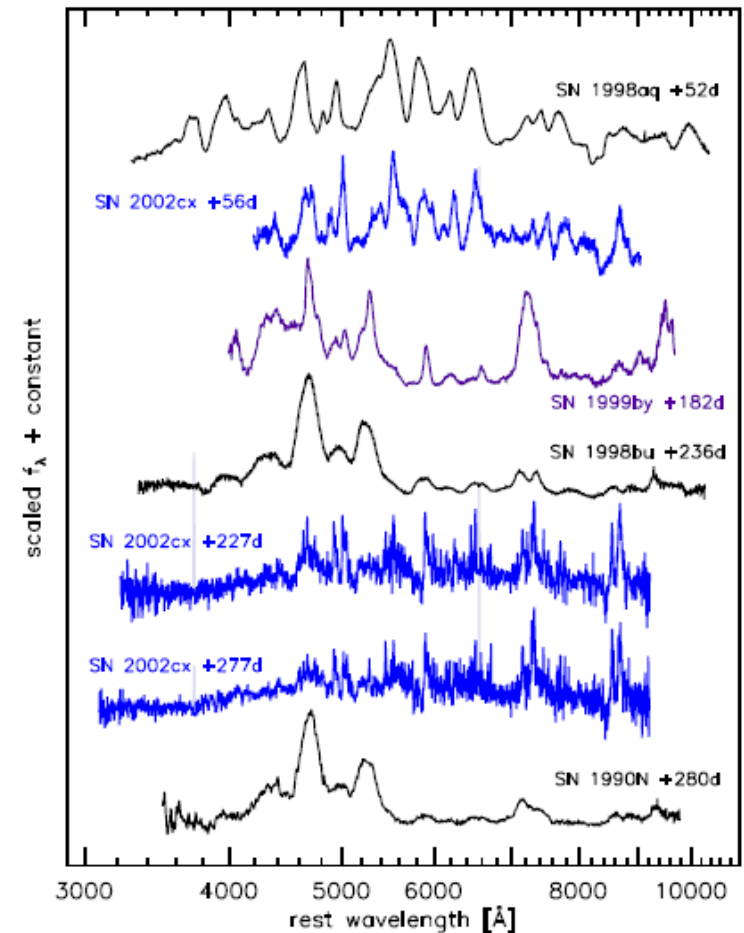


Filippenko et al. 1992
Leibundgut et al. 1993

Truly Bizarre Type Ia SNe



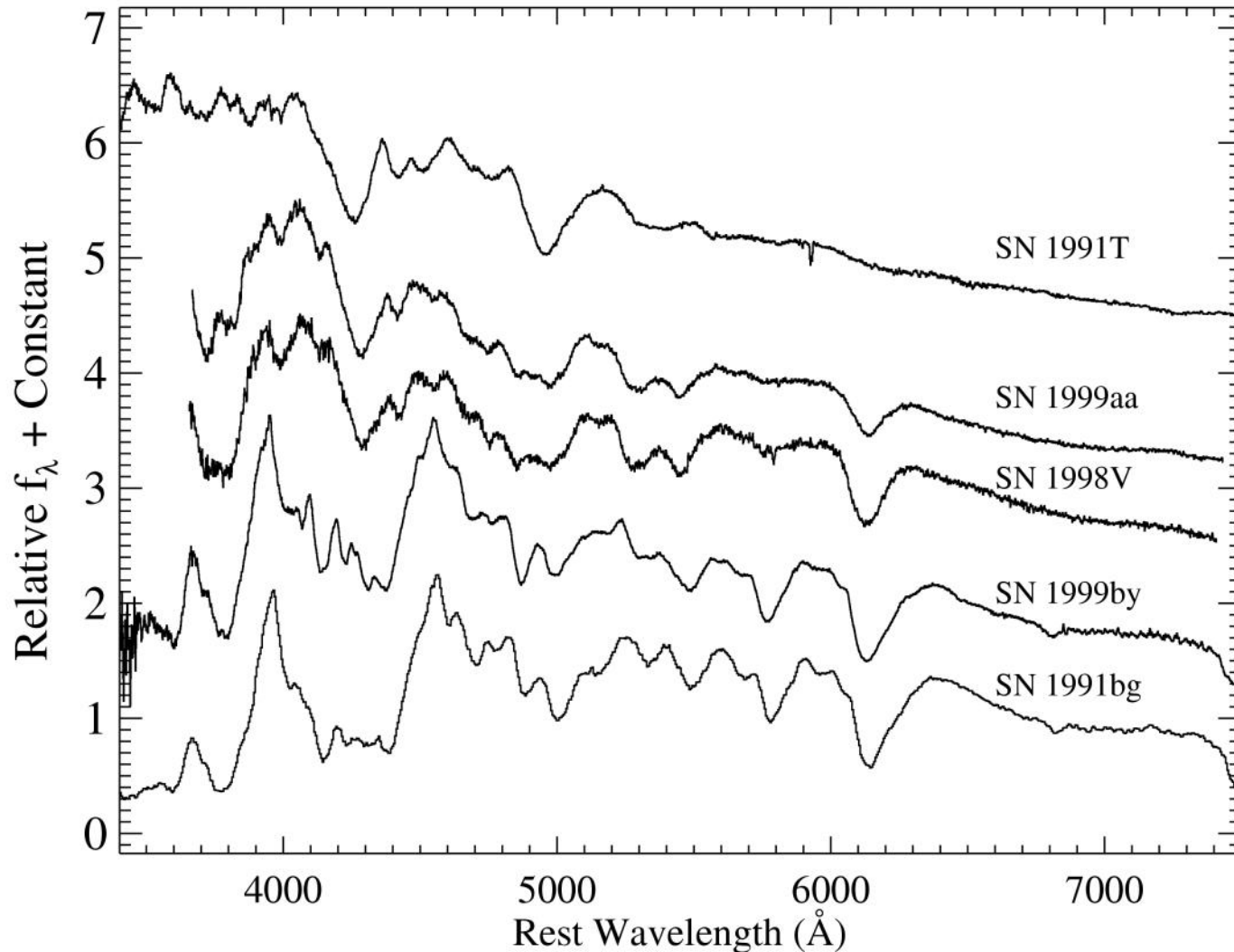
Phillips et al. 2007, Mark's talk



Li et al. 2003 Jha et al. 2006

Not to mention 02ic (Hamuy et al. 2003)
or 05gj (Aldering et al. 2006)

A Continuum of Type Ia Spectra?



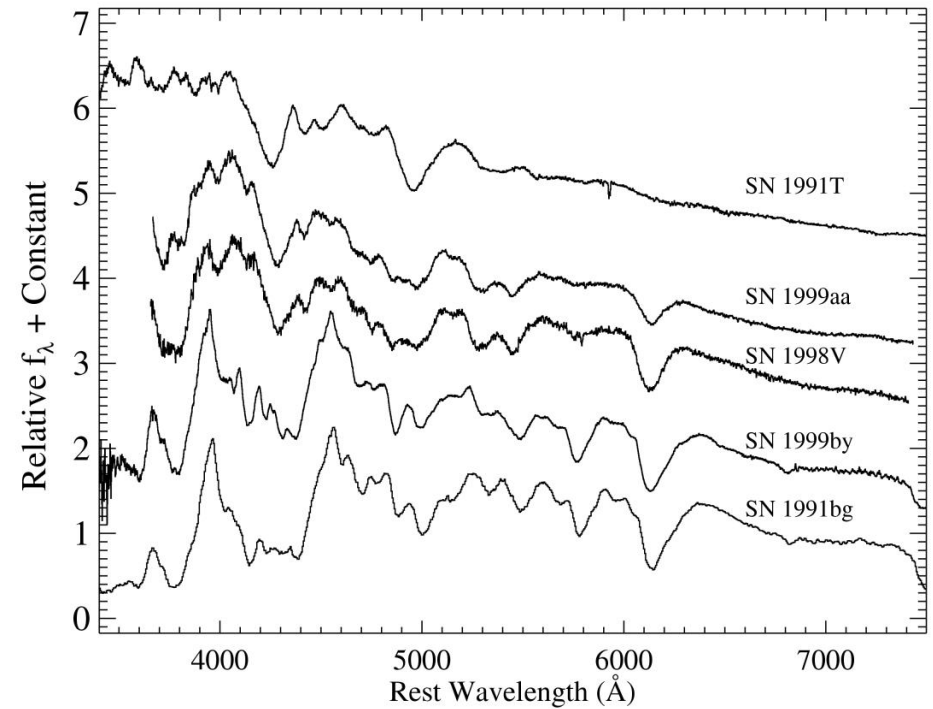
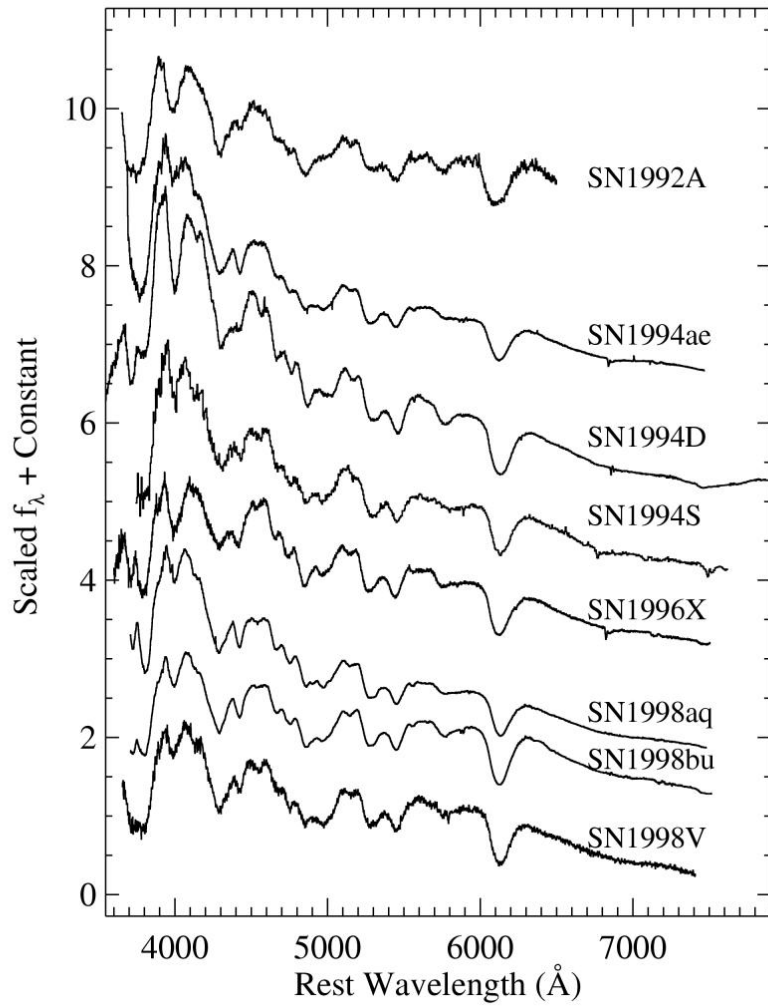
Temperature?
(e.g., Nugent
et al. 1995)

Nickel mass?

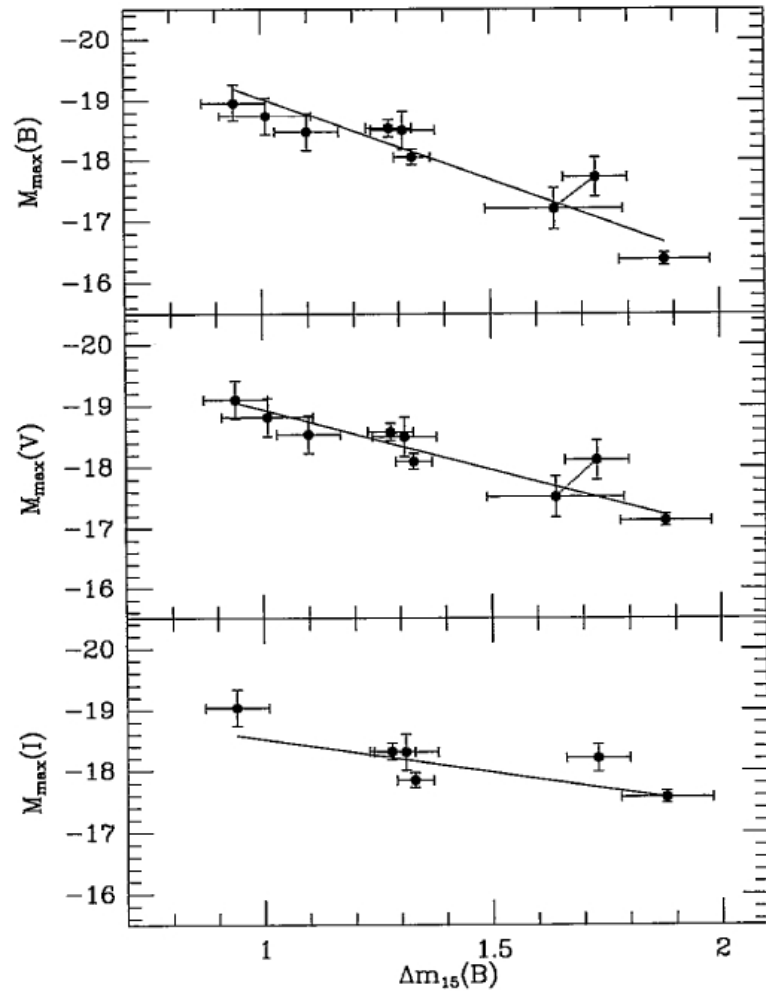
Progenitor?

Viewing angle?

Diversity of Type Ia SNe, Good or Bad?

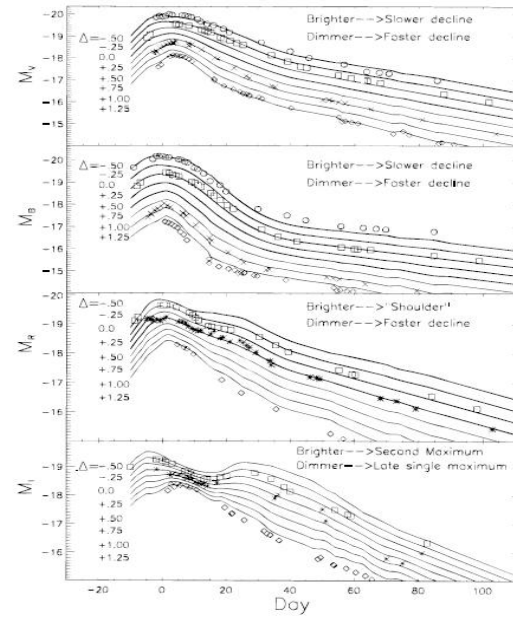


Light-Curve Shape Calibration

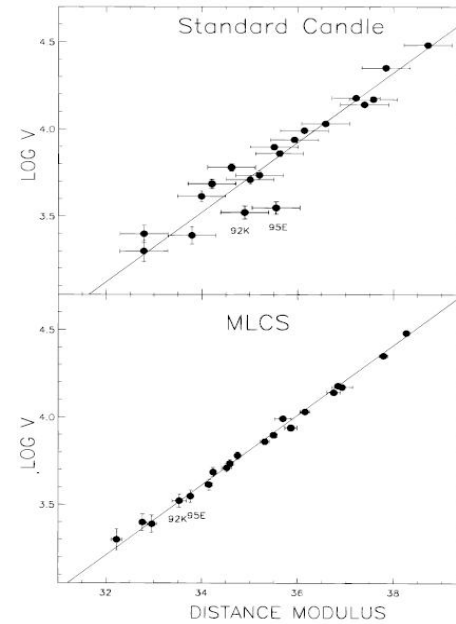


Phillips 1993, Hamuy et al. 1996

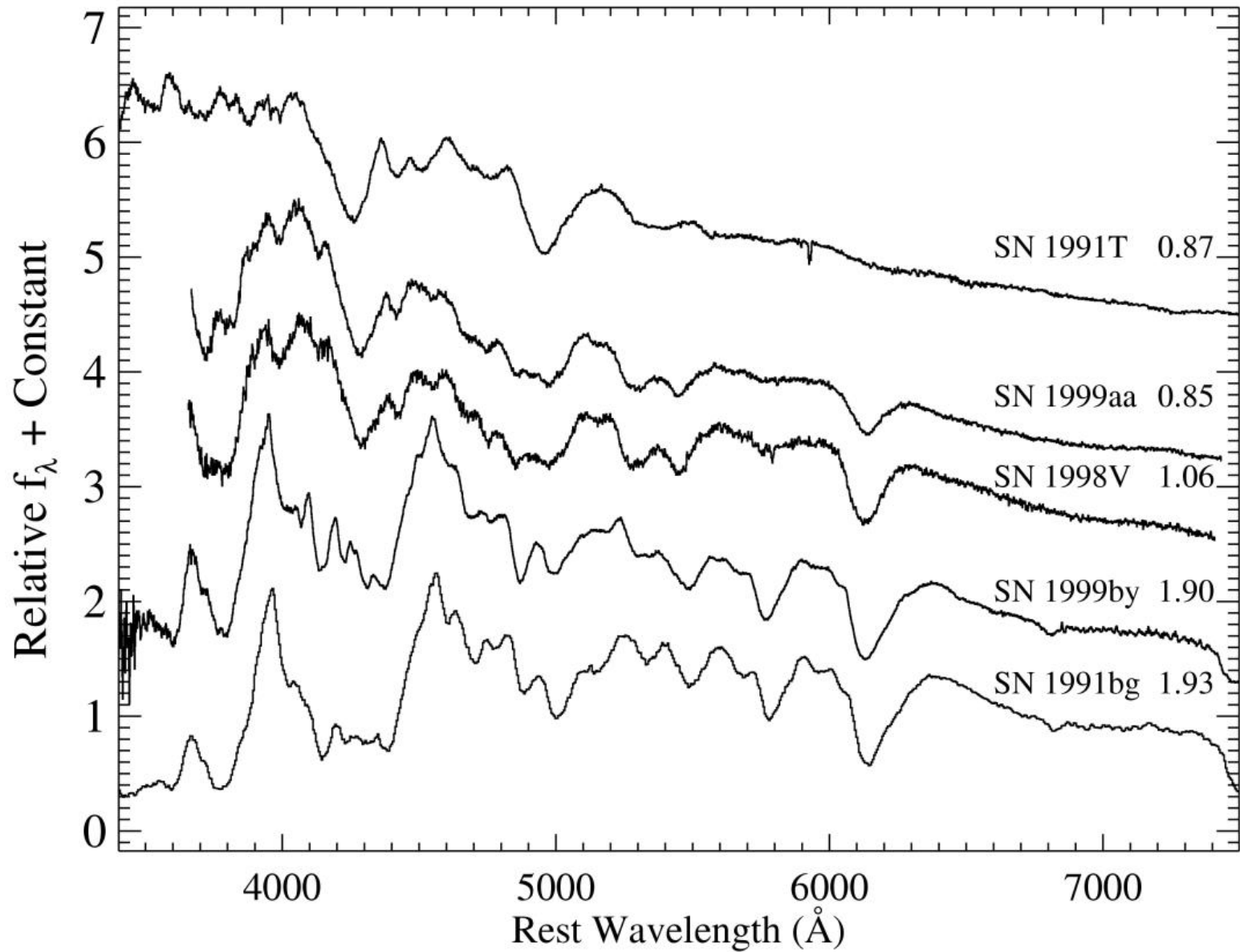
Stretch (Perlmutter et al. 1997)



Riess et al. 1996
Jha et al. 2007



Spectra and Light-Curve Shape

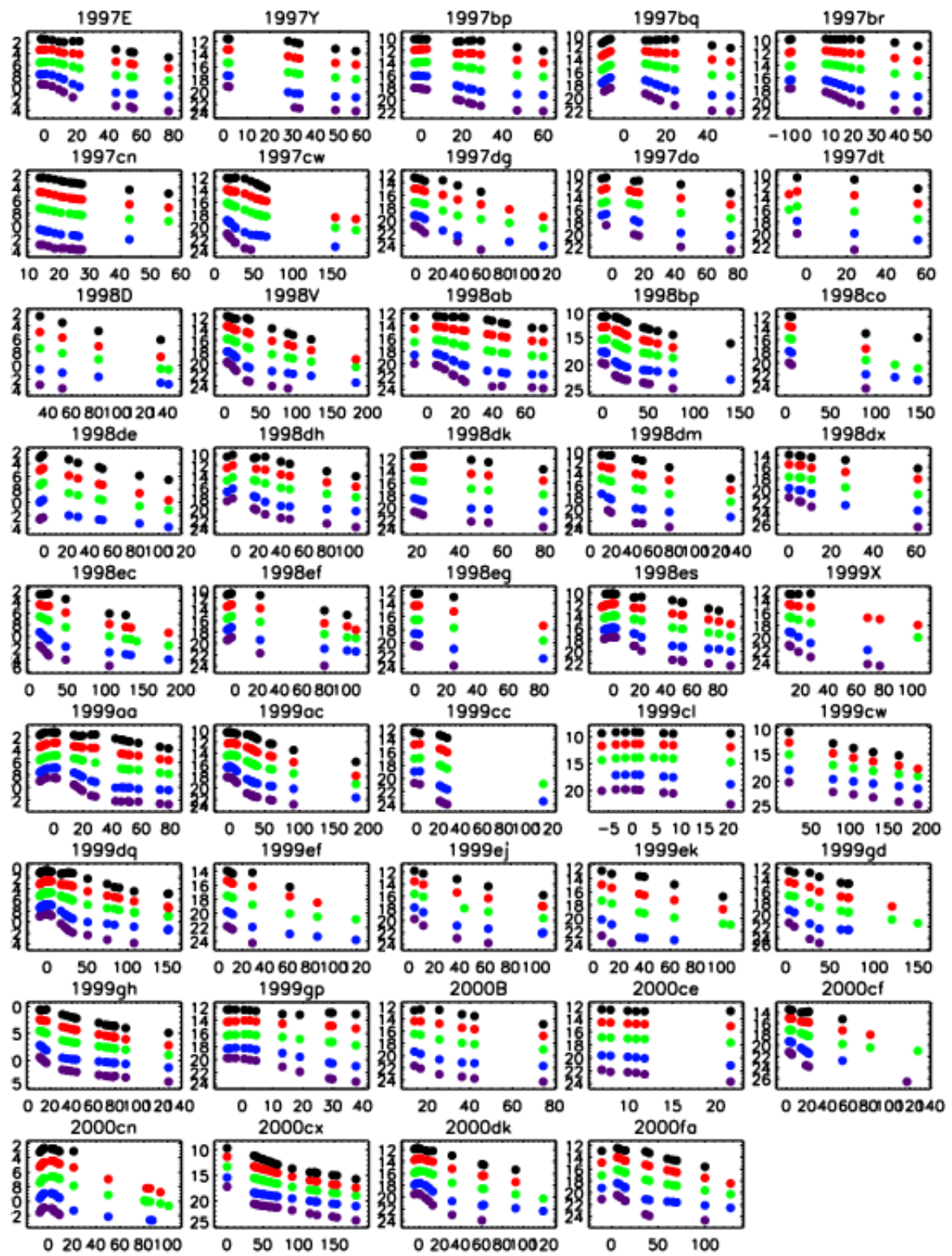


CfA Sample of 44 Type Ia SNe

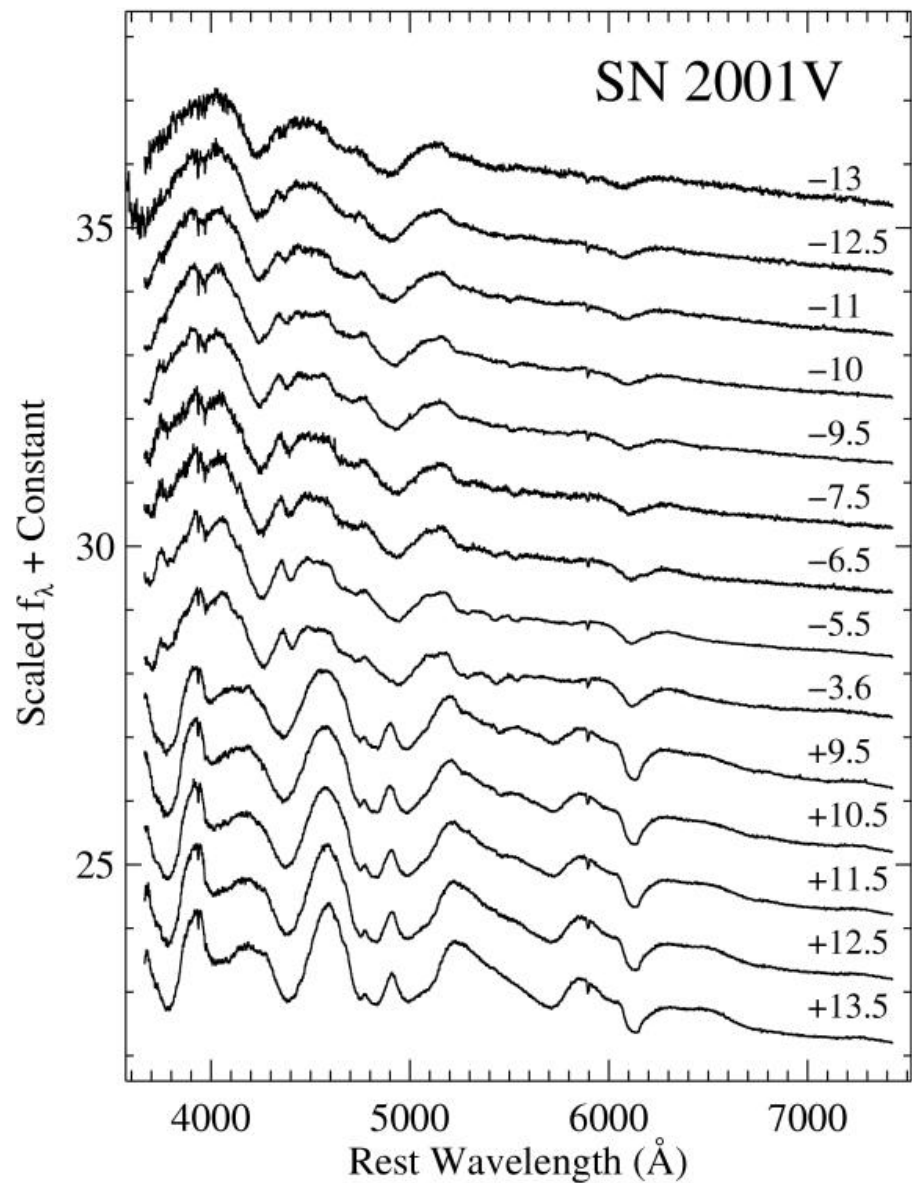
Jha et al. 2006

Includes U band

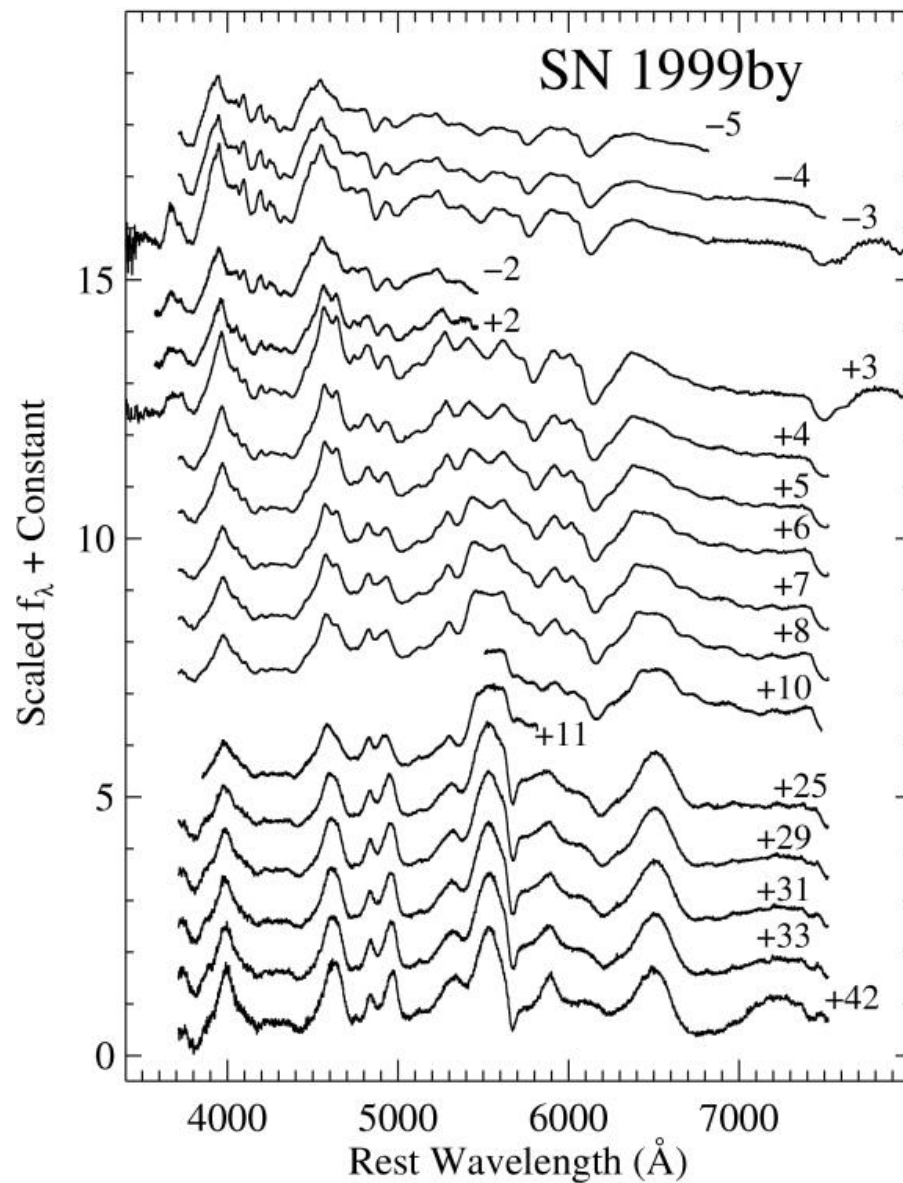
More coming,
Hicken et al.



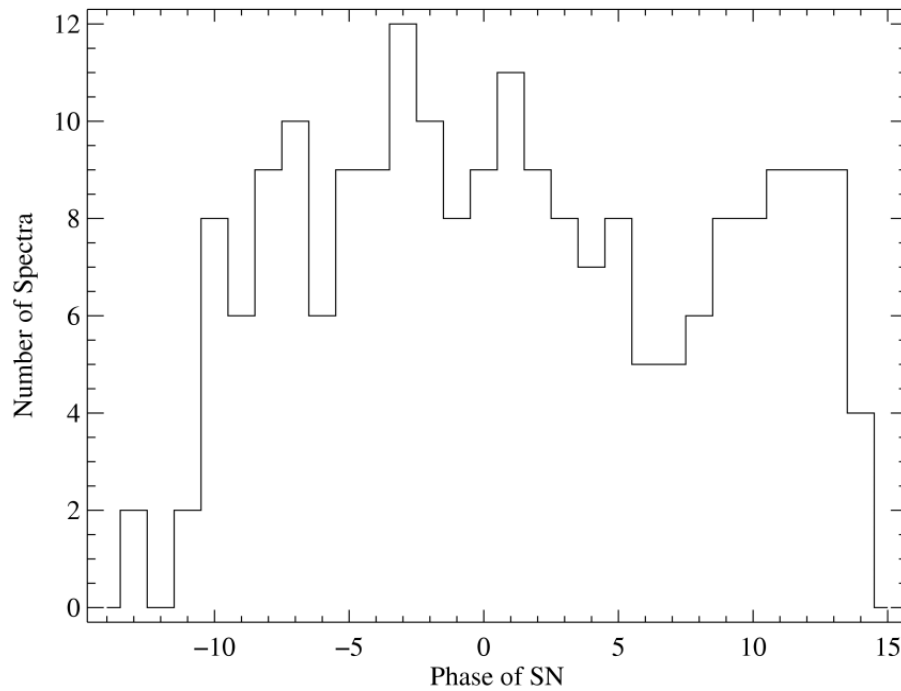
SN 2001V



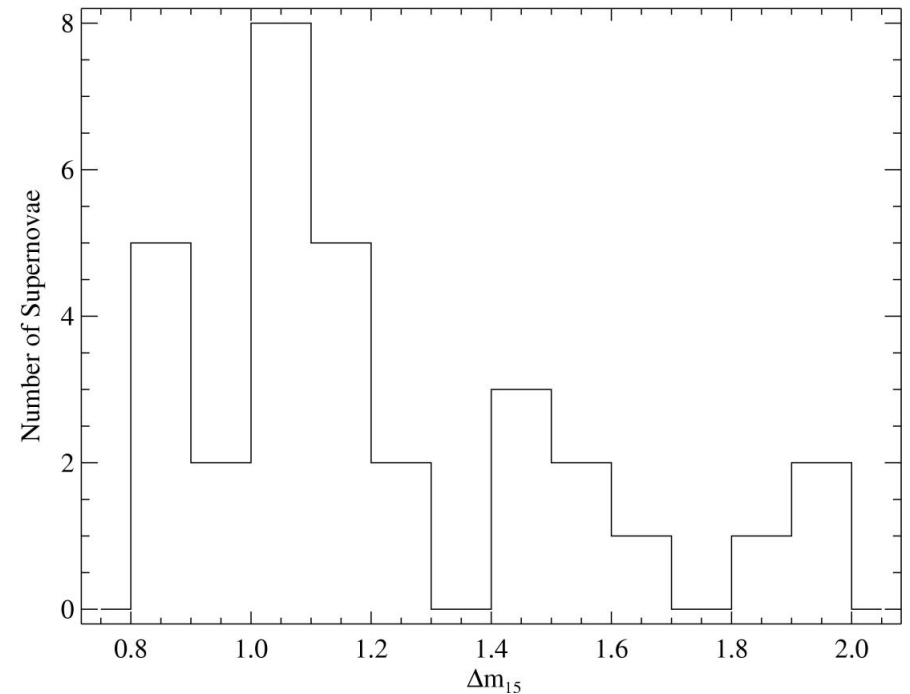
SN 1999by



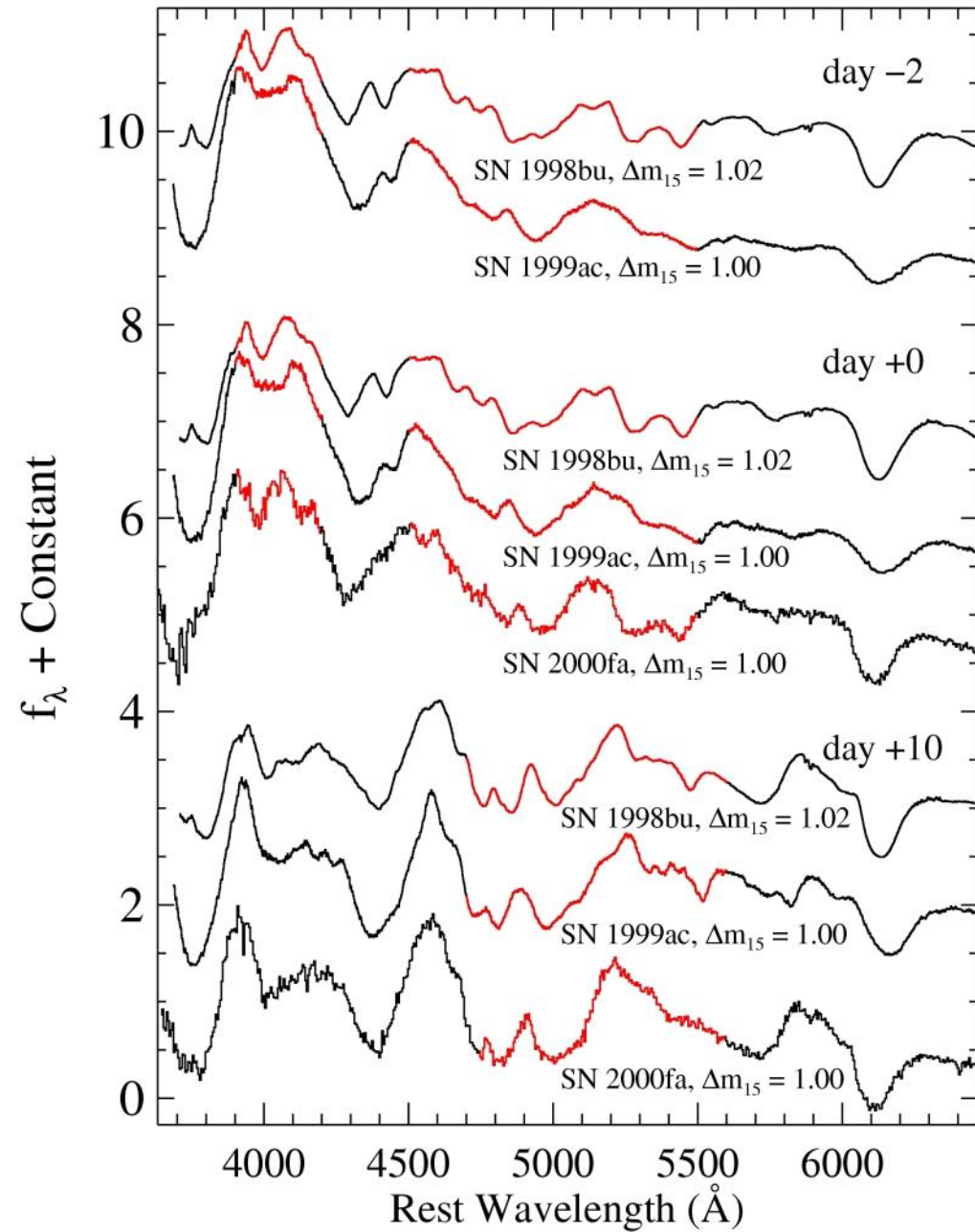
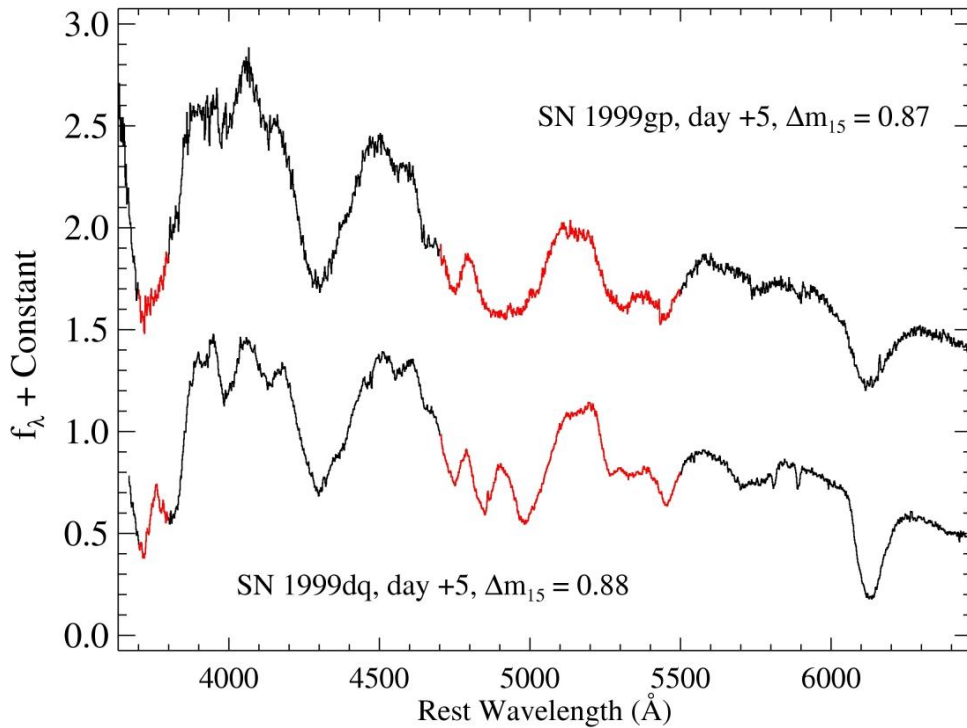
Spectra of Many SNe



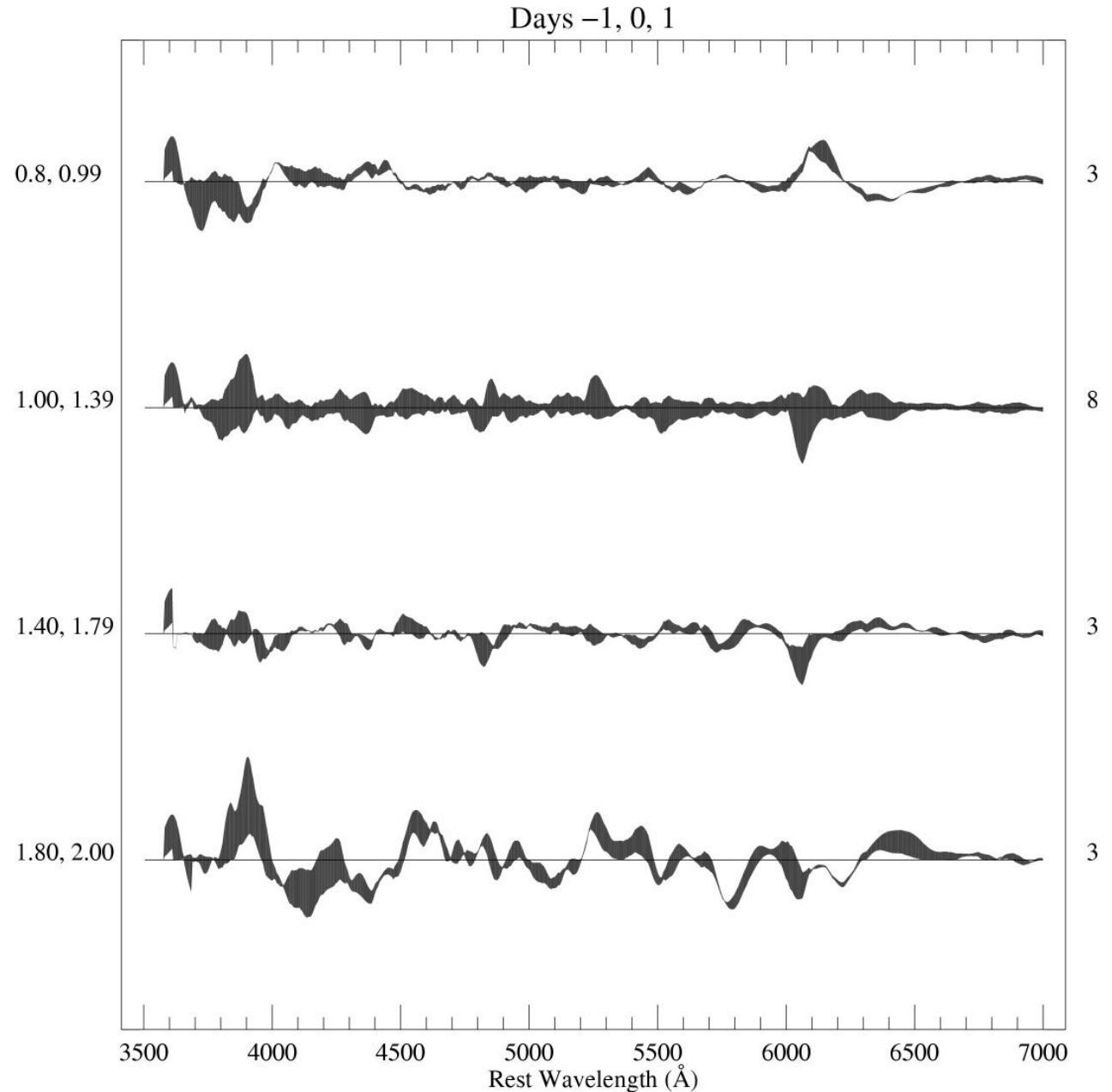
With a Variety of
Light Curve Shape
Parameters



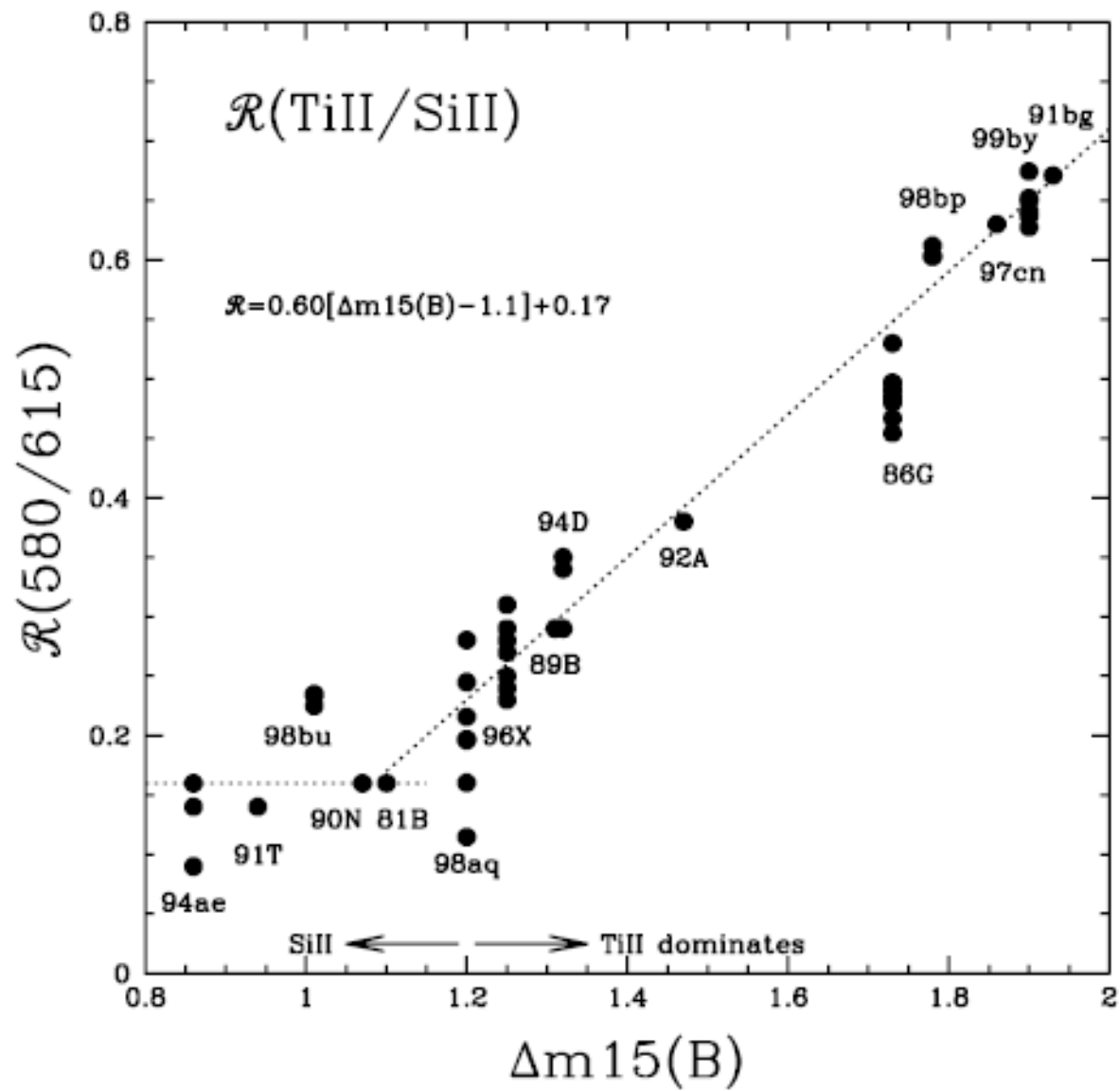
Similar Decline Rate, Some Spectroscopic Differences



Deviations
from median
spectrum in
small phase
range, by
 Δm_{15}

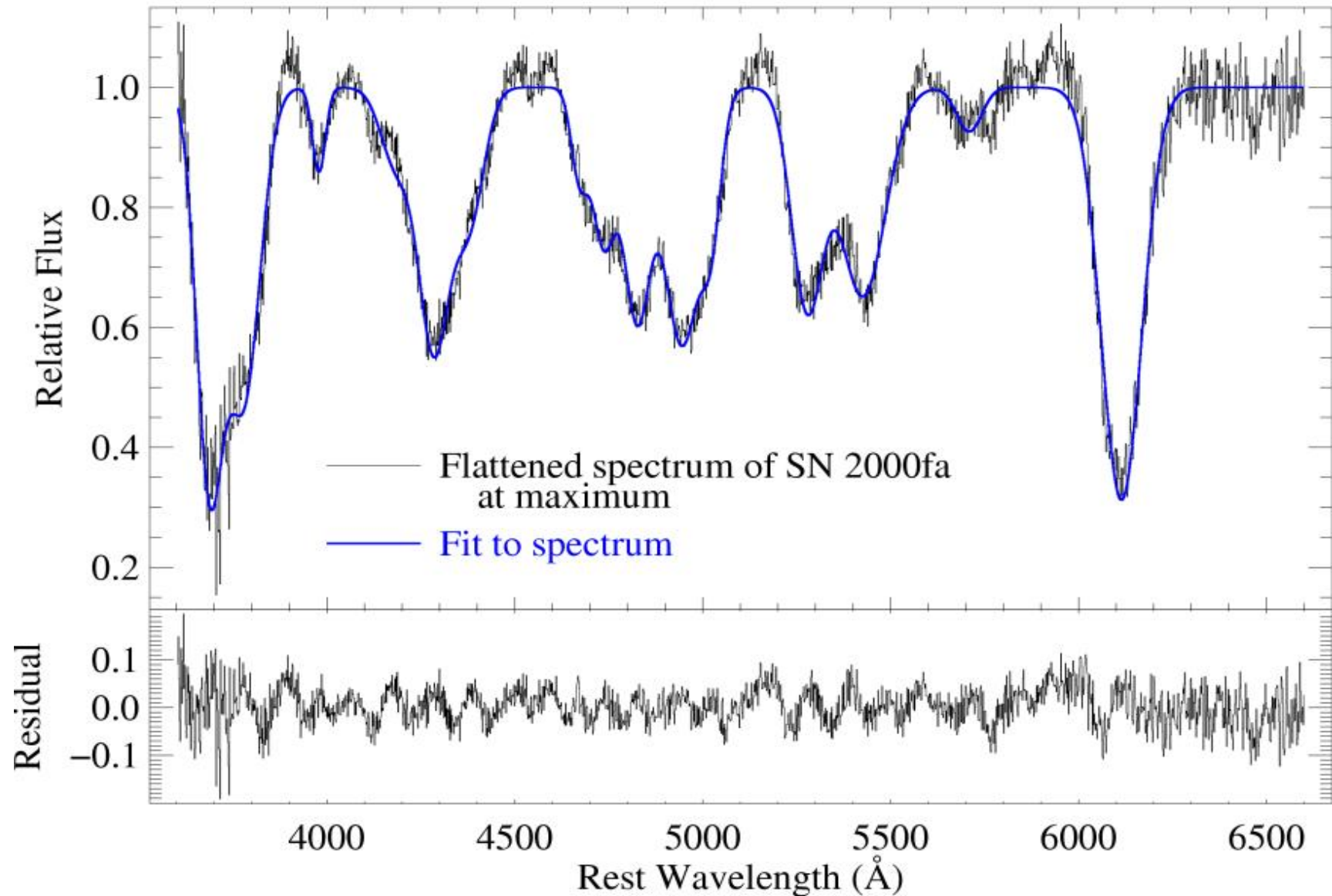


cf. Berian et al. 2006

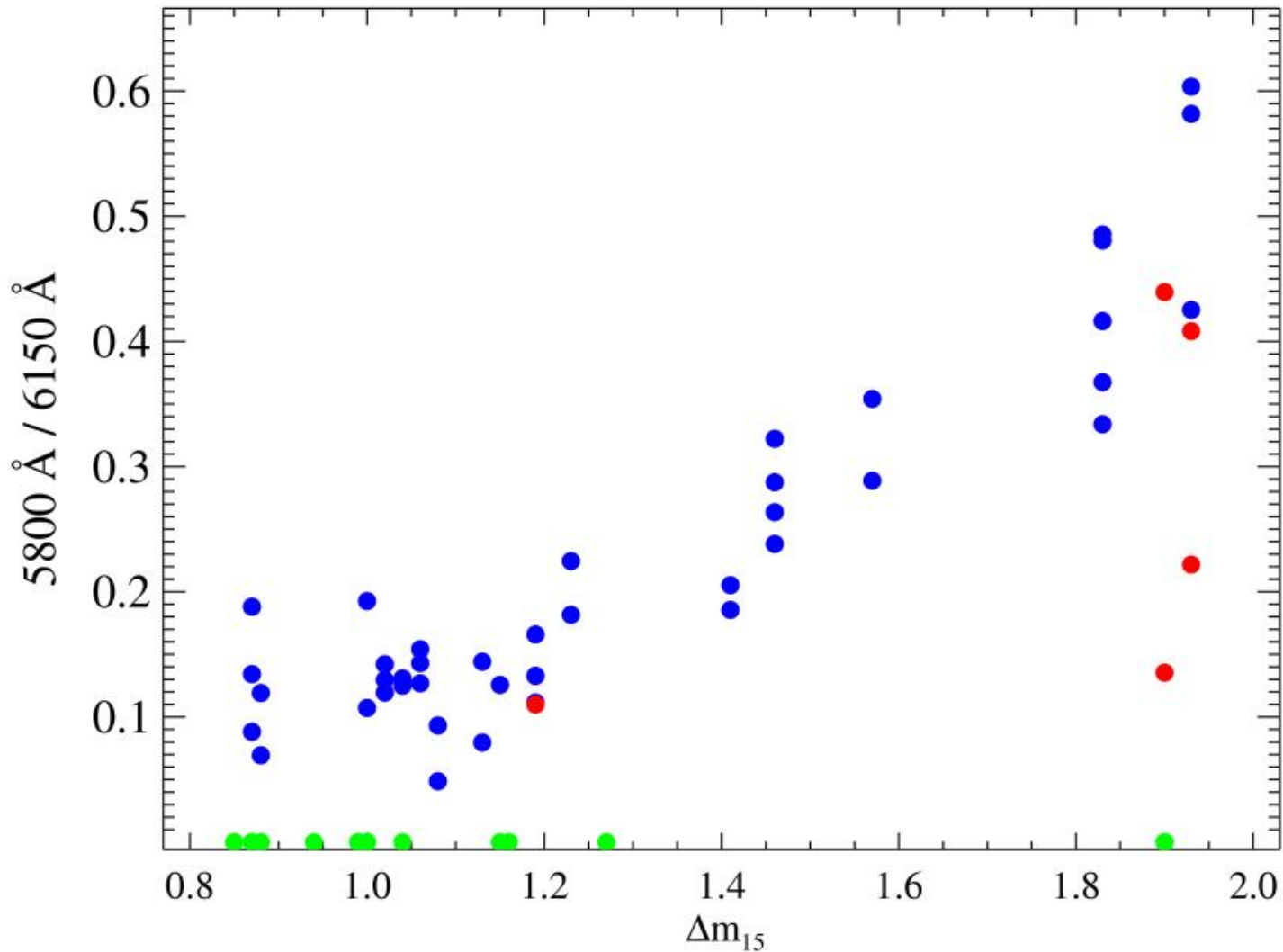


Garnavich et al. 2004

Fitting for Line Strengths and Velocities

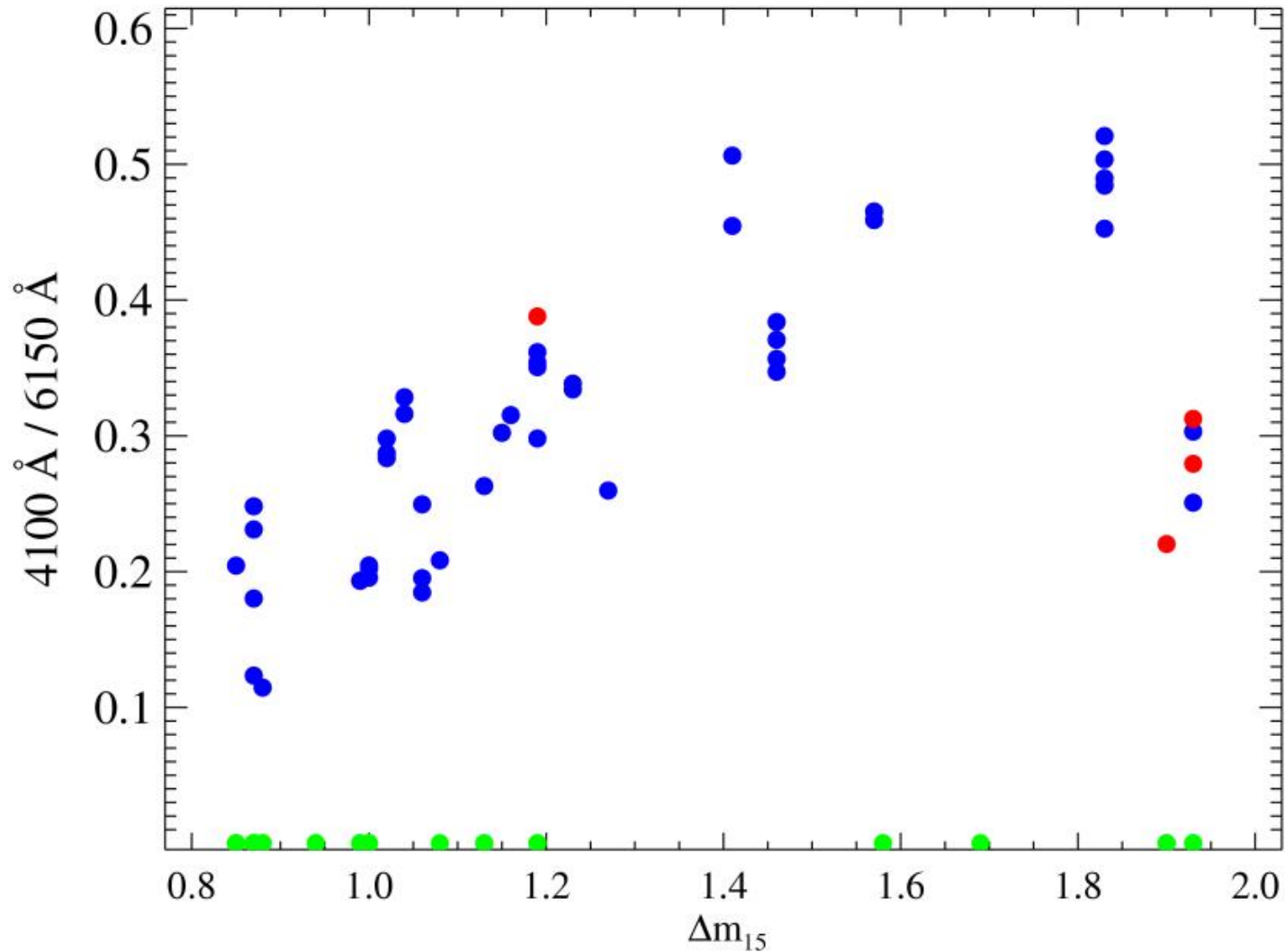


Strength of 5800Å Feature



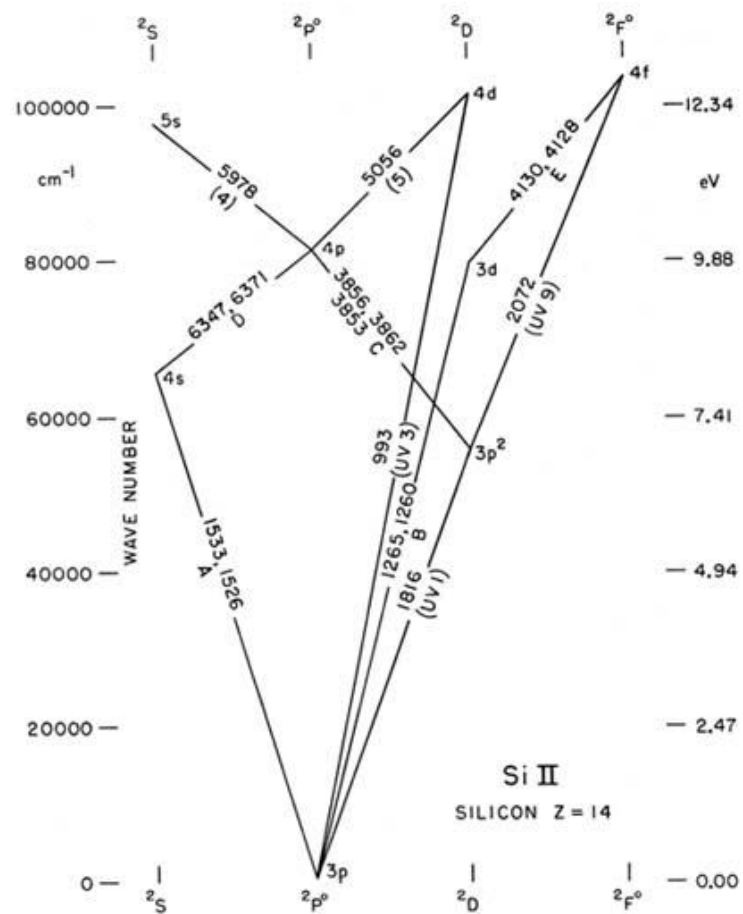
cf. Nugent et al. 1995, Garnavich et al. 2004, Bongard et al. 2006

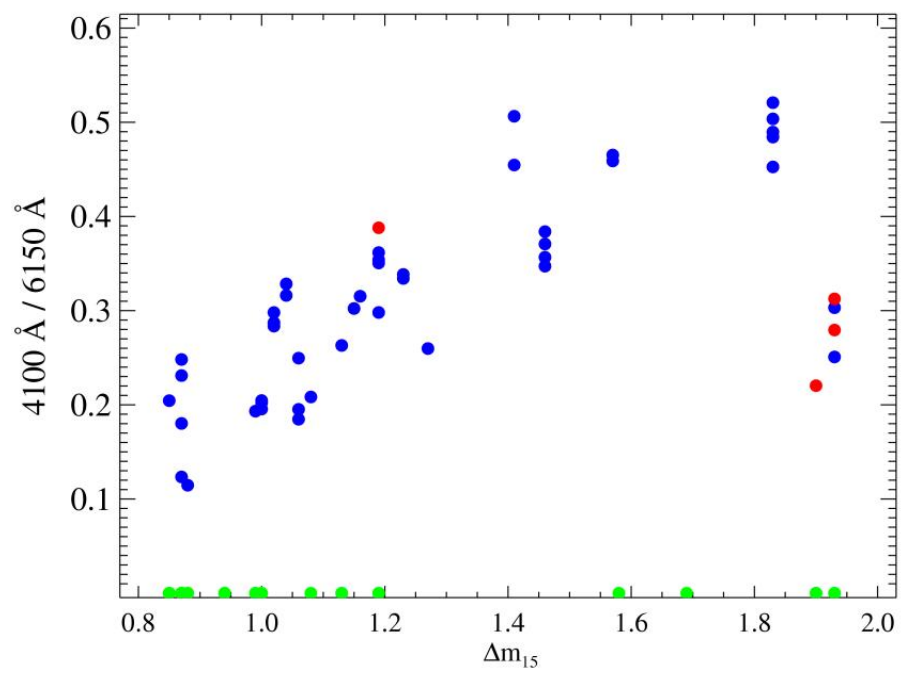
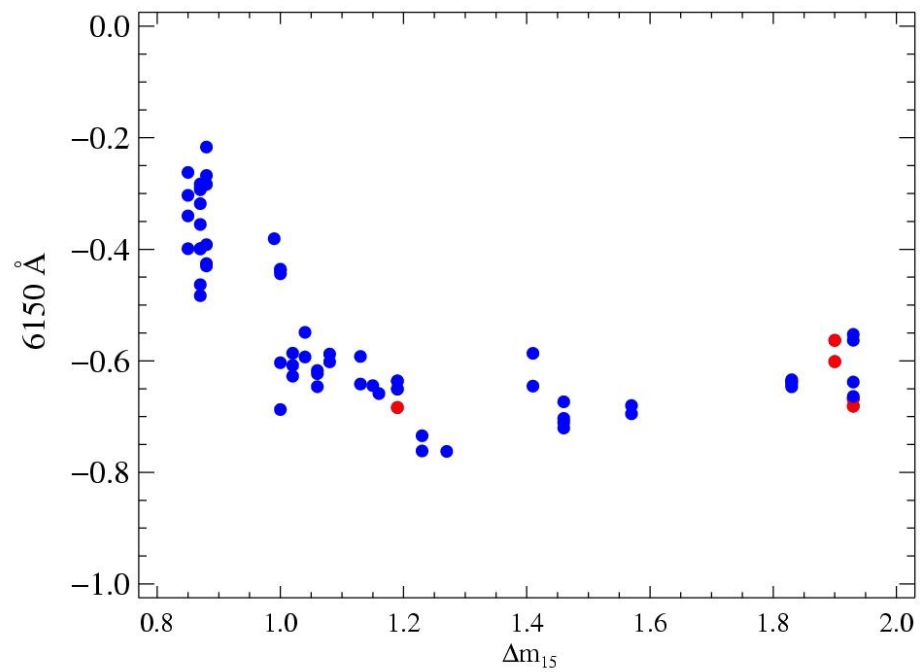
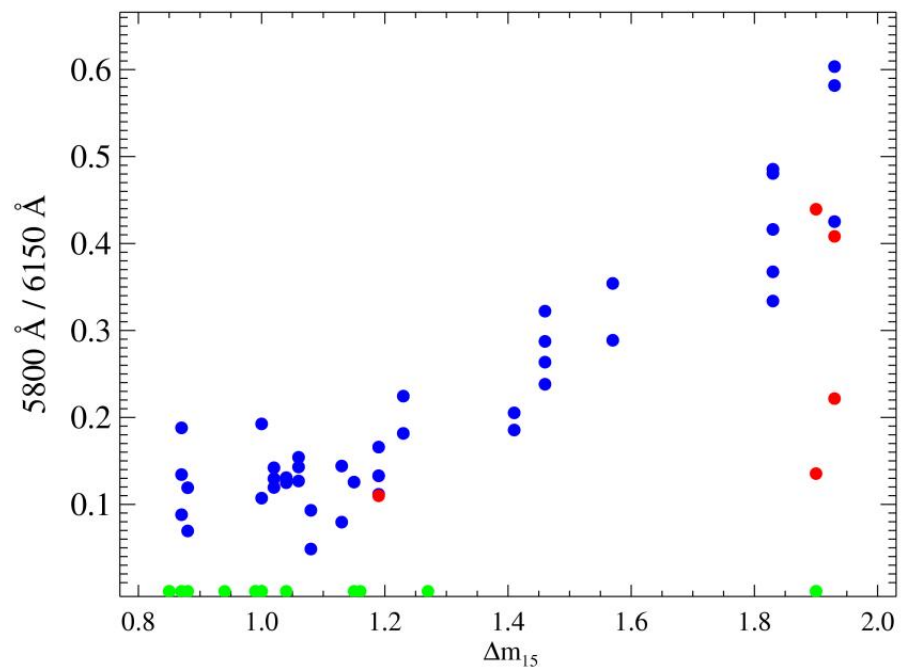
Strength of 4100Å Feature



cf. Nugent et al. 1995 Bronder et al. 2007

Si II Grotrian Diagram





Summary

- Diversity in Type Ia spectra provides challenges and opportunities
- Some variations among spectra correlate with light-curve shape parameters
- Specifically, Si II lines in spectra can provide a good indication of Δm_{15}