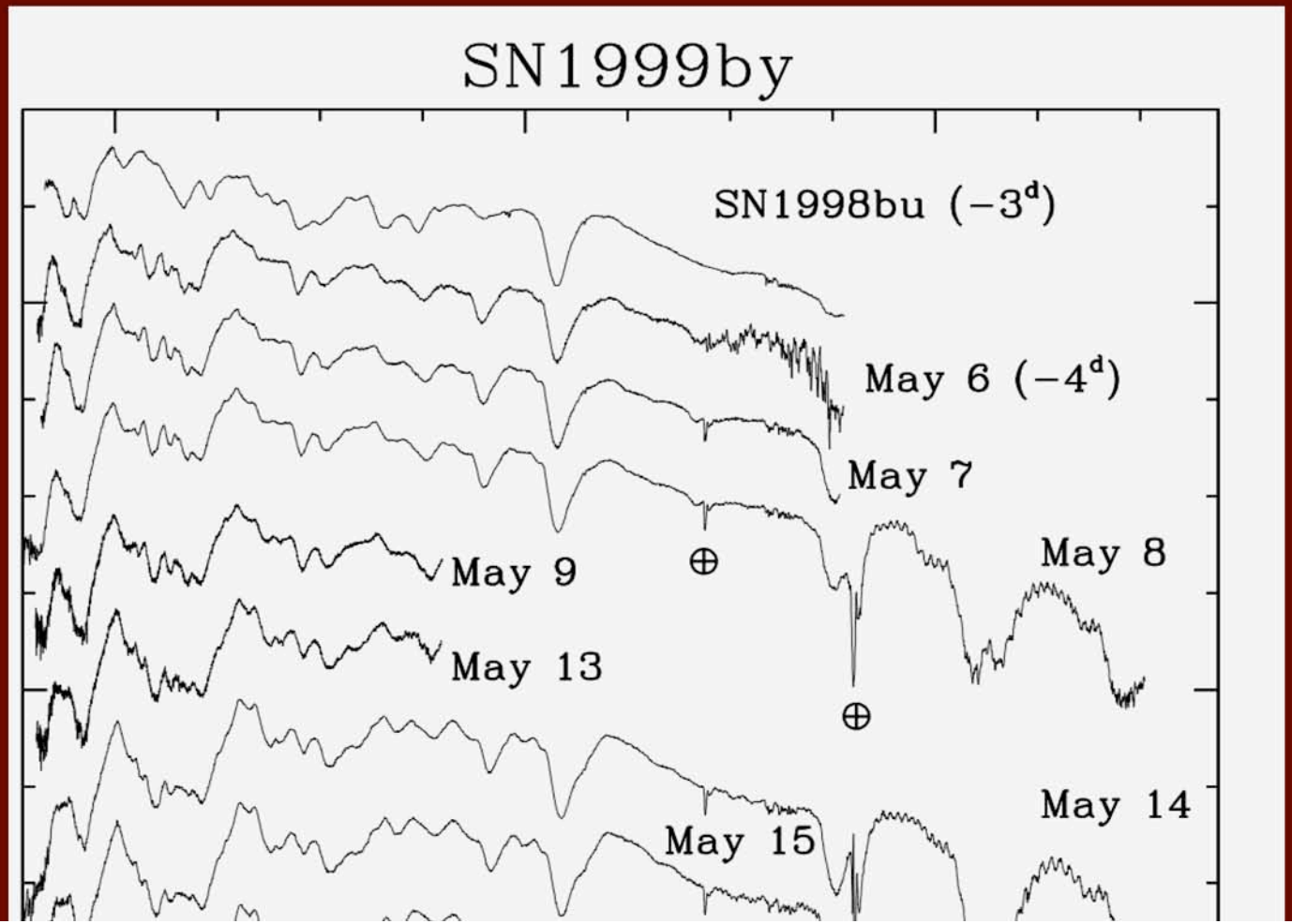
Peculiar or Just Different? What Are 91bg-like SNe



They are:

=> type Ia SNe
SiII, SII, Ni,Co,Fe

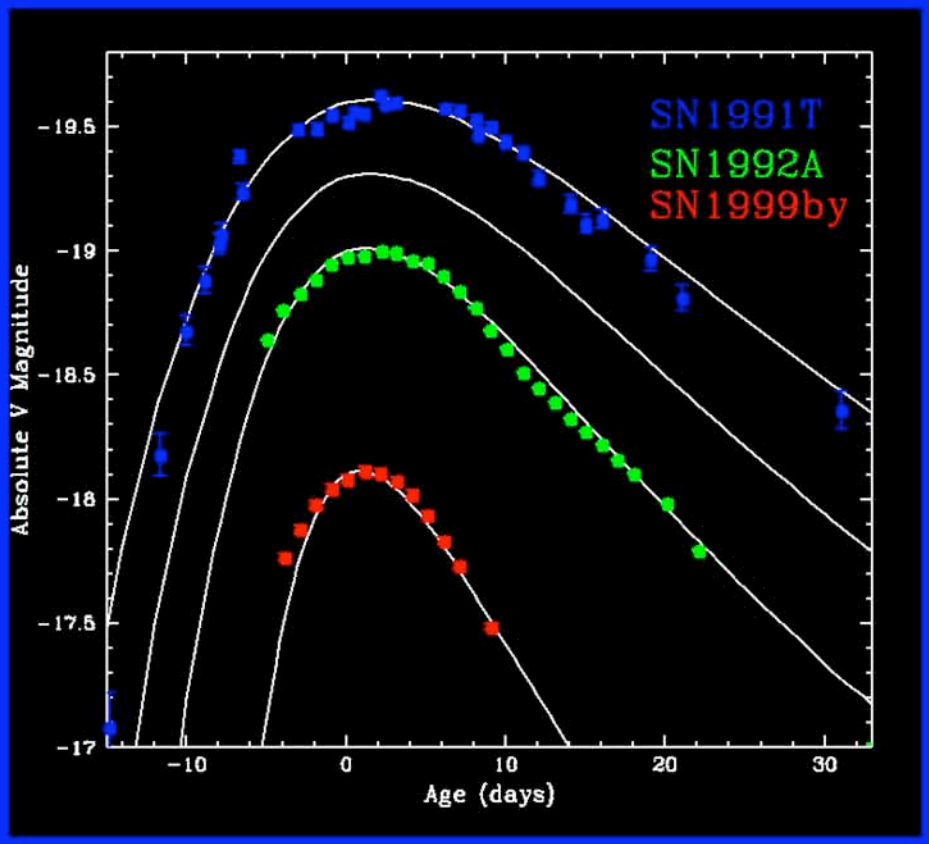
=>Low luminousity

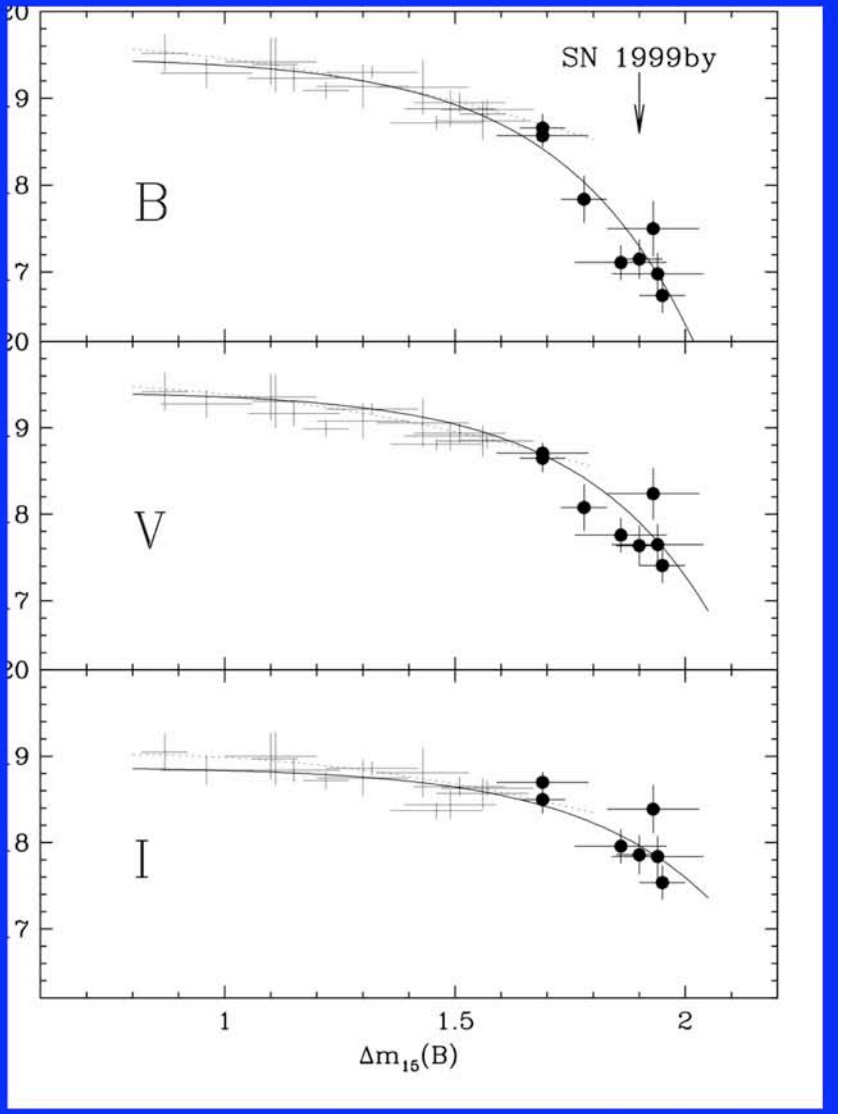
=>Cool photosphere
TiII, red color

=>Low expansion velocity

Sub-Luminous SNIa = Fast Declining LC

"Phillips Relation": correlation between decline rate and peak luminosity

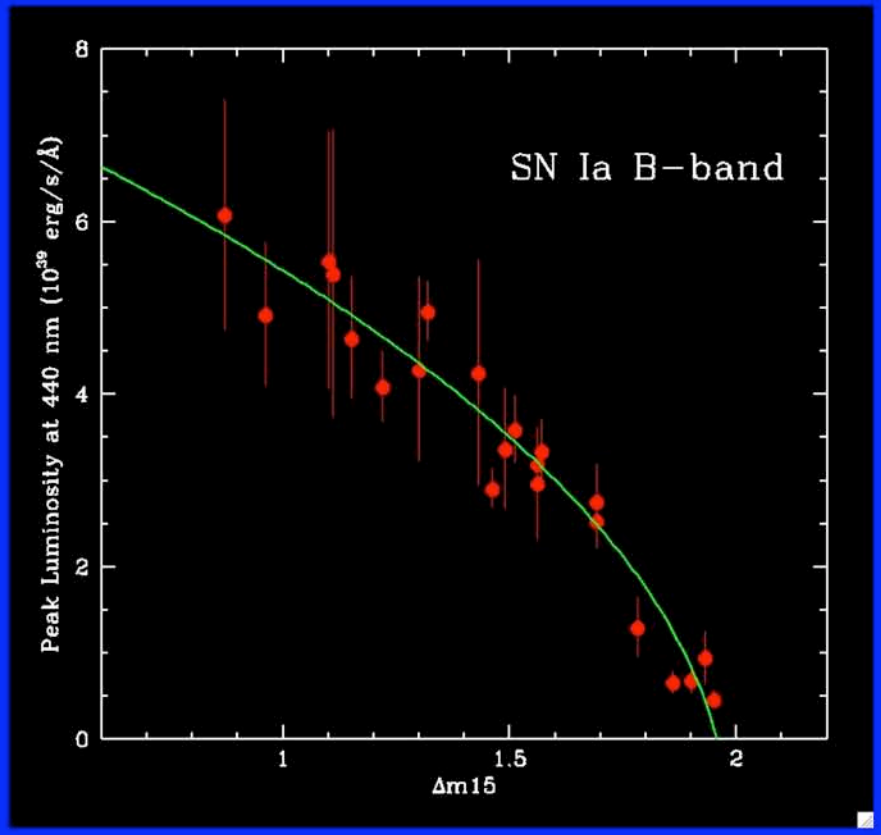




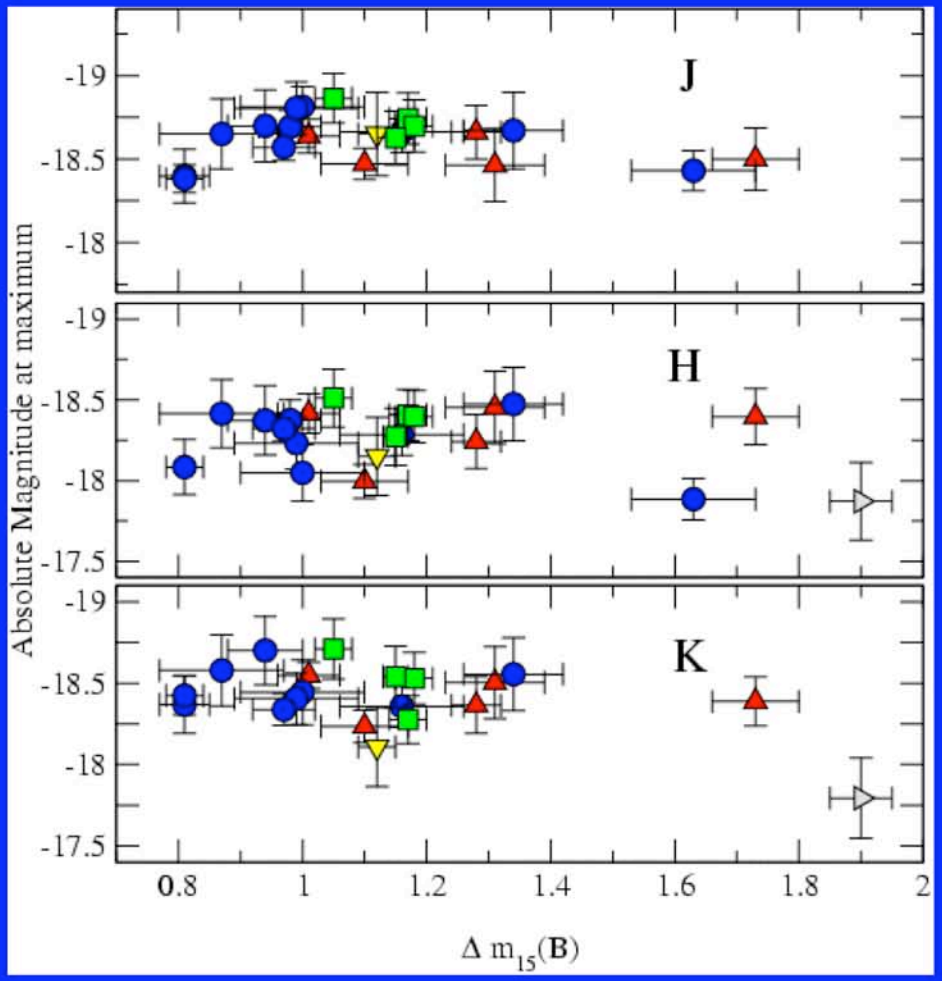
Absolute magnitudes from Hubble Flow (assume H_0) or Cepheids (SN 99by)

Not Very Sub-Luminous in the IR

"Phillips Relation" Flat in IR (Krisciunas et al.)

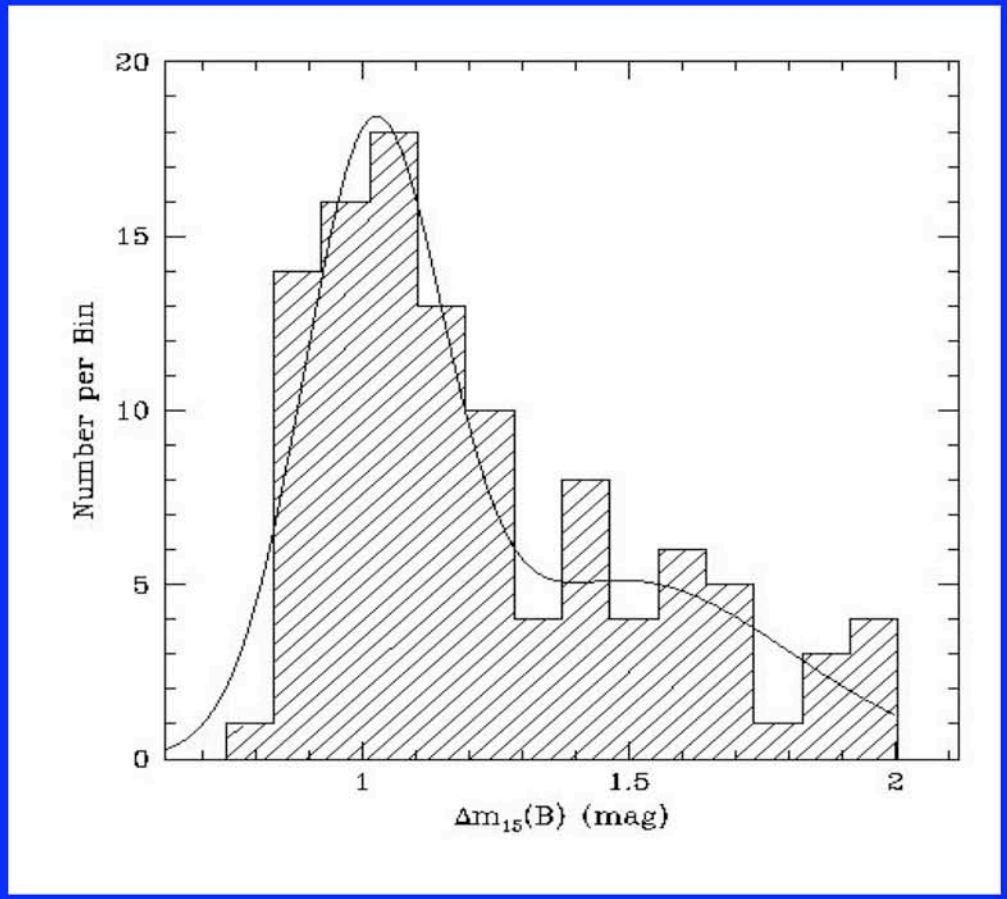


Phillips Relation in Flux



Local Sample - Decline Rate Distribution

Jha et al. 2006 (from IAUC and stuff)

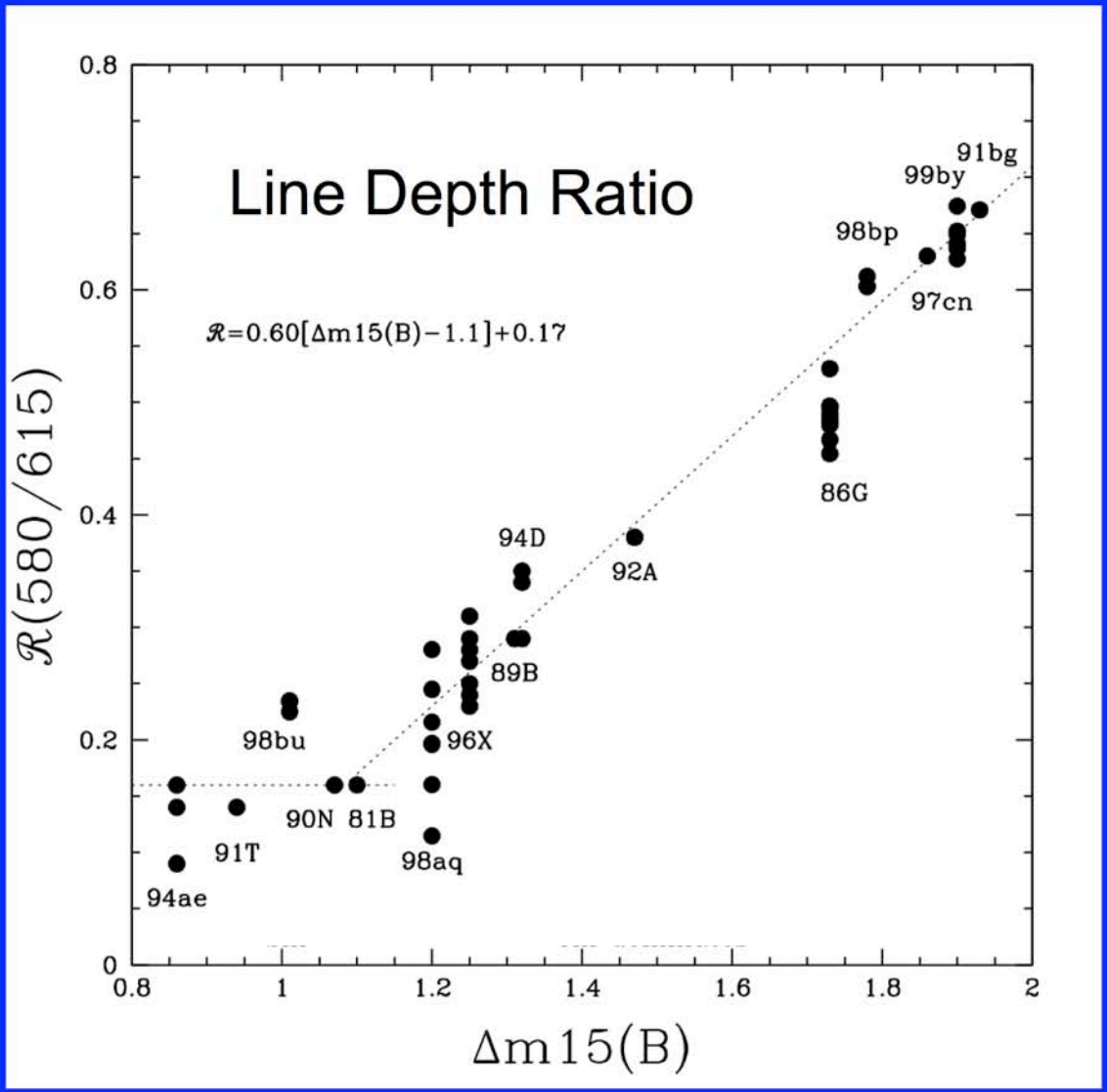


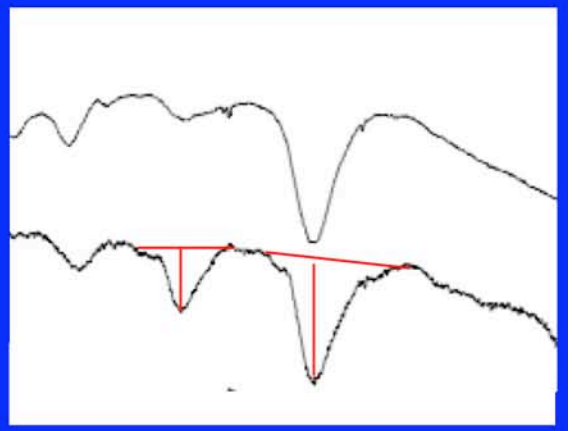
Not an accurate representation of the true relative rate.

Li et al. claim 16% of SNIa are 91bg-like from early KAIT discoveries.

91bg-like Spectroscopic Indicator

First noted by Nugent et al. 1995

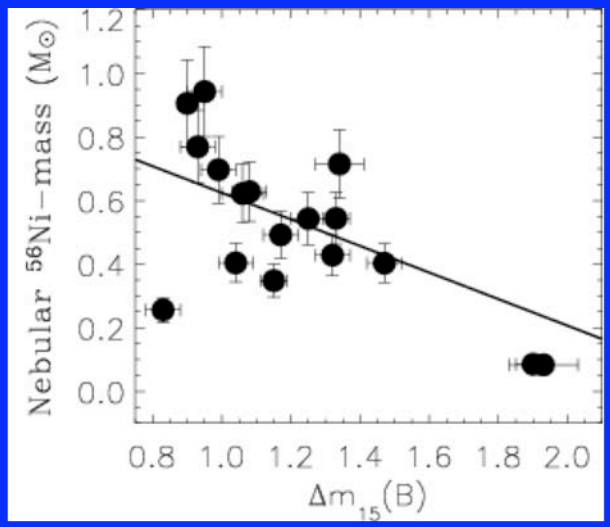




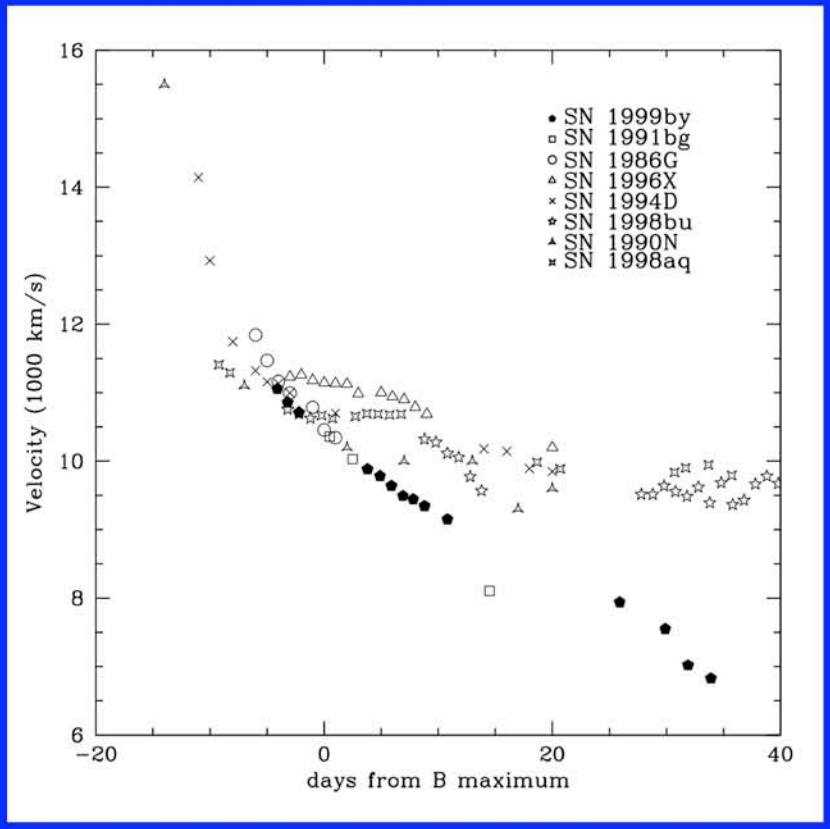
91bg-likes are a continuous extension of the “normal” SNIa.

91bg-like Are Slow and Weak

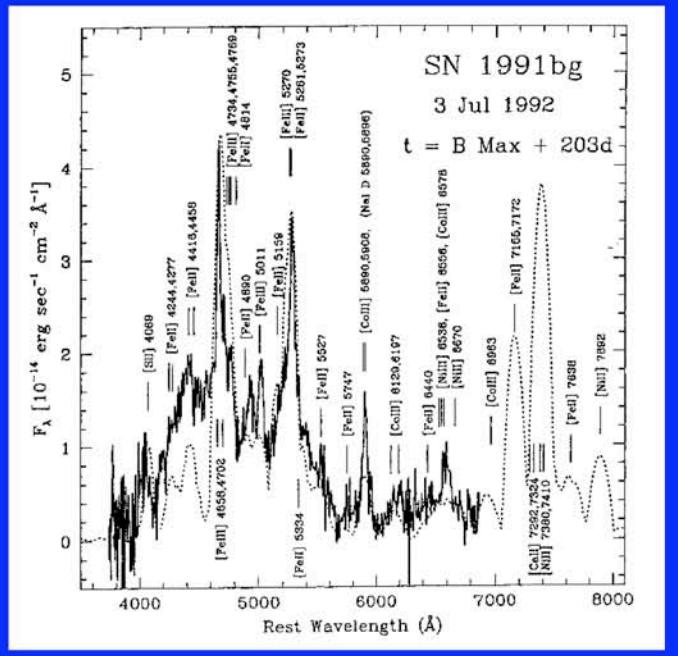
Stritzinger et al. 2006
91bg-likes make only
0.1 M_{sun} ^{56}Ni



SiII velocity continues to decline after maximum => Silicon extends deep

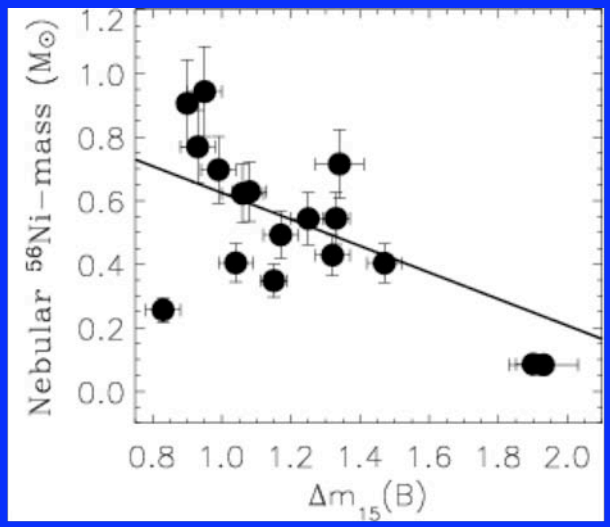


Fe lines narrow in nebular spectra => Ni only out to 2500 km/s (Mazzali et al. 1997)

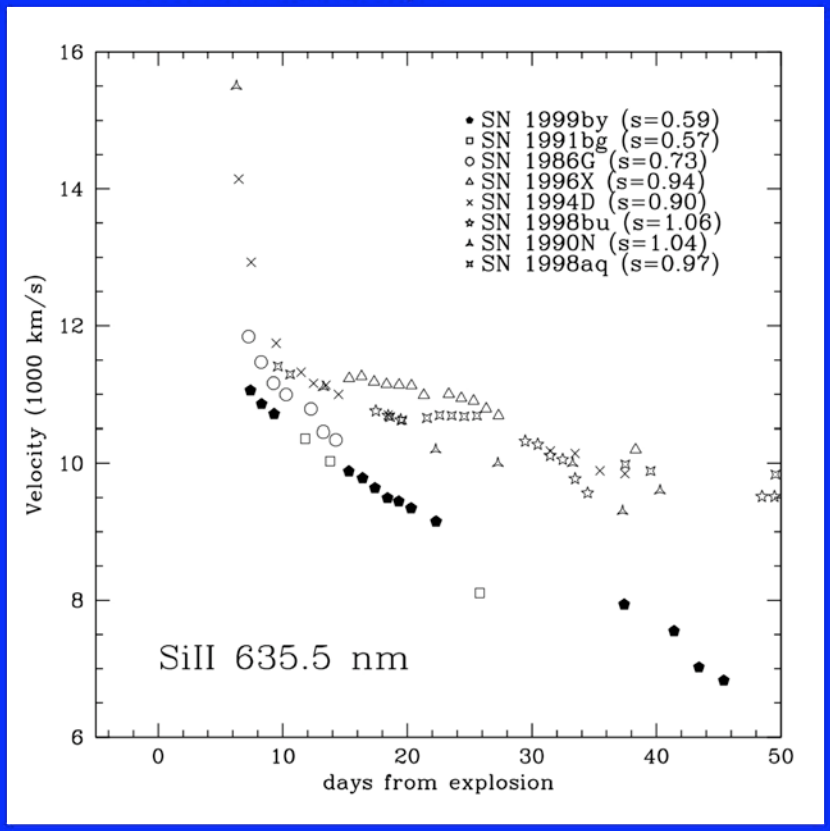


91bg-like Are Slow and Weak

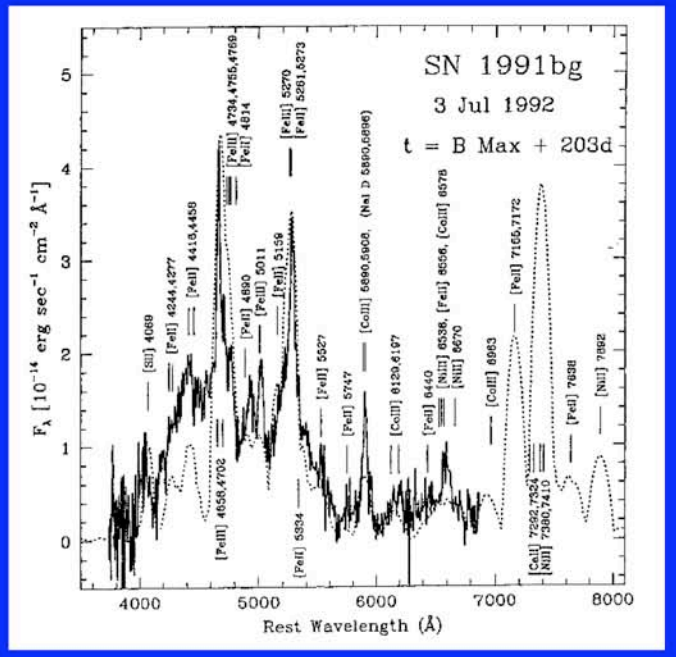
Stritzinger et al. 2006
91bg-likes make only
0.1 M_{sun} ^{56}Ni



SiII velocity continues to decline after maximum => Silicon extends deep



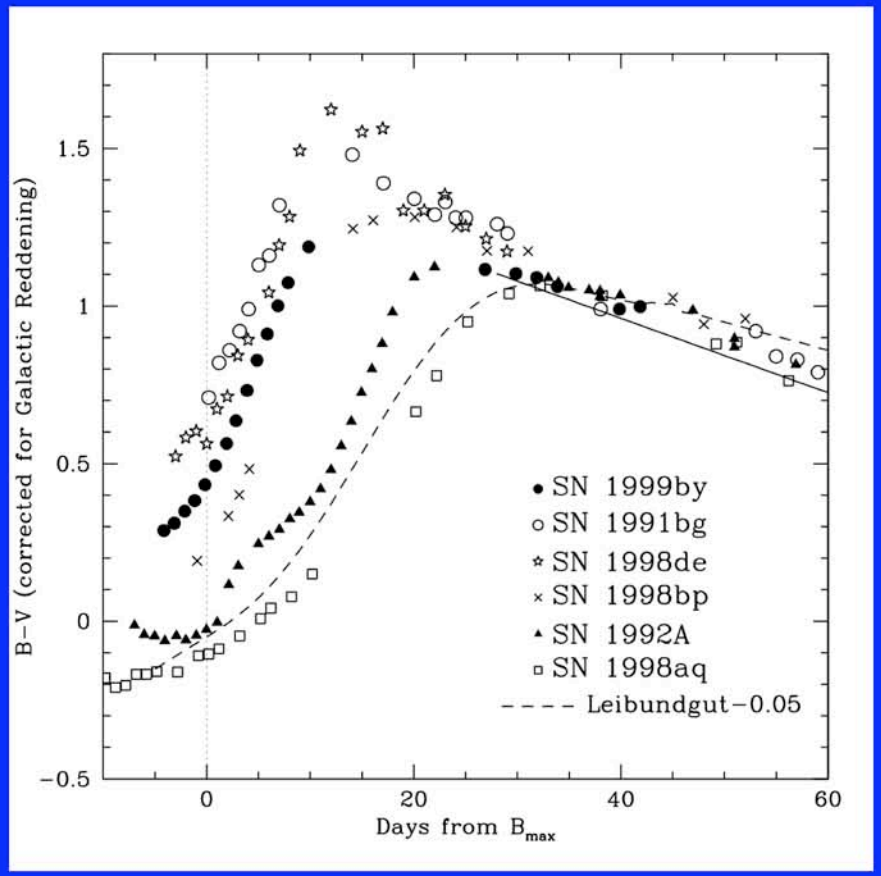
Fe lines narrow in nebular spectra => Ni only out to 2500 km/s (Mazzali et al. 1997)



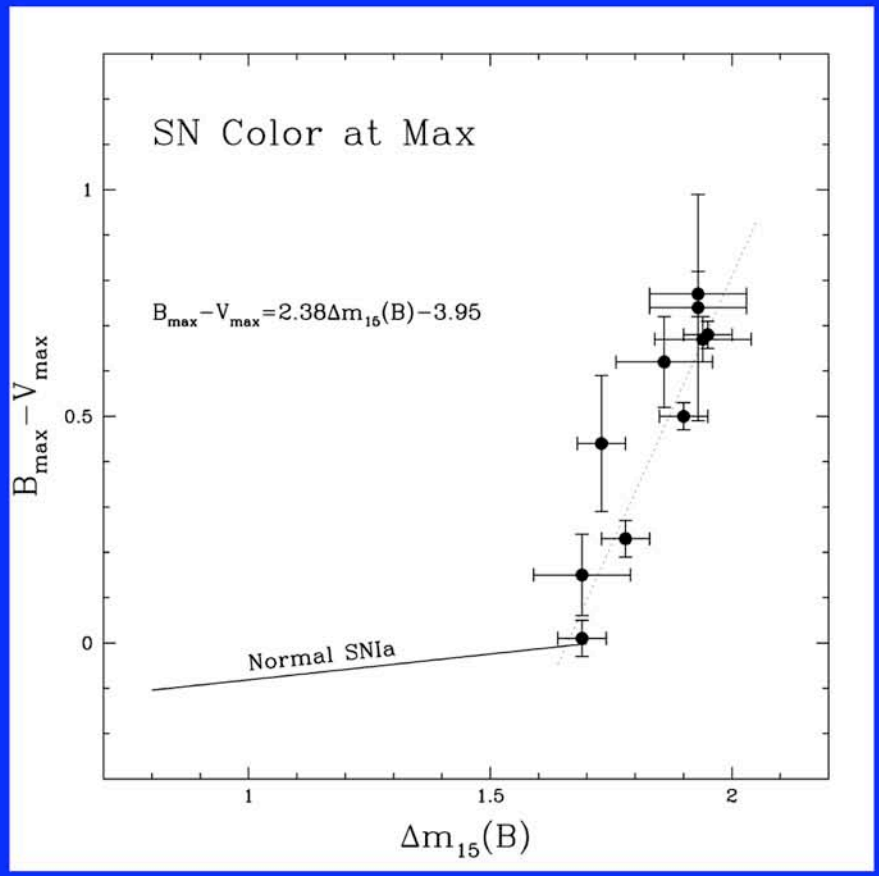
91bg-like Are Cool

Called “peculiar” mainly because they are red at maximum compared with typical SNIa (some of this is TiII line blanketing).

For fast-decliners - color is a better indicator of luminosity than LC shape



color versus time



color versus decline rate

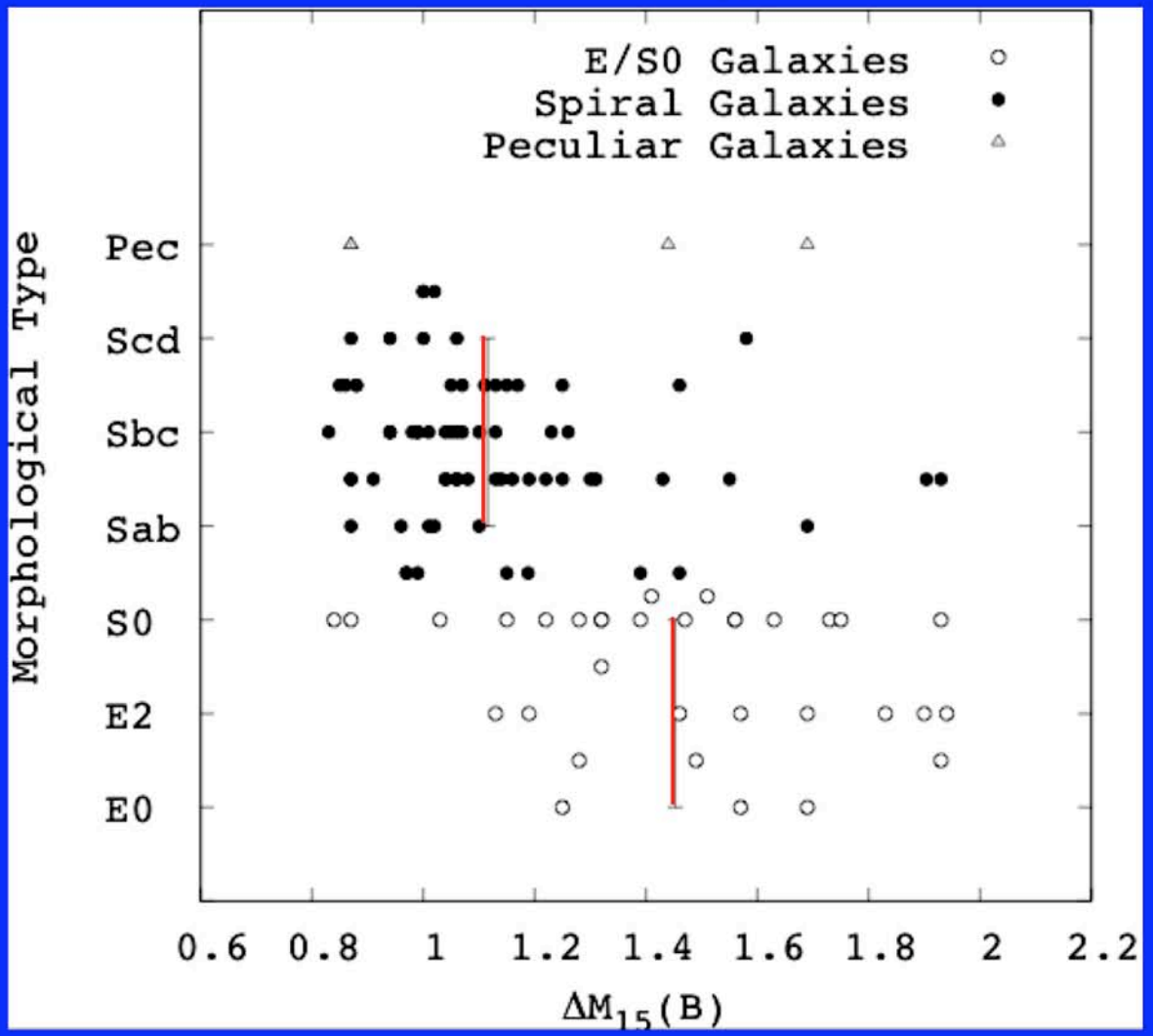
91bg-likes Like Ellipticals/S0

Hamuy et al. (1996) noted a trend between host morphology and SNIa decline rate in Calan/Tololo set

Adding all SNIa available now: See even stronger division between morphological types.

Fast (faint) SNIa like E/S0 galaxies while Slow (bright) events prefer Spirals

Gallagher et al. 2005

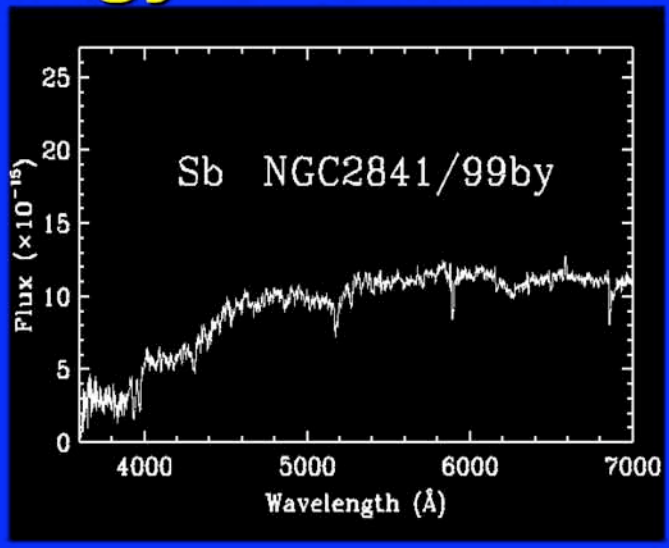


Diversity: Metallicity or population age?

Spectra of Hosts: Morphology is Not Enough

NGC2841 has had two sub-luminous in 50 years (1957A, 1999by) but in an Sb galaxy.

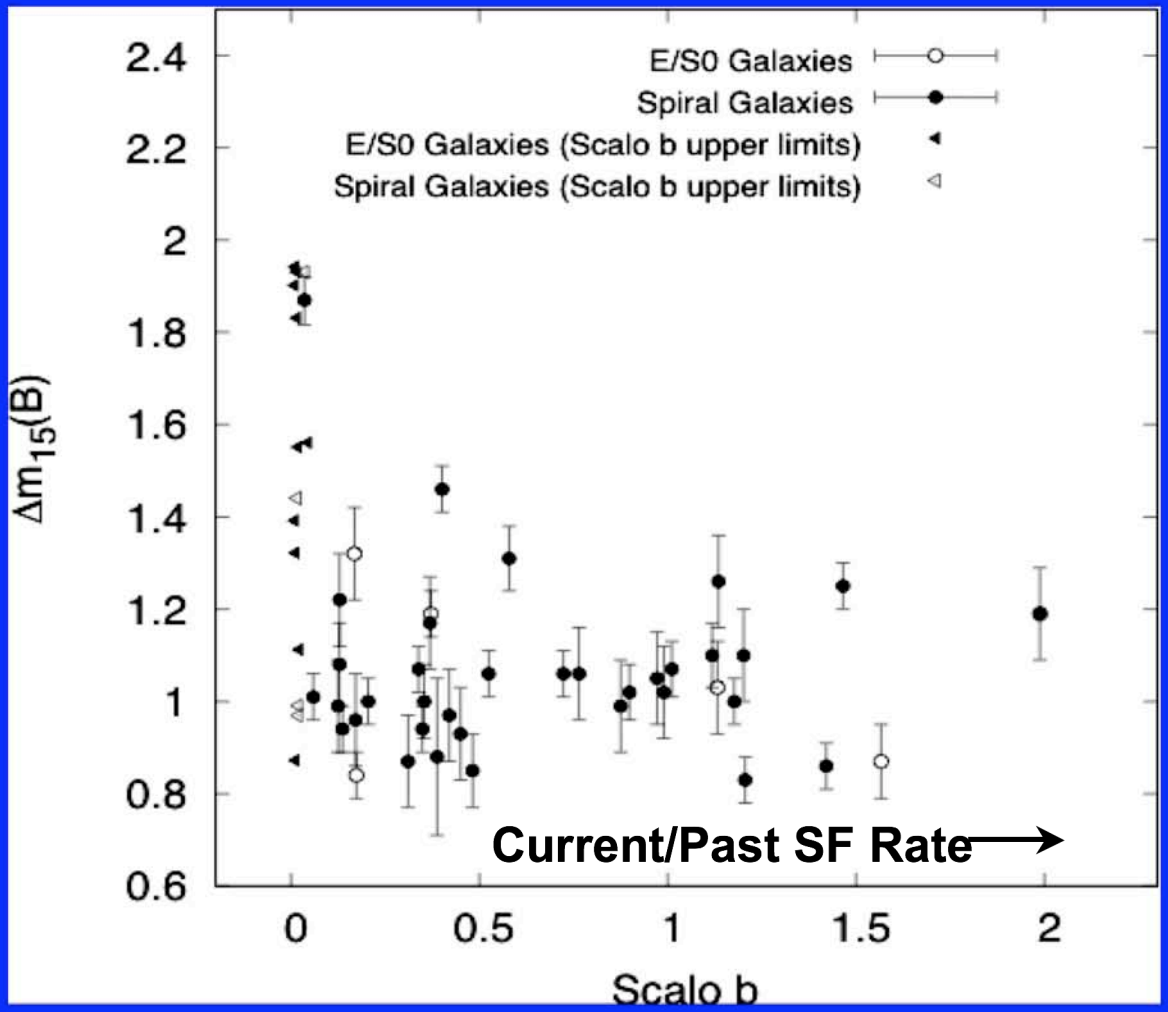
=> Spectra show very little emission indicating a low star-formation rate .



Star Formation History

Hα equivalent width is a measure of the current star formation rate compared to the average in the past – Scalo "b" parameter.

Fast (faint) SNIa found only in hosts with very low SFR (b<<1)



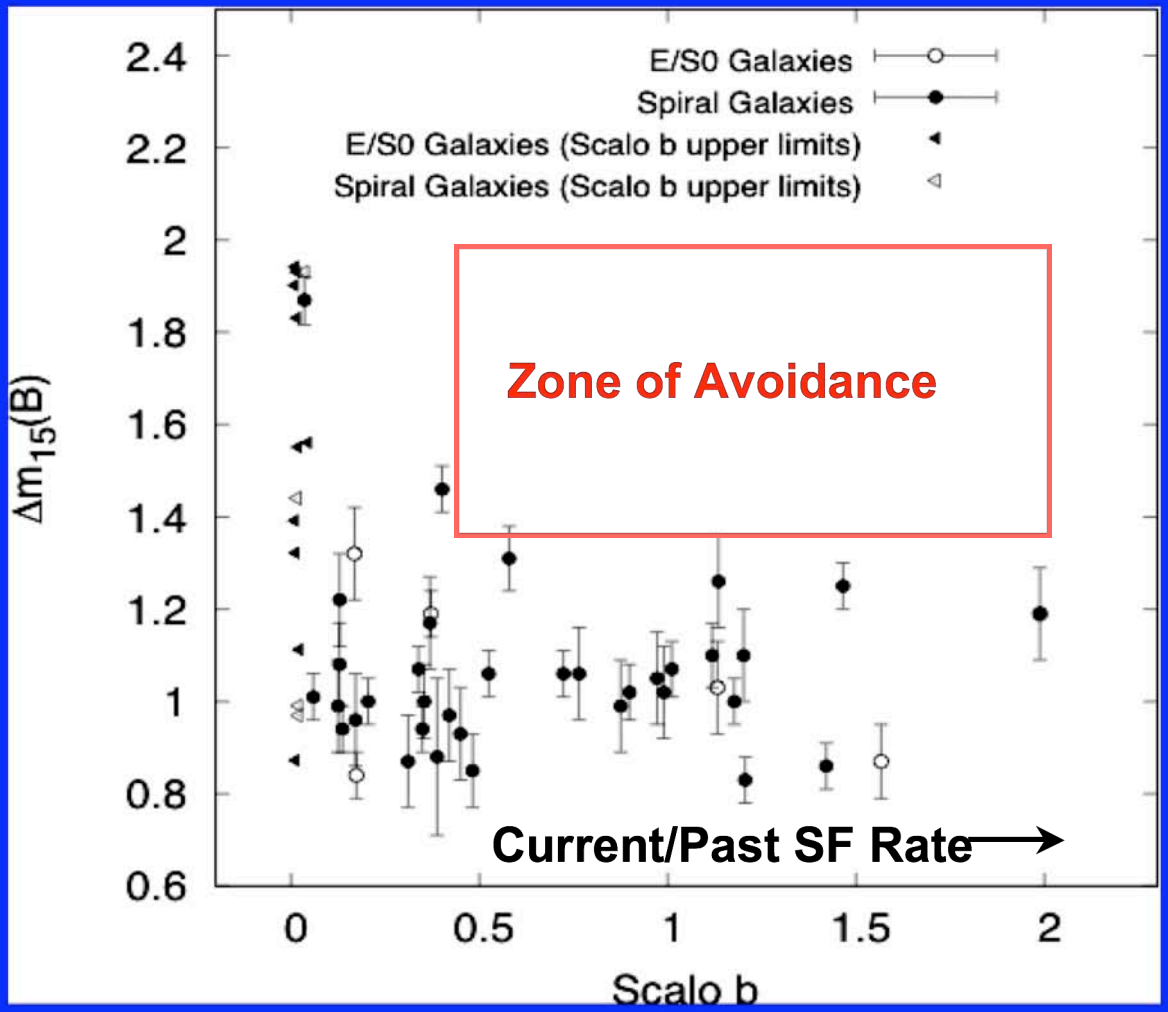
91bg-likes probably require a large population of old stars.

Small star-forming galaxies are dominated by bright, normal SNIa

Star Formation History

Hα equivalent width is a measure of the current star formation rate compared to the average in the past – Scalo "b" parameter.

Fast (faint) SNIa found only in hosts with very low SFR (b<<1)

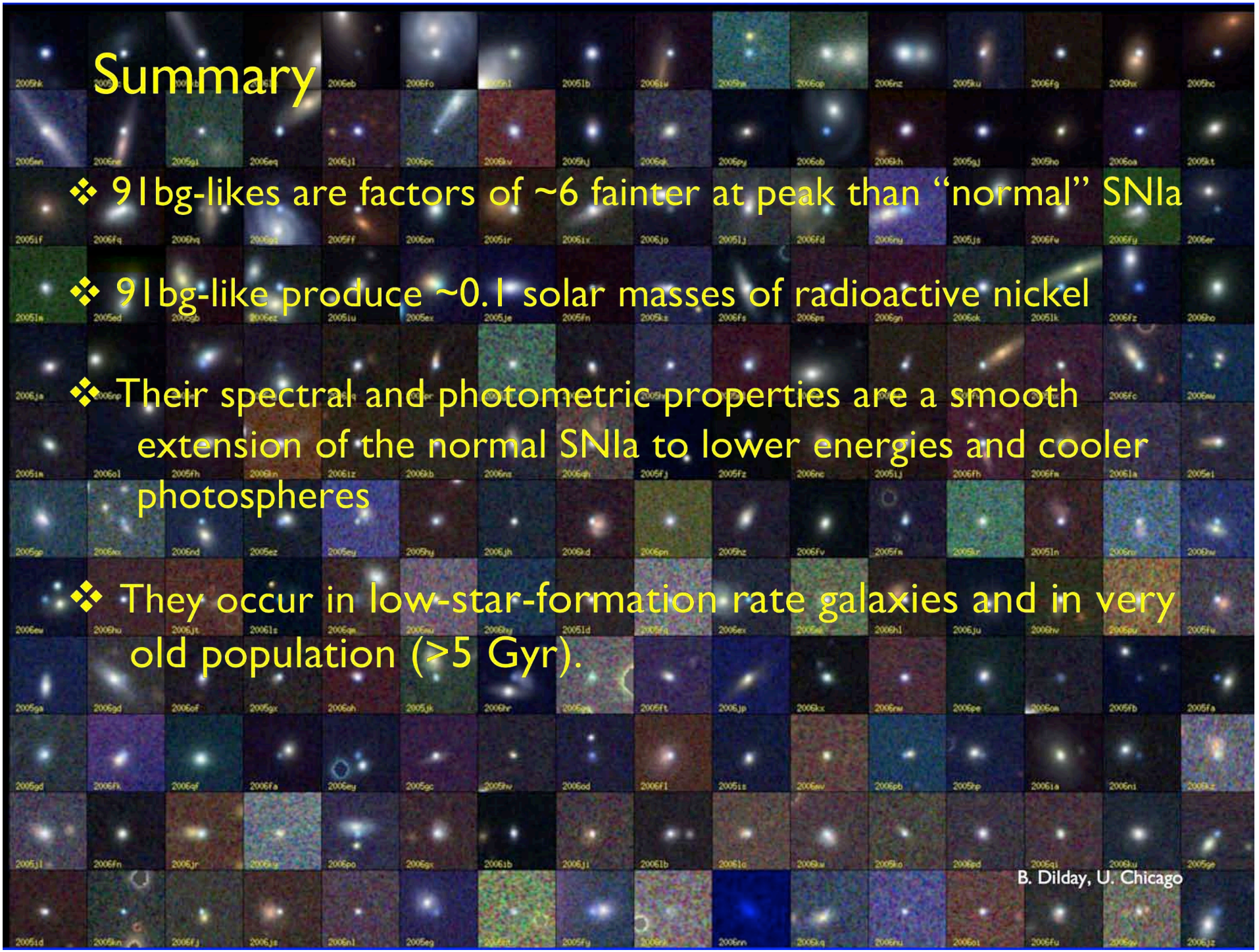


91bg-likes probably require a large population of old stars.

Small star-forming galaxies are dominated by bright, normal SNIa

Summary

- 91bg-likes are factors of ~6 fainter at peak than "normal" SNIa
- 91bg-like produce ~0.1 solar masses of radioactive nickel
- Their spectral and photometric properties are a smooth extension of the normal SNIa to lower energies and cooler photospheres
- They occur in low-star-formation rate galaxies and in very old population (>5 Gyr).



B. Dilday, U. Chicago

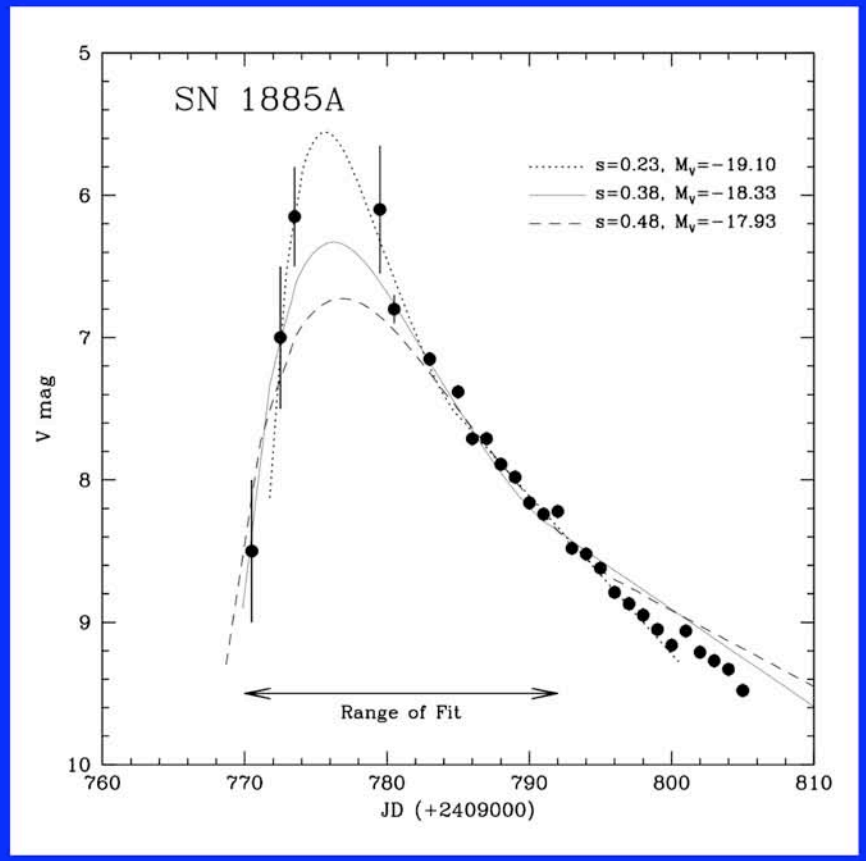
Summary

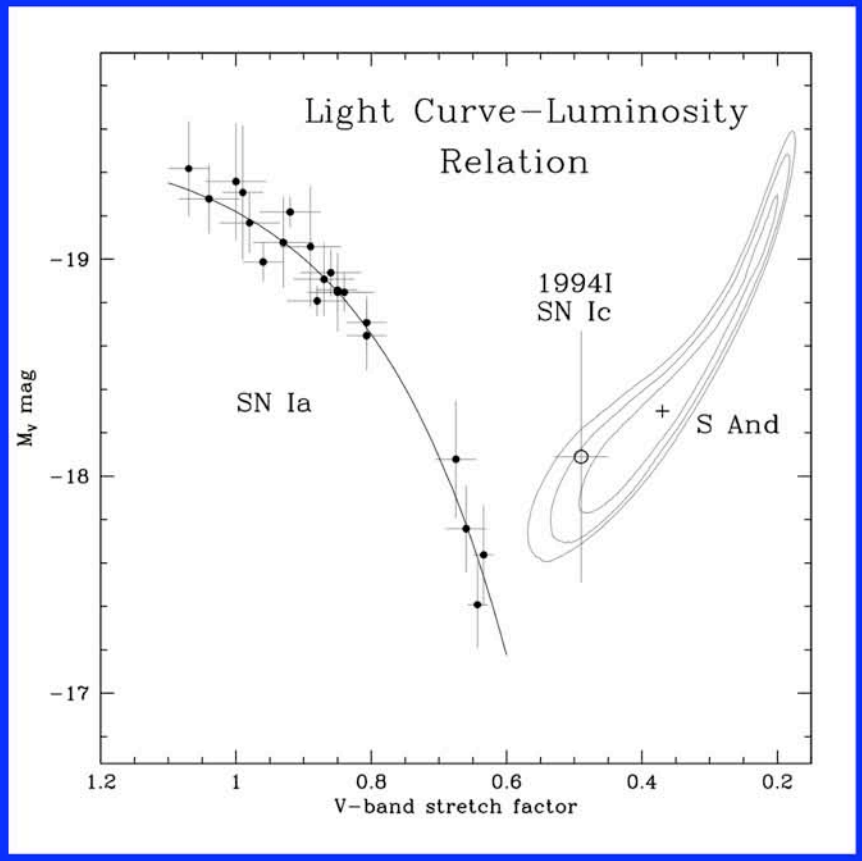
- 91bg-likes are factors of ~6 fainter at peak than "normal" SNIa
- 91bg-like produce ~0.1 solar masses of radioactive nickel
- Their spectral and photometric properties are a smooth extension of the normal SNIa to lower energies and cooler photospheres
- They occur in low-star-formation rate galaxies and in very old population (>5 Gyr).

SN 1885A (in M31): a 91bg-like?

Too bright and fast compared with known 91bg-likes

(If you believe the light curve)





Light Curve from deVaucouleurs & Corwin 1985