

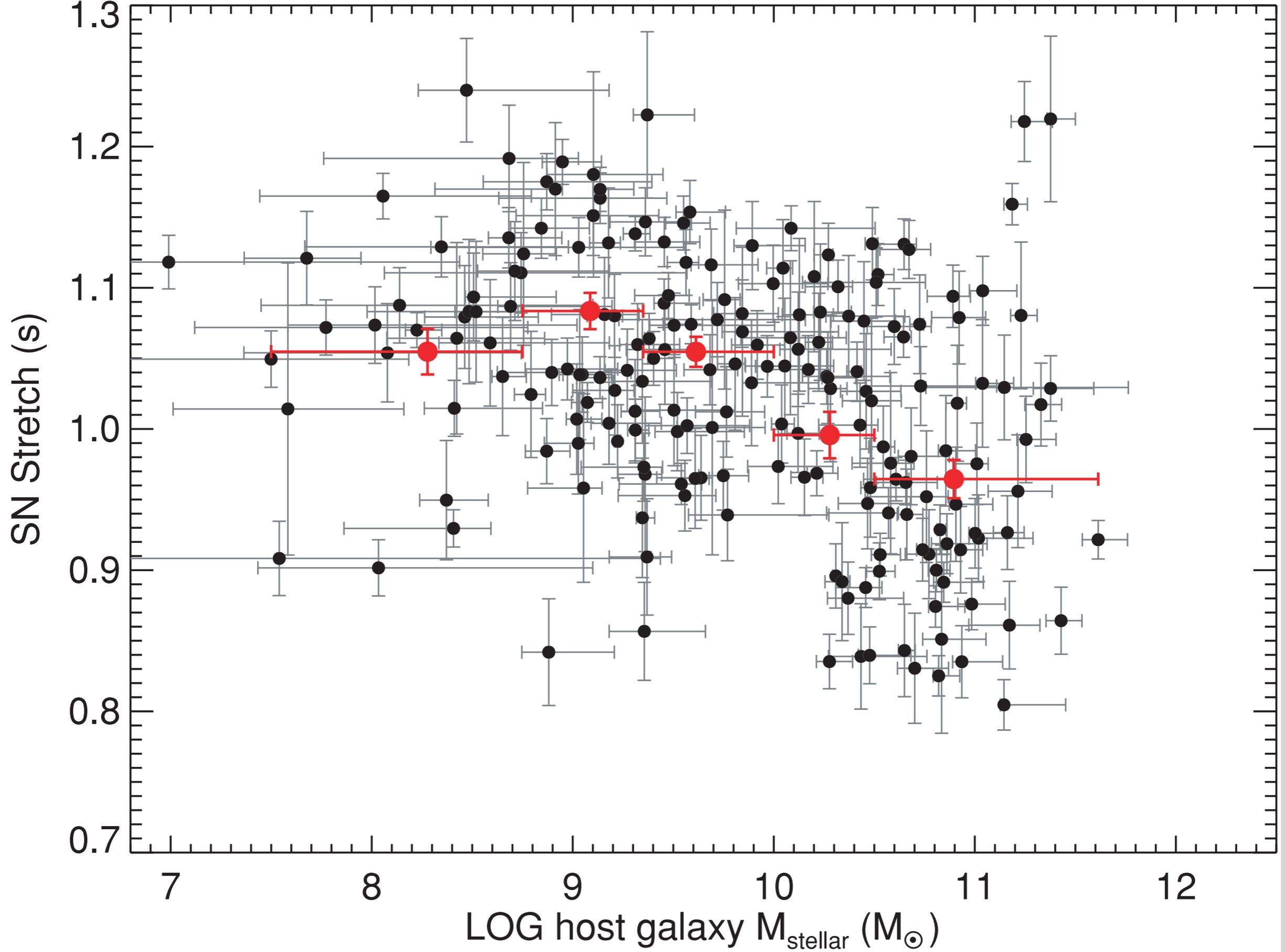
How Supernova Progenitors Affect the Explosions

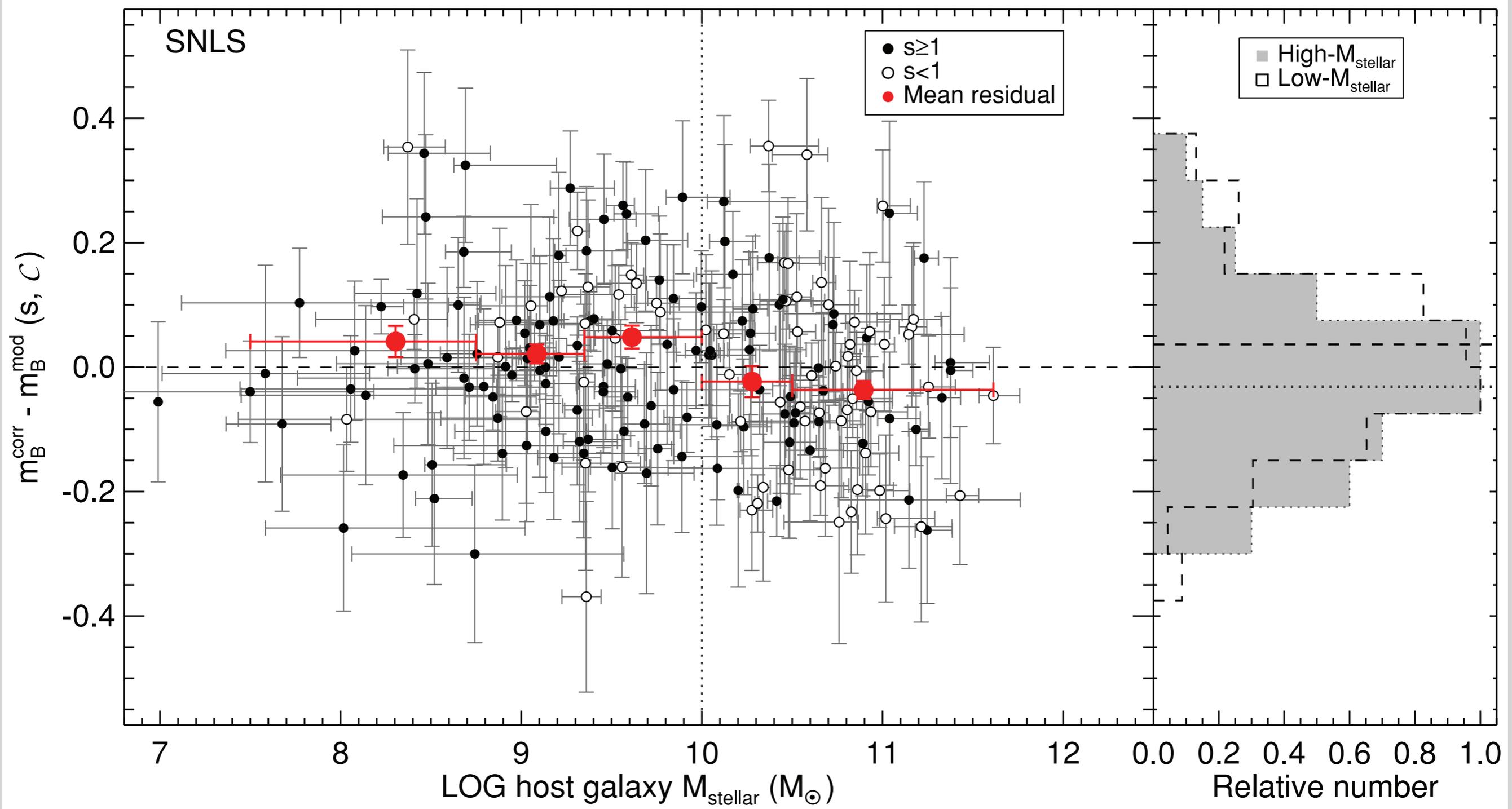
Progenitor System

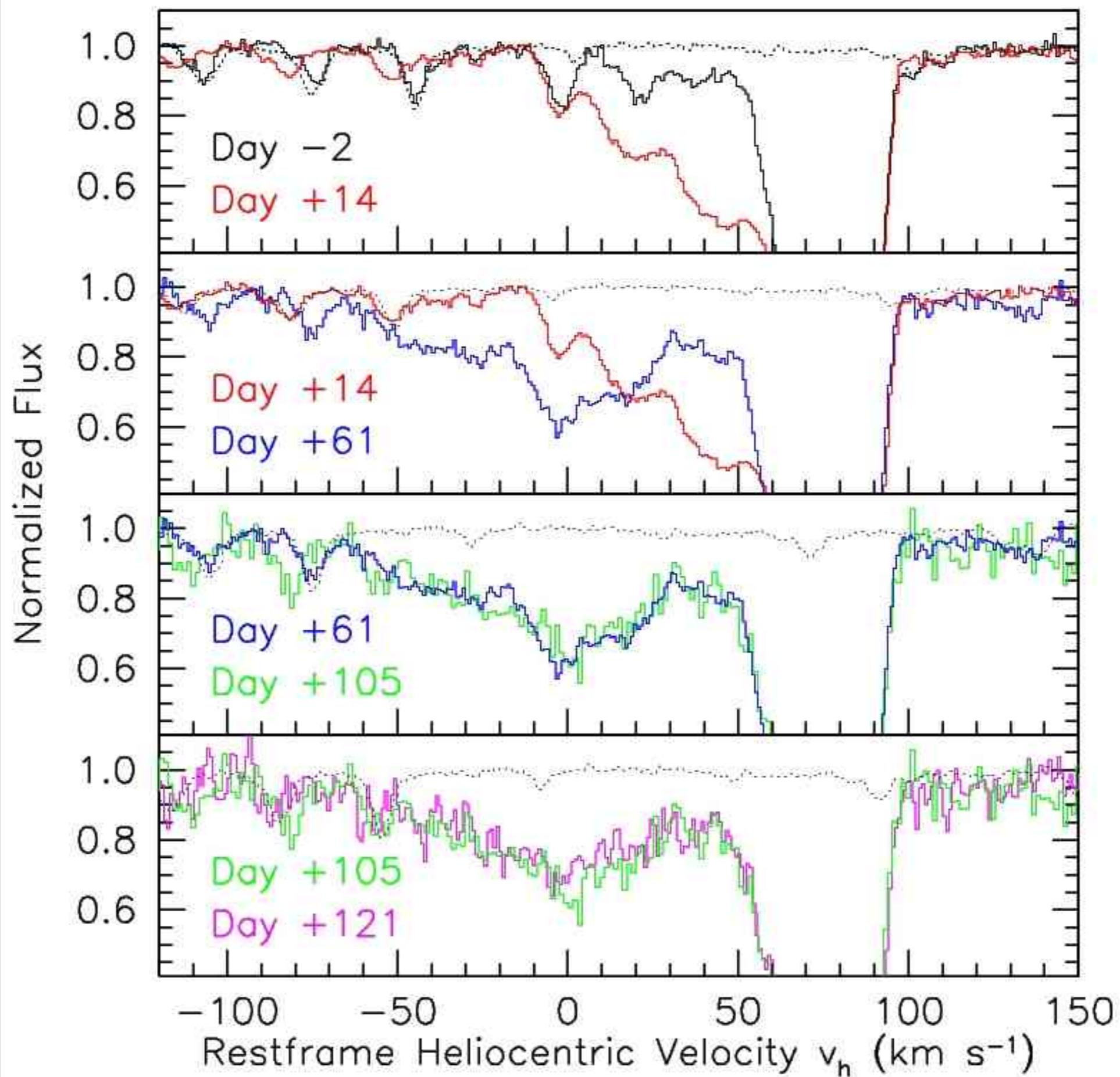
**Single vs. Double Degenerate
Circumstellar Material**

Progenitor Composition

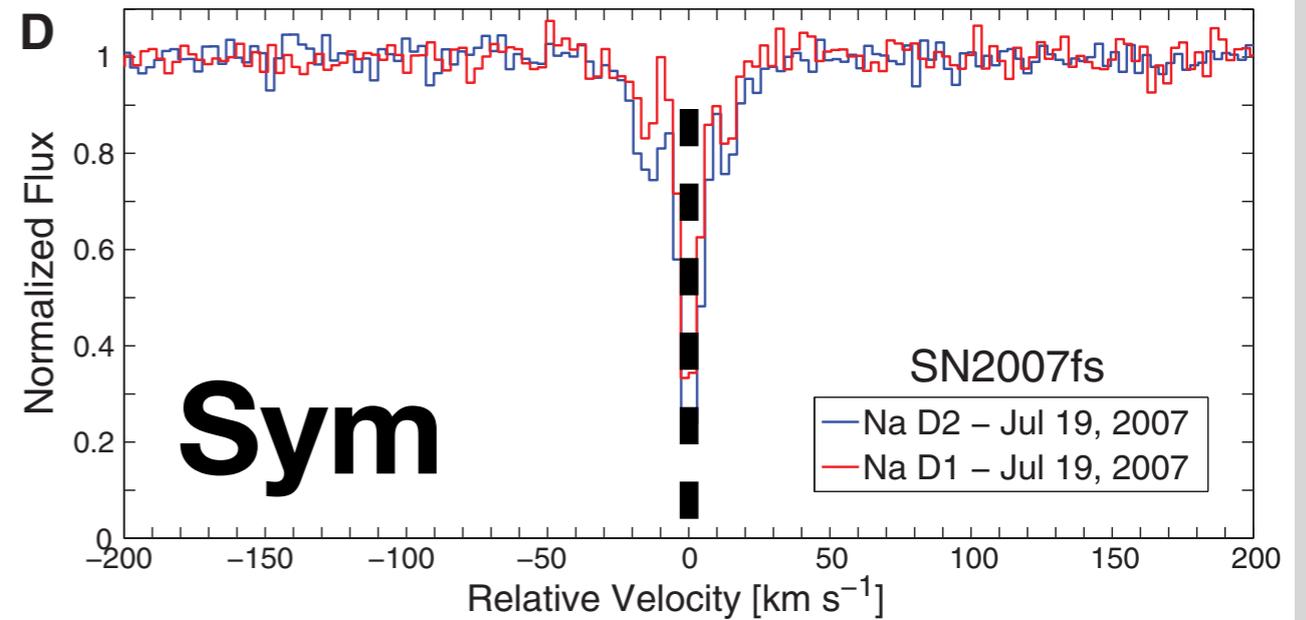
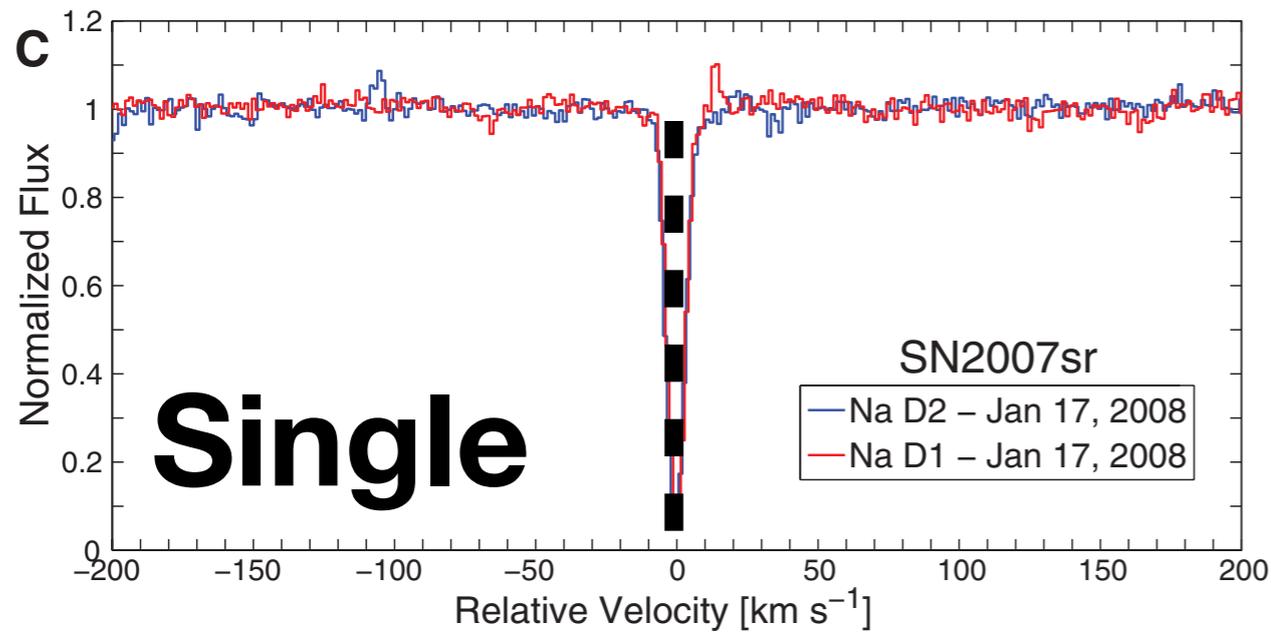
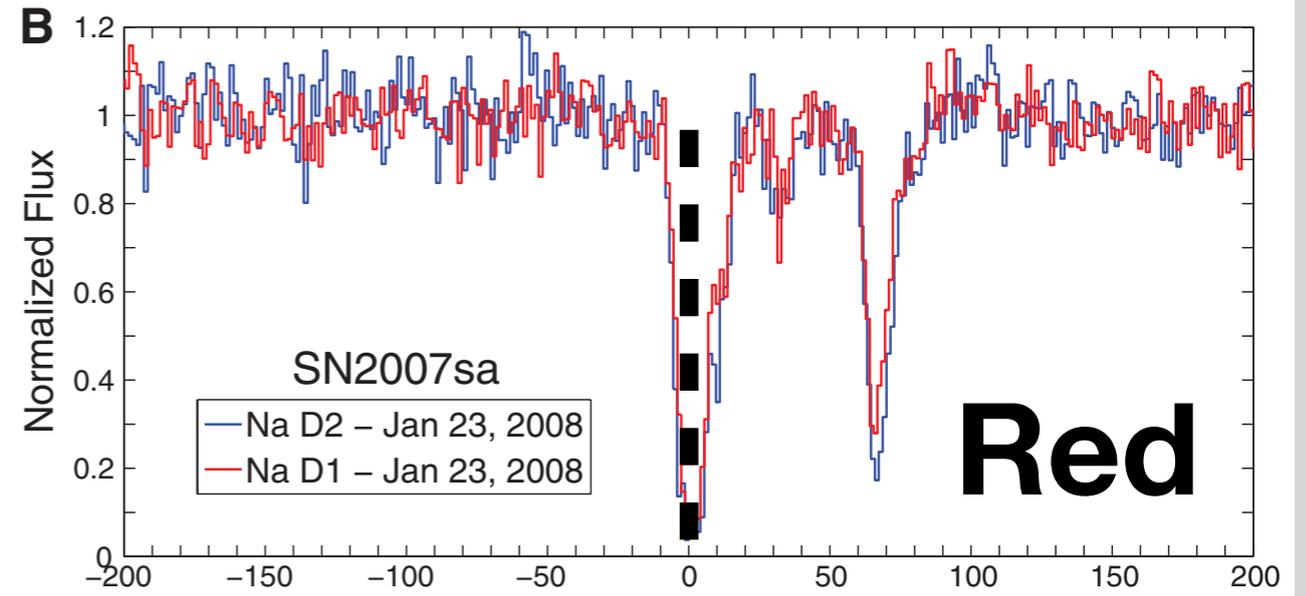
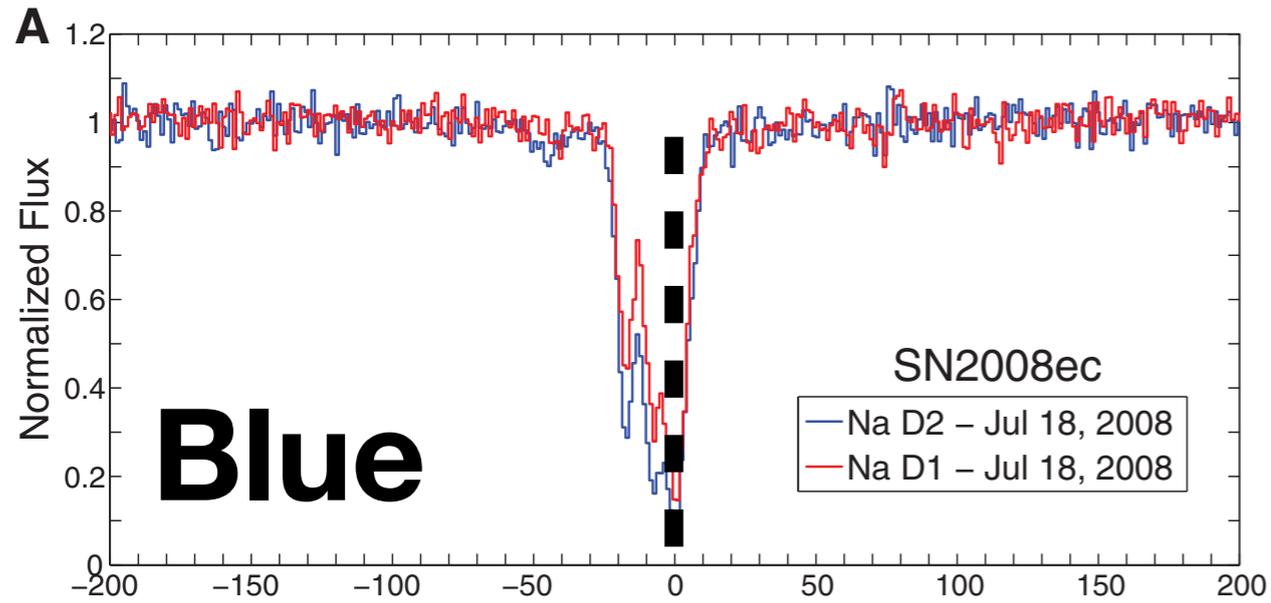
Metal Abundance



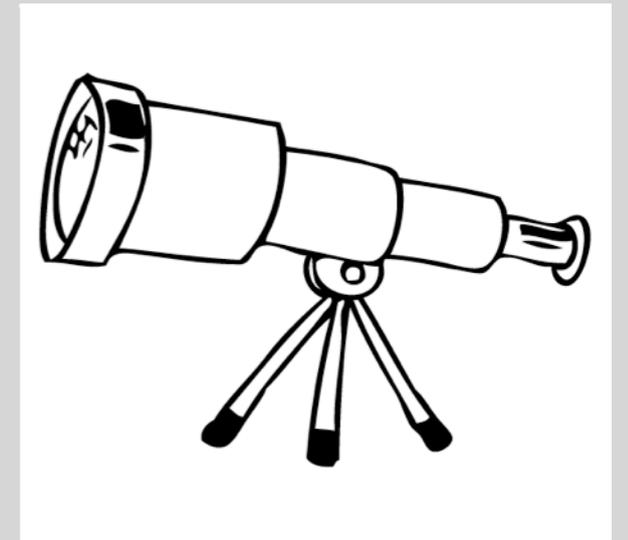
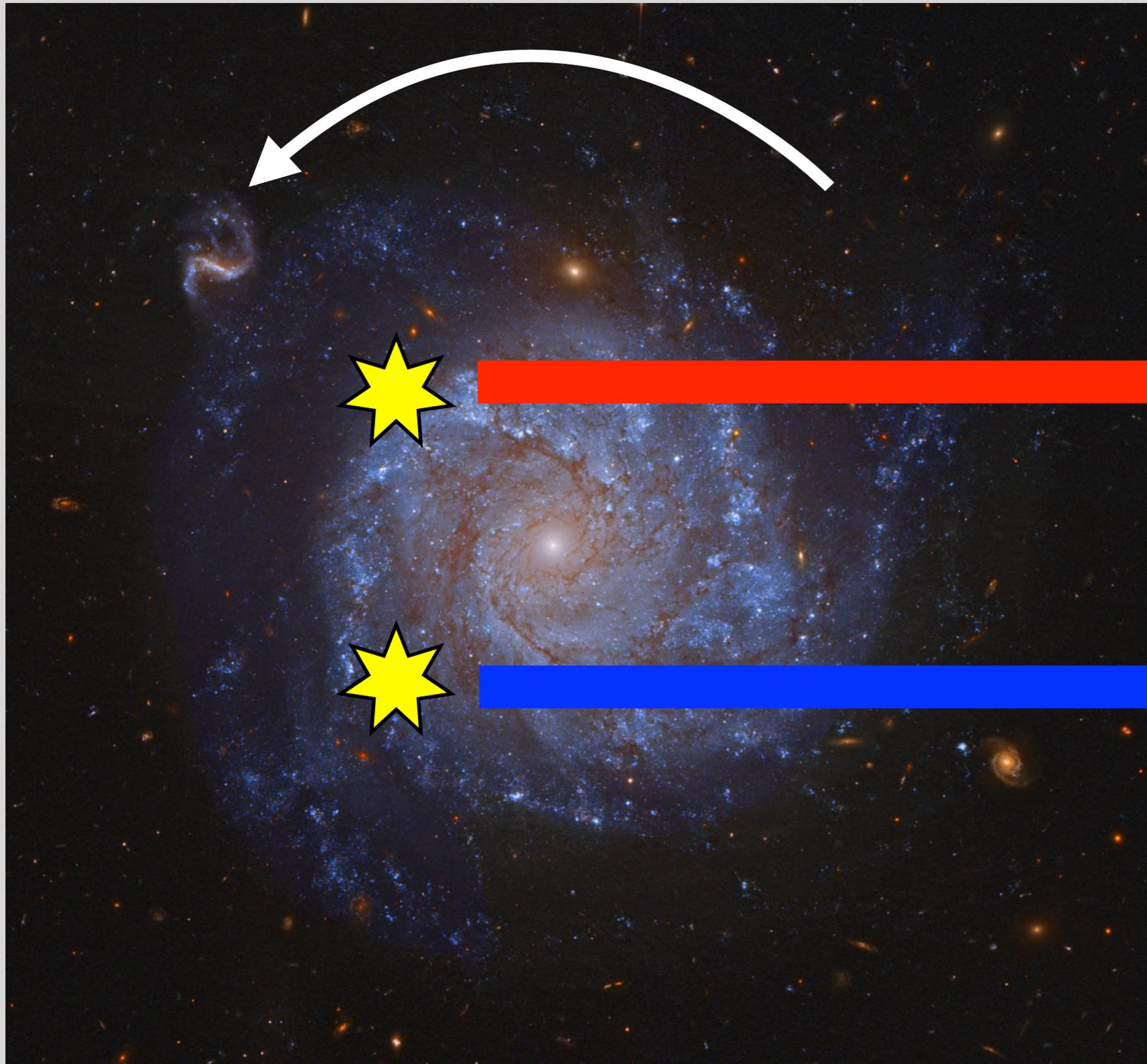




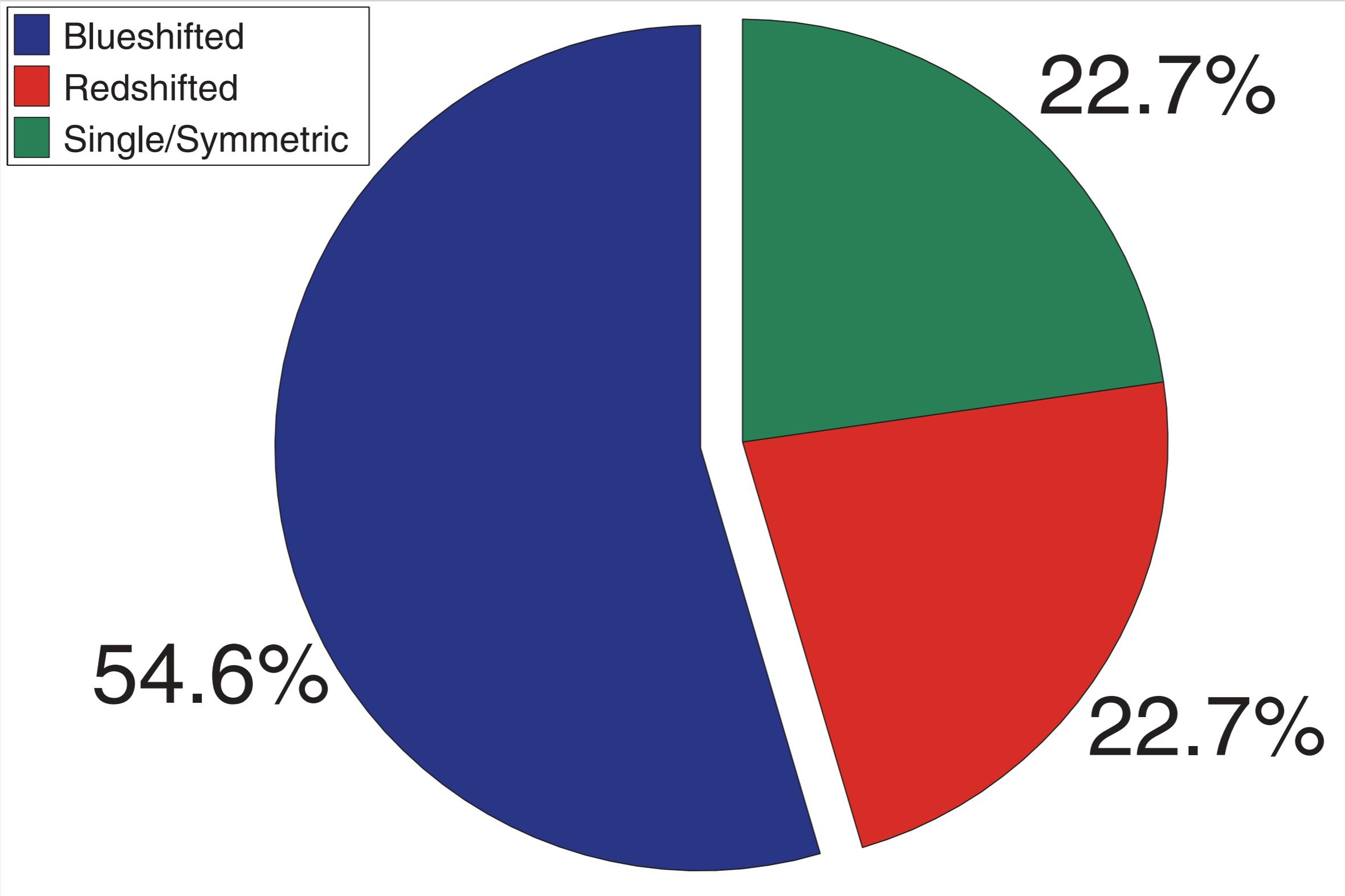
High-Resolution Spectra Probe Gas



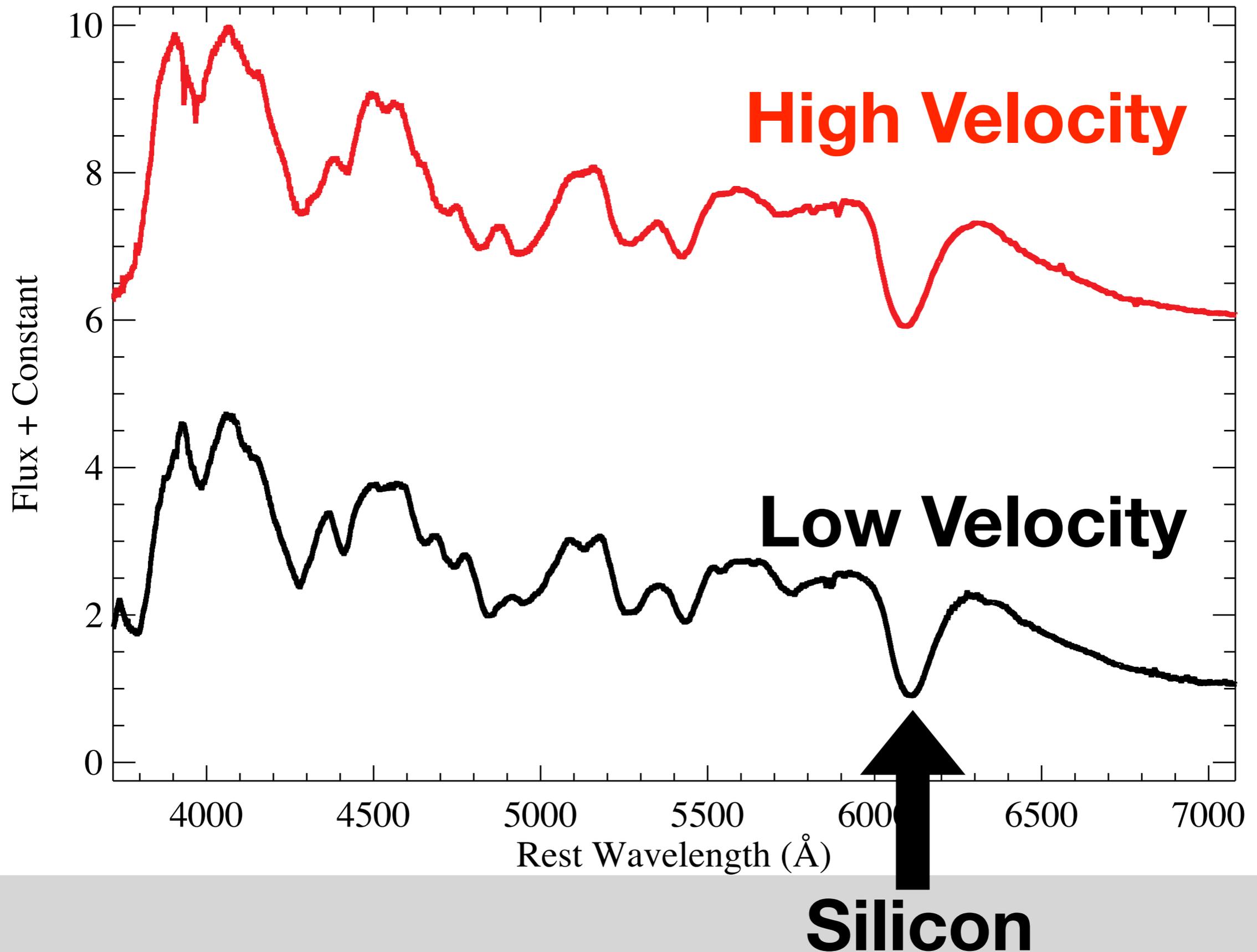
Equal Blue/Redshifted Fraction for ISM



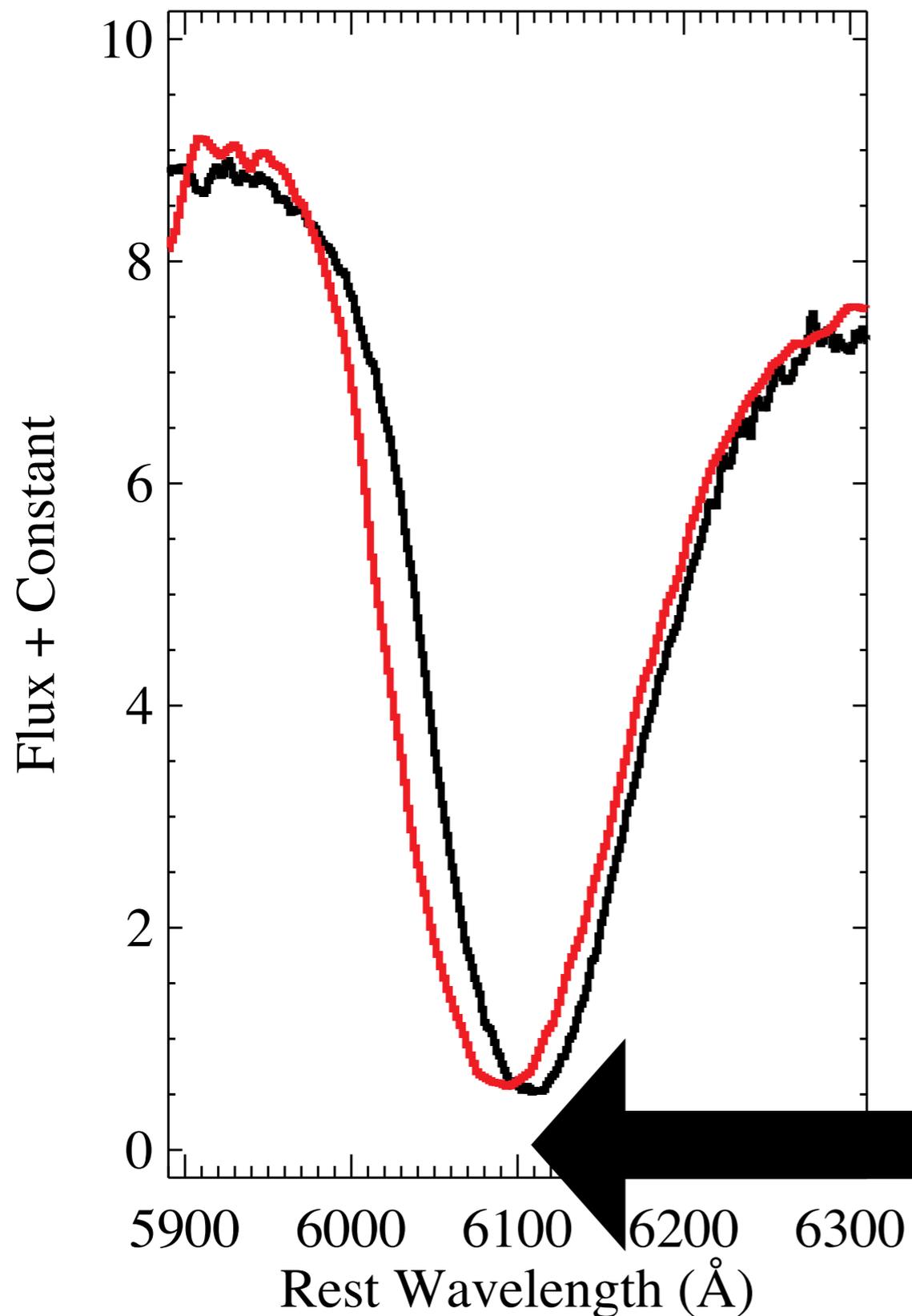
Many SN Ia Progenitors Have Winds



Optical Spectrum to Measure Velocity



Measure Silicon Velocity

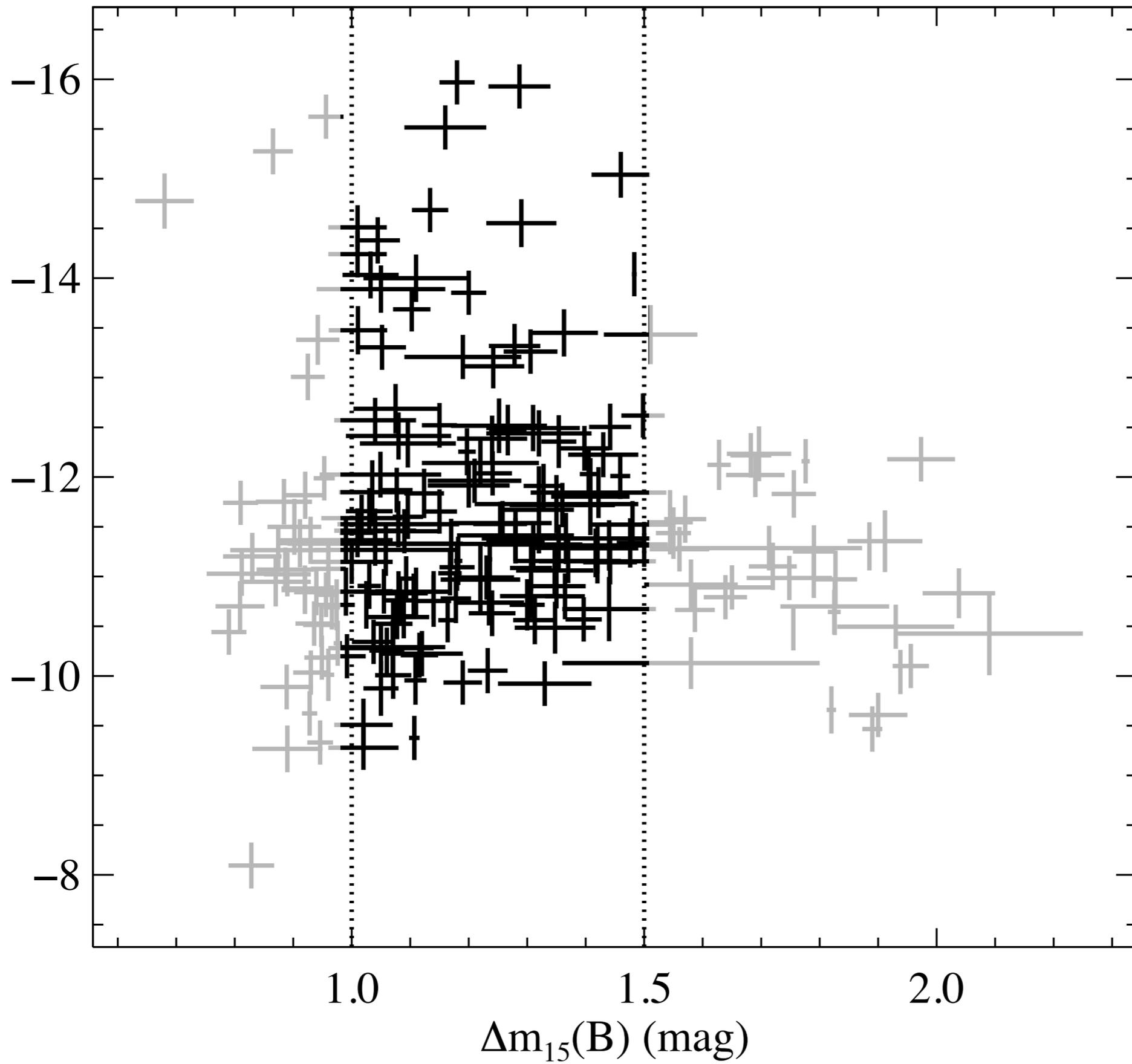


High Velocity:
~ -13,000 km s⁻¹

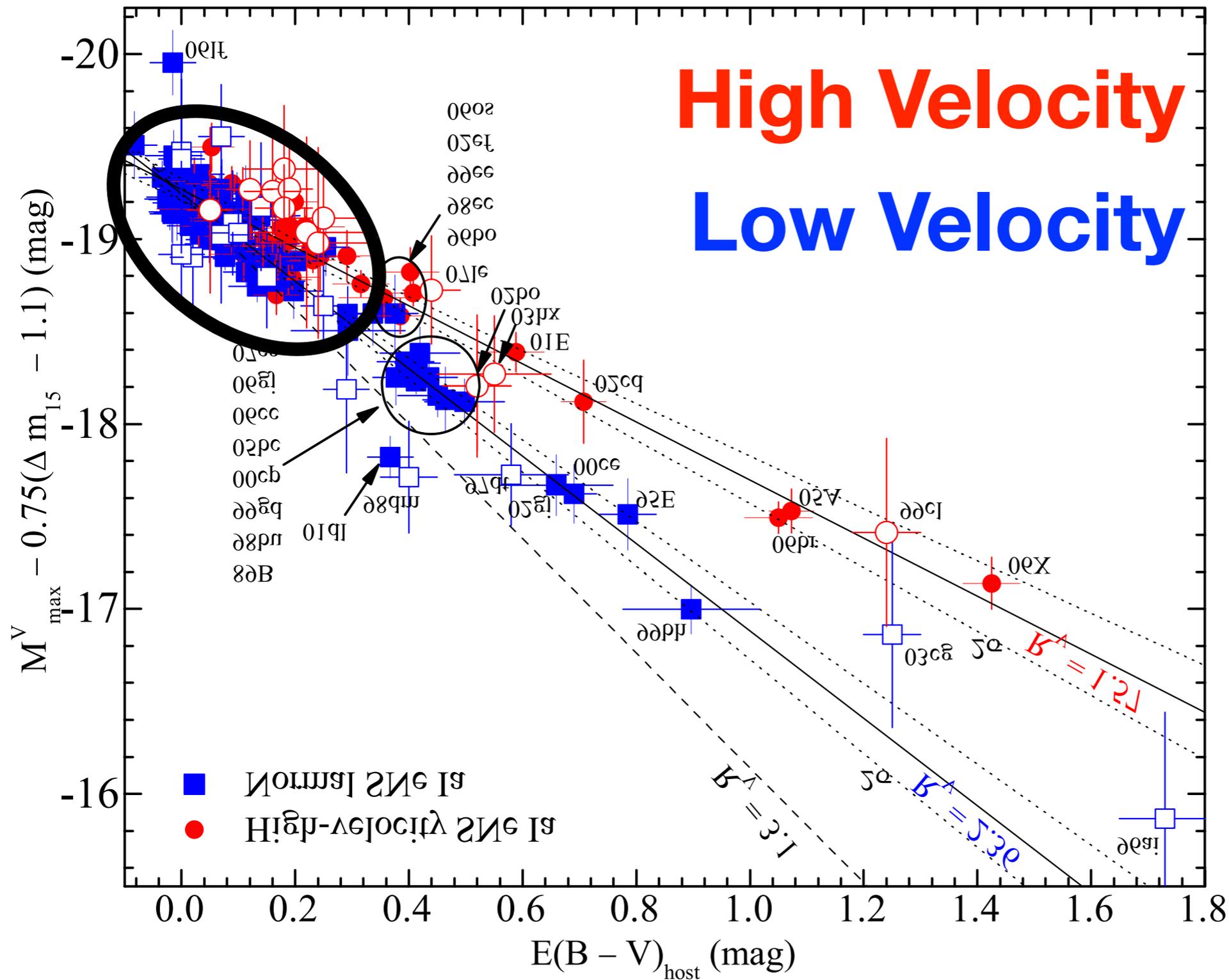
Low Velocity:
~ -10,000 km s⁻¹

**Wider Lines With
Higher Velocity**

Si II Velocity at Maximum Brightness (10^3 km s^{-1})



2 Values of R_V ?



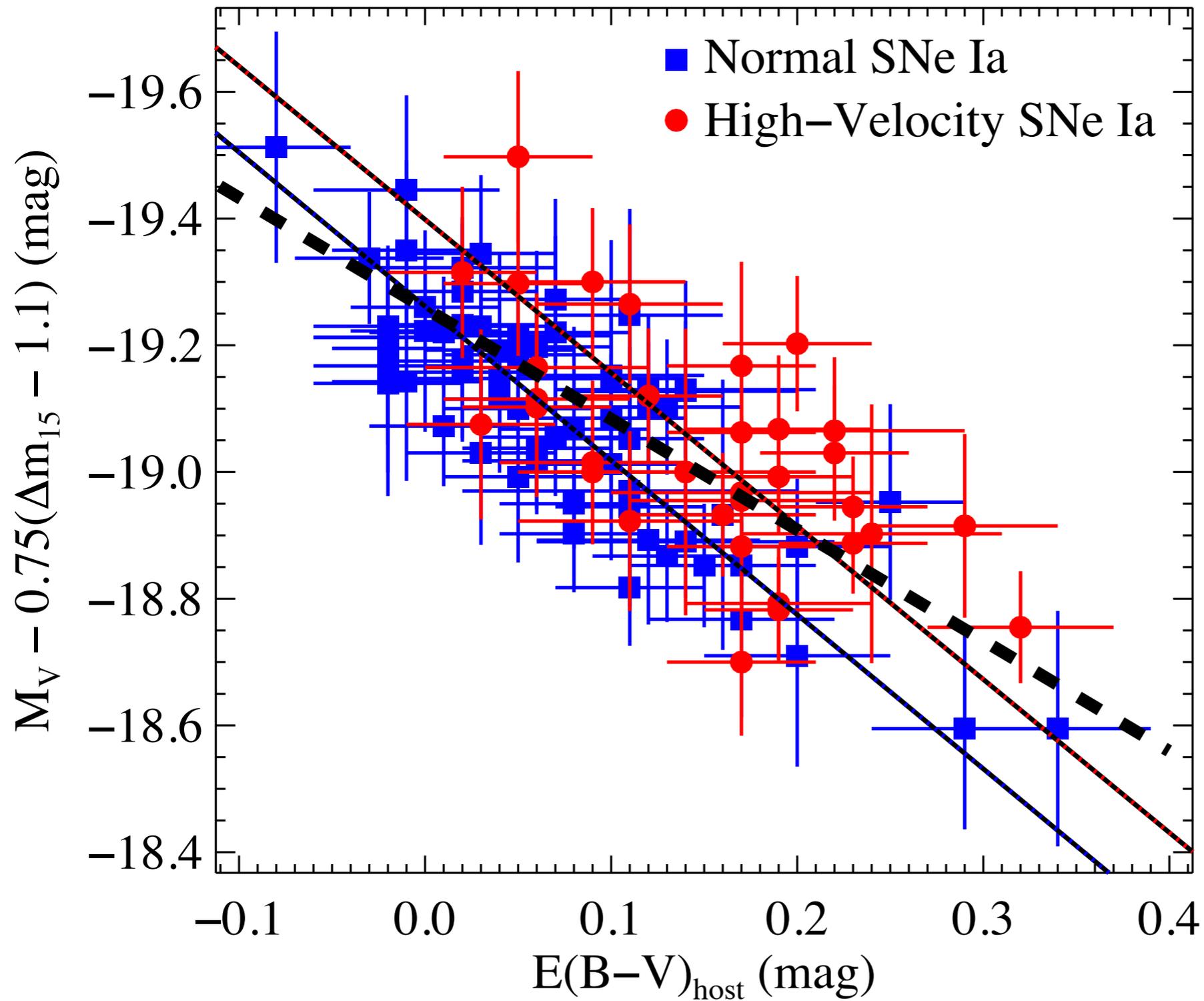
A_V



$R_V =$

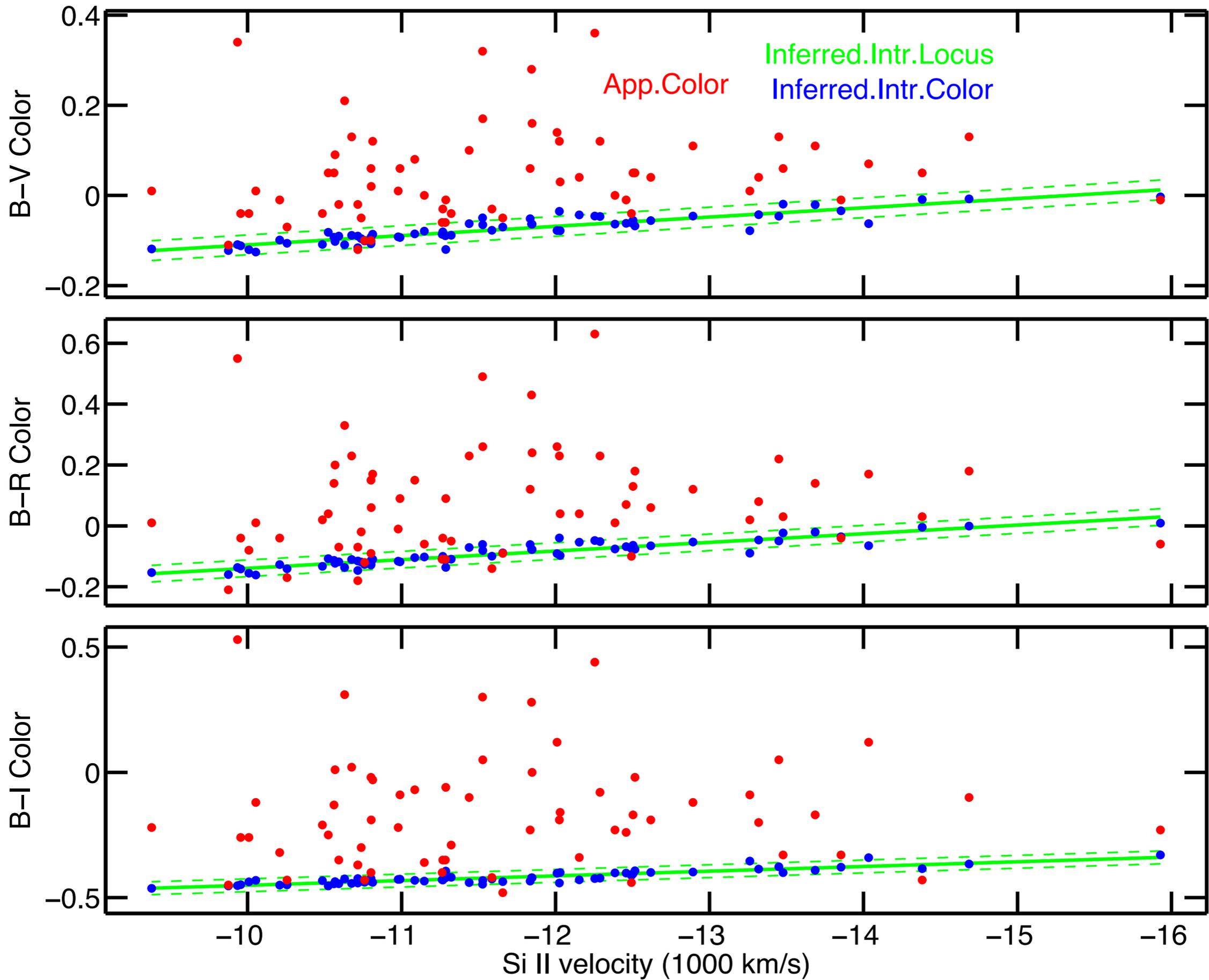
$A_V / E(B - V)$

2 Values of R_V ?

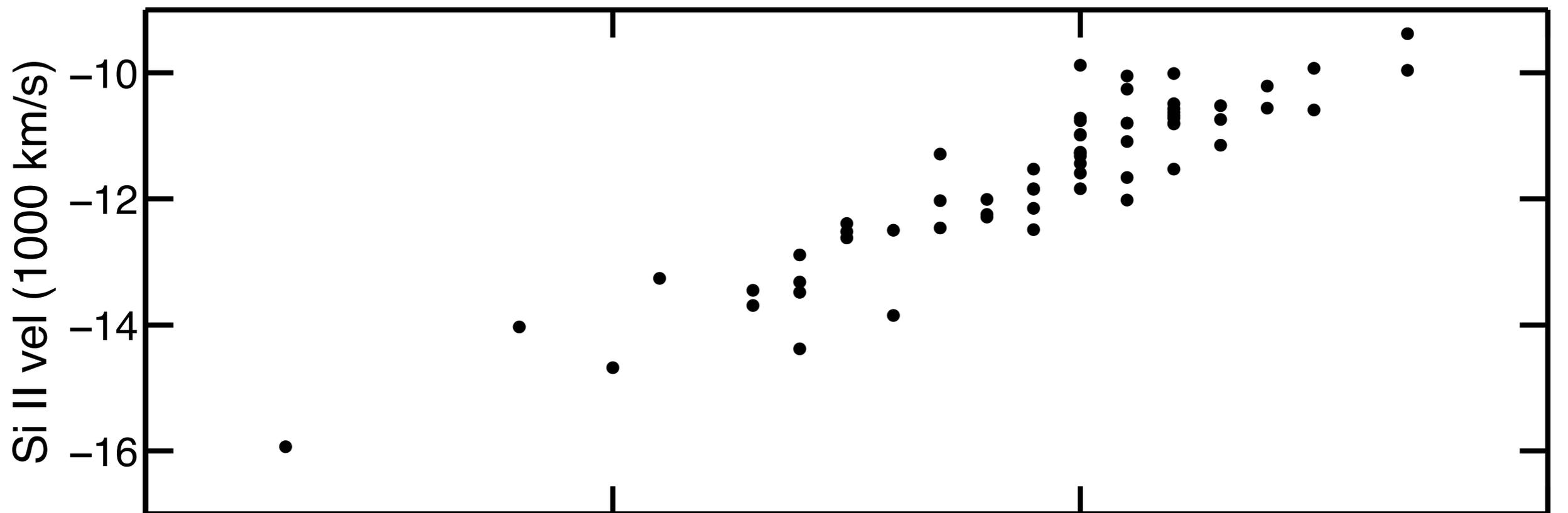


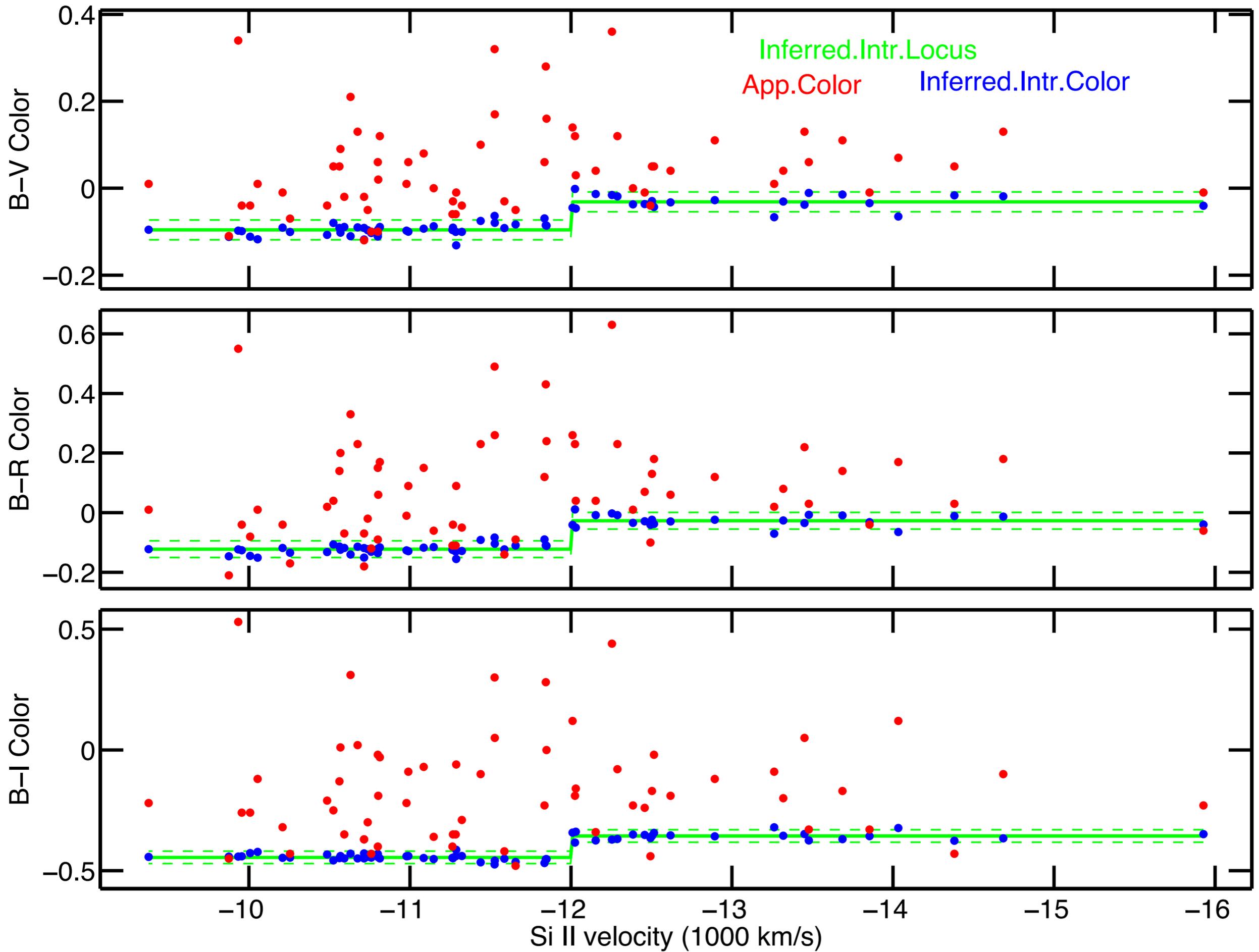
121 SNe

**2 Classes
Raises R_V
(More like
Milky Way)**

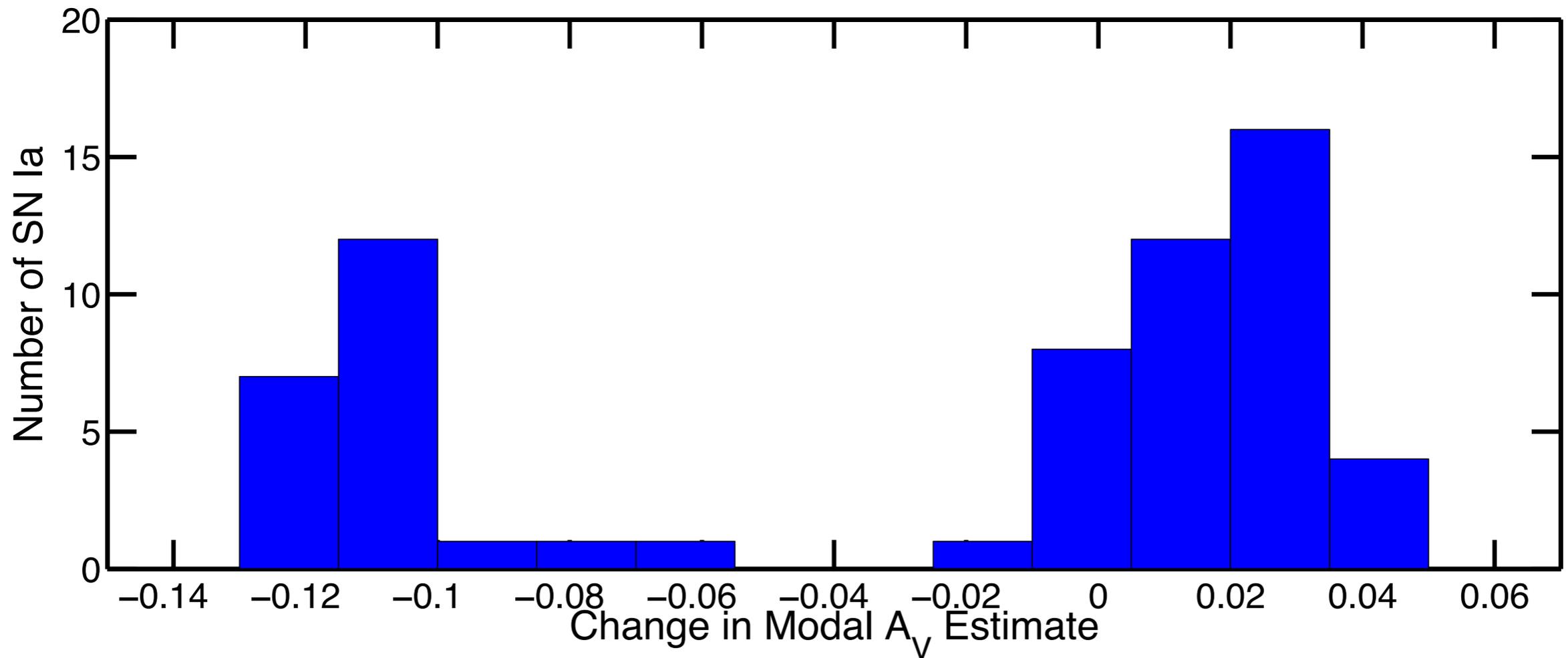
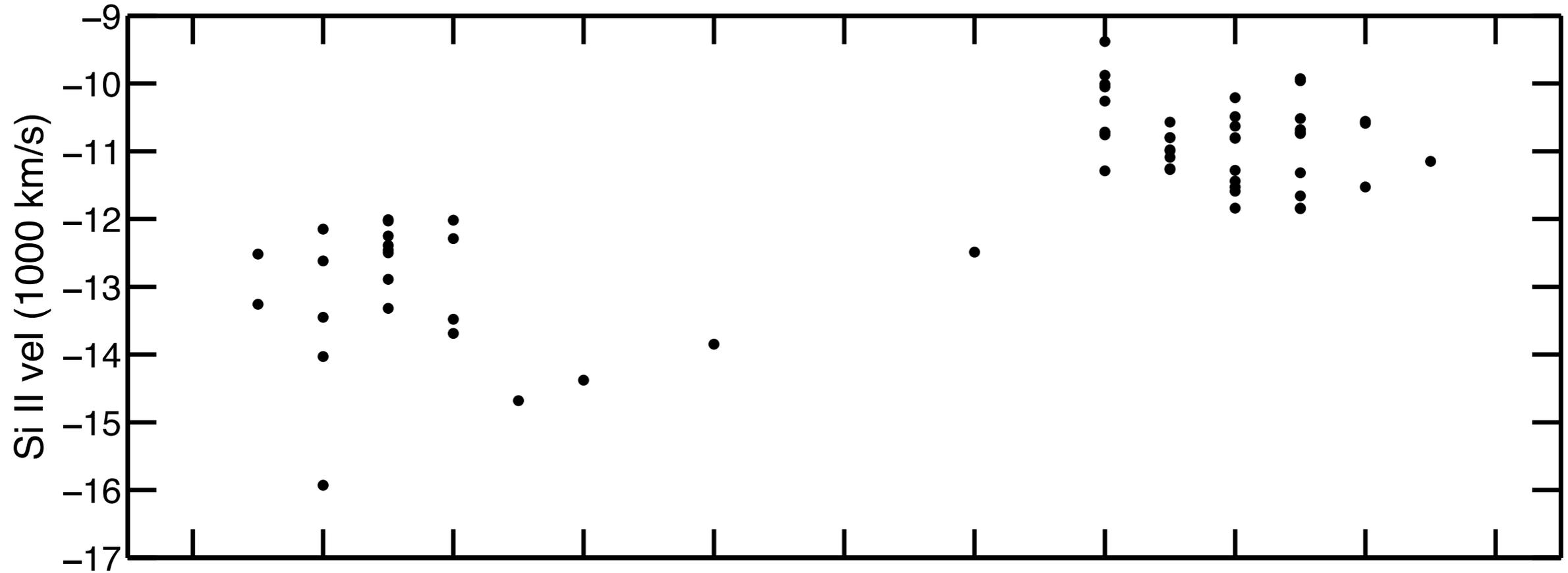


Si II Linear Function versus Constant Mean Color

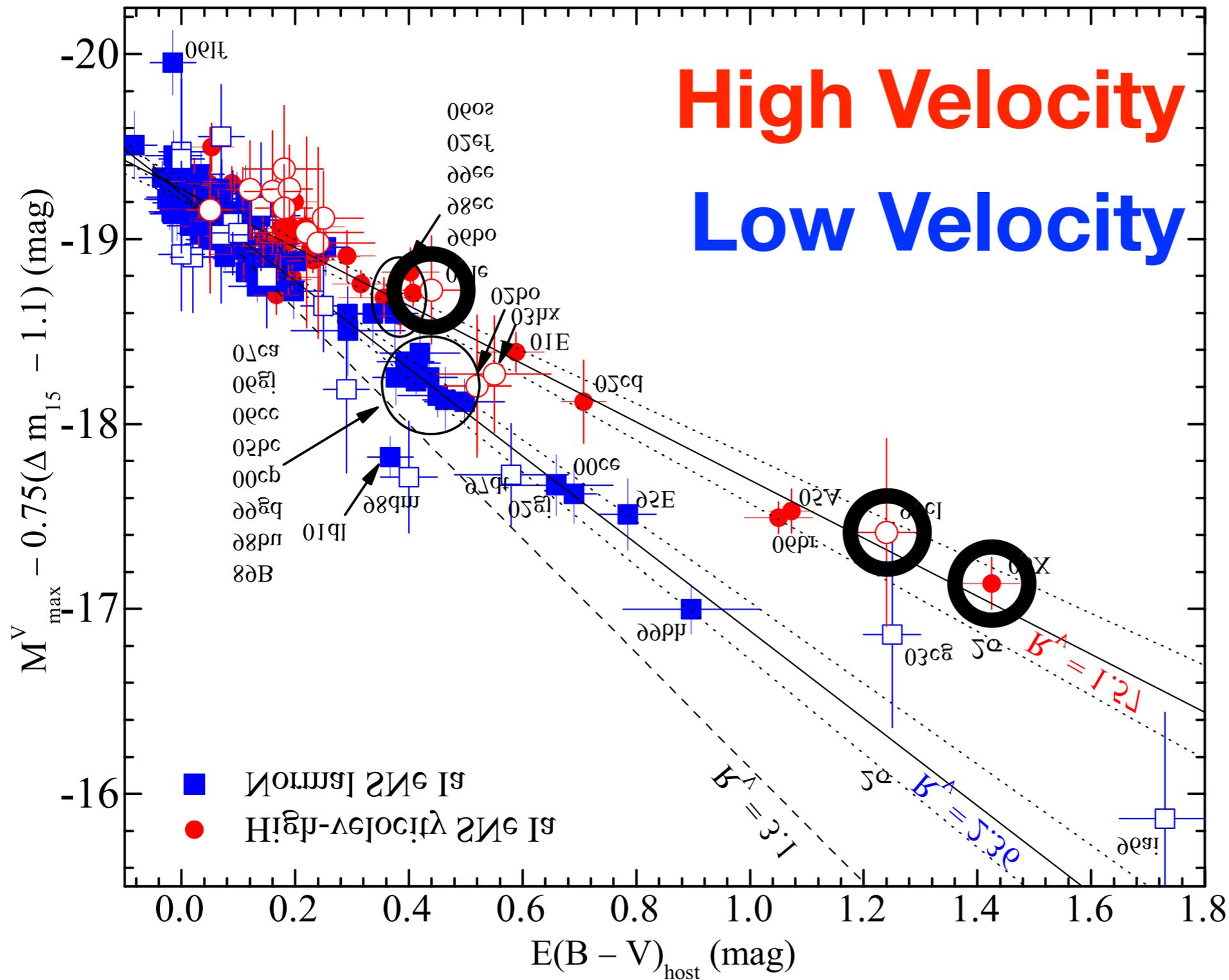




Si II Step Function versus Constant Mean Color



2 Values of R_V ?

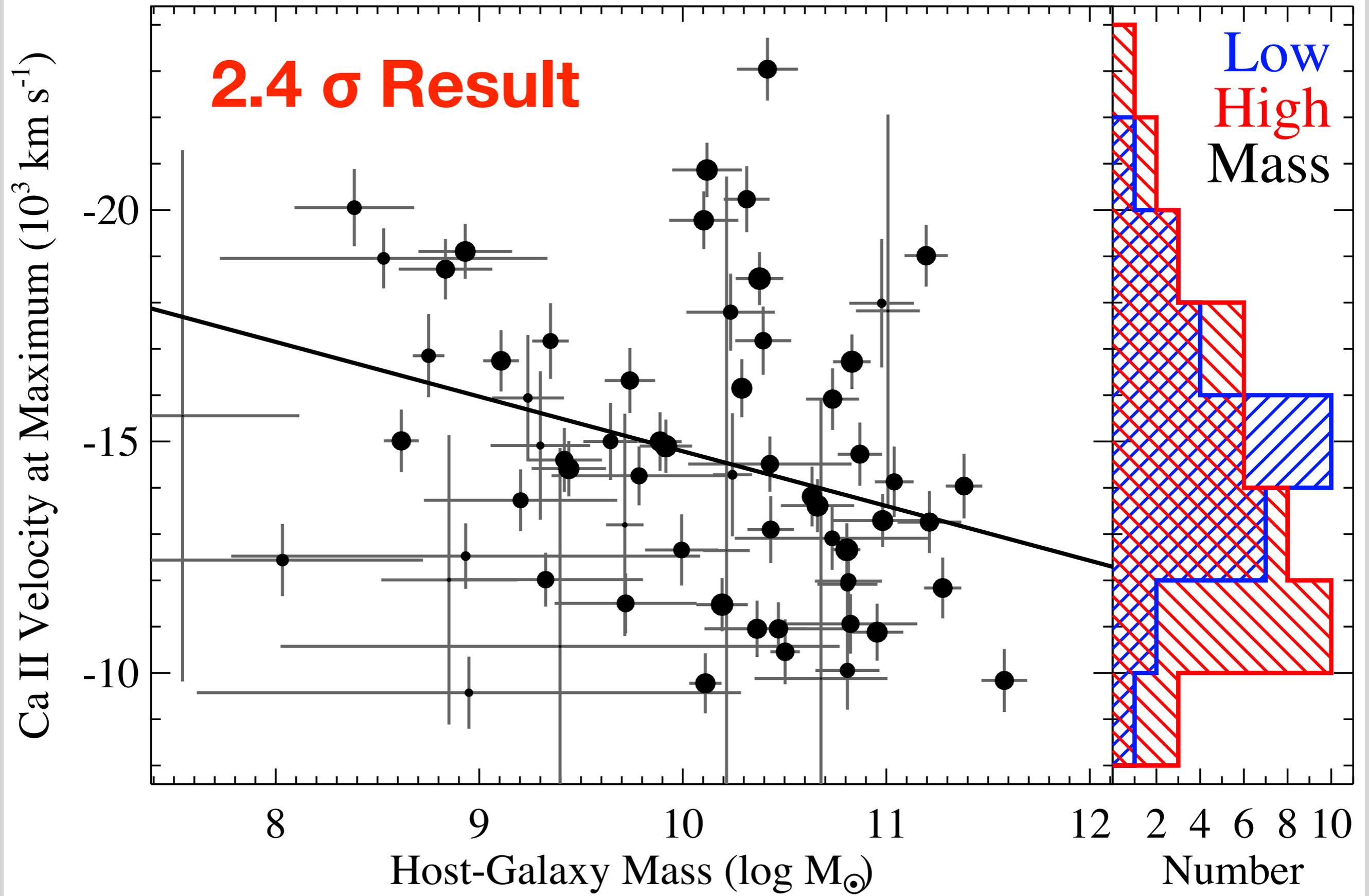


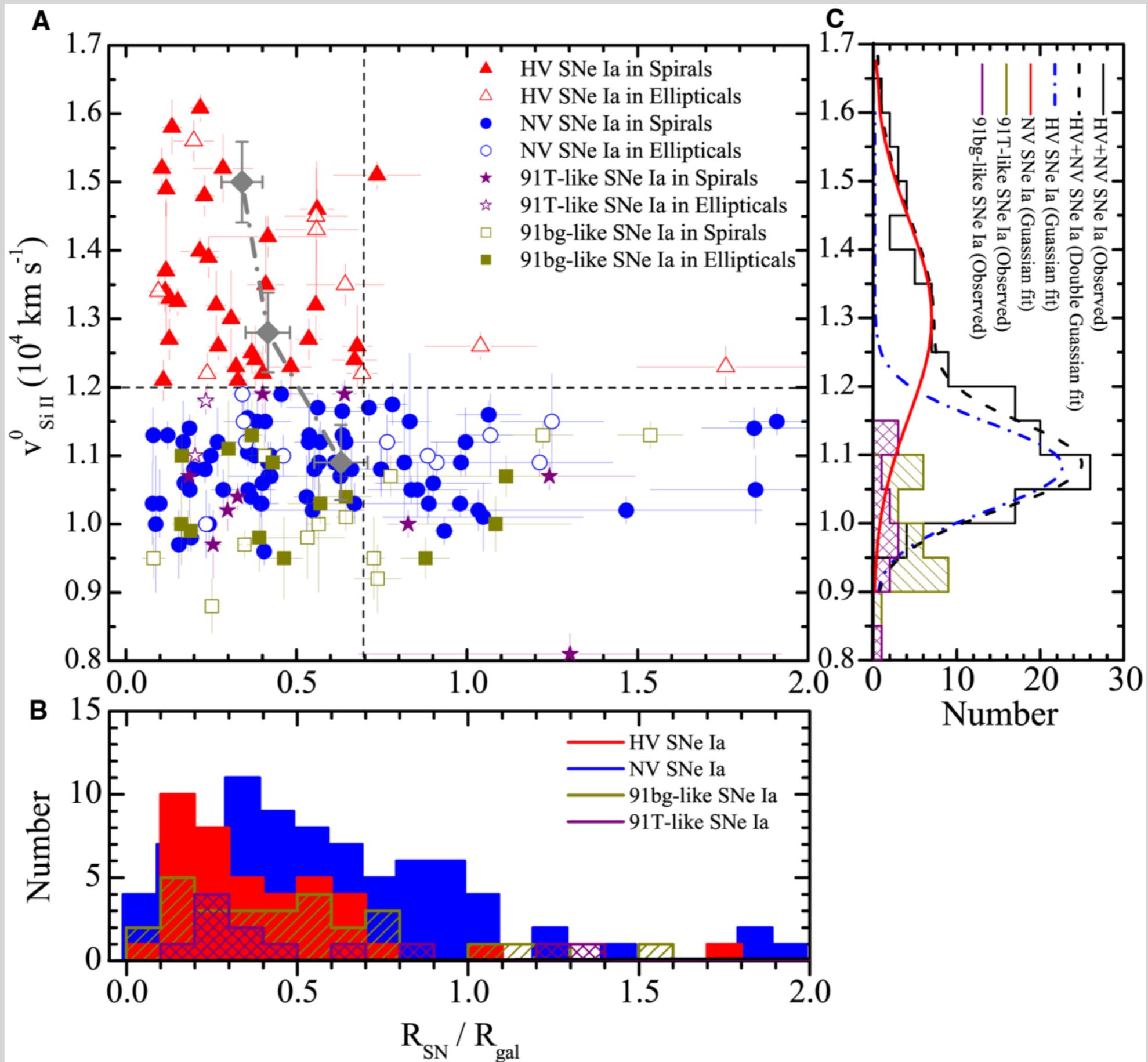
A_V

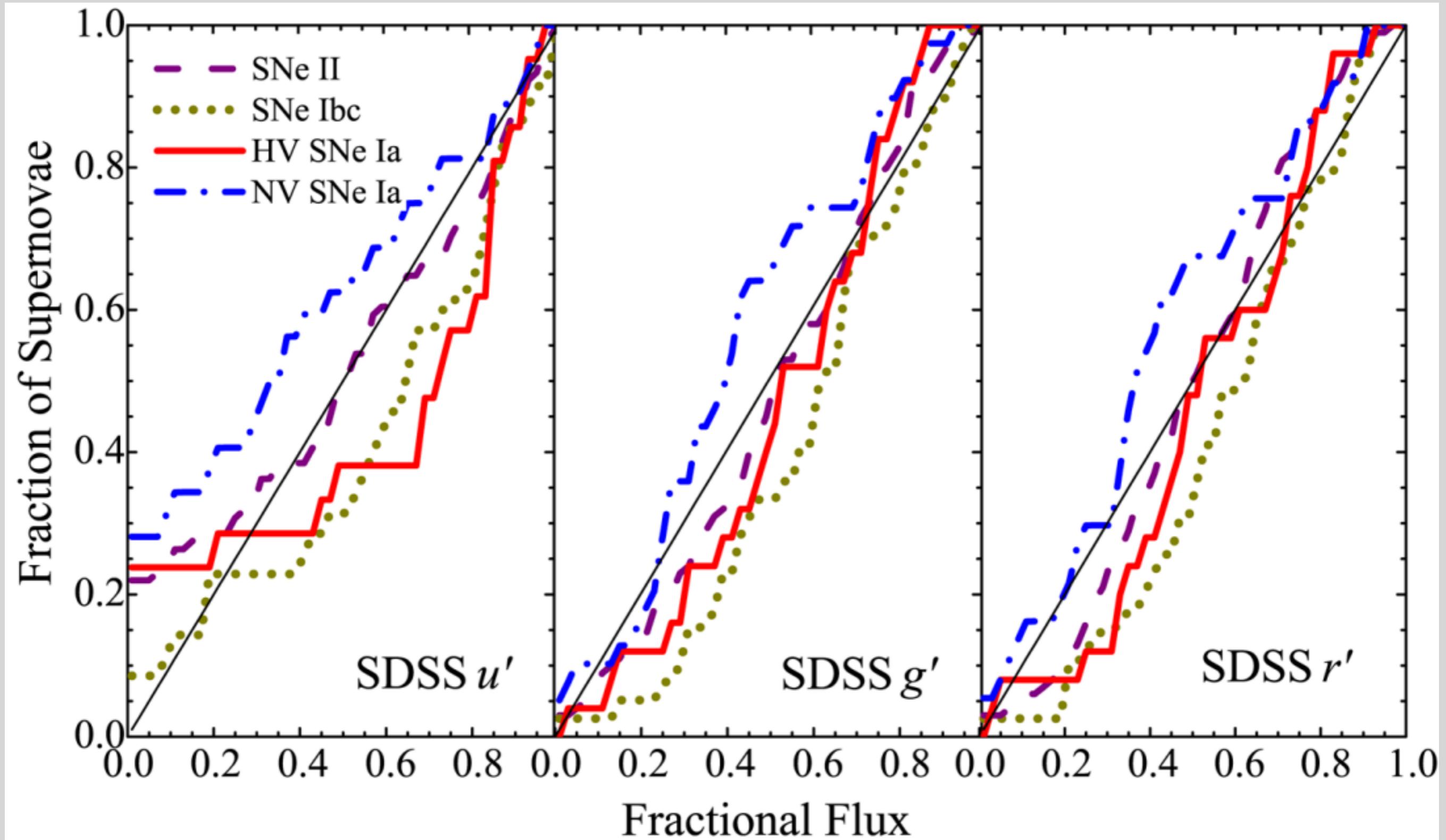


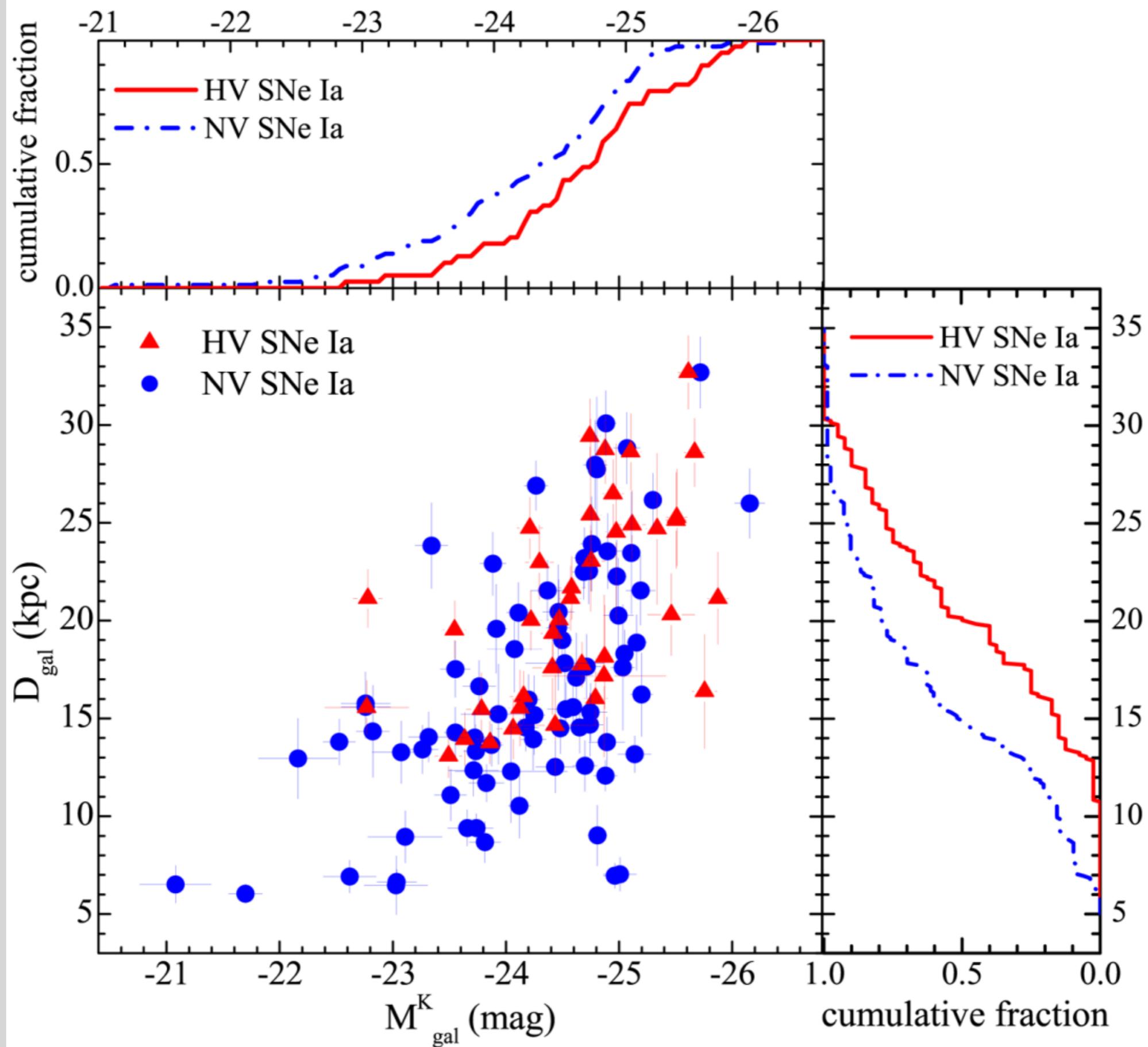
$R_V =$

$A_V / E(B - V)$

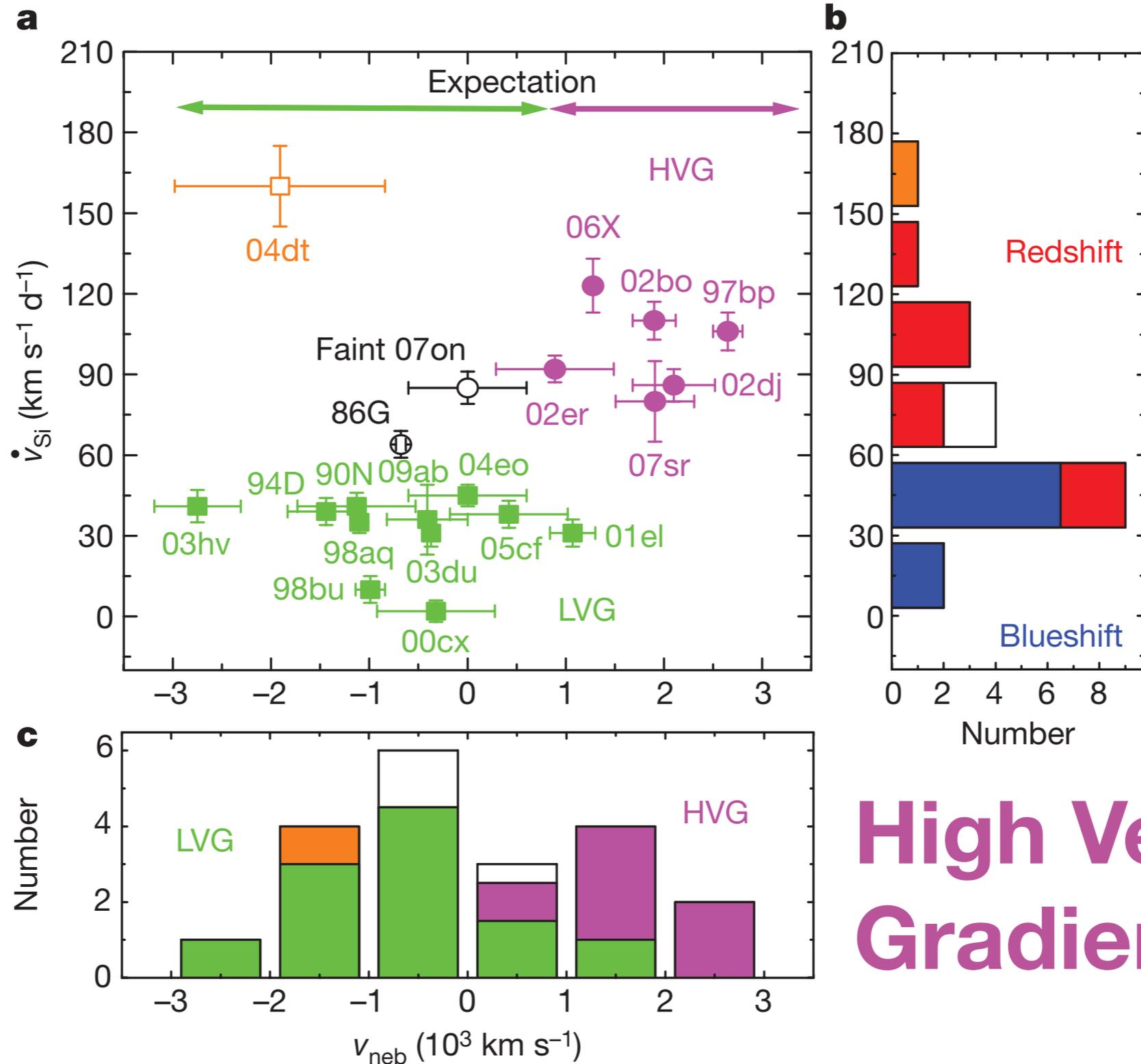








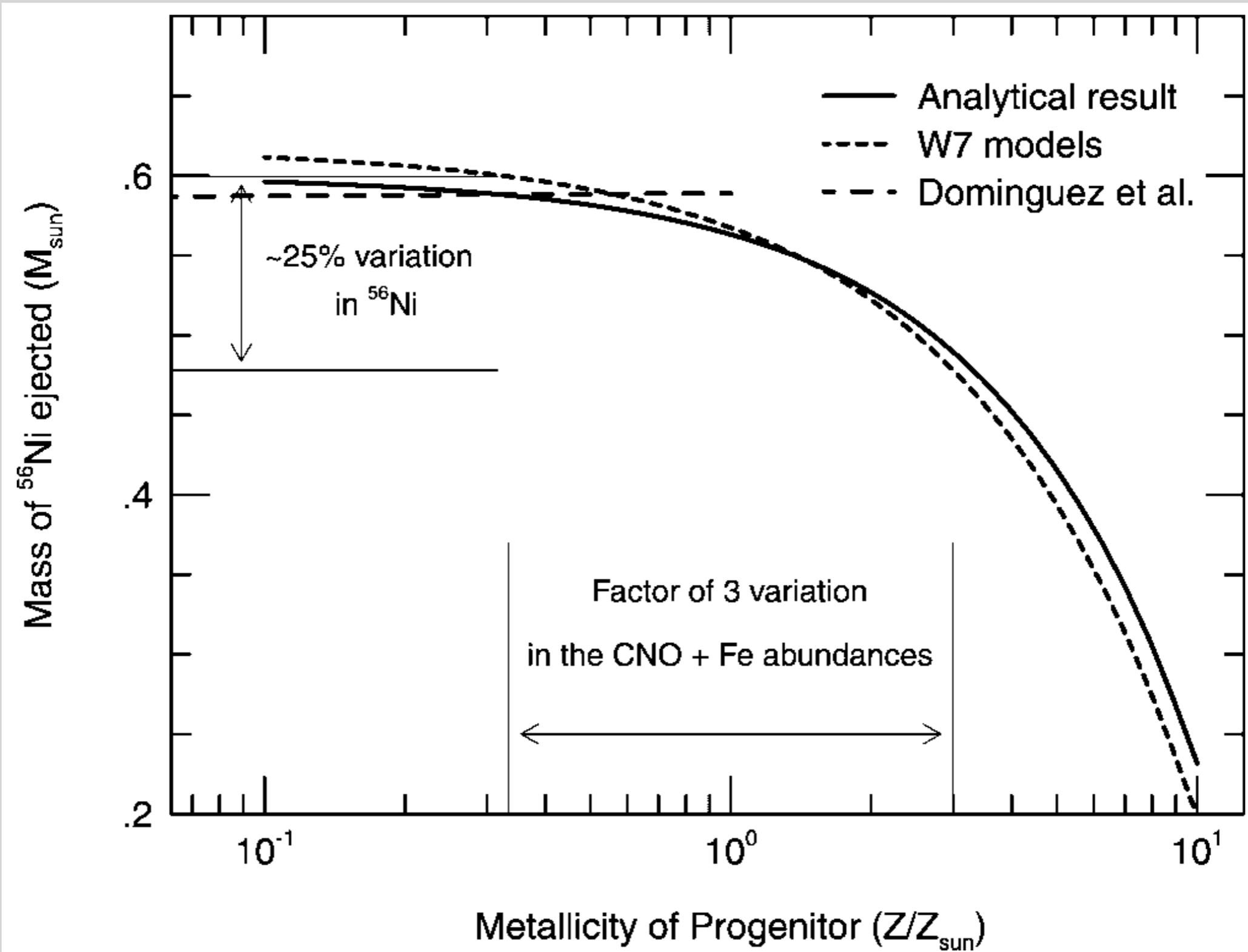
Outer and Inner Layers Linked



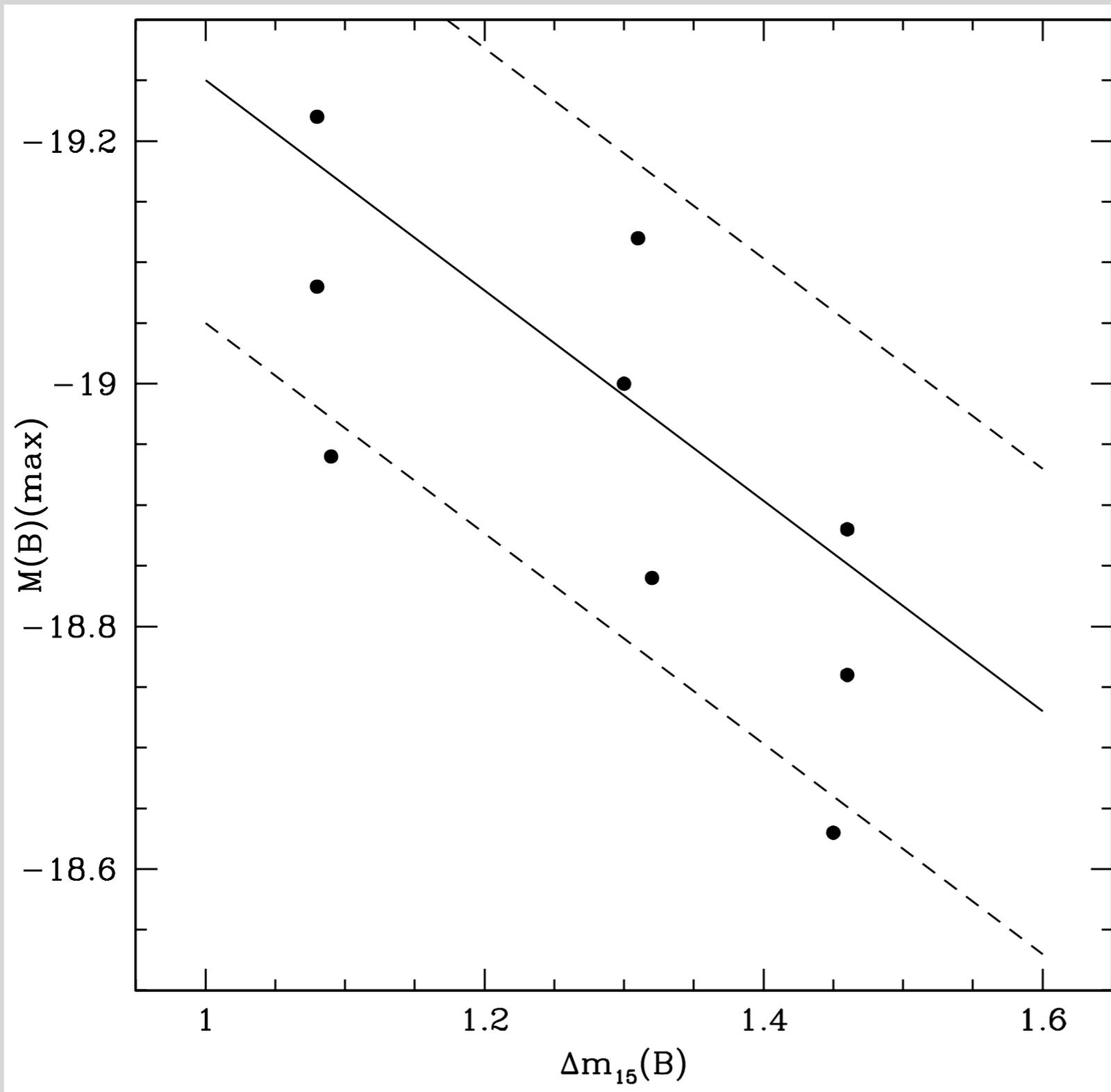
Low
Velocity
Gradient

High Velocity
Gradient

Metallicity Changes ^{56}Ni Yield



Metallicity a (Big?) Systematic

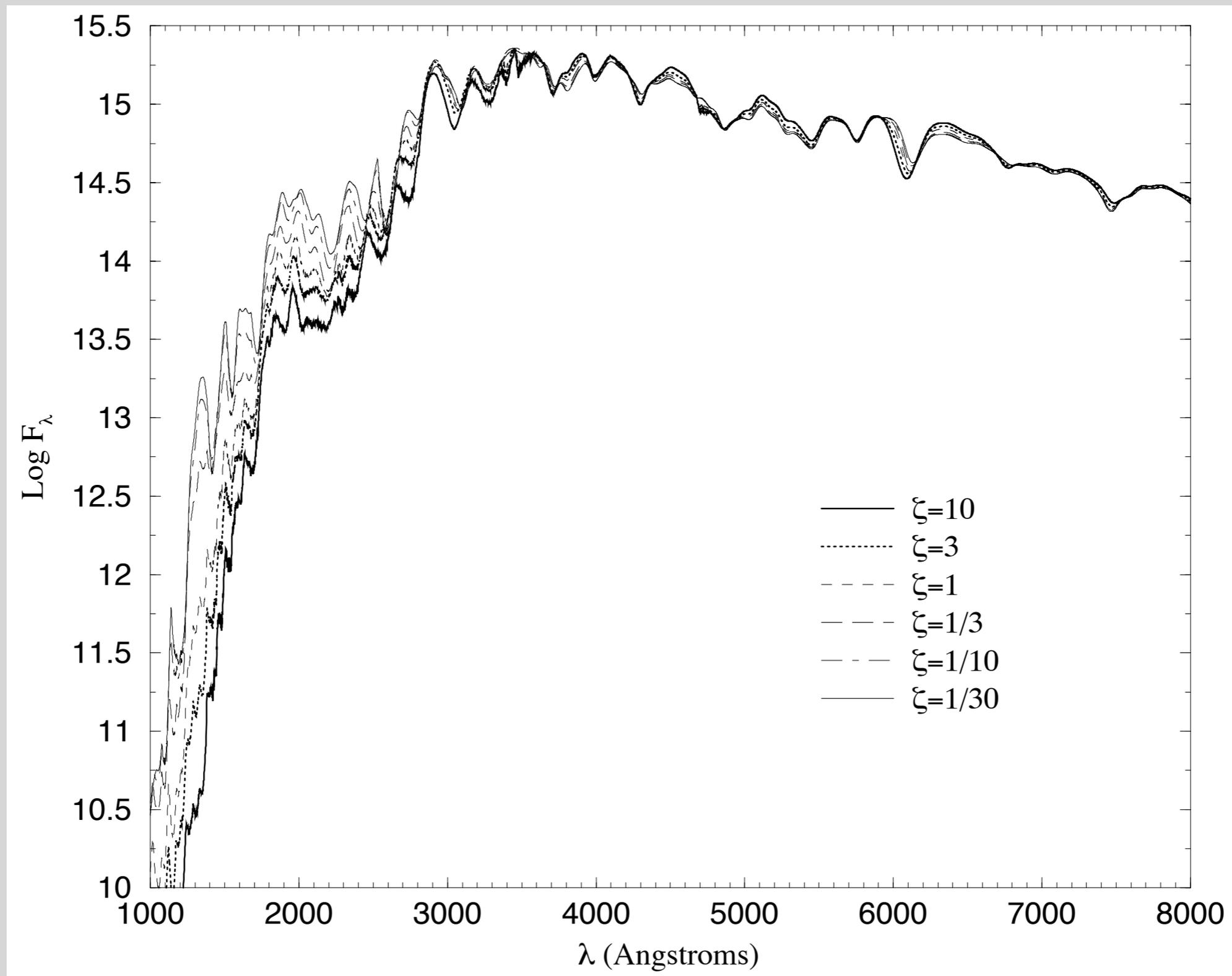


**Different Metallicity,
Same Light-Curve
Shape,
Different Luminosity**

Increased Scatter

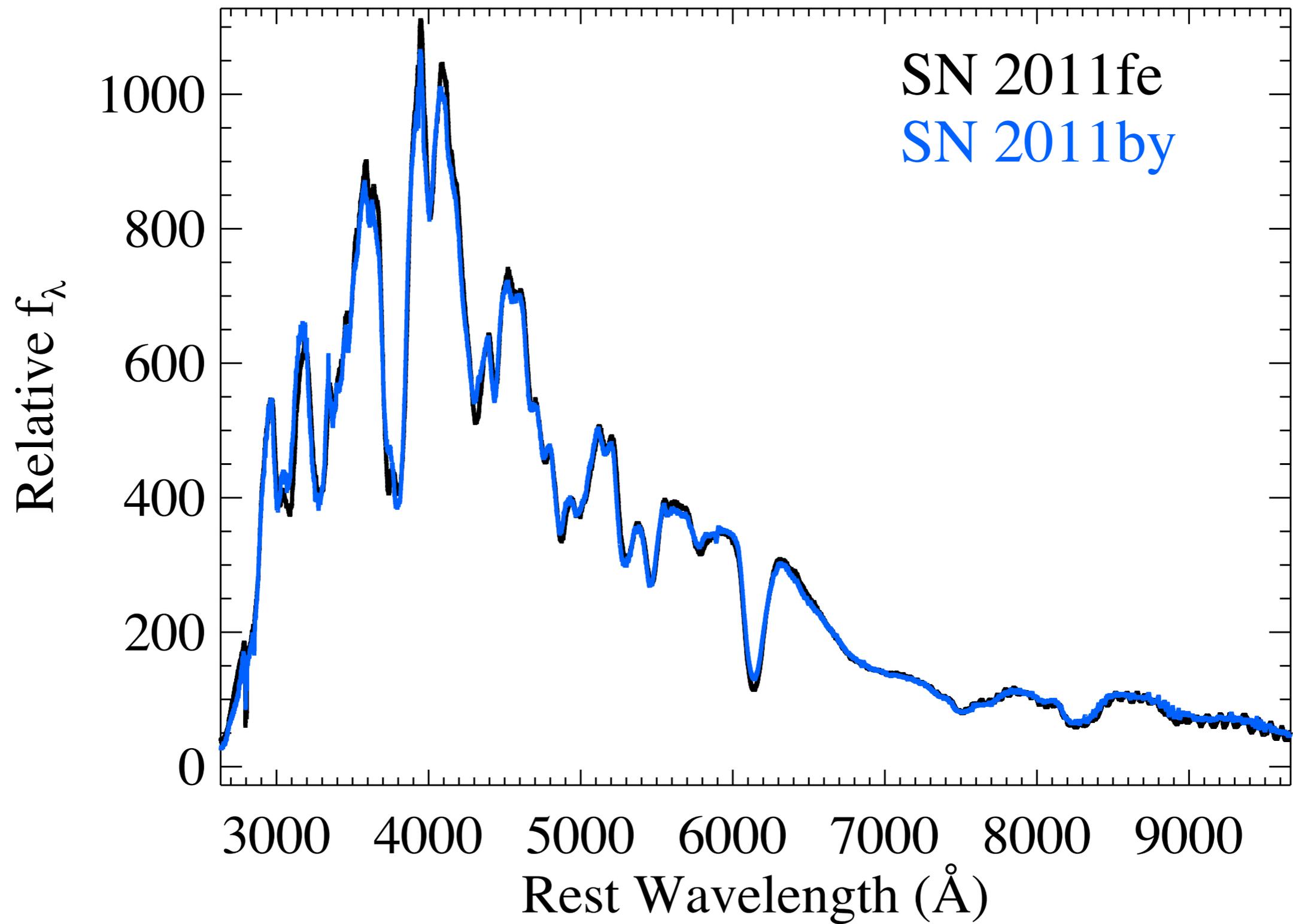
Bias with Redshift?

Metallicity Changes UV, Not Optical

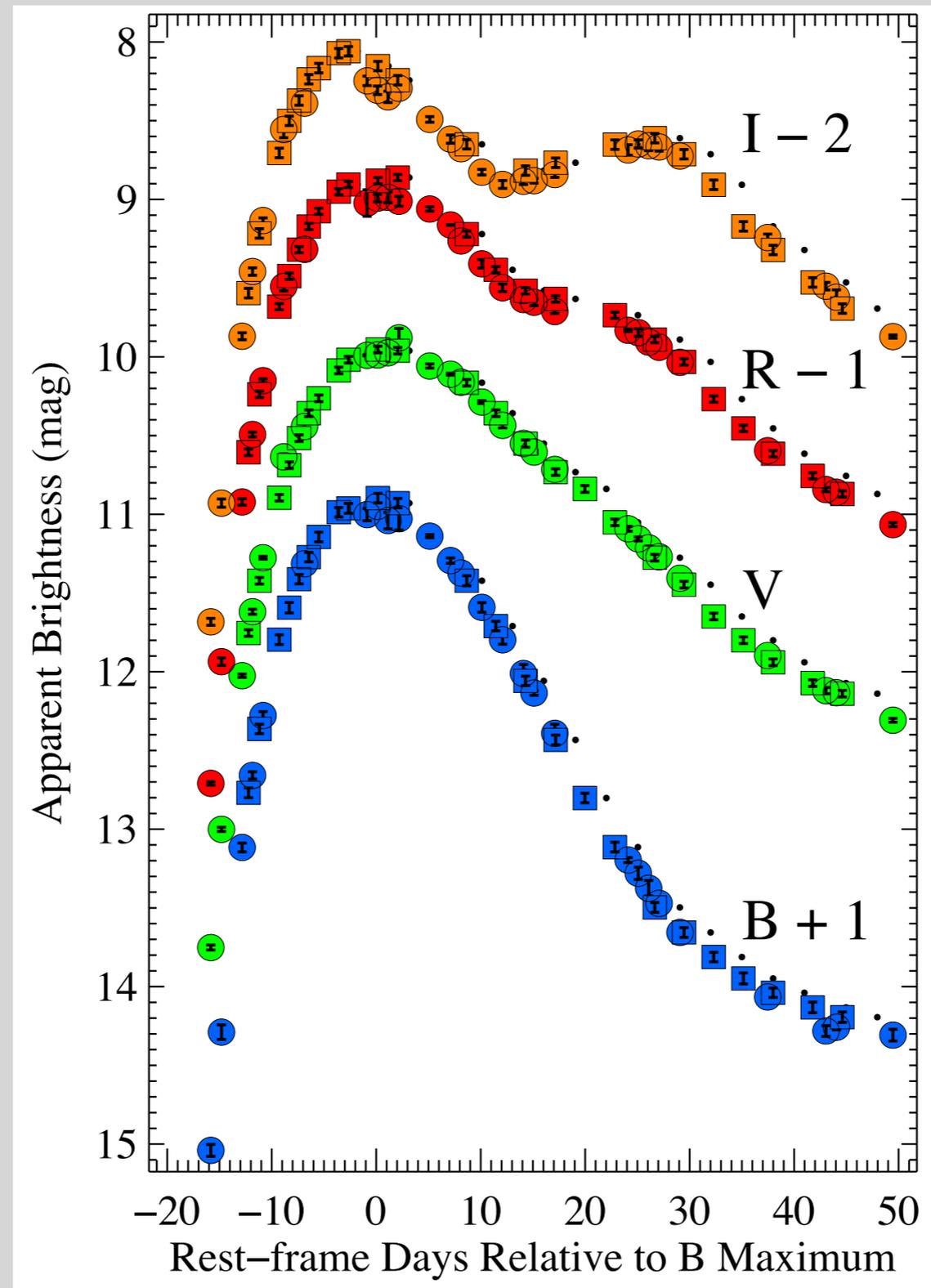


Lentz et al. 2000

“Twin” SNe Same in Optical

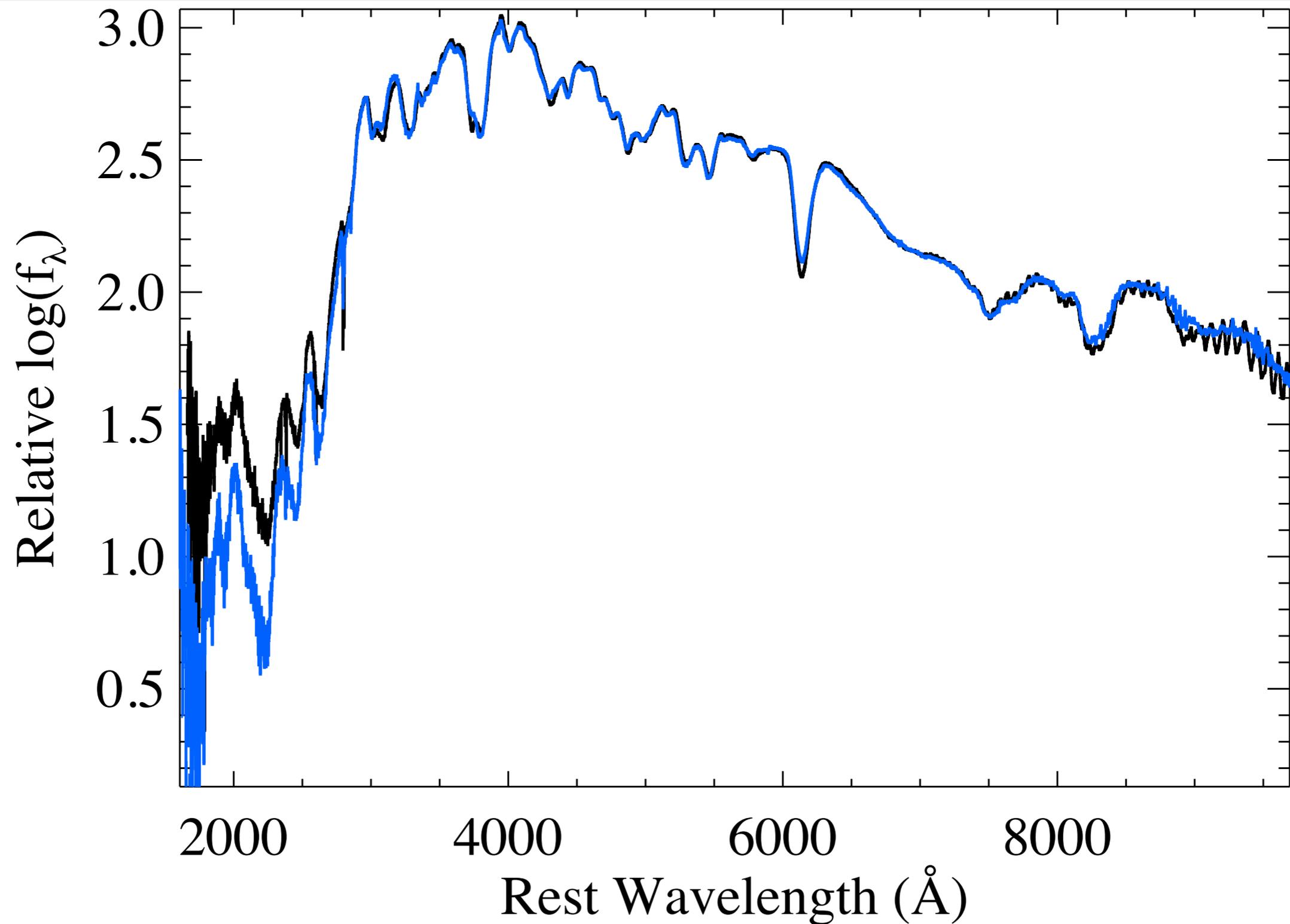


“Twin” SNe Same in Optical

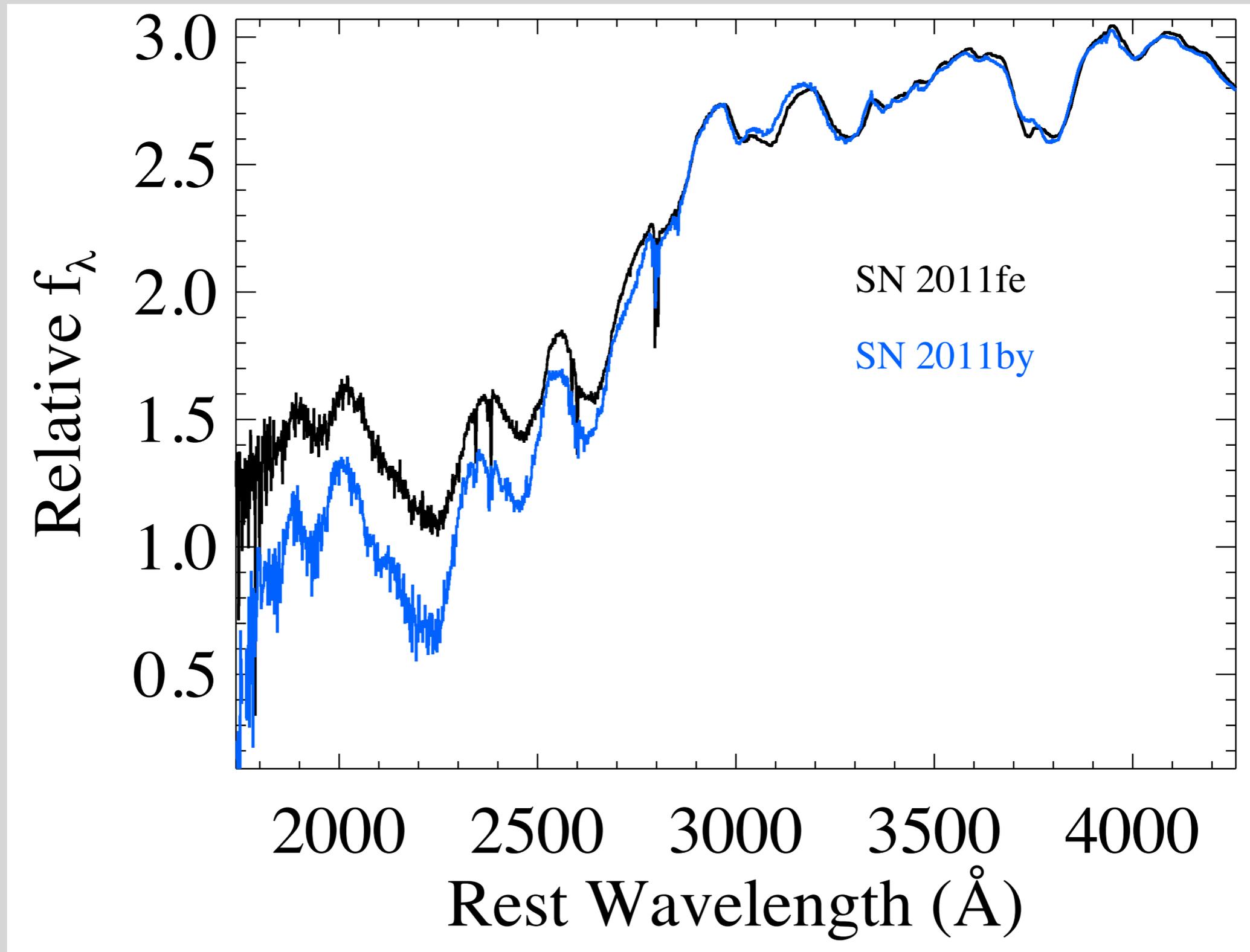


Foley & Kirshner 2013

“Twin” SNe Different in UV



“Twin” SNe Different in UV



Different Metallicity Progenitors

