Two in One
Intrinsic Properties of two fast declining SN Ia in the same Galaxy

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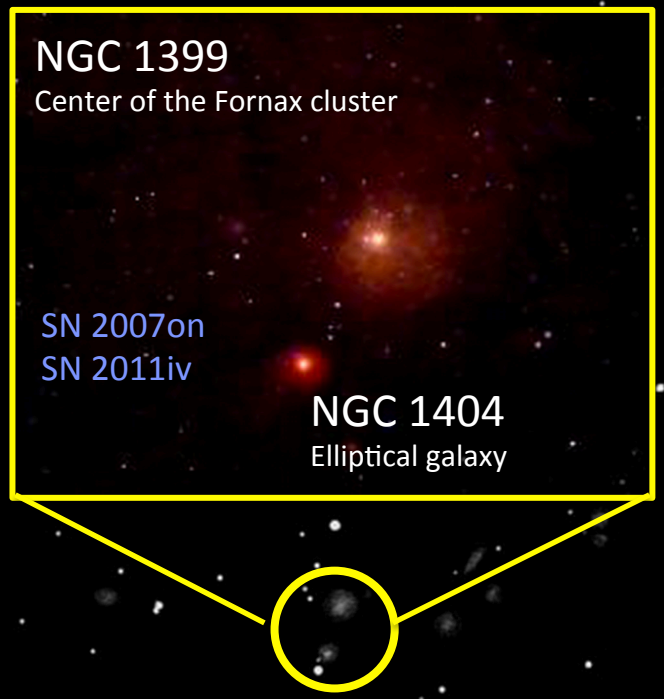
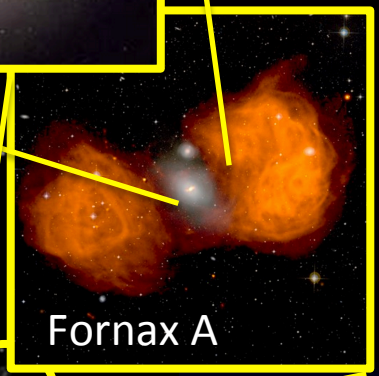
Dark Cosmology Centre

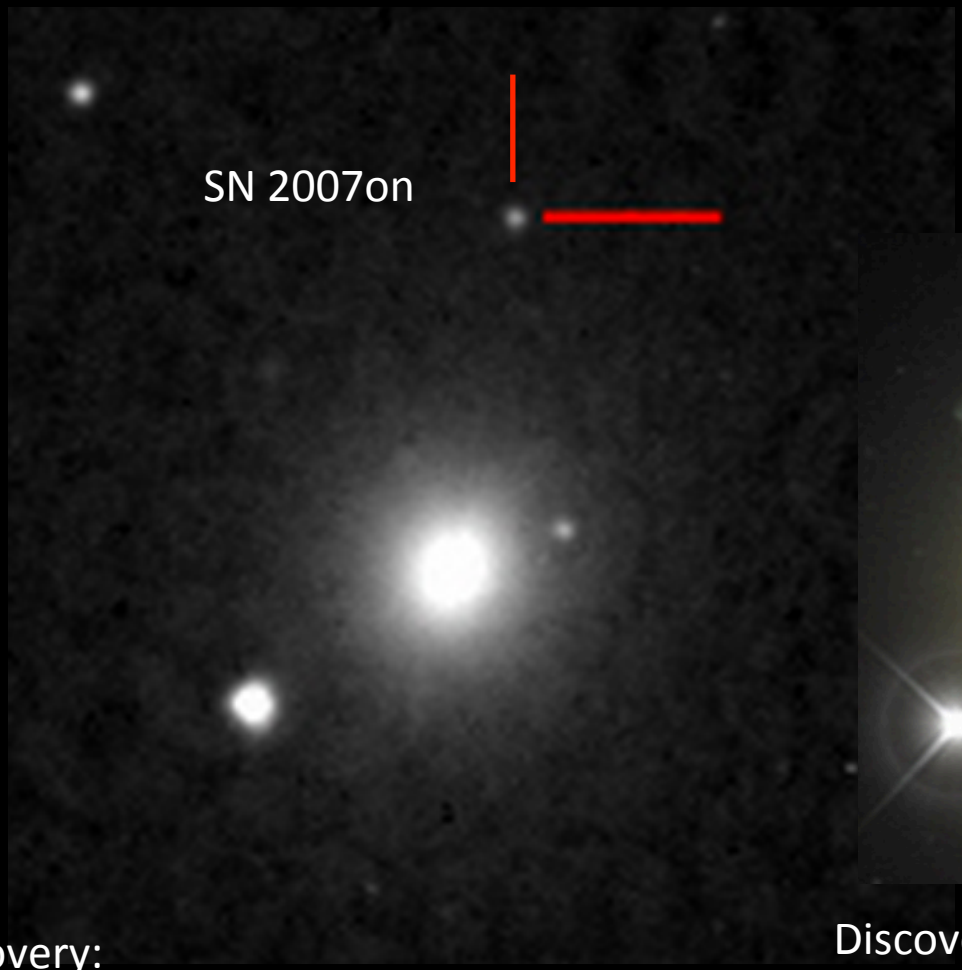
AARHUS UNIVERSITET

Supernovae in the Fornax galaxy cluster





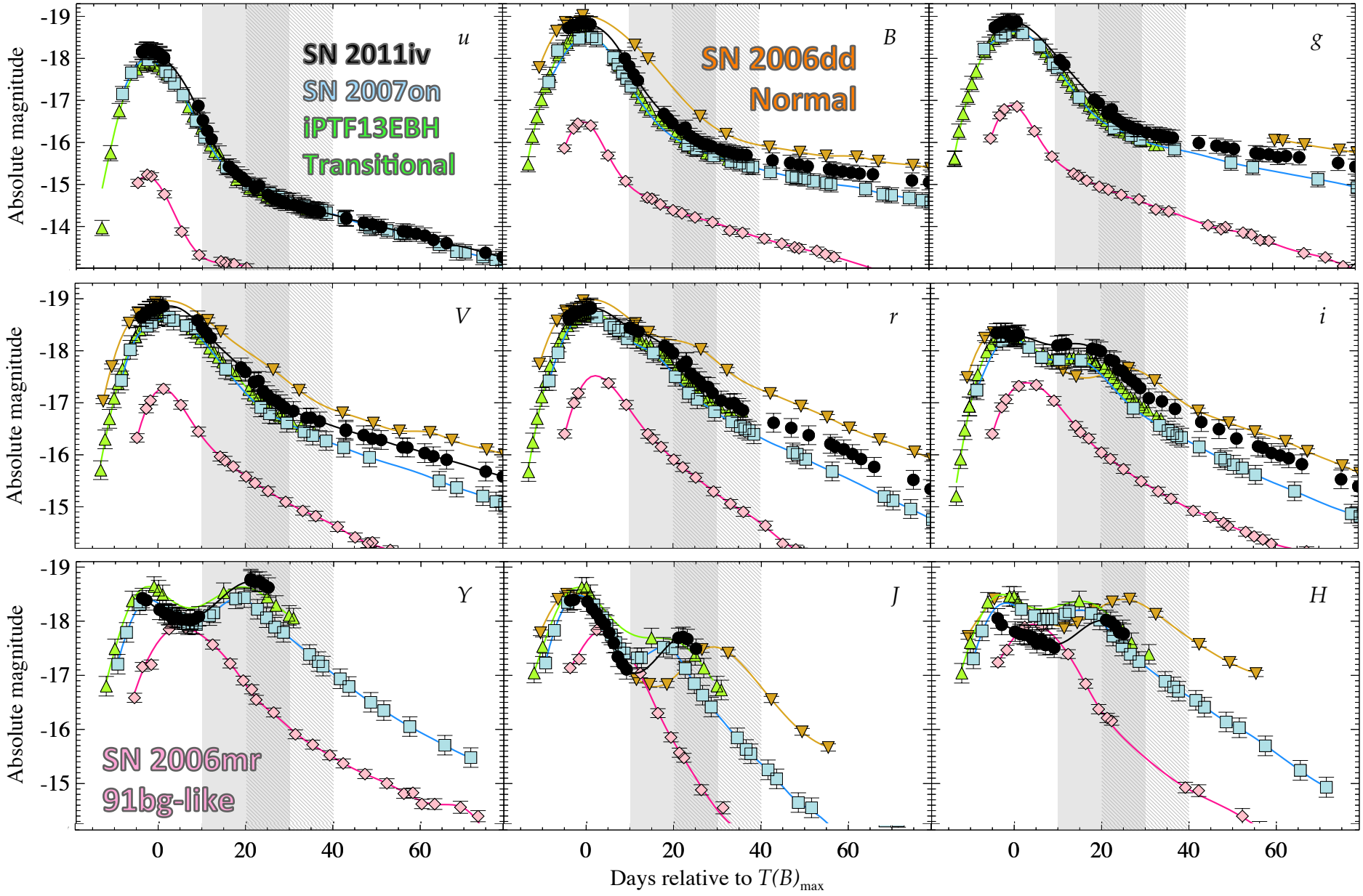
SN 2007on & SN 2011iv in NGC 1404



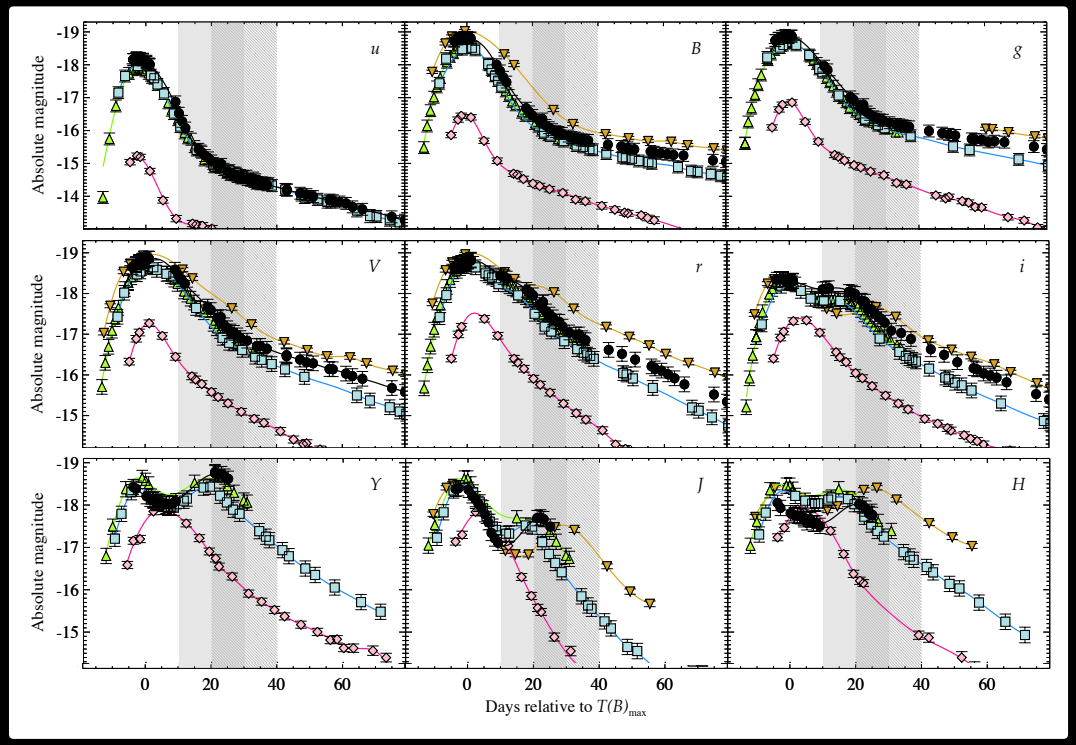
Discovery:
November, 2007, 0.25m robotic TAROT

Discovery:
December, 2011, Stu Parker, New Zealand
CBET 2940

Photometry


SN 2011iv
SN 2007on
iPTF13EBH
Transitional
SN 2006dd
Normal
SN 2006mr
91bg-like
u
B
g
V
r
i
Y
J
H
Absolute magnitude
Days relative to $T(B)_{max}$

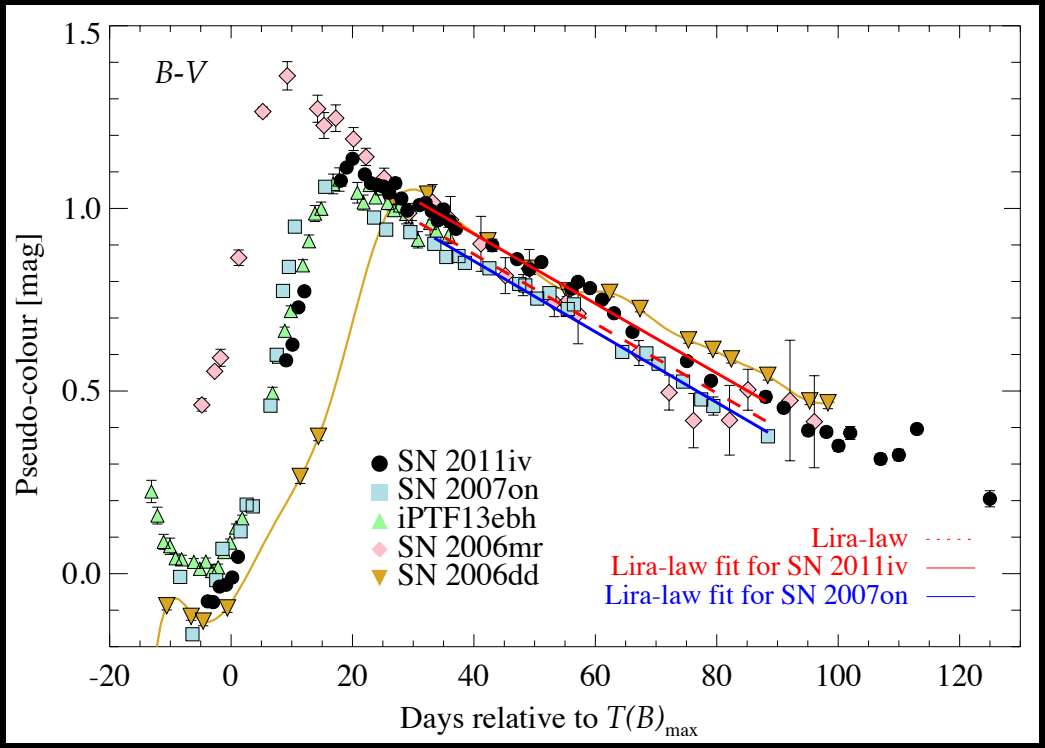
Photometry



SNooPy light curve fitter
EBV, MAX_model
(Burns et al. 2011)

	Transitional		Transitional	91bg-like	Normal
Parameter	SN 2011iv	SN 2007on	iPTF13EBH	SN 2006mr	SN 2006dd
$\Delta m15(B)$	1.73 ± 0.01	1.96 ± 0.001	1.785 ± 0.012	1.82 ± 0.02	1.078 ± 0.025
s_{BV}	0.652 ± 0.007	0.576 ± 0.005	0.631 ± 0.023	0.220 ± 0.005	0.940 ± 0.004
$E(B-V)_{host}$	-0.018 ± 0.009	-0.057 ± 0.01	0.05 ± 0.02	-0.098 ± 0.047	0.043 ± 0.08
DM_{EBV}	31.189 ± 0.06	31.573 ± 0.06	33.603 ± 0.07	31.945 ± 0.085	31.157 ± 0.069
DM_{Tripp}	31.3 ± 0.18	31.57 ± 0.18	33.63 ± 0.18	31.834 ± 0.106	31.276 ± 0.052
			Hsiao et al. 2015	Stritzinger et al. 2010	

B-V Color - Reddening



Lira law for unreddened SNe
(Folatelli et al. 2010)

	Transitional		Transitional	91bg-like	Normal
Parameter	SN 2011iv	SN 2007on	iPTF13EBH	SN 2006mr	SN 2006dd
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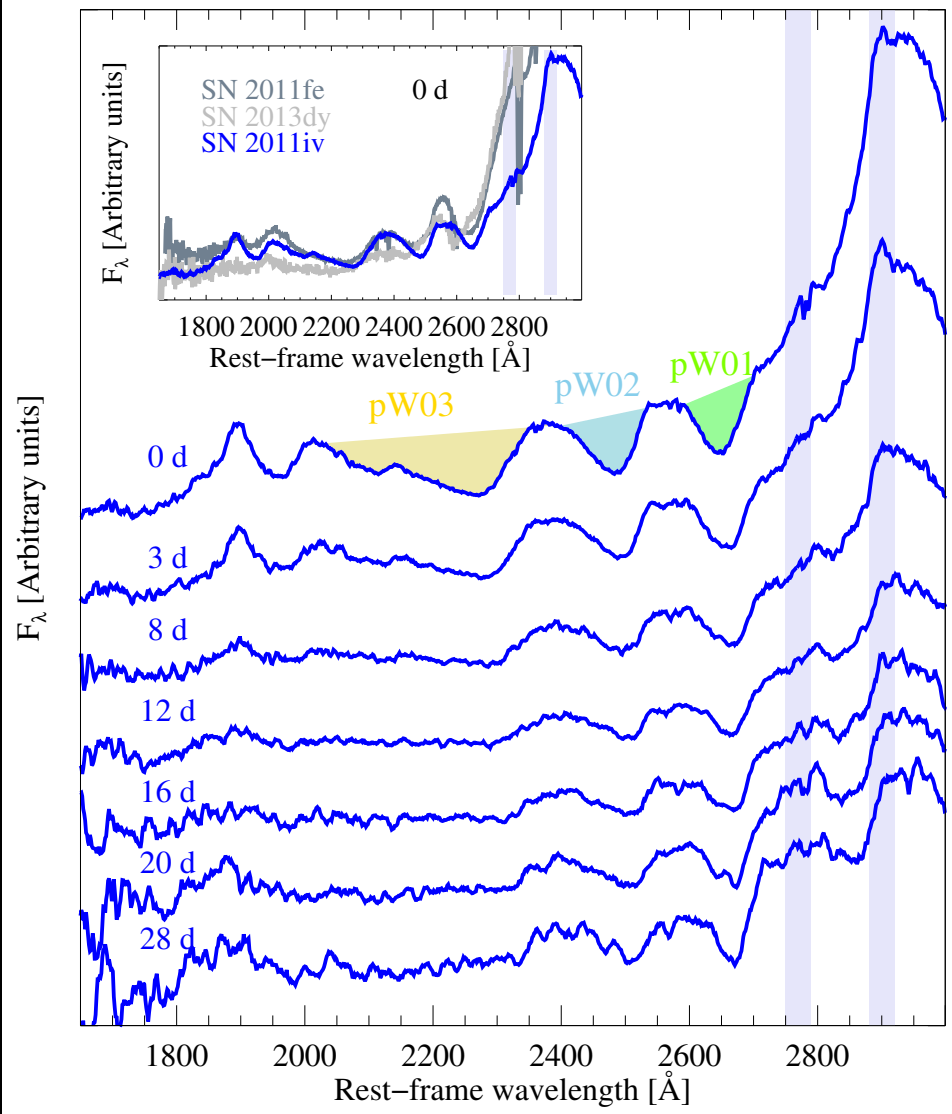
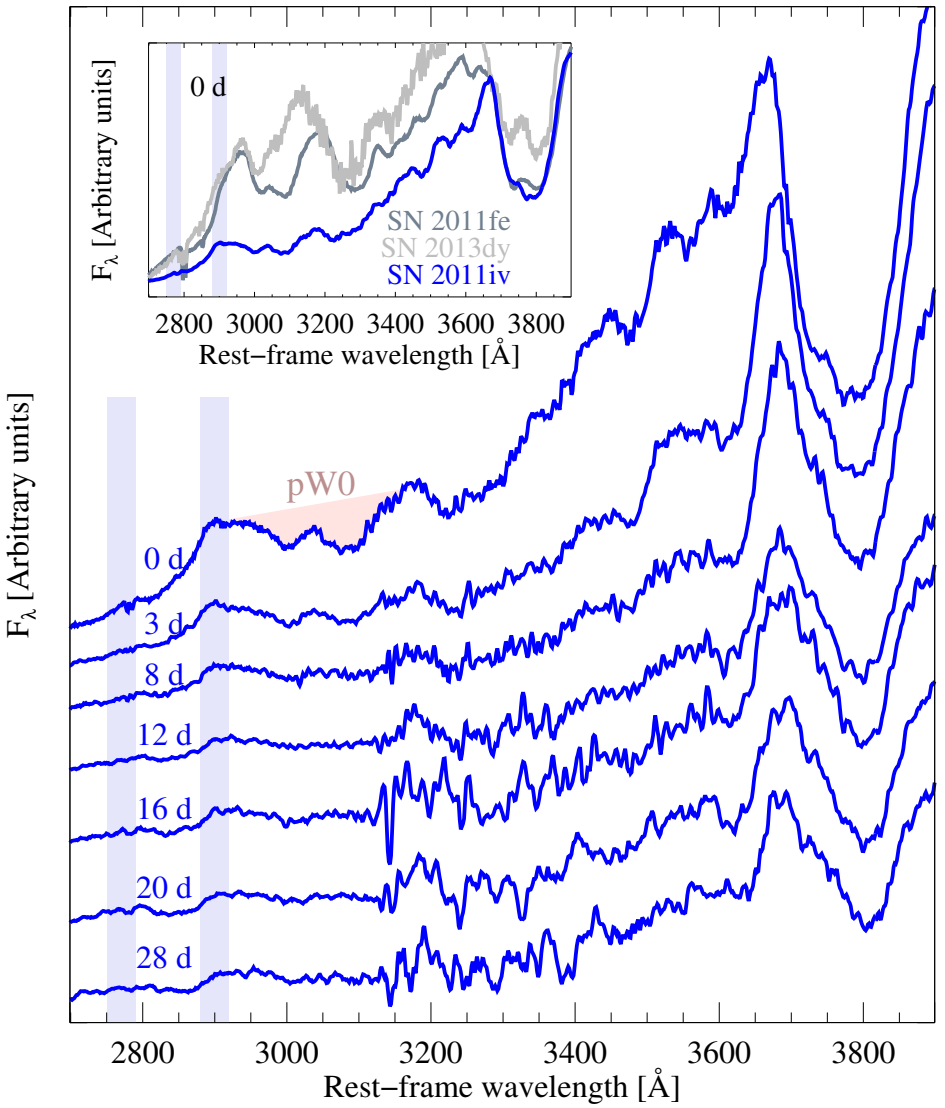
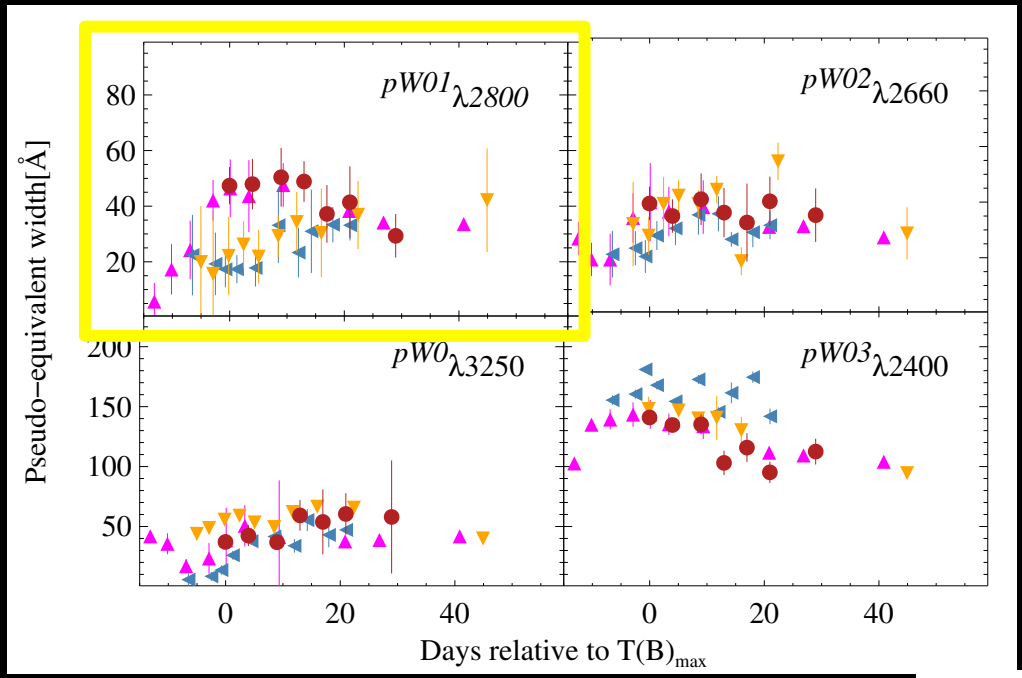
$E(B-V)_{host}$	-0.018 ± 0.009	-0.057 ± 0.01	0.05 ± 0.02	-0.098 ± 0.047	0.067 ± 0.06
$E(B-V)_{Lira}$	**0.055 ± 0.001**	**-0.033 ± 0.01**	**0.0025 ± 0.002**	**-0.002 ± 0.008**	**0.092 ± 0.009**
			Hsiao et al. 2015	Stritzinger et al. 2010	

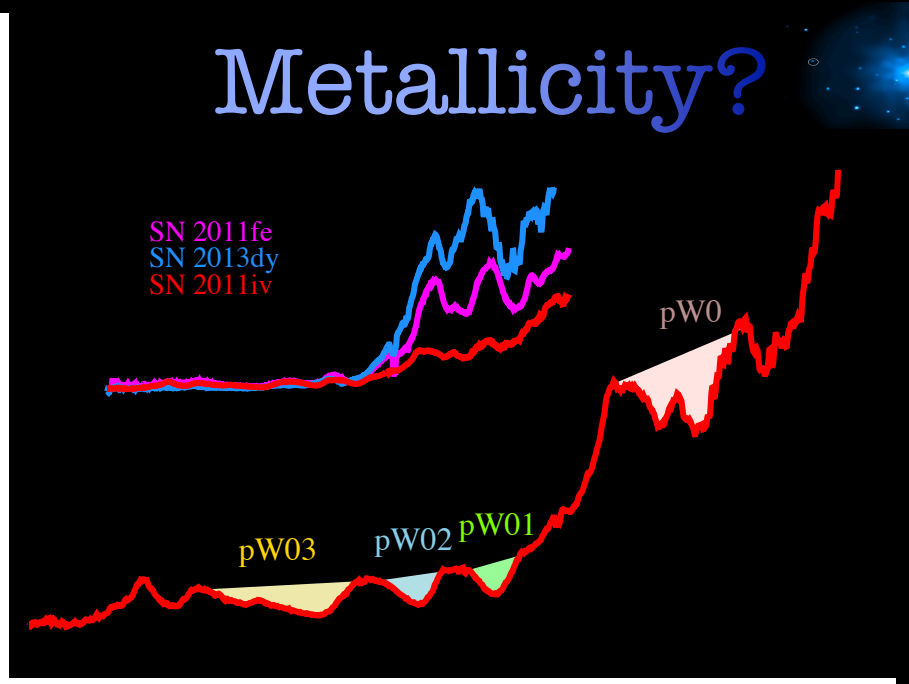
HST UV Spectroscopy





2011iv: Maximum brightness spectrum by Foley et al. 2012; 2011fe: Patat et al. 2013; 2013dy: Pan et al. 2015





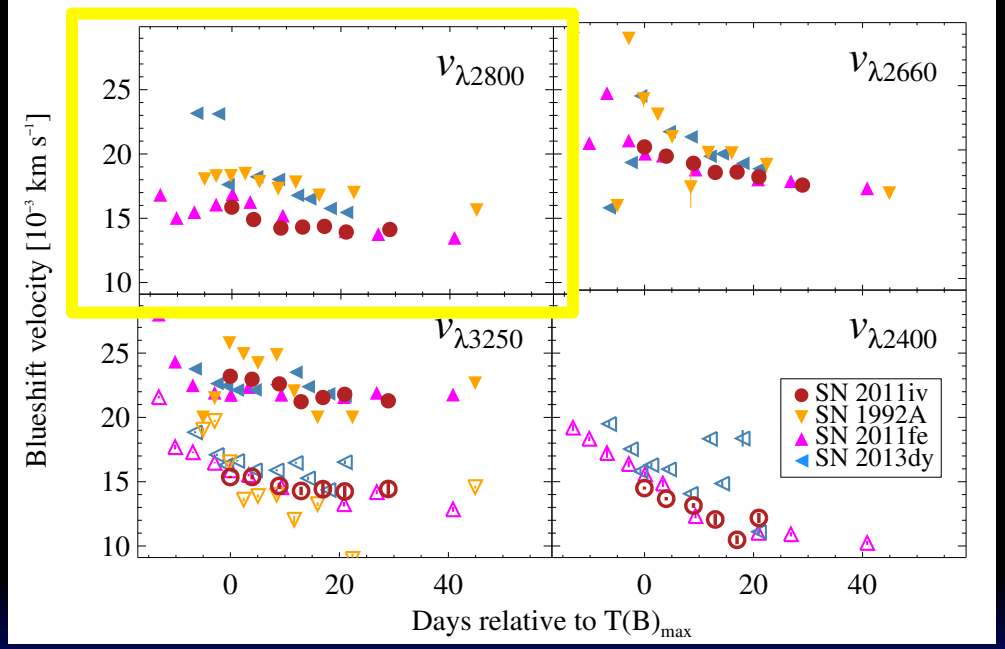
UV-Continuum flux:
depends on various mechanism:

- explosion model
- geometry and viewing angle effects
- complexity incorporated in models

Theory predicts metallicity effects:

- weaker UV features
- larger blueshifts

for increasing metallicity
(e.g., Lenz et al. 2001)



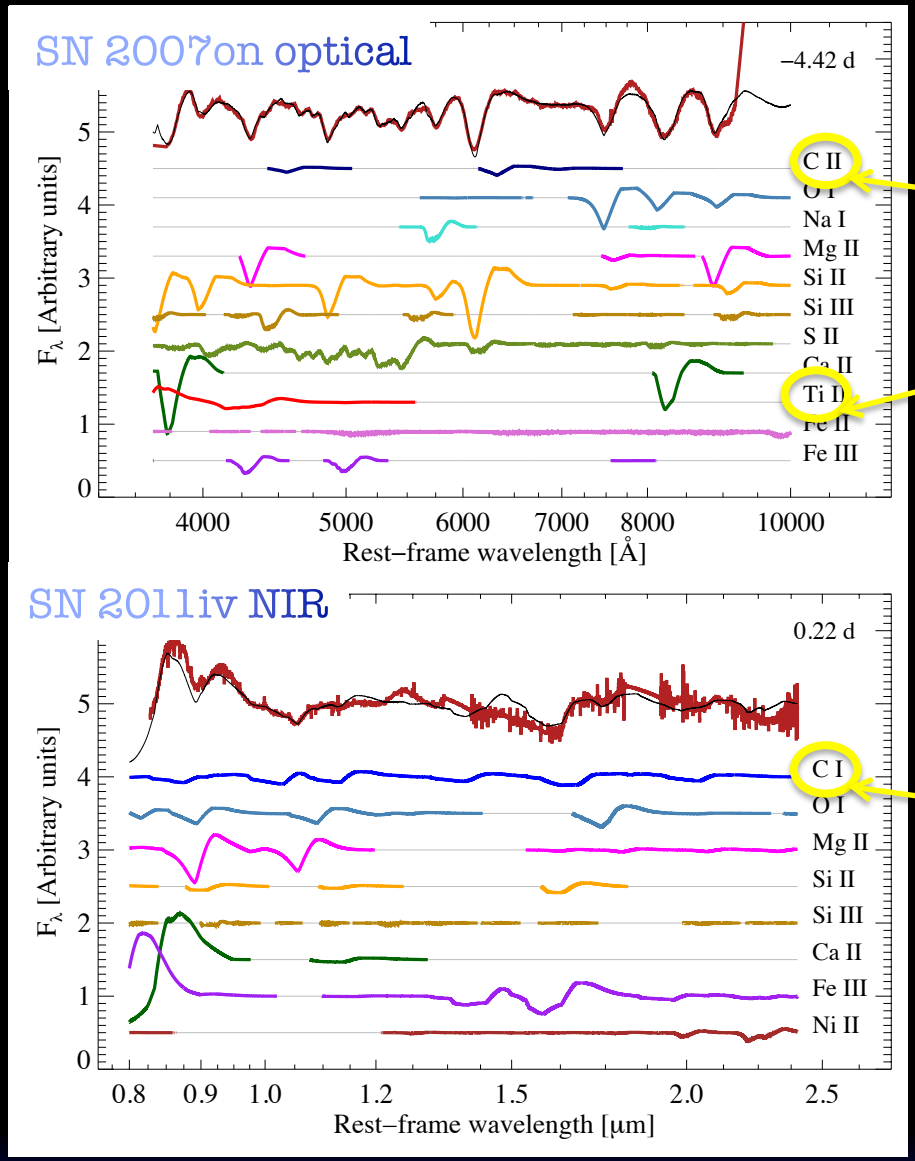
Spectroscopy

SN 2007on
17 optical spectra
-4 to +89 days
(Folatelli et al. 2013)
4 late phase spectra
+101 to +380

SN 2007on:
2 spectra
+33, +93 days

SN 2011iv
22 spectra
-7 to +42 days
2 late phase spectra
+141, +260

13 NIR spectra
+0.2 to +83 days



C II, pristine carbon

Ti II

SYNAPPS

C I, pristine carbon

Maximum UV—NIR brightness spectrum (Foley et al. 2012)

What are the differences?

SN 2007on

- Fainter ($M_{B,max}$ = -18.598 mag)
- Redder (early phase)
- Bluer (late phase)
- Faster declining (1.96)
- Lower color stretch(0.57)
- Weak titanium
- C I in the optical
- Lower ^{56}Ni mass (0.25 $M_{\odot}$)
- Away from the center
- Larger distance

SN 2011iv

- Brighter ($M_{B,max}$ = -18.901 mag)
- Bluer (early phase)
- Redder (late phase)
- Slower declining (1.73)
- Larger color stretch(0.65)
- No titanium
- C II in the NIR
- Larger ^{56}Ni mass (0.4 $M_{\odot}$)
- Close to the center
- Shorter distance

Challenges

What makes them different?

- Temperature  ^{56}Ni mass
- Challenges in distance measurements vs physical differences
- Progenitor metallicity
- Progenitor mass

What makes them similar?

- Explosion mechanism
- Abundance stratification
- Layered structure