

The light curve bumps of the Type IIn SNe 13z and 11fzz



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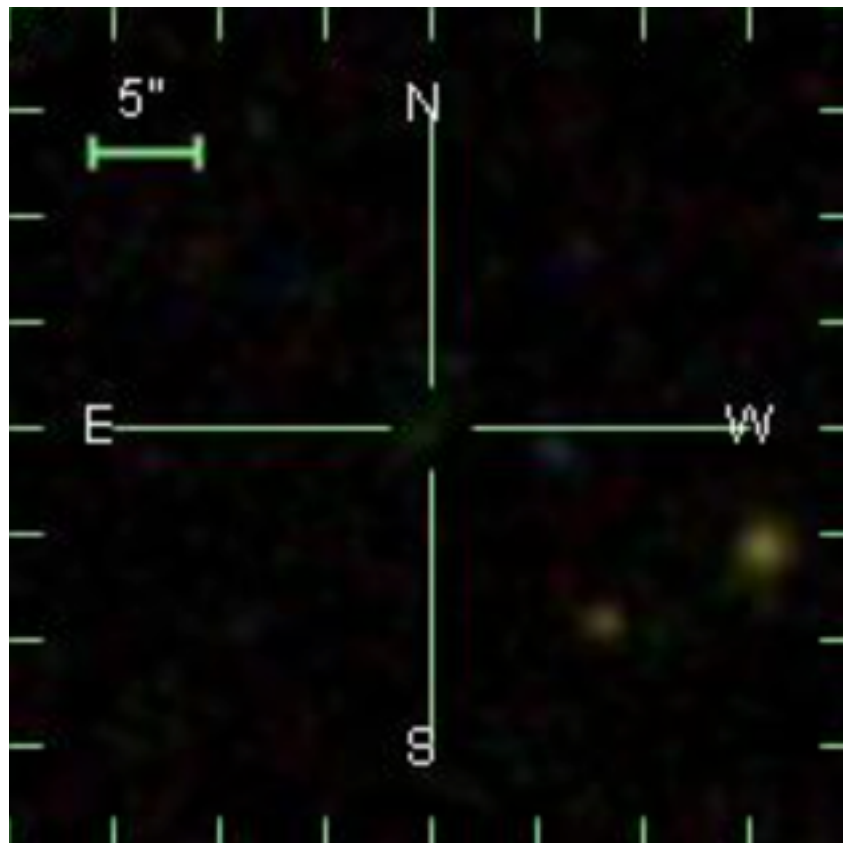
2014 June 02

Supervisor: Jesper Sollerman

SN IIn crash course

- Core collapse SNe
- Classification introduced by Schlegel (1990)
- Blue spectra with narrow H emission lines superimposed on broader components; see e.g. Pastorello (2012)
- Gal-Yam & Leonard (2009) report SN 2005gl preceded by a LBV
Ofek et al. (arXiv:1401.5468) report that IIn precursor events are common

Host galaxies



SDSS DR 10

SN iPTF 11fzz

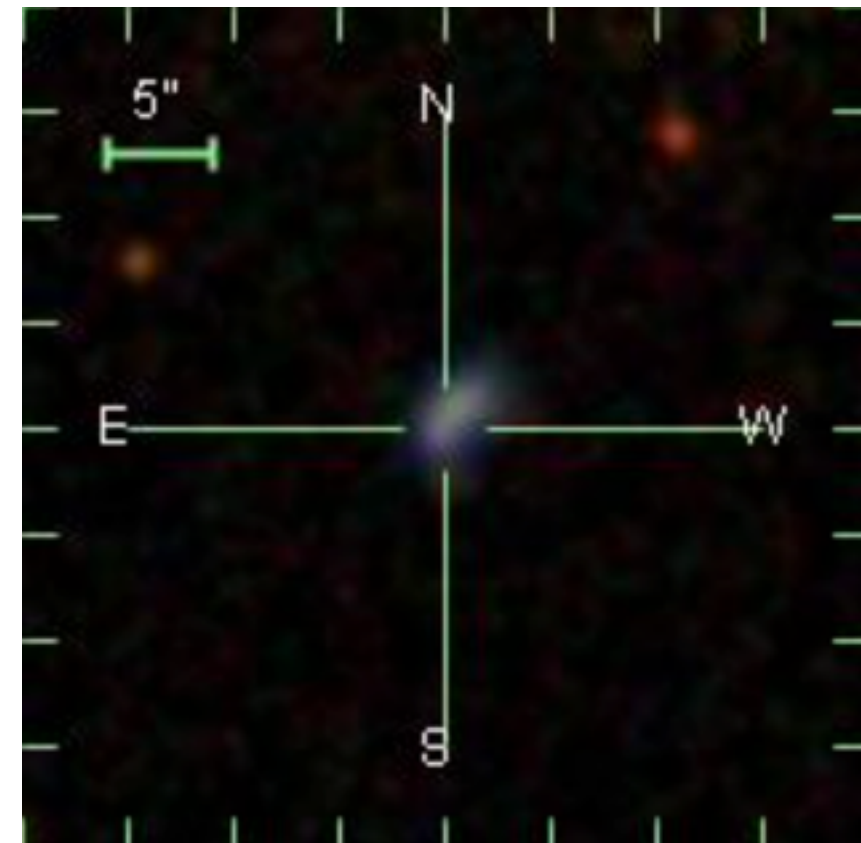
Host: anonymous (in Ursa Major)

$r = 22.34$, $(u-r) = 1.00$

$z = 0.082$ (luminosity distance: 370 Mpc)

$M_r = -15.14$

$Z/Z_{\text{solar}} = 0.12$



SDSS DR 10

SN iPTF 13z

Host: SDSS J160200.05+211442.4 (in Hercules)

$r = 23.34$, $(u-r) = -2.25$

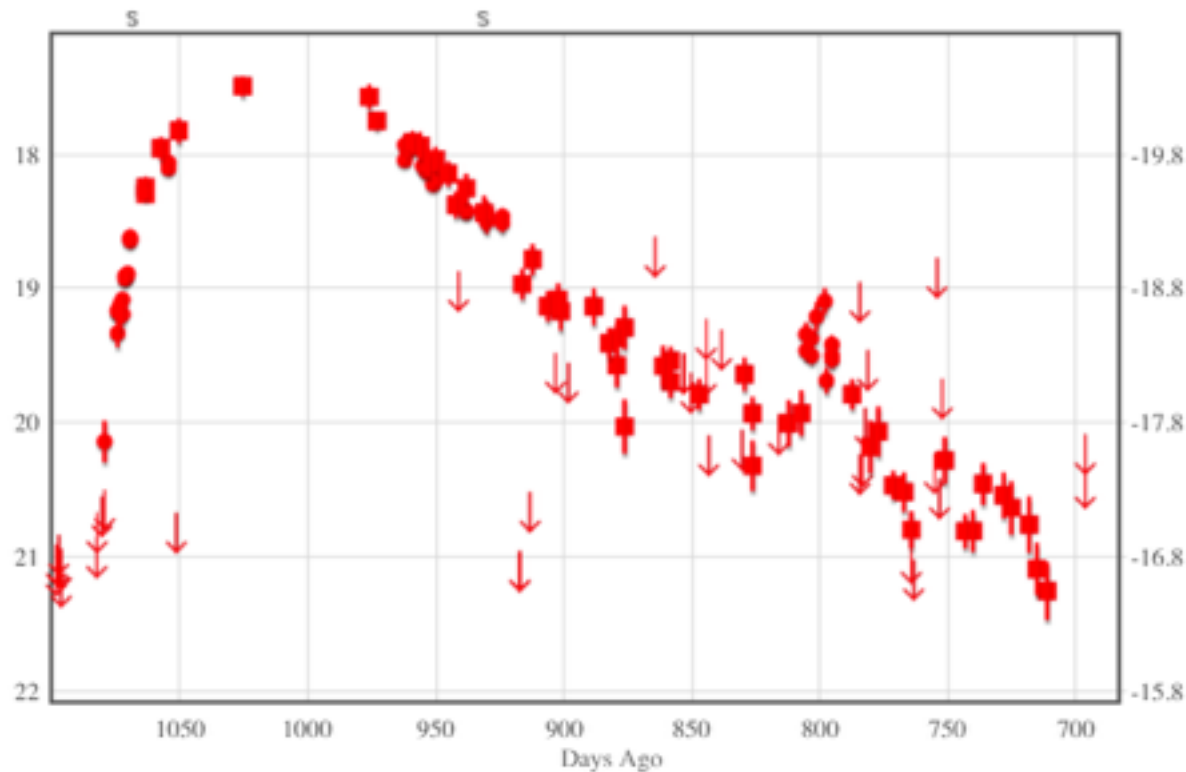
$z = 0.033$ (luminosity distance: 143 Mpc)

$M_r = -12.41$

$Z/Z_{\text{solar}} = 0.04$

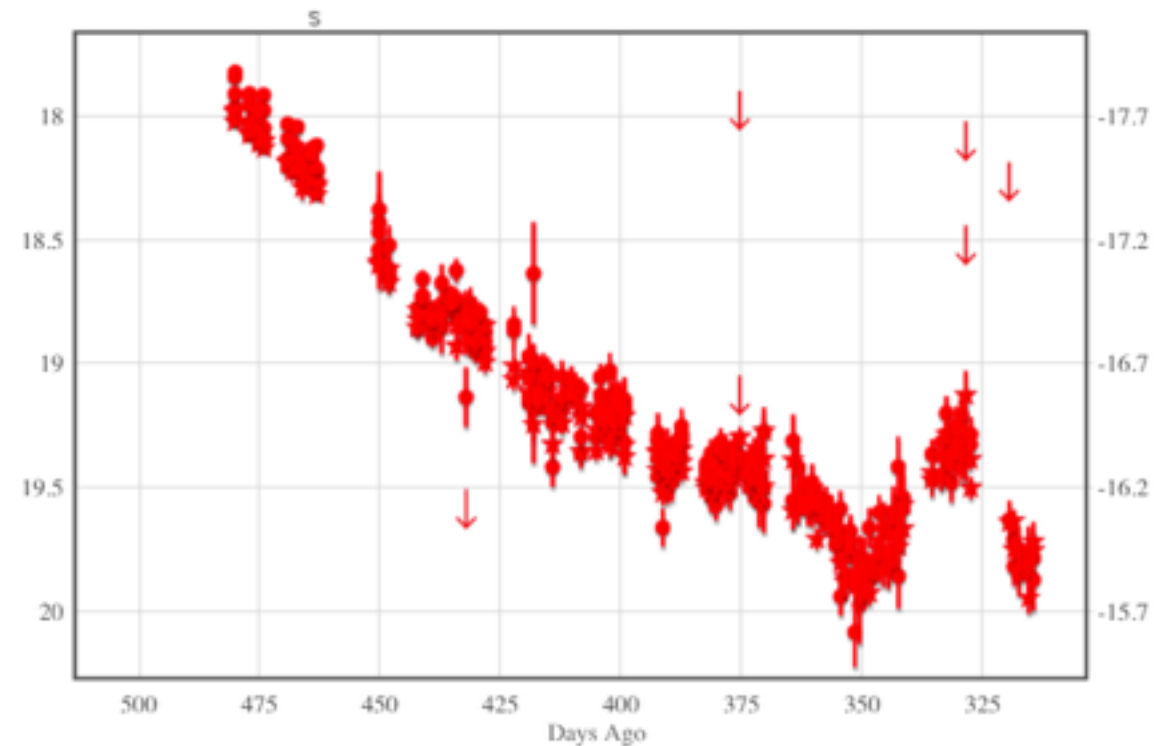
Metallicity estimate using the Arcavi et al. (2010) absolute magnitude/metallicity fit.

SN photometry



SN iPTF 11fzz

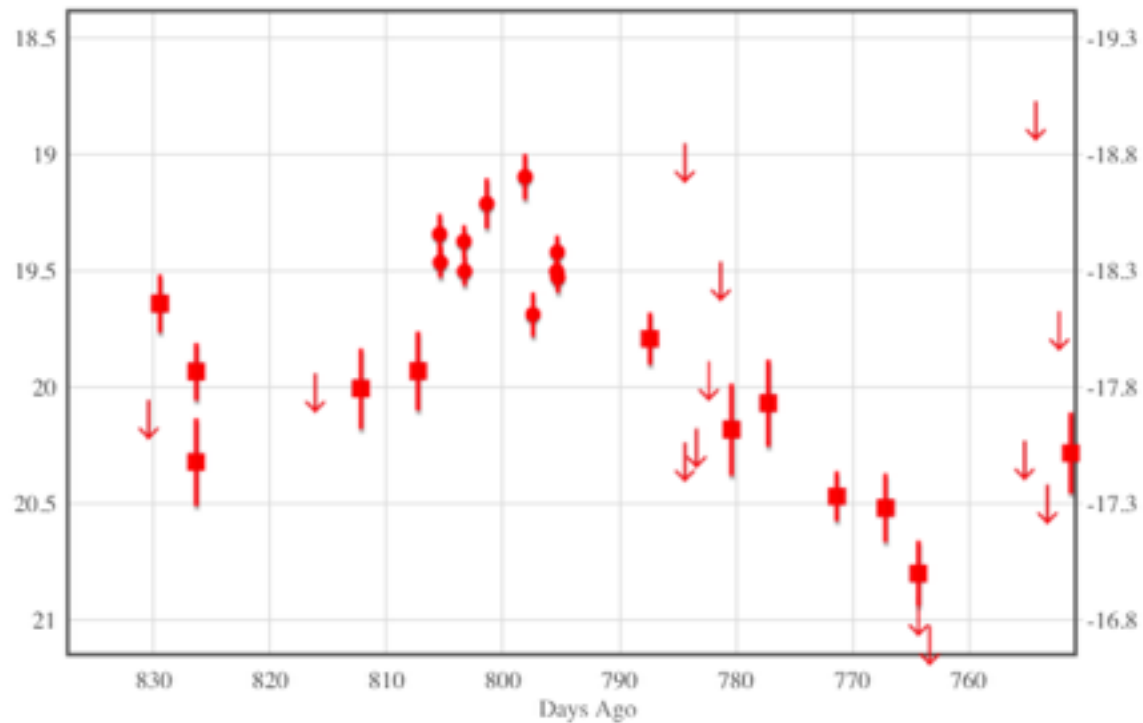
Discovered by iPTF 2011 Jul 18
Bump ca 200 days after r max
Brighter than 13z in absolute terms



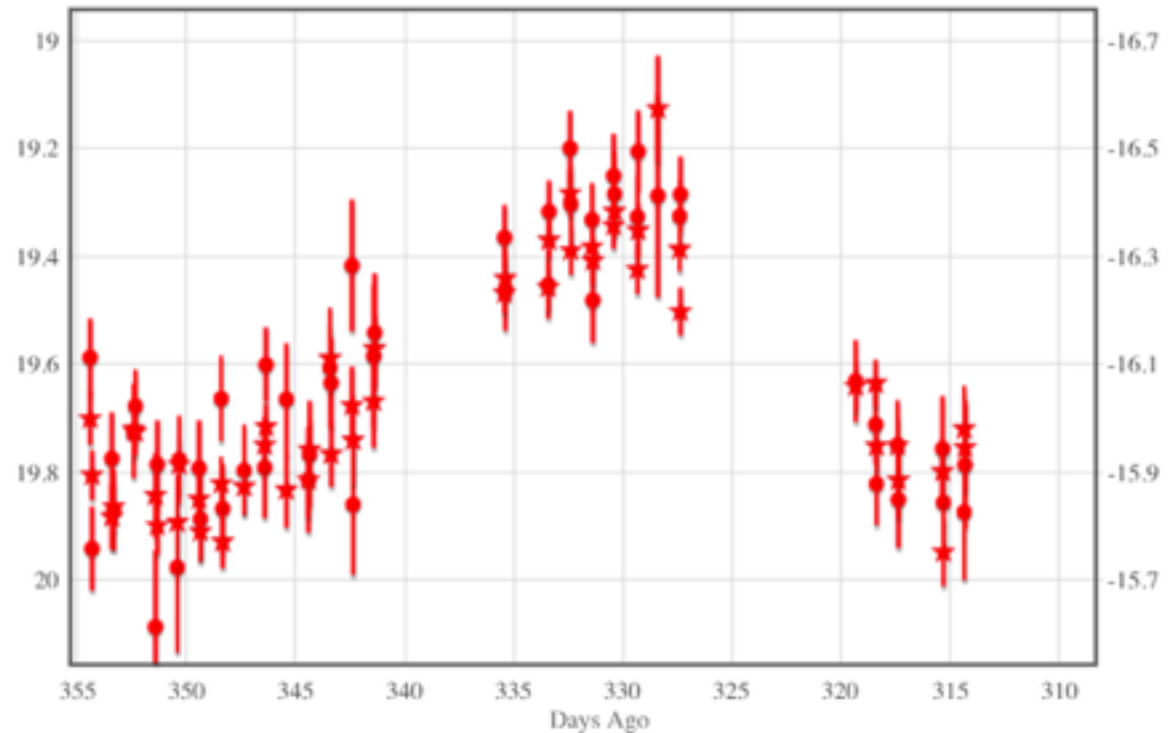
SN iPTF 13z

Discovered by iPTF 2013 Feb 04
Bump >150 days after r max

The bumps

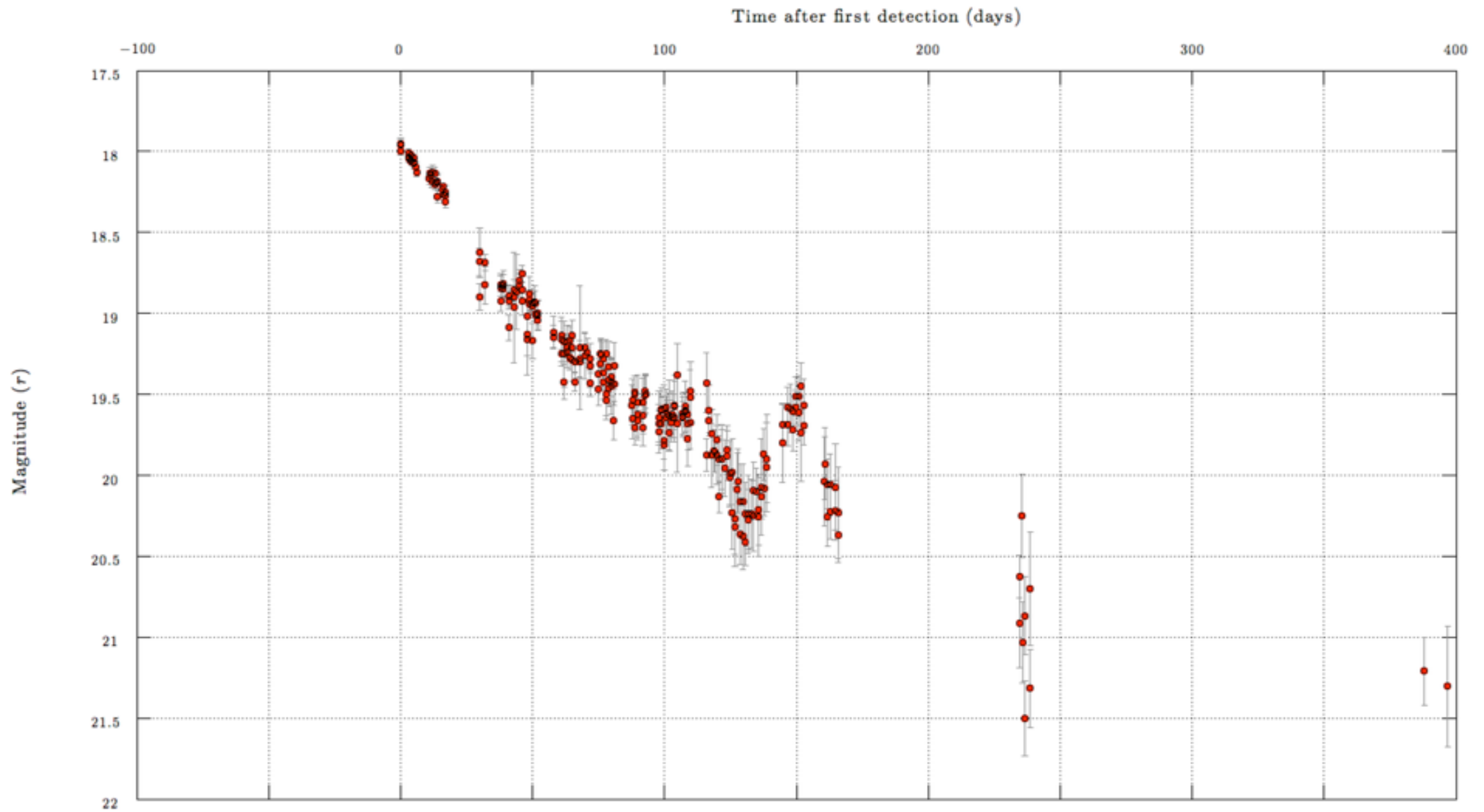


The bump of 11fzz
Middle: ca 2012 March 20
Duration: 30 days
Amplitude: 1 mag.

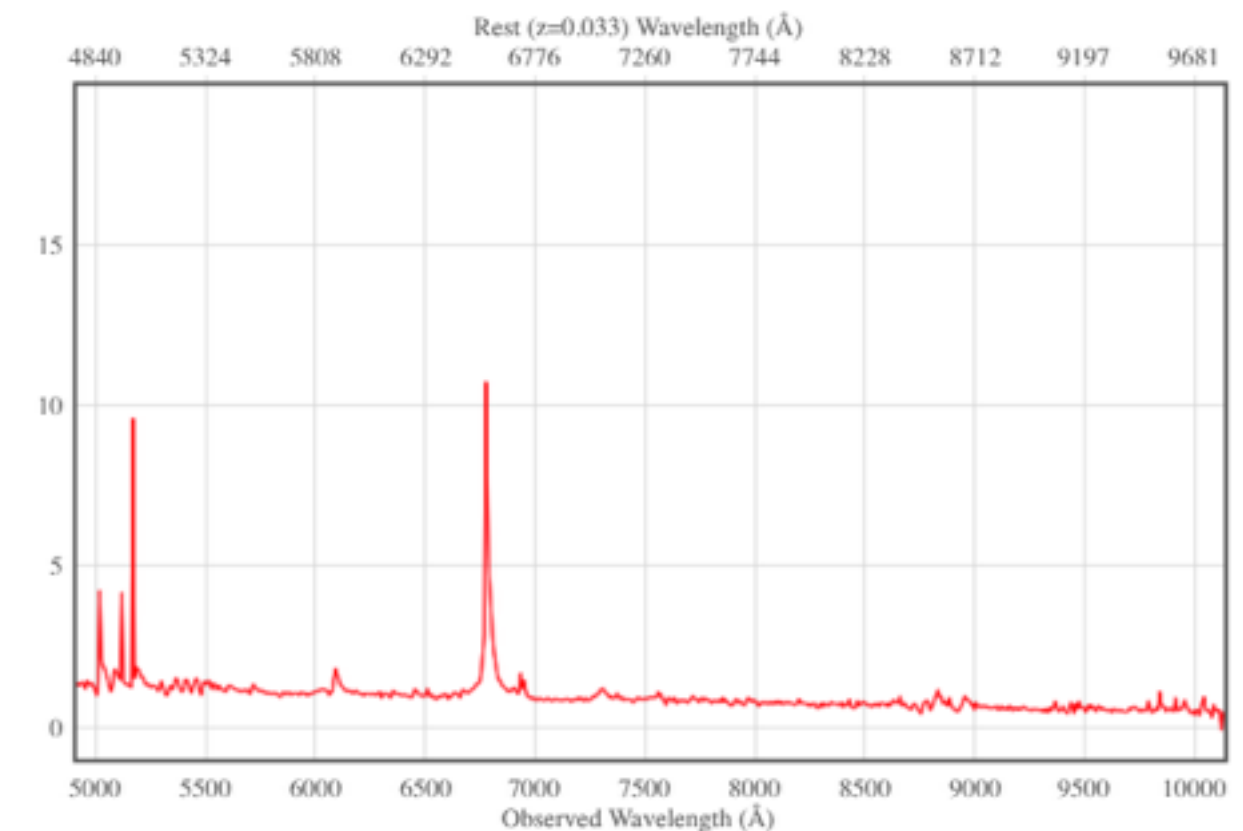
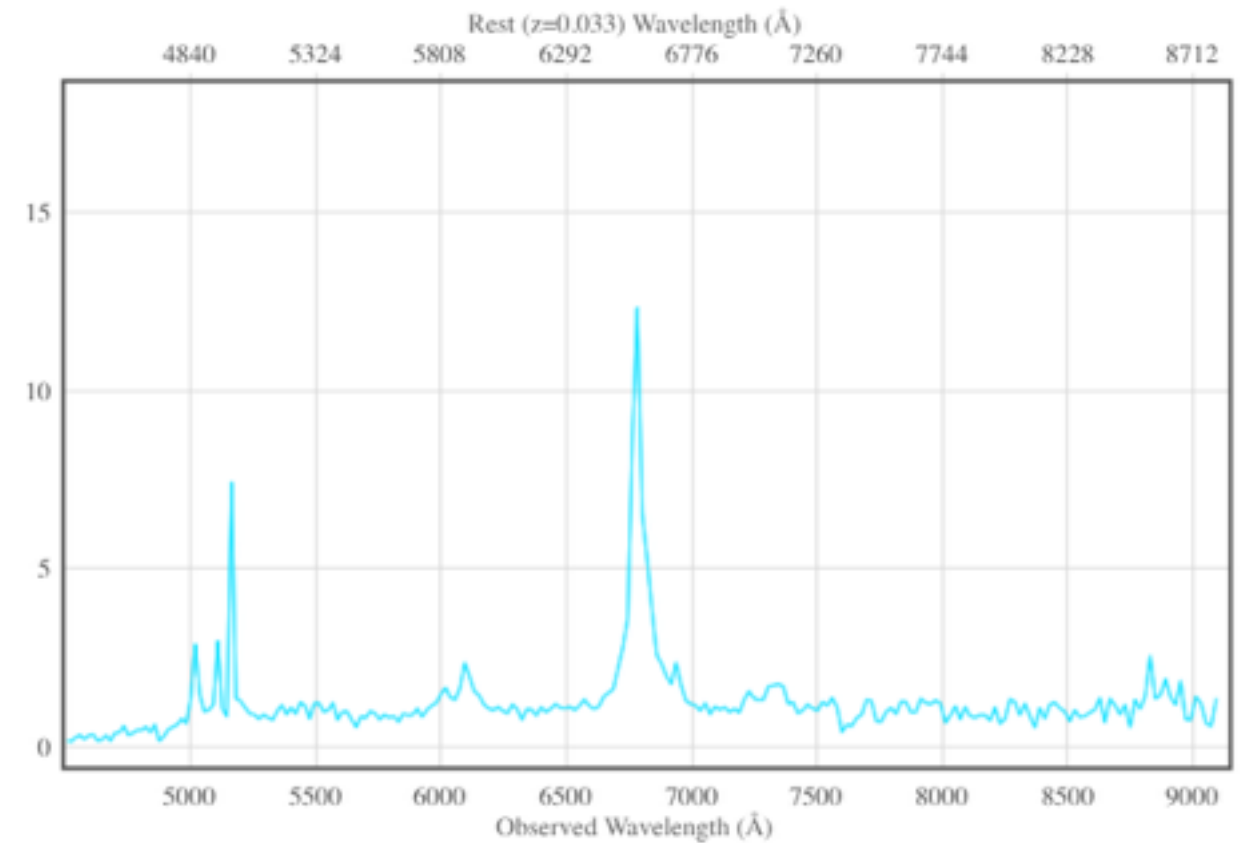
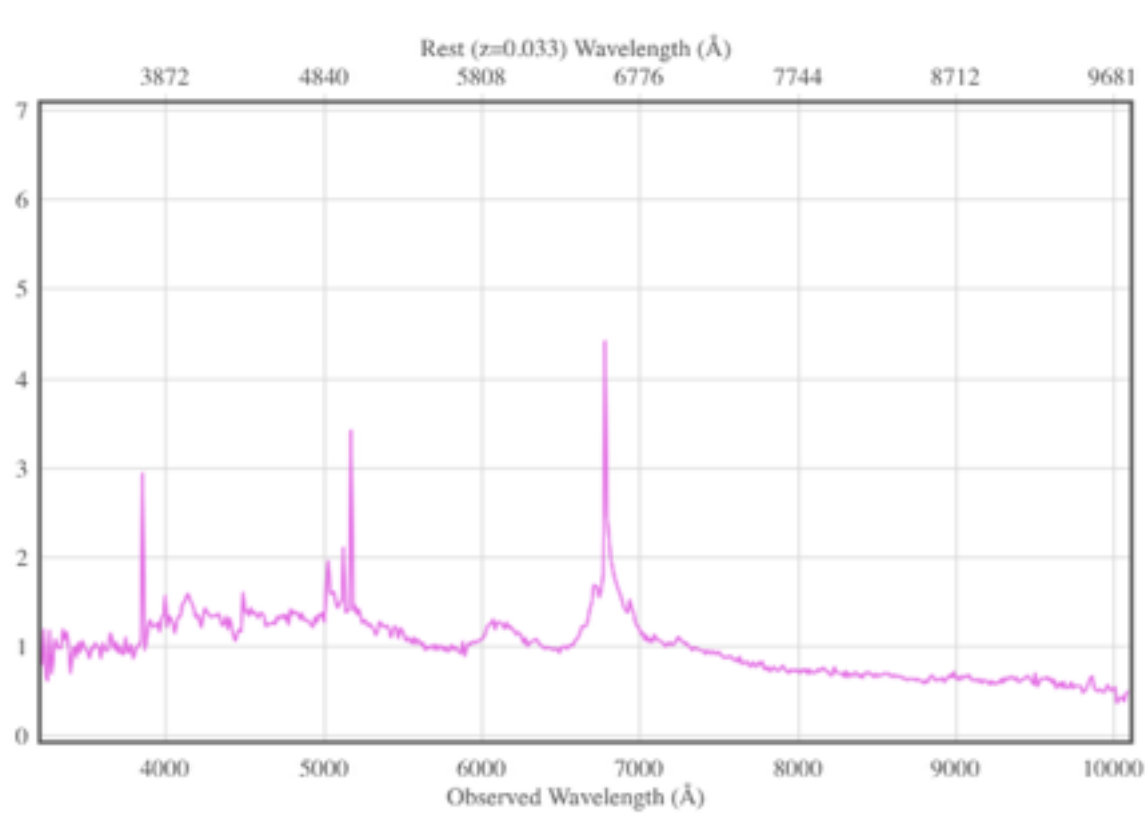


The bump of 13z
Middle: ca 2013 July 02
Duration: 30 days
Amplitude: 0.8 mag.

13z photometry reduced with the Fremling pipeline



Spectra of 13z



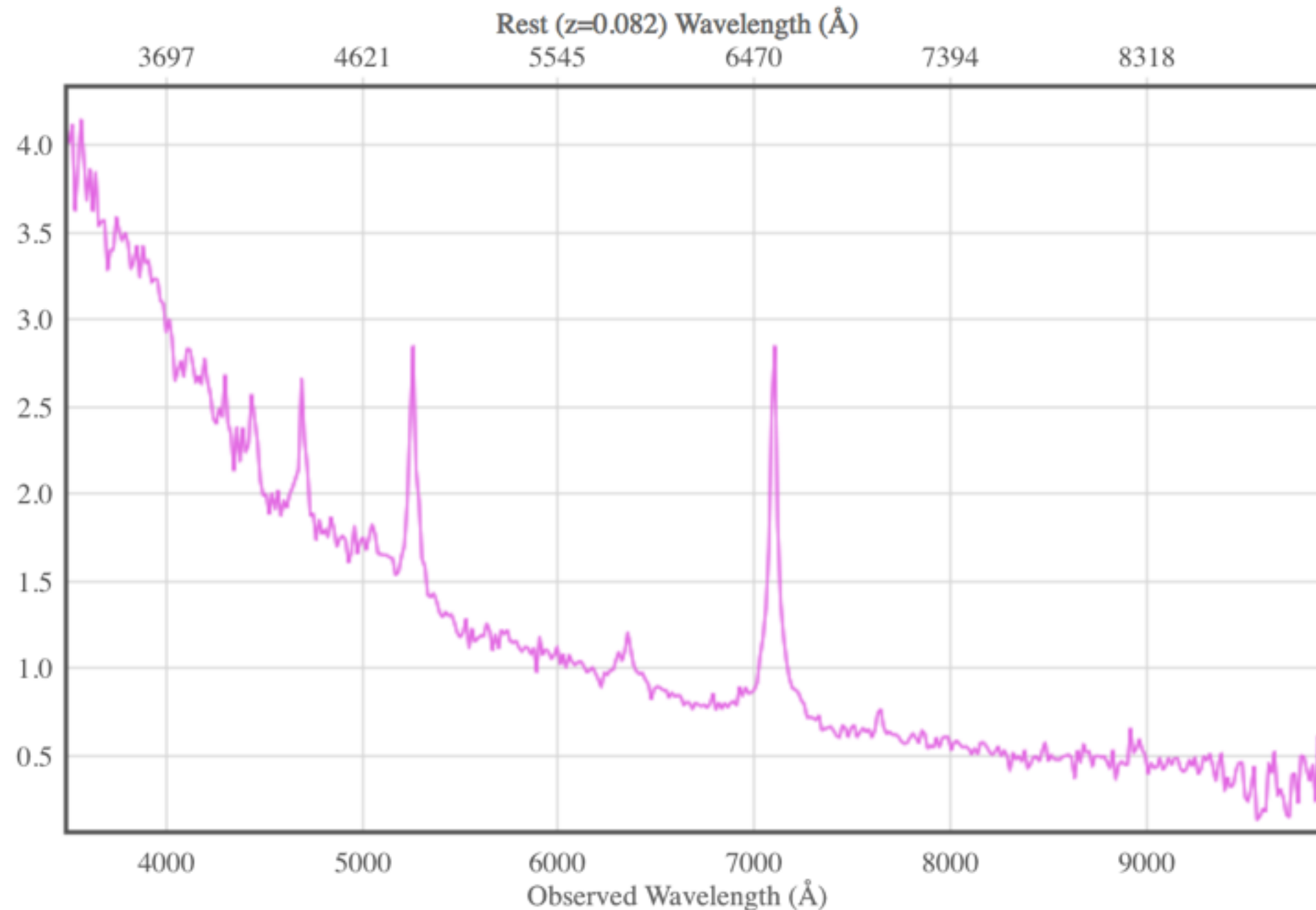
Clockwise:

2013 Feb 18, P200

2014 Jan 12, NOT

2014 May 26, Keck2

Spectrum of 11fzz (2011 July 24, P200)



Other LC bumps:

- Stritzinger et al. (2012) report a long duration (~ 500 days) $\Delta m \sim 1$ bump in the r band LC of Type II In **SN 2006jd**. Discuss explanation involving shell-like geometry of CSM.
- Fraser et al. (2013) and Graham et al. (2014) discuss a bump in the LC of Type II In **SN 2009ip** around 2012 November 1.
- Bietenholz et al. (2010) report bumps in the 5 GHz radio LC of Type I b/c **SN 2009bb** at 52 days after shock breakout

Some more musings on LC bumps

Some ratios:

- 200 Type II in the Asiago Supernova Catalog, 2 bump SNe on previous slide: 1 %
- 97 Type II in now in the iPTF sample, 2 bump SNe: 2 %

Aims of this study:

- Use the LC bumps to quantify the properties of the CSM and late history of the progenitors

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- Use LC bumps to probe the geometry of the CSM
- Suggest cause of the LC bumps
- Compare with other SNe II and put in context