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at North Carolina State University

Remarkable Features Observed in Recent Type Ib Supernovae

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With thanks to

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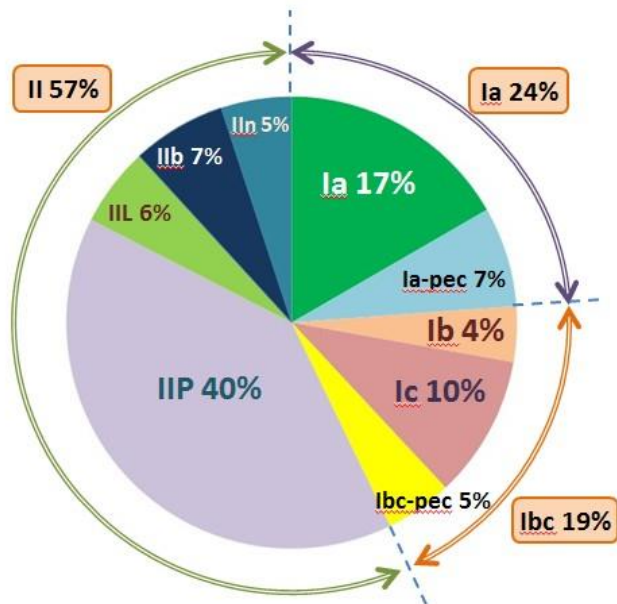
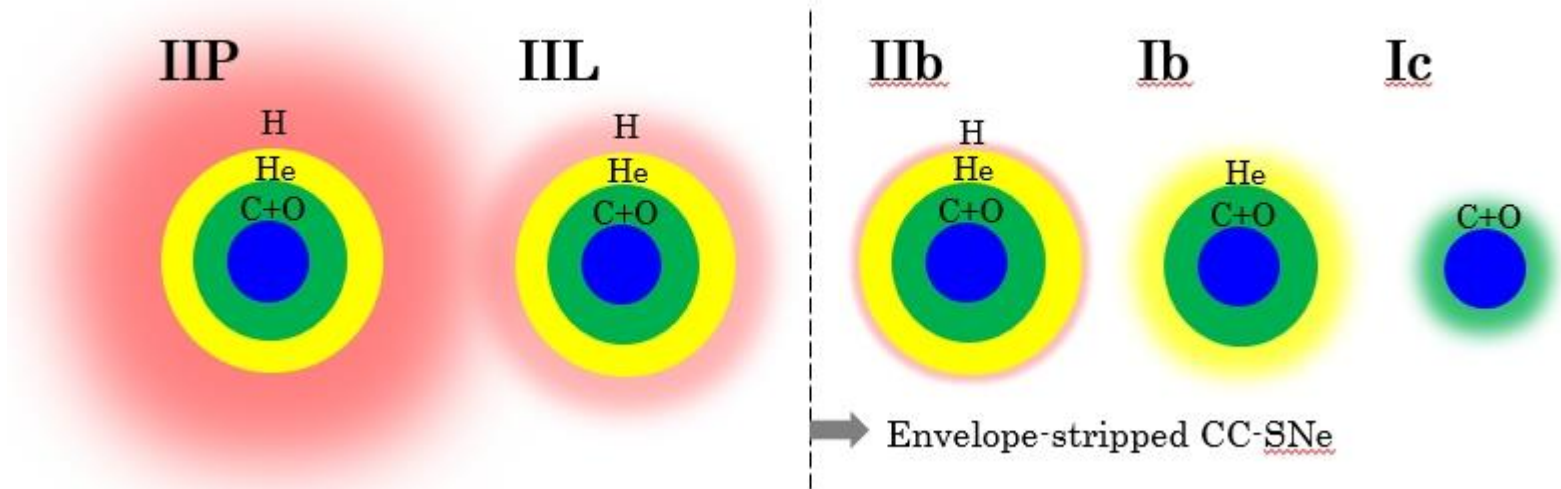
b : Konan University, Japan

c : Kyoto University, Japan

d : NAOJ, Japan

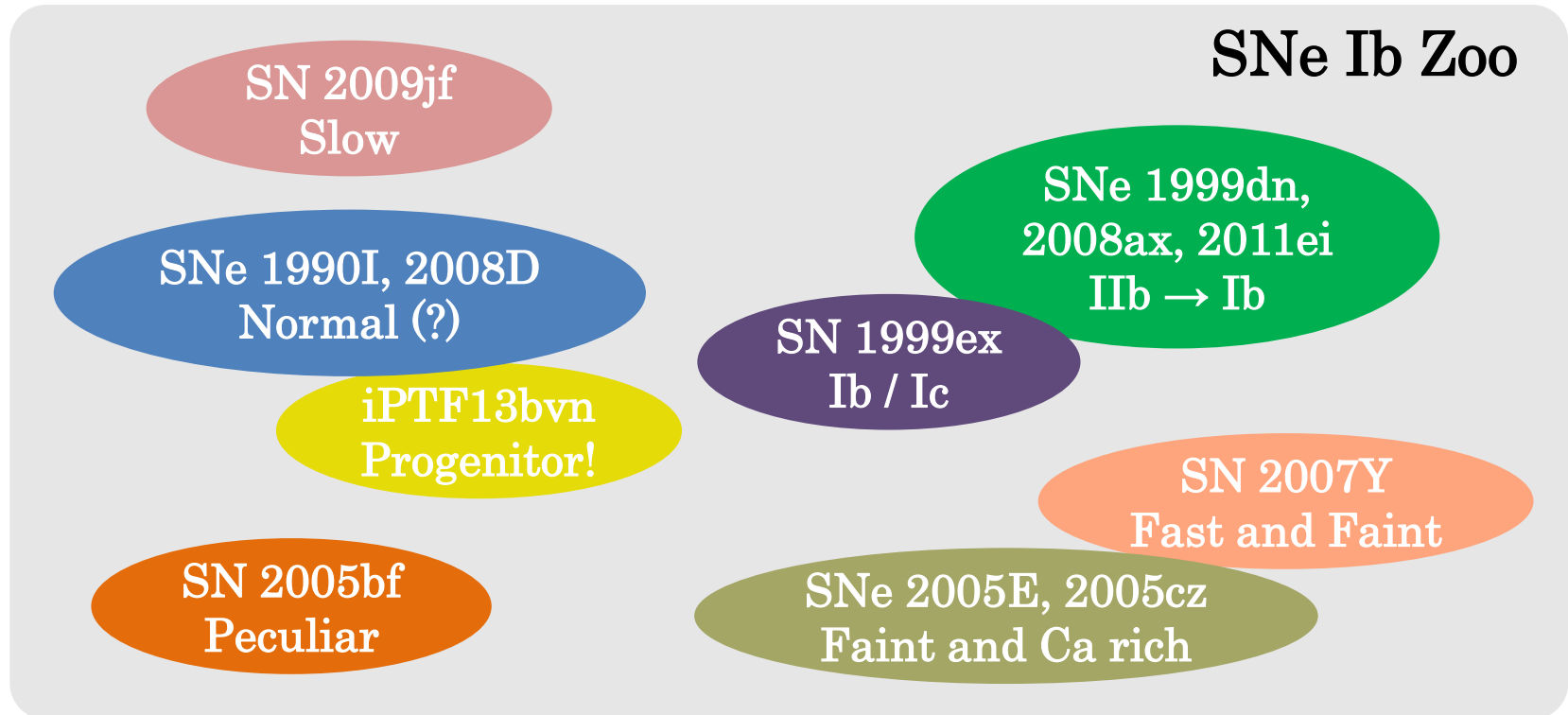
T

type Ib Supernovae



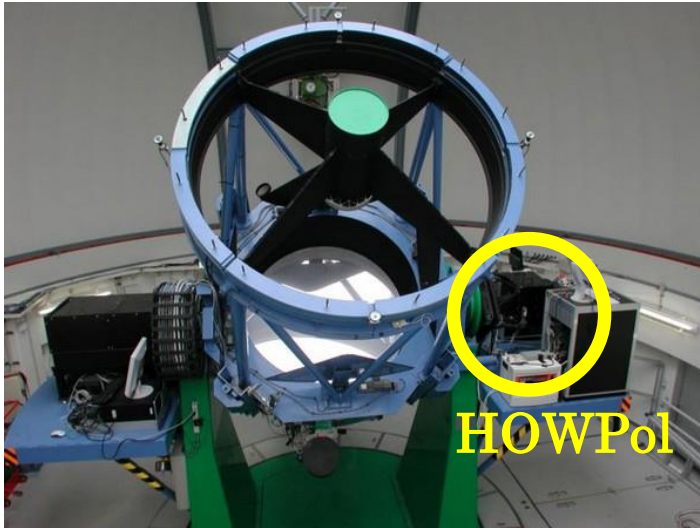
- ❑ No Hydrogen, but Helium remained
- ❑ Ununderstood explosion mechanism.
- ❑ Progenitor : Single or Binary?
- ❑ Connection to Ic? IIb?

Diversity among SNe Ib



- ❑ Many characters (not being uniformed)
New SN often shows remarkable features
- ❑ Here I introduce mainly SNe 2012au and 2014C.

I nstruments



Kanata telescope (1.5m)

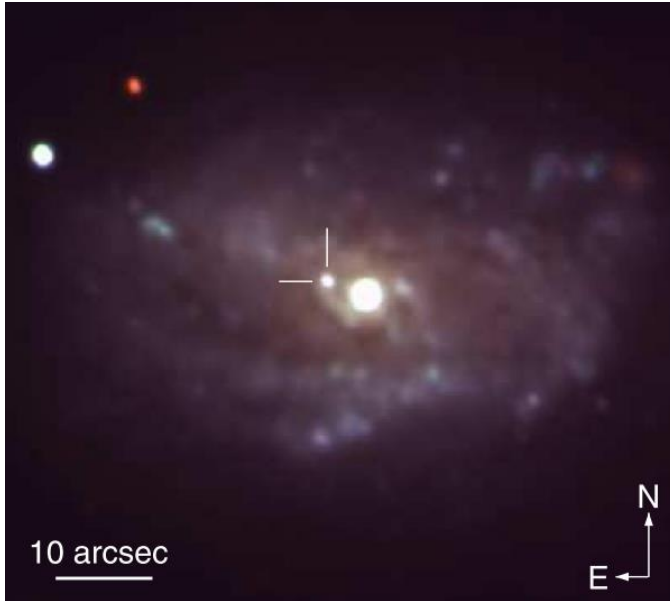
- at Higashi-Hiroshima, Japan
- can use freely and flexibly
- **HOWPol** (2008~)
 - optical – image, spec., polari.,
- HONIR (2014~)
 - opt&NIR – image, spec.,
 - polari., specpol.



Subaru telescope (8.2m)

- at Mauna kea, Hawaii
- for late phase
- Normal proposal for 2014B–148
- **FOCAS**
 - optical image, spec., polari.,

S N 2012au



R.A. 12 : 54 : 52.18

Dec -10 : 14 : 50.2

Host NGC 4790

Distance 23.6Mpc

Redshift 0.004483

SN Ib similar to hypernova

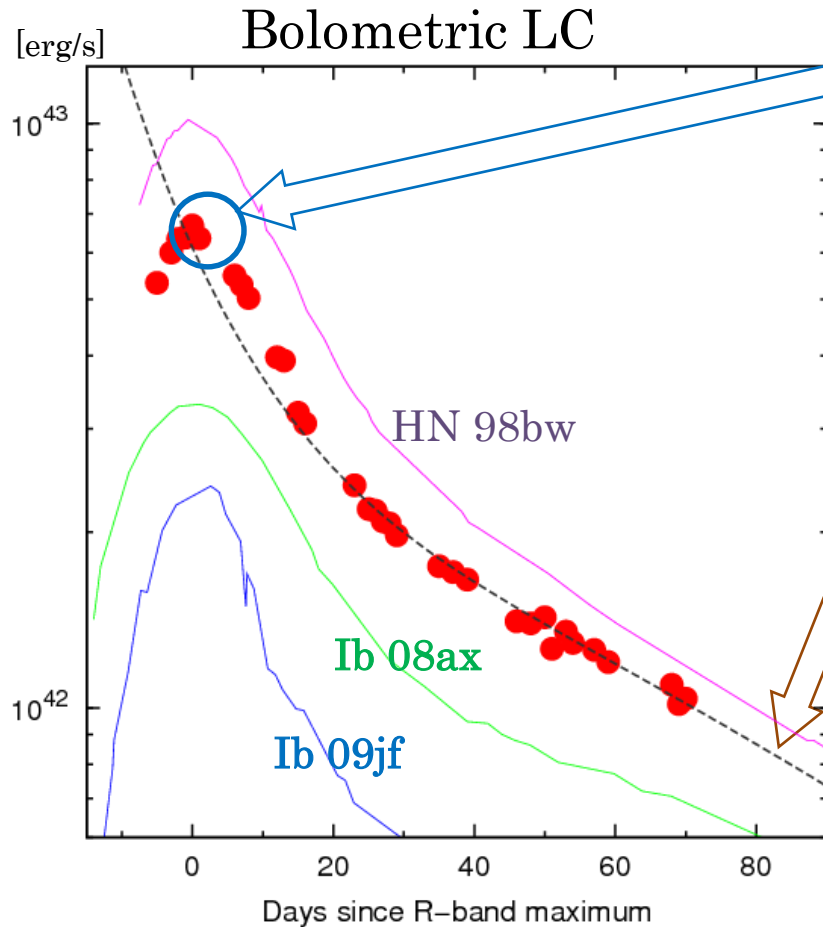
References

Early phase : KT et al. 2013, ApJ, 772, 17L

Late phase : Milisavljevic et al. 2013, ApJ, 770, 38L

Radio : Kamble et al. 2014, ApJ, 797, 2

S N 2012au early-phase results 1



(KT+ 13)

Peak

Very bright
close to 98bw

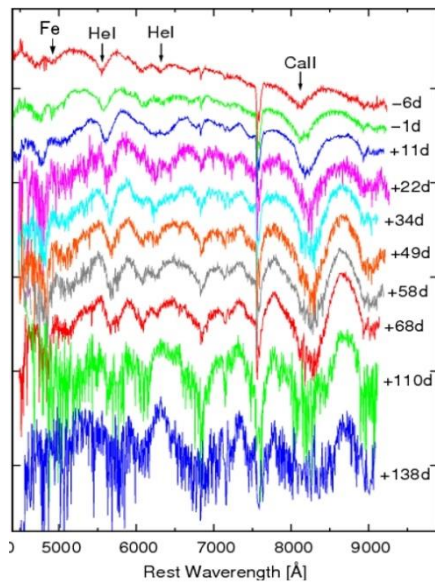
Tail

LC model fitting
(Maeda+ 03)

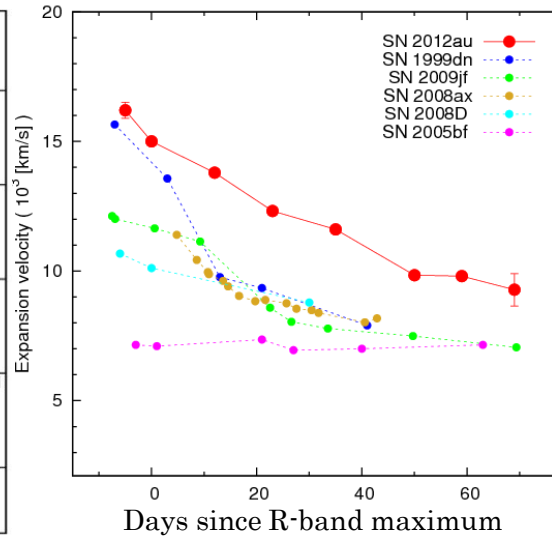
		12au	98bw
Outer	M(⁵⁶ Ni)	0.12	0.44
	tau	2	1
Inner	M(⁵⁶ Ni)	0.14	0.11
	tau	20	26

- ☐ Very high density
in inner region
- ☐ Density structure is
similar to that of 98bw

S N 2012au early-phase results 2



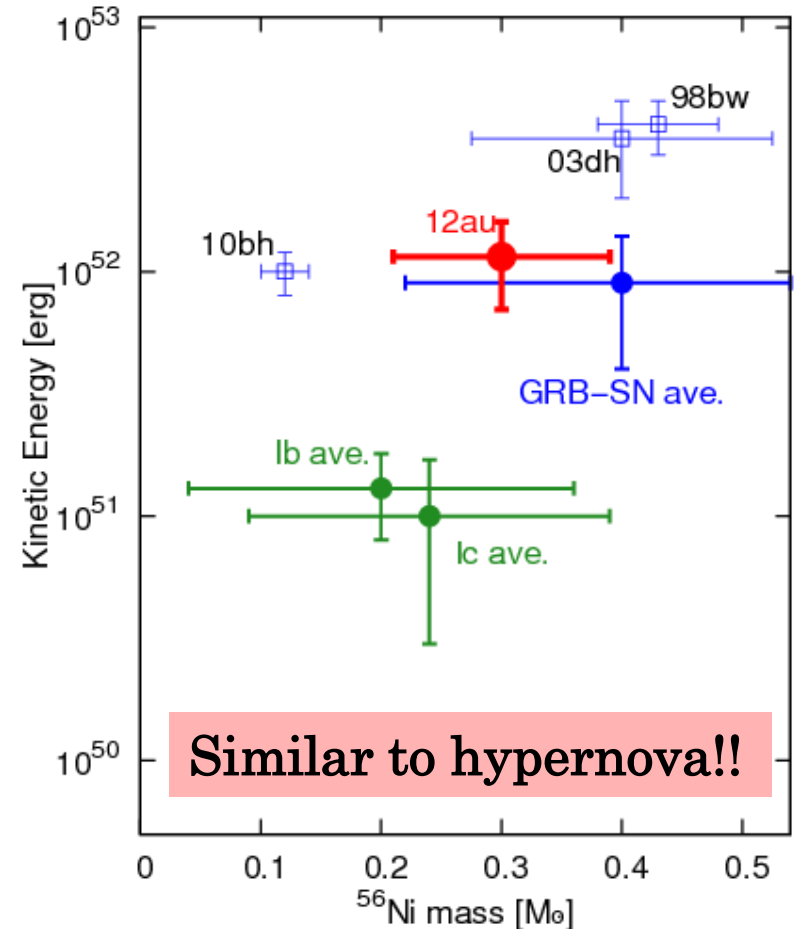
Rather typical



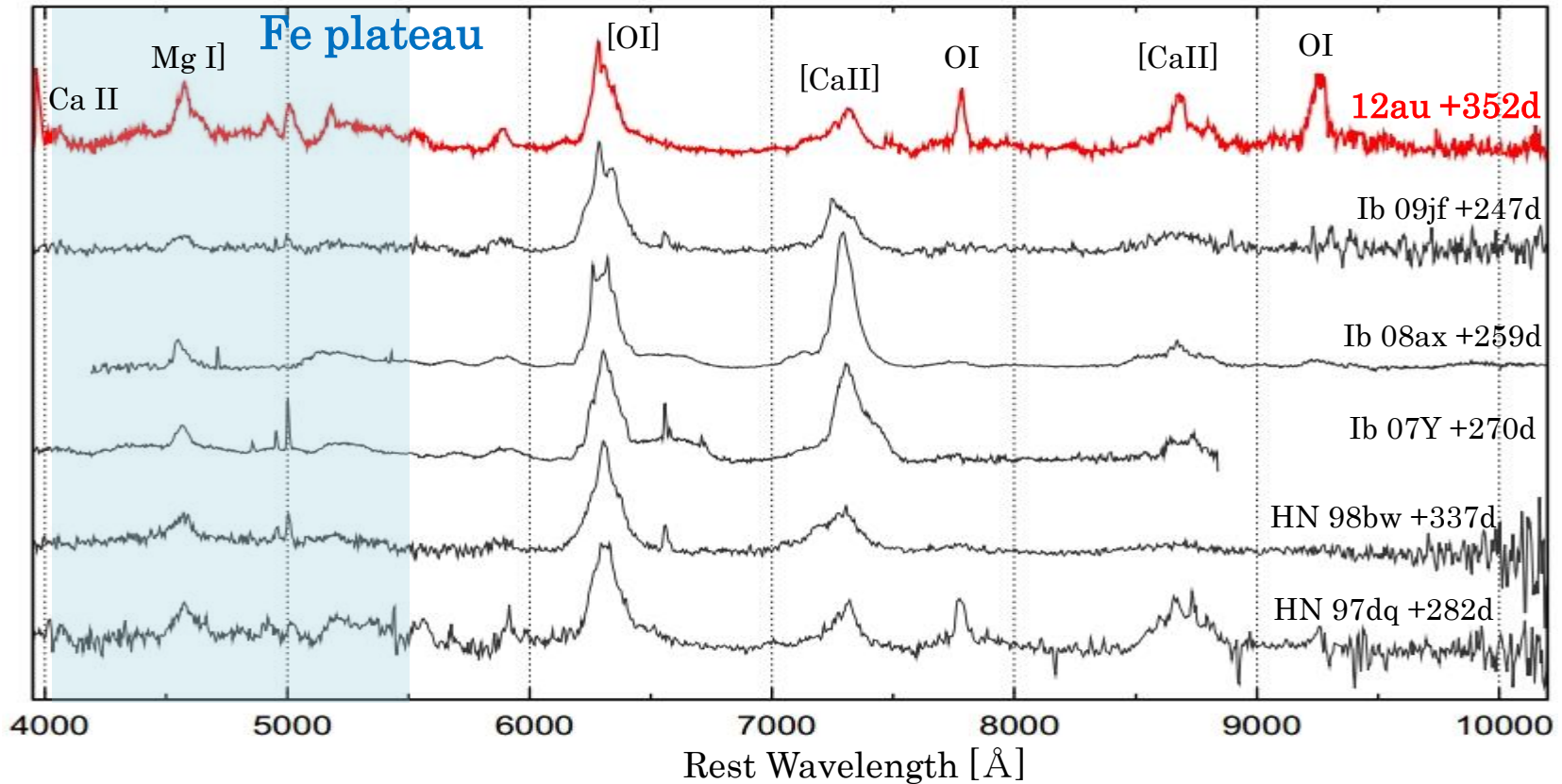
High velocity

Derived parameters;

Produced ^{56}Ni : $0.30 M_{\odot}$
 Ejected mass : $5 - 7 M_{\odot}$
 Kinetic energy : $(7 - 18) \times 10^{51}$ erg



S N 2012au late-phase results 1



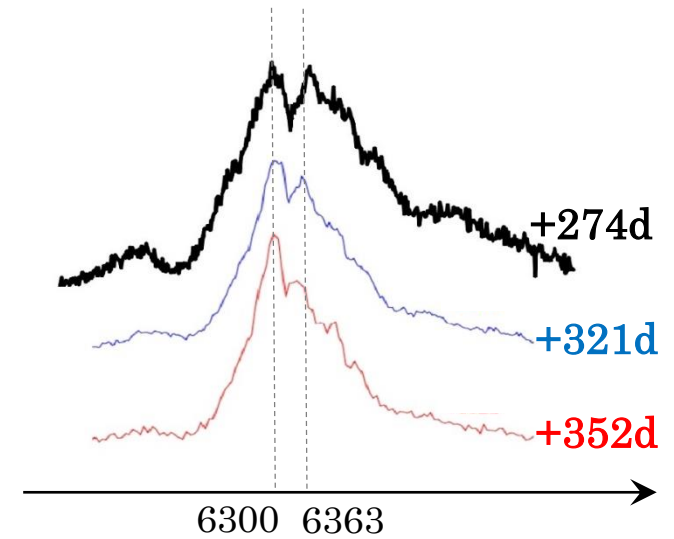
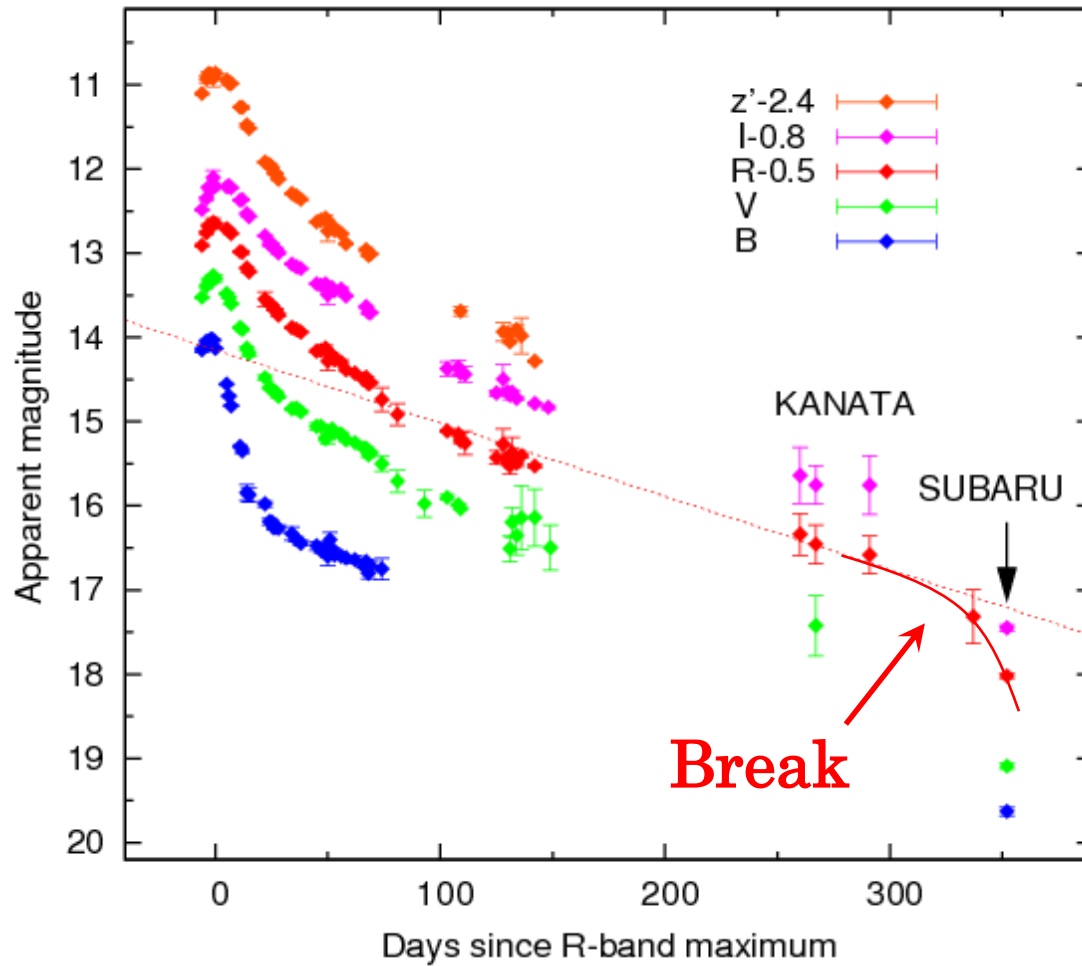
☐ Strong O lines → High density region of Oxygen

☐ Strong Fe lines → Large ^{56}Ni ($^{56}\text{Ni} \rightarrow ^{56}\text{Co} \rightarrow ^{56}\text{Fe}$)

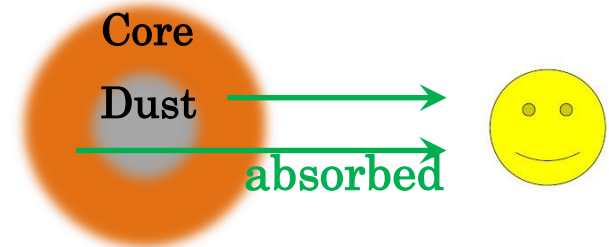
→ Consistent with Early phase

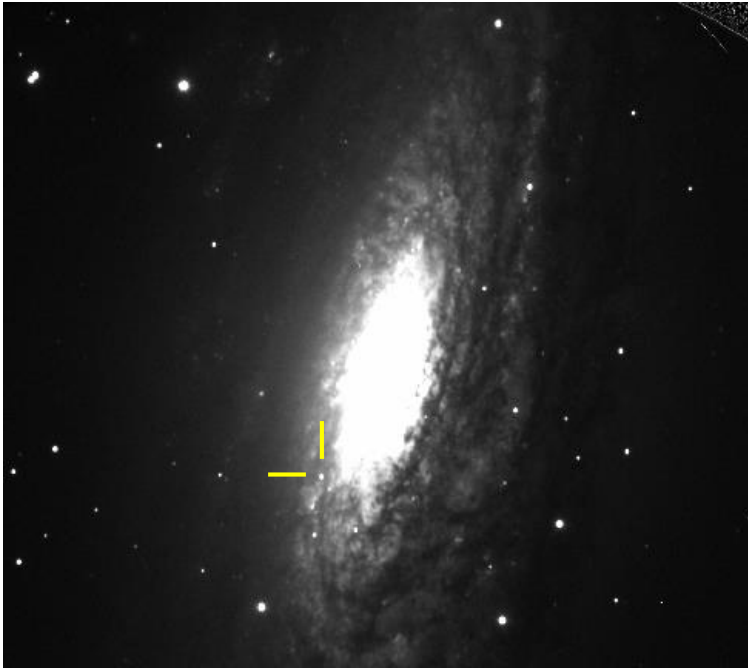
S

N 2012au late-phase results 2



Dust produced ...?





FOCAS R band

R.A. 22 : 37 : 05.60

Dec +34 : 24 : 31.9

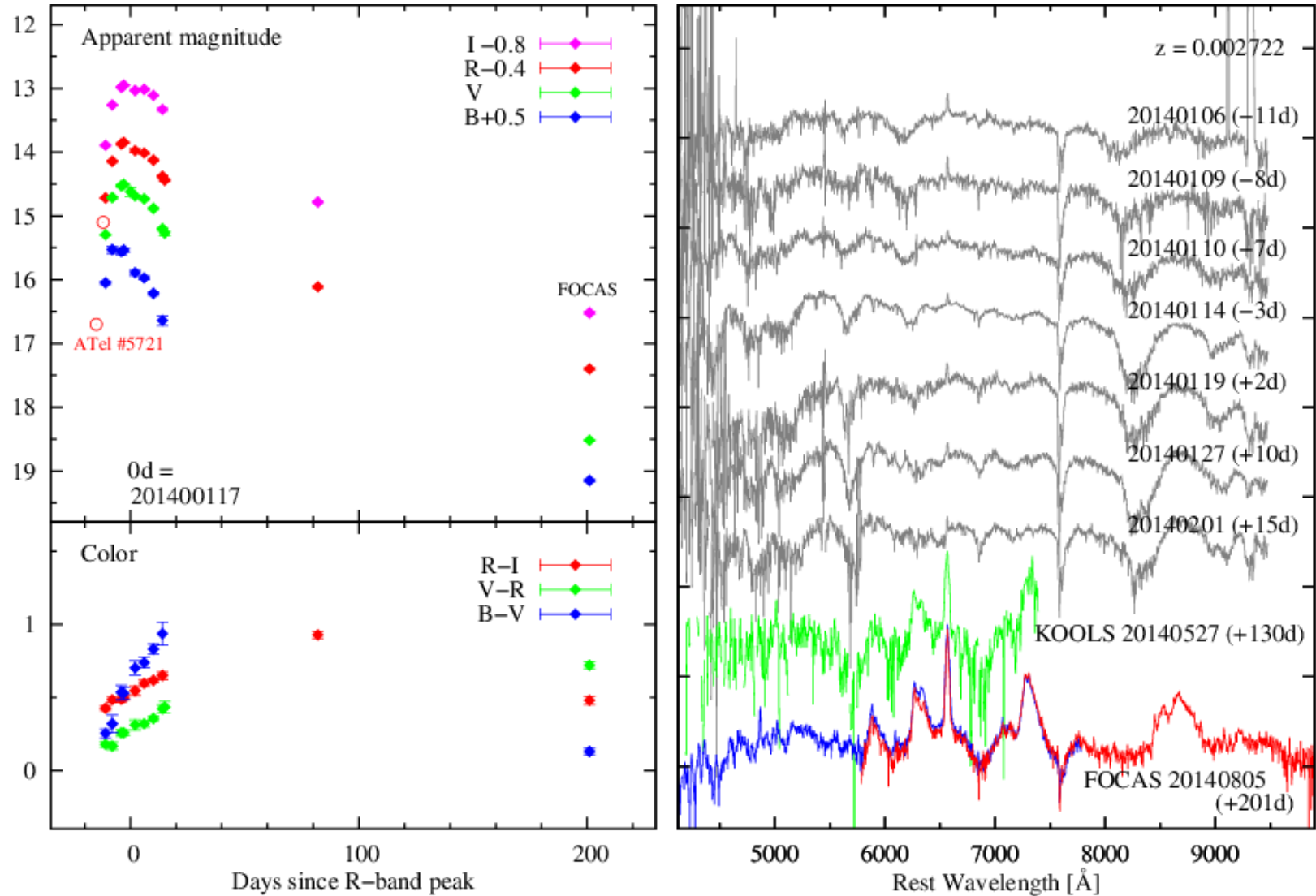
Host NGC 7331

Distance ~15Mpc

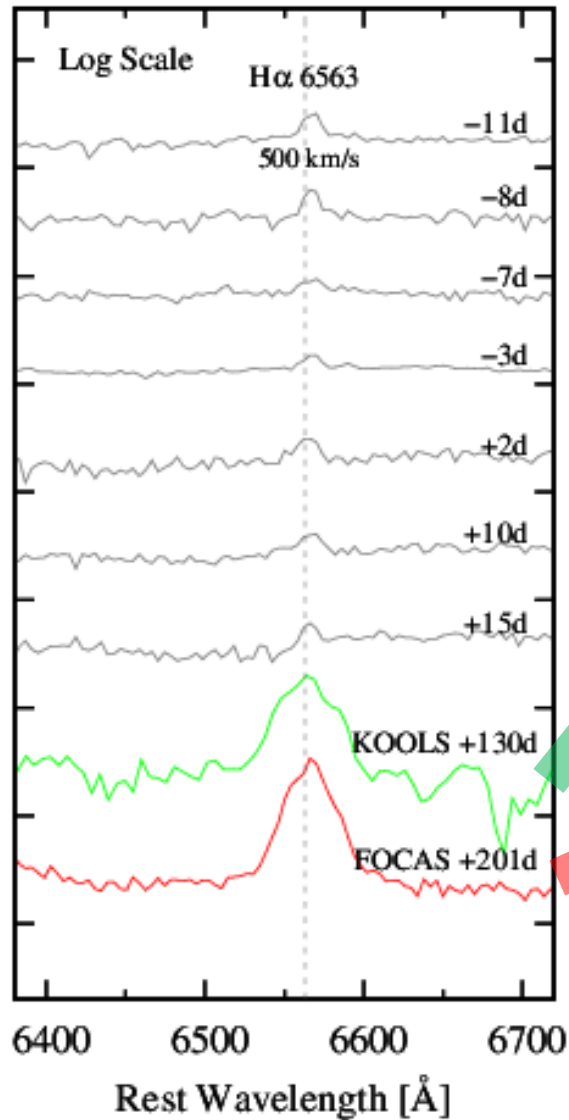
Redshift 0.002722

Interaction with CSM?

S N 2014C results 1

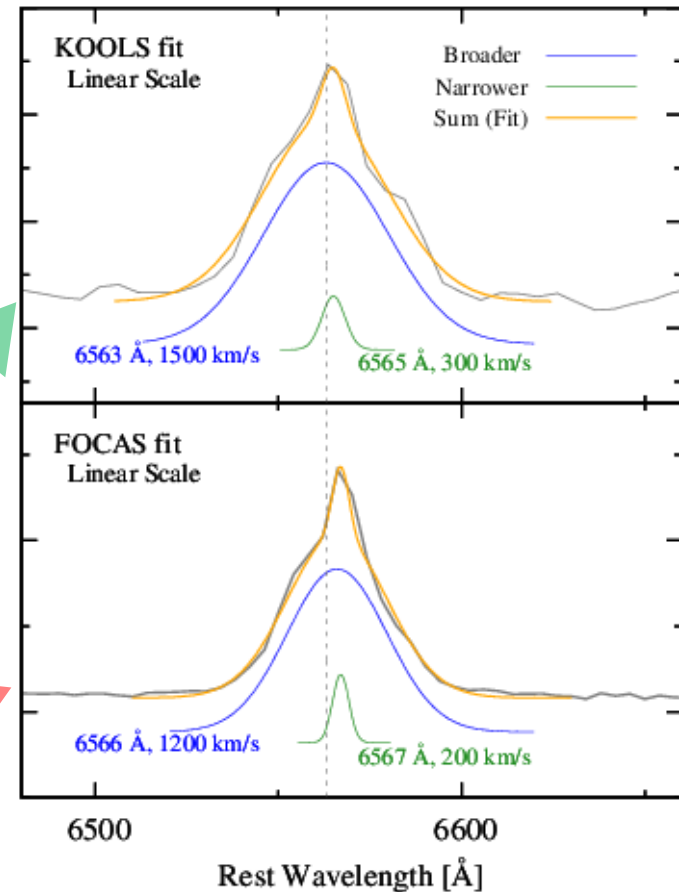


S N 2014C results 2



Zoomed

Zoomed



Interaction with CSM? Binary? ...

S ummary

❑ SN 2012au

Very bright, large explosion energy, density structure
→ similar to hypernovae

LC break and [OI] profile changed
→ peculiar, dust produced?

❑ SN 2014C

Typical Ib as a whole (?)

In late phase, medium width of H α appeared
→ interaction with CSM or engulfing binary or ...?

❑ Other Ib may show also attractive features