

せいめい望遠鏡を使った  
近傍超新星の追観測について

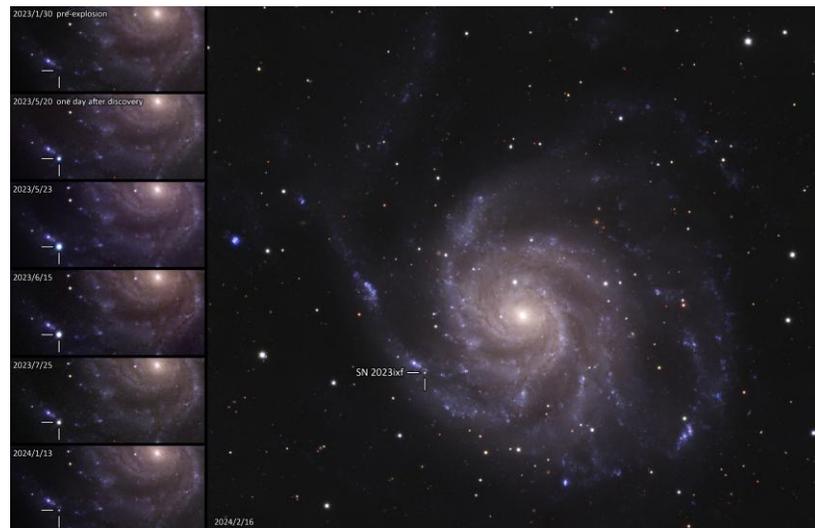
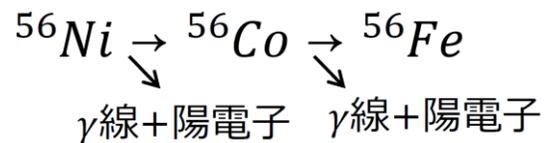
2025年10月22日

光赤外線天文学大学間連携ワークショップ

京都大学 川端美穂

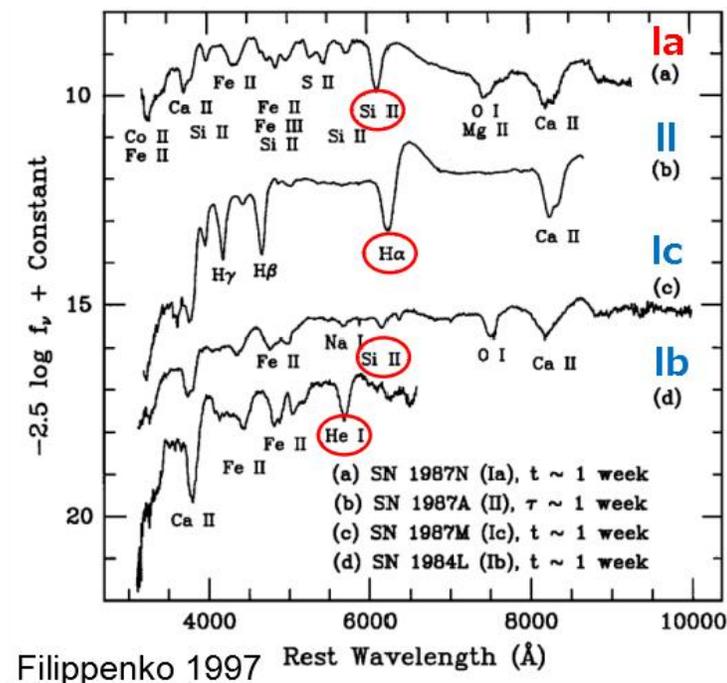
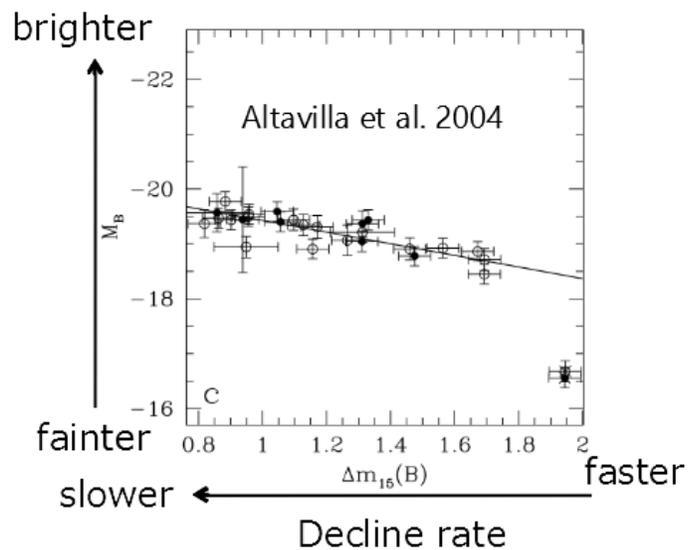
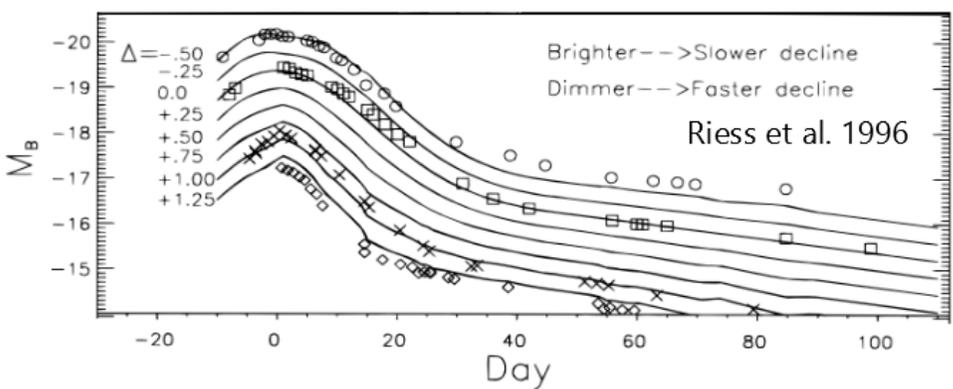
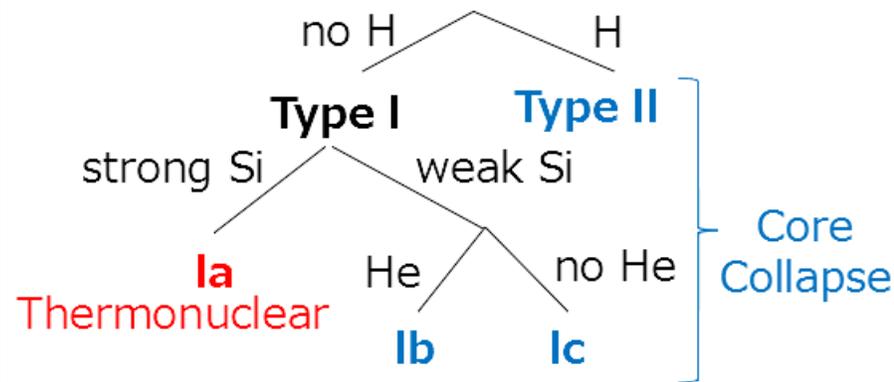
# About Supernovae

- Energy Source



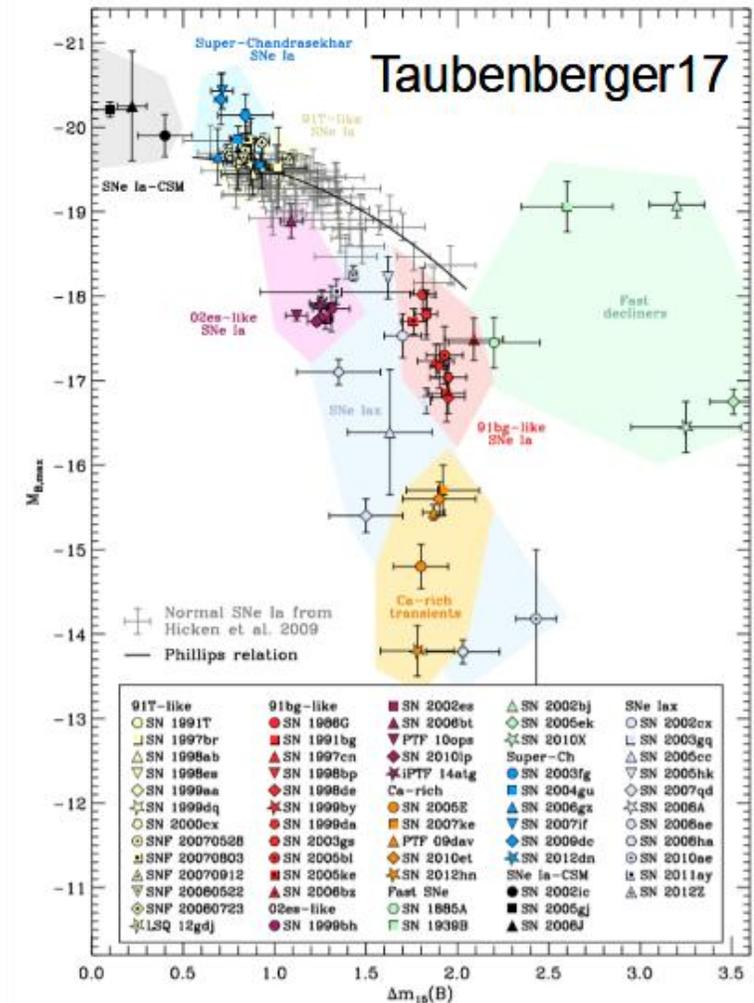
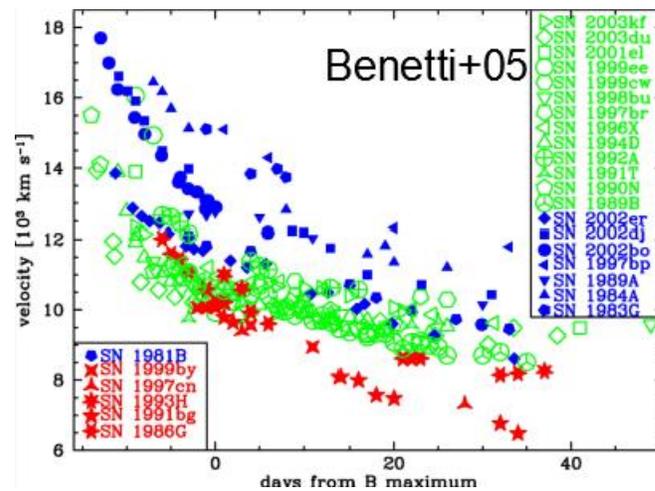
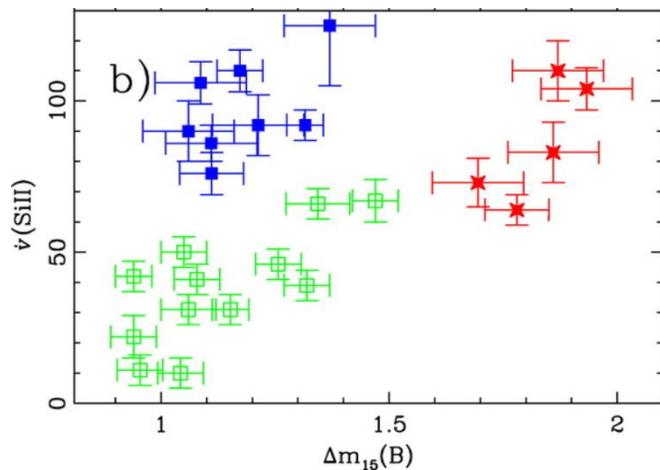
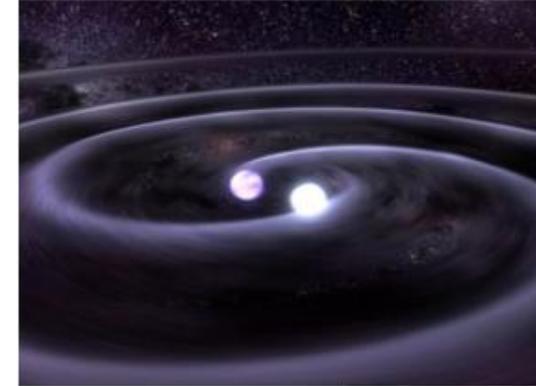
Okayama Astronomical Observatory, Kyoto University / University of Tokyo

- Classification  
→ Spectra @maximum



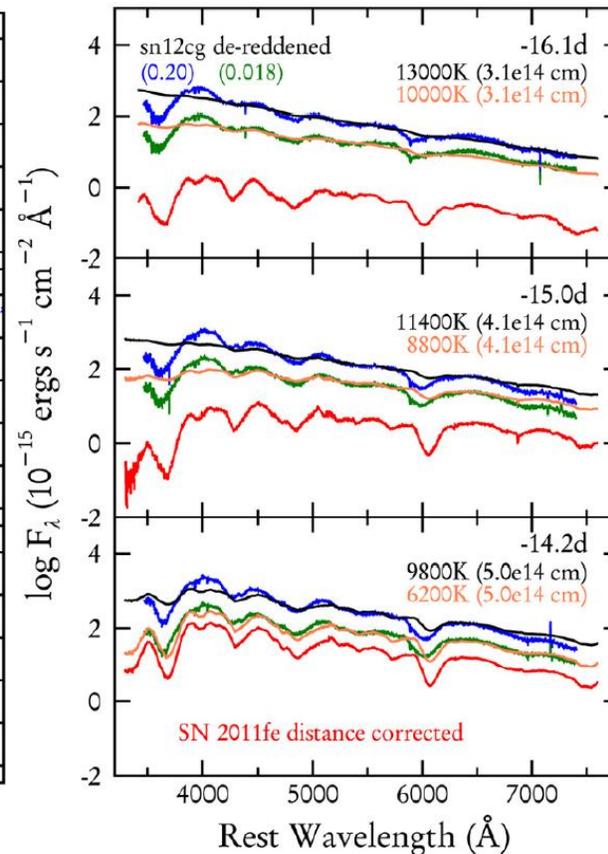
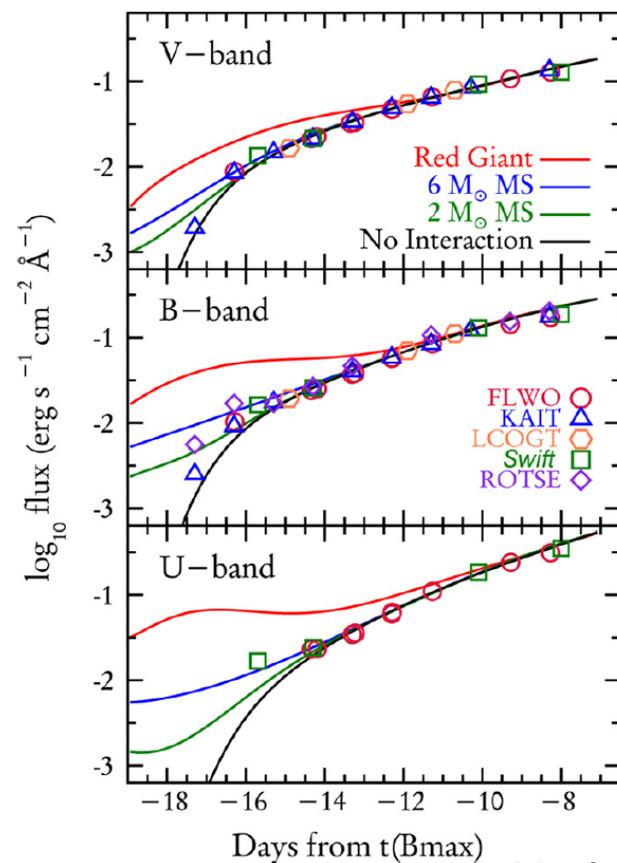
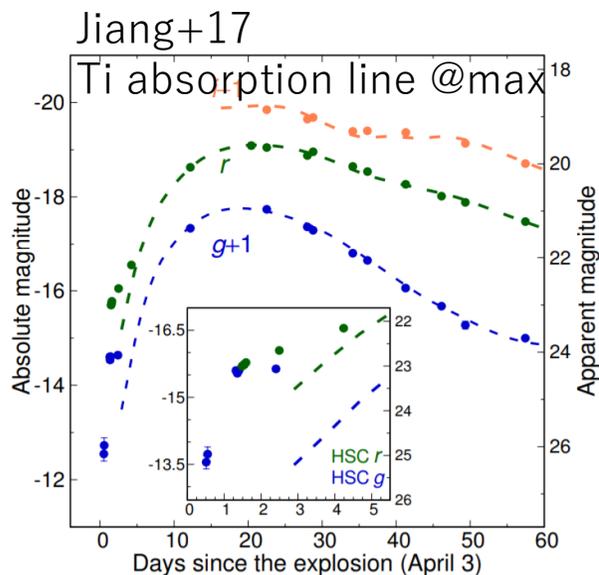
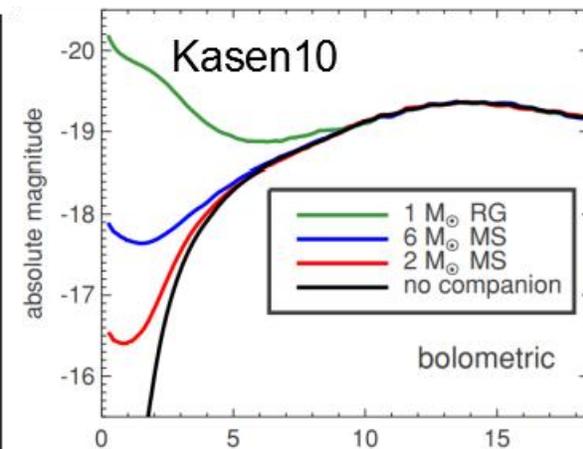
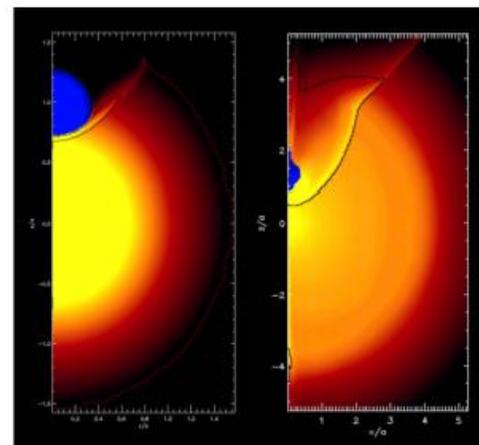
# Unresolved Problems : SNe Ia

- Progenitor system:  
Single Degenerate or Double Degenerate?
- Explosion mechanism:  
Where does ignition start?  
Detonation or Deflagration?
- Diversity:  
Peculiar subclass of SNe Ia



# Early-phase excess : SNe Ia

- Excess in early phase
  - Possible causes: Companion / CSM interaction, Ni distribution, or He detonation
- Requires: Spectroscopy and multi-band photometry



Marion et al. 2016

# KASTOR

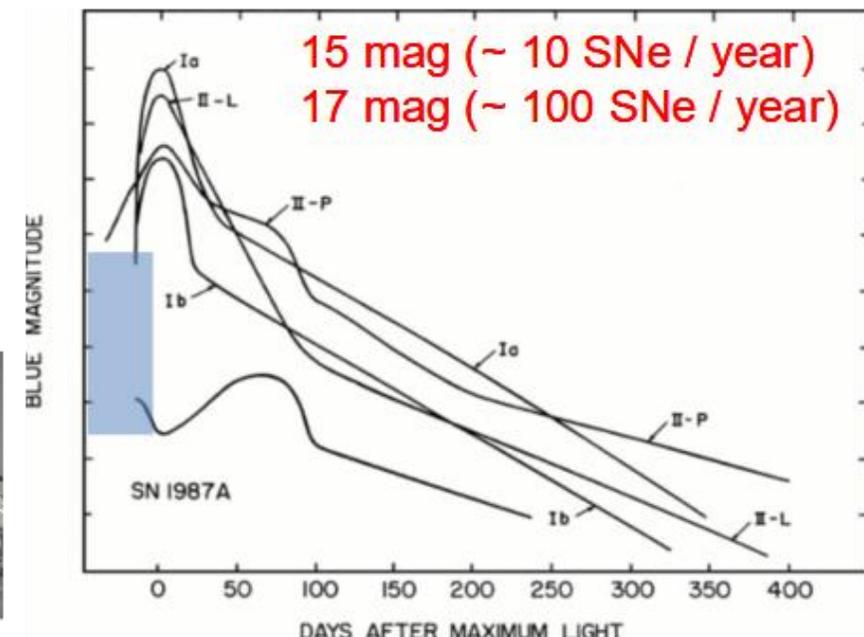
## Kanata And Seimei Transient Observation Regime

- 3.8m Seimei telescope:
  - Optical spectroscopy and photometry
- 1.5m Kanata telescope:
  - Optical spectroscopy and photometry
  - NIR photometry
  - Optical + NIR polarimetry
- Follow-up of new transients discovered in surveys such as Tomo-e, WFST
- Collaborate with Indian Telescope, Subaru, NOT, etc.



	Tomo-e SN Survey
instrument	Tomo-e Gozen
sensor	CMOS
readout time	~0 sec
period	2018/9-
survey area [deg <sup>2</sup> ]	10,000
cadence	2 hours / 1 day
exposure time / visit	3 sec
depth	18 mag / 19 mag
filter	no (~g+r)
#(SBOs), #(SNe) / yr	5, 1000
data storage	daily-stacked image SN cutout images
reference	-

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# KASTOR

## Kanata And Seimei Transient Observation Regime

- 3.8m Seimei

Optical spectroscopy and photometry

- 1.5m Kanata

Optical spectroscopy and photometry

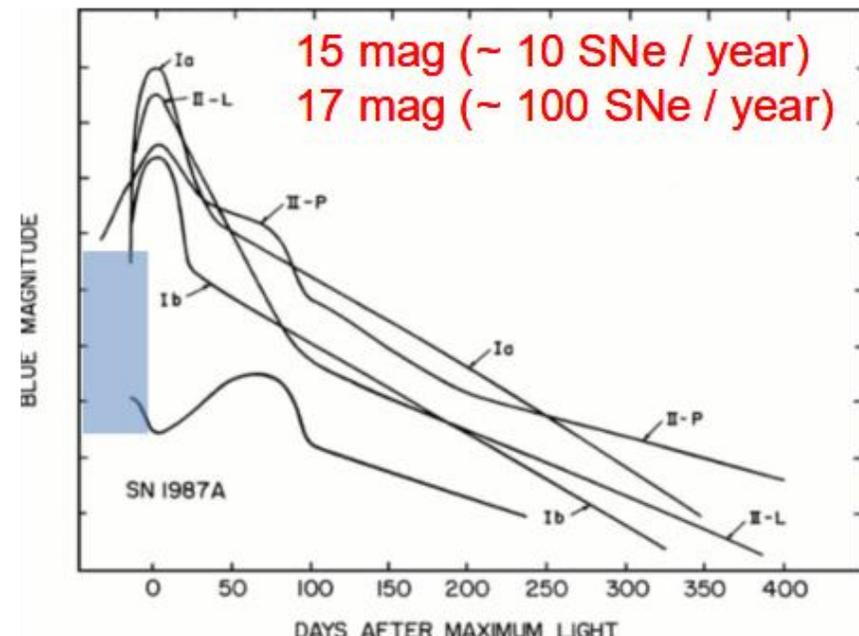
NIR photometry

	Ia	Ib, Ic	II	other	?	TNS
25年	11	5	11	4	5	1
24年	18	7	25	5	16	7
23年	17	11	19	10	4	13
22年	22	7	12	6	13	13
21年	17	4	17	7	5	4
20年	19	6	9	3	17	3
19年	22	5	12	6	17	2



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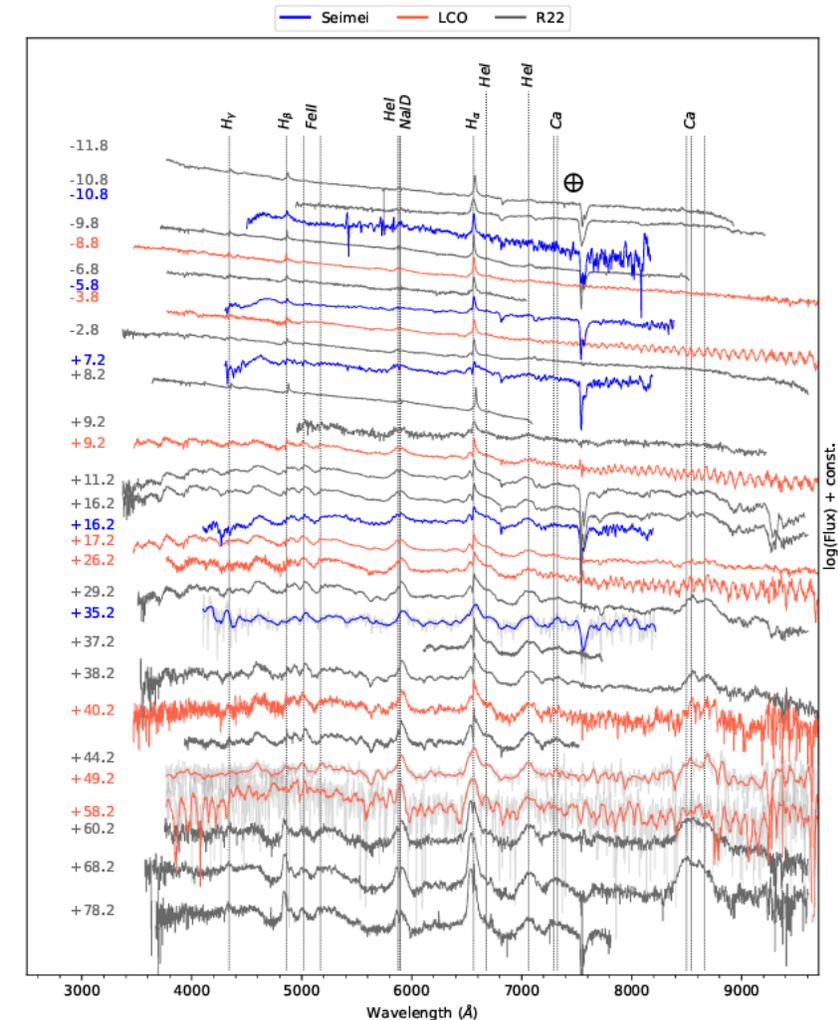
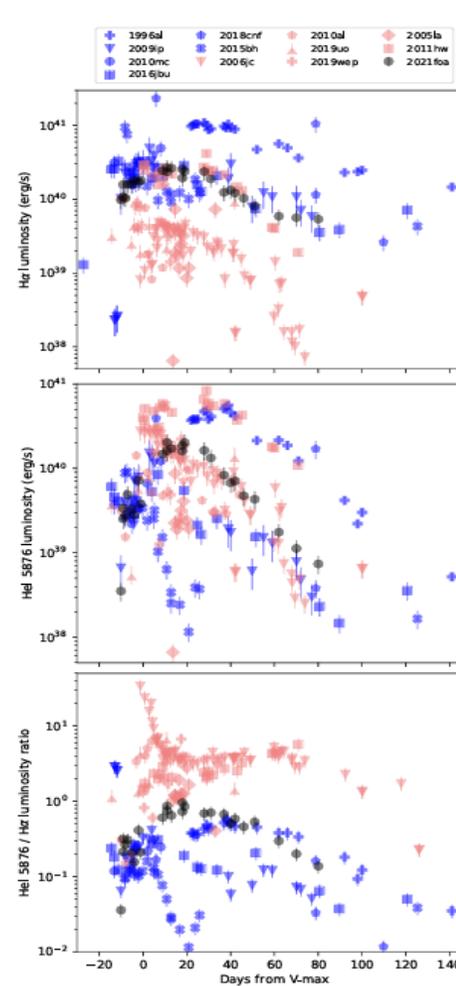
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# SN 2021foa

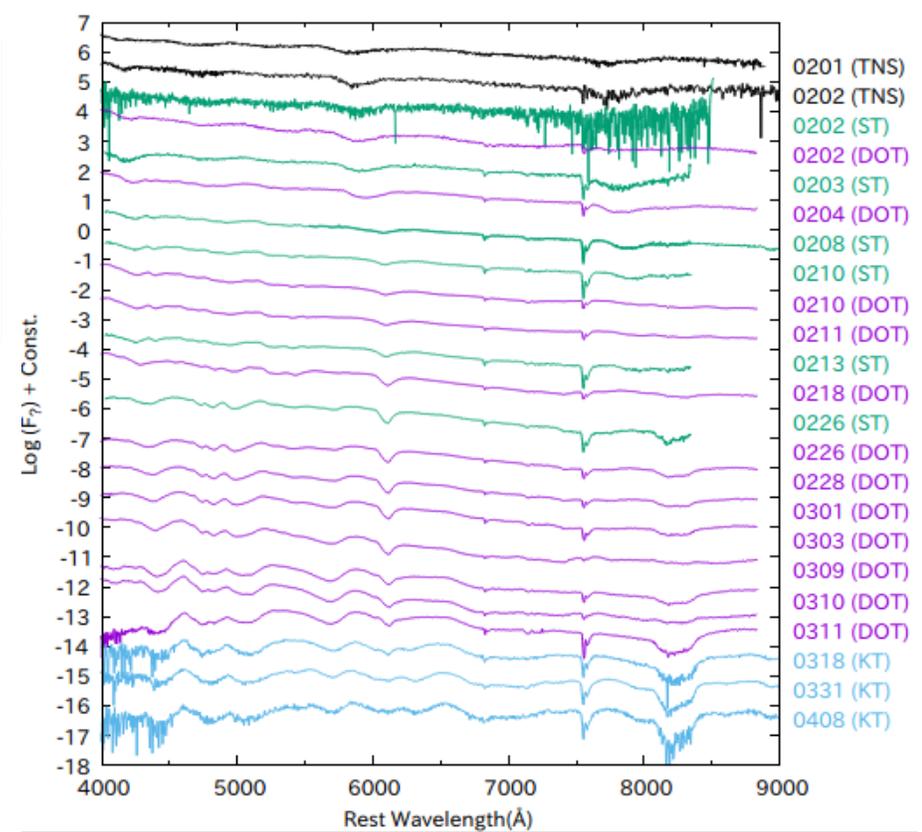
- Gangopadhyay et al.,  
“SN 2021foa: the bridge between SN IIn and Ibn”  
MNRAS 537, 2898 (March 2025)

- He I lines as strong as  $H\alpha$   
→ transitional features between IIn and Ibn
- Peak luminosity and color consistent with typical IIn/Ibn
- Narrow P-Cygni with multi-components  
→ disk-like CSM
- Likely LBV star transitioning to WR,  
with enhanced pre-SN mass loss or binary interaction.

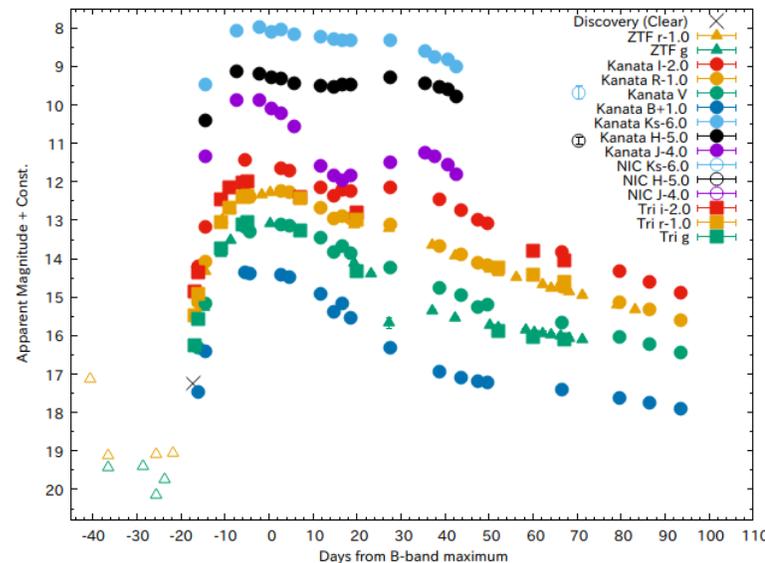


# SN 2023bee

- Discovered by DLT40 on Feb. 01.75
- Initially classification as Type Ic/Ic-BL  
→ reclassified as Type Ia the next day

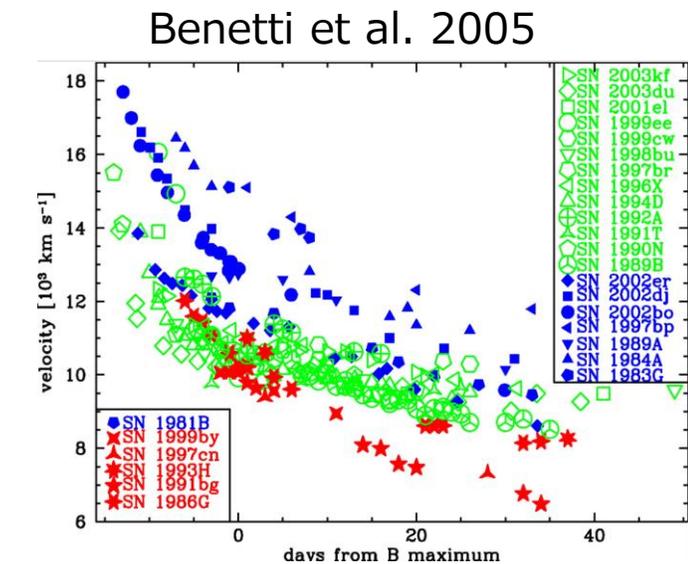
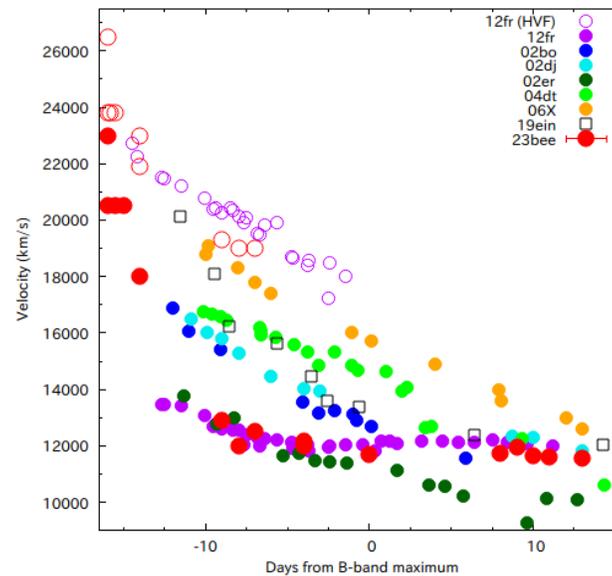
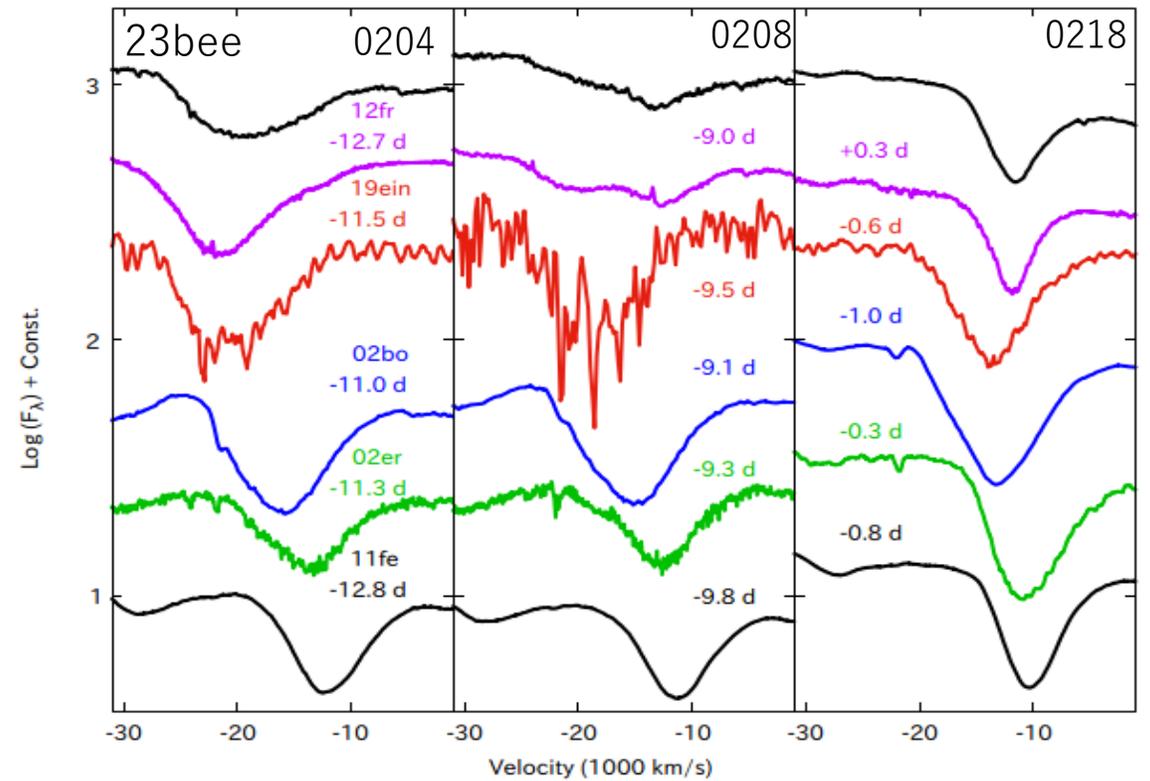


- Decline rate :  $\Delta m_{15}(B) \sim 0.79$  mag  
→ Slightly slower than normal SNe Ia



# SN 2023bee

- Early-phase spectrum:
  - high-velocity Si II similar to SN 2012fr
  - Si II 6355  $\sim 12,000$  km/s @maximum
  - Asymmetric absorption line
  - photospheric + HVF component



## Summary and Future

- ~50 supernovae are observed annually with Seimei Telescope
- Follow-up observations of ~10 of these are ongoing
- For particularly interesting events, ToO observations with other telescopes are considered
- As observational data on nearby SNe accumulate, statistical analyses will become possible, beyond studies of individual objects