せいめい望遠鏡を用いた
近傍超新星のフォローアップ観測

2025年9月4日　せいめいユーザーズミーティング

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About Supernovae

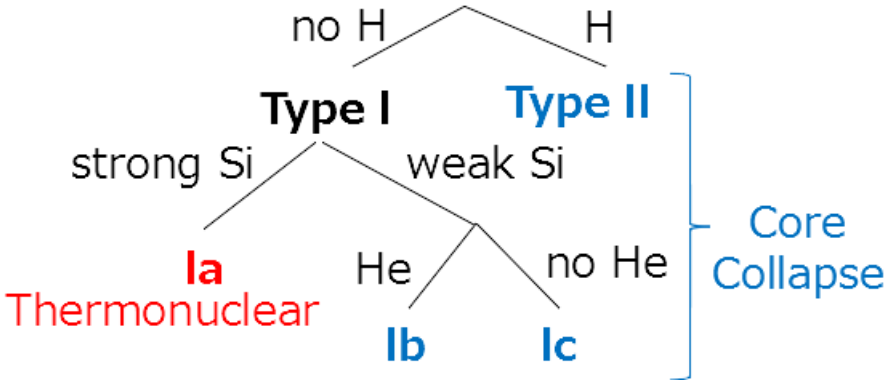
- Energy source

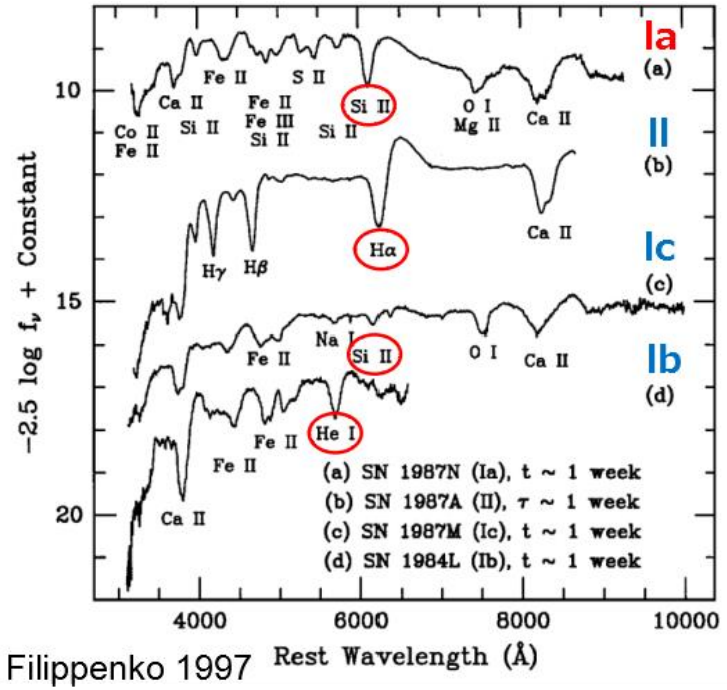
$$^{56}Ni \rightarrow {}^{56}Co \rightarrow {}^{56}Fe$$

γ線+陽電子　γ線+陽電子

Okayama Astronomical Observatory, Kyoto University / University of Tokyo

- Classification
  Spectra @ maximum





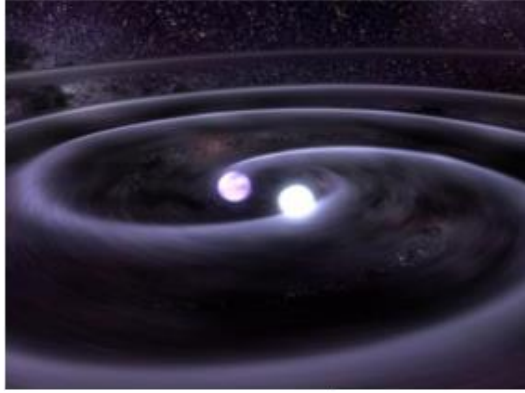
Filippenko 1997

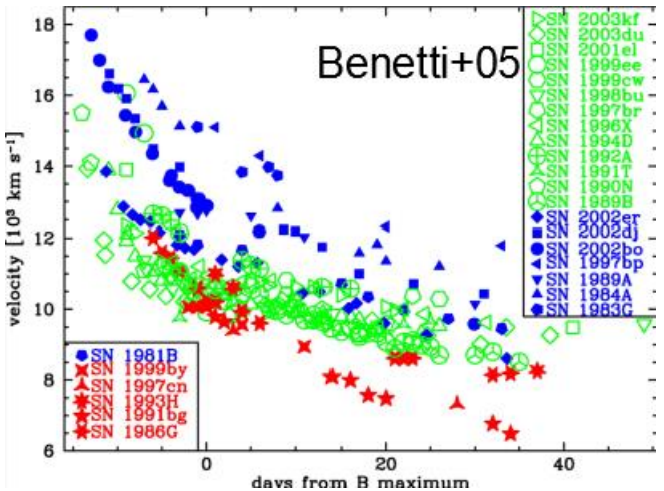
Unresolved Problems : SNe Ia

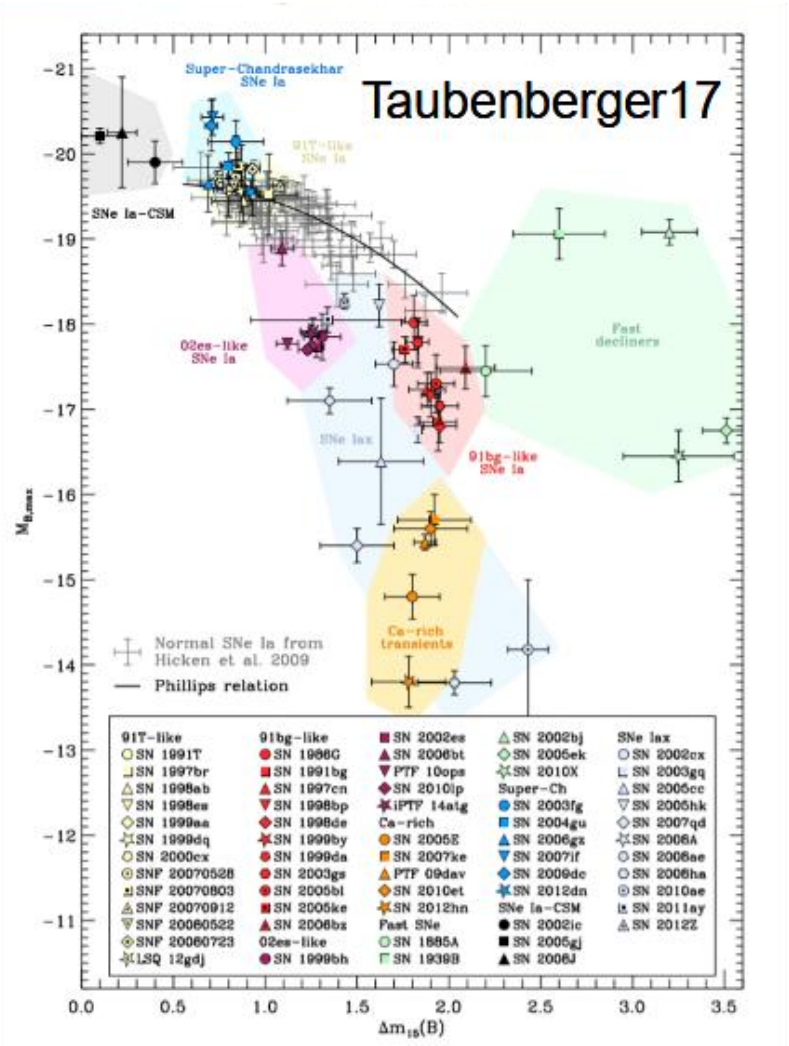
- Progenitor?
  - Single Degenerate?
  - Double Degenerate?

- Explosion mechanism
  - Initial ignition point?
  - Detonation? Deflagration?

- Diversity, Peculiar SNe Ia







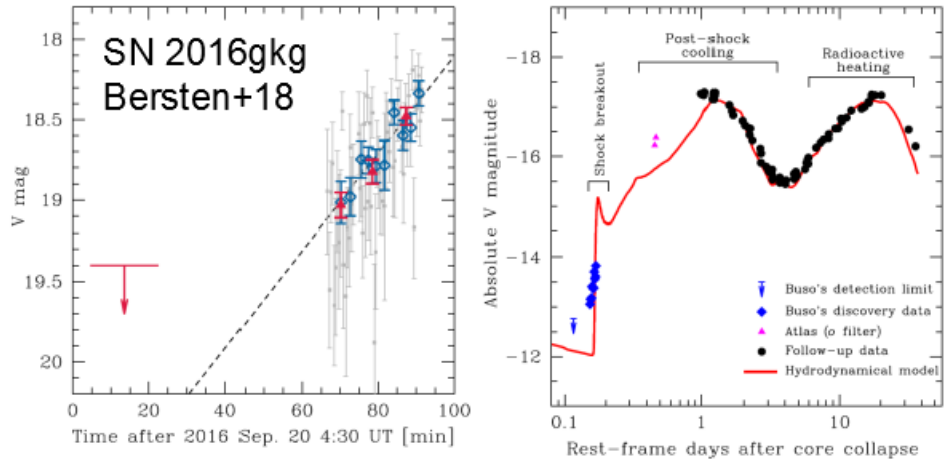
Unresolved Problems : Core Collapse SNe

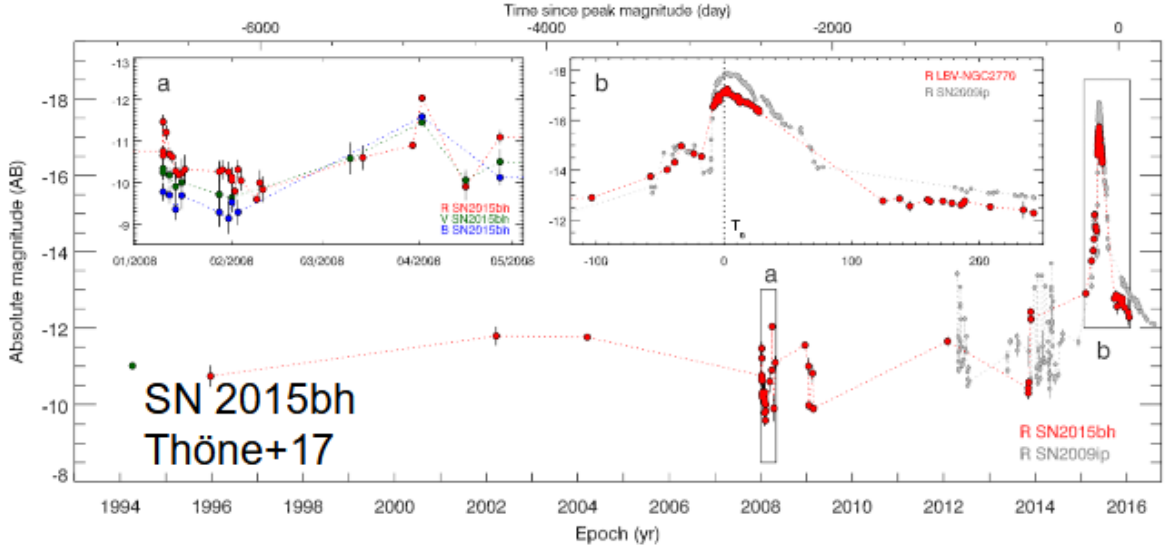
- Some massive stars lose outer envelopes
  → stripped-envelope SNe

- Mechanism of mass loss ?

  → Shock cooling emission

  → Estimate radius and stellar structure of progenitors





KASTOR

Kanata And Seimei Transient Observation Regime

- 3.8m Seimei

  Optical spectroscopy and photometry

- 1.5m Kanata

  Optical spectroscopy and photometry

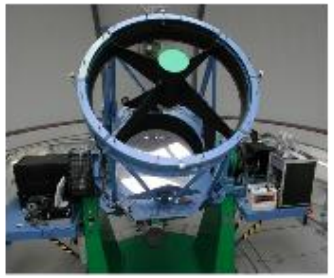
  NIR photometry

  Optical + NIR polarimetry

- Follow-up of new transients discovered in surveys such as Tomo-e, WFST

- Collaborate with other telescopes

  NOT, Indian Telescope, Subaru, and ALMA



	Tomo-e SN Survey
instrument	Tomo-e Gozen
sensor	CMOS
readout time	~0 sec
period	2018/9-
survey area [deg2]	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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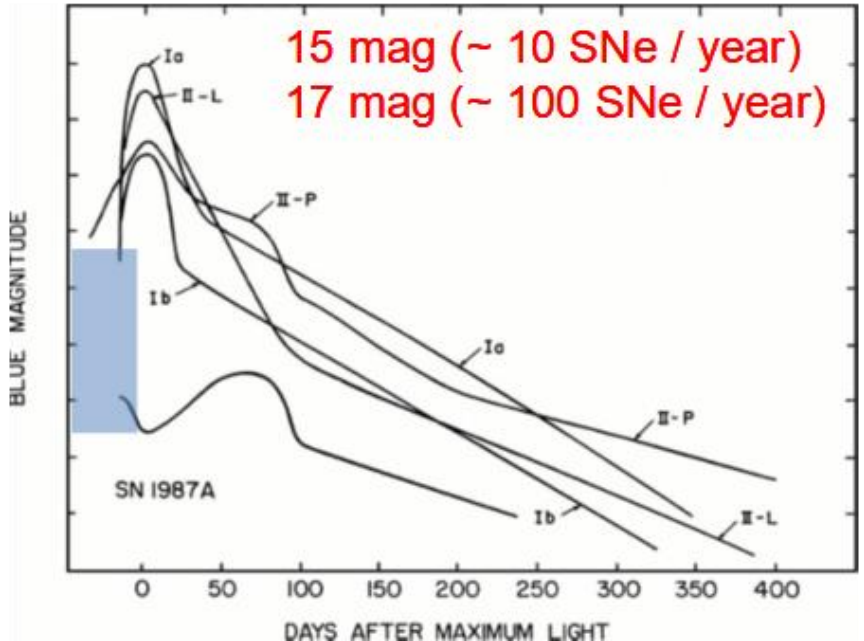


Follow-up observations

- Observation of Seimei telescope

  Kyoto Univ. time + Open use time

  Classical + ToO

- About 50 SNe are observed each year

	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

SN 2021foa

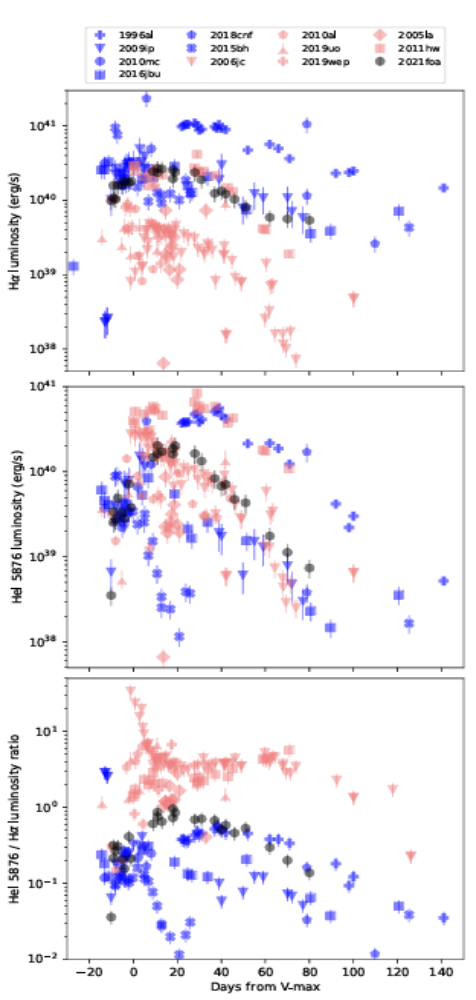
- Gangopadhyay et al.,
  “SN 2021foa: the bridge between SN Iin and Ibn”
  MNRAS 537, 2898 (March 2025)

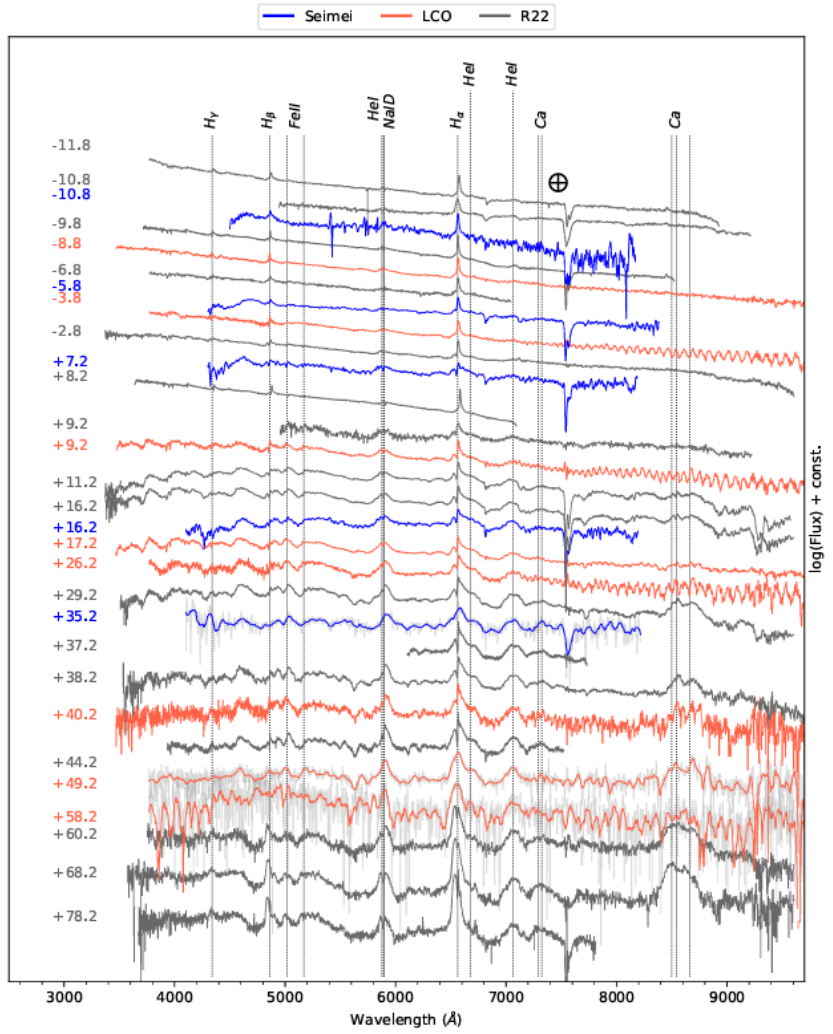
- He I lines as strong as H α
  IIn → IIn/Ibn → IIn-like (SN 1996al)

- Peak luminosity and color consistent with typical IIn/Ibn

- Narrow P-Cygni
  + multi-component profile
  → disk-like CSM

- Likely LBV star transitioning to WR with enhanced pre-SN mass loss or binary interaction.





Summary and Future

- Follow-up observations of nearby supernovae
  → About 50 SNe are discovered annually at Seimei Telescope
  → Follow-up observations of ~10 of these SNe are ongoing

- For particularly interesting SNe, we are also considering ToO with other telescopes.

- While discussions have primarily focused on individual SNe, as observational data on nearby supernovae has accumulated, maybe statistical discussions are possible in the future