

SN2021aaev: a H-Rich Superluminous SNe with Early Flash and Long-Lived Circumstellar Interaction in an Unusual Host Environment



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SCAN TO THE PAPER

KEY FINDINGS

- Peak luminosity:** SN 2021aaev (SLSN-IIIn) reached -21.35 mag in o band, radiating $\sim 1.41 \times 10^{51}$ erg.
- Spectral Evolution:** narrow Balmer lines persisted for ~ 100 days.
- Flash Ionisation:** He II, C III and/or N III in early spectra. The first known SLSN-IIIn flasher.
- Powering source:** Long-lived CSM interaction from $1-2 M_{\odot}$ ejecta ploughing into massive ($10-20 M_{\odot}$), extensive ($1.3-2.0 \times 10^{16}$ cm) CSM
- Progenitor ambiguity:** eruptive mass-loss episodes from LBV; obscuration of massive CSM means a Type Ia-CSM origin cannot be ruled out.
- Unusual host:** star-forming spiral with a quiescent red substructure (SFR = $0.02^{+0.13}_{-0.02} M_{\odot} \text{ yr}^{-1}$); a dwarf satellite/merging companion
- Significance:** expands the diversity within the SLSN-IIIn subclass.

HOST GALAXY

$$\log M_{\text{galaxy}} = 10.81^{+0.14}_{-0.14} M_{\odot}$$

$$\log M_{\text{clump}} = 9.75^{+0.17}_{-0.18} M_{\odot}$$

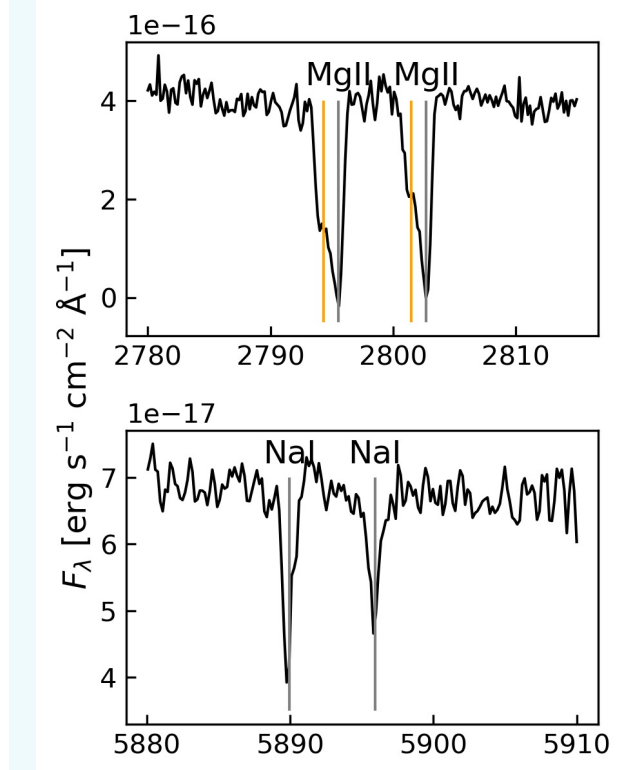
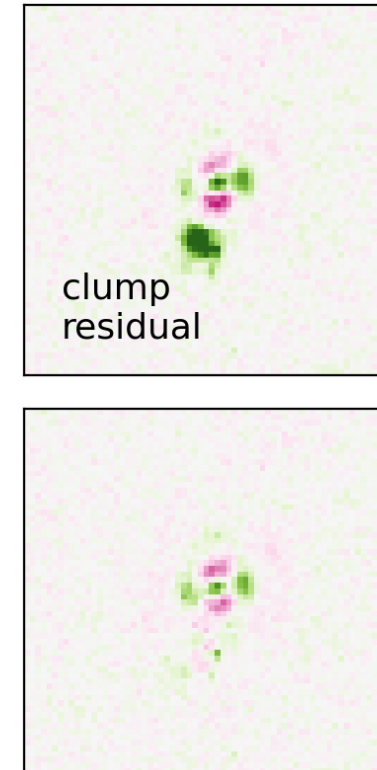
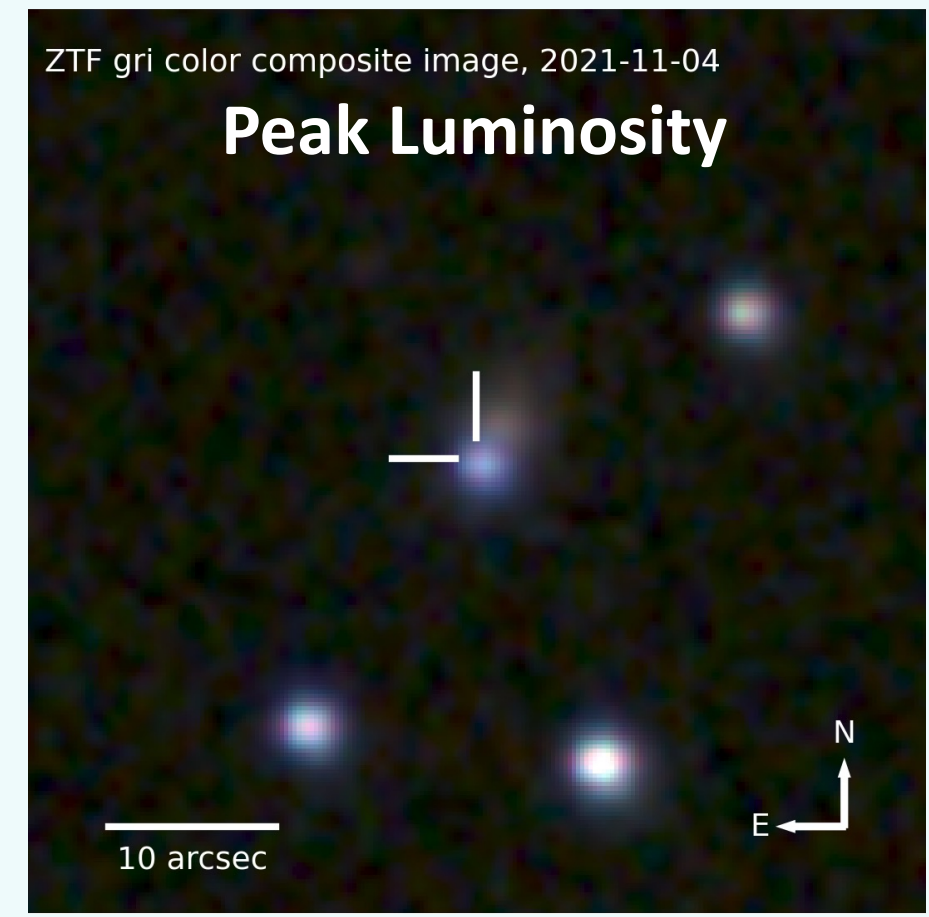
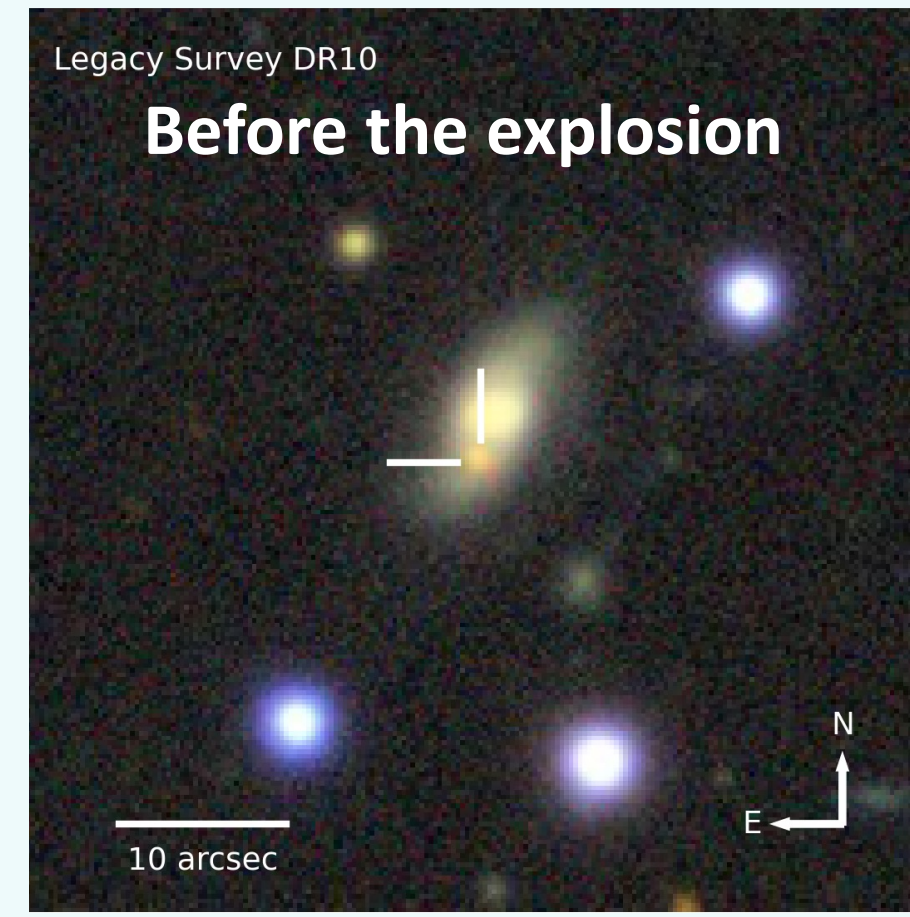
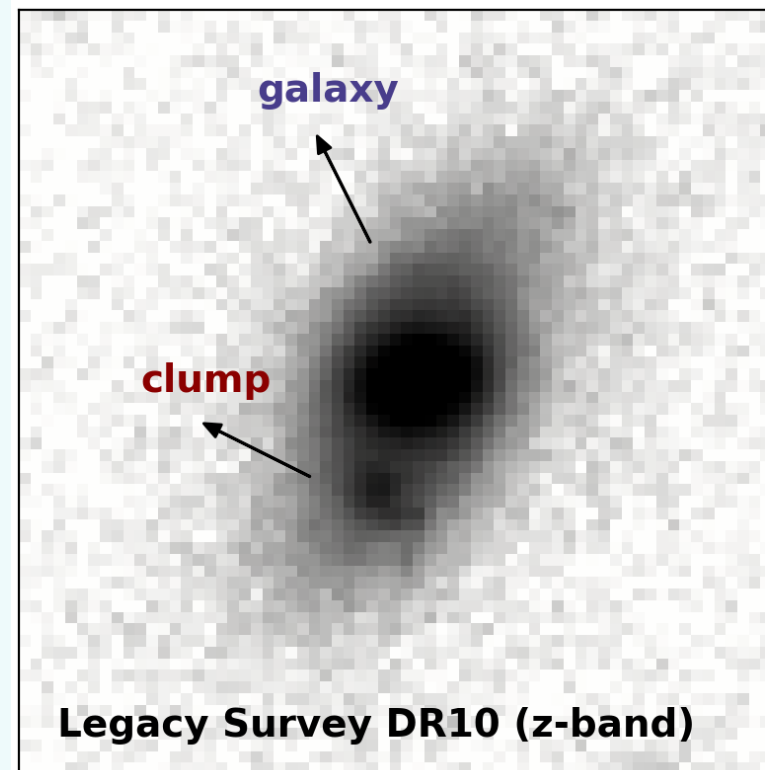
$$\text{SFR}_{\text{galaxy}} = 8.77^{+8.43}_{-6.12} M_{\odot} \text{ yr}^{-1}$$

$$\text{SFR}_{\text{clump}} = 0.03^{+0.16}_{-0.02} M_{\odot} \text{ yr}^{-1}$$

$$A_{\text{v, galaxy}} = 1.06^{+0.47}_{-0.57} \text{ mag}$$

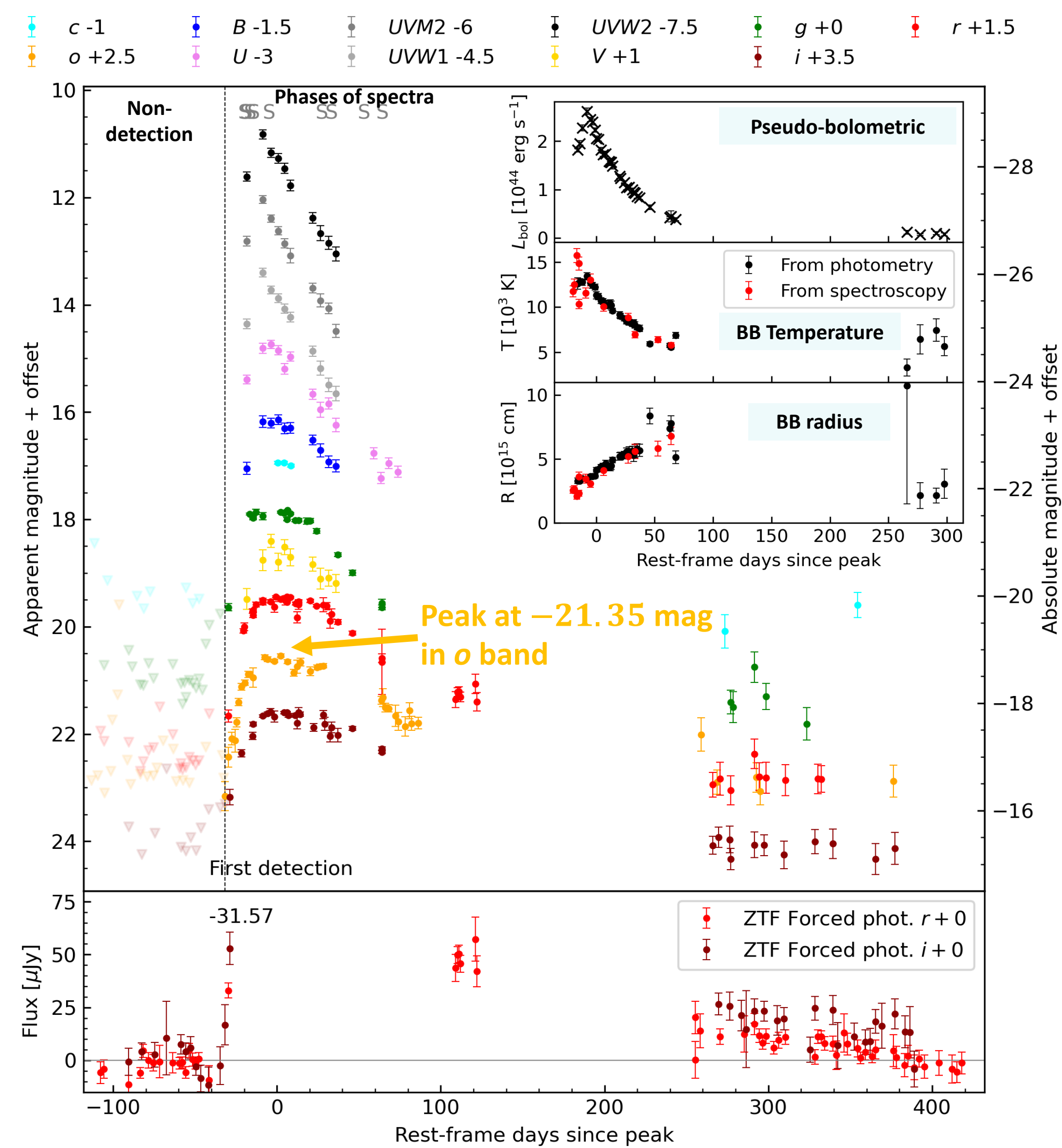
$$A_{\text{v, clump}} = 1.67^{+0.25}_{-0.42} \text{ mag}$$

$$\rightarrow E(B-V)_{\text{clump}} = 0.54 \text{ mag}$$



- Host Mg II lines have a **secondary component** with velocity offset $139 \pm 21 \text{ km s}^{-1}$
- Na I doublets give $E(B-V)_{\text{host}} = 0.086 \pm 0.032 \text{ mag}$, < that from the PYRSIC modelling

PHOTOMETRY

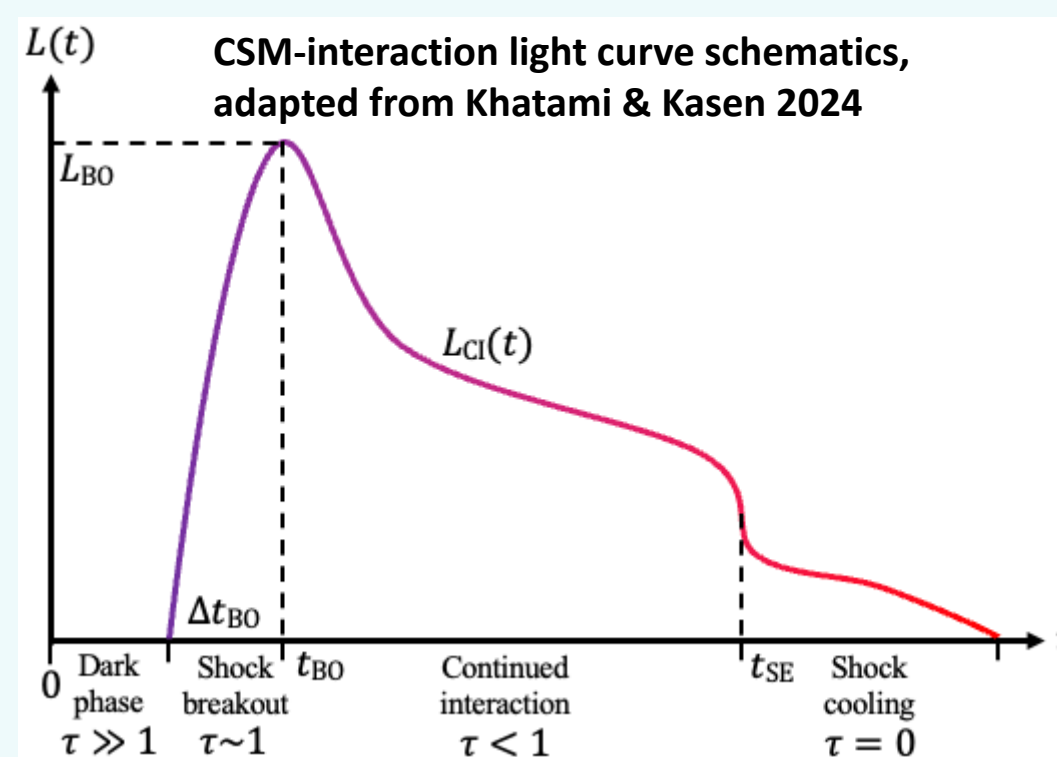
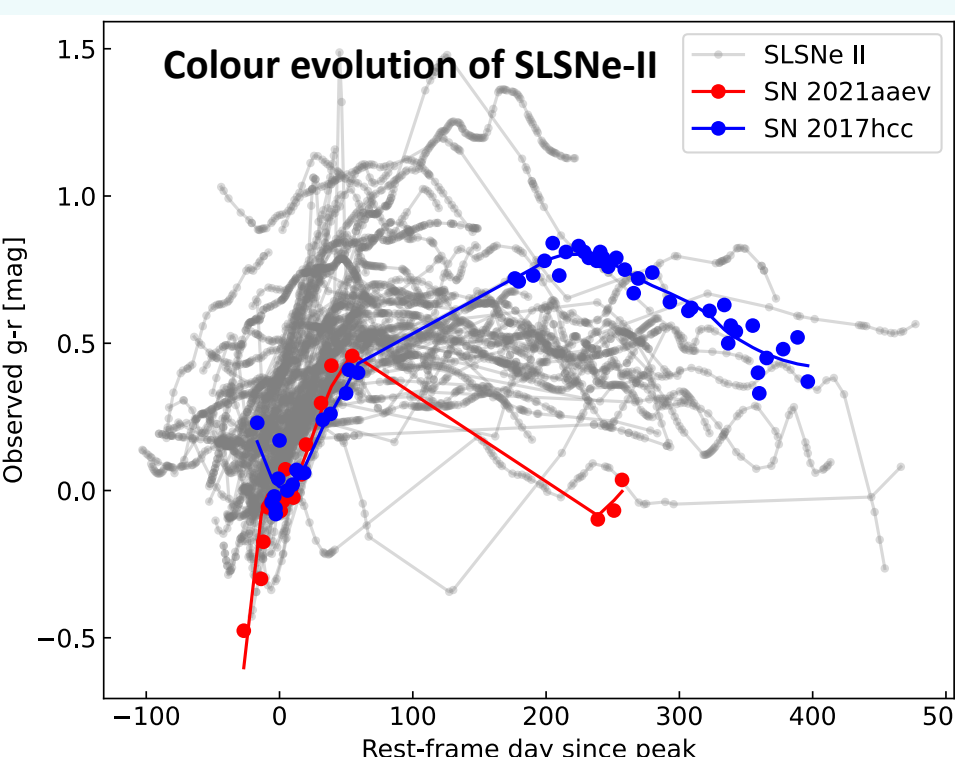


Colour:

blue to red, re-bluen at 200 days
► Continued/renewed interaction

Model:

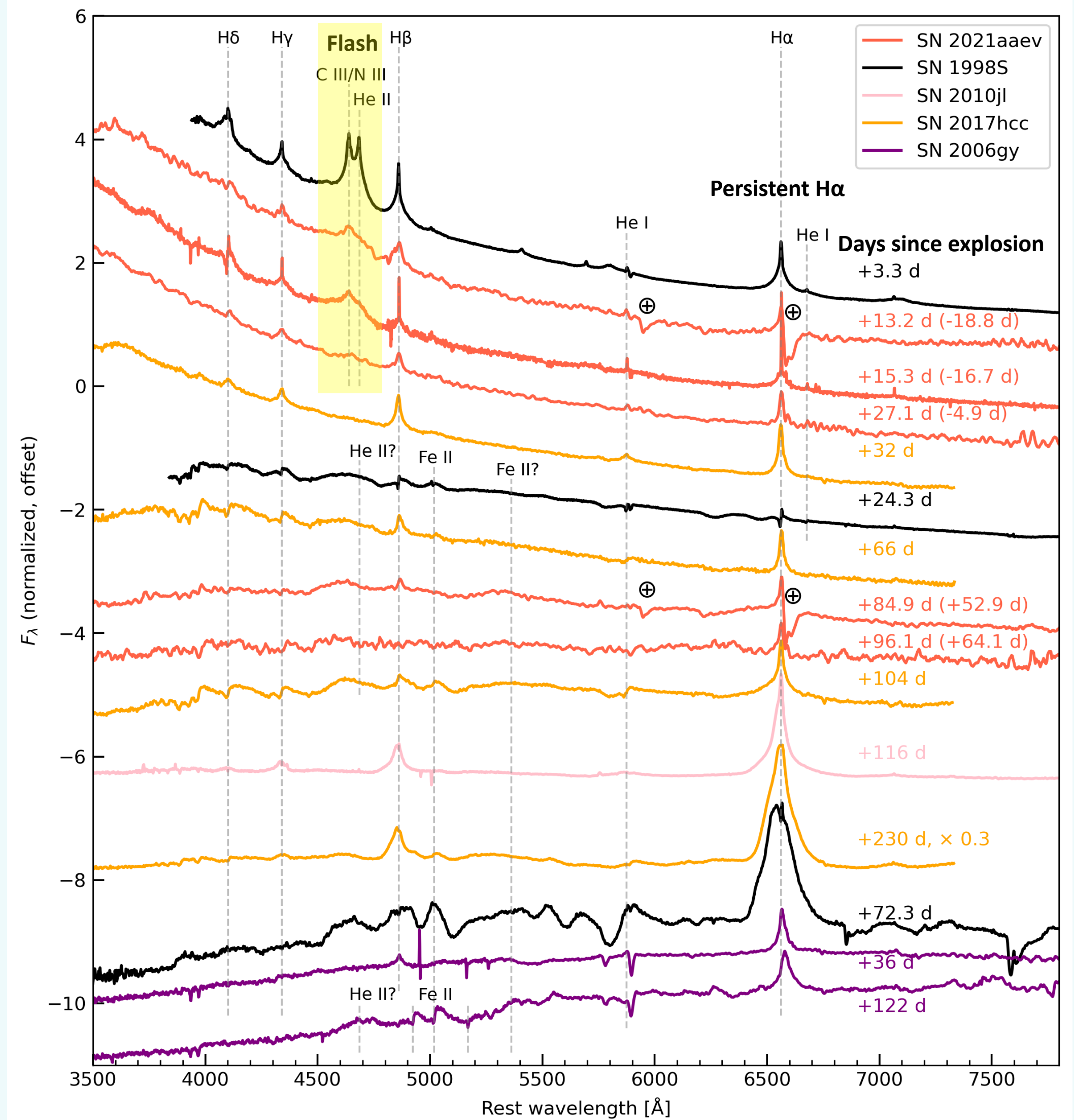
- Heavy CSM, interior breakout scenario
- Spin-down of a magnetar



*** have different pre-set ϵ

Best-fit parameters									
Model	ϵ	M_{ej} [M_{\odot}]	v_{ej} [10^3 km s^{-1}]	M_{CSM} [M_{\odot}]	R_{CSM} [10^{16} cm]	k_0	s	B_p [10^{14} G]	P_0 [ms]
CSM*	0.87	$1.34^{+0.06}_{-0.06}$	11	$12.9^{+3.8}_{-3.9}$	$1.57^{+0.35}_{-0.29}$	$0.85^{+0.10}_{-0.11}$	$1.55^{+0.98}_{-1.02}$	-	-
CSM**	0.60	$1.96^{+0.09}_{-0.08}$	11	$14.4^{+4.4}_{-4.1}$	$1.78^{+0.36}_{-0.31}$	$0.85^{+0.10}_{-0.10}$	$1.51^{+1.03}_{-1.04}$	-	-
Magnetar	-	$1.17^{+0.05}_{-0.05}$	$9.85^{+0.13}_{-0.14}$	-	-	-	-	$1.53^{+0.96}_{-0.45}$	$3.95^{+0.56}_{-0.56}$

SPECTROSCOPY



Flash features in SN 2021aaev:

- Broad, 'ledge' feature because
 - it is a blend of highly-ionized He, C, N,
 - this feature broadens as it evolves (see purple)
 - Lorentzian wing
 - Electron scattering from $\sim \tau = 3$
 - Long flash timescale
 - positive correlation with peak abs mag
- Pearson = -0.835 ($p = 0.000003$)

