
A multiwavelength view of a puzzling dragon.

Bridging the gap between SLSNe and SE-Sne

[Simongini et al., A&A, 713, A269 \(2026\)](#)

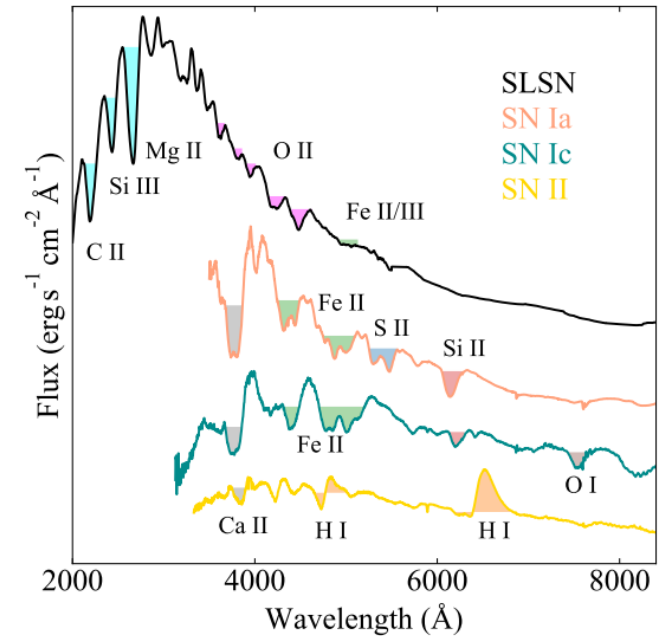
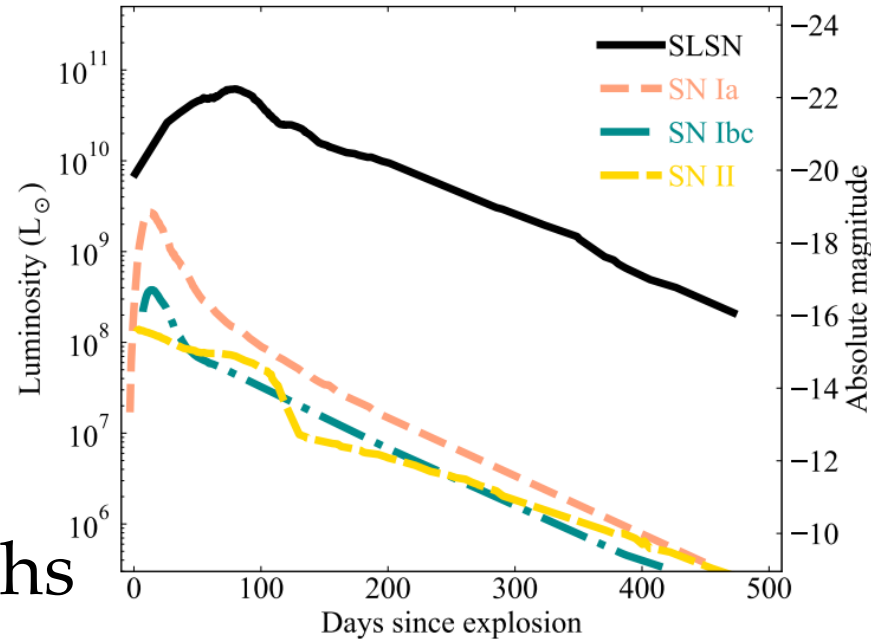


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Superluminous Supernovae

- Brighter than -20 mag
- Strong oxygen lines
- Order of 10^2 events
- Faint at other wavelengths
- Central engine or CSM interaction?



Magnetar scenario

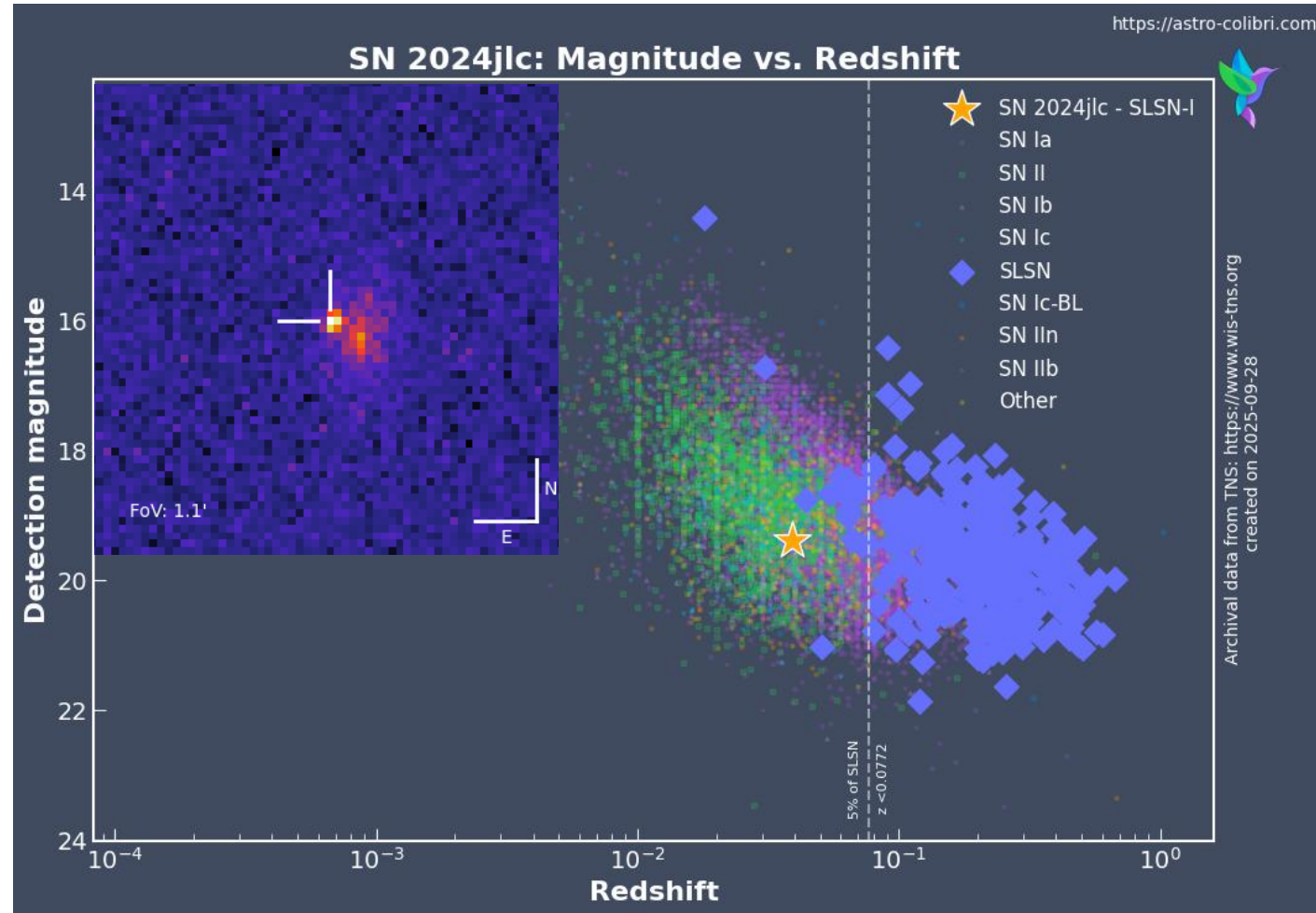
- W-shaped Oxygen features
- Specific light curve tail
- More luminous
- X-rays by IC
- Optical-to-gamma-ray luminosity ratio of 1

CSM scenario

- Narrow lines
- Radioactive decay
- Less luminous
- X-rays by Bremsstrahlung
- Optical-to-gamma-ray luminosity ratio of $\ll 1$

SN 2024jlc

- Discovered on May 28, 2024
- $z = 0.039$
- $D_L = 179.38$ Mpc
- Classified as SLSN-I
- Reported peak at -19.2 mag



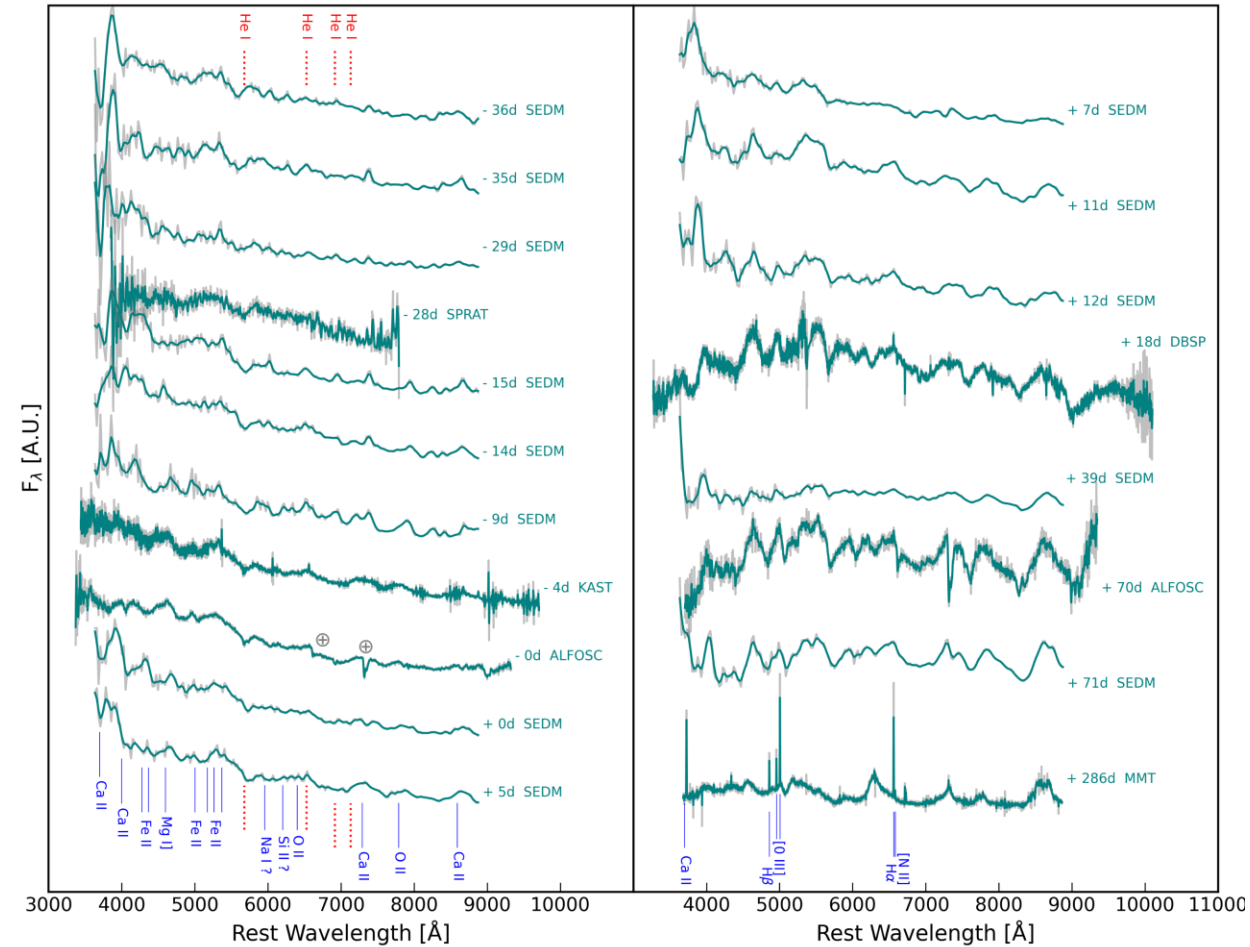
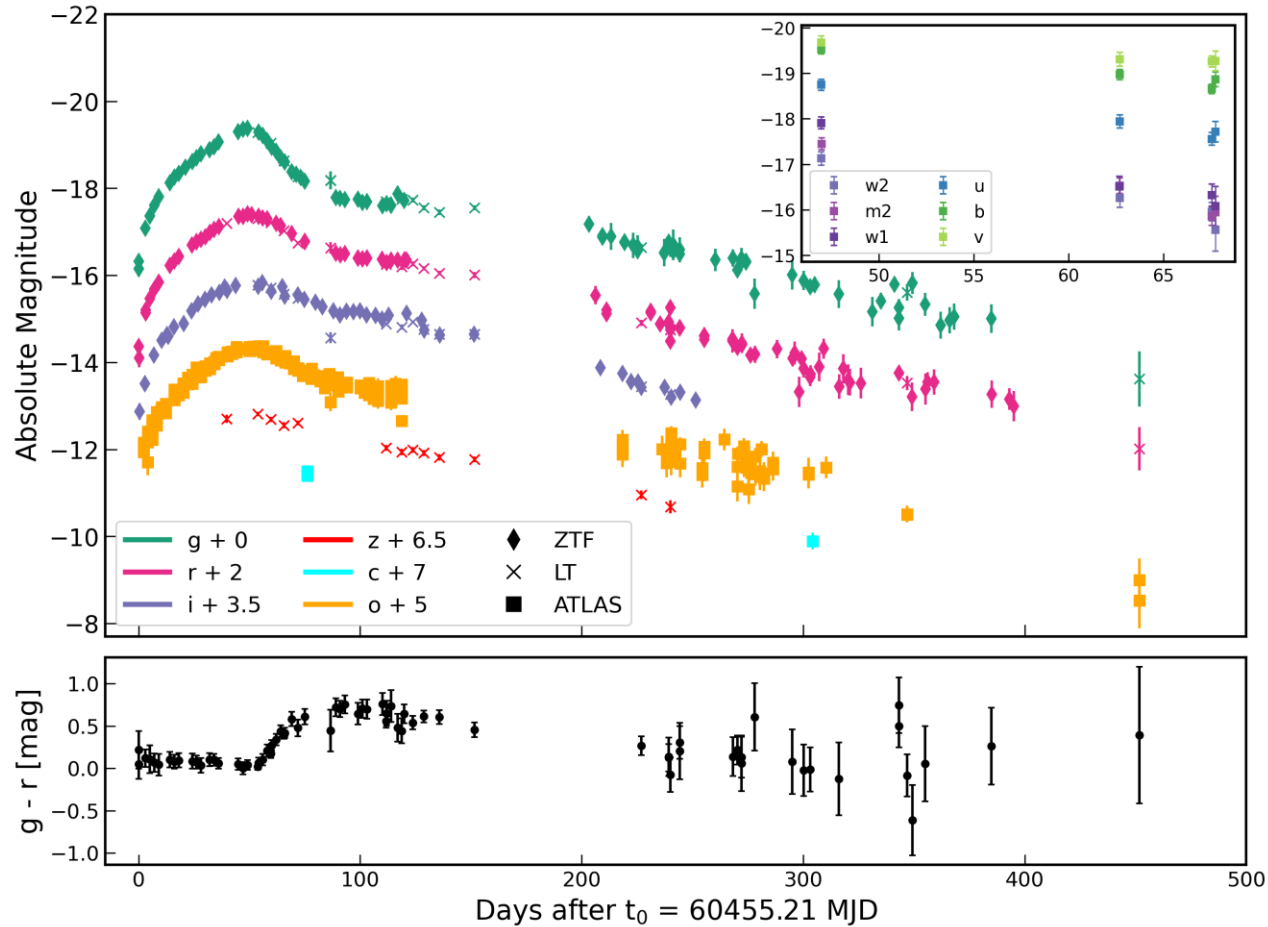
SN 2024jlc

- Engine problem: *what powers the luminosity?*
- Classification problem: *is this really a SLSN event?*

1.

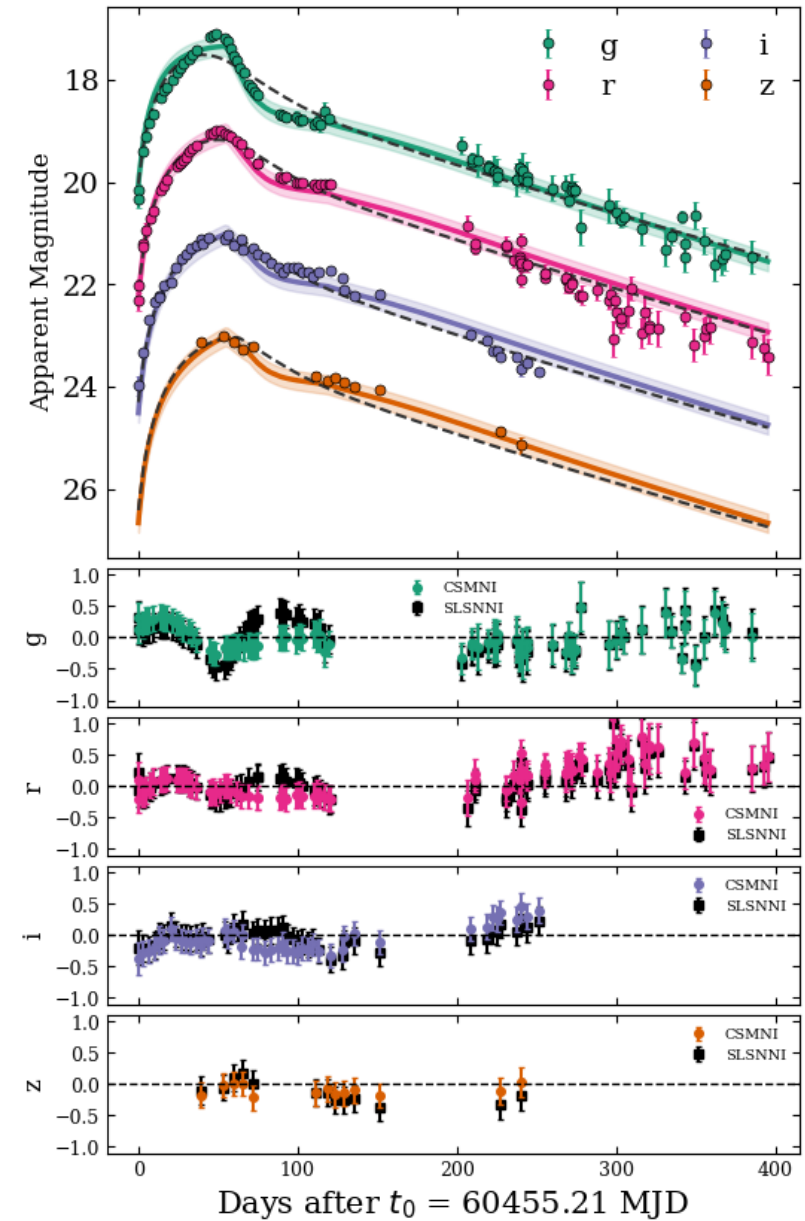
Comprehensive optical and X-ray analysis

Optical dataset



Powering mechanism

- We used [MOSFiT](#) to fit the magnetar and the CSM models.
- Both models well fit the light curves:
 - Magnetar model: $\chi^2 = 1.00$
 - CSM model: $\chi^2 = 1.03$
- High contribution from nickel decay in both cases.
- No clear preference towards one or the other mechanism.



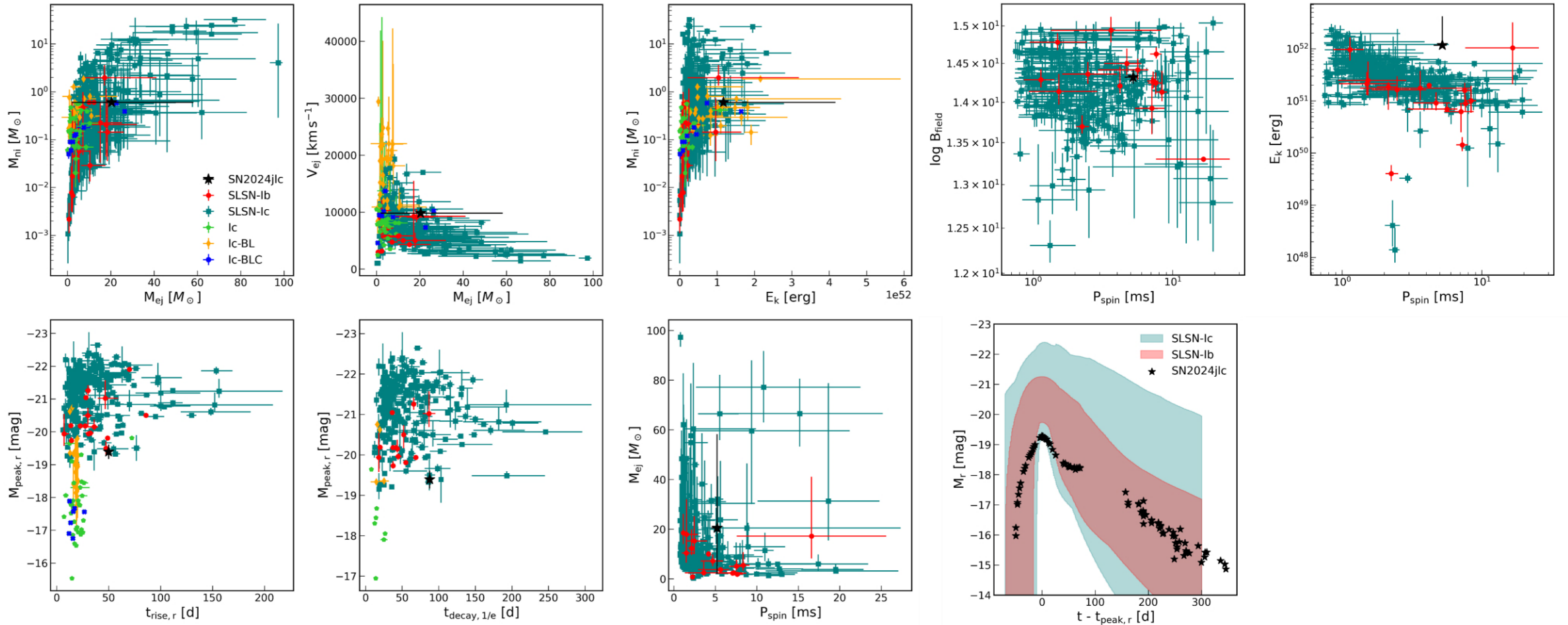
X-rays

Date	Counts	Flux	Luminosity	Exposure
MJD	10^{-3} (cts s $^{-1}$)	10^{-13} (erg cm $^{-2}$ s $^{-1}$)	10^{41} (erg s $^{-1}$)	(s)
60502	14.7	5.076	20.33	770
60517	4.53	1.564	6.27	1910
60522	5.10	1.761	7.05	2200
—	≤ 2.43	≤ 0.839	≤ 3.36	4880

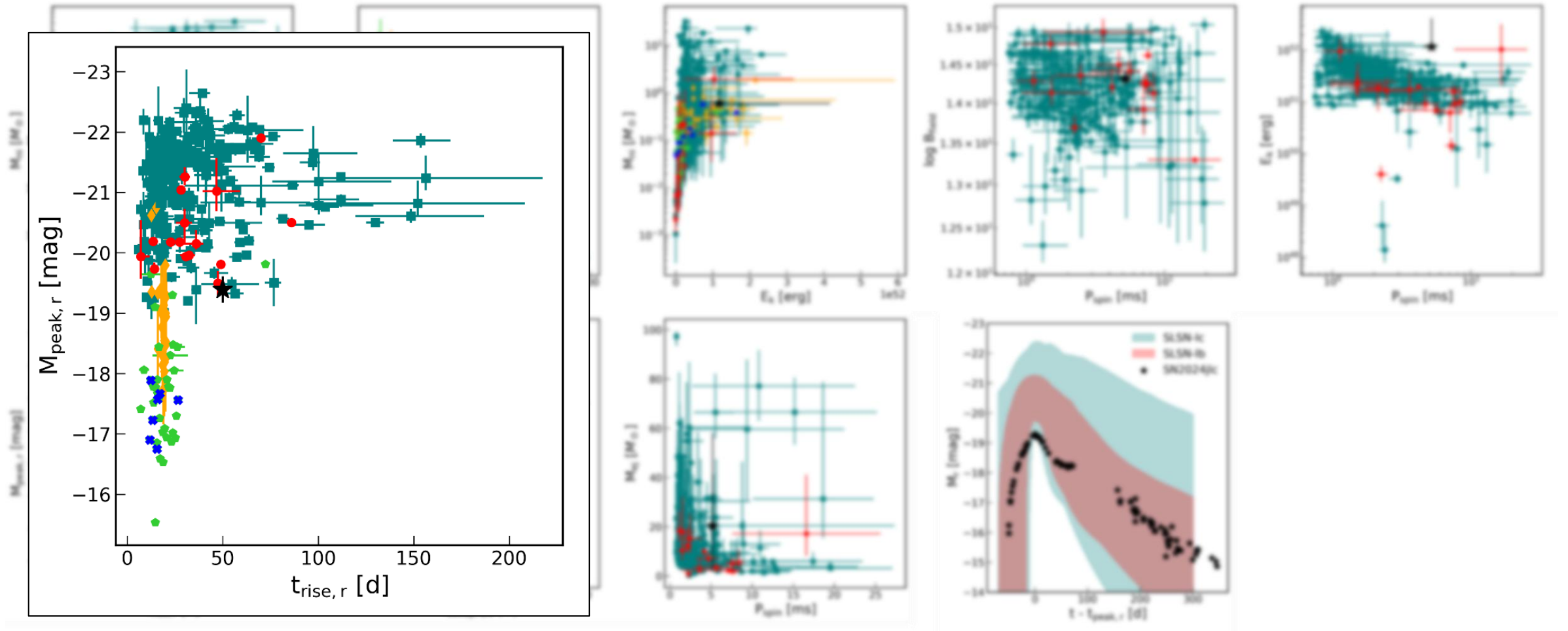
- X-rays are produced by Inverse Compton scattering at early times, and $L_{IC} \propto L_{bol}$.
- We use our X-rays upper-limits to constrain the IC luminosity and thus the mass-loss history of the progenitor.
- We obtained $\frac{\dot{M}}{u_w} \leq 2.2 \times 10^{-3} \frac{M_{\odot}}{yr} \frac{s}{km}$ assuming $\kappa = 0.1 \text{ cm}^2 \text{ g}^{-1}$, constraining a region that is $R_s < 6 \times 10^{15} \text{ cm}$ from the explosion, i.e. material expelled < 10 years before the explosion.

2.

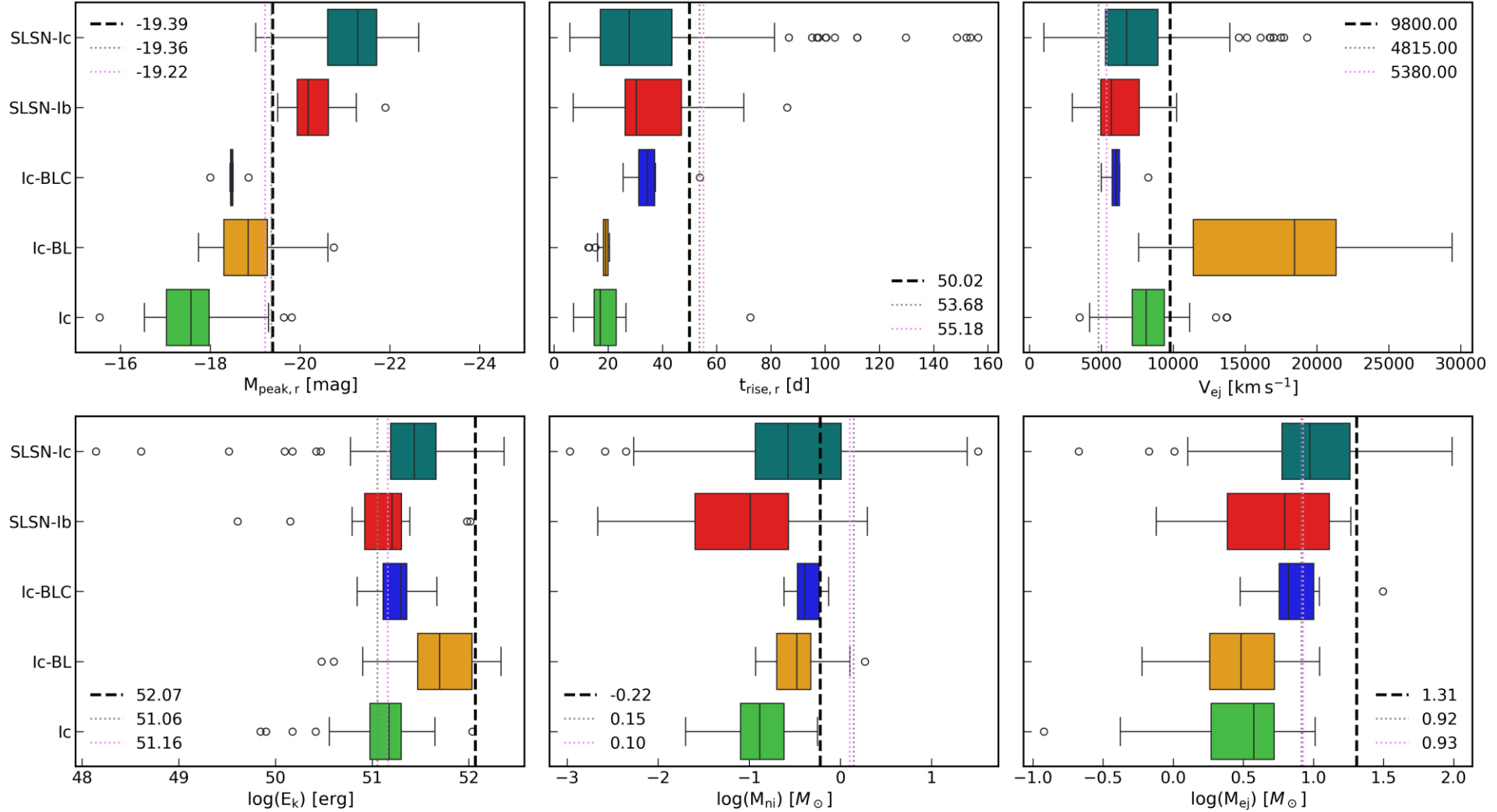
Statistical comparison of parameters



254 SLSNe-Ic 44 Type Ic 30 Ic-BL 16 SLSNe-Ib 8 Type Ic-BLC



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254 SLSNe-Ic 44 Type Ic 30 Ic-BL 16 SLSNe-Ib 8 Type Ic-BLC

Classification problem: *is this really a SLSN event?*

- We performed a random-forest classification comparing SN 2024jlc parameters with those of larger samples of SLSNe and SE-SNe.
- Our results are indicative of a clear preference for SLSNe and Ic with broad light curves (although SN 2024jlc is far too bright to belong to this sub-class).

	SLSN-Ic	SLSN-Ib	Ic-BLC	Ic-BL	Ic
Model independent (%)	36.81	23.66	14.98	13.79	10.77
csmni (%)	39.57	21.71	26.34	3.36	9.02
slsnni (%)	34.25	19.70	34.20	3.09	8.77
Model independent (%)	–	35.69	30.97	21.68	11.67
csmni (%)	–	34.10	51.71	3.73	10.46
slsnni (%)	–	29.82	56.71	3.54	9.93

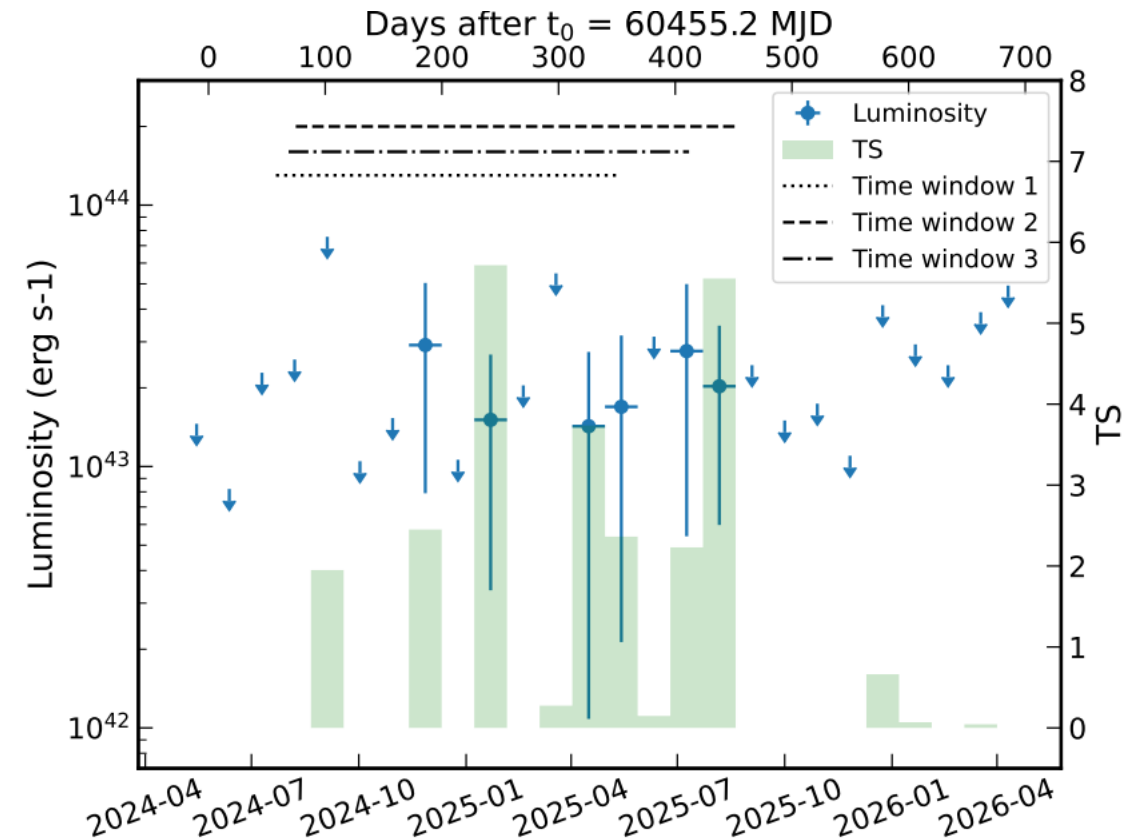
We conclude that SN 2024jlc is a SLSN event based on its parameters and not based on general assumptions on the group

3.

The key role of
gamma-rays

Engine problem: *what powers the luminosity?*

- We analyzed 2 years of Fermi-LAT data.
- In one time window we find $TS = 12.9$, corresponding to 3.6σ .
- If true, the signal would have a flux of $2.7^{+1.2}_{-1.0} \times 10^{-13} \text{ erg s}^{-1} \text{ cm}^{-1}$
- This leads to $\frac{L_\gamma}{L_{\text{optical}}} = 0.38$



Although we cannot claim a detection, this hint is suggestive of a gamma-ray component comparable to the optical one, consistent with a **magnetar scenario**

Conclusions

Have a read!

- The puzzling picture of SN 2024jlc is only partially solved.
- Statistical analysis confirmed the SLSN classification, while the hint of gamma-rays is indicative of a magnetar scenario.
- Next step: simulate the broadband signal using the model by [Mukhopadhyay et al. 2026](#)



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