

# Connections Between H-poor Superluminous Supernovae and long Gamma-Ray Bursts

Dr. Ragnhild Lunnan (OKC & Caltech)  
EWASS GRB Symposium  
June 26, 2017



**Caltech**



# The Extraordinary, Engine-Driven Supernova iPTF16asu

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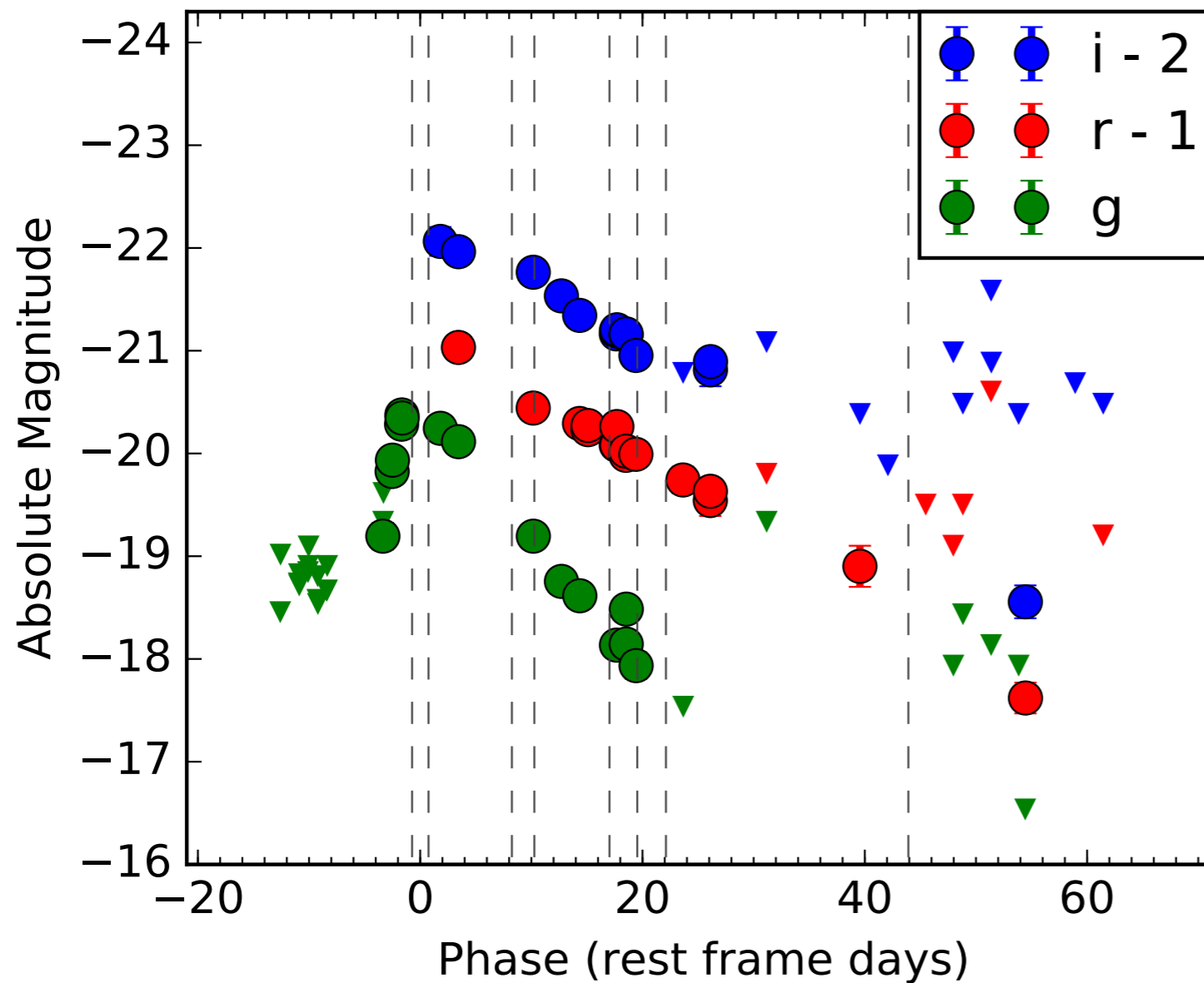
in collaboration with **Lindsey Whitesides**, Mansi Kasliwal, Daniel Perley, Alessandra Corsi, Brad Cenko, Francesco Taddia, Christoffer Fremling, Jesper Sollerman, Nadia Blagorodnova, and the iPTF transient group



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# iPTFI 6asu light curve

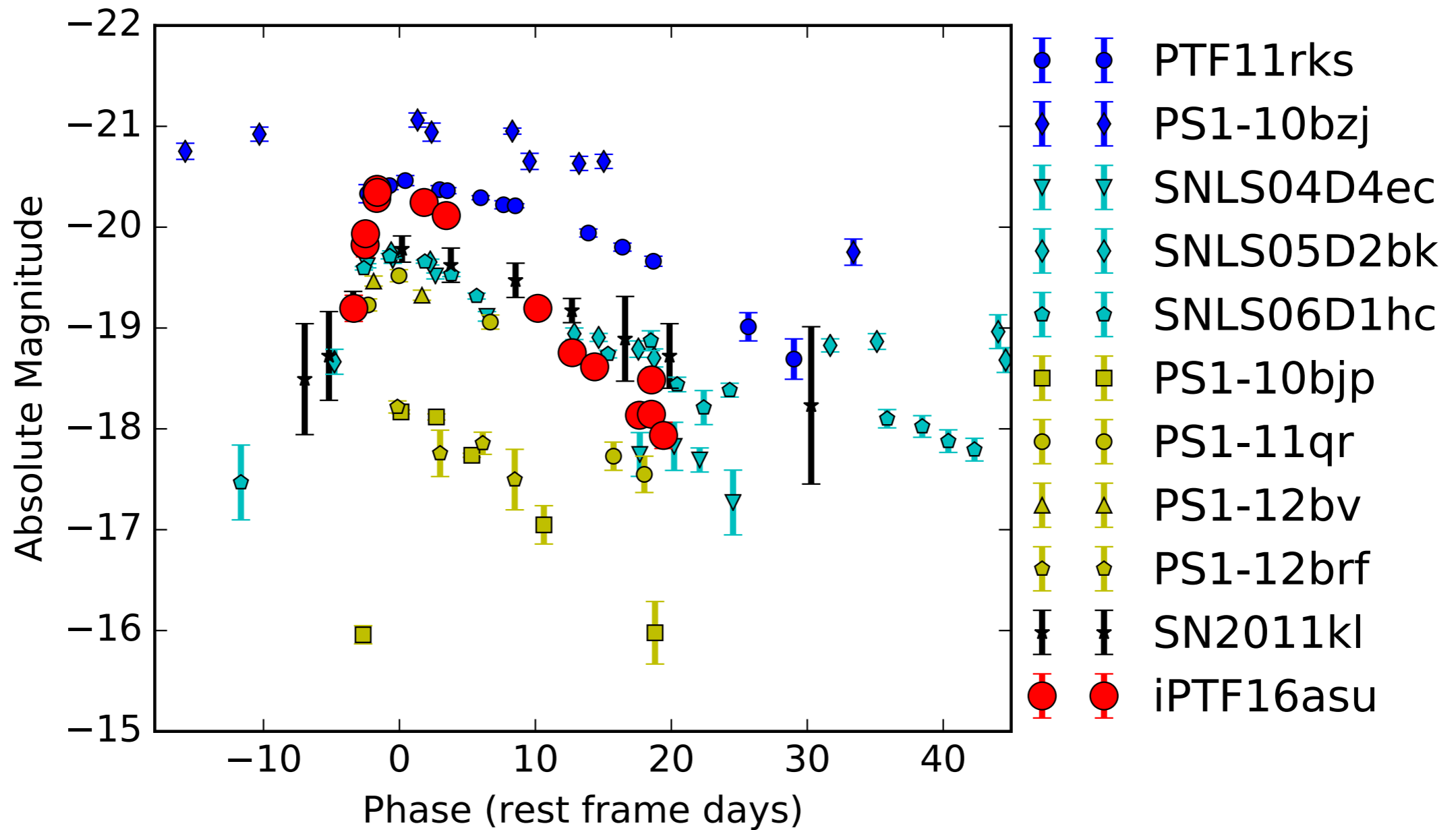


Four day rise time!

Peak  $M_g = -20.4$  mag

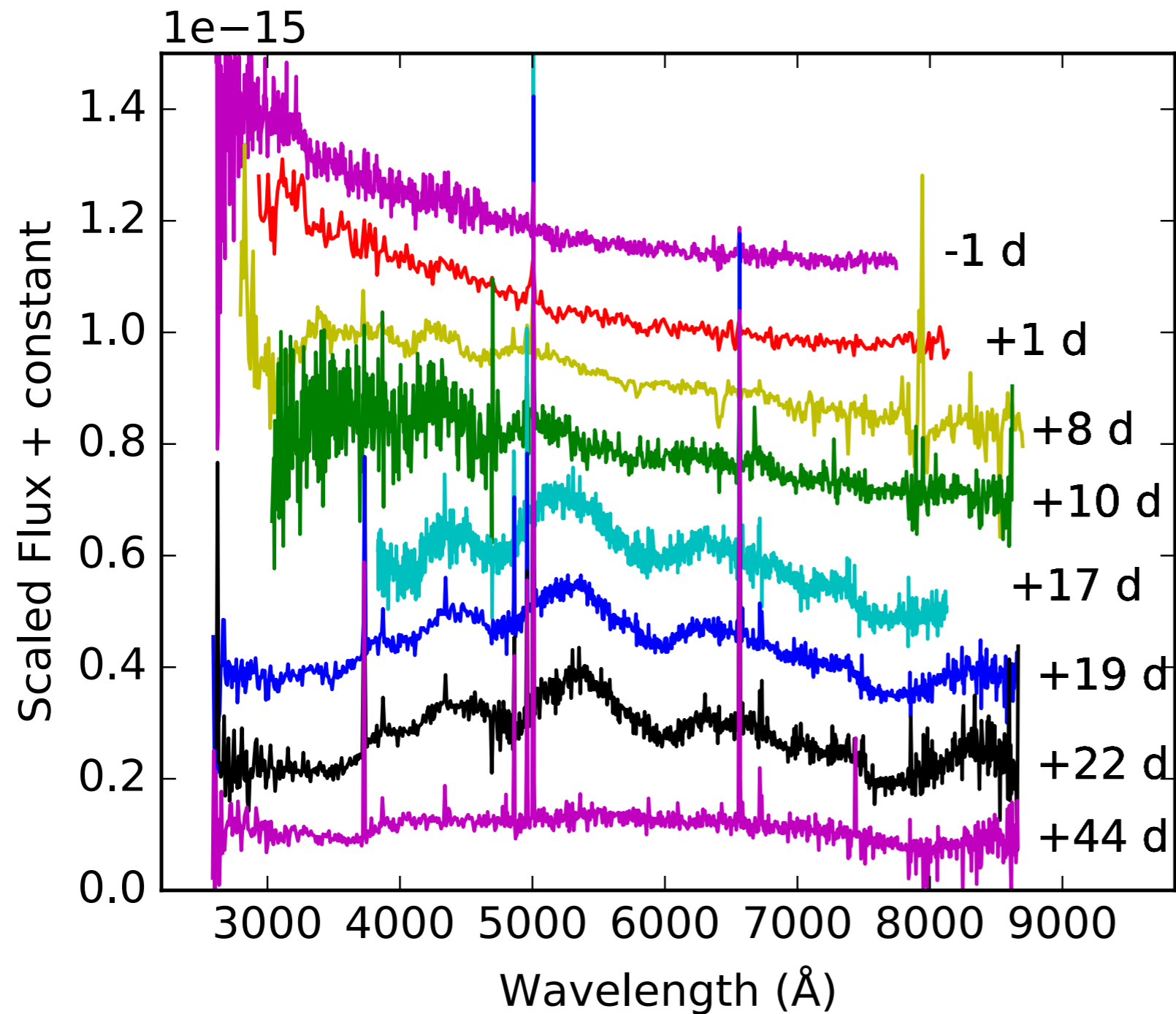
Whitesides, Lunnan et al. 2017, arXiv:1706.05018

# iPTF16asu compared to other fast and/or luminous transients



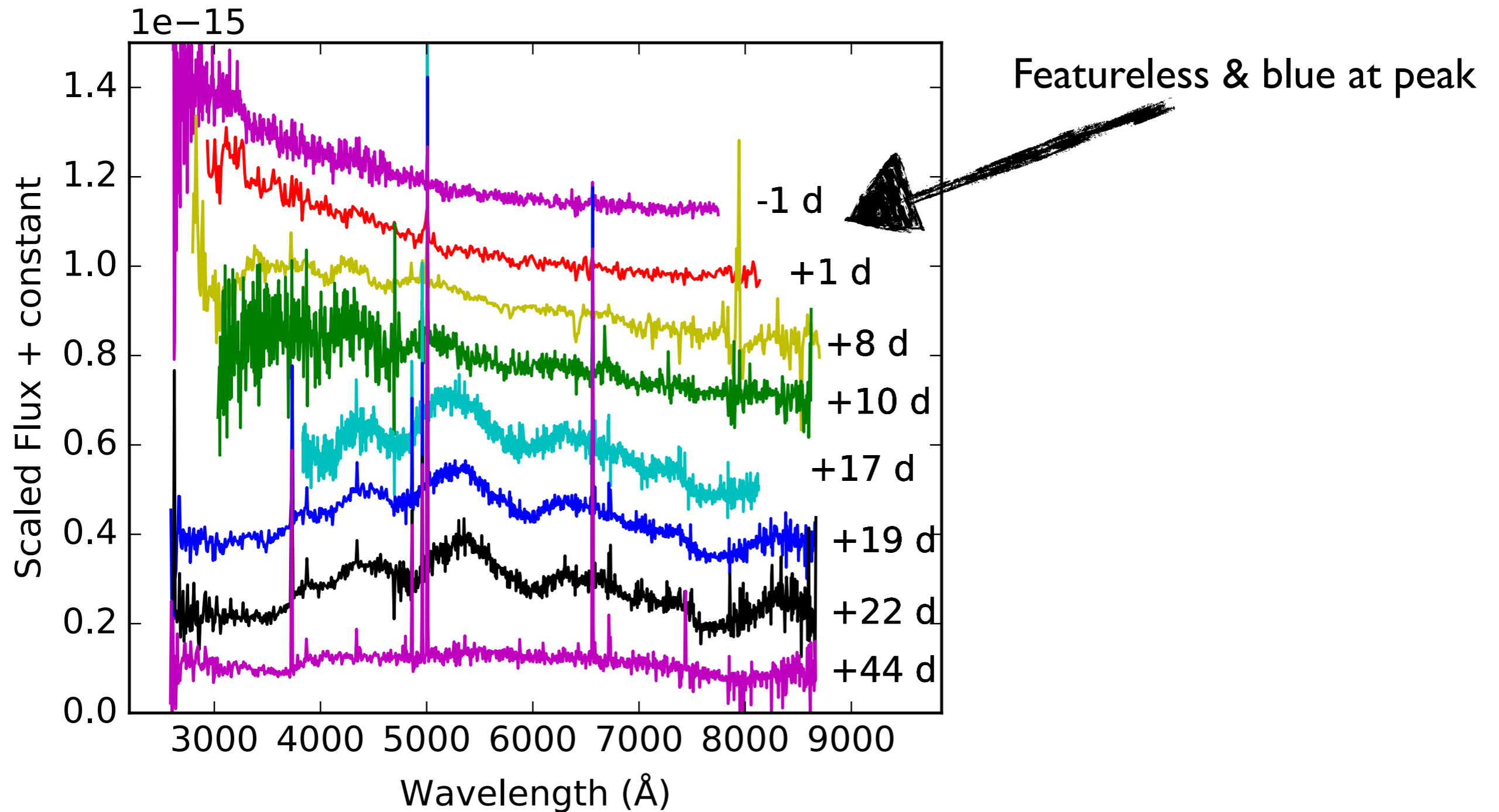
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# Spectroscopic Evolution



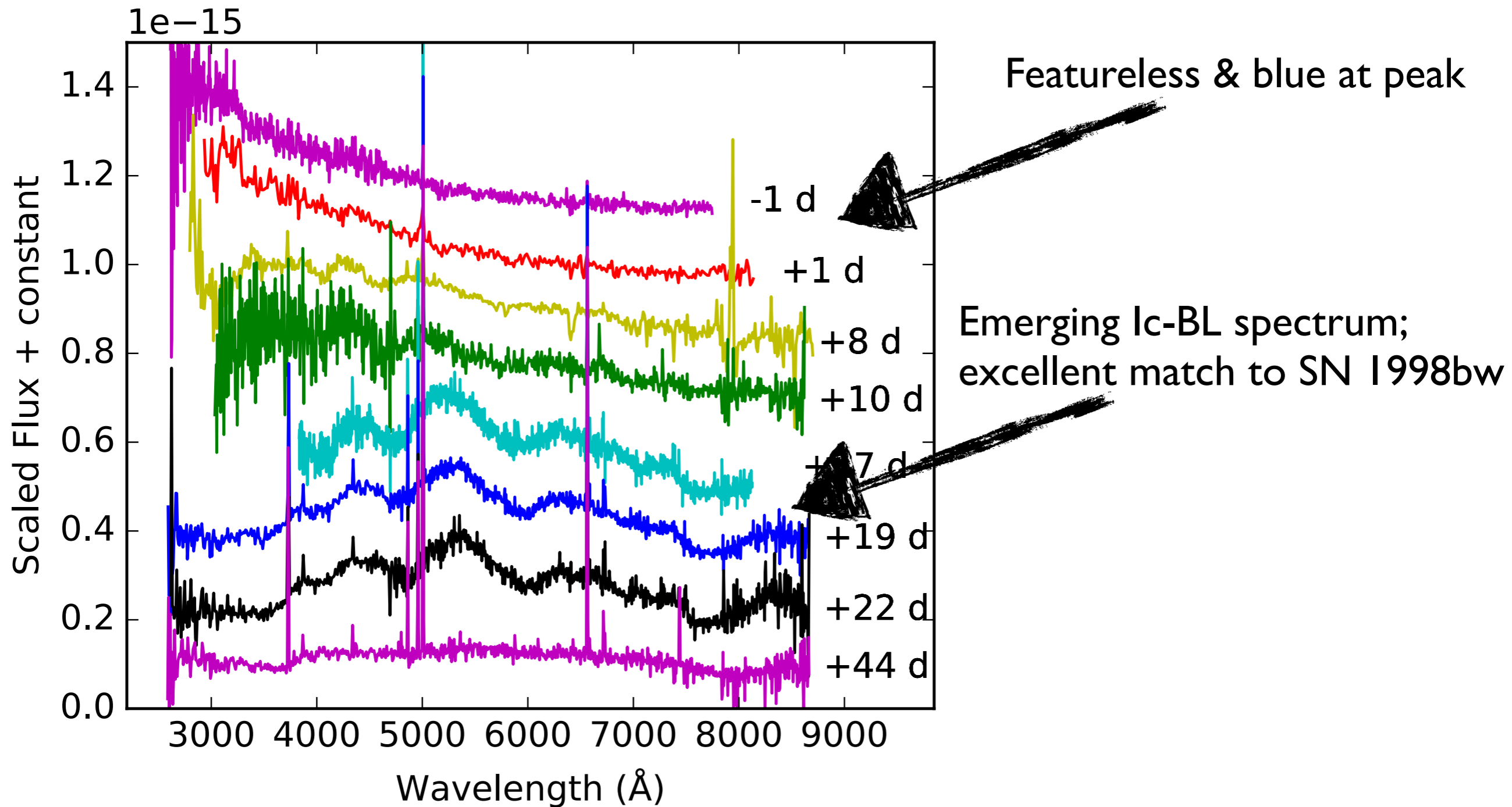
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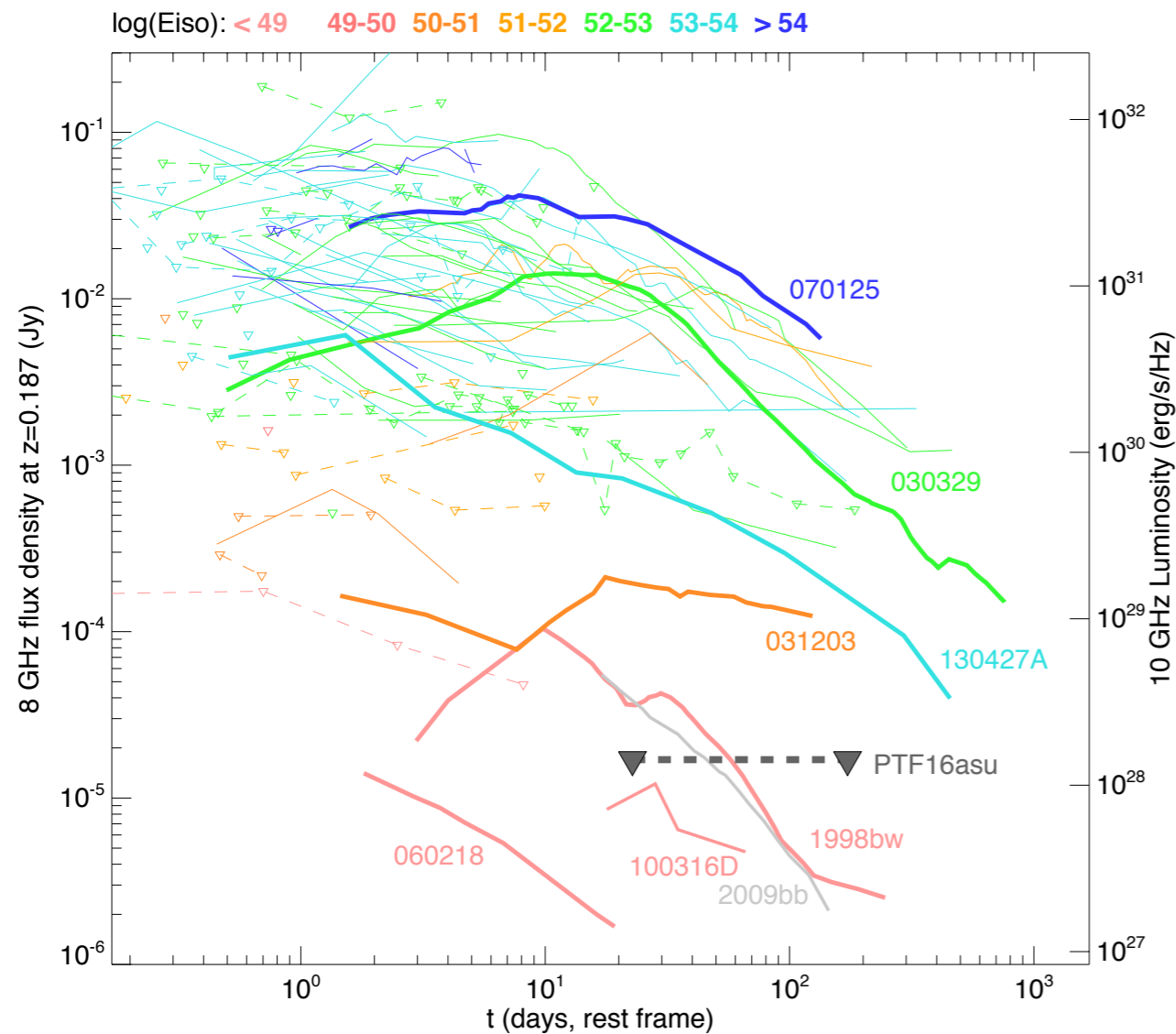
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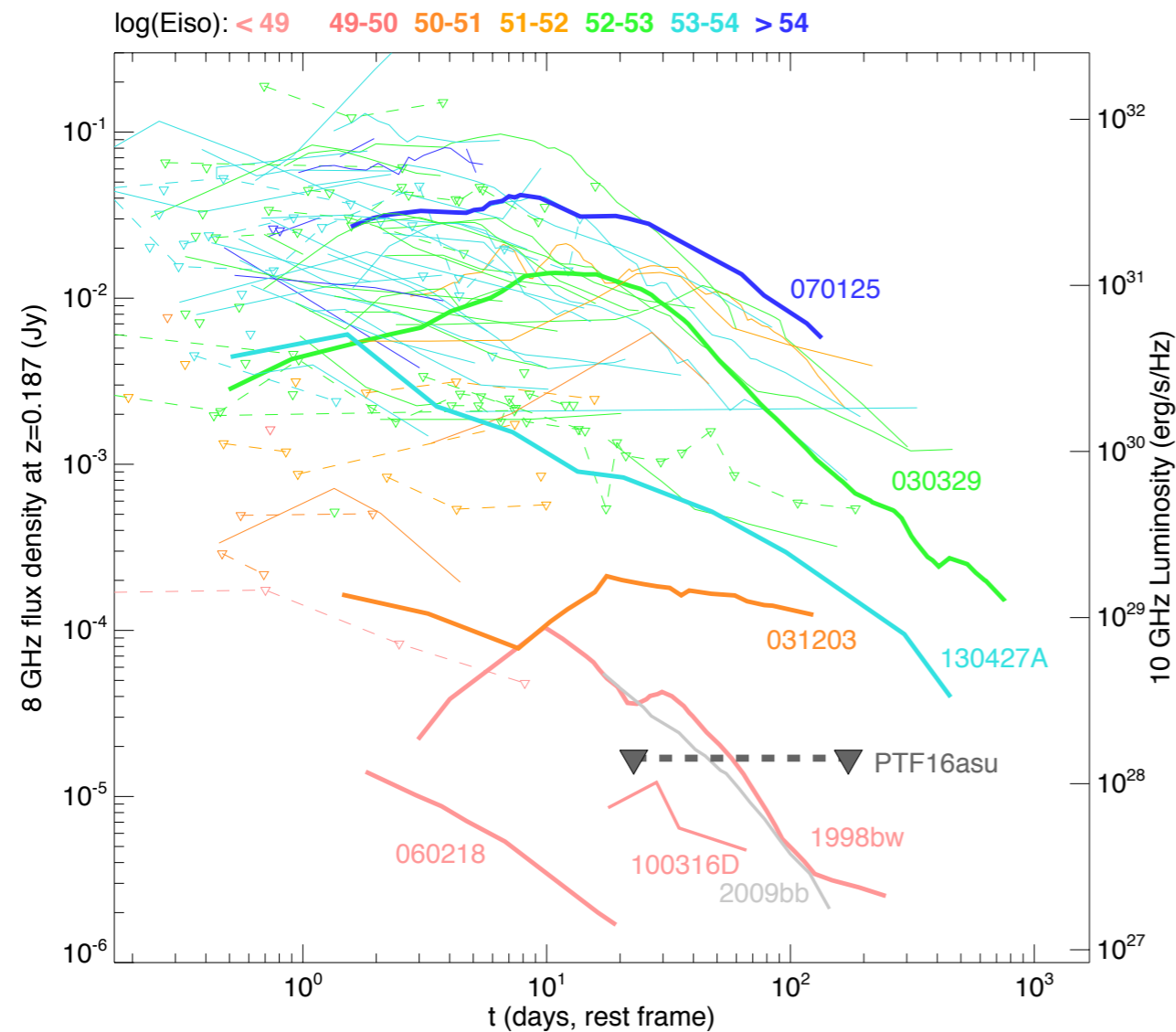
# Radio & X-ray nondetections constrain any associated GRB to be low-energy



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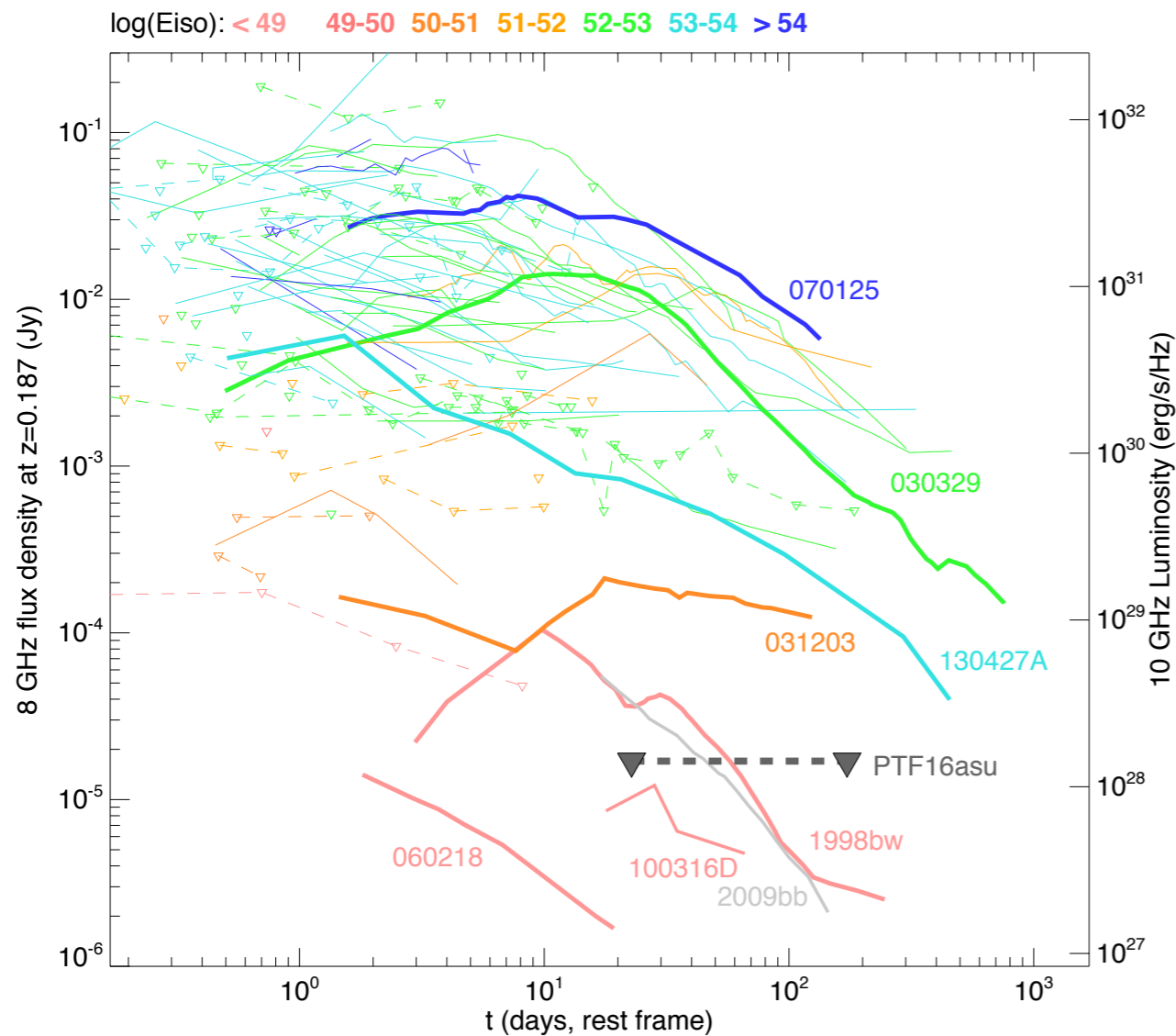
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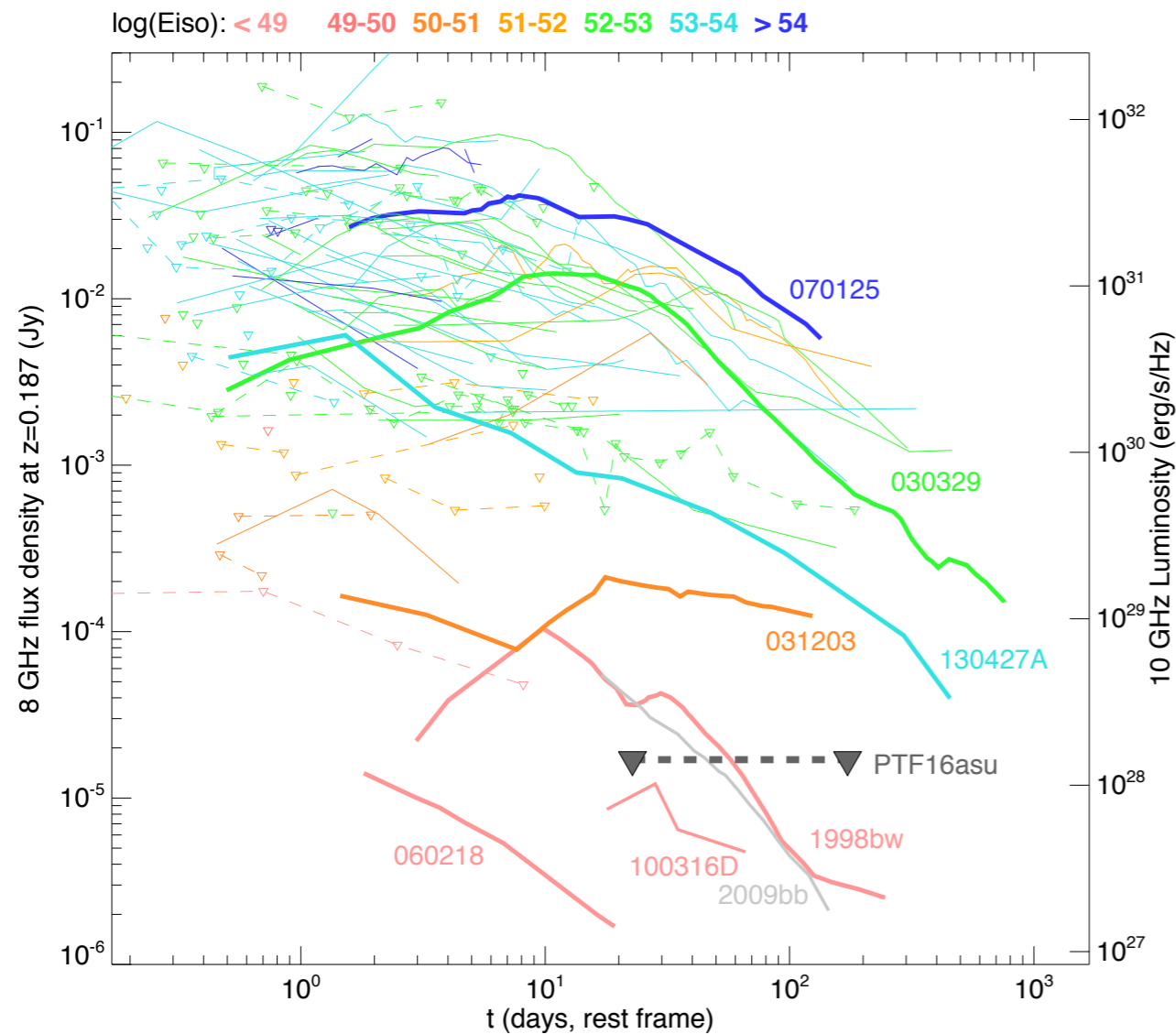
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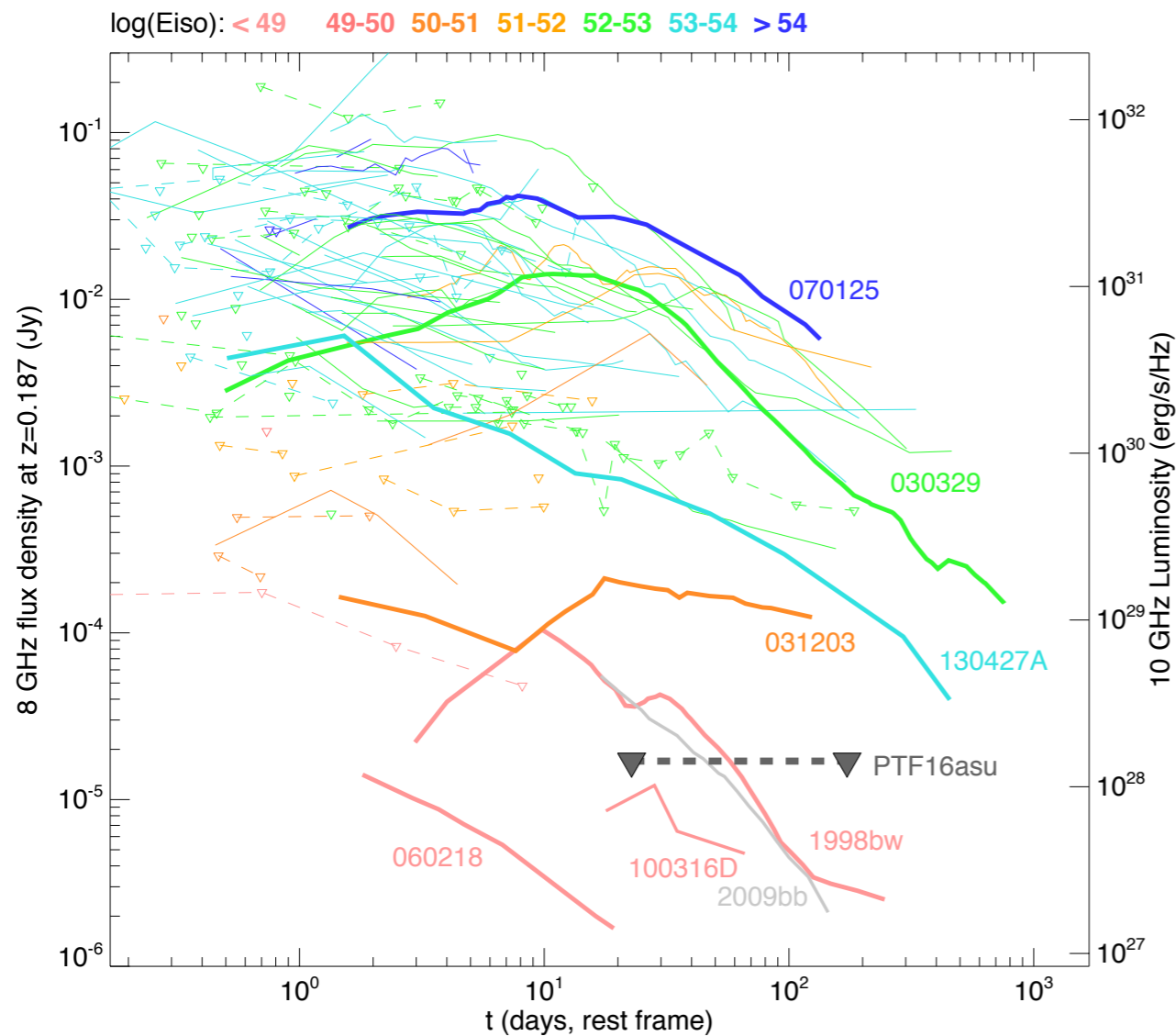
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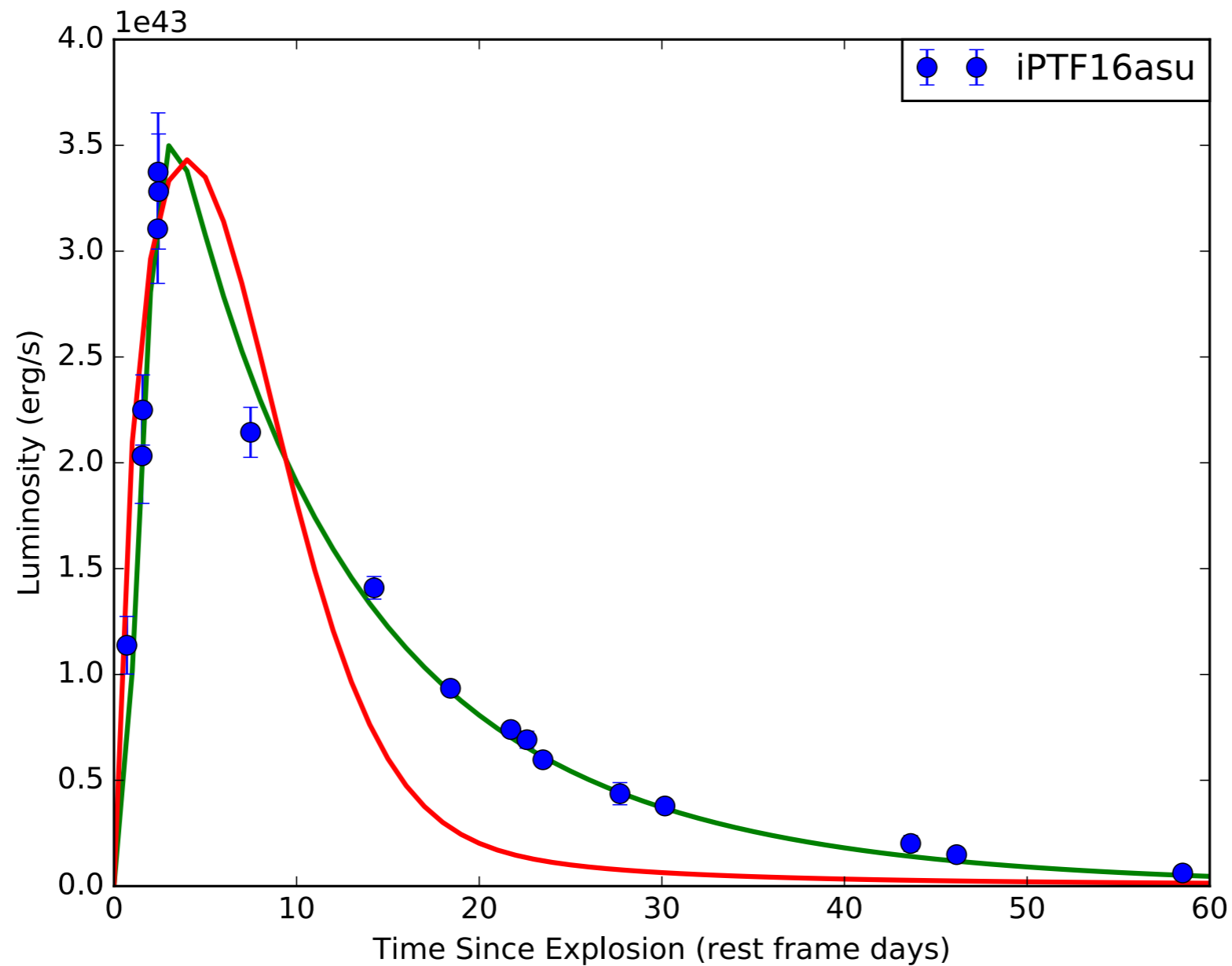
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- Spectral shape, light curve decay, X-ray to optical slope not GRB-like

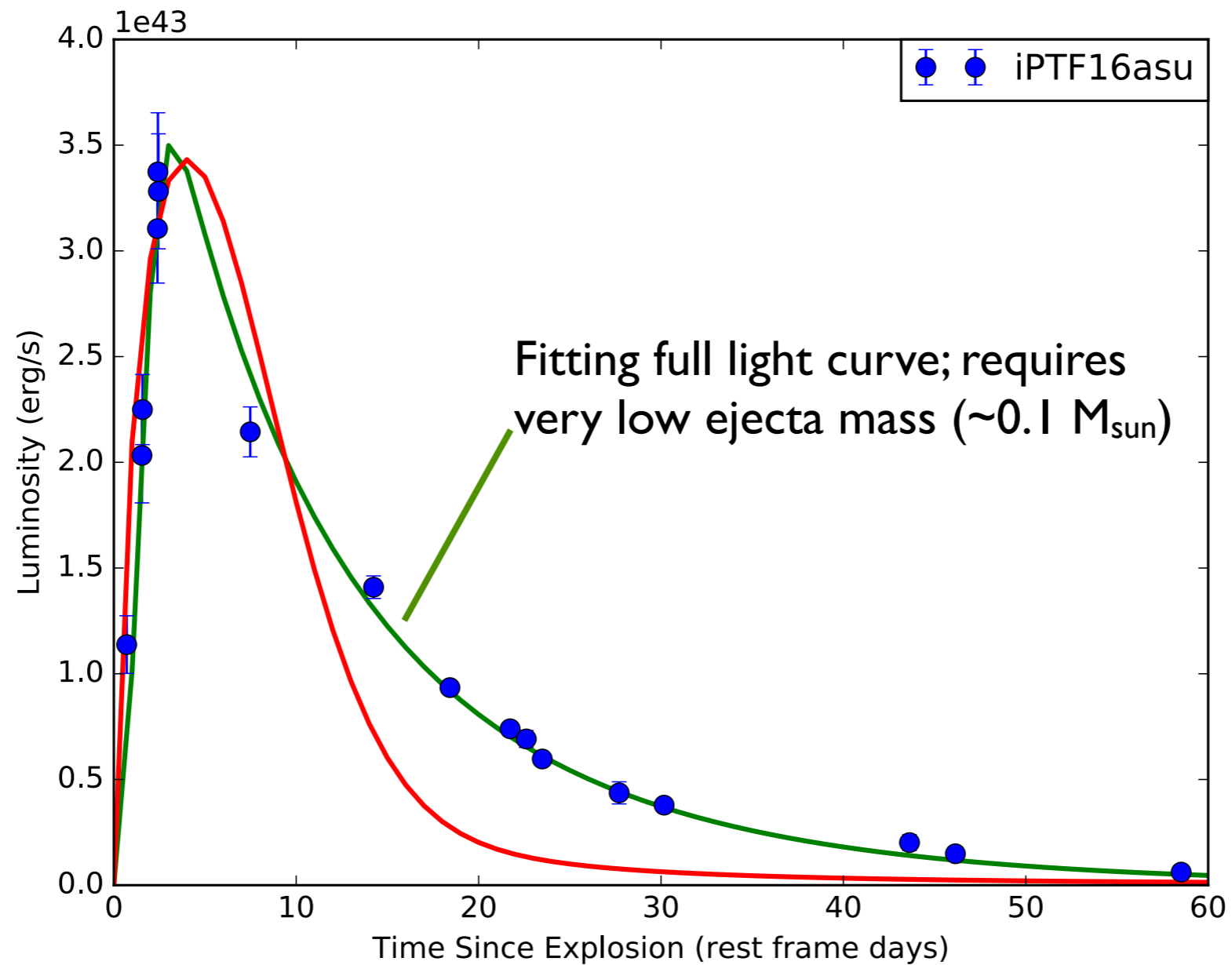
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# What Powered iPTF16asu: Magnetar Spin-down?



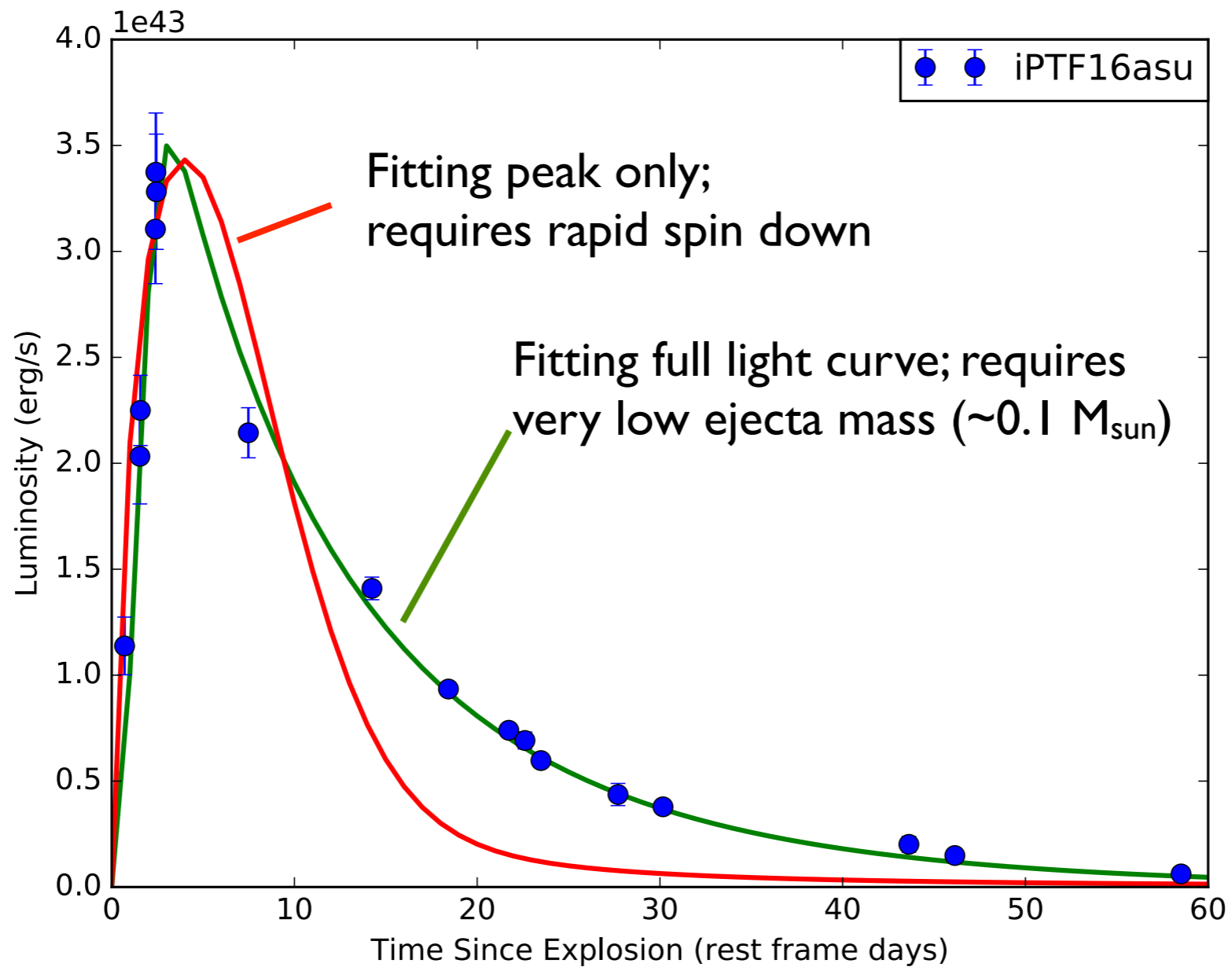
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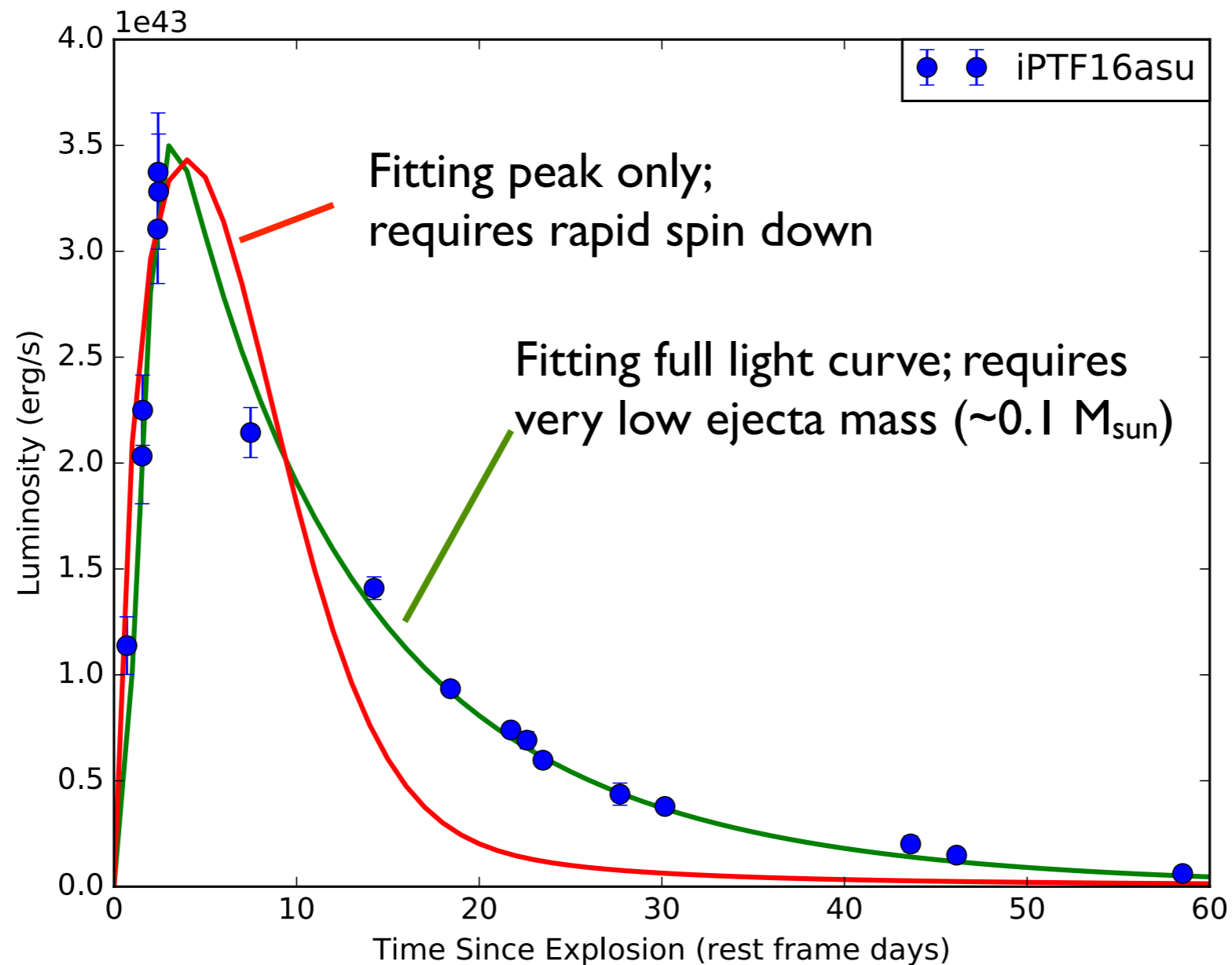
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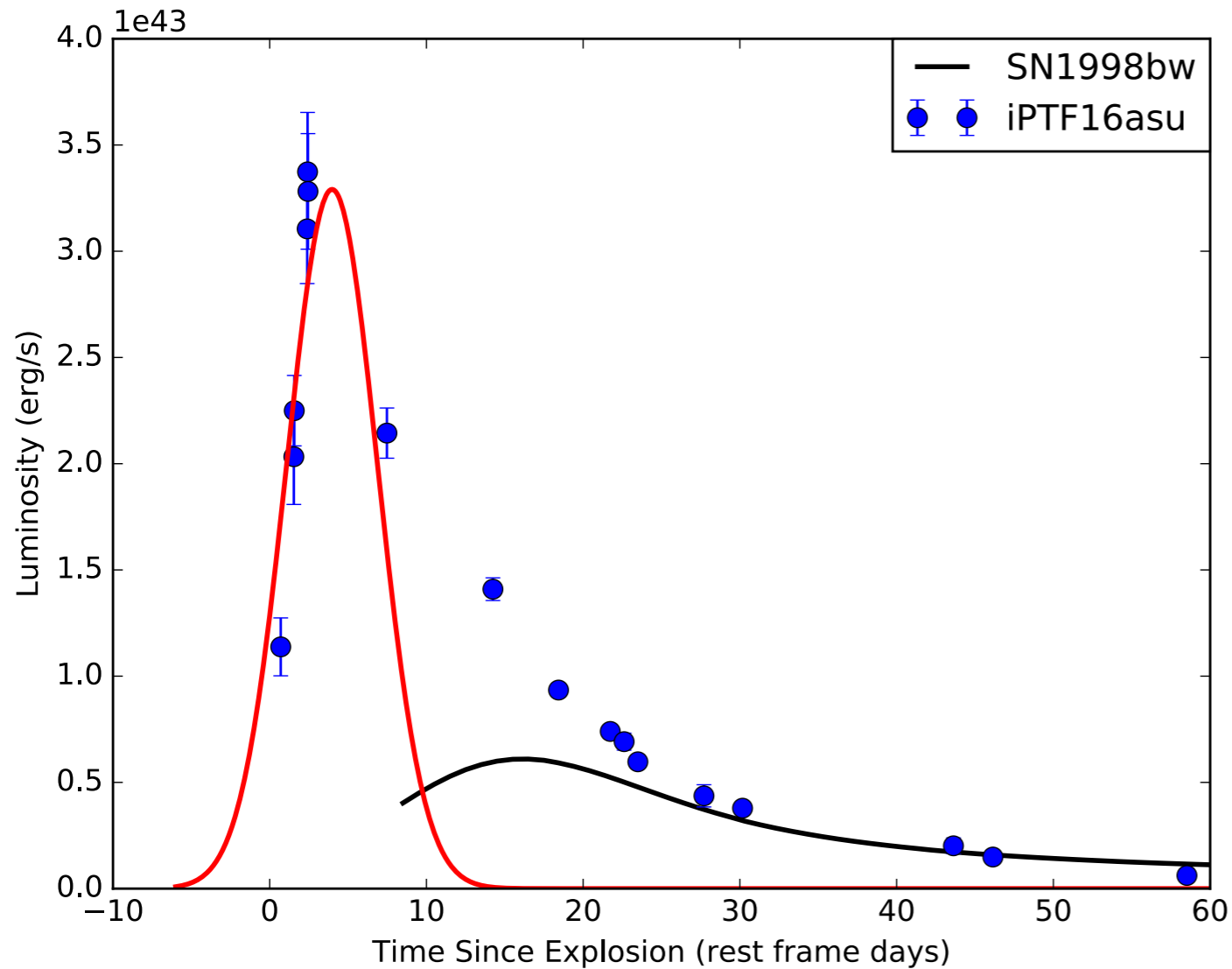


→ Could explain the peak, if sufficiently fast spin-down time.

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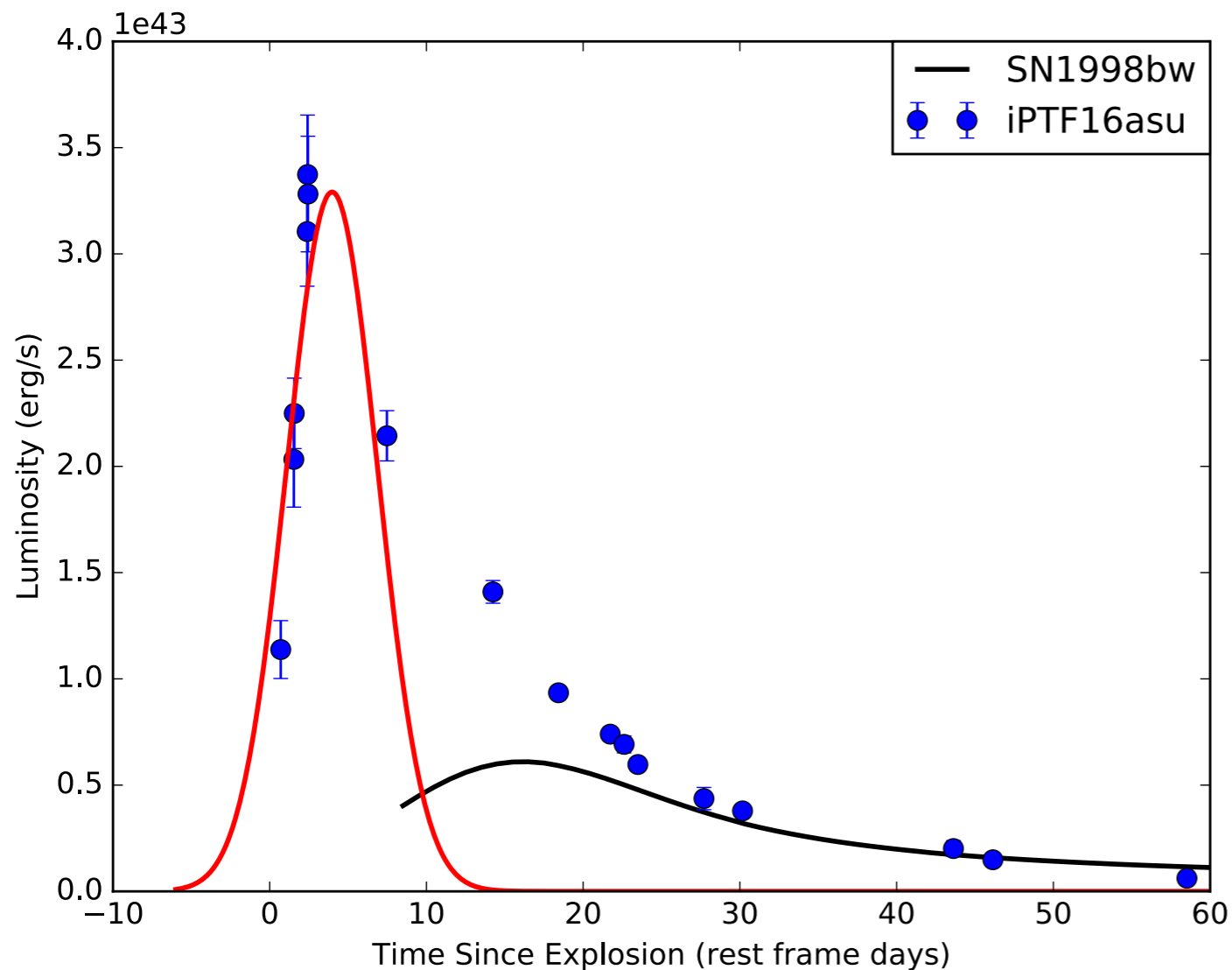
# What Powered iPTF16asu: Extended Envelope Shock Breakout?



- Luminosity & duration of luminous peak explained by extended envelope of  $\sim 0.5 M_{\text{sun}}$
- Given velocities, require large amount of energy (several FOE) transferred to the envelope - smothered GRB model

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- Given velocities, require large amount of energy (several FOE) transferred to the envelope - smothered GRB model

→ Could explain the peak, if underlying explosion is sufficiently energetic.

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# Summary

- iPTF16asu was a SN Ic-BL with a luminous ( $M_g = -20.4$  mag), rapidly-rising ( $t_{\text{rise}} = 4\text{d}$ ) peak.
- Non-detections in the radio & X-ray constrain any associated GRB to be low-luminosity
- Powering the optical peak likely requires a central engine, either in the form of a magnetar, or an engine-driven shock
- Transition object between SN Ic-BL, GRB-SNe and superluminous supernovae, not unlike SN2011kl.

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