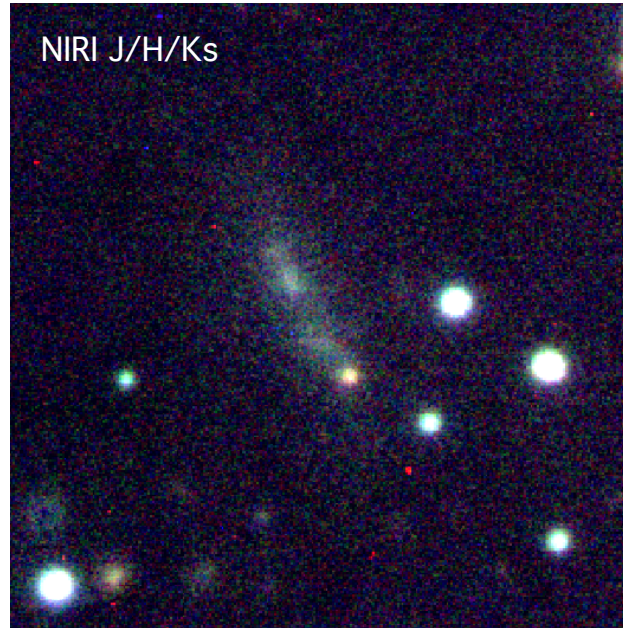
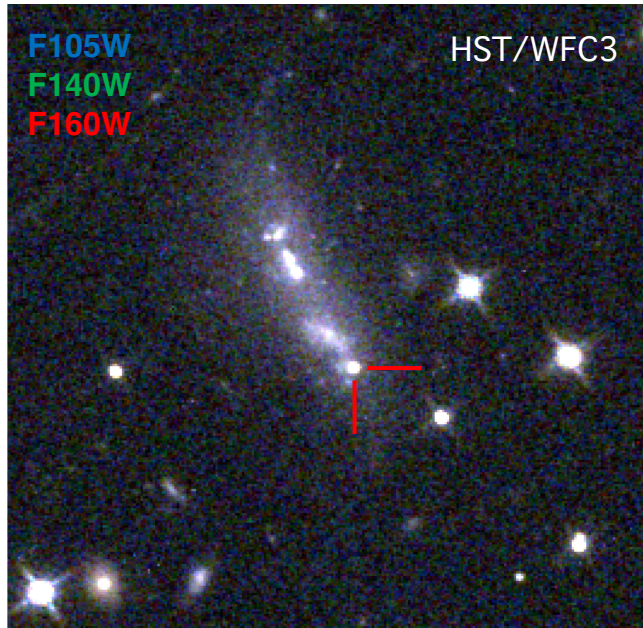


# The Mysterious SN2020wnt

## A Supernova That Defies All Models (Even Magnetars!)



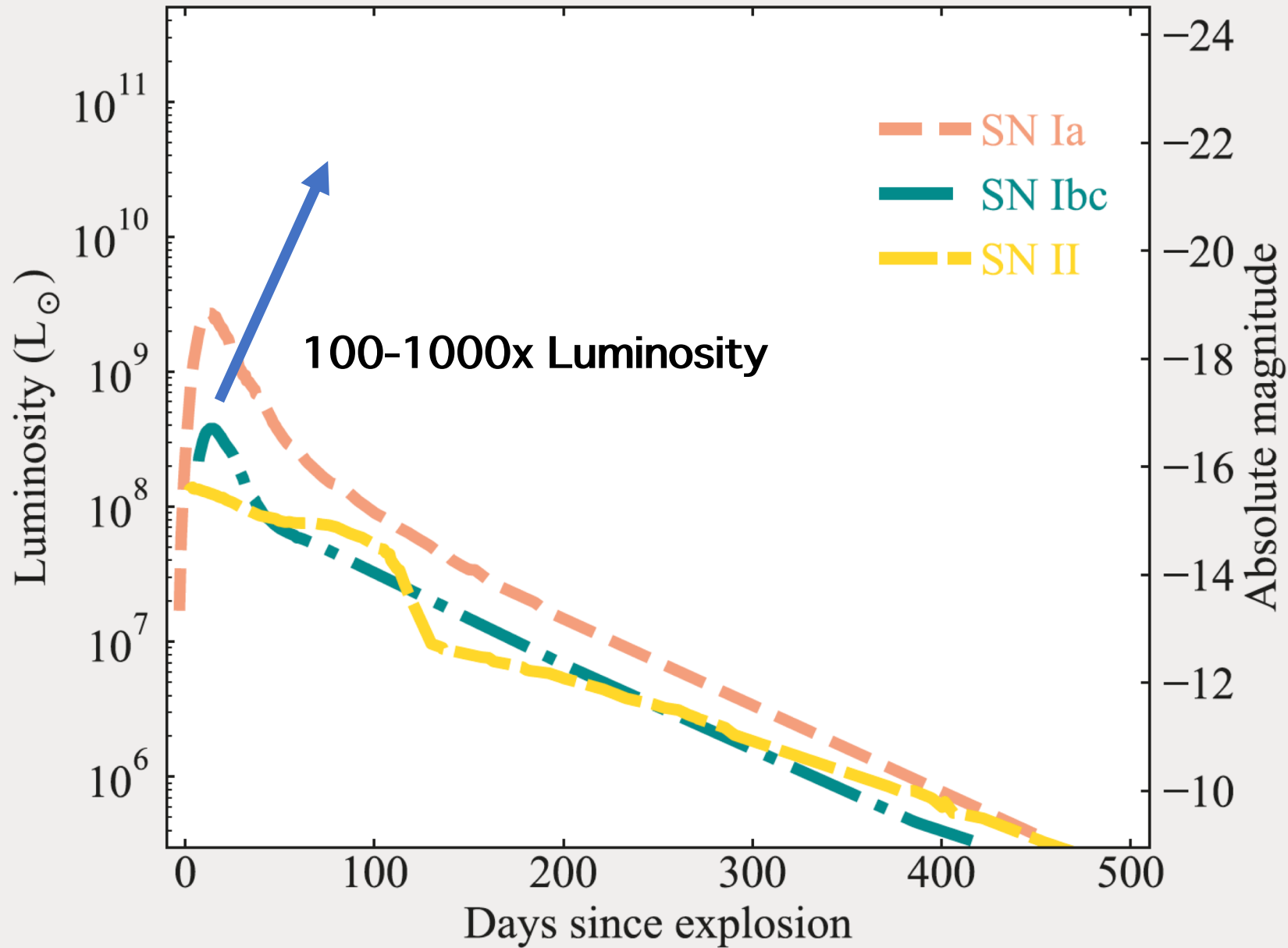
**Kaew Samaporn Tinyanont**

University of California Santa Cruz

Gemini Science Meeting, July 2022

with Ryan Foley, Kirsty Taggart (UCSC), Lin Yan (Caltech), Ragnhild Lunnan (Stockholm)  
Stan Woosley (UCSC), Yen-Chen Pan (NCU Taiwan), et al.

# Superluminous Supernovae

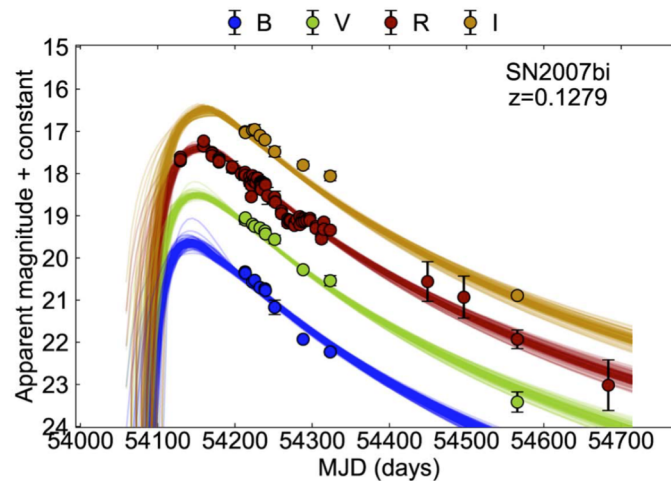
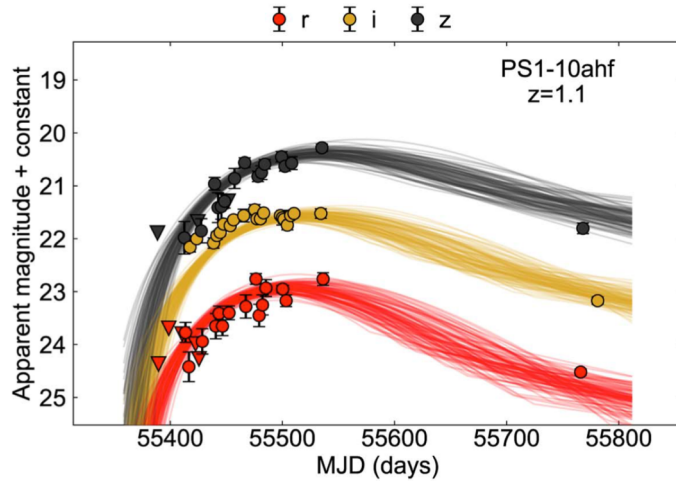
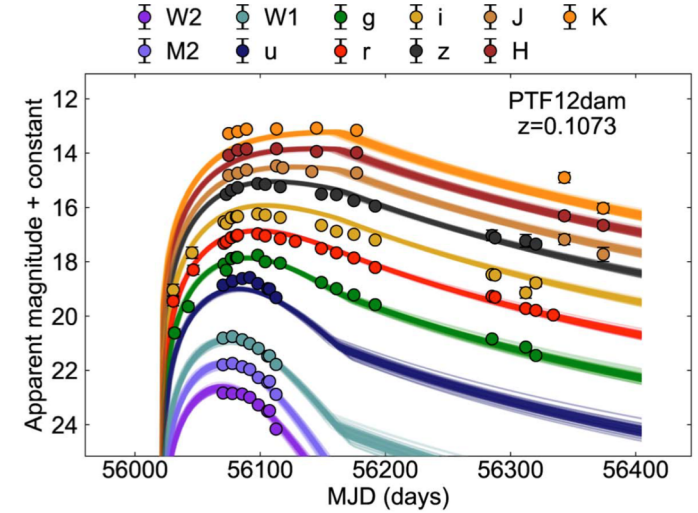
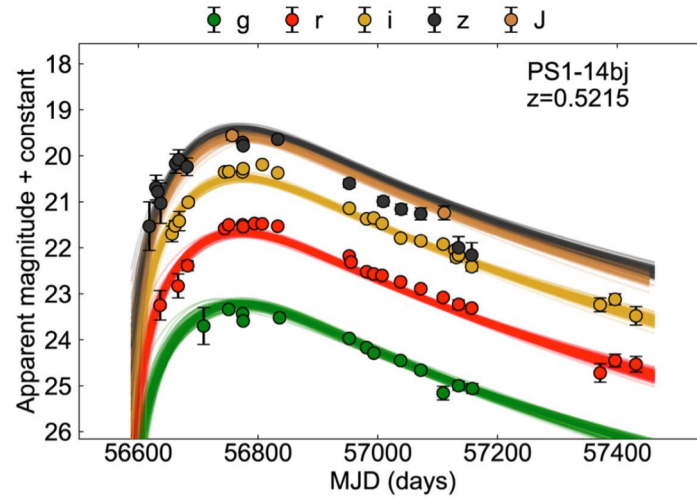
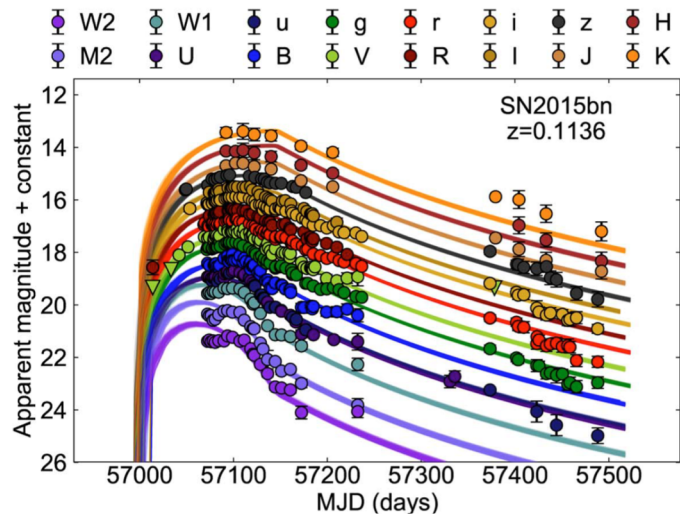


Nicholl 2021

# How to boost the luminosity?

- Radioactive decay: boost the  $^{56}\text{Ni}$  mass
  - More Nickel = brighter; more total mass = longer rise time
  - Most SLSNe would require more Nickel than ejecta mass
- Magnetar spin-down
  - Smooth energy injection from dipole radiation (simple model)
  - Have clear spectroscopic imprints: blue continuum, O II absorptions
- Circumstellar Medium (CSM) interaction
  - Can explain bumpy light curves
  - Also have clear spectroscopic imprints: narrow lines (if CSM is dense enough)

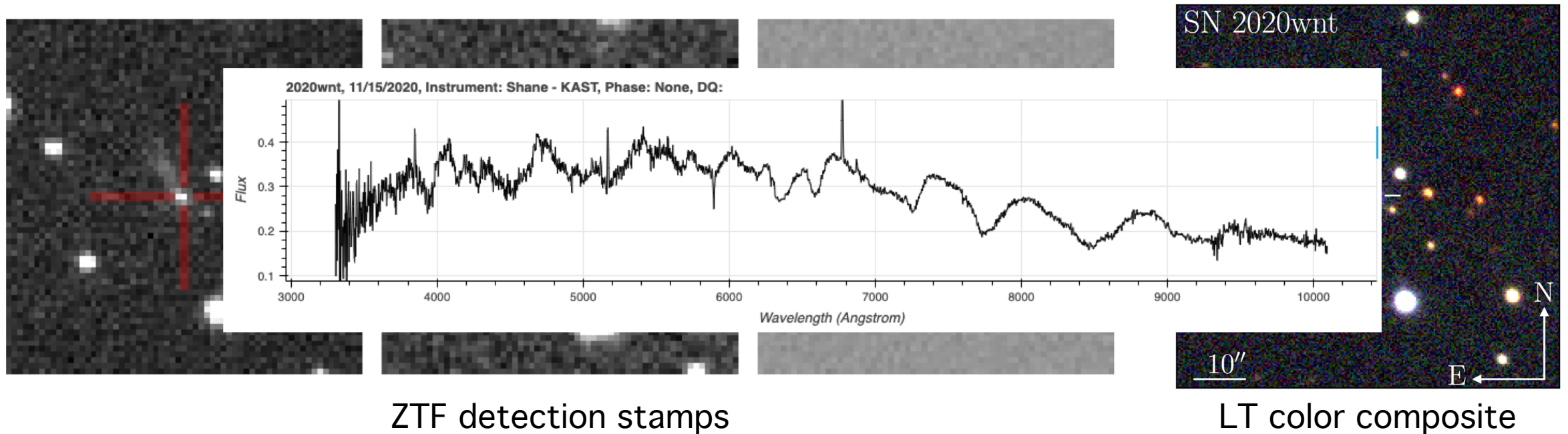
# Magnetar models work really well

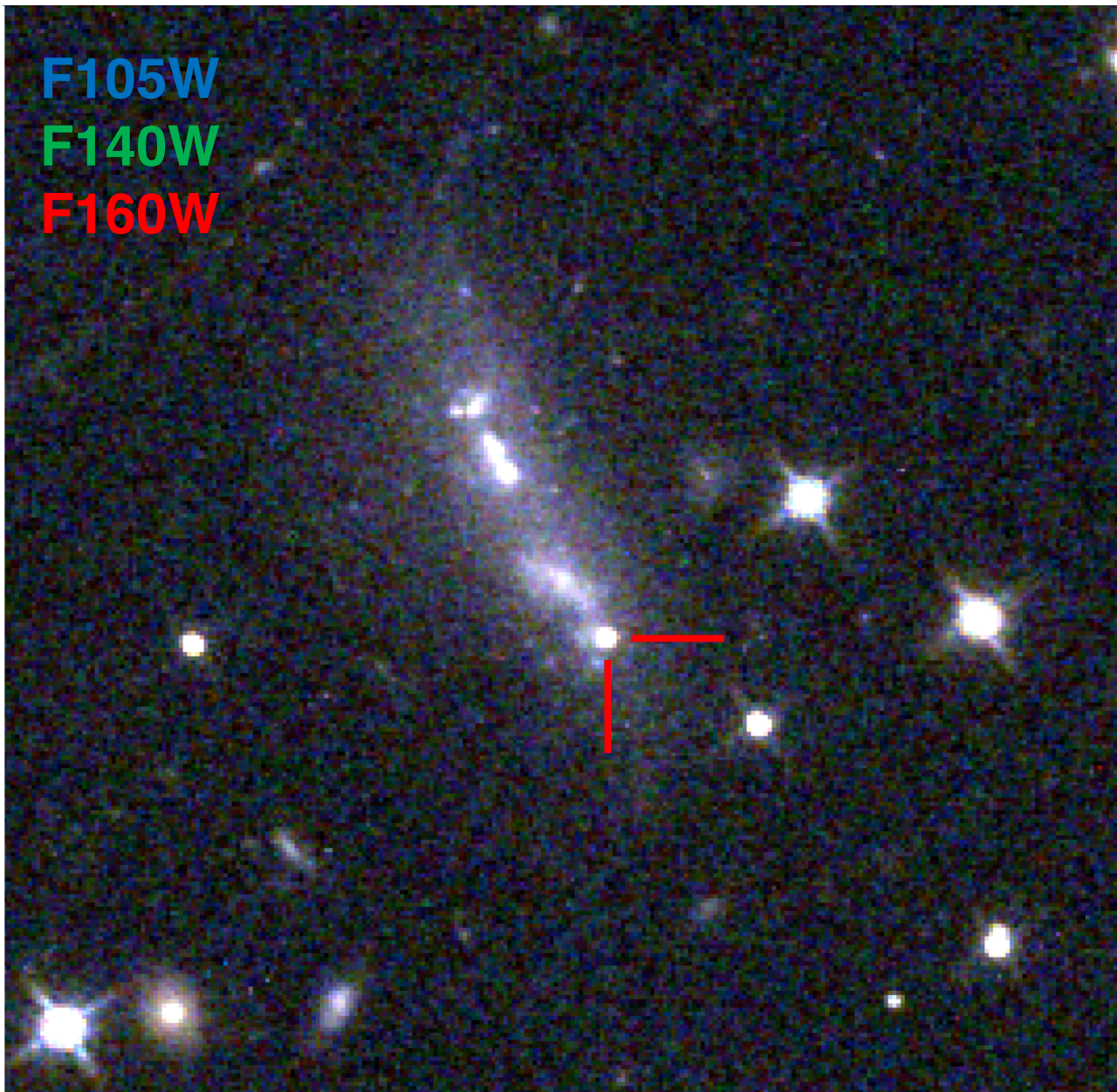
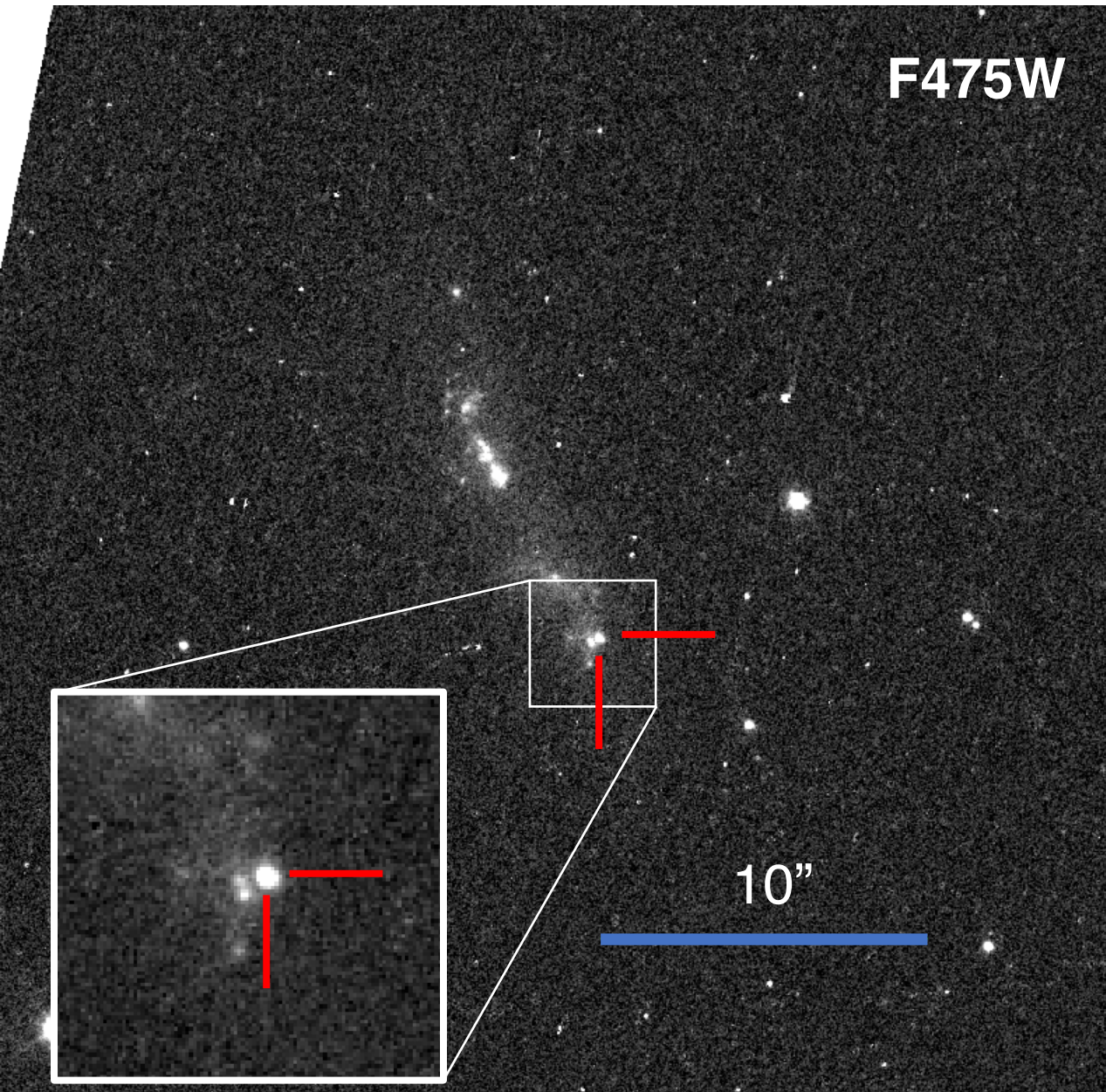


Nicholl, Guillochon,  
Berger 2021

# SN 2020wnt at 140 Mpc

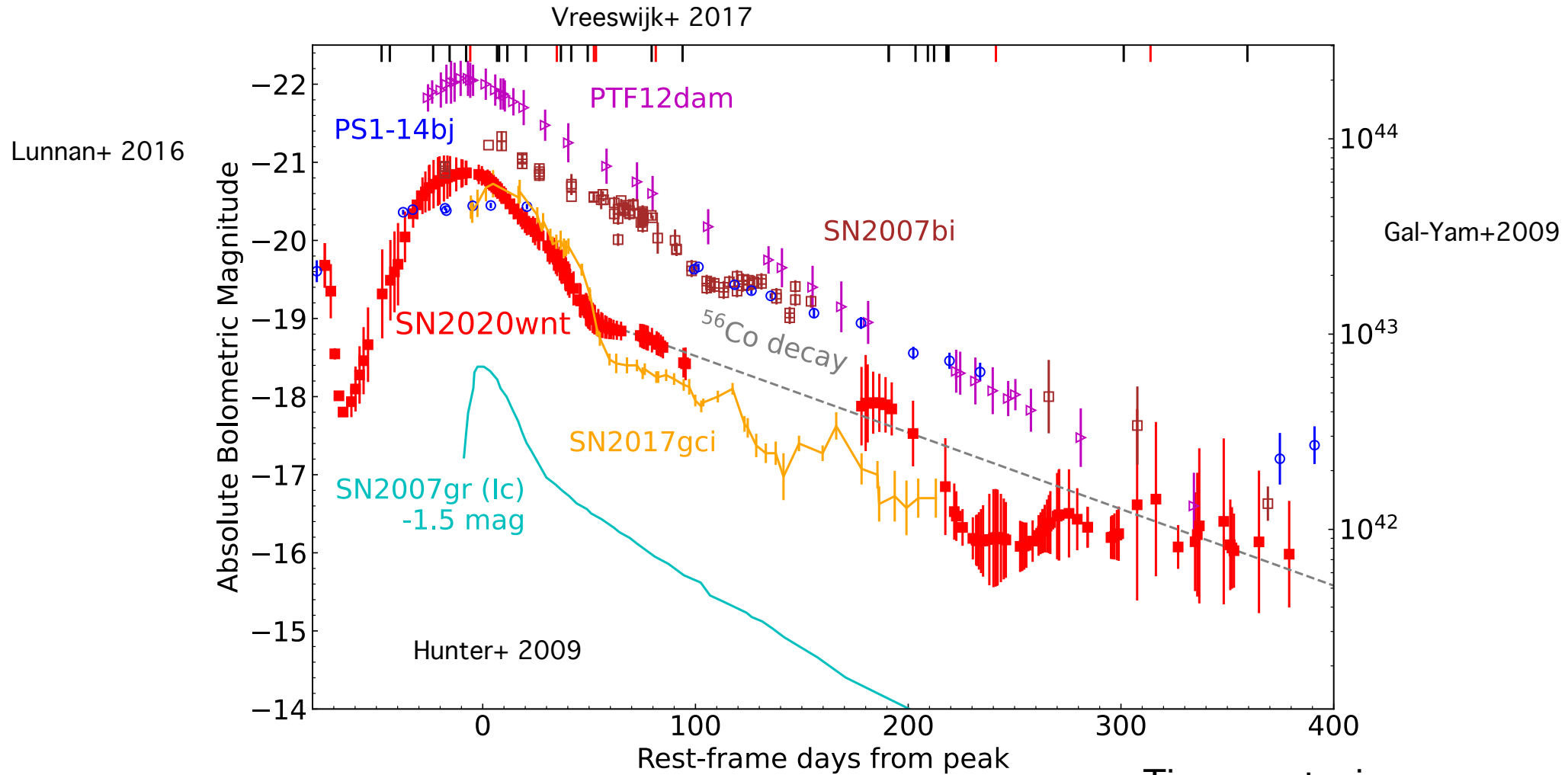
ZTF20acjflr; discovered on 2020 Oct 14  
No hydrogen or helium



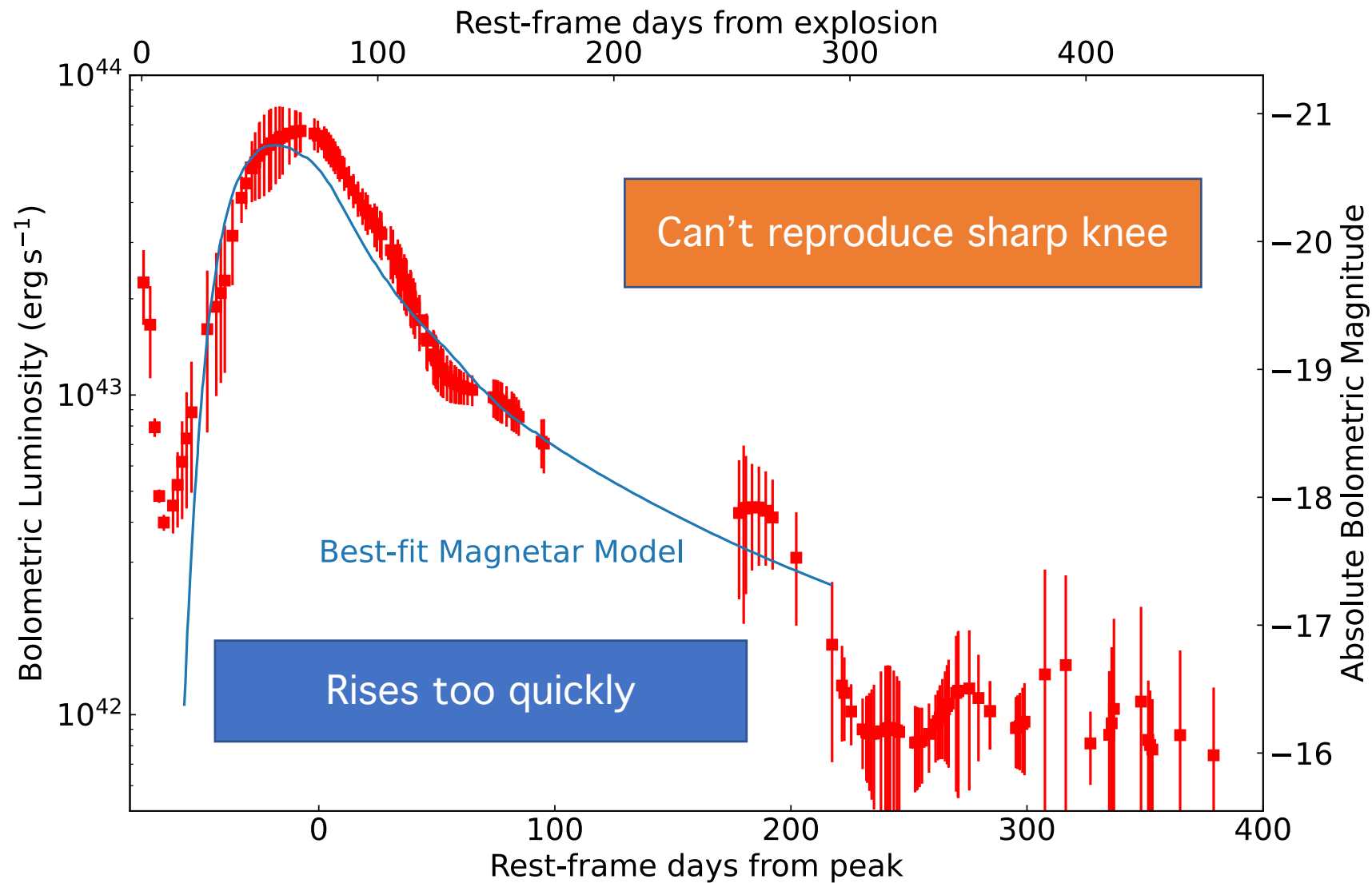


# Similar Light Curve to SLSNe

Epochs with spectroscopy



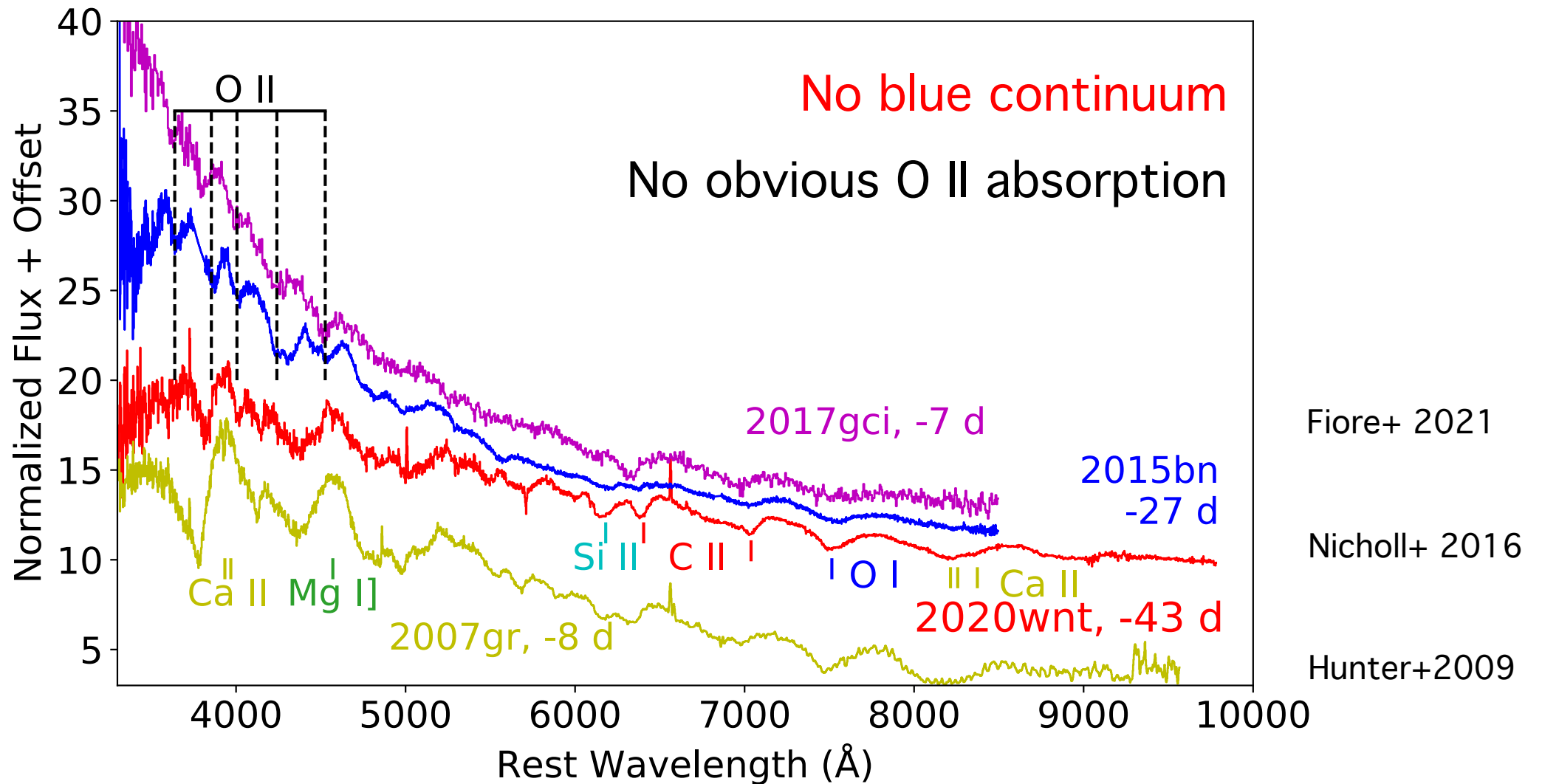
# Magnetar model's poor fit



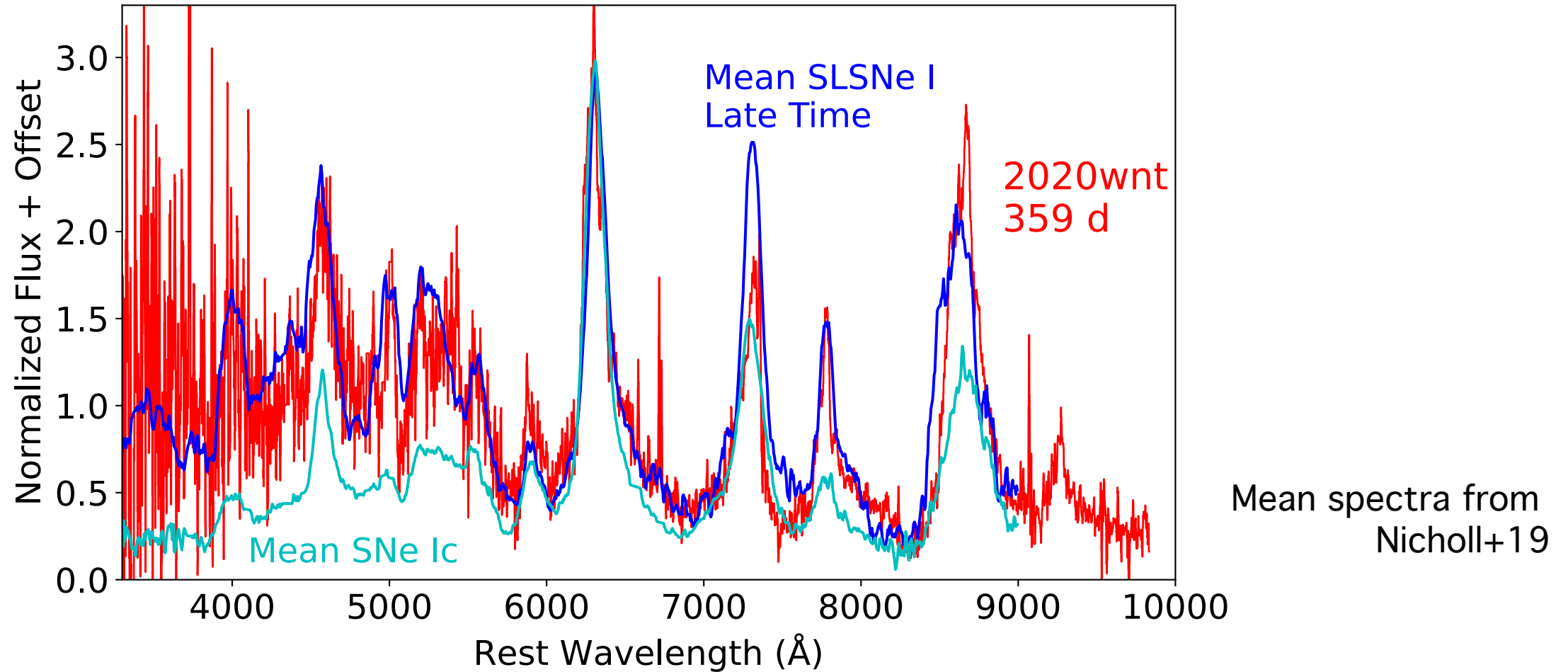
Tinyanont+ in prep



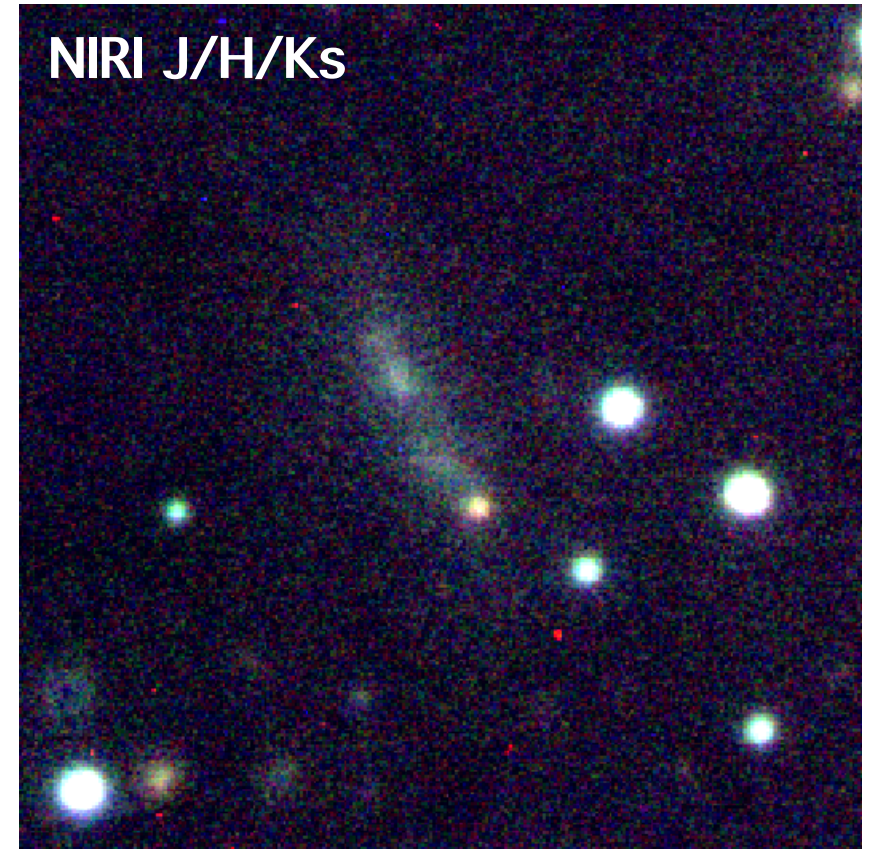
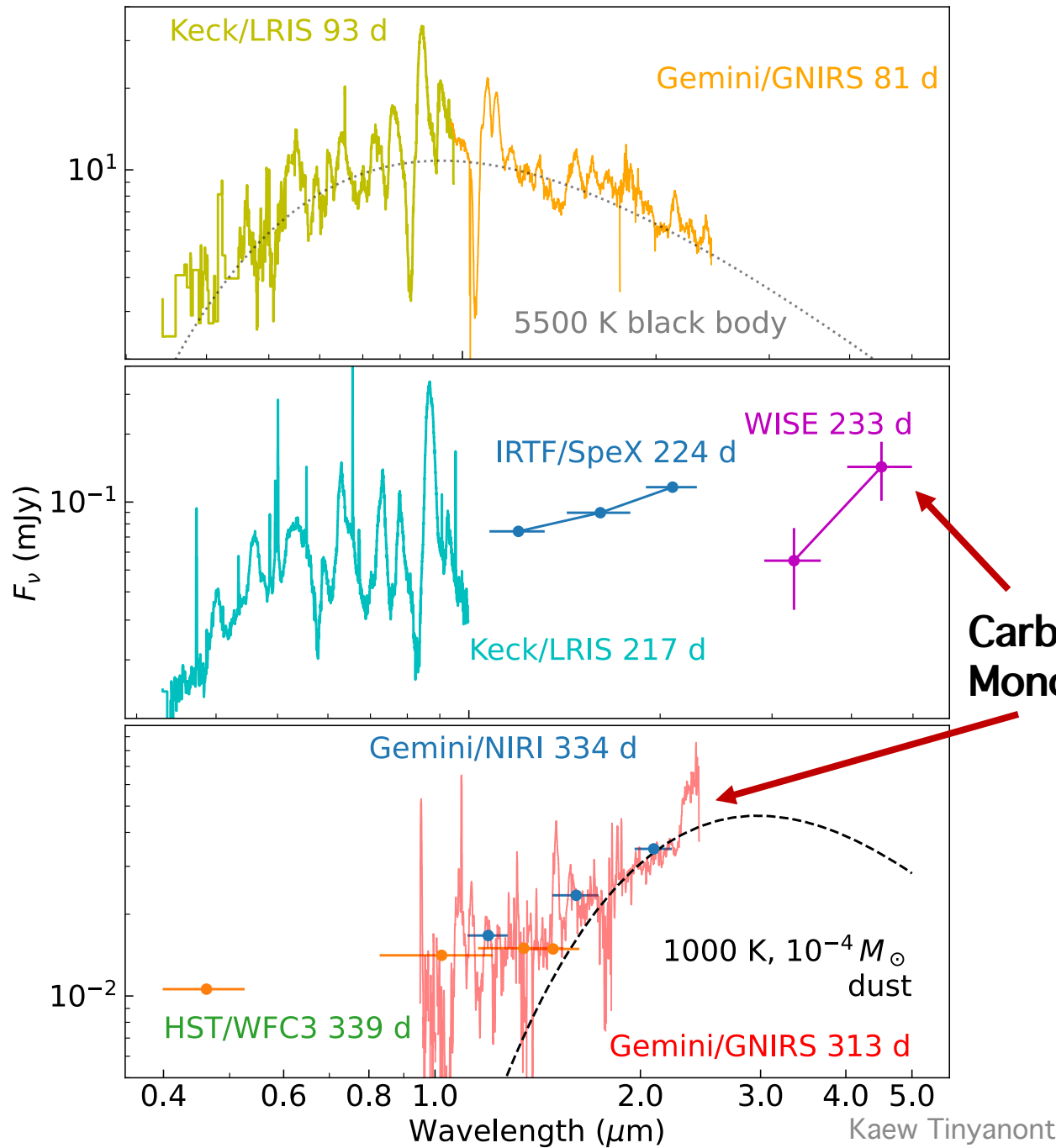
# Peak spectra look like a normal SNe Ic



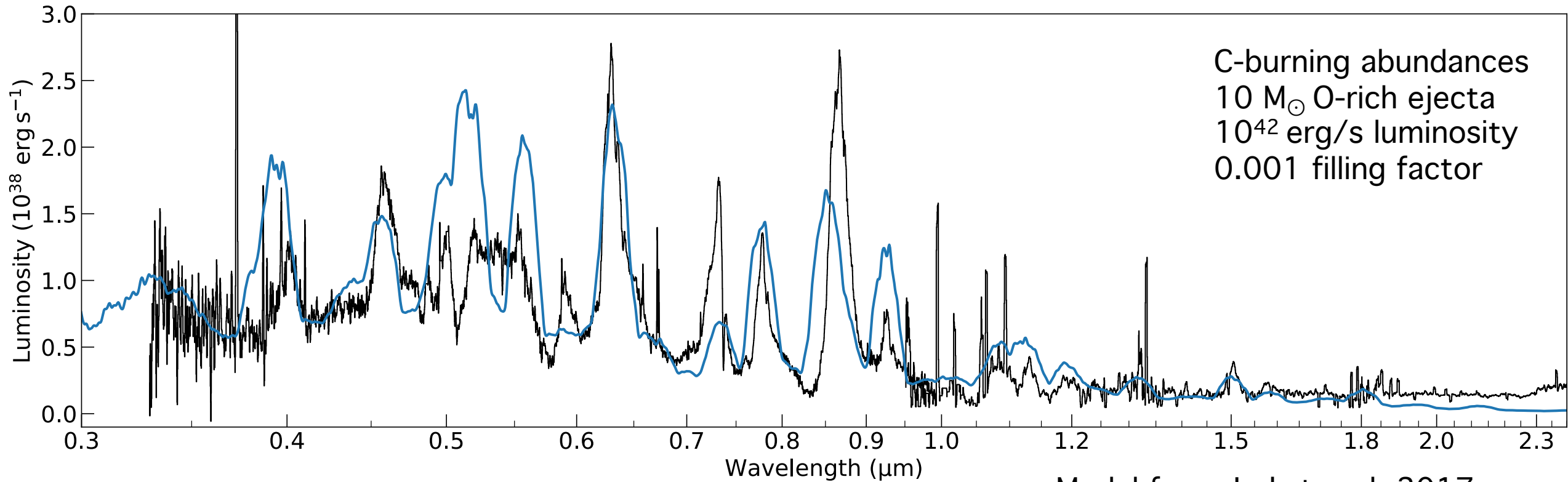
# Late-time: similar to an average SLSN spectrum



# Carbon Monoxide & Dust formation

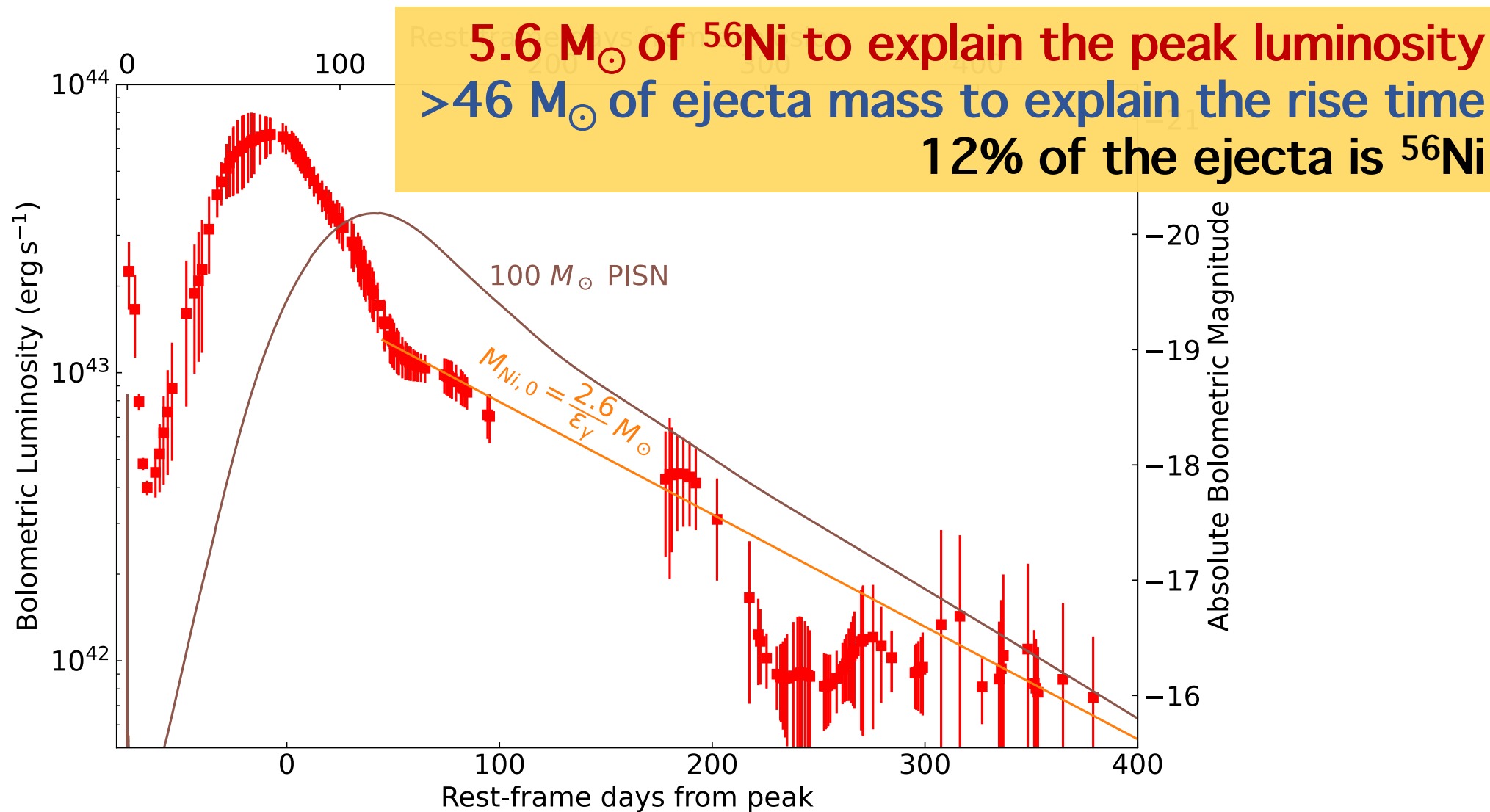


# Constraints on explosion mechanism from a Keck + Gemini nebular spectrum



Model from Jerkstrand+2017

# Radioactivity Models



# So what is the progenitor?

- Magnetar may be there (from nebular spectrum), but does not power the peak
- Strong CSM interactions unlikely: no narrow lines at any phase, no radio detection
- Core-collapse can't produce  $\sim 5-6 M_{\odot}$  of Ni, other mechanism needed.
  - Pair-instability predicts longer rise and lower velocity
  - Nucleosynthesis of Ni in magnetar wind?

# Summary

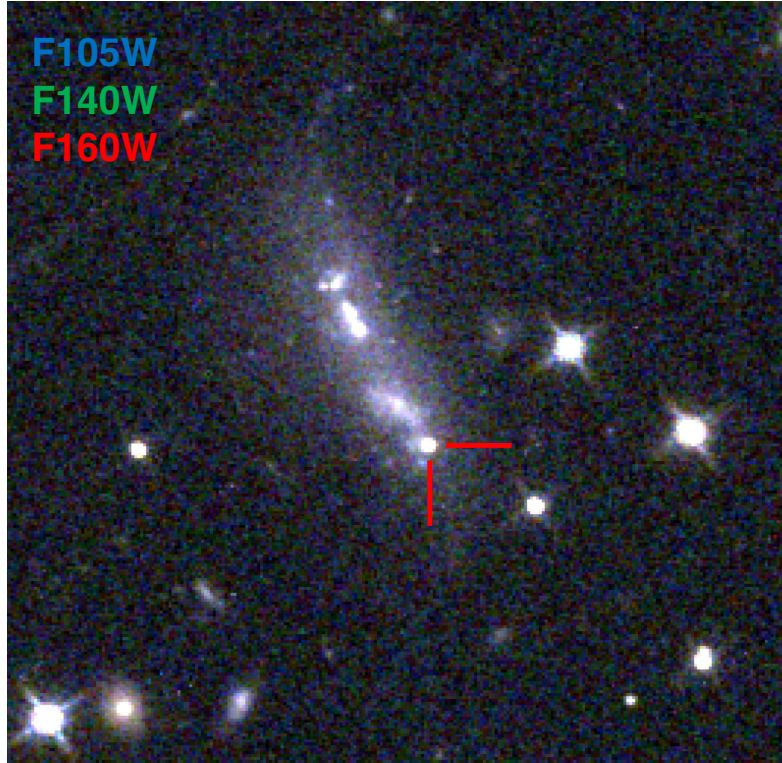
SN 2020wnt is a luminous H/He-poor SN  
from a very massive progenitor star

Low metallicity environment

Forming CO and dust

Peak not powered by a magnetar

Could be powered by radioactivity with  
 $\sim 5.6 M_{\odot}$  of  $^{56}\text{Ni}$  and  $\sim 45 M_{\odot}$  ejecta mass



stinyanont@ucsc.edu