



# COW, CAMEL AND OTHER EXPLOSIVE ANIMALS



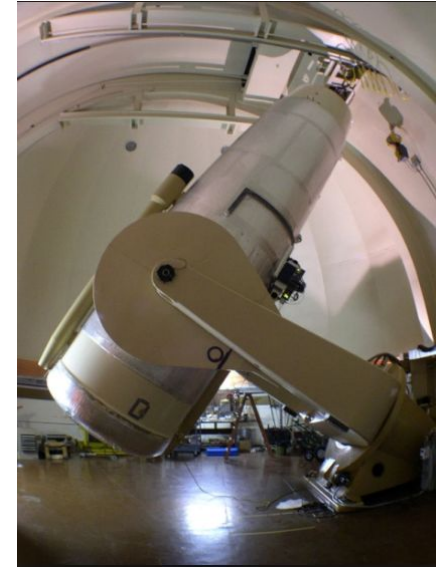
# Transient Industry



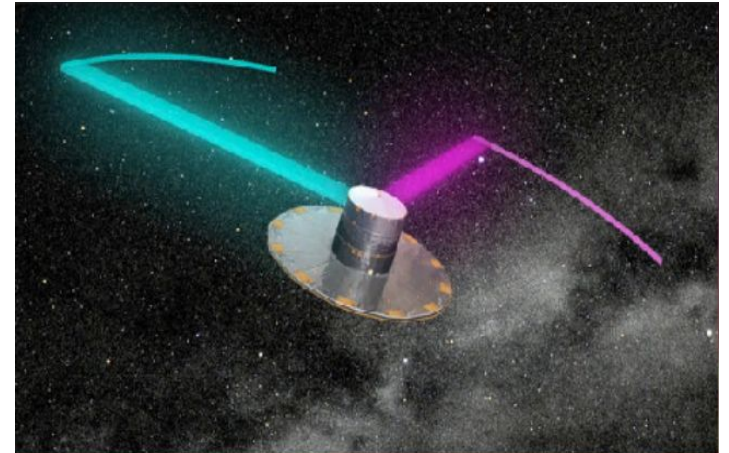
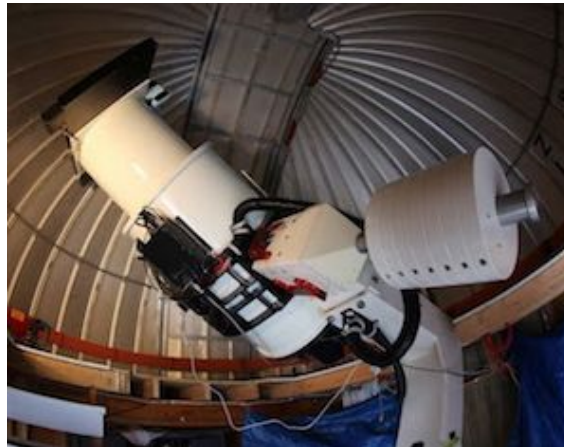
OGLE



ZTF



ASAS-SN



**ATLAS**  
Mariusz Gromadzki  
**Cow, Camel and other explosive animals**

**Gaia**

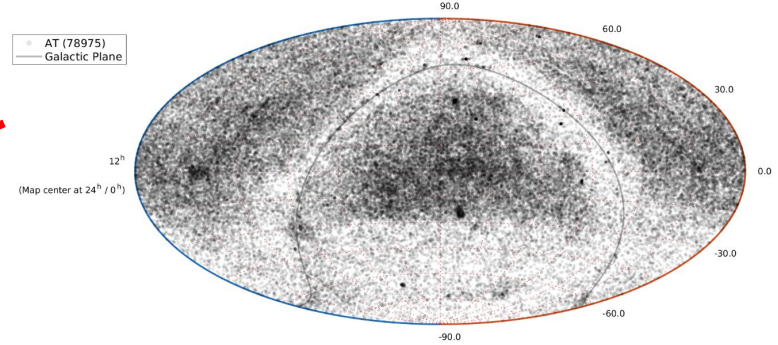
# How works transient industry

Discovery



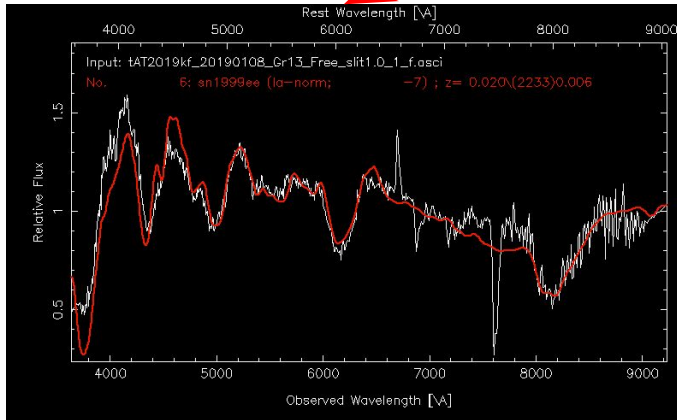
Report discovery to TNS

TNS Full-Sky Map by Type  
Types Plotted: ATs



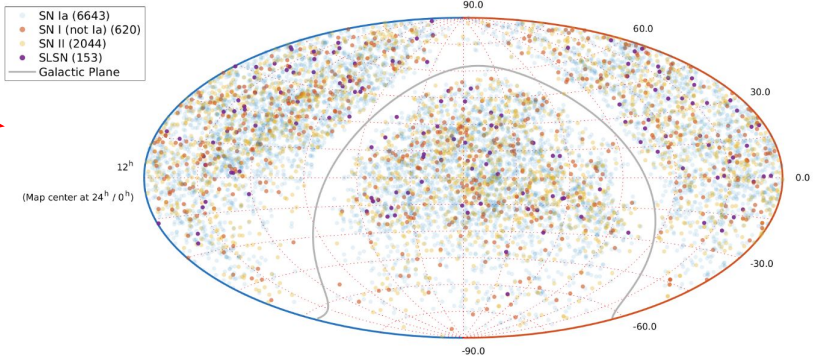
Plot Generated 12-Jan-2022

Spectroscopic classification



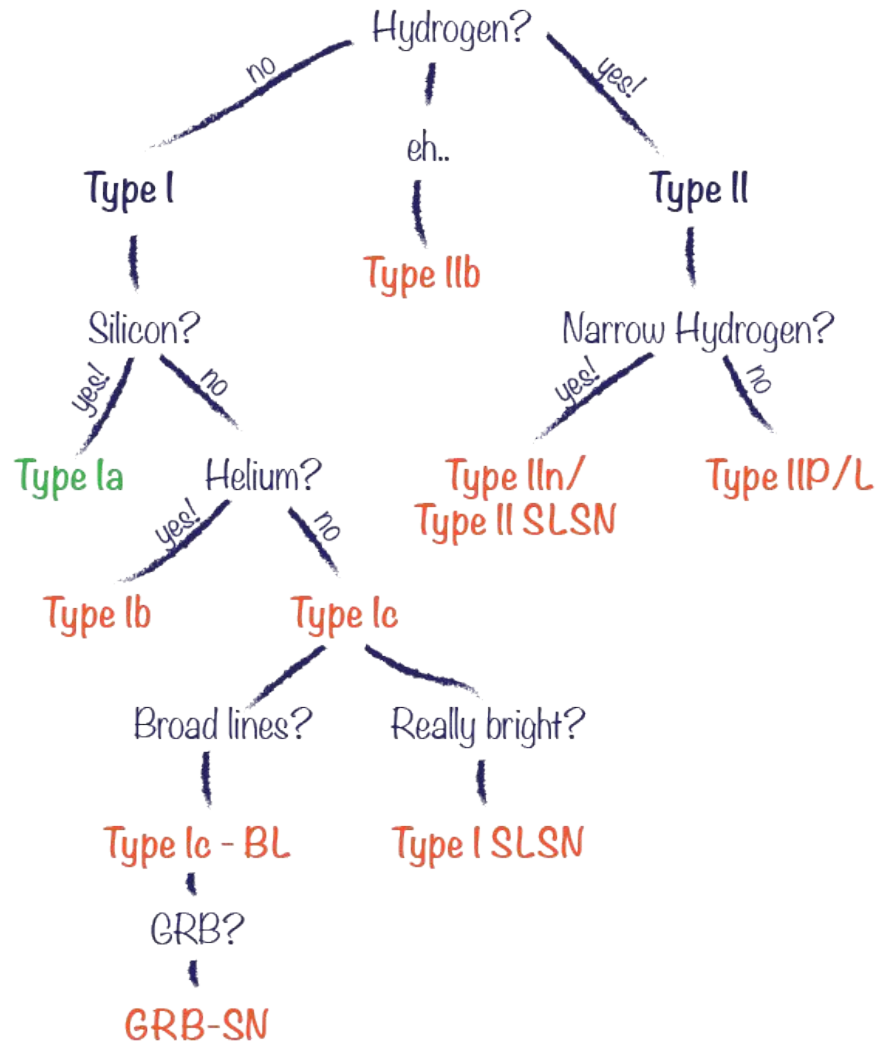
Report classification to TNS

TNS Full-Sky Map by Type  
Types Plotted: All SNe



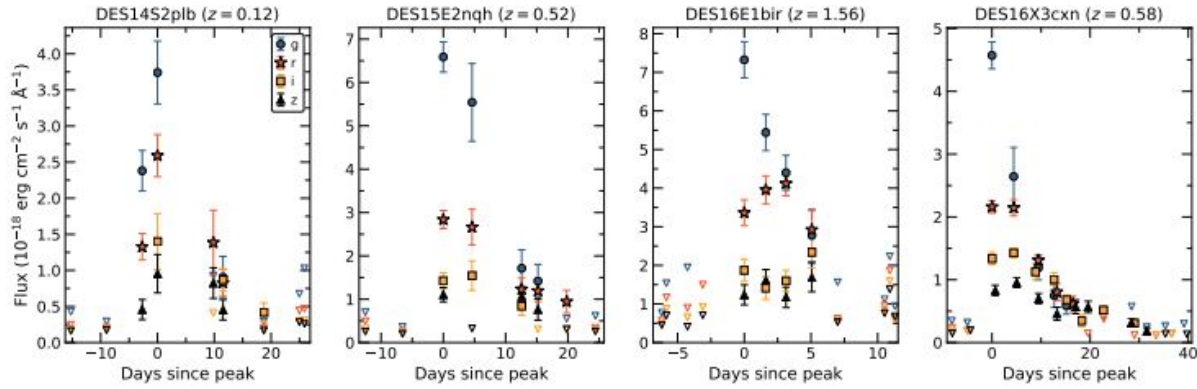
Plot Generated 12-Jan-2022

# The Supernova Zoo

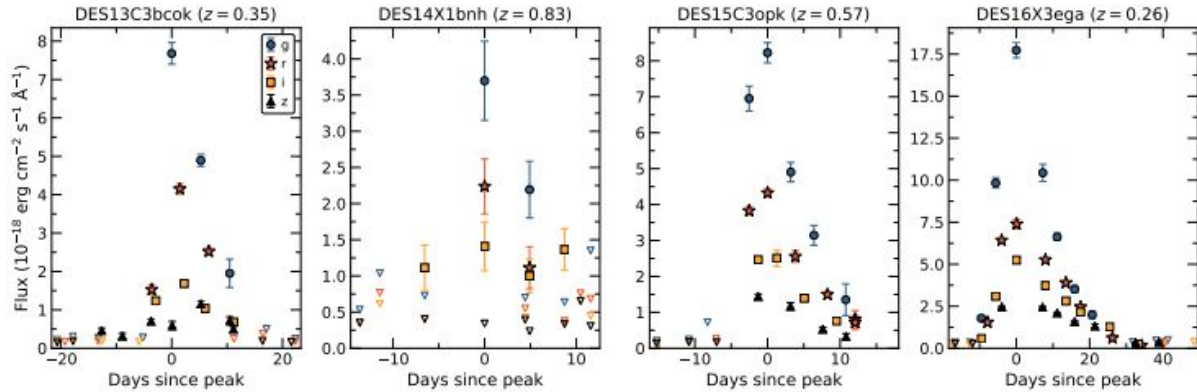


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# Rapidly evolving transients



**Figure 4.** Rest frame light curves since peak in  $g$  band of four gold sample transients. Open triangles represent  $1\sigma$  error of data points below  $3\sigma$  detection.



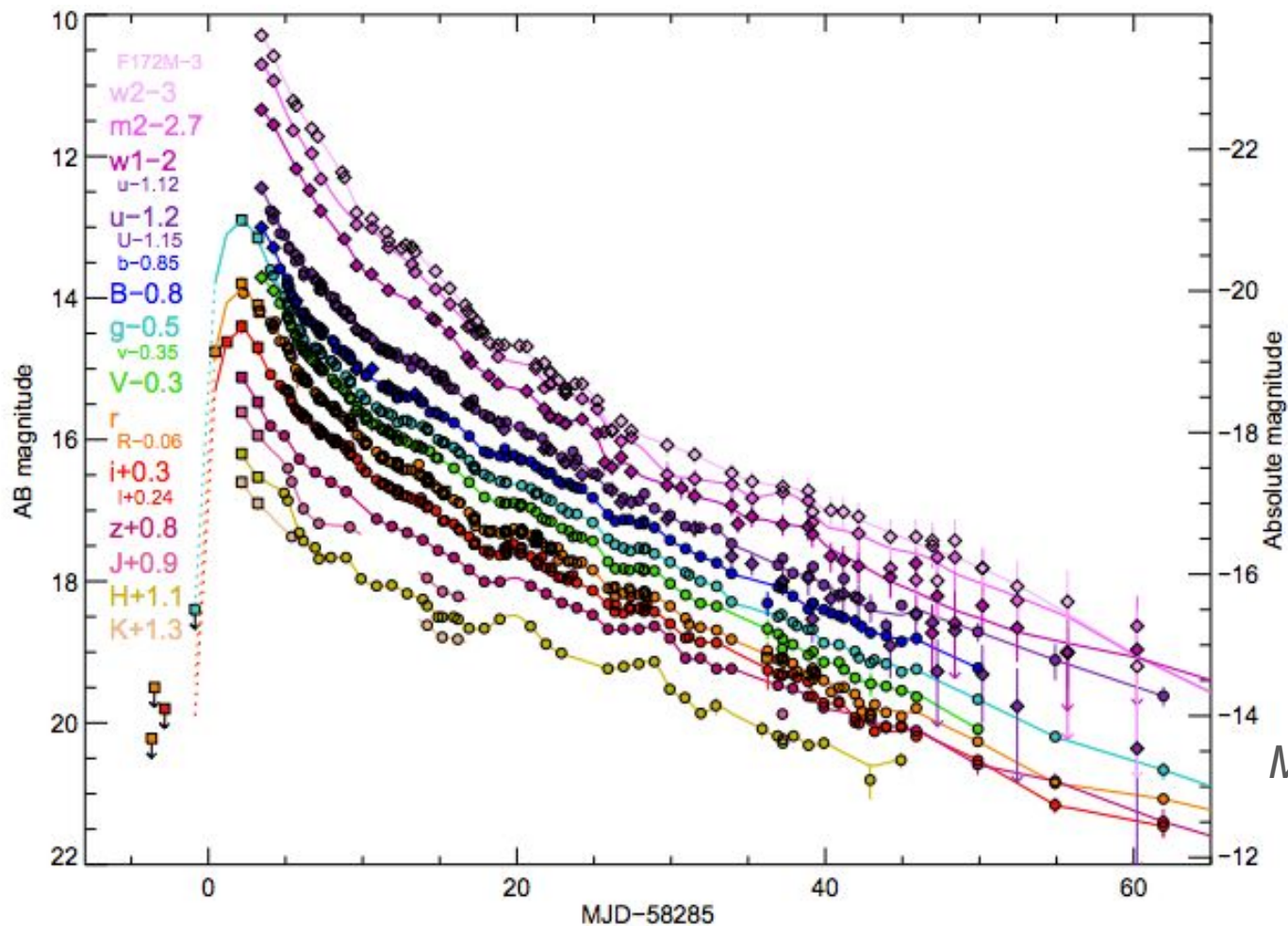
# AT 2018cow (ATLAS18qqn)



at CGCG 137-068 ( $z = 0.014$ ,  $d \sim 60$  Mpc)

Perley et al. 2018  
Prentice et al. 2019  
Ho et al. 2019  
Margutti et al. 2019

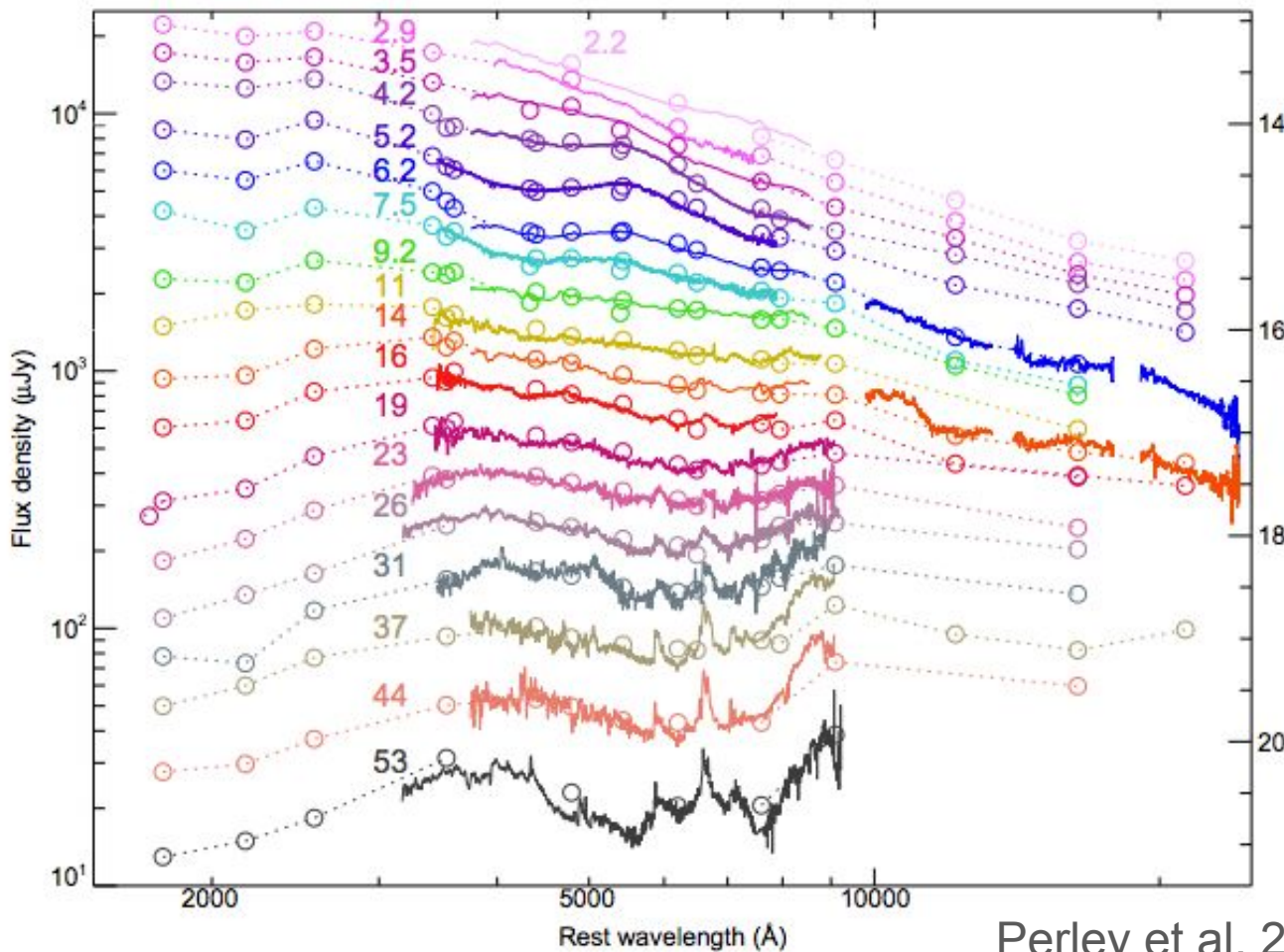
# Light curves



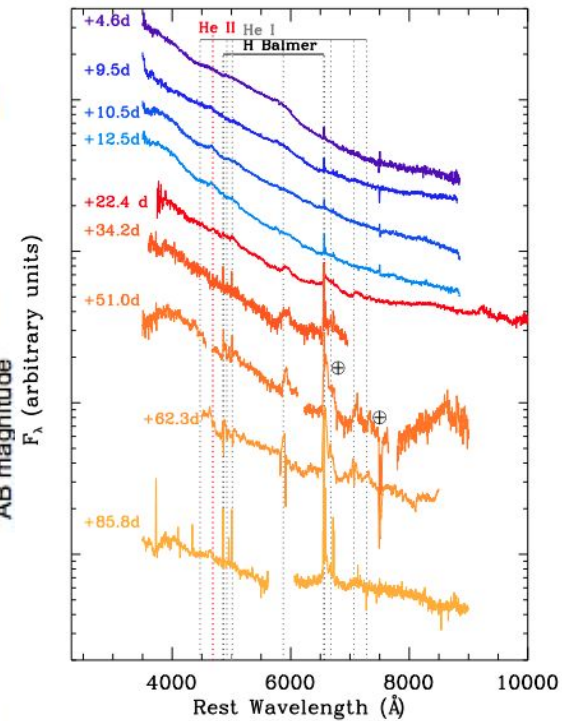
$$L \sim t^{-2.5}$$

$$M_{\text{Ni}} < 0.04 M_{\text{Sun}}$$

# Spectroscopic evolution



Perley et al. 2018



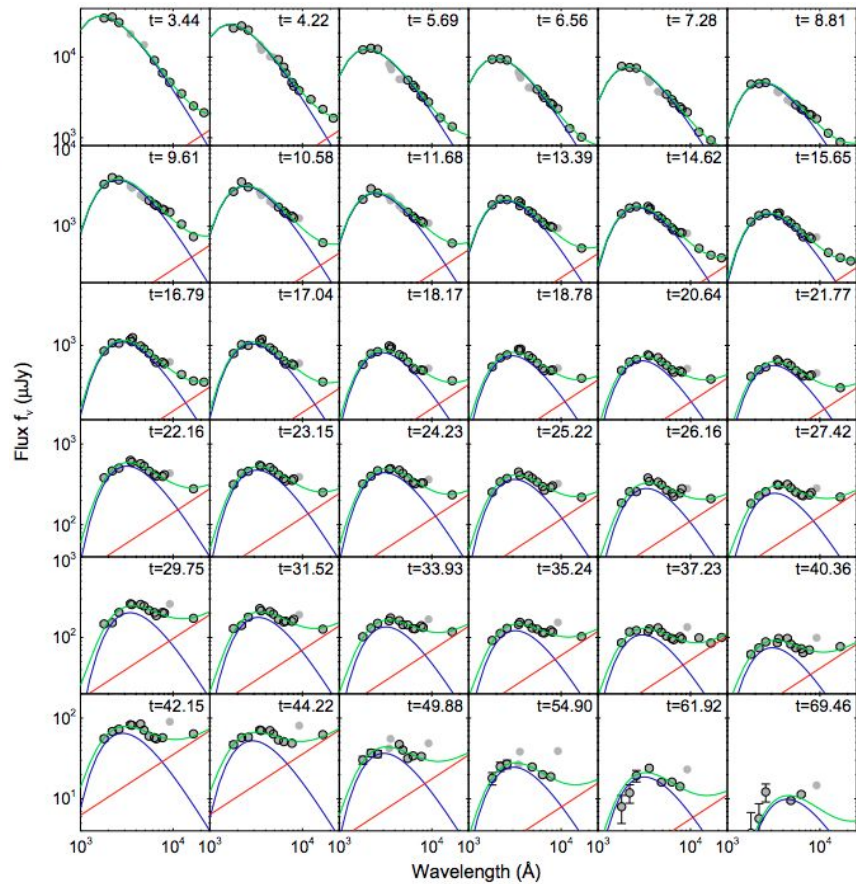
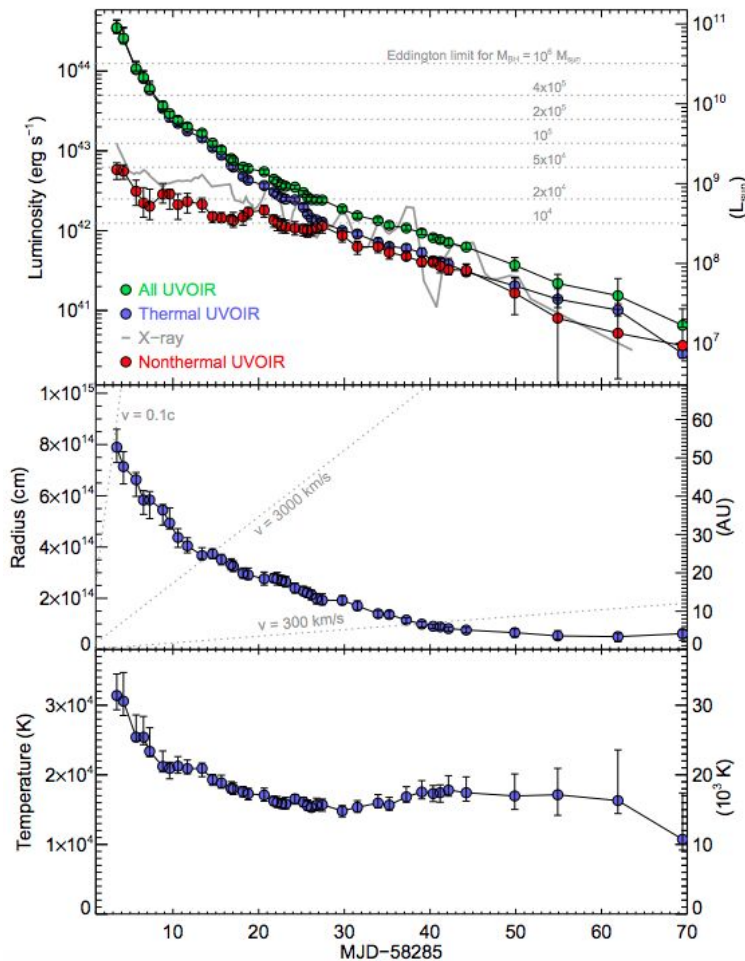
Margutti et al. 2019

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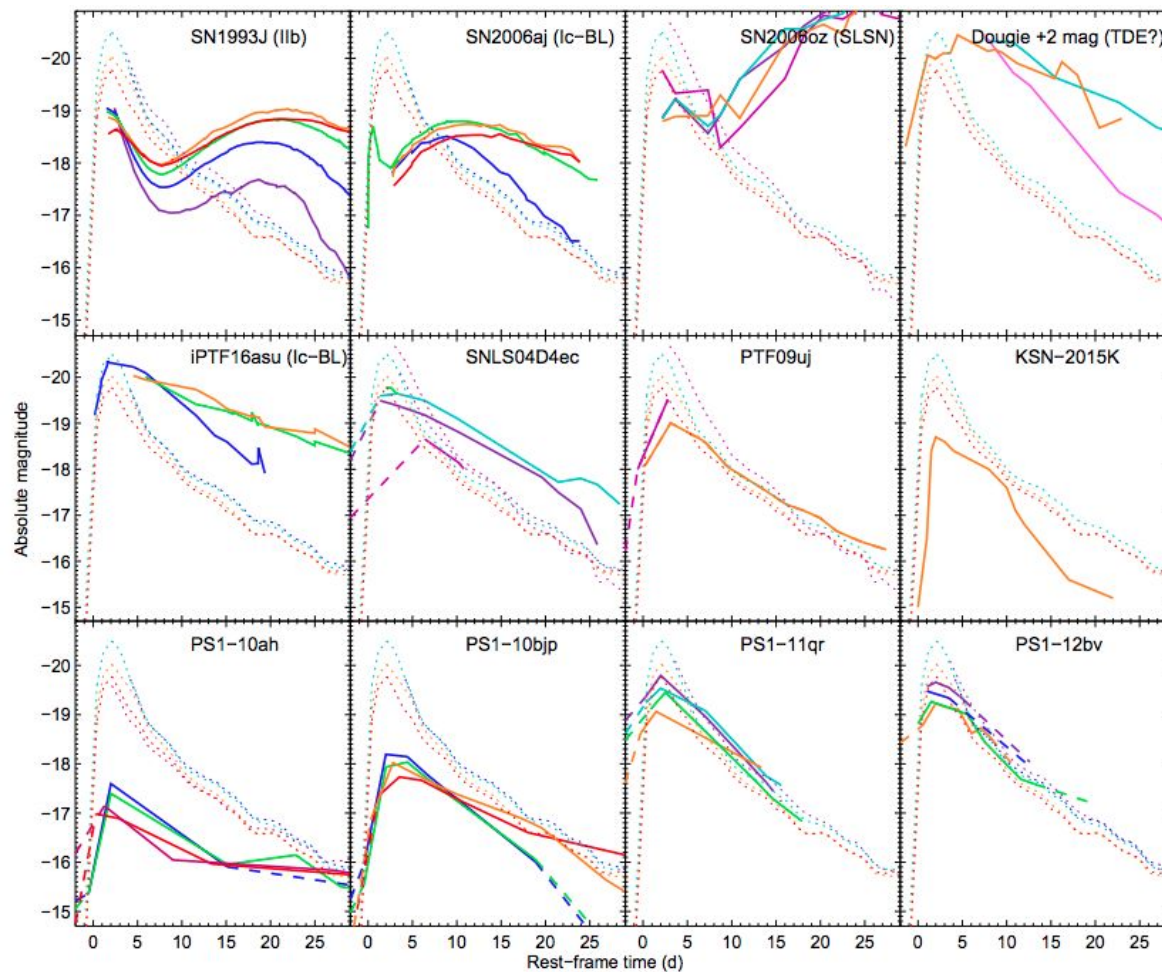


# SED and BB evolution

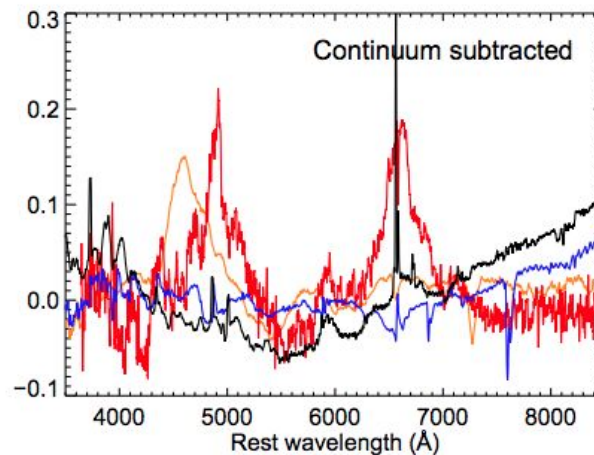
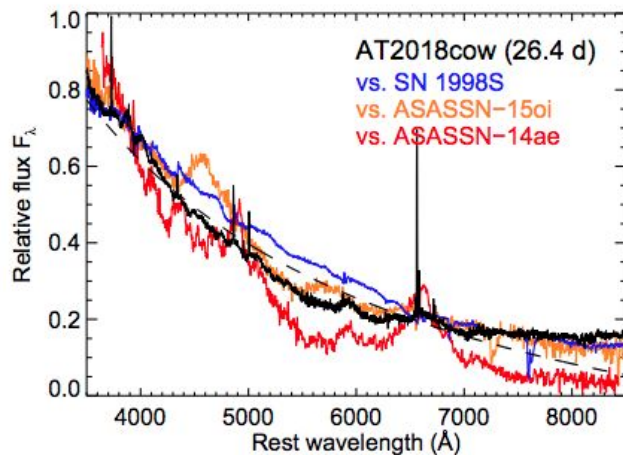
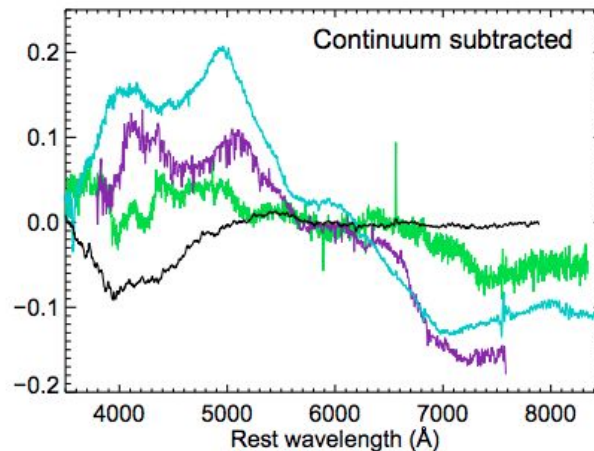
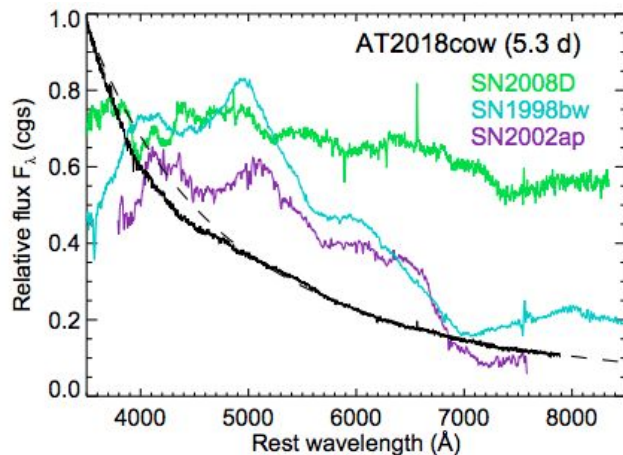
BB+ $v^{-0.75}$



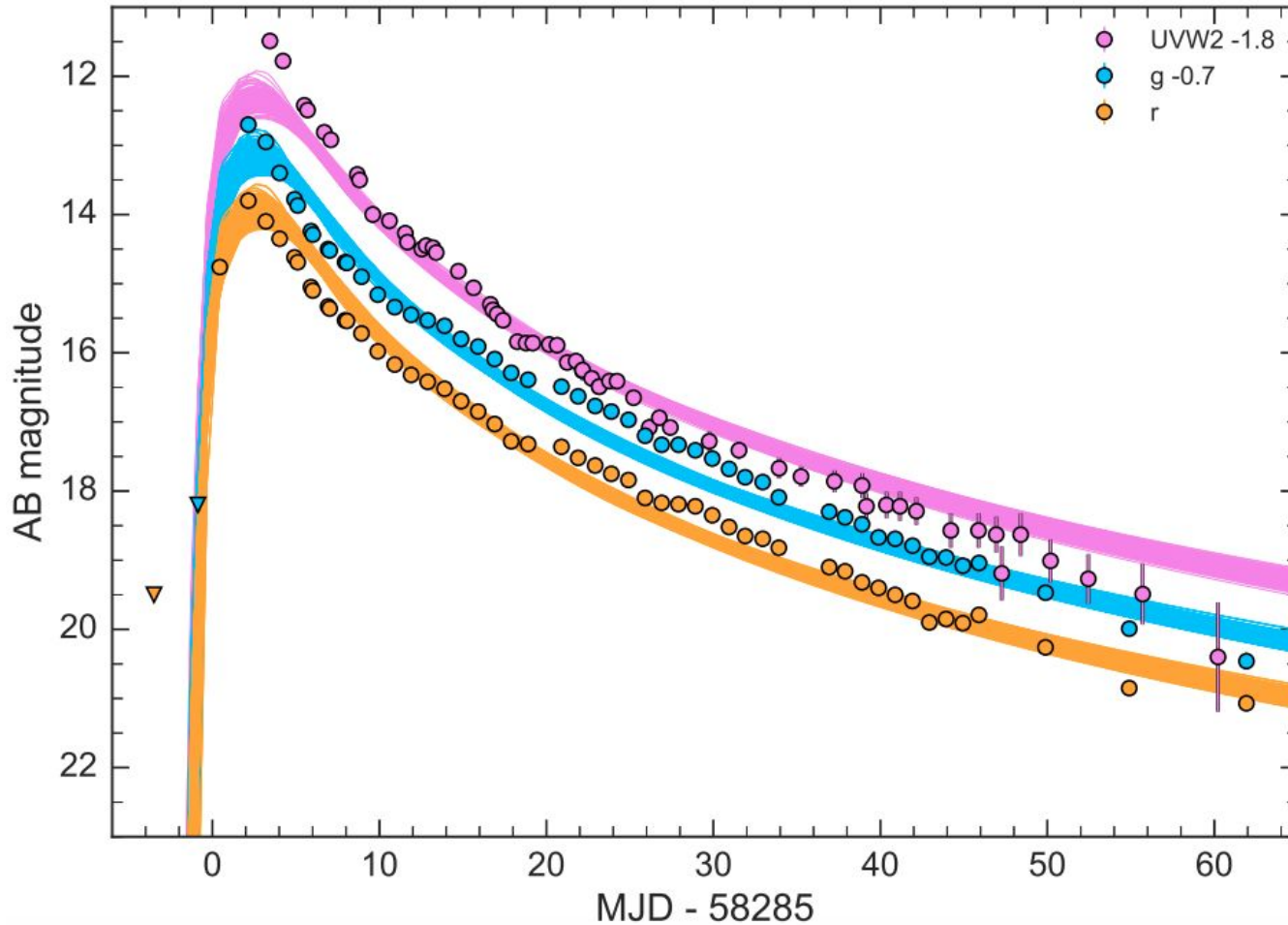
# Comparison with other transient



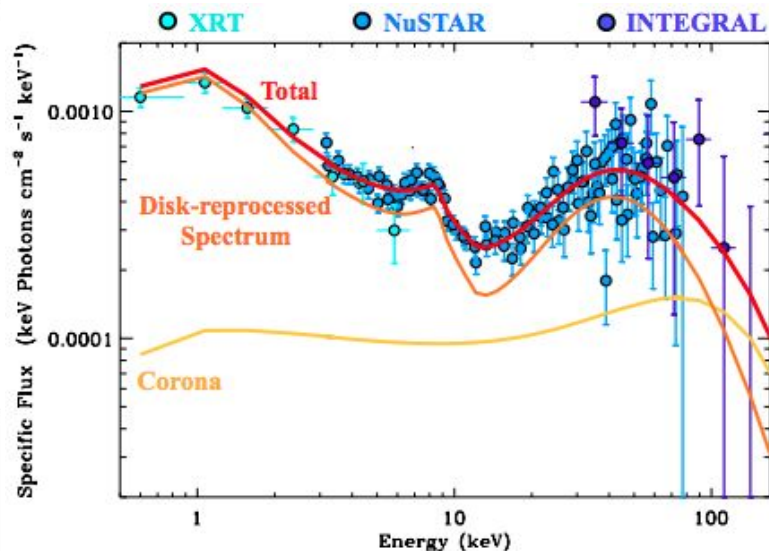
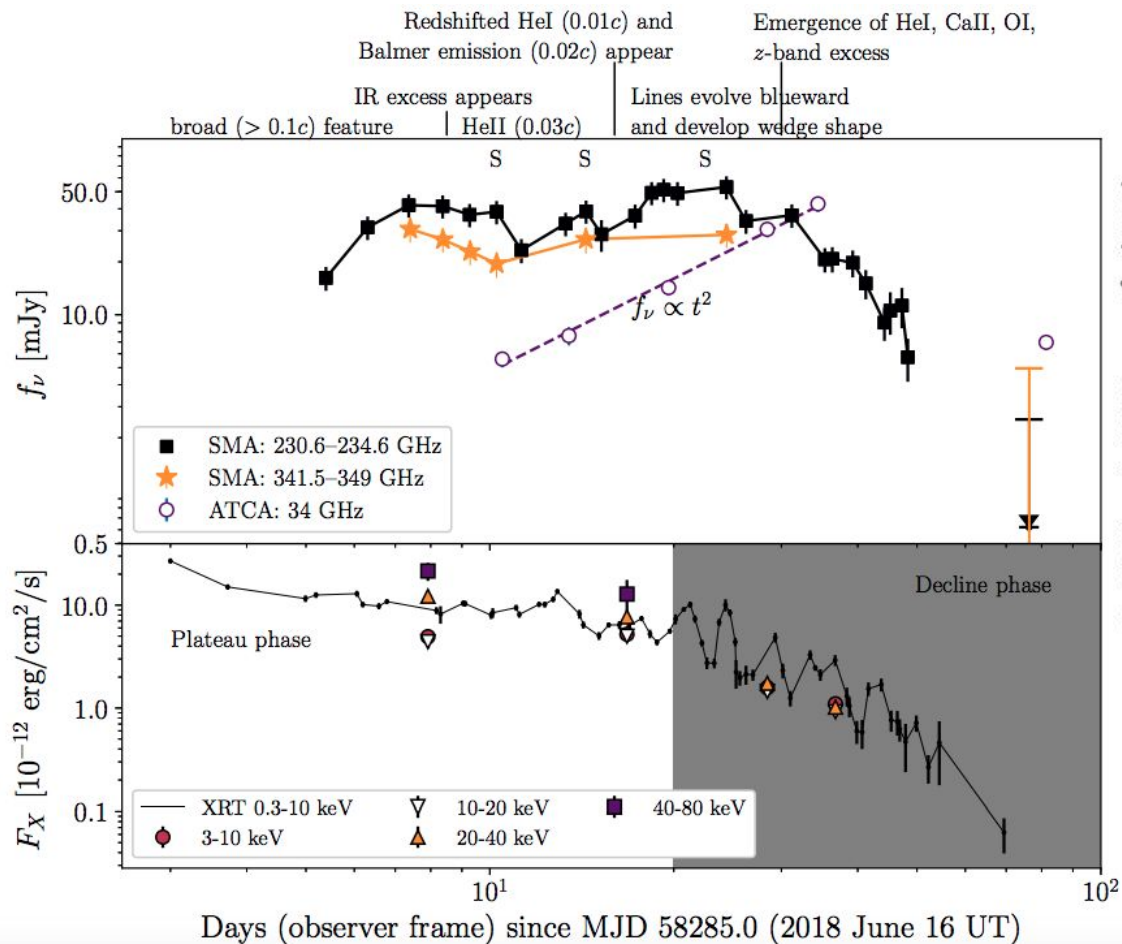
# Comparison with other transient



# TDE by IMBH ?

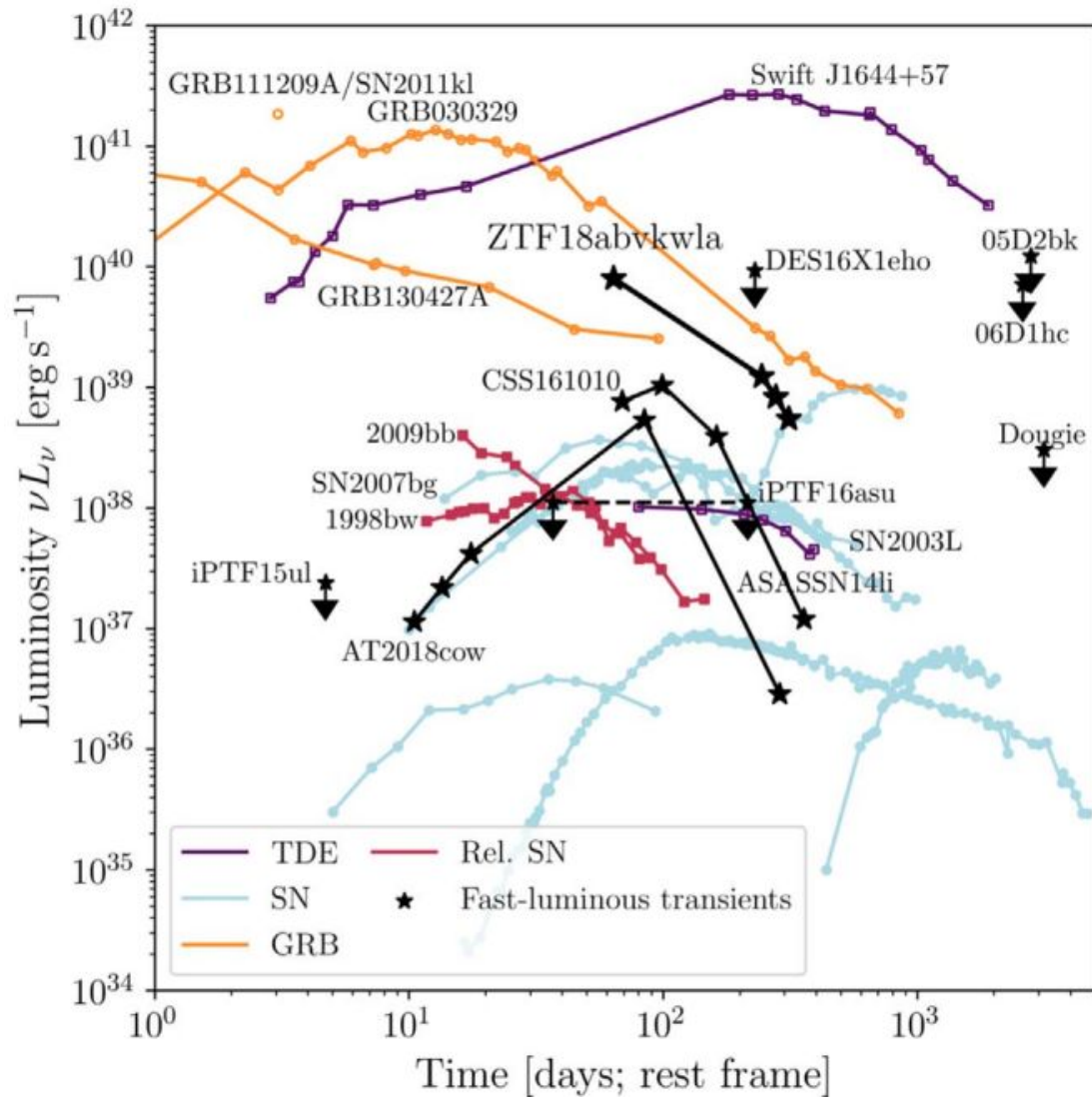


# X-ray and radio observation

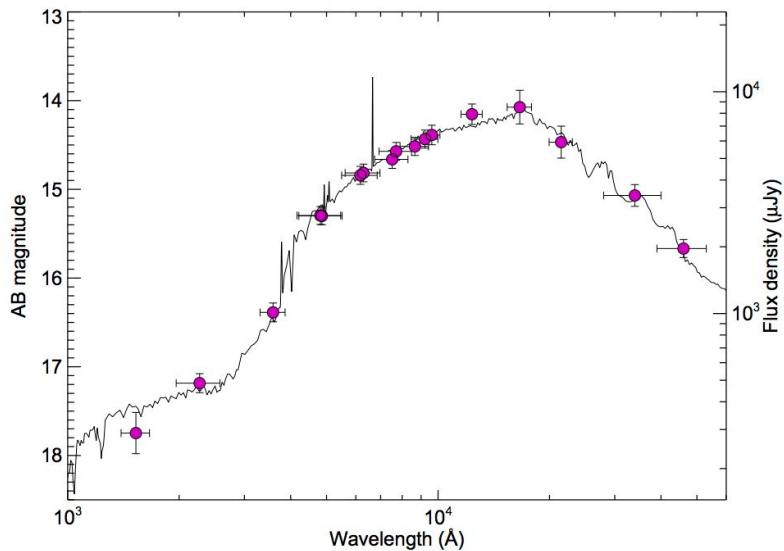


Margutti et al. 2019

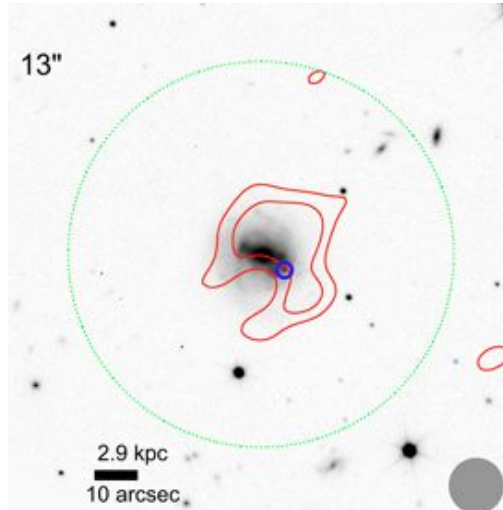
# 10 GHz



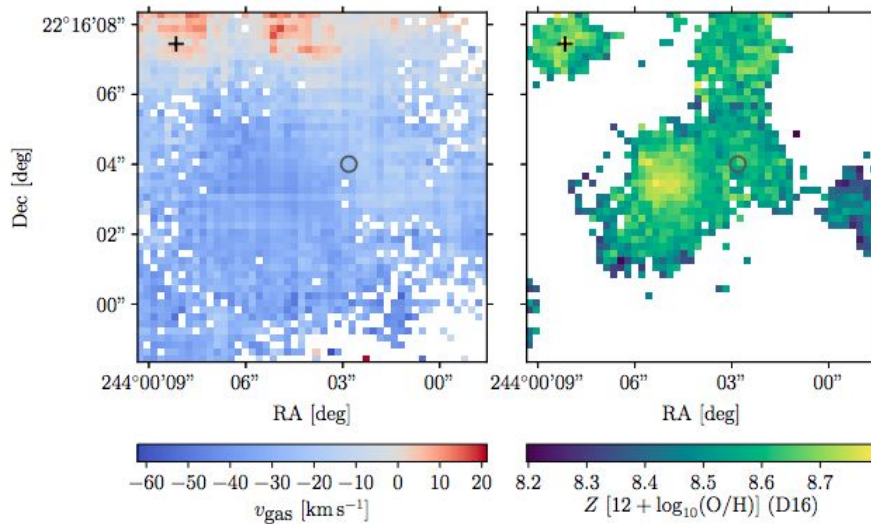
# Host properties



Perley et al. 2018

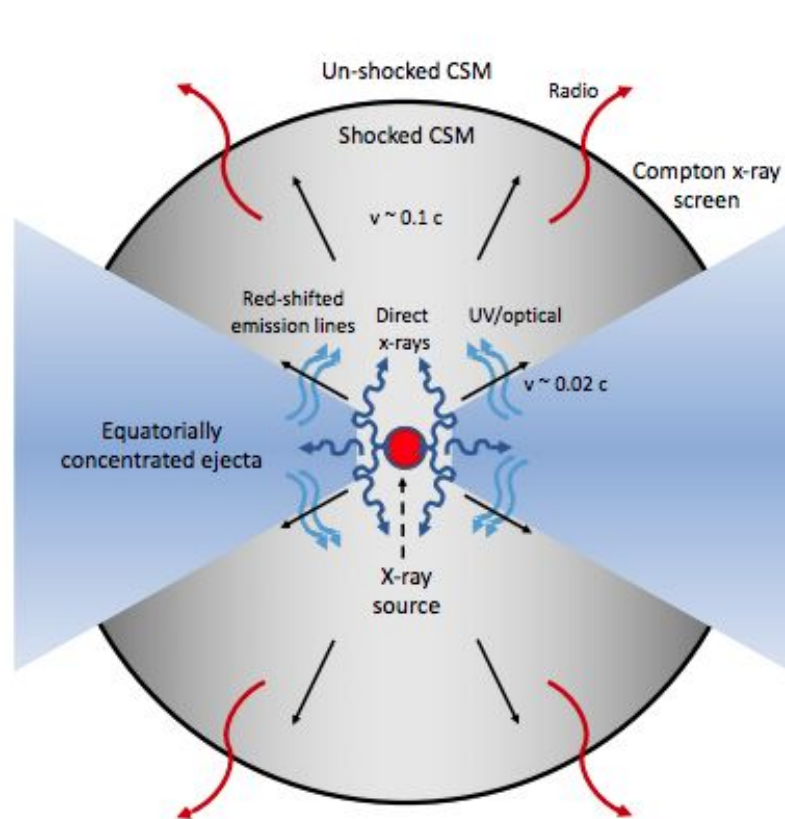
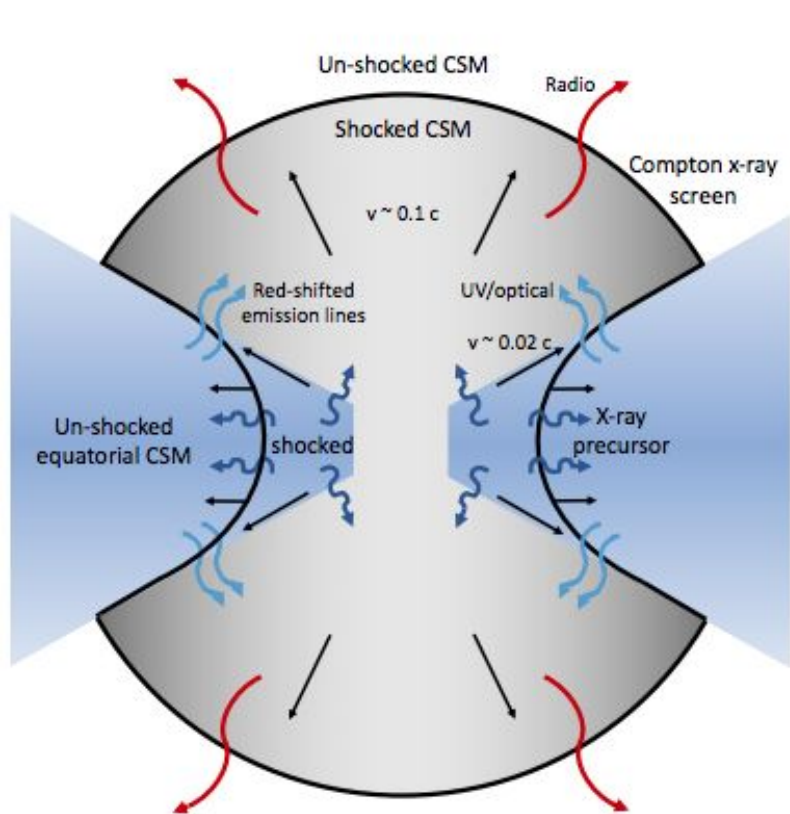


Michałowski et al. 2019



Lyman et al. 2020

# Compact central





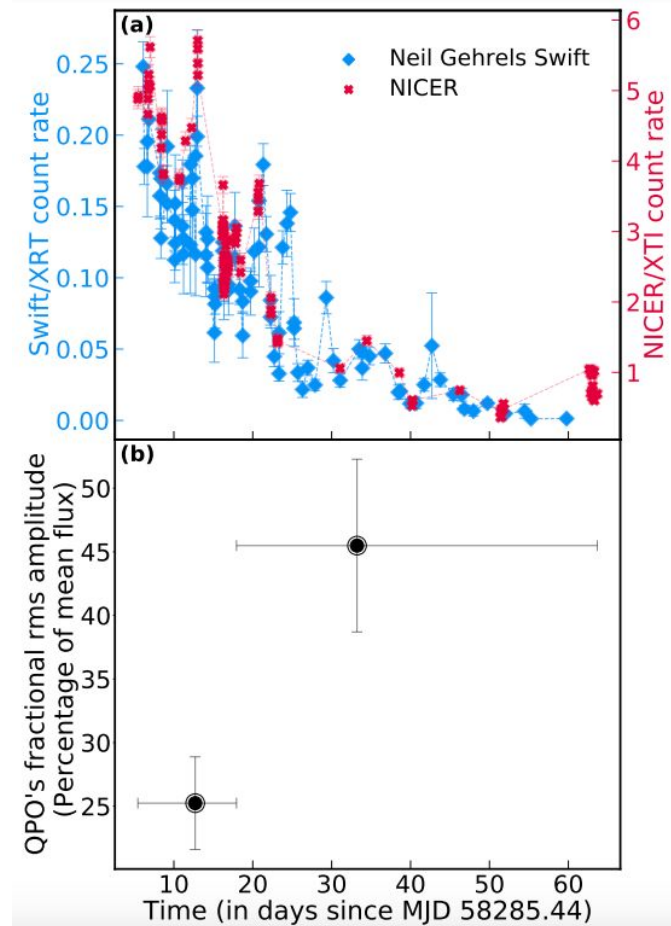
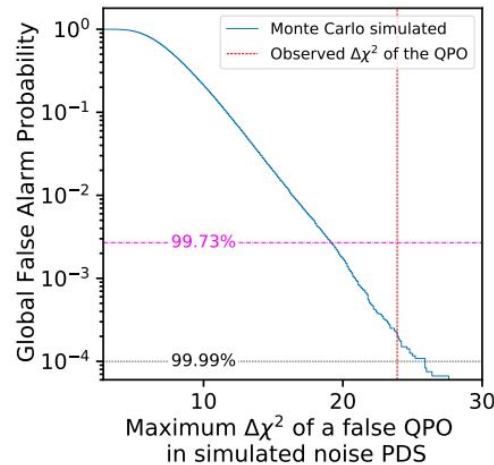
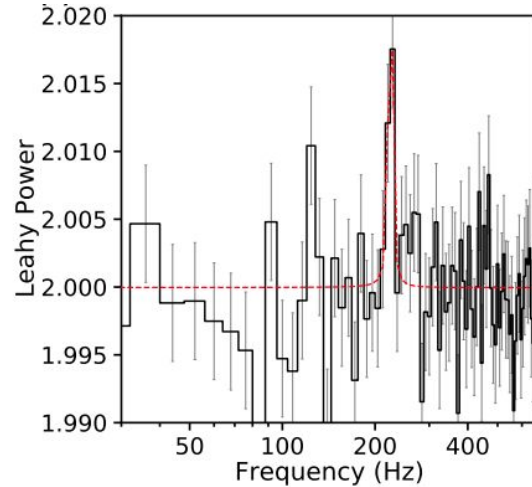
# Evidence of compact object

QPO  $\sim 224$  Hz (4.4 ms)  
in NICER data

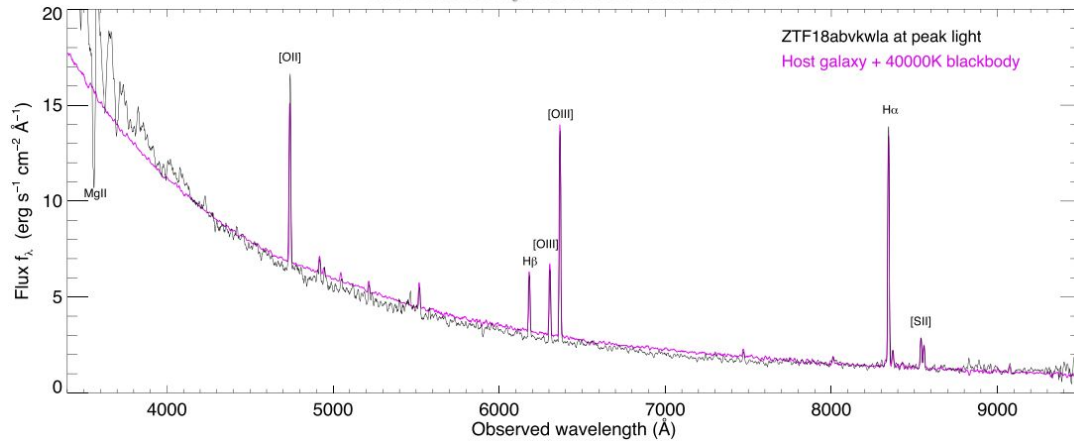
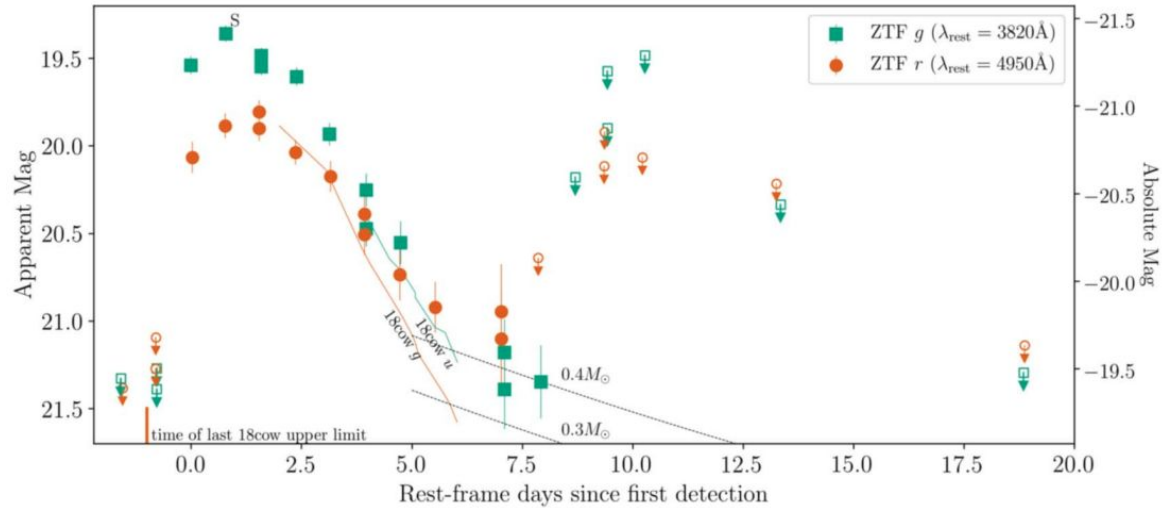
Excluded contamination  
of other source base on  
XMMS and Swift images

Suggests presence BH  
( $M < 850 M_{\text{Sun}}$ ) or NS

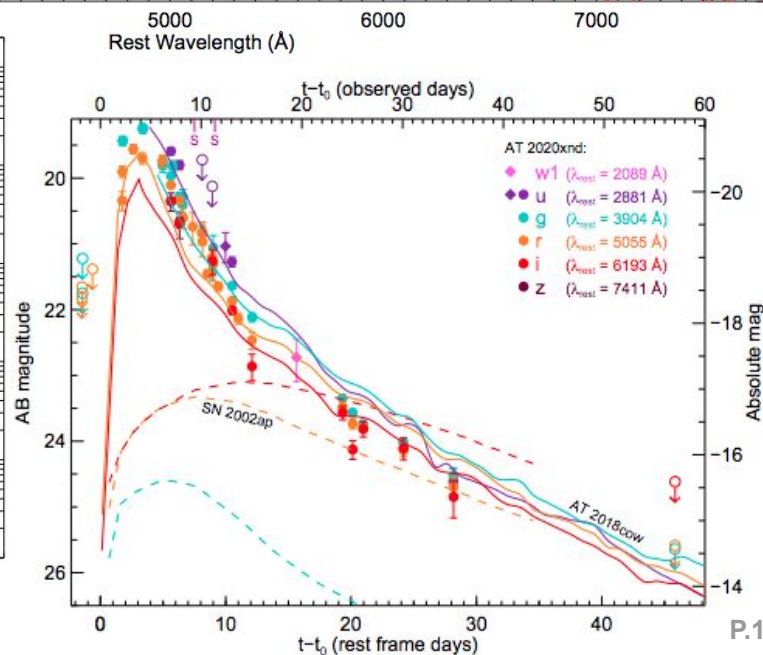
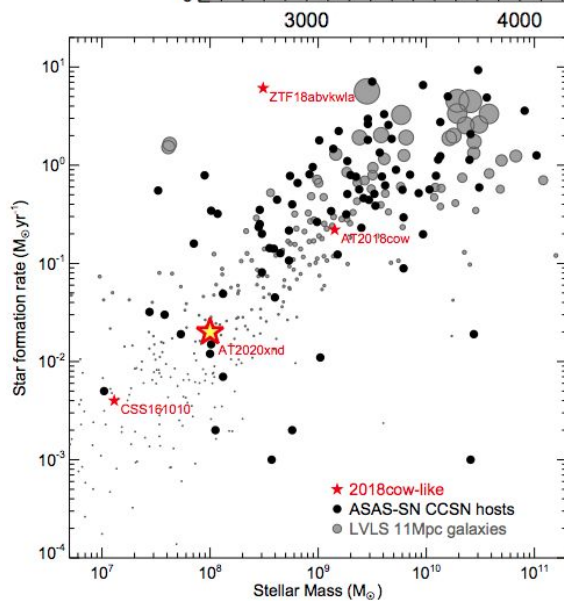
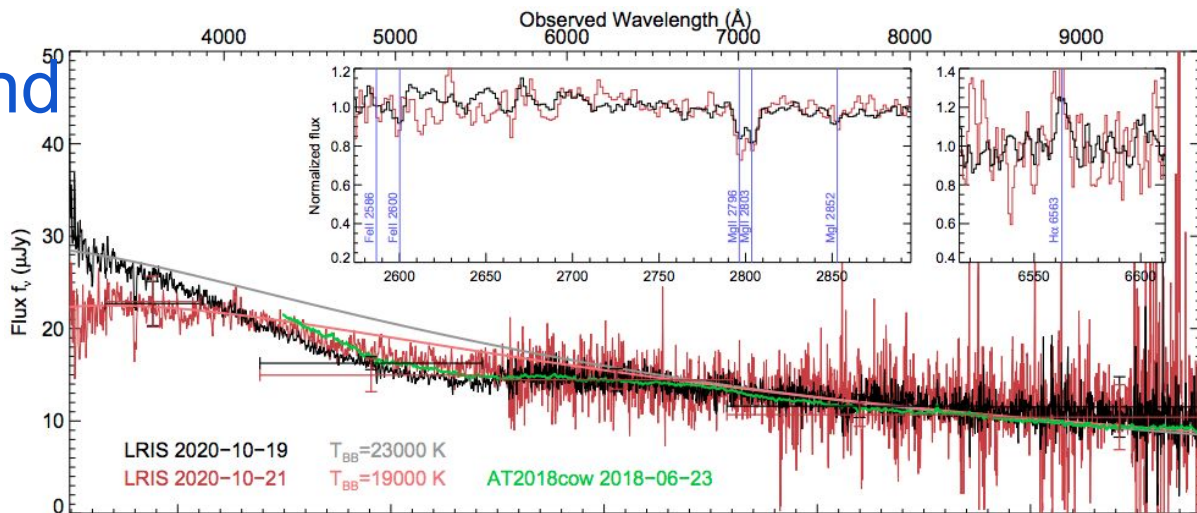
Discussed few possible  
scenarios



# KOALA: AT2018fug, ZTF18abvkwla



# CAMEL:AT2020xnd ZTF20acigmel



Perley et al. 2021

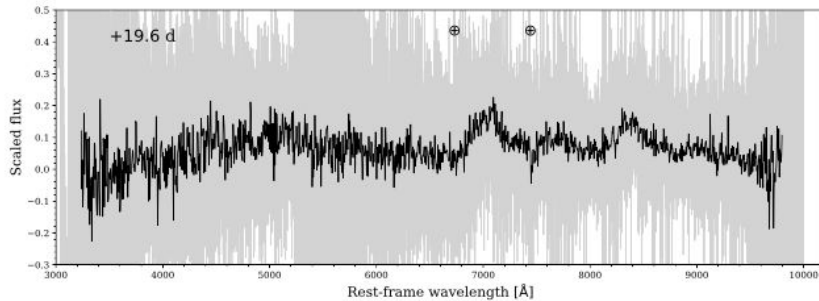
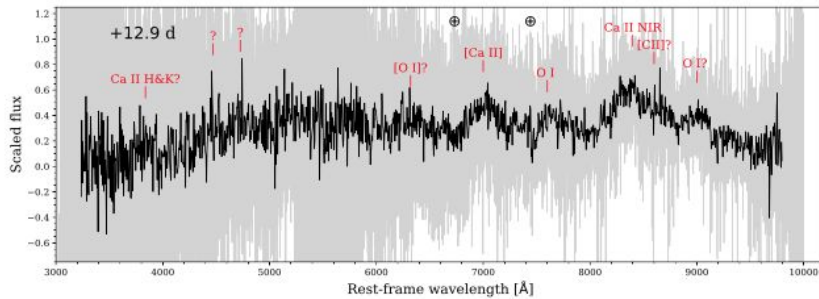
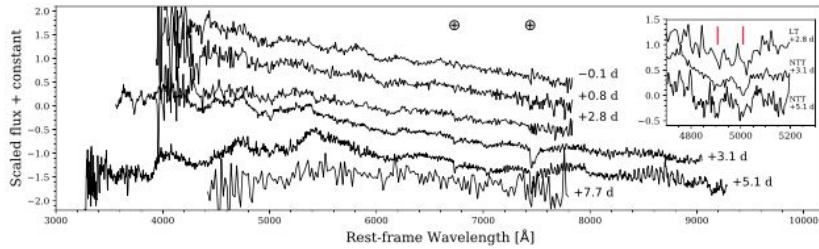
# Summary

**Table 2.** Central X-ray “Engine” Models for AT 2018cow

Model	Ejecta Mass/Velocity	Engine Timescale	CSM?	He?	H?	Reference
NS-NS Merger Magnetar	X	✓	X	X	X	1
WD-NS Merger	✓	✓	X	X	X	2
IMBH TDE	✓	Maybe†	X	✓	✓	3
Stripped-Envelope SN + Magnetar/BH	✓	✓	✓	Maybe	X	4
Electron Capture SN + Magnetar	✓	✓	✓	✓	✓	5
Blue Supergiant Failed SN + BH	✓	✓	✓	✓	✓	6
SN + Embedded CSM Interaction	✓	✓	✓	✓	✓	7

Rate  $\sim 10^{-7} \text{ yr}^{-1} \text{ Mpc}^{-3}$

# SN 2019bkc

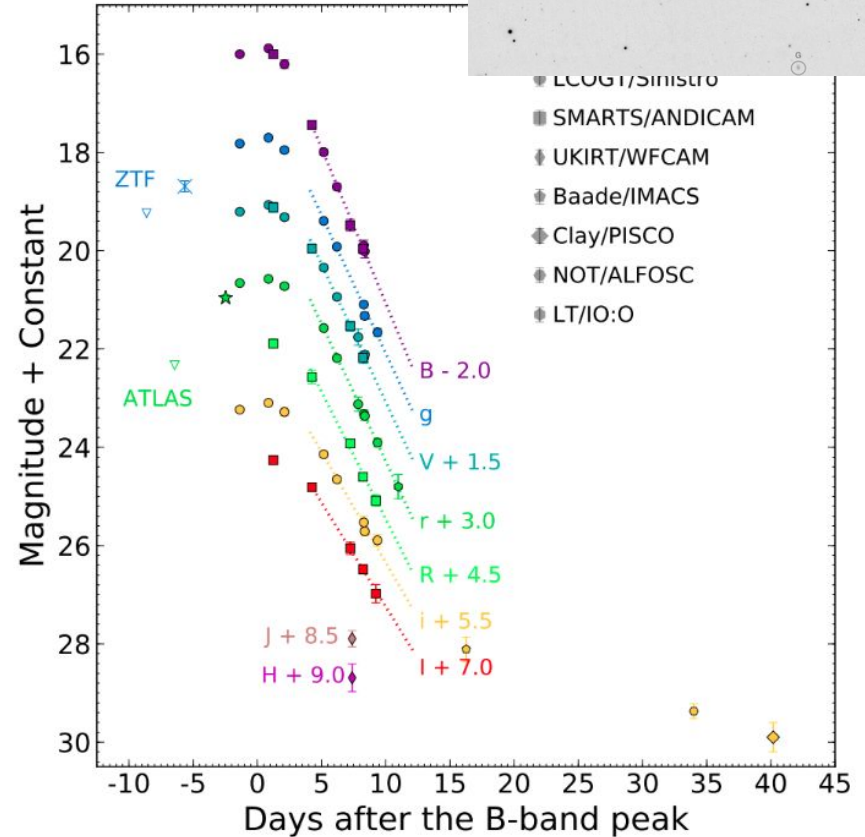
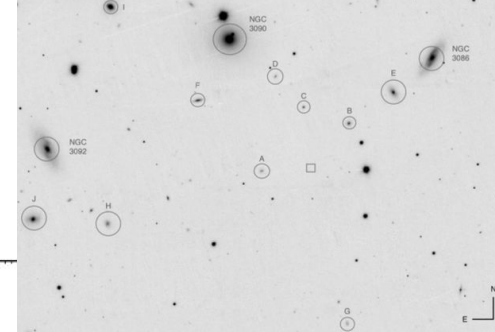


Prentice et al. 2019



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Chen et al. 2019

# SN 2018kzr

