The article:
"**The unluckiest star:** A spectroscopically confirmed repeated partial tidal disruption event AT 2022dbl"
Lin, Jiang, Wang T.G., Kong et al., 2024, ApJL, 971, L26.

AT 2022dbl : A spectroscopically confirmed repeated partial TDE

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24.10.15 @TDLI, Shanghai

Scenario of a repeated partial TDE

An unluckiest star **orbits elliptically** around a SMBH.
Every time it reaches the pericenter,
it gets partially tidal disrupted and produces a flare

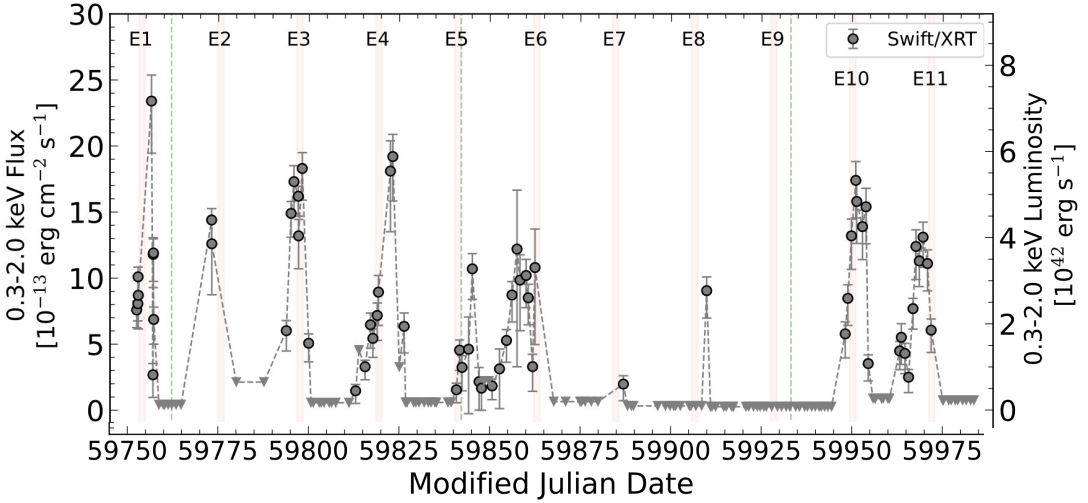
Possible mechanism for the elliptical orbit:

/ Tightly bound star
Hills mechanism (Hills 1988): Binary
\ Hyper-velocity star

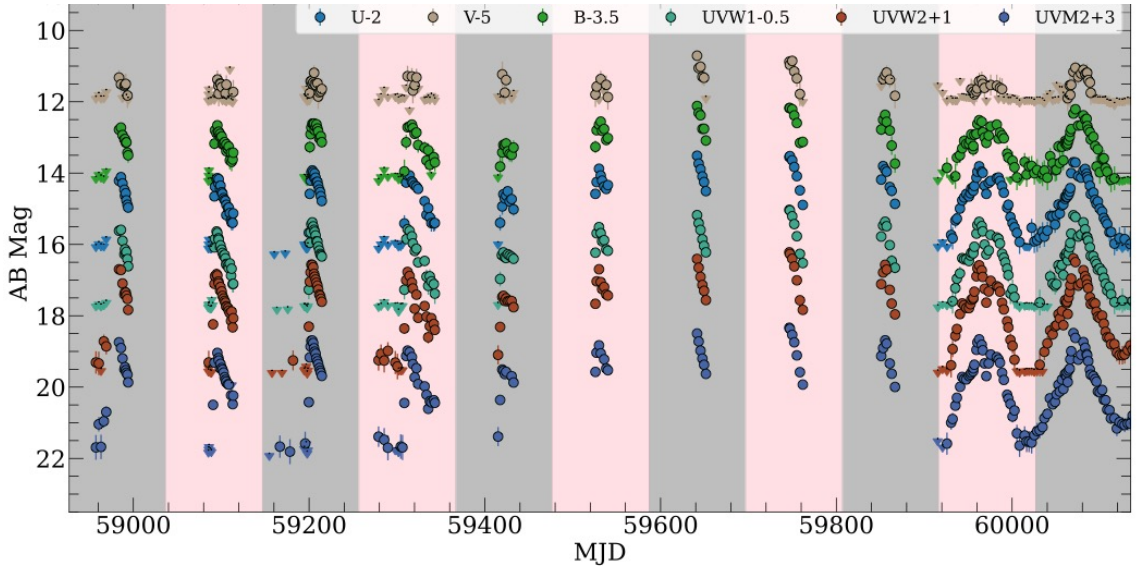
Figure: NASA

Current discoveries -
Candidates that have showed multiple flares

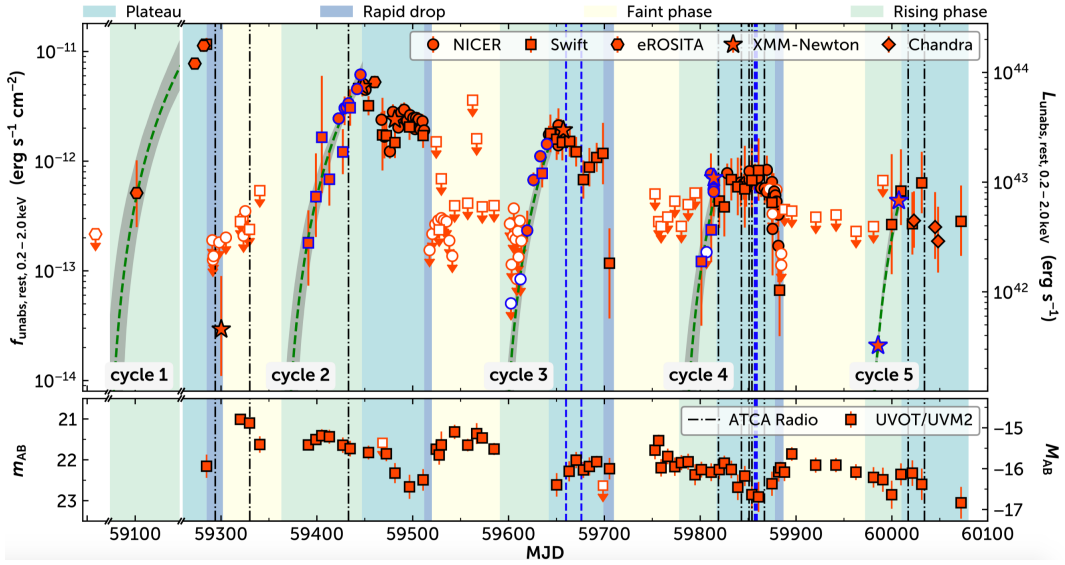
Name	Host Type	Band	Period/Interval (Days)	Flares
ASASSN-14ko[1,2,3,4]	Seyfert 2	Opt./UV/X-ray†	115.2	∼30
Swift J023017.0+283603[5,6]	Weak AGN	X-ray	∼22	∼11
eRASSt J045650.3–203750[7,8]	Quiescent	X-ray/UV†	299→193	5
IC 3599[9,10,11,12,13]	Seyfert 1.9	X-ray/Opt.*	∼3470?	2/3
AT2018fyk[14,15,16]	Quiescent	UV/X-ray	∼1200	2
RX J133157.6-324319.7[17,18]	Quiescent	X-ray	∼10000	2
AT 2020vdq[19,20,21]	E+A	Opt./UV*/X-ray*	∼870	2
AT 2022dbl[22]	QBS	Opt./UV	∼710	2



Swift J0230 (Figure: Guolo+2024)



ASASSN-14ko (Figure: Huang S.+2023)



eRASSt J0456 (Figure: Liu Z.+2024)

Current discoveries -
Candidates that have showed two optical-UV flares

Name	Host Type	Band	Period/Interval (Days)	Flares
ASASSN-14ko[1,2,3,4]	Seyfert 2	Opt./UV/X-ray†	115.2	∼30
Swift J023017.0+283603[5,6]	Weak AGN	X-ray	∼22	∼11
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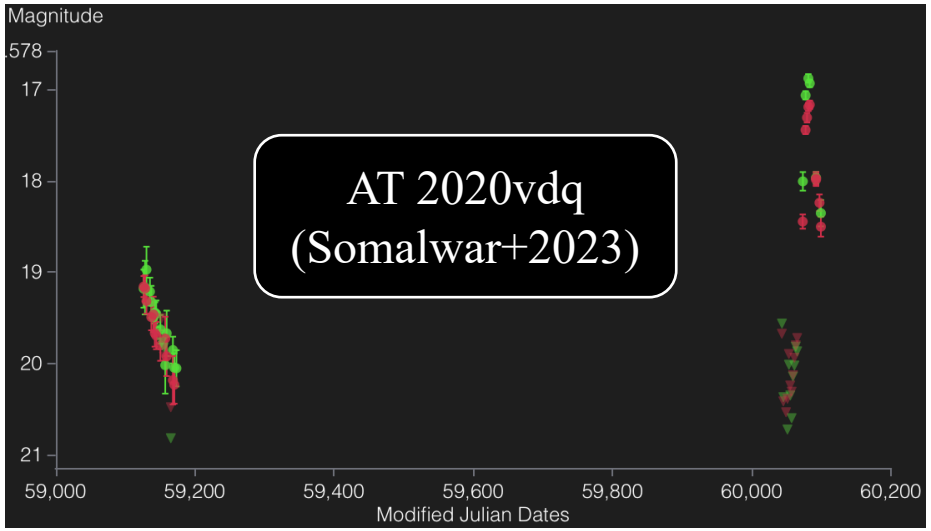
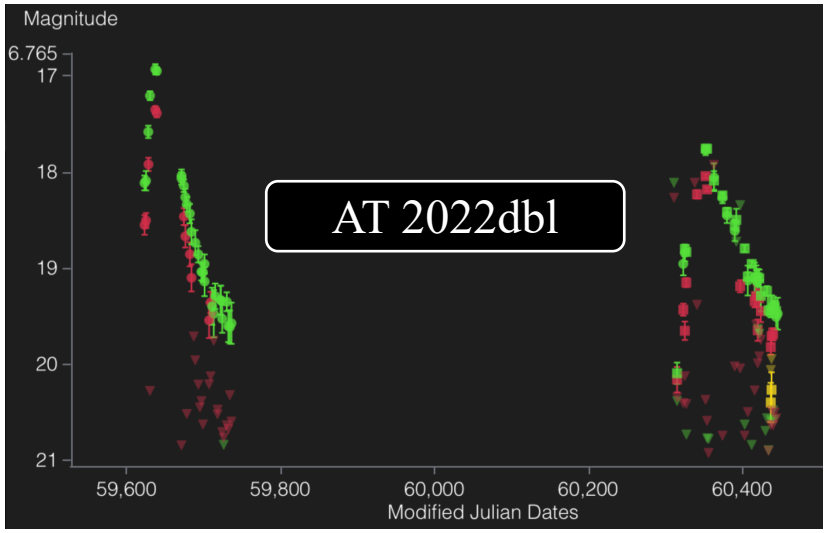
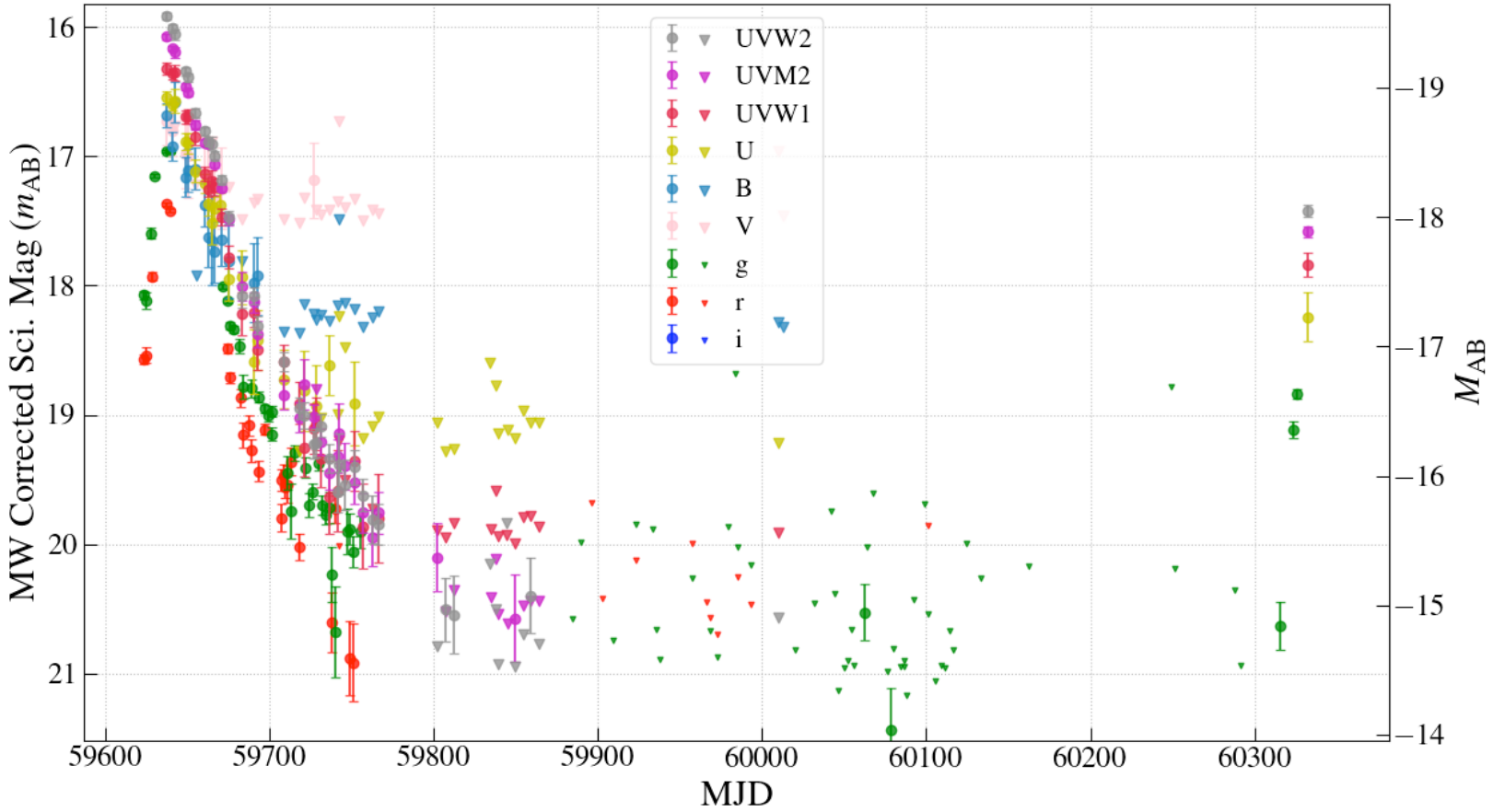


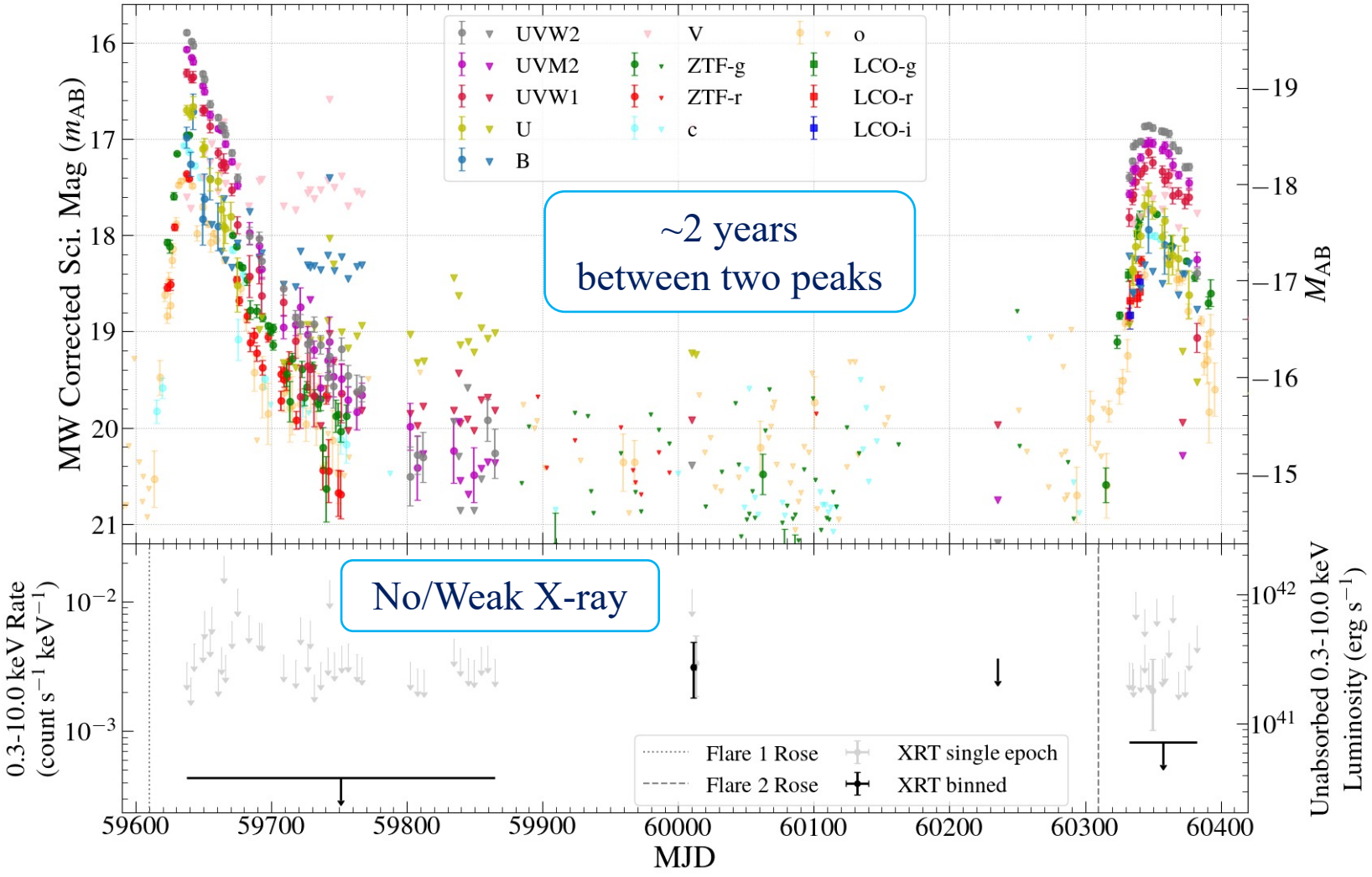


AT 2022dbl

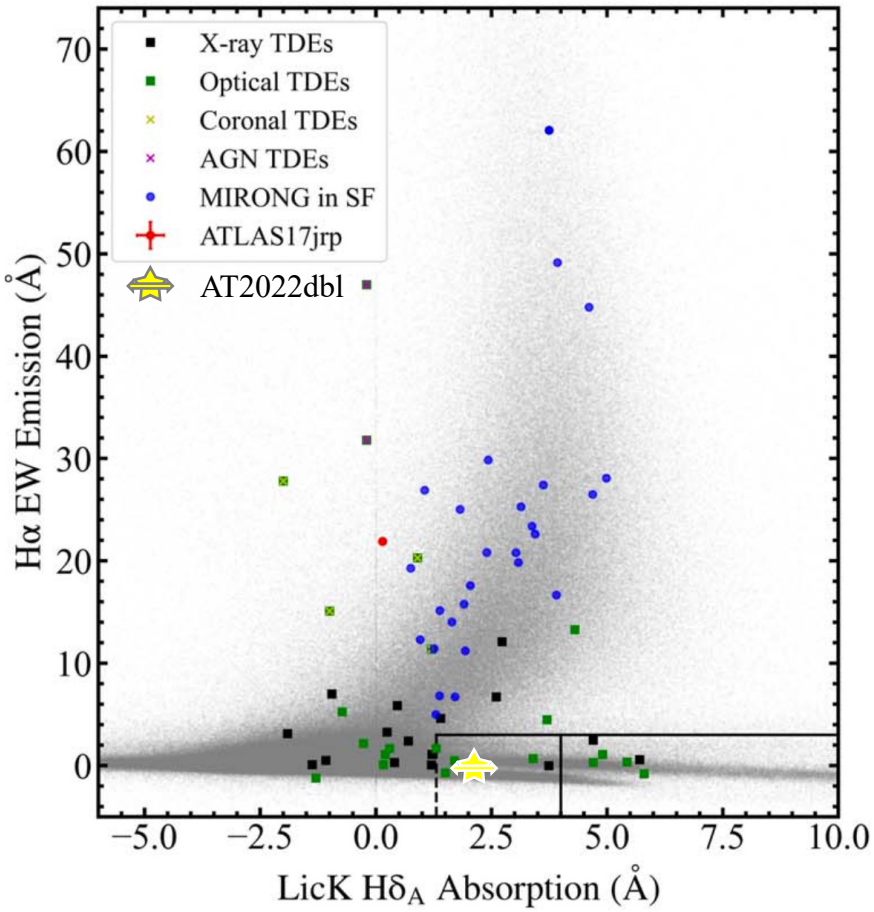
Jan 2024: Discover rebrightening, apply for daily-cadence Swift & LCO observations



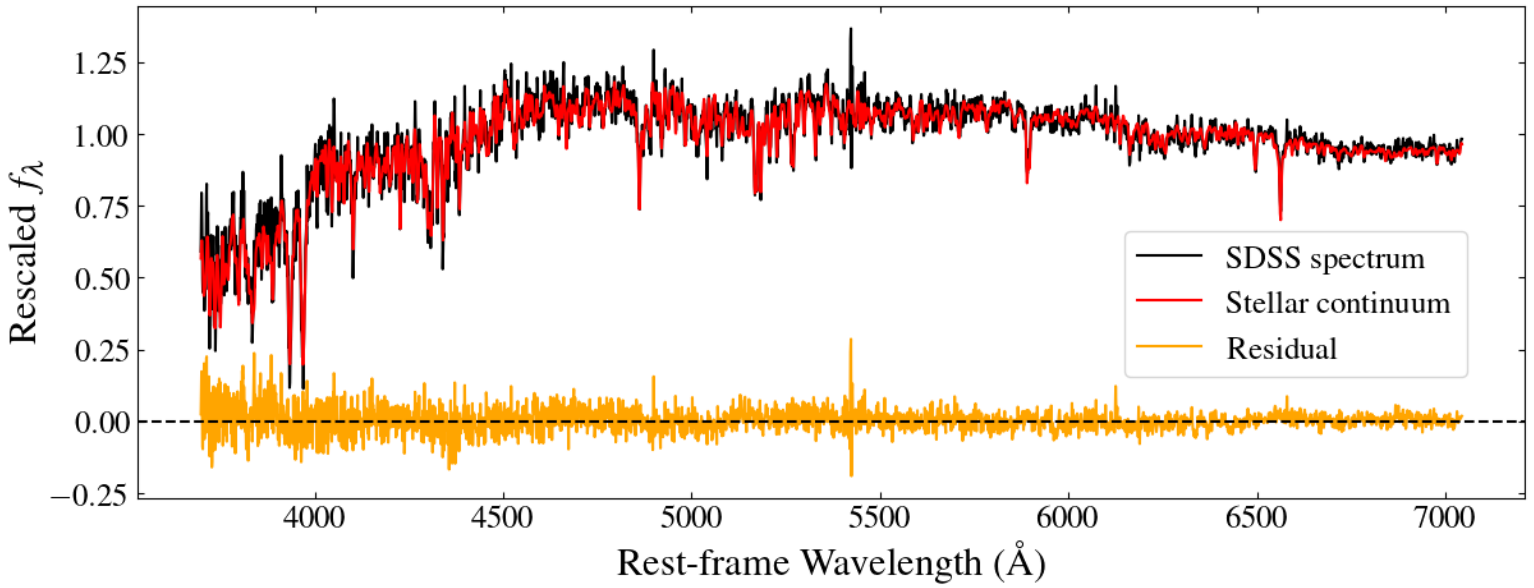
Full light curve: Optical, UV & X-ray



Typical TDE Host galaxy:
Quiescent Balmer strong galaxy, $z = 0.0284$, $\log(M_{BH,\sigma}) \sim 6.4$



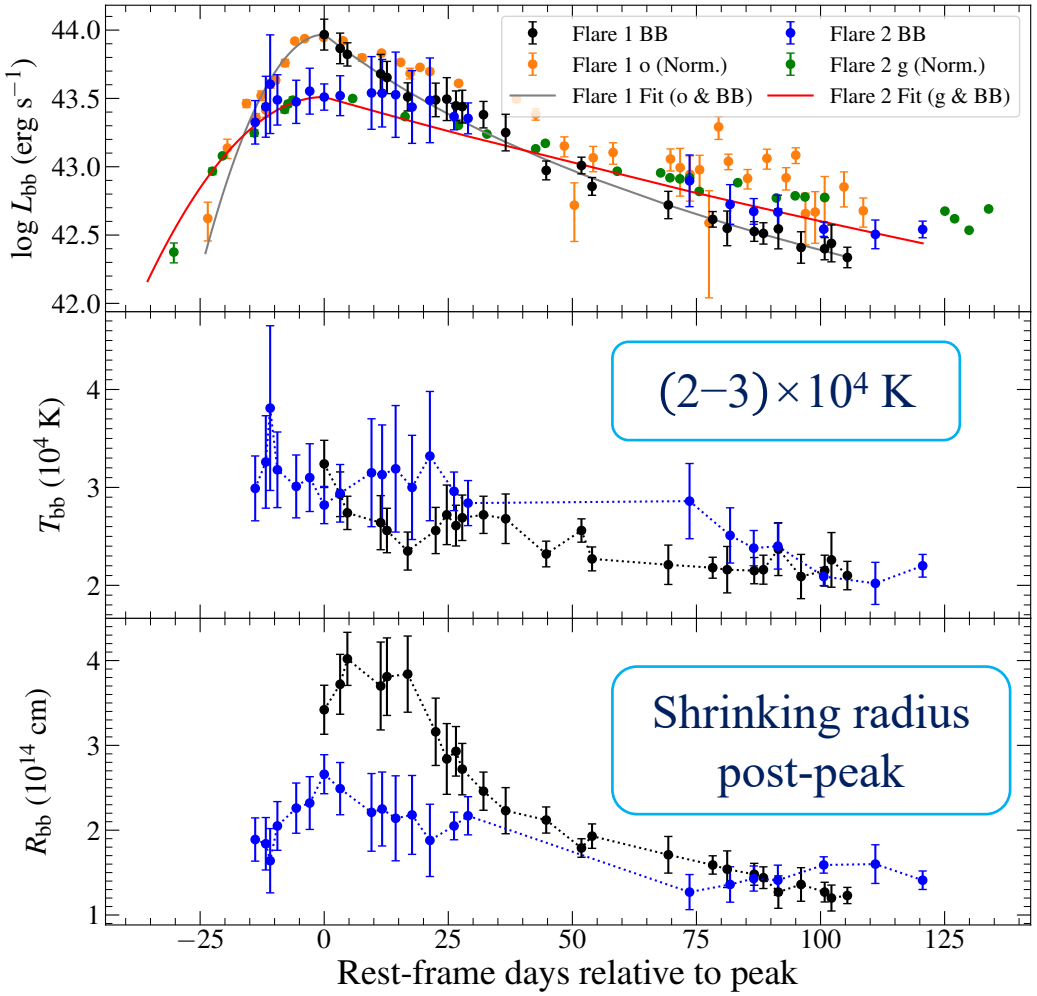
Adapted from Wang Y.+2022,
that adapted from French+2016

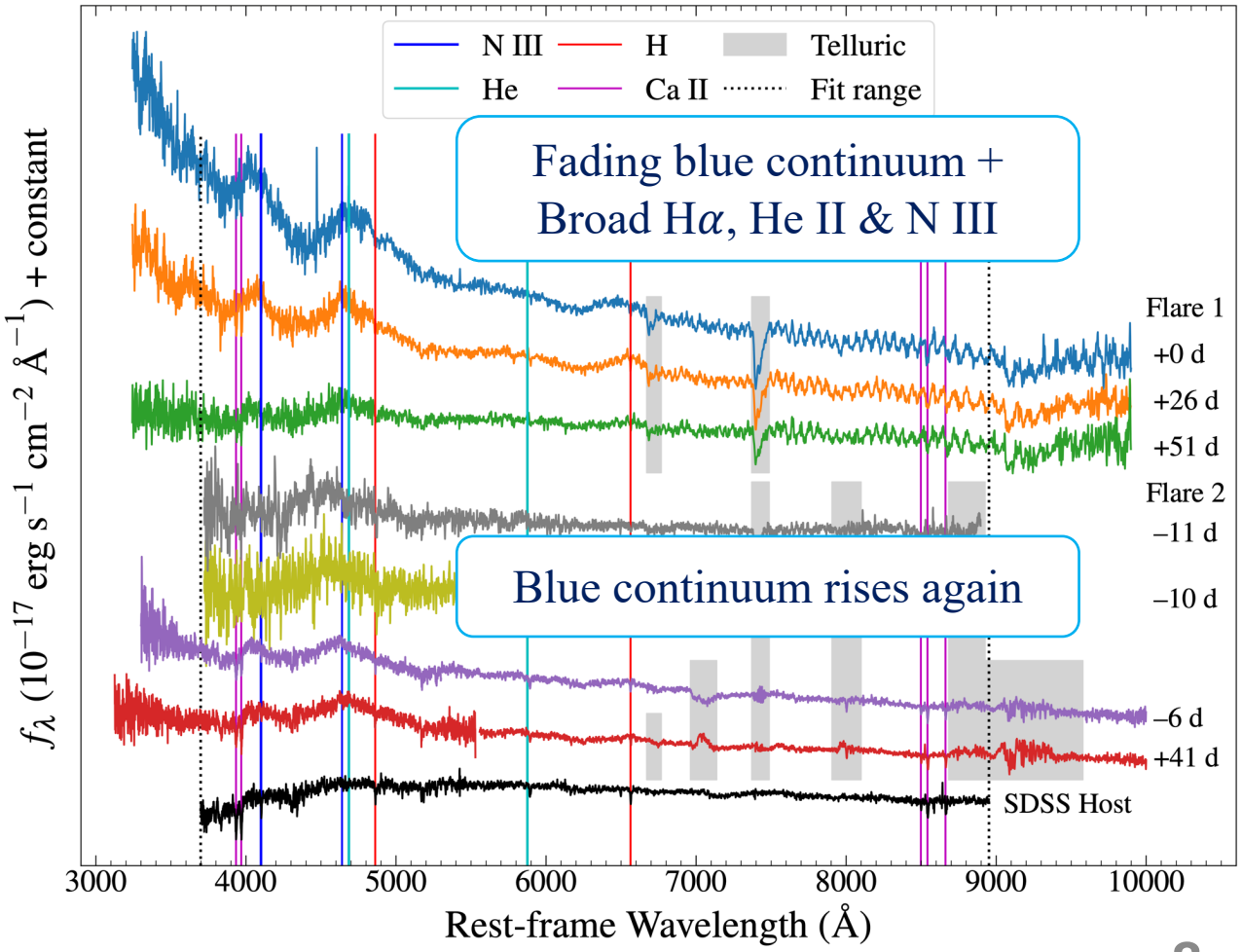


pPXF - absence of emission lines

TDE origins for both flares

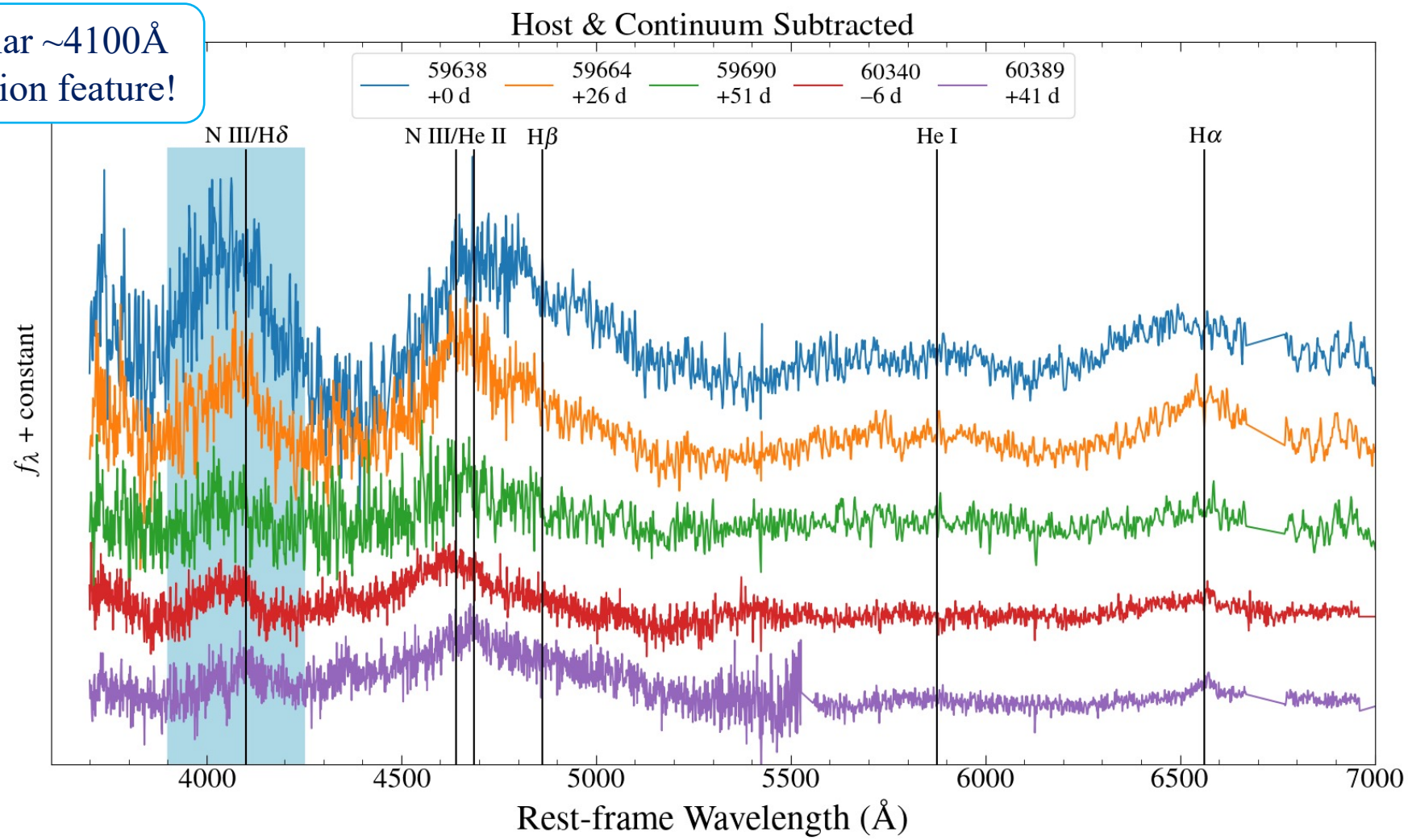
Host galaxy: Quiescent Balmer strong galaxy; **Pre-flare: lack of variability in optical & MIR**





Spectral connection between two flares

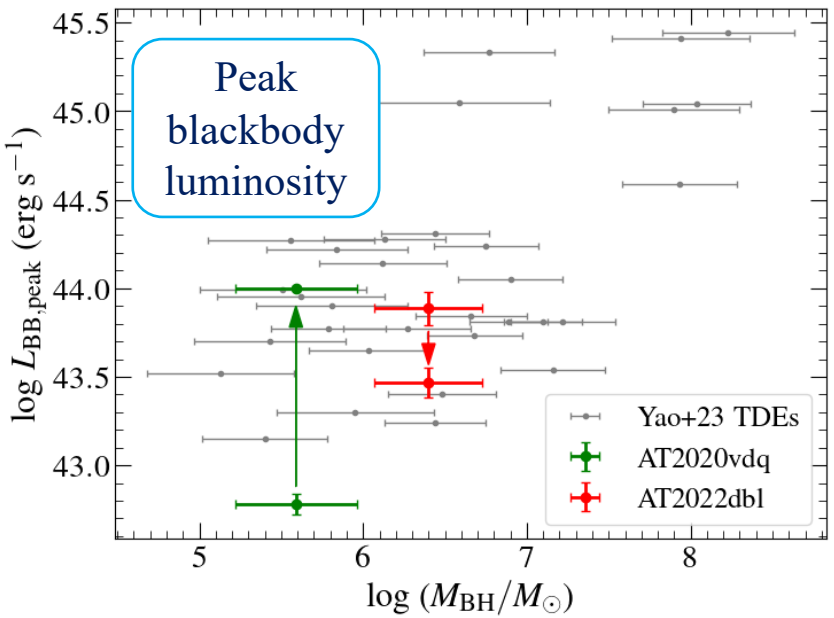
Similar ~4100Å emission feature!

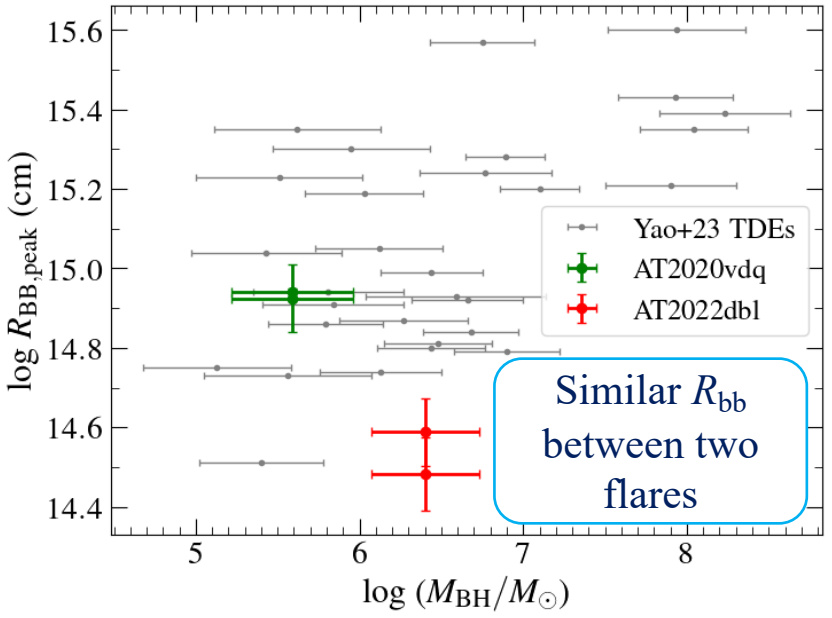


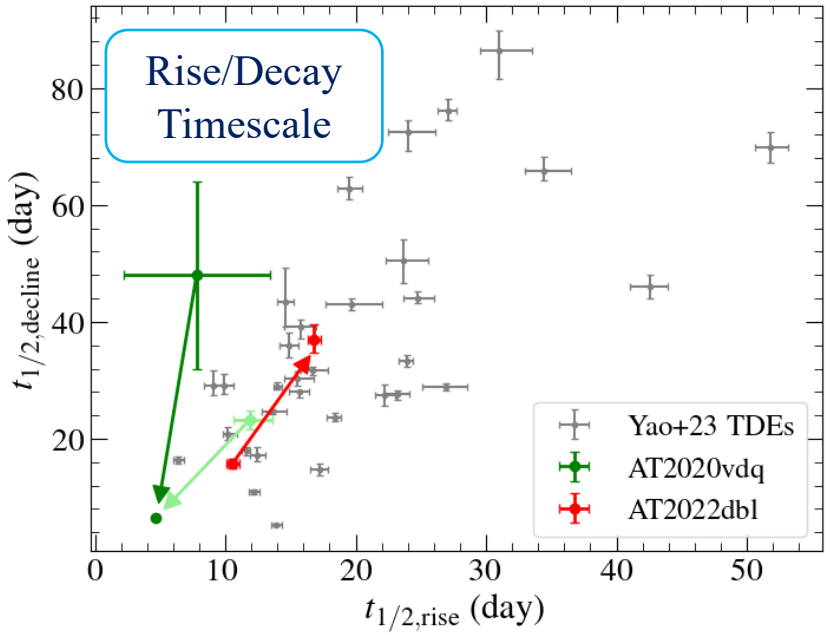
Comparison

The two flares of AT 2022dbl are both typical!

Guess: Partial TDEs can hide in the current TDE sample?







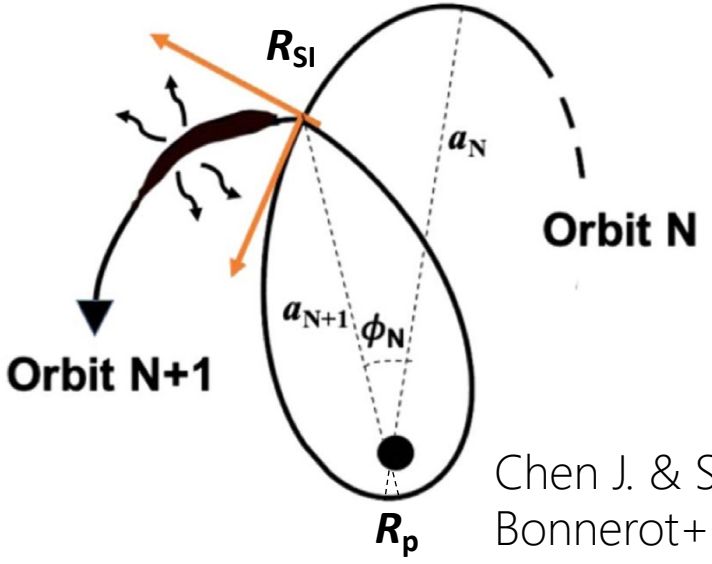
Possible studies

1. The similar peak R_{bb} between two flares:

   For AT 2022dbl: $R_p \sim 10^{13.0}$ cm; $R_{bb,peak} \sim 10^{14.5}$ cm; $a = 10^{15.5}$ cm

   For AT 2020vdq: $R_p \sim 10^{12.7}$ cm; $R_{bb,peak} \sim 10^{14.9}$ cm; $a = 10^{15.3}$ cm

   - Guess: Similar $R_{bb,peak}$ + weak X-ray - Self-intersection at similar radius R_{SI}?



Chen J. & Shen R. 2021
Bonnerot+2017

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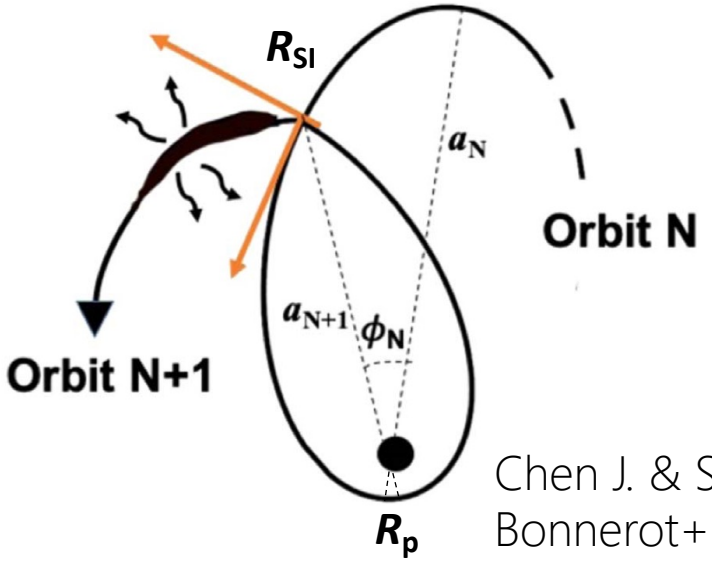
2. The rise of the third flare in ~2 years? 👀



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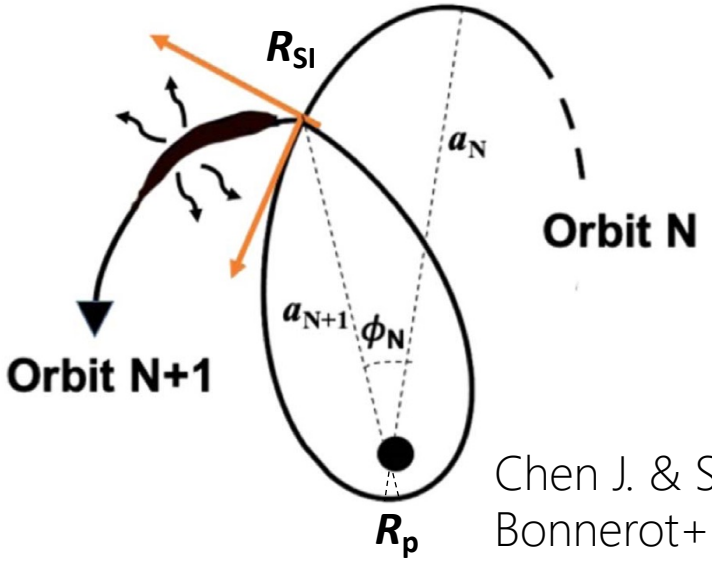
3. Light curve modeling
   - Recent works: Liu C.+2024; Bandopadhyay+2024; …



Chen J. & Shen R. 2021

Bonnerot+2017

Summary

Plan to graduate on June 2025.
Looking for a postdoc position!
Scan this QR code for my CV PDF:

AT 2022dbl is a highly-confident repeated partial TDE, as its two flares show TDE spectroscopic and photometric features, especially the ~4100Å emission pattern.

A third flare is expected to come in ~2 years, providing the final judgment for this classification!

The similar peak R_{bb} between two flares and weak X-ray emission can help distinguish optical/UV/X-ray emission models (e.g., Self-intersection & Reprocessing).

For more details:

"**The unluckiest star:** A spectroscopically confirmed repeated partial tidal disruption event AT 2022dbl"
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Thanks!