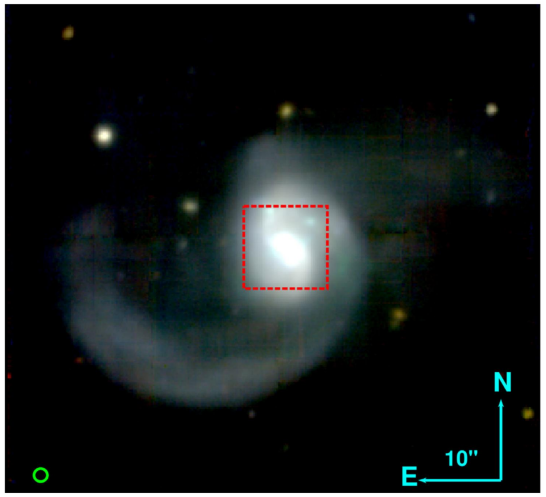
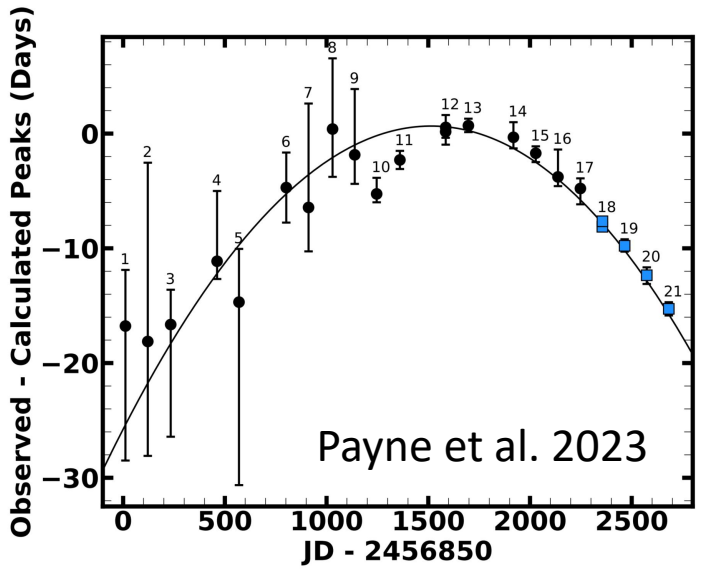
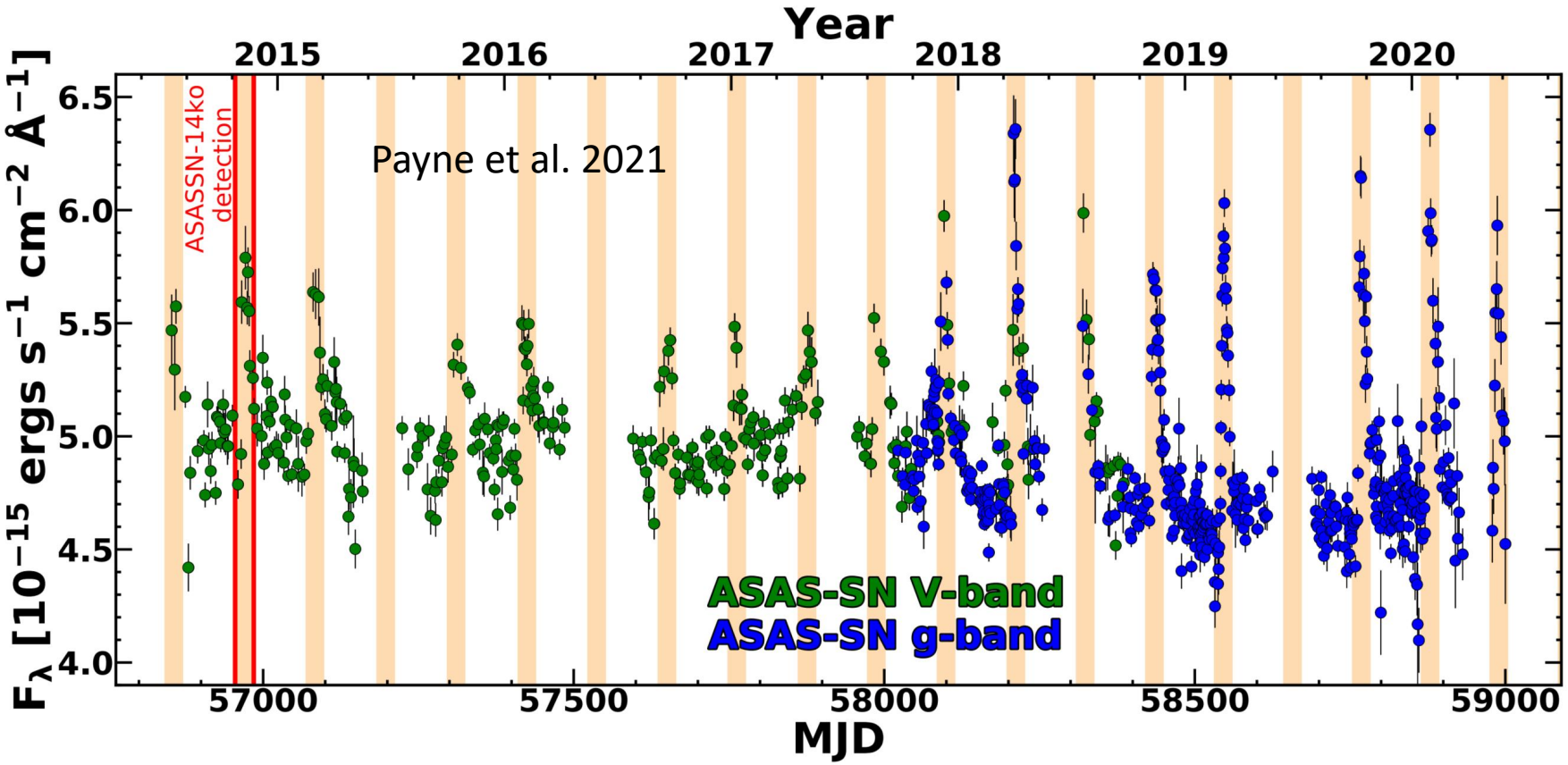
Unveiling the Cosmic Dance of Repeated Partial Tidal Disruption Event ASASSN-14ko: Insights from Multiwavelength Observations

Shifeng Huang
University of Science and Technology of China

Discovery of the periodicity

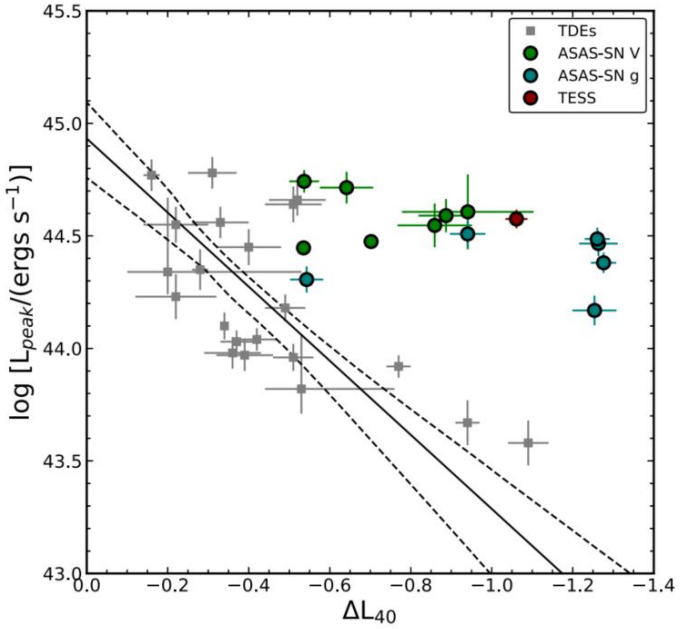


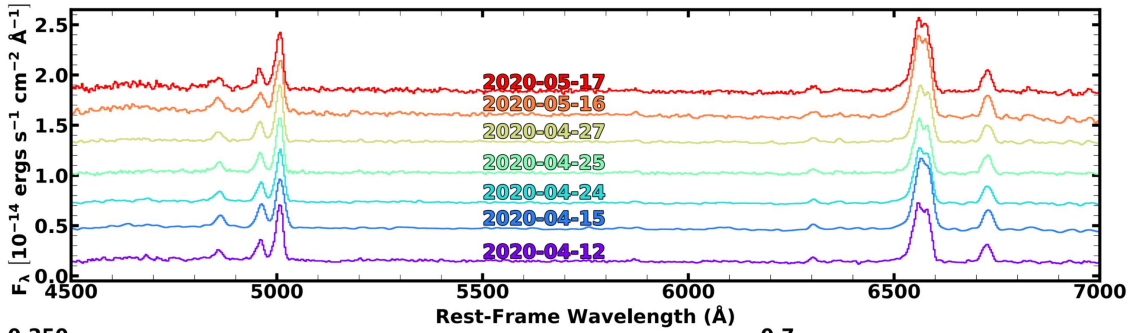


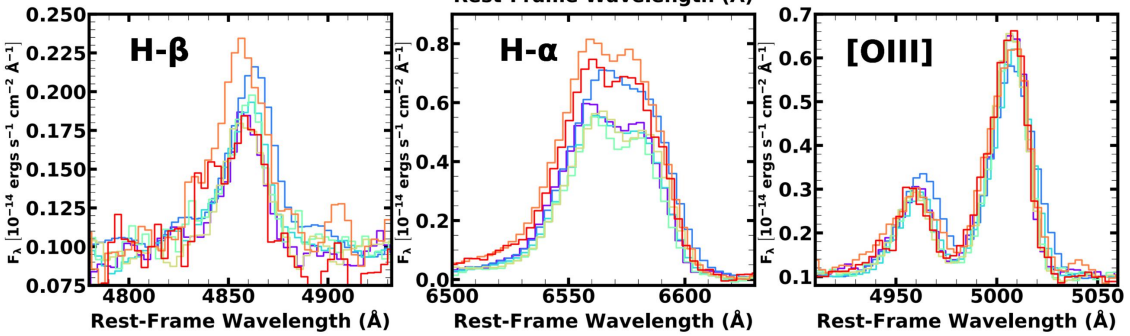


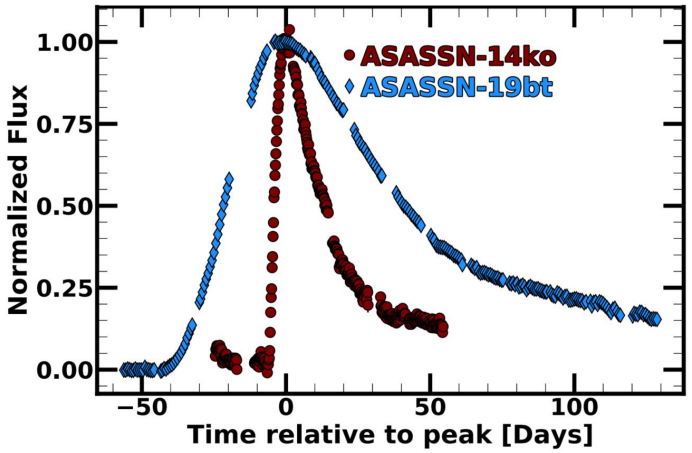
ESO 253-G003 is the hos galaxy of ASASSN-14ko with z=0.042. The mass of central black hole is $10^{7.86} M_{\odot}$ (Payne et al. 2021). A 115-day periodicity was detected in optical bands.

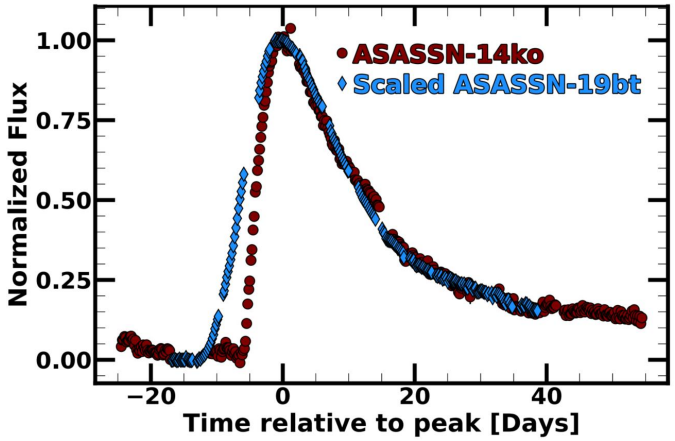
ASASSN-14ko is a repeated partial TDE

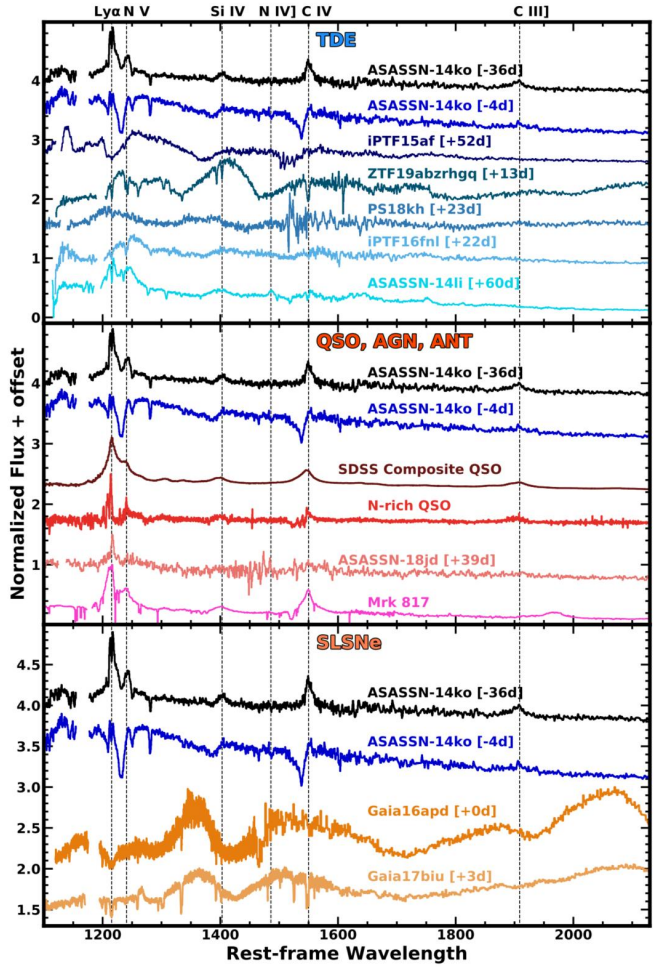








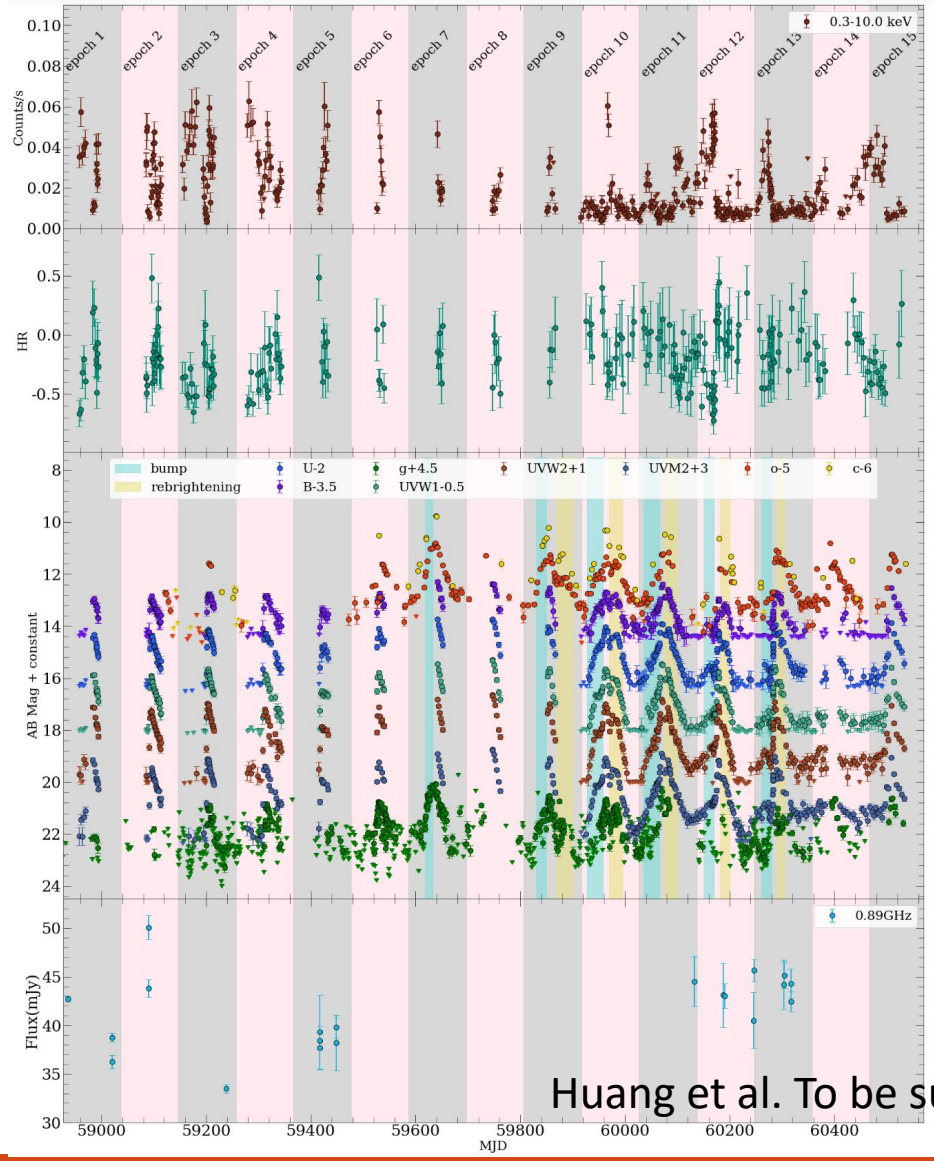


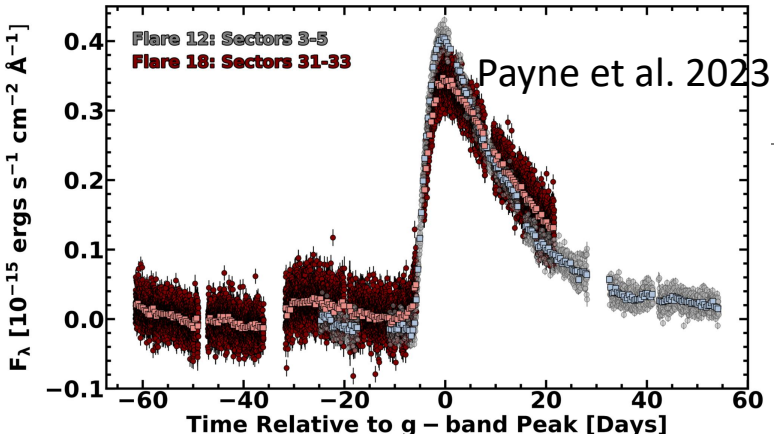


Payne et al. 2023

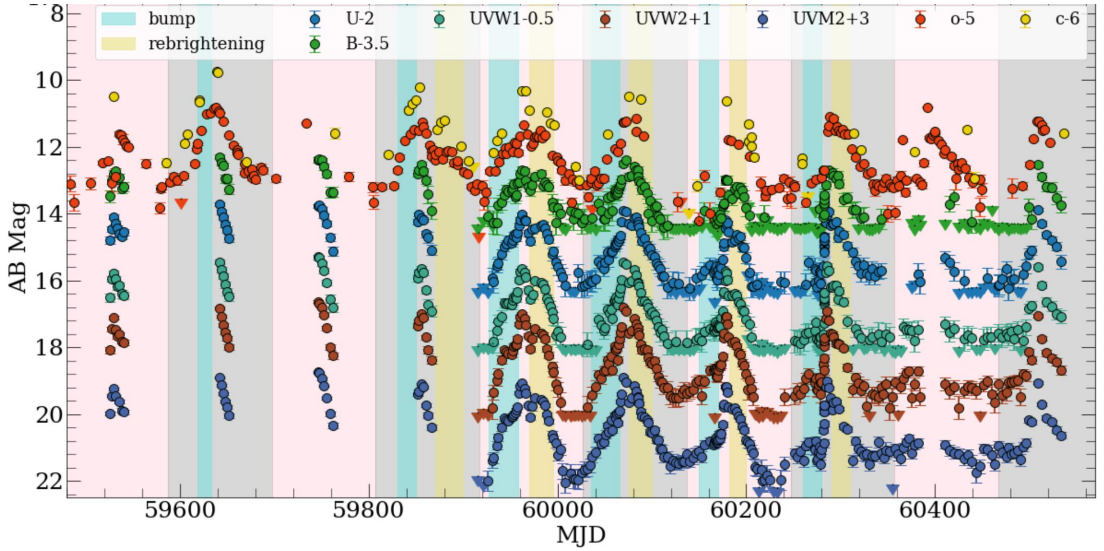
Payne et al. 2021

Multiwavelength Light Curves of ASASSN-14ko



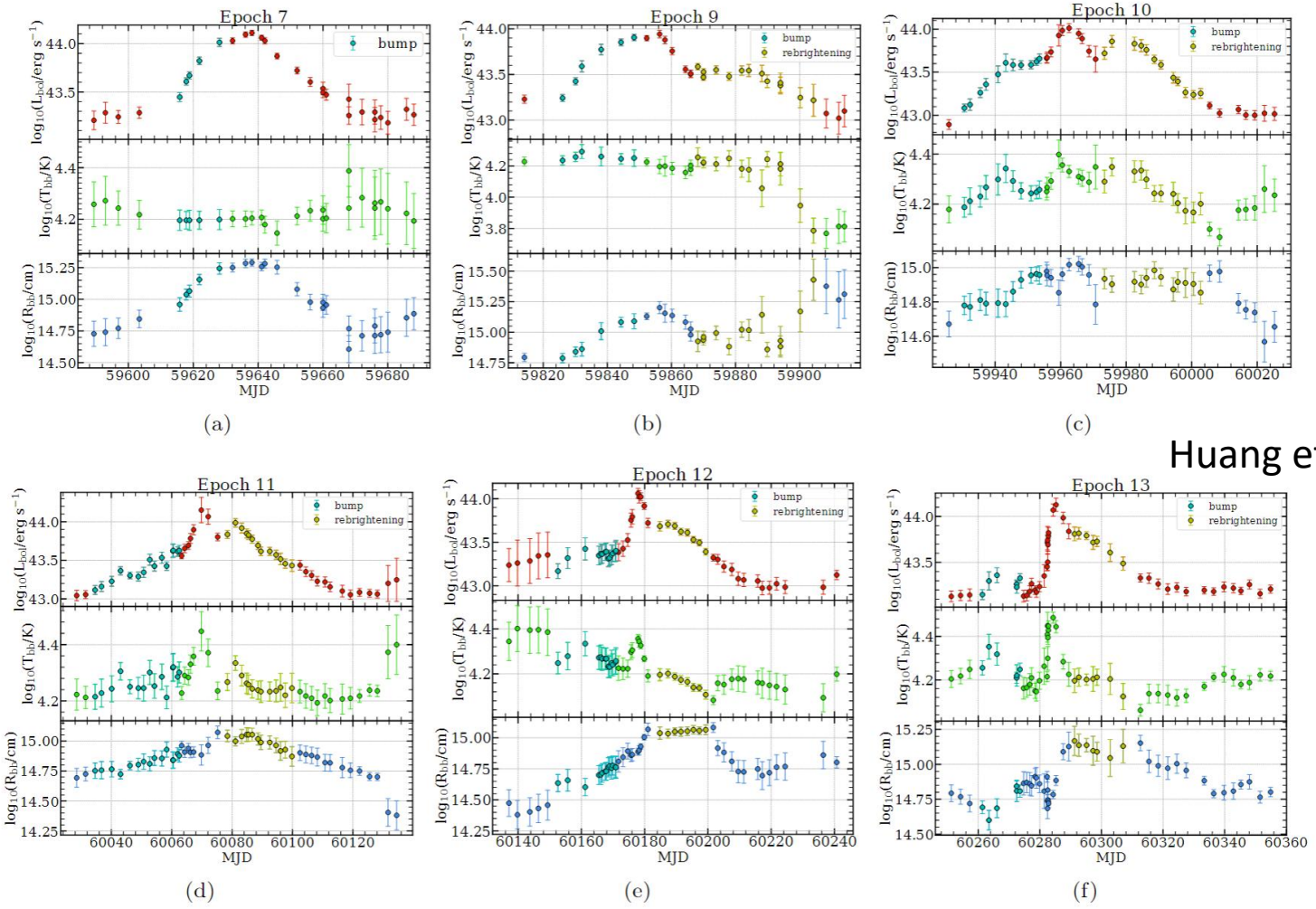


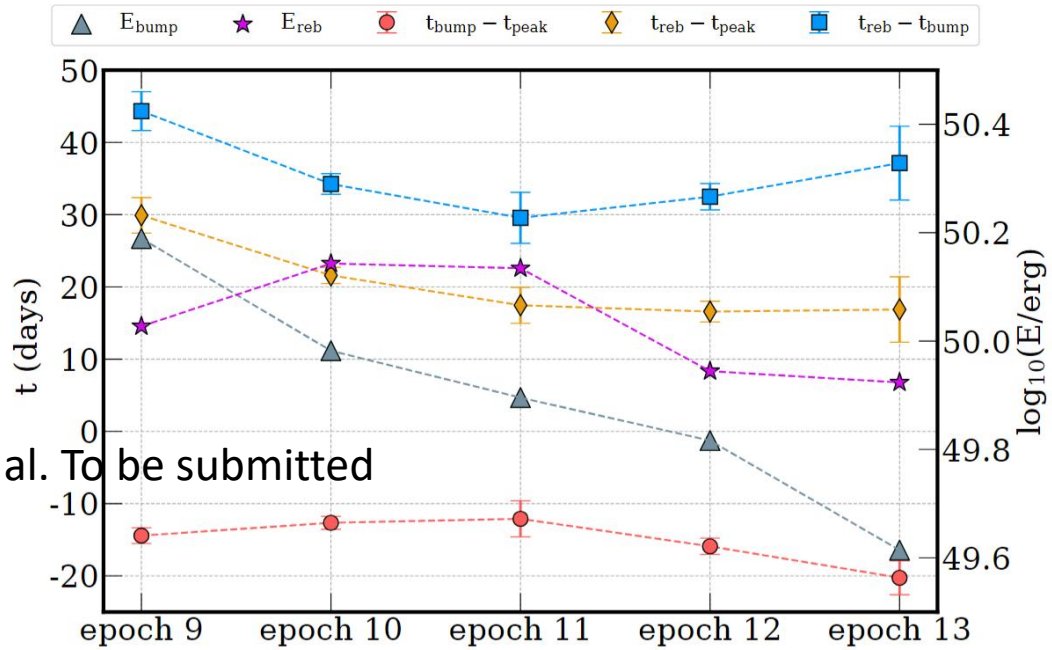
Our high-cadence multiwavelength observations for ASASSN-14ko show the repeated early bumps and rebrightenings in UV/optical bands light curves.



Huang et al. To be submitted

Repeated Bumps and Rebrightenings in ASASSN-14ko





Huang et al. To be submitted

The bumps and rebrightenings show a decreasing trend!

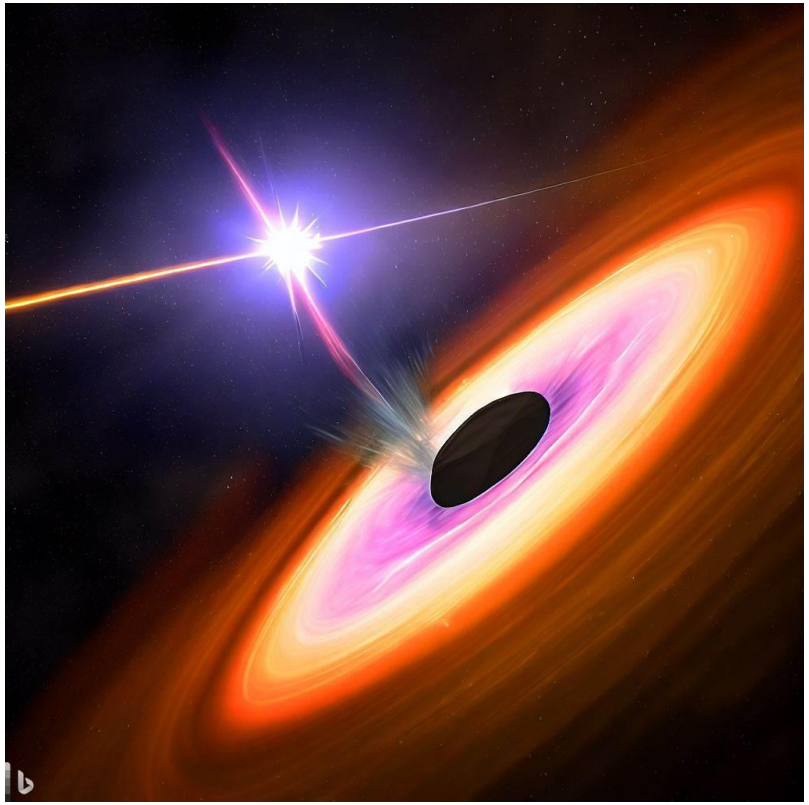
Repeated Bumps and Rebrightenings in ASASSN-14ko

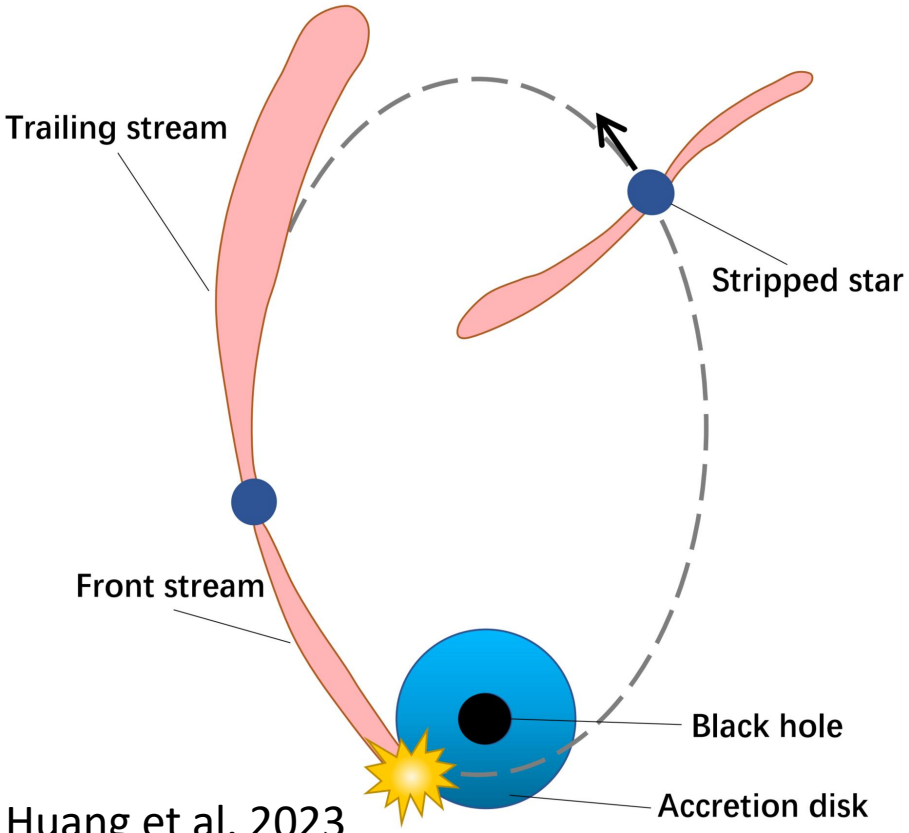
The repeated bumps and rebrightenings in ASASSN-14ko is probably caused by streams-disk collision.

$$\Delta t_{\rm fb} = \frac{3}{2} \times \frac{2\Delta E}{|E_*|} P = 3 \left(\frac{a}{R_{\rm p}}\right) \left(\frac{R_{\rm p}}{a}\right)_{\rm crit} P$$

Δt_{fb}~1/3 P

The fallback time of the two streams is consistent with the time intervals between the bumps and rebrightenings in each outburst.

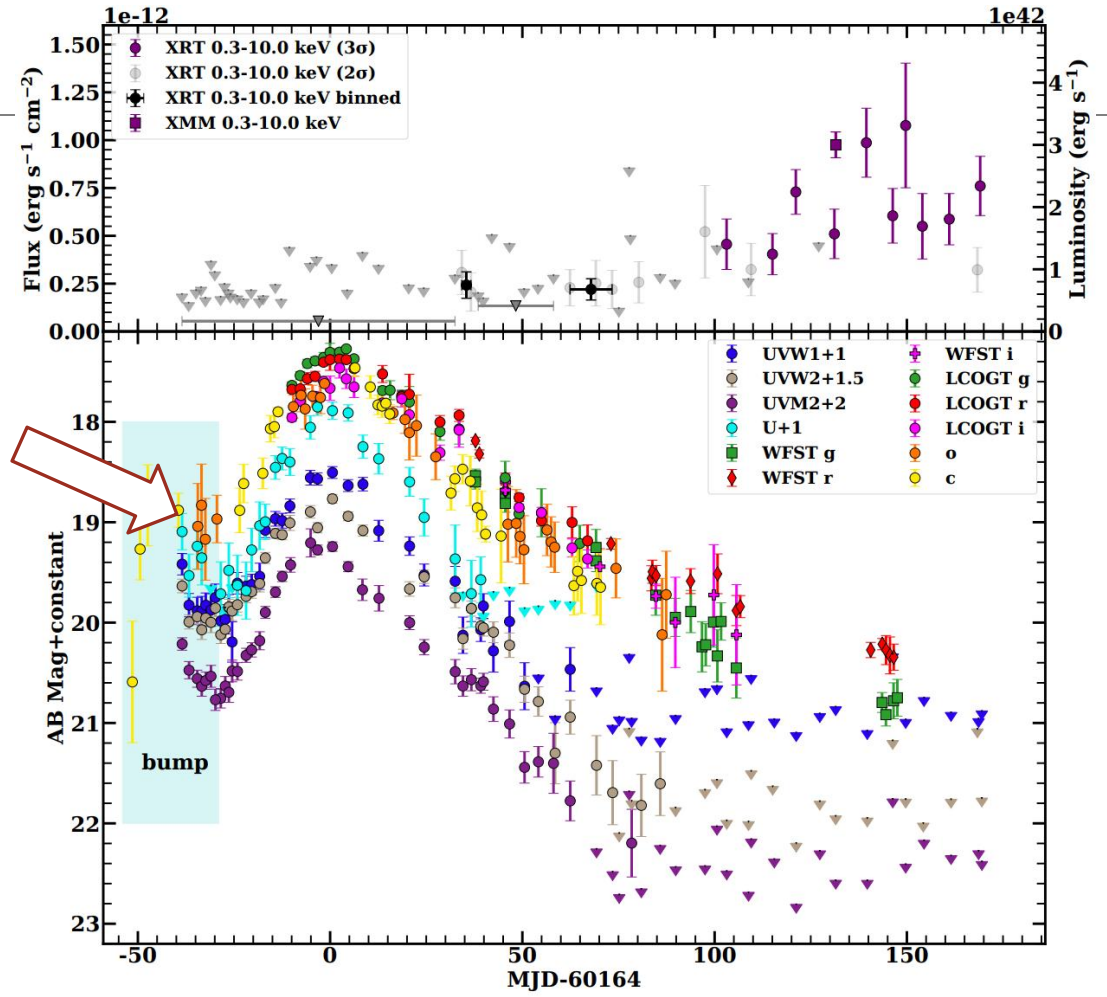


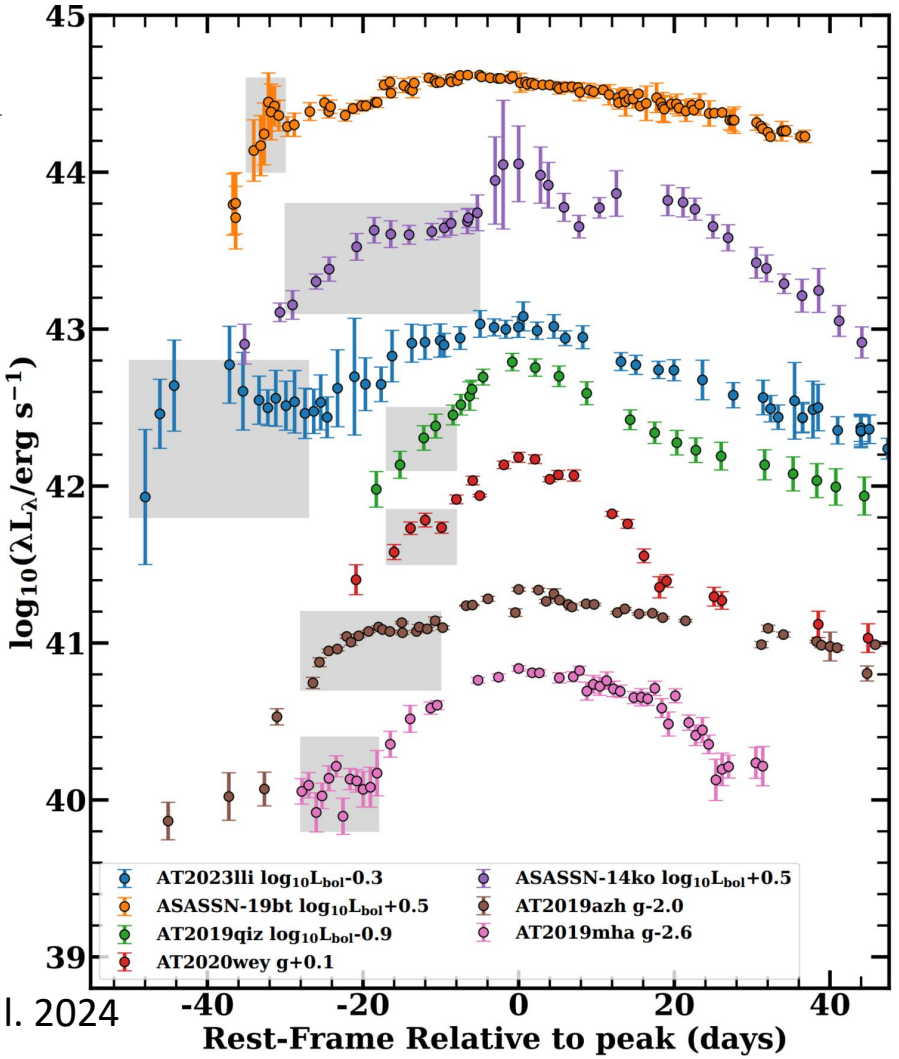


Huang et al. 2023

Comparison with bump TDEs

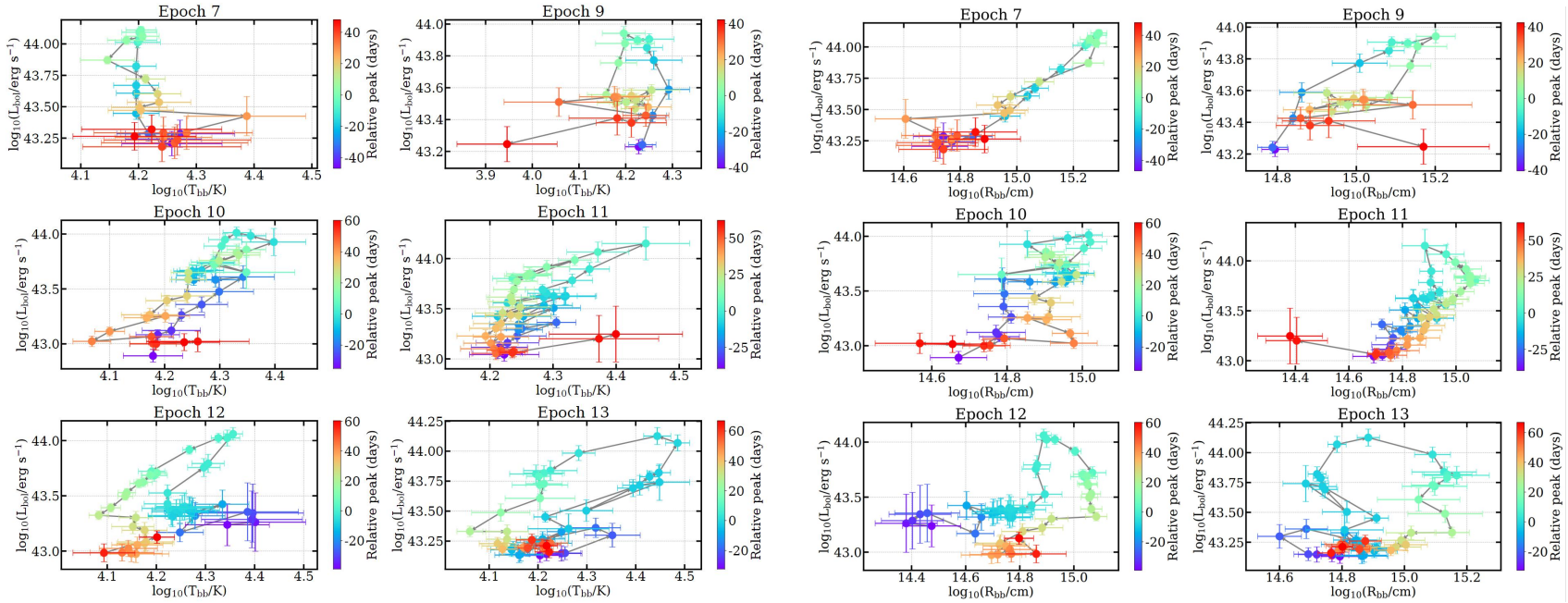
The most prominent early bump in UV/optical light curves so far!



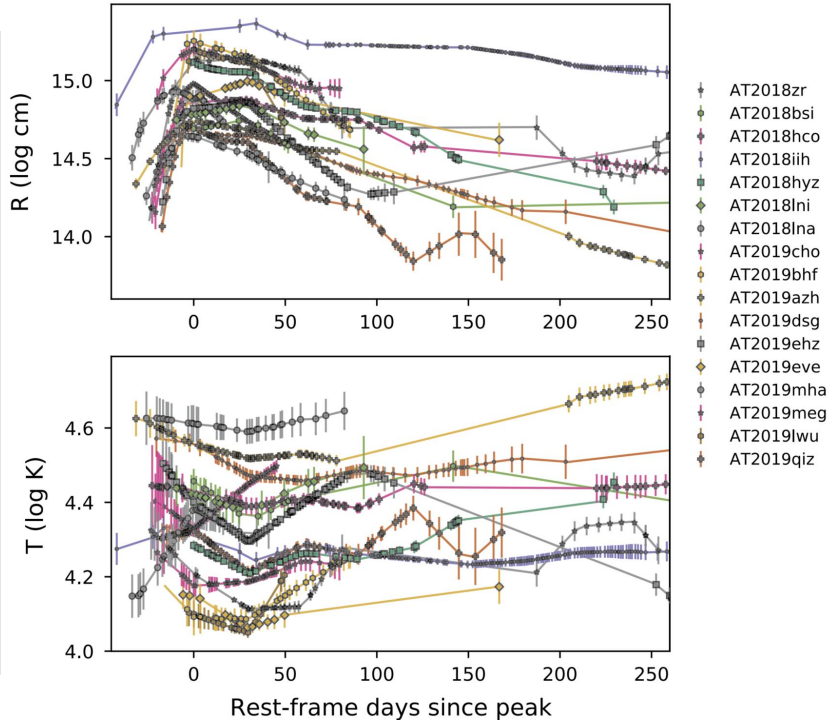


Huang et al. 2024

Evolution of temperature and radius



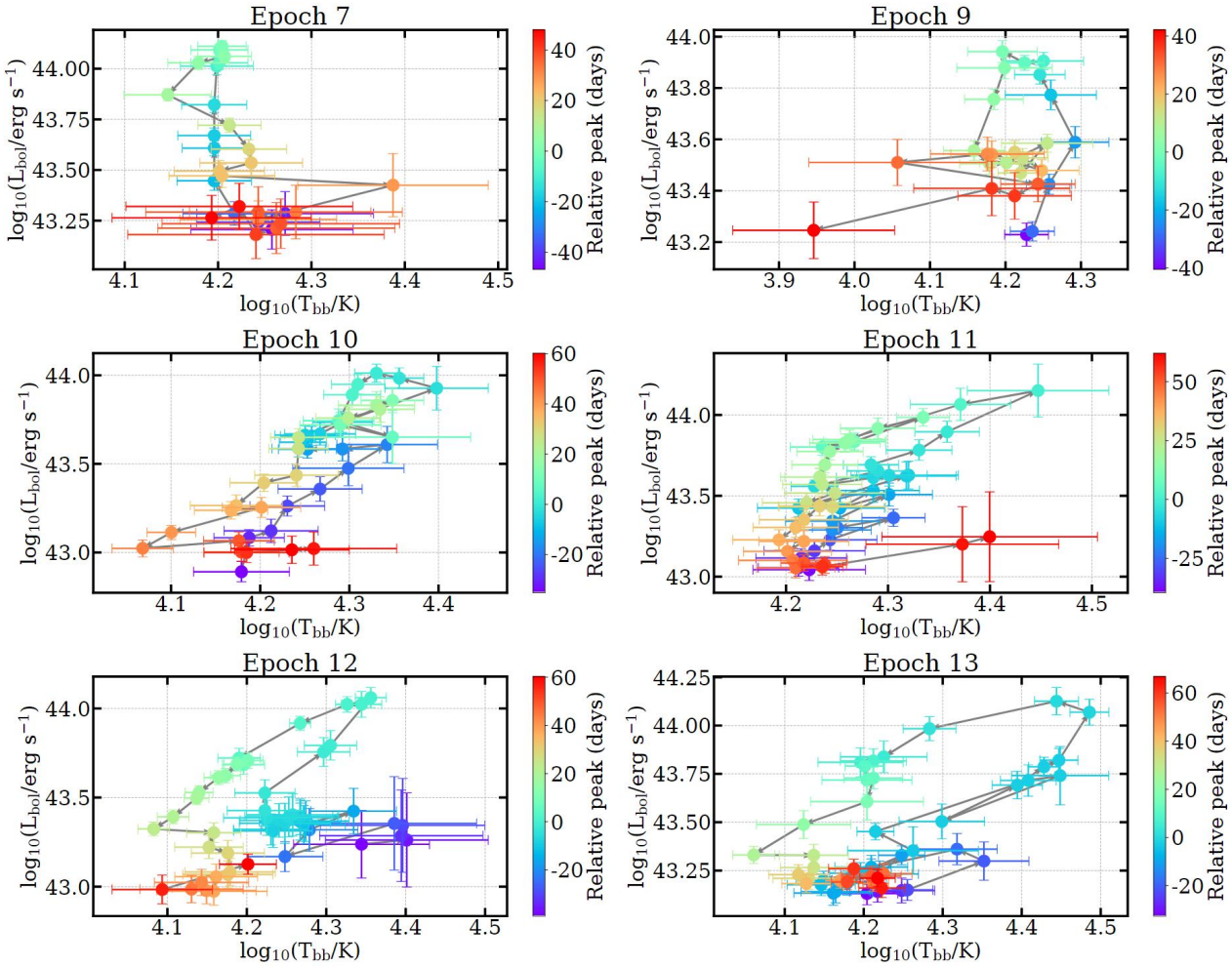
Huang et al. To be submitted



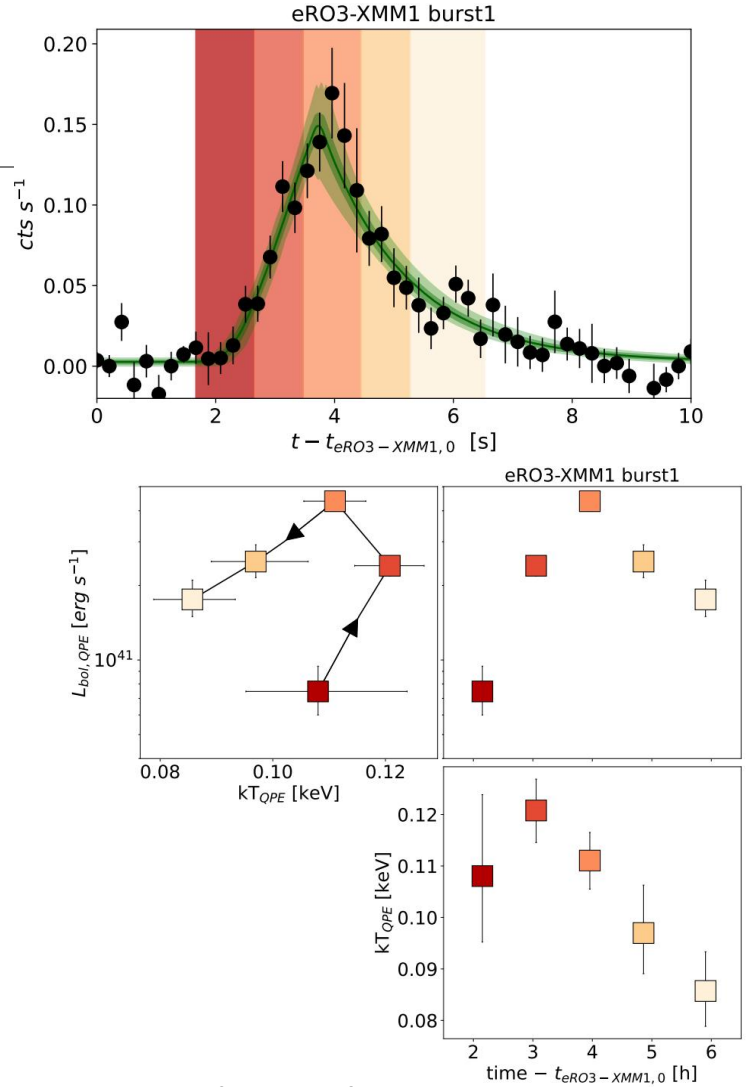
van Velzen et al. 2020

Temperature Evolution: Optical QPE?

UV/optical luminosity increases with the blackbody temperature!

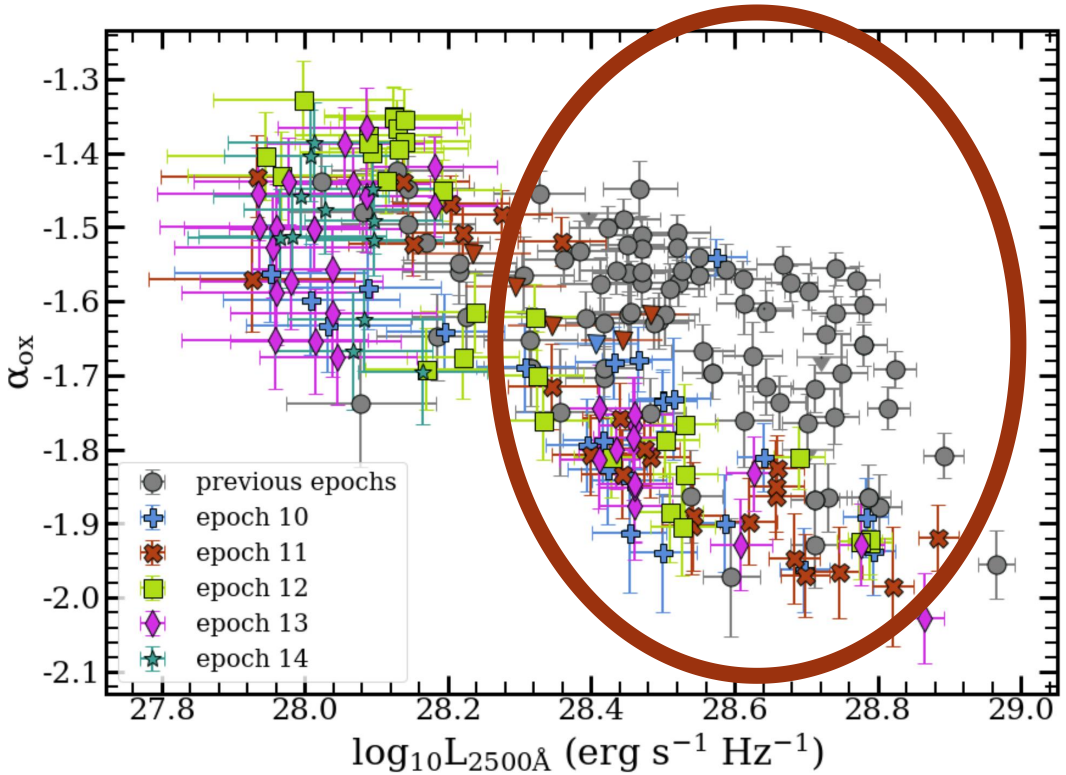


Huang et al. To be submitted

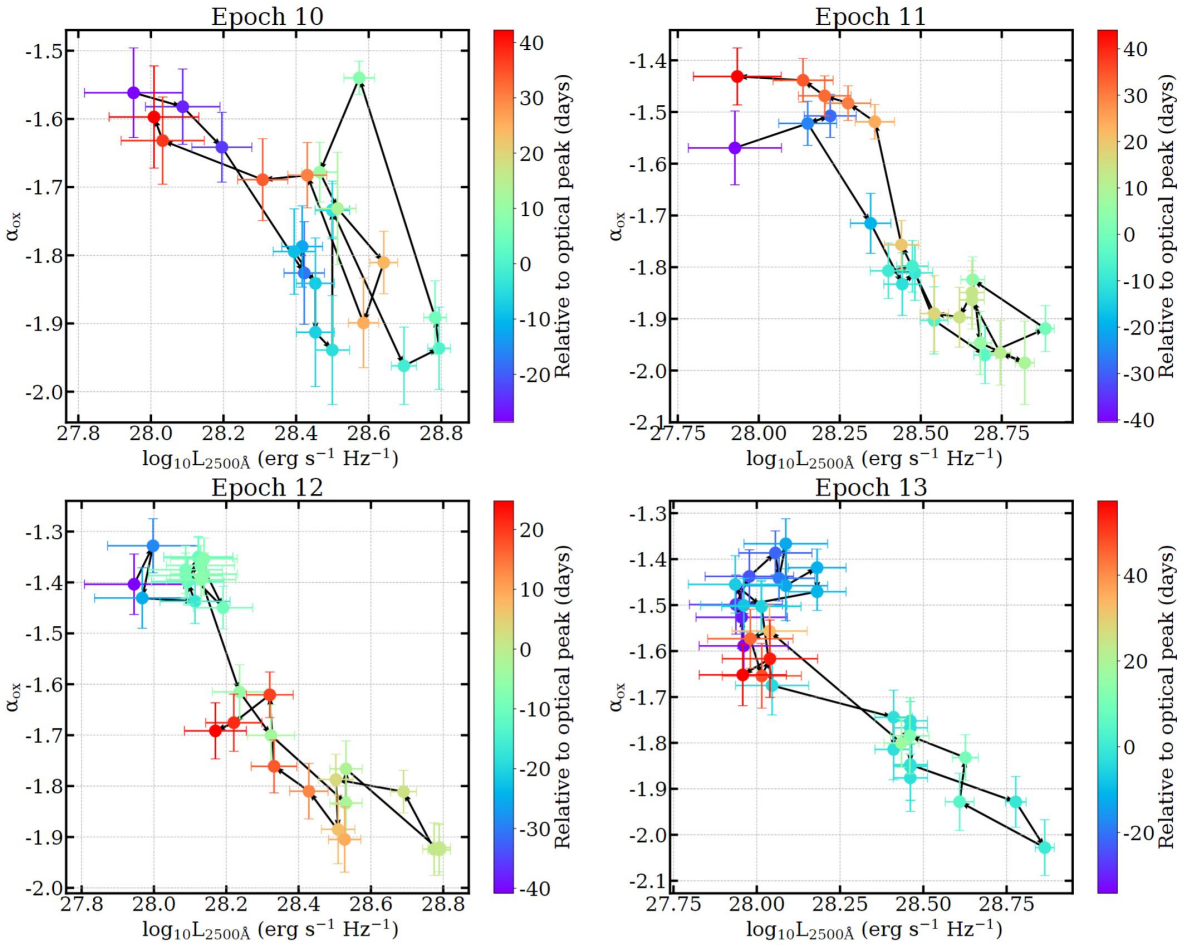


Acordia et al. 2024

Correlation between X-ray and UV

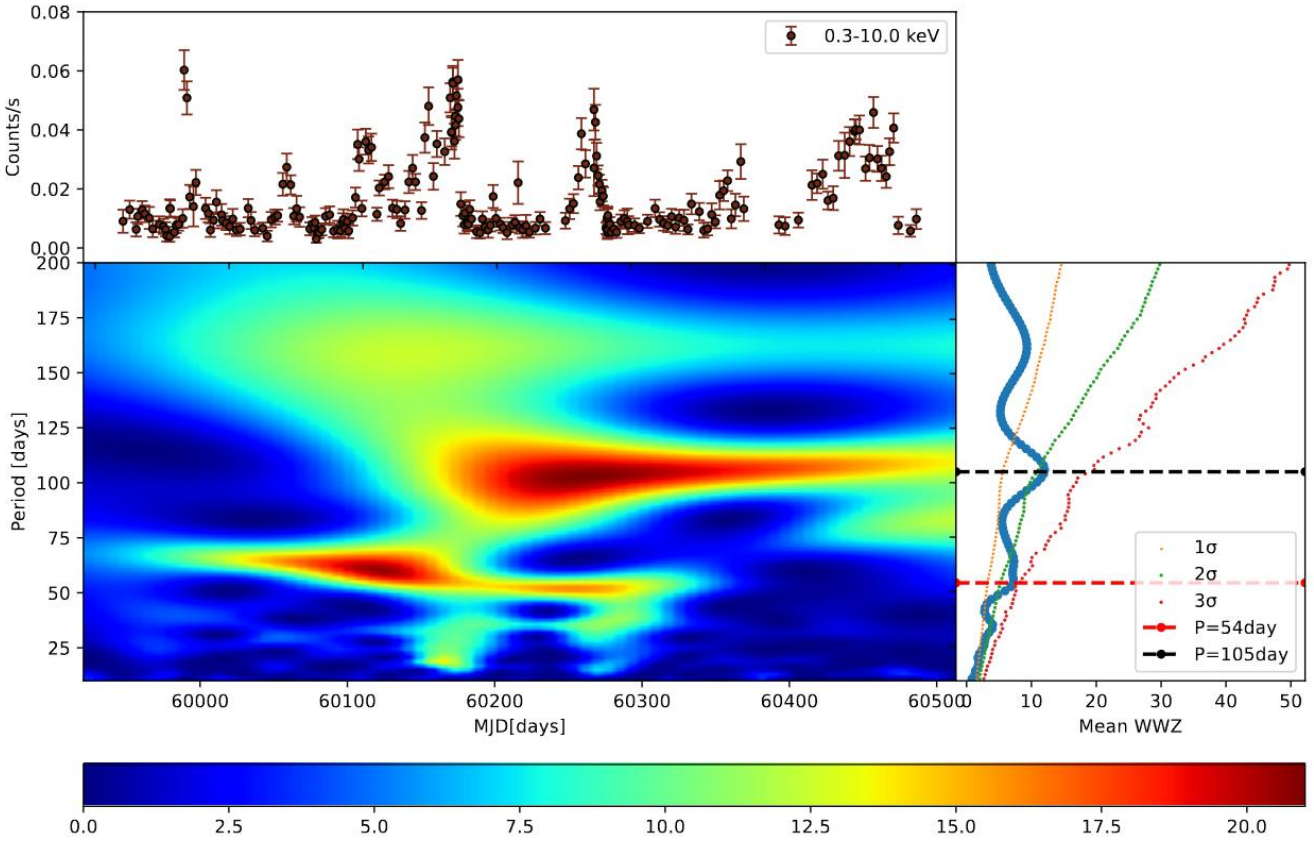


$$\alpha_{ox} = 0.3838 \log\left[\frac{F(2\ keV)}{F(2500Å)}\right]$$

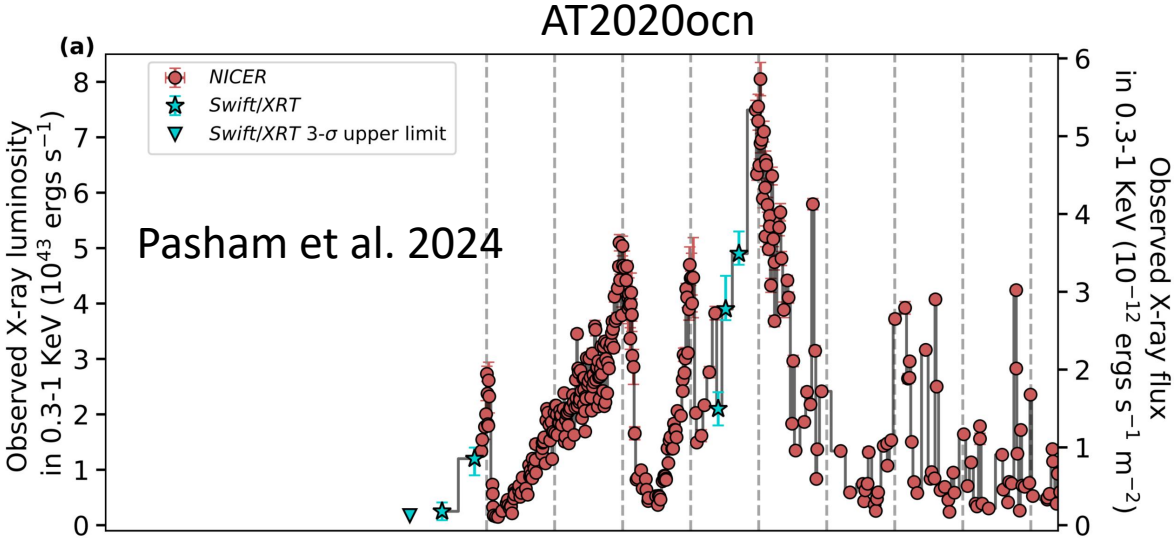


Huang et al. To be submitted

Long Quasi-periodicity in X-ray of TDEs



Huang et al. To be submitted



Our high-cadence observations for ASASSN-14ko show the periodicity in the X-rays.

Summary

- The physical processes involved are still not particularly well understood, and more and more questions (such as early bump and rebrightening) need to be addressed.
- The stream-disk collision can produce both the repeated bumps and rebrightenings in ASASSN-14ko.
- The luminosity of ASASSN-14ko evolves with temperature. It may be a special type of QPEs.
- The periodicity in X-ray may be related to the corona.
- More such events will be discovered in the future as more and more surveys are promoted.