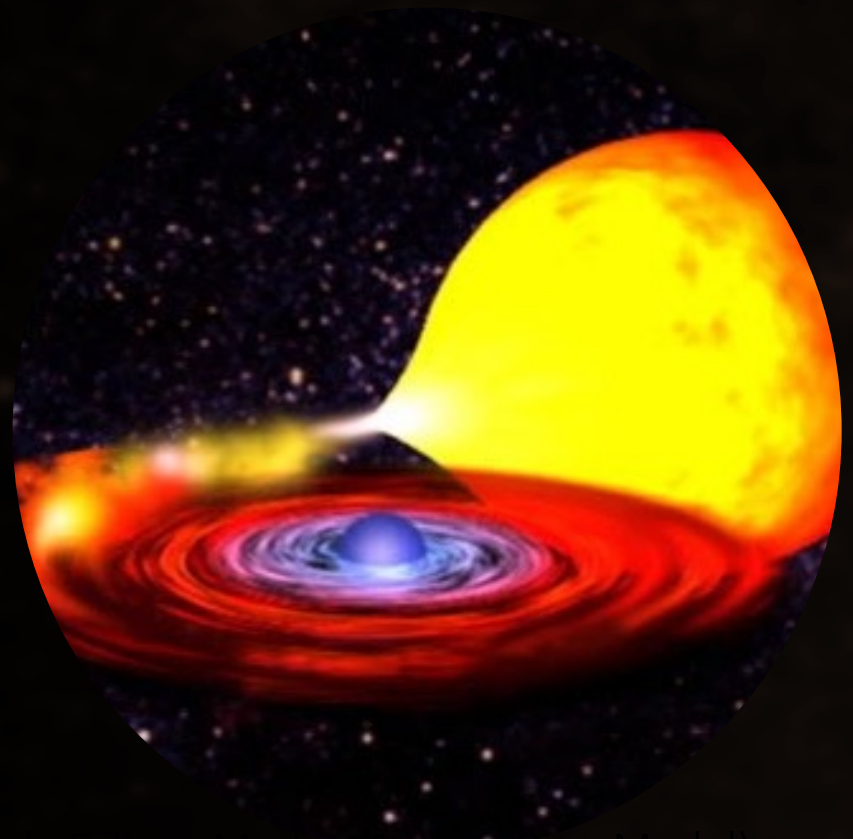
Amy Knight, Jakob van den Eijnden, Adam Ingram, Sara Motta, Diego Altamirano, Giulio Mancuso, James Matthews, Matt Middleton and Rob Fender.

Type I X-ray Bursts *during* the Eclipses of EXO 0748-676

An artist's impression of an Accreting X-ray Binary.
Credit: NASA/CXC/M.Weiss

Amy Knight, Lauren Rhodes, Lucy Oswald, Jakob van den Eijnden, Adam Ingram, Douglas J.K. Buisson, Matt Middleton & Aris Karastergiou

EXO 0748-676



Simple Eclipse Model (Straight Line Model)

- Neutron Star Low-Mass X-ray Binary
- 24 Year Outburst (1985-2009)
- X-ray Eclipse Duration ~ 500s
  Parmar 1986, 1991,Wolff et al. 2009, Knight et al. 2022a,2023
- Orbital Period = 3.824 hrs
  Parmar 1986,1991, Wolff et al. 2009
- Neutron Star ~2 Solar Masses
  Ozel et al. 2006, Munoz-Darias et al. 2009, Knight et al. 2022a
- Inclination ~ 76 degrees
  Knight et al. 2022a

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Type I X-ray Bursts

- Thermonuclear Flashes from the Neutron Star Surface

- Type I X-ray Bursts & Burst Oscillations
  Galloway et al. 2010

- NS Spin Period ~ 552 Hz
  Galloway et al. 2010

- Simple Eclipse Model (Straight Line M

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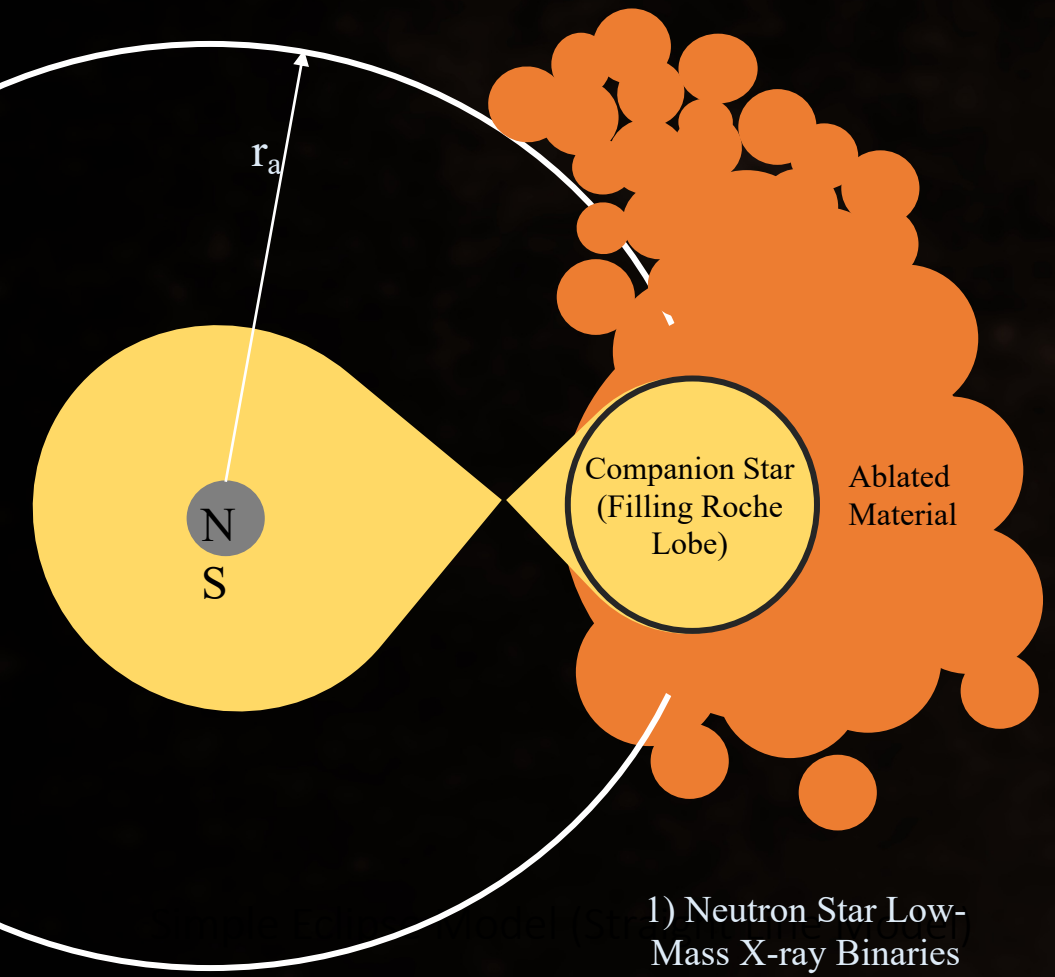
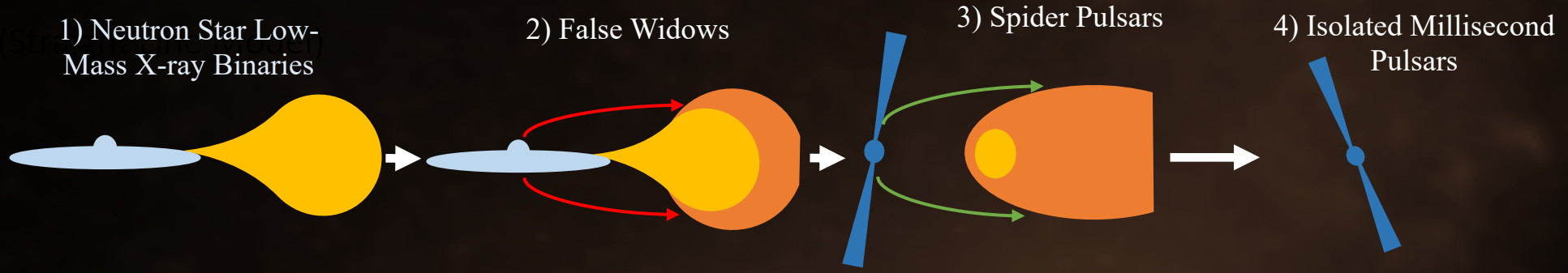
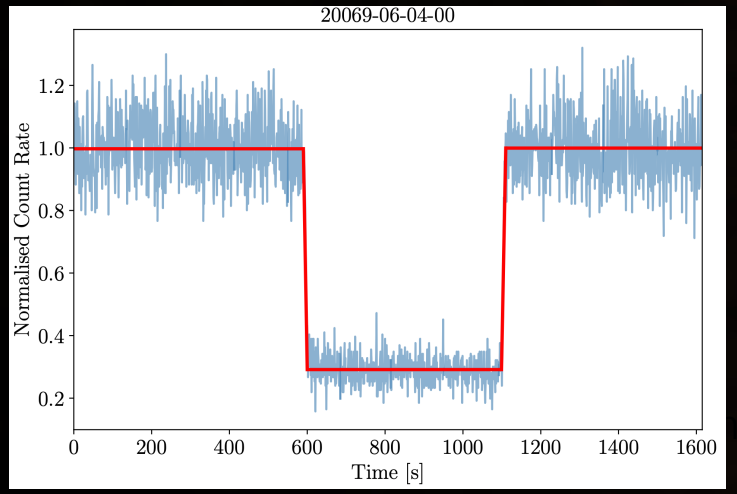
EXO 0748-676

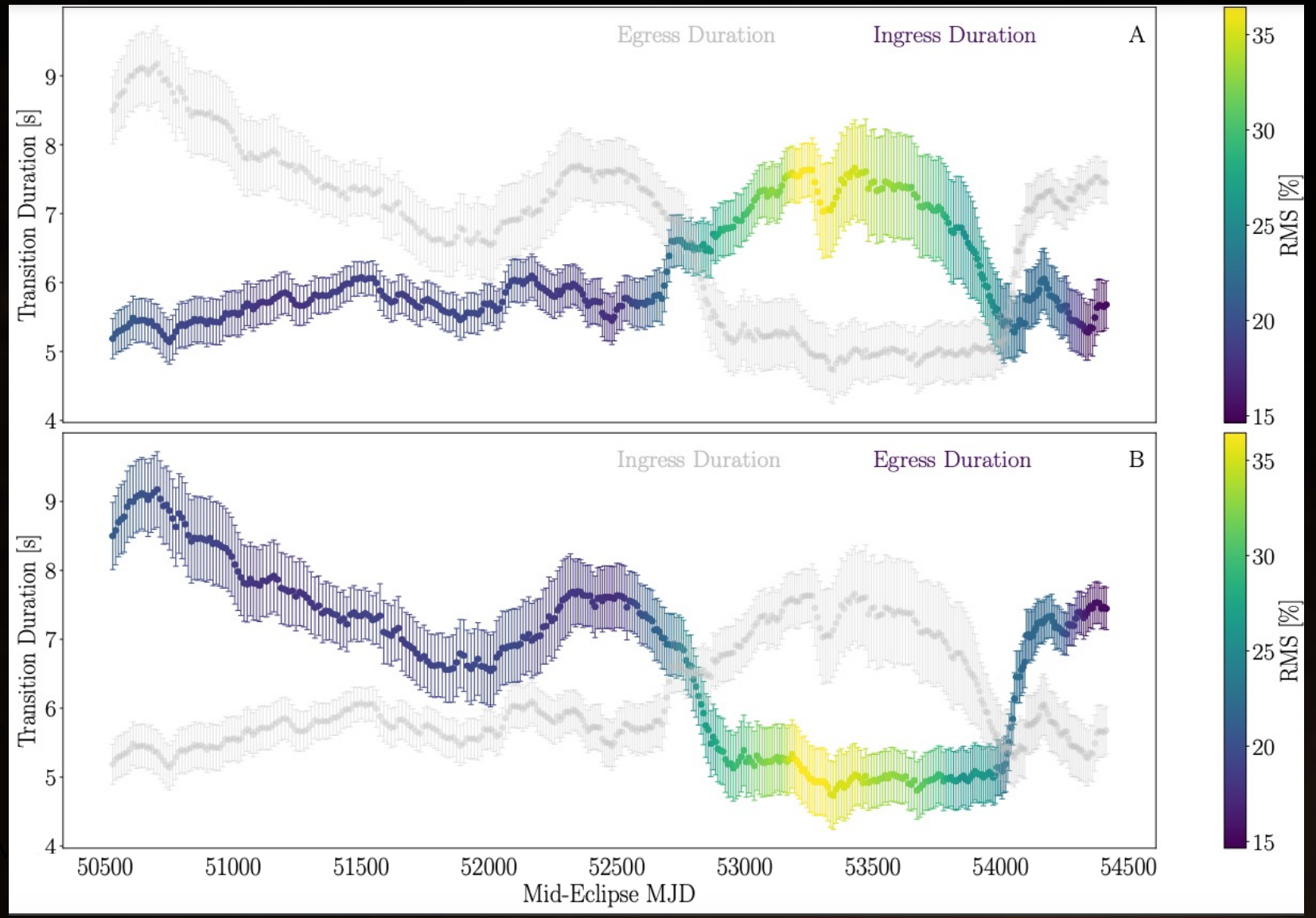


- **First False Widow Binary**
  Knight et al. 2022a,2023
- Irradiation Driven Ablation
- Strongly Ionised & Clumpy
- Energy Dependent & Asymmetric Eclipse Profiles



EXO 0748-676 Eclipse Timings





Knight et al. 2023

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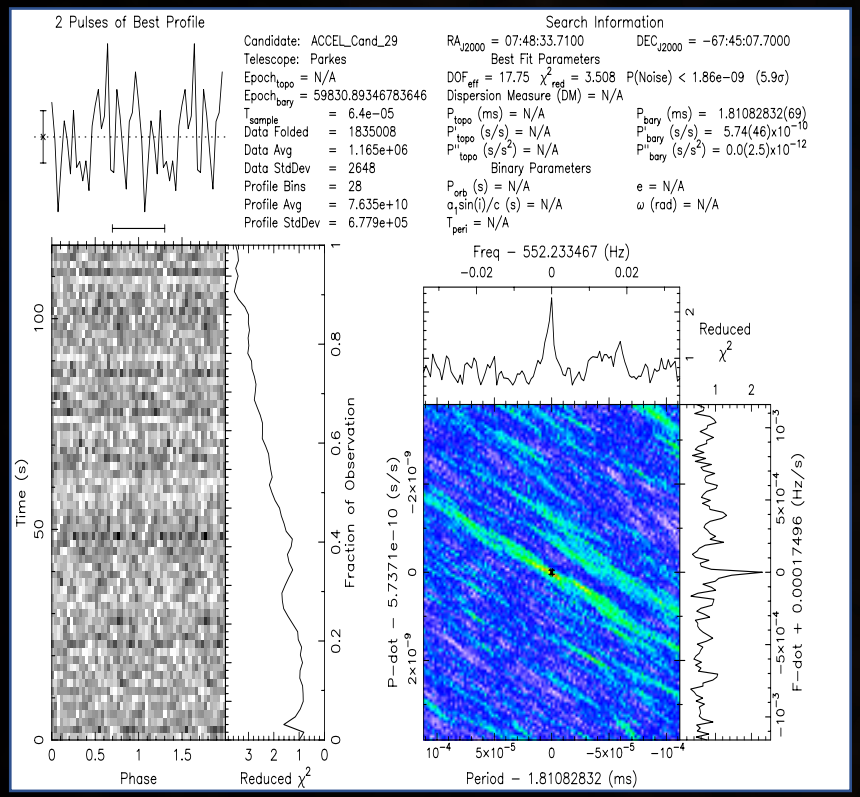
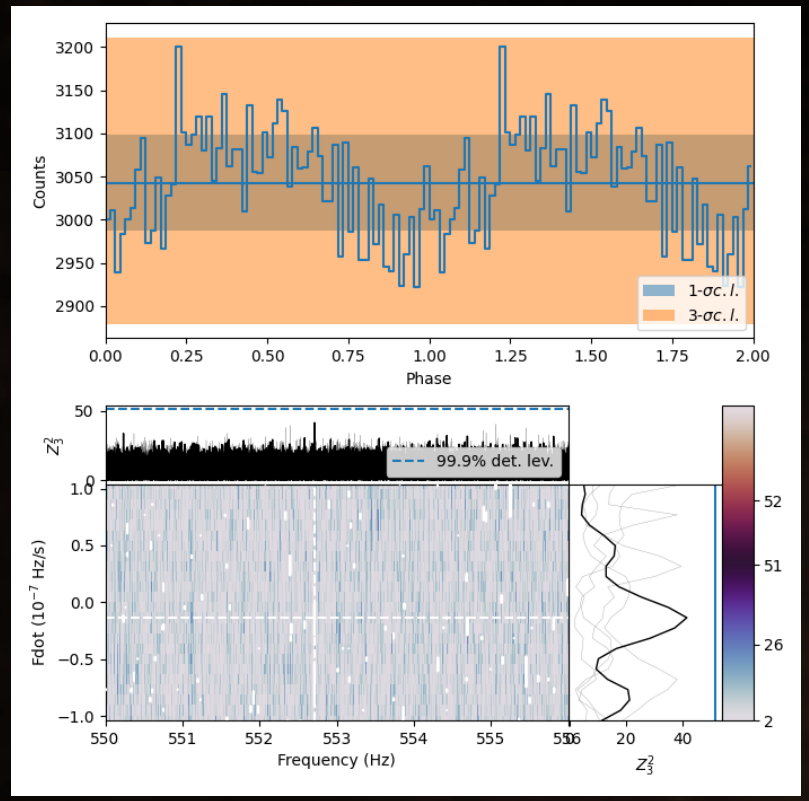
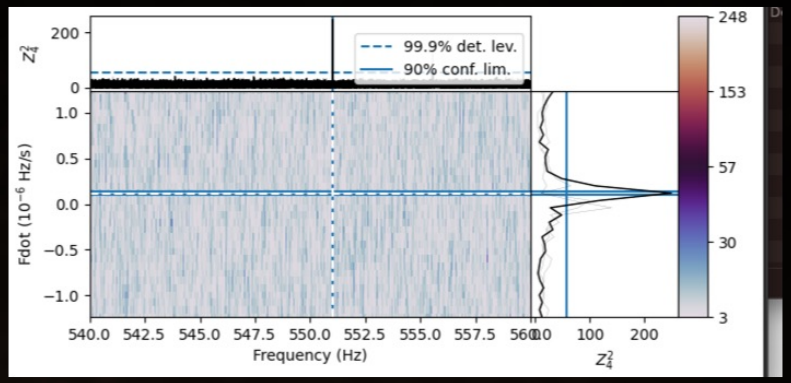
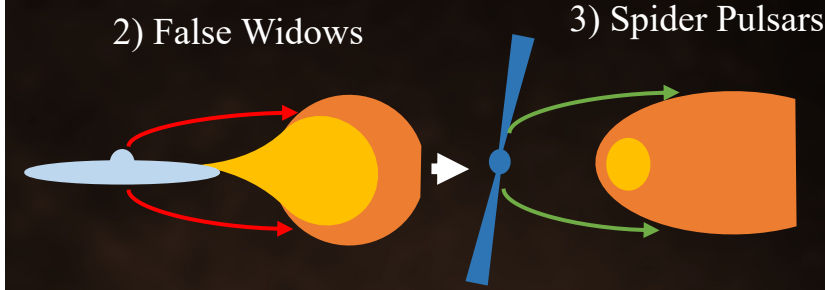
Evidence for ~ 552 Hz Pulsations









Knight et al. in prep

Tight Eclipse Model (Straight Line Model)

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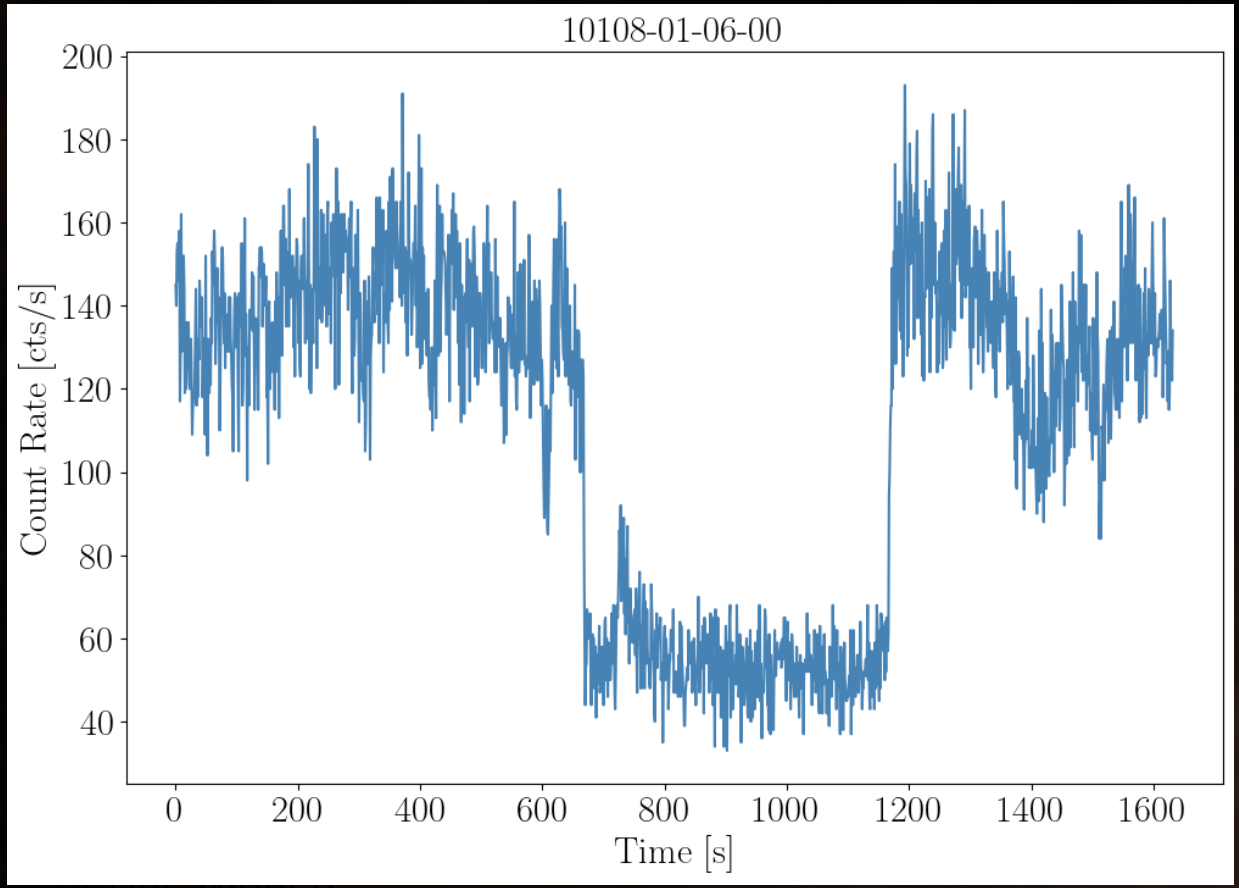
Type I X-ray Bursts *during* Eclipses?



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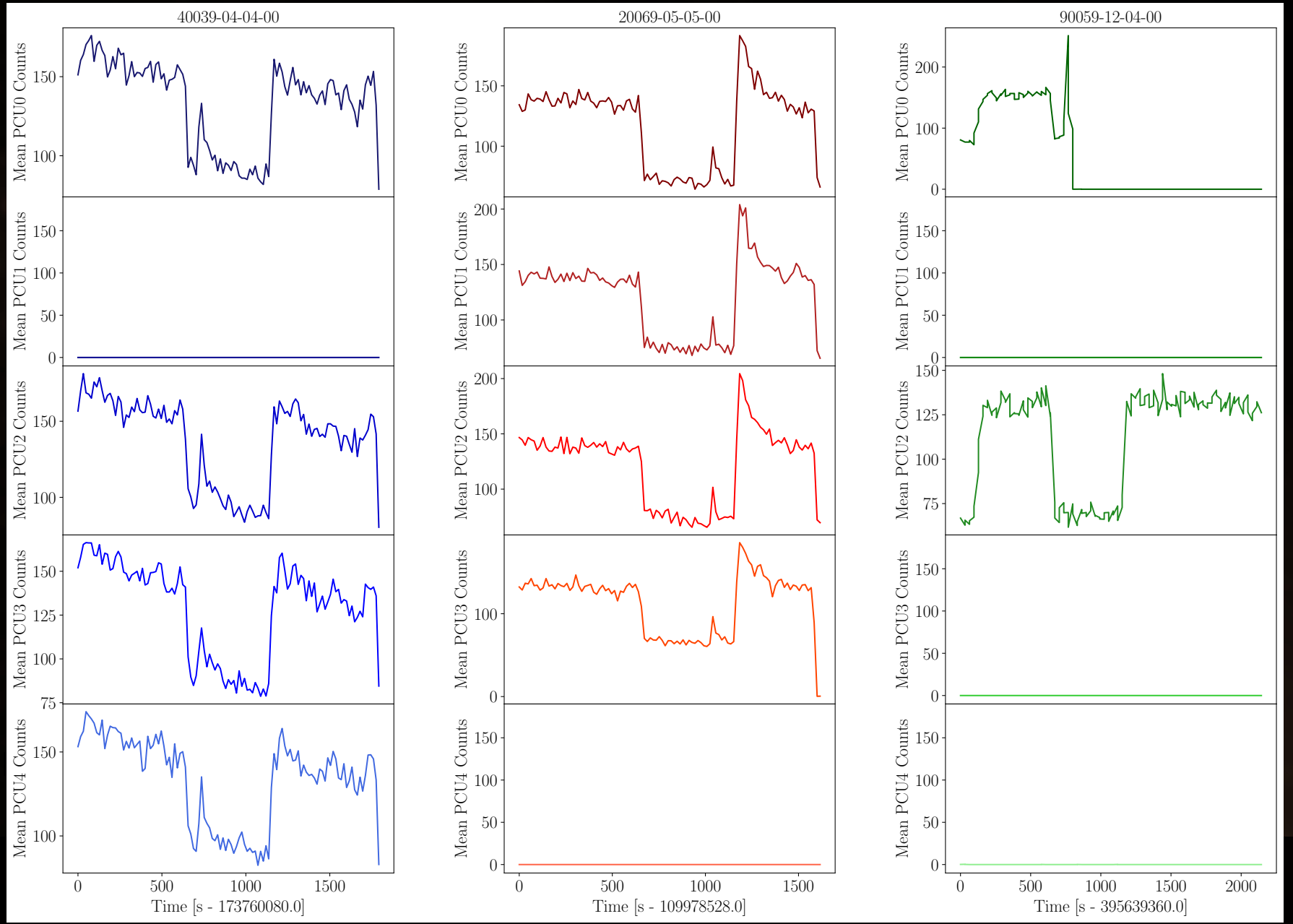
Are They Real?

- Seen in all active PCUs indicates a real burst.
- Not seen in all active PCUs indicates a non-physical burst.
- PCU flare/malfunction& switches off.



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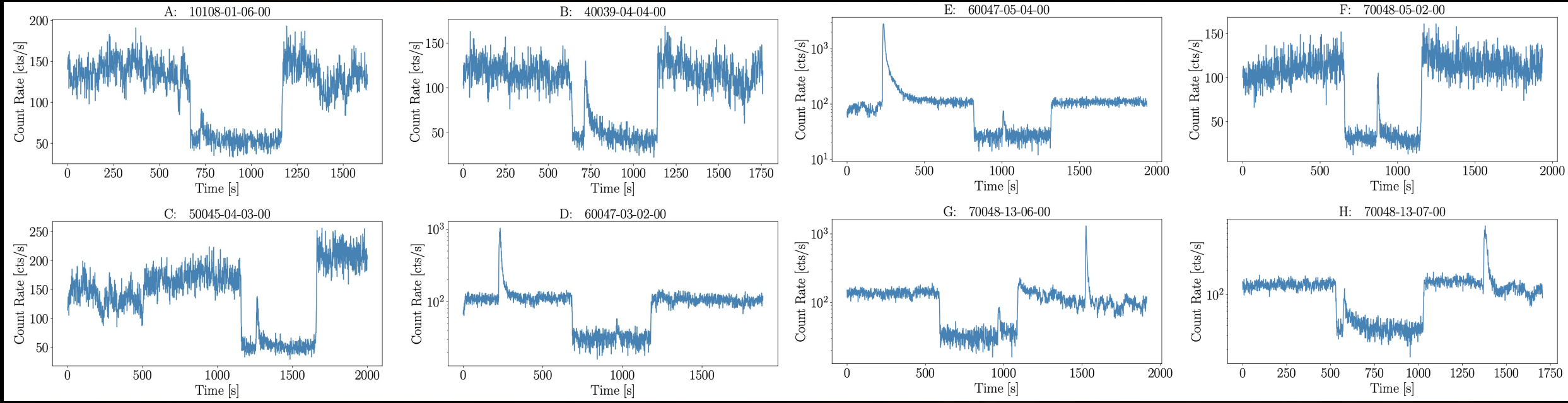
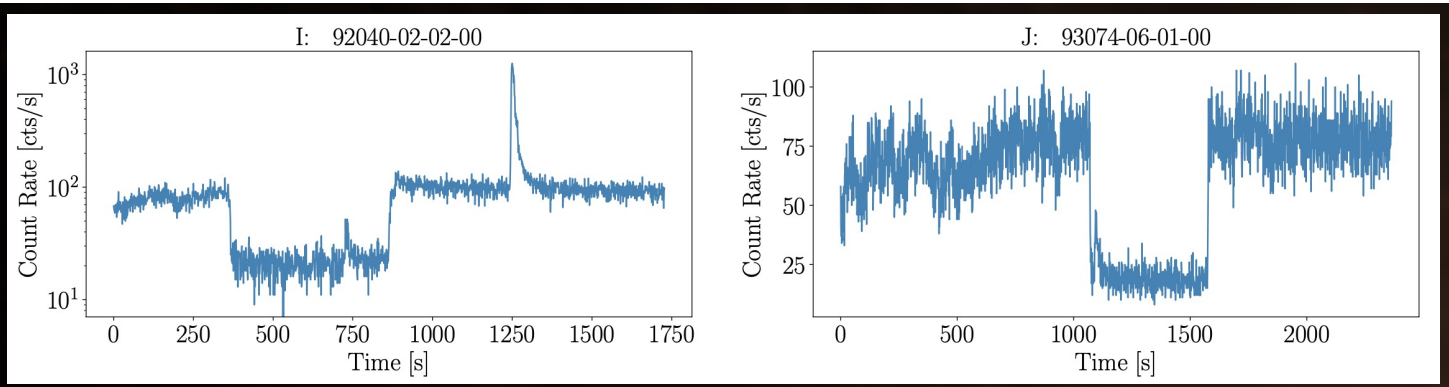
In-Eclipse X-ray Bursts





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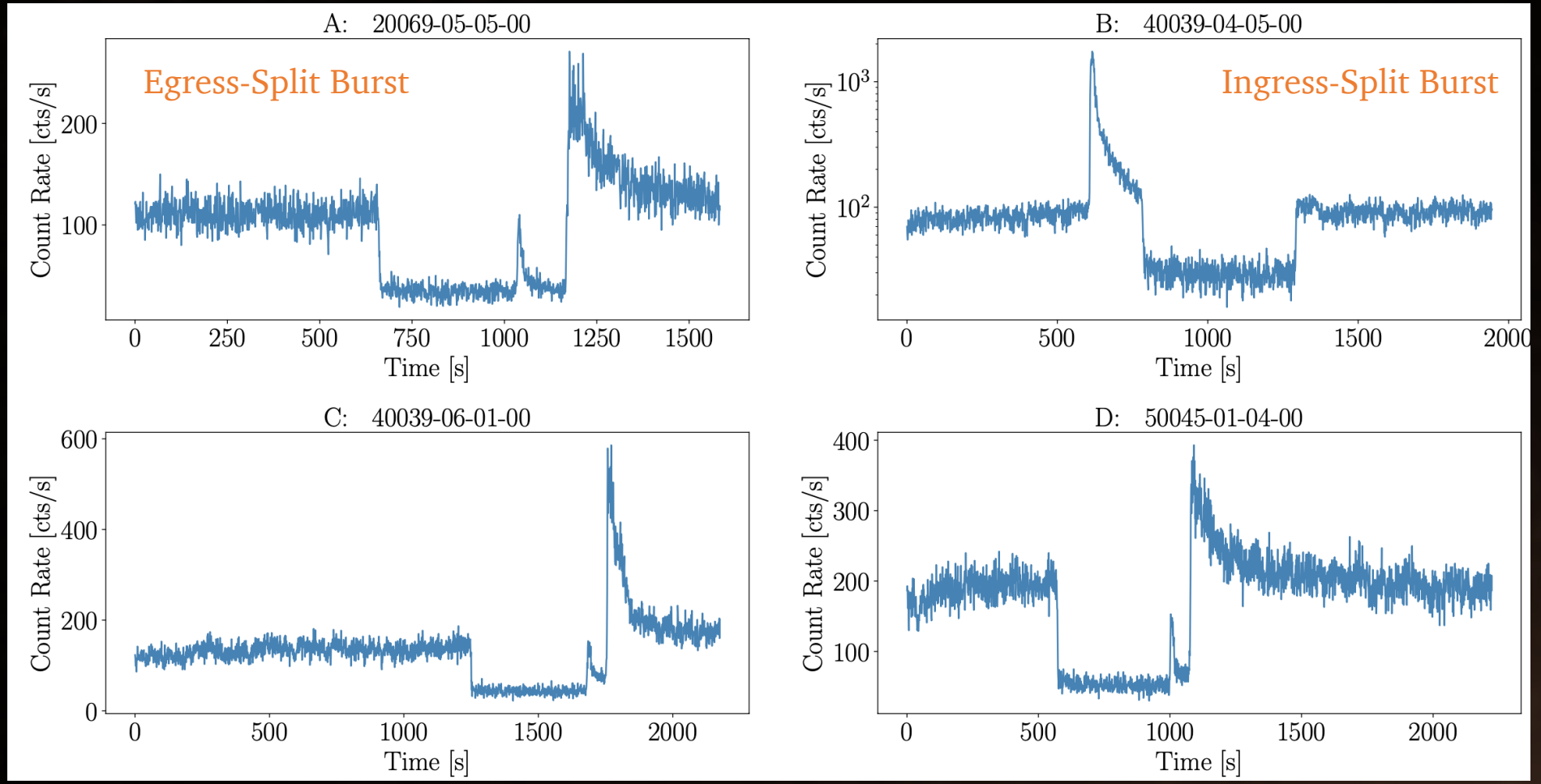
Split X-ray Bursts



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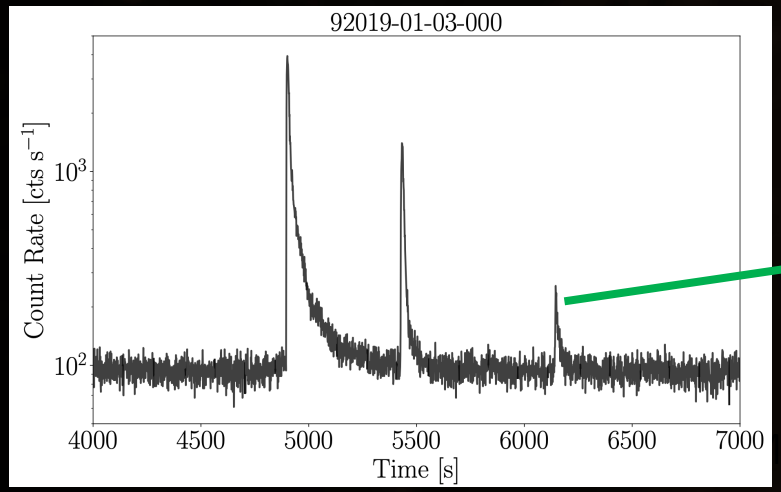
Peak Flux Distribution

- Dichotomy in the Burst Population.
- Reflection Fraction of In-Eclipse Bursts 10 - 15%



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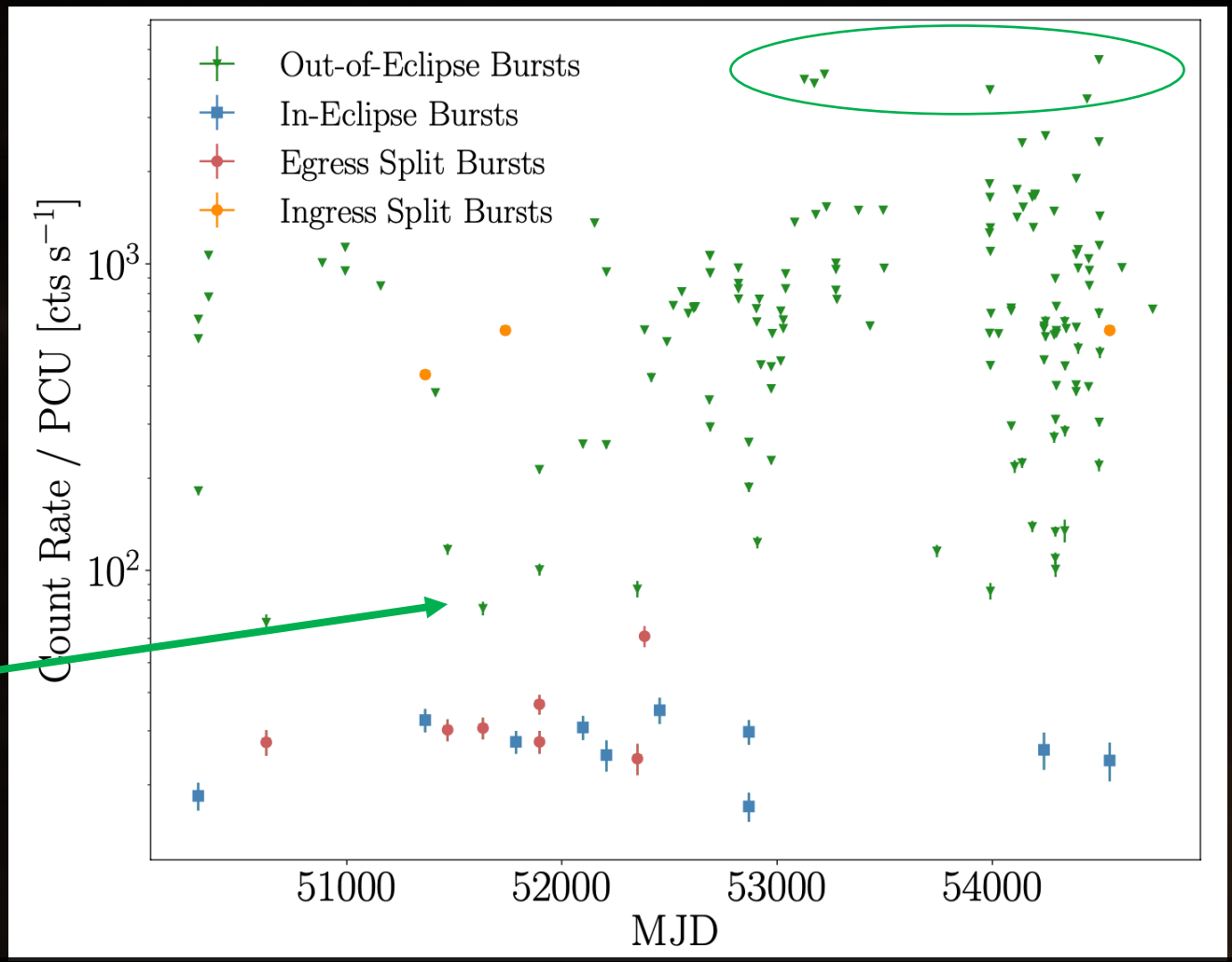
PRE Bursts



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Peak Burst Spectra
(Preliminary)

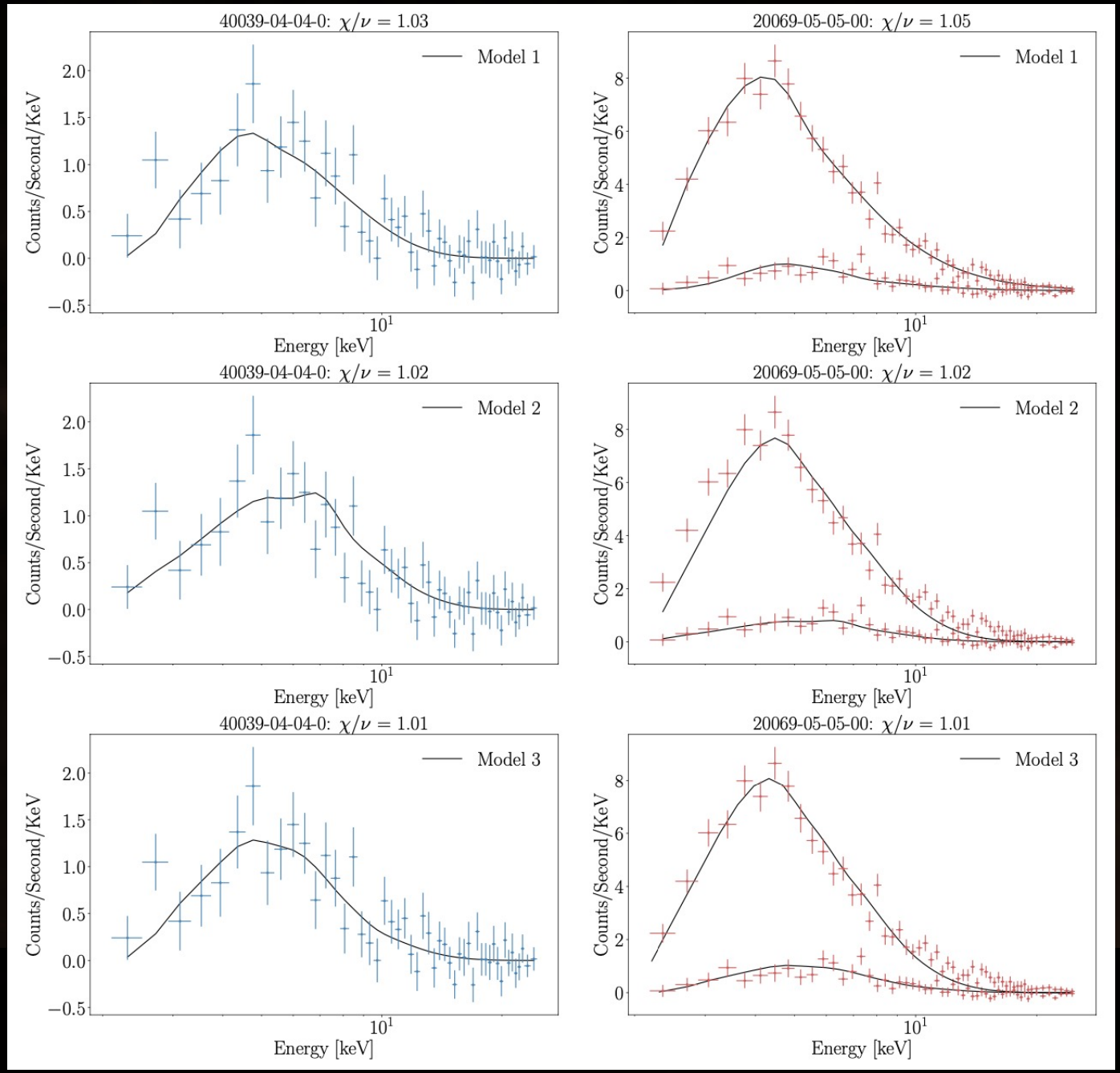
1) TBABS*(DISKBB+BBODYRAD)

Negligible Accretion Disc Contribution

2) TBABS*ZXIPCF*PEXRIV

3) TBABS*ZXIPCF*XILLVERNS

High Ionisation: log(xi) = 3.3 – 3.5



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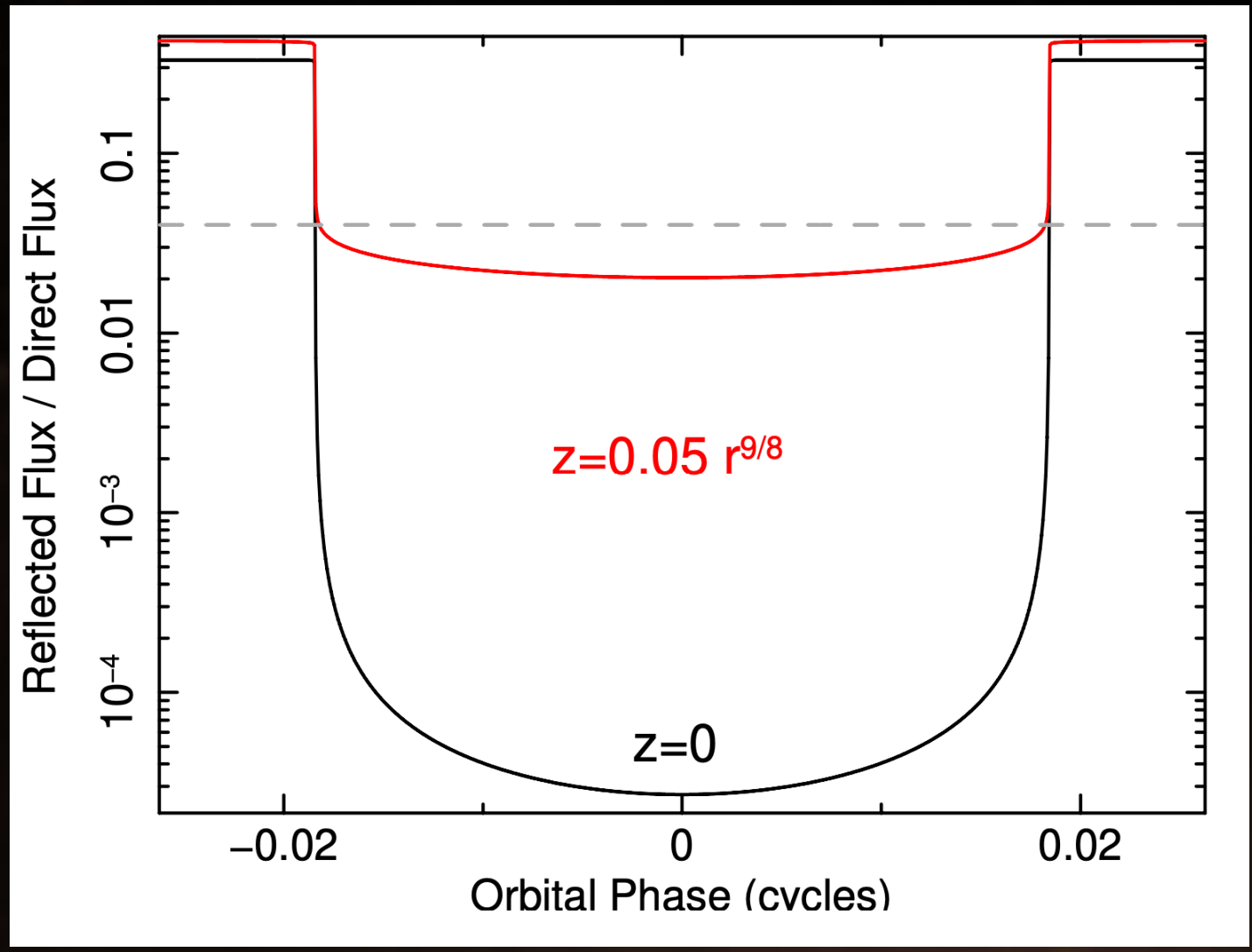
Outer Disc Reflection?

Flat Disc (Black)

Maximally Flared Disc (Red) = 2% Reflection

Grey Dashed Line, Residual In-Eclipse Flux = 4%



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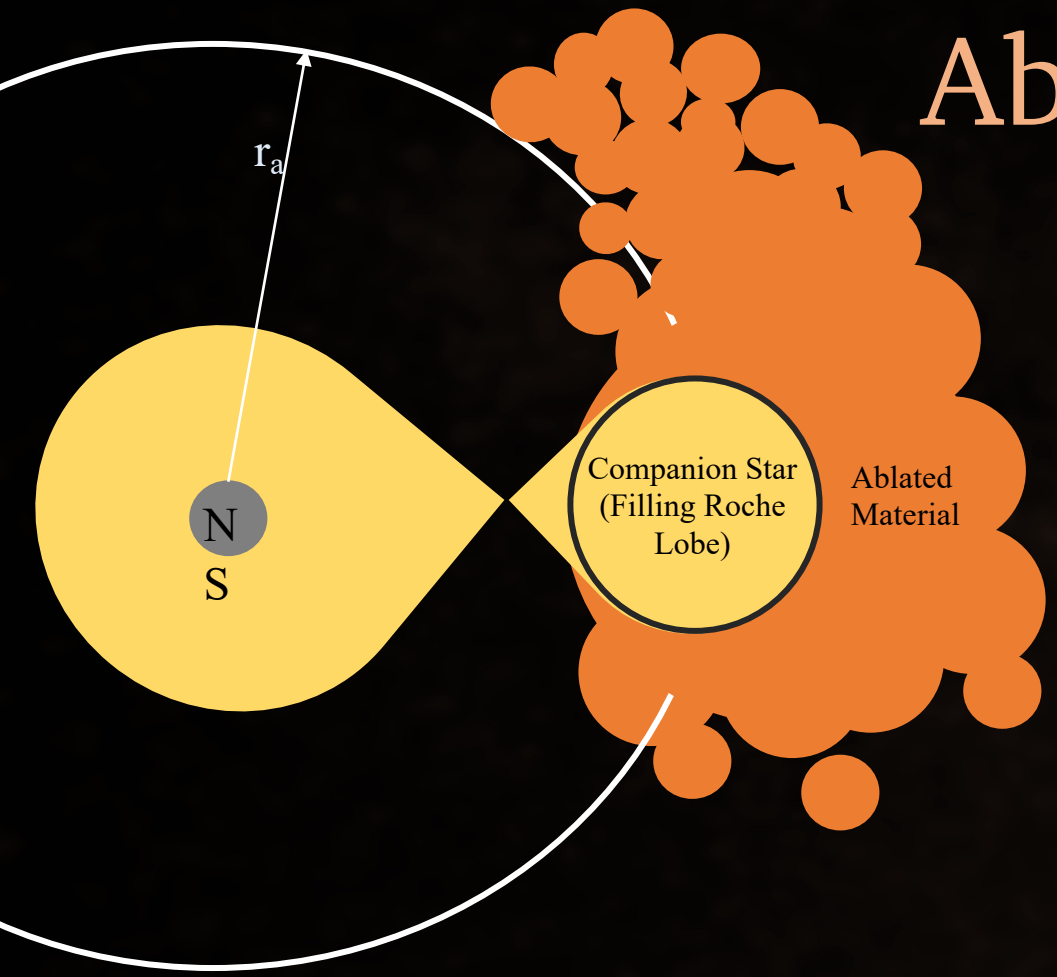
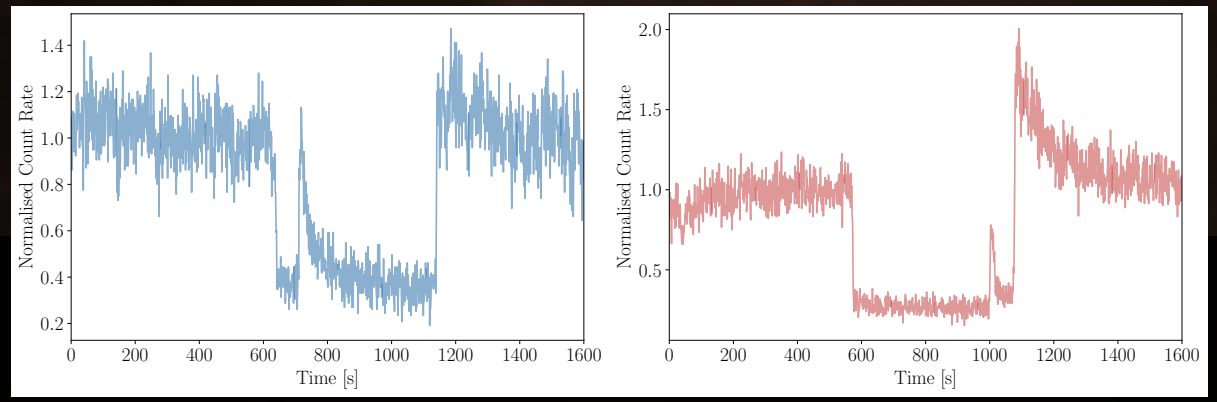
Ablated Outflow Reflection?



1. Spectral Analysis Implies Disc is not Visible
2. Consistent with Eclipse Analysis – Ablated Material Blocks View of Disc.
3. High Ionisation of Absorber is Consistent with Spectral Analysis.
4. Fits within the False Widow Evolutionary Scenario

… but disc wind reflection is also possible.



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