

Probing orbits of stellar-mass objects deep in
galactic nuclei with quasi-periodic eruptions

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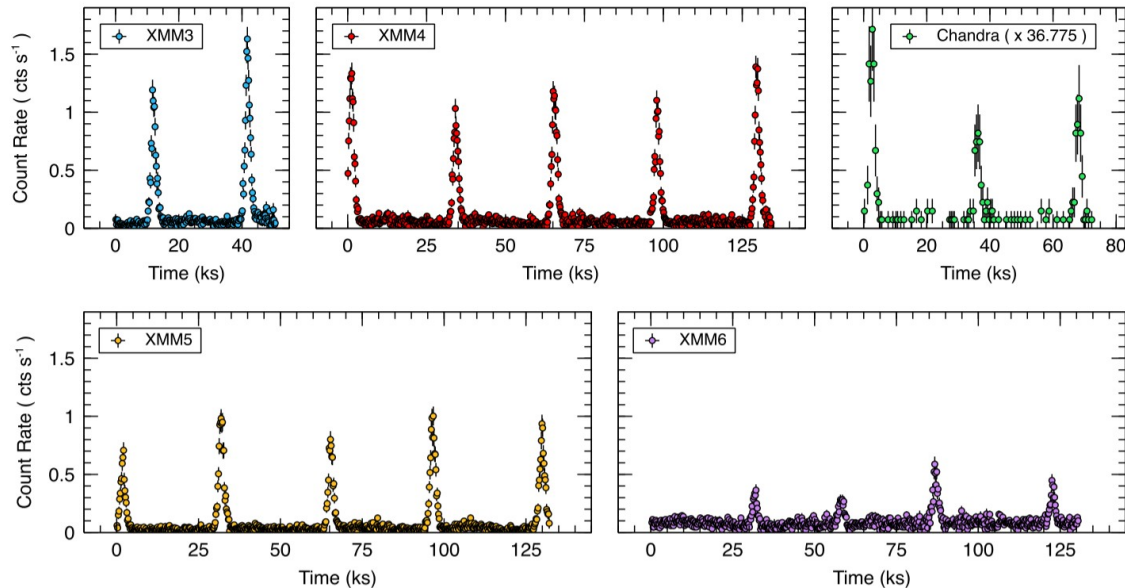
with Cong Zhou, Lei Huang, Carol Guo
2023.12.12 @Texas Symposium

quasi-periodic eruptions (QPEs)

- QPEs are fast bright soft X-ray bursts repeating every O(1-10) hours with peak luminosity $\sim 10^{42}$ ergs/s.
- 6 QPE sources (e.g., GSN 069 and ERO-QPE1)

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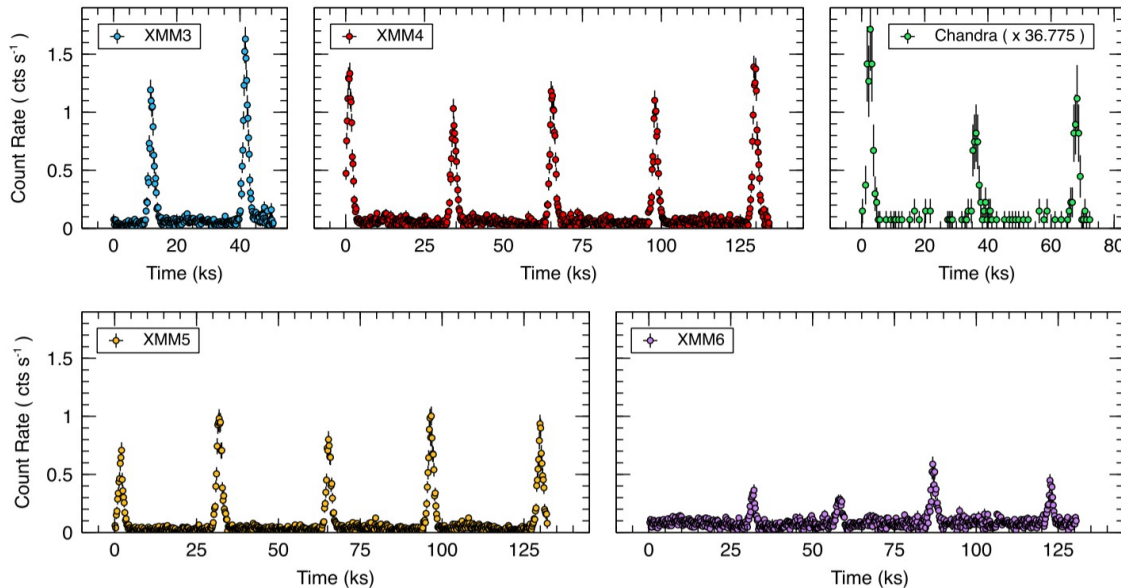
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Miniutti+2023

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1. $I_{\text{strong}} \& I_{\text{weak}}$

2. $T_{\text{long}} \& T_{\text{short}}$

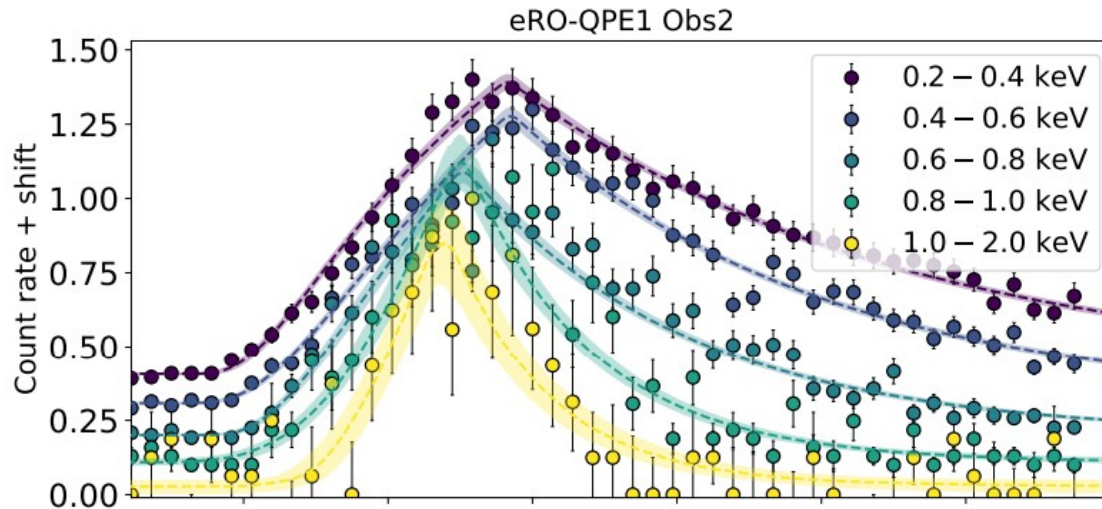
$$(\delta T/T)_{\text{long,short}} \sim 6\%$$

$$(\delta T/T)_{\text{sum}} \sim 0.3\%$$

3. TDE association (3/6)

quasi-periodic eruptions (QPEs)

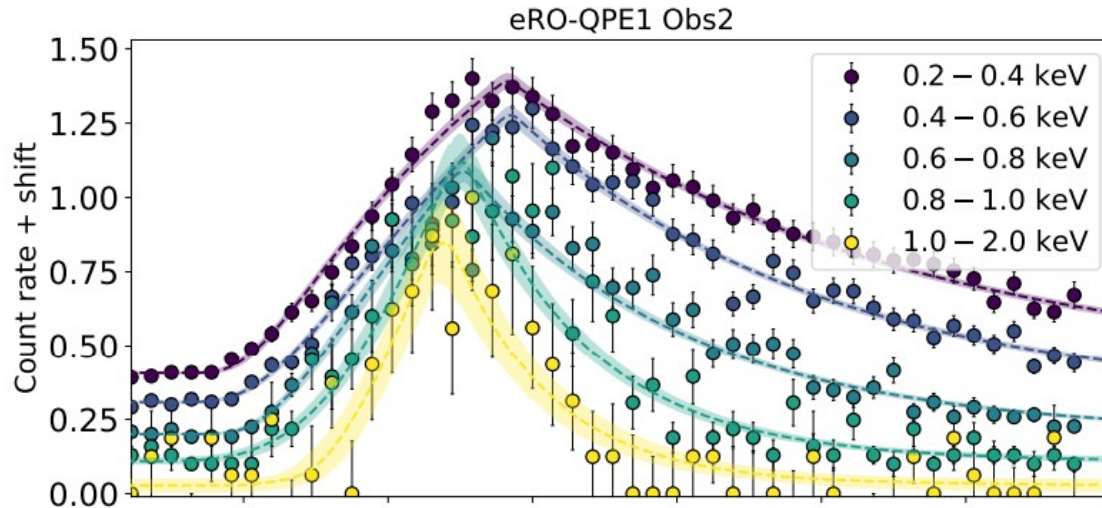
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Arcodia+2022

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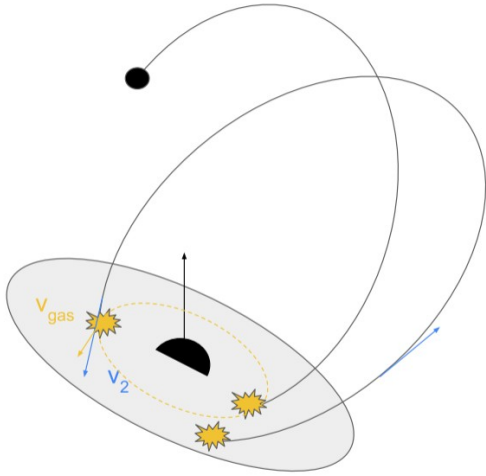


4. higher-energy peaks come earlier

5. fast rising slow decay

6. light SMBH (6/6)
1e5 -- a few 1e6 Msun

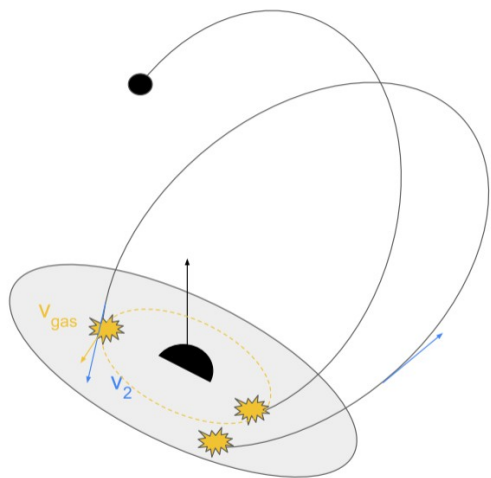
EMRI + TDE disk model



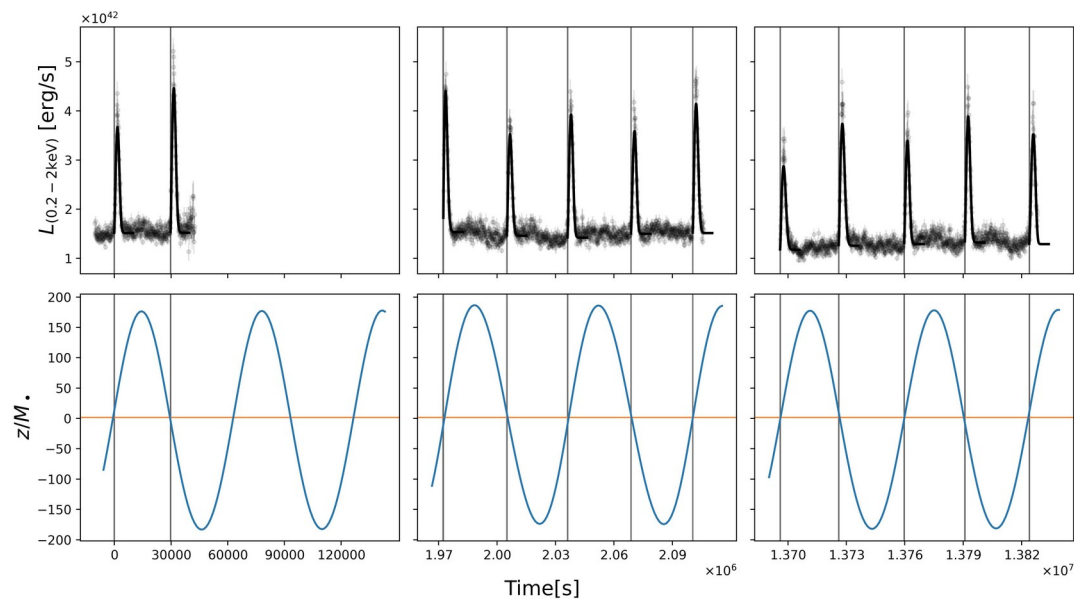
Franchini+2023: stellar mass BH

Linial+2023: normal star

EMRI + TDE disk model



Franchini+2023: stellar mass BH
Linial+2023: normal star



Zhou+(in prep): light curve + flare timing
With $M=7e5 M_{\text{sun}}$, $a = 212 M$, $e = 0.047$

Summary and questions

1. EMRI+TDE disk model vs other models ?

e.g., Repeating partial TDEs, disk instabilities

2. If EMRI+TDE disk:

What can we learn from the orbital properties ($a \sim 100 M$, $e < 0.1$) ?

- Loss cone channel (no)
- Hills mechanism (?)
- Wet channel (yes)
- Other sources (?)

