IMAGINARY QPO in the SOFT-TO-HARD TRANSITION of MAXI J1820+070

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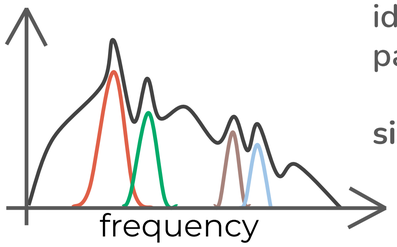
Power spectrum has been the primary tool for identifying variability for the past ~40 years

but this can lead us to miss significant signals.



HOW TO SPOT THEM?

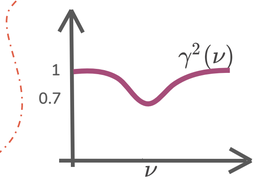
Cross spectrum

is more sensitive than the PS to signals with **large imaginary part** and a **small real part** in the CS

Lags *ν*-spectrum

can unveil an **independent component** that produces an **abrupt change in the lags behaviour**

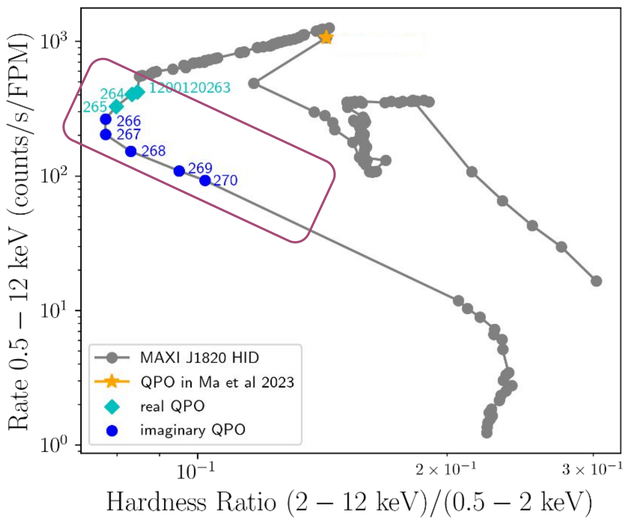
Coherence function



drops when 2 signals with different amplitudes and phases **overlap** in *ν*

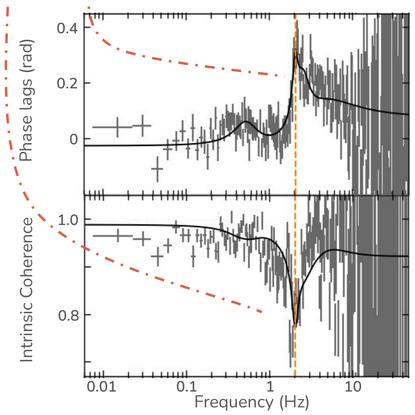
Vaughan & Nowak (1997)

SOFT-TO-HARD TRANSITION of MAXI J1820+070



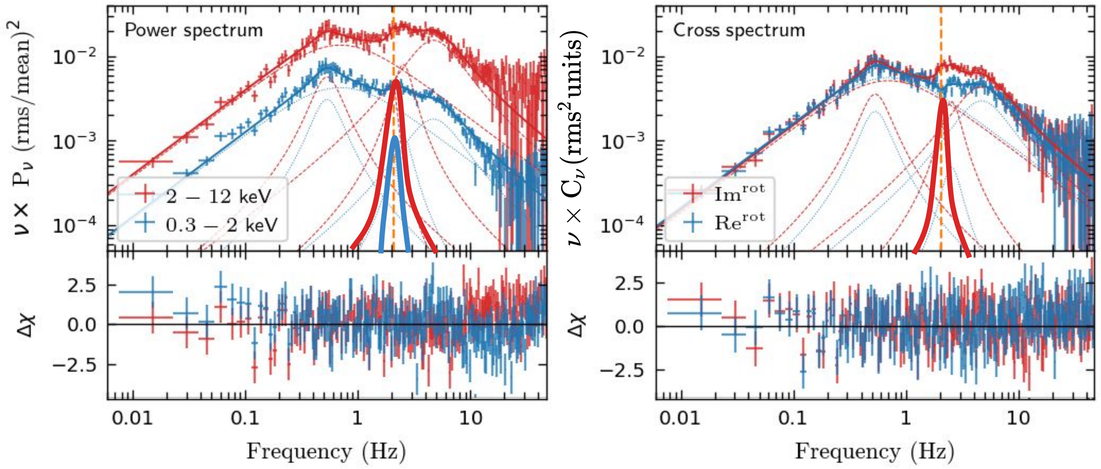
Analysing the NICER data of the transition we found several observations with

drop in the coherence function
& abrupt change in lag spectrum

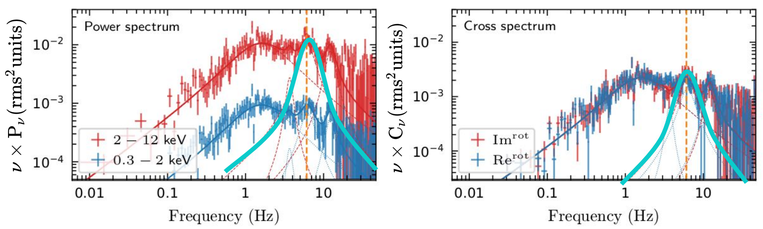


These models were derived from the best-fitting model of the PS and CS following technique of Mendez et al 2024.

We **simultaneously** fitted the PS in two energy bands and the real and imaginary parts of the CS using linear combinations of the same Lorentzian functions.



The first 3 observations of the transition do **not** exhibit narrow features in the lag spectrum or coherence function. By fitting a multi-Lorentzian model, we found a significant QPO that we identified as type-C QPO.



type C QPO morphs into the imaginary QPO as the source evolves, with decreasing ν for harder states.

~ 9 Hz
ν
~ 1 Hz

We found a component that was **not significant in neither of the PS** but it was **needed in the CS: imaginary QPO**

large imaginary part & small real part in CS ↔ large hard lag

Including this narrow component is the only way to recover the narrow features in the lags & coherence

The imaginary QPO is a real and independent component of variability

References:

Méndez, M., Peirano, V., García, F., et al. 2024, MNRAS, 527, 9405 - Vaughan, B. A. & Nowak, M. A. 1997, ApJ, 474, L43