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Unveiling hidden variability: an imaginary QPO in the soft-to-hard transition of MAXI J1820+070

Black hole X-ray binaries (BHXBs) show strong variability in their X-ray light curves over a broad range of time scales. Fast X-ray variability in BHXBs is key to understanding the properties of the innermost regions of the accretion flow in these sources. Among the most notable features of this variability are quasi-periodic oscillations (QPOs), which provide a unique insight due to their well-defined frequencies.
A recent study shows that signals with a large Imaginary and a small Real part of the cross spectrum (CS) can get hidden in the power spectrum (PS) when overlapping in frequency with other signals. For the last four decades, the power spectrum (PS) has been the primary tool for identifying the variability components, therefore, we have been missing significant signals. In this talk, I will show how using a novel technique, we revealed a narrow hidden variability component in the PS of the BHXB MAXI J1820+070. We call this component "imaginary QPO", given its large Imaginary part in the CS. Moreover, we found that this imaginary QPO evolves smoothly along the soft-to-hard transition of MAXI J1820+070, decreasing its characteristic frequency together with other variability components. We also found that this imaginary QPO morphs from a type-C QPO detected in earlier observations when the source just left the High-Soft state. The presence of a similar imaginary QPO in Cygnus X-1, and its possible link to the type-C QPO, suggests a deeper connection between these timing features and the accretion dynamics during state transition.

Affiliation

Kapteyn Astronomical Institute (RUG) - Instituto Argentino de Radioastronomía (IAR-CONICET)

E-mail

bellavitacandela@gmail.com

Author: BELLAVITA, Candela Abril (Kapteyn Astronomical Institute (RUG) - Instituto Argentino de Radioastronomía (IAR-CONICET))

Co-authors: GARCIA, Federico (Instituto Argentino de Radioastronomia (IAR-CONICET)); Prof. MENDEZ, Mariano (Kapteyn Astronomical Institute, University of Groningen); Dr KOENIG, Ole (Center for Astrophysics - Harvard & Smithsonian); MA, Ruican

Presenter: BELLAVITA, Candela Abril (Kapteyn Astronomical Institute (RUG) - Instituto Argentino de Radioastronomía (IAR-CONICET))

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