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A Unified Framework for Type B and C QPOs via Disk Warping in X-ray Binaries

Low-frequency quasi-periodic oscillations (LFQPOs) are among the most striking timing features in black hole X-ray binaries, yet their physical origin and diversity remain unresolved. In this talk, I will present a new framework that naturally explains the transition from type C to type B QPOs through the progressive warping of the accretion disk. I will show that when the transition radius of the hot inner flow drops below a critical break radius, the outer disk begins to warp. This leads to several observational signatures: a sharp drop in QPO amplitude, the disappearance of broadband noise, and a modification of lag behavior—hallmarks of the hard-to-soft transition. This framework also accounts for the consistent properties of type B QPOs across different systems and offers a physical explanation for the lack of simultaneous type B and type C QPOs. If time permits, I will also discuss how this geometry-dependent behavior may generate the flip-flop variability observed in several X-ray binaries. Overall, this model provides a predictive, physically grounded framework to interpret LFQPO behavior across spectral states and offers new insights into the interplay between accretion geometry and variability.

Contribution

Oral talk

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