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Resonant Excitation of Disk Oscillations in Deformed Disks: An Alternative Method

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High frequency quasi-periodic oscillations (HF QPOs) have been observed in low-mass X-ray binaries. Clarification of the origin of the oscillations will give an important clue to the structure of the innermost part of relativistic disks and the spin of the central sources.

Kato (2004) showed that in deformed (warped or eccentric) relativistic disks a set of positive- and negative-energy oscillations can be resonantly excited by nonlinear interaction through disk deformation, and suggested that these resonantly excited oscillations are one of possible origins of HF QPOs.

In this talk, we present a new analytical method for studying excitation of disk oscillations in deformed disks. Disk oscillations are decomposed into an orthogonal set of oscillations, and simultaneous differential equations describing time variation of the amplitudes of these oscillations are derived. The time variation of the amplitudes occurs by non-linear couplings among oscillations through disk deformation. In an idealized case where only two oscillations resonantly couple through deformation, the excitation condition is found to be that these two oscillations have opposite signs in their wave energy, which is consistent with the results obtained by Kato by a different analytical method.