J64a Excitation of Trapped Oscillations in Accretion Disks around Black Holes

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High-frequency quasi-periodic oscillations (QPOs) have been detected in the spectrum of black-hole X-ray binaries. They appear only in high-luminosity states and occur at fixed frequencies in the range of 100-450 Hz. According to one model, QPOs arise from oscillations resonantly excited in deformed disks. An oscillation trapped in the inner region of an accretion disk with a global deformation (warping or eccentricity) gives rise to an intermediate oscillation through non-linear coupling mechanism. Via resonant coupling with the deformed disk, the intermediate oscillation then amplifies the original oscillation.

In this paper, we study this mechanism numerically, following the formulation by Kato (2008). For simplicity, we take the pseudo-Newtonian potential to emulate the relativistic effect. We also assume that the accretion disk has a constant thickness. We first solve linear hydrodynamic equations to obtain a neutral oscillation trapped in the inner part of the accretion disk, and then solve another set of equations with a nonlinear coupling term between the original oscillation and the disk deformation to obtain an intermediate oscillation. Finally, the growth rate of the original oscillation is calculated by evaluating the resonant interaction between the intermediate oscillation and the disk deformation. We find that the trapped g-mode oscillations with the eigenfrequencies close to the maximum of epicyclic frequency are amplified by the resonant excitation.