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Excitation of Trapped Oscillations in Accretion Disk around Black Holes II

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High-frequency quasi-periodic oscillations (HFQPOs) have been detected in the X-ray variability of black-hole candidates. According to one model, HFQPOs arise from oscillations resonantly excited in deformed disk. An inertial oscillation trapped in the inner region of an accretion disk, coupled with the global deformation (warping or eccentricity) of the disk, through non-linear coupling mechanism, gives rise to an intermediate oscillation. Via resonant coupling with the deformed disk, the intermediate oscillation amplifies the original oscillation.

Following the formulation by Kato (2008), we study this mechanism numerically for a warped disk, where the resonant excitation via intermediate oscillation with mode number$(\tilde{m}, \tilde{n})$ = (1,0) and (1,2) is expected. For simplicity, we adopt Newtonian hydrodynamic equations with relativistic expressions for the characteristic frequencies. We also assume that the accretion disk is isothermal and has a constant scale-height.

In the previous meeting, we have presented our results for intermediate oscilation with $(\tilde{m}, \tilde{n}) = (1, 0)$ where we find that the first overtones of trapped g-mode oscillations with eigenfrequencies close to the maximum of epicyclic frequencies are excited by the resonant excitation. However, since then, we have made corrections in our formulation on the coupling mechanism, including terms that are previously ignored in the calculation. After the corrections, we find that the growth rates increases as the the warp amplitude increases or the sound speed decreases, while the dependence of the growth rate on the spin parameter is not monotonic. In this paper, we also report on the result for the excitation via intermediate oscillation with $\tilde{m}, \tilde{n} = (1, 2)$.