Abstract

In this dissertation, we studied the stability and variability of luminous non-stationary accretion disks around a white dwarf, neutron star or stellar mass black hole. The work in this thesis includes analytic, semi-analytic and global three dimensional general relativistic radiative magnetohydrodynamical (GRRMHD) simulations. The analytic and semi-analytic approaches are followed to solve two problems: (i) the effect of rapid rotation of accreting star on the geometrically thin accretion disk around it, (ii) the relativistic effects on the disk corona due to luminosity enhancement of the accreting X-ray source. The global numerical simulations address two main achievements: (i) thermal and viscous instability in the geometrically thin radiation pressure dominated disks, (ii) oscillation eigenmodes of hydrodynamical tori subjected to radial, vertical and diagonal velocity perturbations. In our global simulations of radiation pressure dominated disk, we confirm the analytic and local simulation findings of thermal instability. We also see the first evidence of viscous instability in our radiation pressure dominated thin disk simulations. In order to study high frequency quasi-periodic oscillations, a set of ray-traced GRHD simulations of oscillating tori has been carried out. In our study of oscillating tori, we also propose a possible model which can correspond to the 3:2 frequency ratio observed in certain X-ray binary sources. The numerical simulations are carried out using the GRRMHD code *Cosmos++*. Raytracing of hydro simulations to compute the power-density spectra has been performed using relativistic raytracing code *GYOTO*.