N36b Viscous Decretion Disks around Be stars in Be/X-ray Binaries

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A Be/X-ray binary consists of a compact star (in general, a neutron star) and a Be star. The X-ray emission is due to accretion of matter from the Be star by the compact companion. Since the mass ratio of these two stars is about 0.1, the disk around the Be star is likely truncated due to the tidally-induced eccentric instability.

In this paper we examine the structure and the long-term variabilities of disks around Be stars in Be/X-ray binaries, based on the viscous decretion disk scenario (Lee et al. 1991, MNRAS 250, 432). For simplicity, we consider an isothermal disk truncated at the radius of 3:1 resonance. We adopt the Shakura-Sunyaev's α-viscosity prescription.

We find that the outflow in disks formed by viscous decretion is highly subsonic. Roughly, the outflow velocity increases as r and the surface density decreases as r^{-2}. We also find that the decretion disks are in general overstable for one-armed ($m = 1$) spiral modes. The growth rate is of the order of $\alpha(H/r)^2\Omega$, which is about 1–10 yr for $\alpha \sim 0.1$, where H is the disk scale-height and Ω is the angular frequency of disk rotation. The characteristics of these modes agree with the long-term variabilities of the Balmer line profiles observed for some systems, which are similar to those of isolated Be stars except for much shorter periods (Negueruela et al. 1998, A&A in press). In the present model, the orbital phase of the periodical (Type I) outbursts depends on the phase and the amplitude of one-armed modes in Be-star disks.