N41b Tidal Truncation of Be-star Disks in Be/X-ray Binaries

Be/X-ray binaries form a major subset of high mass X-ray binaries. These are systems consisting of a Be star earlier than B2 and a compact star, which is mostly a neutron star. The orbit is wide and eccentric. The mass ratio of the compact star to the Be star is $\lesssim 0.1$.

A Be star has two-component envelope, a polar wind emitting UV radiation and an equatorial disk from which Balmer lines arise. Reig et al. (1997) found that for Be/X-ray biraries the maximum equivalent width of the Hα line correlates with the orbital period of the system. This indicates that the equatorial disks around Be stars in Be/X-ray binaries are truncated by something related to the binary separation.

In this paper, we study the tidal truncation of disks around Be stars in Be/X-ray binaries, assuming that the Be-star disks are formed by viscous decretion with Shakura-Sunyaev's α-viscosity. From the criterion for tidal truncation obtained from the comparison of the viscous torque and the tidal torque applied to the gas at a given radius [see Artymowicz and Lubow (1994)], we have a critical value of viscosity parameter, $\alpha_{\rm crit}$, at each resonance radius, where the disk is truncated at the given resonance if $\alpha < \alpha_{\rm crit}$. As a case study, we evaluate the tidal truncation criterion for two Be/X-ray binaries, A 0535+262 ($P_{\rm orb} = 110.3\,{\rm d}$, $e = 0.47$) and 4U 0115+634 ($P_{\rm orb} = 24.3\,{\rm d}$, $e = 0.34$), and find that $\alpha \sim 0.1$ is compatible with the disk radii estimated from the Hα observations for these systems.

References

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