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Light curve modeling for time-dependent accretion disks in X-ray novae with general relativity effects taken into account

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Abstract

We present a method of modeling X-ray and optical light curves of time-dependent accretion α-disks in X-ray novae. The model is based on an analytic solution for α-disk evolution after the outburst maximum. The method involves relativistic effects near a Kerr black hole and self-irradiation of an accretion disk. The method is applied to the outbursts of X-ray Nova Monocerotis 1975 (A 0620-00) and X-ray Nova Muscae 1991 (GRS 1124-68). Recently, narrow limits were obtained for the masses and the distances of these binaries (11 ± 2M⊙, 1.1 kpc for A 0620-00 and 7 ± 0.6M⊙, 5.1 kpc for GRS 1124-68, Gelino et al. (2001a,b)). This allows us to limit other model parameters: Kerr parameter (0.5-0.7 and ~ 0.95 respectively for A 0620-00 and GRS 1124-68) and α-parameter (0.6-0.8 and 0.4-0.5). The inner radius of the accretion disk in GRS 1124-68 has to be few times larger than that of the last marginally stable orbit. Modeled disks in both systems should be thicker than in the standard theory and should thermalize a significant part of the incident X-ray flux (≳ 20%). Possible reasons for these results are discussed.

Keywords

Accretion disks, Binaries, Novae: Individual (Nova Mon 1975; Nova Mus 1991)