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Relation between the X-ray and optical luminosities in binary systems with accreting nonmagnetic white dwarfs

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Abstract

We investigate the relation between the optical (g-band) and X-ray (0.5-10 keV) luminosities of accreting nonmagnetic white dwarfs. According to the present-day counts of the populations of star systems in our Galaxy, these systems have the highest space density among the close binary systems with white dwarfs. We show that the dependence of the optical luminosity of accreting white dwarfs on their X-ray luminosity forms a fairly narrow one-parameter curve. The typical half-width of this curve does not exceed 0.2-0.3 dex in optical and X-ray luminosities, which is essentially consistent with the amplitude of the aperiodic flux variability for these objects. At X-ray luminosities Lx ~ 1032 erg s-1 or lower, the optical g-band luminosity of the accretion flow is shown to be related to its X-ray luminosity by a factor ~2-3. At even lower X-ray luminosities (Lx ≲ 1030 erg s-1), the contribution from the photosphere of the white dwarf begins to dominate in the optical spectrum of the binary system and its optical brightness does not drop below Mg ~ 13-14. Using the latter fact, we show that in current and planned X-ray sky surveys, the family of accreting nonmagnetic white dwarfs can be completely identified to the distance determined by the sensitivity of an optical sky survey in this region. For the Sloan Digital Sky Survey (SDSS) with a limiting sensitivity mg ~ 22.5, this distance is ~400-600 pc.

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Keywords

binary systems, white dwarfs, X-ray and optical luminosities