HARDNESS RATIO IN EVOLVING LOW-MASS X-RAY BINARY SYSTEMS

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Spectral observations of low-mass X-ray binaries (LMXBs) show that the soft component usually dominates over the hard one. These results provide additional support to an interpretation based on models of LMXBs in which the neutron star while, on the average, spinning up, is also experiencing a spinning down torque. Under these conditions, a fraction of the luminosity associated with the gravitational release of energy on the surface of the accreting neutron star may manifest itself as luminosity originating in the inner part of the accretion disk. It is probably possible to separate the two contributions; the stellar luminosity can be associated with the hard component of the spectrum and the disk luminosity, related to the exchange of energy due to the torque between the rapidly spinning neutron star and the accretion disk, can be associated with the soft spectral component.

We have calculated the evolution of the binary system and of the stellar and disk luminosities for several initial conditions with H and He companion stars. The hardness ratio turned out to be quite sensitive to the evolution of the mass transfer rate, or, in other words, to the nature of the companion star and to the nature of the torques. In particular, for a He companion, a regime exists in which the energy released in the slowing down of the neutron star is in excess of the accretion energy. This slowing down energy is assumed to be deposited not on the neutron star surface but mostly in the disk.

We conclude that in the course of the evolution of LMXBs, from 10^{37} ergs s^{-1} down to 10^{36} ergs s^{-1}, the hard component may become more dominant depending upon the mechanism by which spin down energy is deposited in the disk and on the nature of the companion star. A survey of a sample of such sources can thus provides clues to the actual form of the torques.

D. J. Helfand and J.-H. Huang (eds.), The Origin and Evolution of Neutron Stars, 199.