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The thickness of accretion α-disks: Theory and observations

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Abstract

Observations of X-ray binaries indicate substantial half-thicknesses for the accretion disks in these systems (up to $h/R \approx 0.25$, where h is the disk half-thickness and R its radius), while standard α accretion disks predict appreciably smaller half-thicknesses. We study the theoretical vertical structure of such disks using two independent numerical methods, and show that their maximum half-thicknesses in the subcritical regime cannot exceed $h/R \approx 0.1$. We consider various reasons for the apparent increase in the disk thickness, the most probable of which is the presence of matter above the disk in the form of a hot corona that scatters hard radiation from the central source and inner parts of the disk. As a result, the observed thickness of the disk and the illumination of its outer parts effectively increase. This mechanism can also explain both the optical-to-X-ray flux ratio in these systems and the observed parameters of eclipsing X-ray binaries. © 2007 Pleiades Publishing, Ltd.

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