The Complex Spectrum of Cygnus X-1 in the Intermediate State: A New Twist on a Familiar Black Hole

Miller, J. M.(*MIT*) Marshall, H. L., Remillard, R. A., Wijnands, R., Pooley, D., Lewin, W. H. G. (*MIT*), Di Matteo, T. (*Harvard Univ.*), Fabian, A. C. (*Cambridge Univ.*), Cui, W. (*Purdue Univ.*)

Abstract

The behavior observed in Cygnus X-1 has formed a basis for understanding Galactic black hole systems. Yet, the state transitions and accretion flow geometry in even this system have been described with conflicting models. We recently observed Cygnus X-1 with the Chandra HETGS in the "intermediate" state, as it transitioned from an extended "high/soft" state episode to its persistent "low/hard" state. We find a narrow, neutral Fe K_{α} emission line, and discuss likely production mechanisms (e.g. disk reflection, the O-star companion itself, the companion wind). Chandra reveals a degree of complexity previously unseen in Cygnus X-1: we find a wealth of absorption and emission lines from highly ionized atomic species, which we discuss within the context of the O-star companion wind and an accretion disk corona. We will present our results in detail and discuss their impact on our understanding of this system and the models proposed to describe its behavior, as well as implications for other Galactic black hole systems.

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