APR11-2010-000069

Abstract for an Invited Paper
for the APR11 Meeting of
the American Physical Society

Measuring the Spins of Stellar-Mass Black Holes[1]

JEFFREY MCCLINTOCK, Harvard-Smithsonian Center for Astrophysics

Starting with Cygnus X-1 in 1972, we now have a good sample of 23 stellar-mass black holes, which are located in X-ray binary systems. During the past five years, we have measured the spins of nine of these black holes. The values we find cover the full allowable range of prograde spins from $a/M = 0$ to > 0.98. These data are used to argue (1) that the high spins of at least some of these black holes are natal, and (2) that the relativistic jets observed for two low-spin black holes are powered largely by the accretion disk, rather than by the spin energy of the black hole. We measure spin by fitting the thermal continuum X-ray spectrum of the black hole to the relativistic accretion-disk model of Novikov and Thorne, thereby determining the radius of the inner edge of the disk. We identify this disk radius with the black hole's innermost stable circular orbit (ISCO). We then trivially obtain the spin from the ISCO radius, which depends only on the spin and mass of the black hole. Strong theoretical evidence that the thin accretion disks we study are sharply truncated at the ISCO, and that they are well-described by the Novikov-Thorne model, is provided by our GR MHD simulations. Likewise, strong empirical support for identifying the measured disk radius with the radius of the ISCO is provided by 26 years of observations showing the extreme stability of the inner-disk radius of LMC X-3. Thus, our measurements of spin are supported by both observational and theoretical evidence.

[1]Work supported in part by NASA grant NNX11AD08G.