Measuring the supermassive black hole parameters

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Recent X-ray observations of microquasars and Seyfert galaxies reveal broad emission lines in their spectra, which can arise in the innermost parts of accretion disks. Simulations indicate that at low inclination angle the line is measured by a distant observer as a characteristic two-peak profile. However, at high inclination angles ($> 85^0$) two additional peaks arise. This phenomenon was discovered by Matt et al. (1993) using the Schwarzschild black hole metric to analyze such effect. They assumed that the effect is applicable to a Kerr metric far beyond the range of parameters that they exploited. We check and confirm their hypothesis about such a structure of the spectral line shape for the Kerr metric case. We use no astrophysical assumptions about the physical structure of the emission region except for the assumption that the region should be narrow enough. Positions and heights of these extra peaks drastically depend on both the radial coordinate of the emitting region (annuli) and the inclination angle. It was found that these extra peaks arise due to gravitational lens effect in the strong gravitational field. Specifically, they are formed by photons with some number of revolutions around a black hole. This conclusion is based only on relativistic calculations without any assumption about physical parameters of the accretion disc like X-ray surface emissivity, etc. We discuss how an analysis of the iron spectral line shapes could give an information about an upper limit of the magnetic field near the black hole horizon. Based on results of numerical simulations we discuss the origin of double peaked and double horned profiles and clarify the Müller & Camenzind hypothesis (2003).

Recently Holz & Wheeler (2002) have considered a very attracting possibility to detect retro-MACHOs, i.e. retro-images of the Sun by a Schwarzschild black hole. In this paper we discuss glories (mirages) formed near rapidly rotating Kerr black hole horizons and propose a procedure to measure masses and rotation parameters by analyzing these forms of mirages. In some sense that is a manifestation of the gravitational lens effect in the strong gravitational field near a black hole horizon and a generalization of the retro-gravitational lens phenomenon. We analyze the case of a Kerr black hole rotating at arbitrary speed for some selected positions of a distant observer with respect to the equatorial plane of a Kerr black hole. Some time ago Falcke (2000) suggested to search shadows at the Galactic Center. We also propose to use future radio interferometer RADIOASTRON facilities to measure shapes of mirages (glories) and to evaluate the black hole spin as a function of the position angle of a distant observer.