Black Holes from Stars to Galaxies – Across the Range of Masses
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Measuring the supermassive black hole parameters with space missions

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Abstract. 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. Recently Müller & Camenzind (2004) classified different types of spectral line shapes and described their origin. Zakharov (2006b) clarified their conclusions about an origin of doubled peaked and double horned line shapes in the framework of a radiating annulus model and discussed s possibility to evaluate black hole parameters analyzing spectral line shapes.

Keywords. Black holes – X-ray astronomy – supermassive black holes

There are a lot of papers discussing theoretical aspects of possible scenarios for generation of broad iron lines in AGNs, see for example, reviews by Fabian *et al.* (2000); Matt (2006). Moreover, an influence of microlensing on Fe K_α line shapes and spectra was discussed by Popovic *et al.* (2006); optical depths for these phenomena were calculated by Zakharov *et al.* (2004, 2005a,b). Formation of shadows (mirages) is another example when general relativistic effects are extremely important and in principle they could be detected with forthcoming interferometrical facilities such as Radioastron, Millimetron, MAXIM, as was shown by Zakharov *et al.* (2005c,d,e,f,g,h) (perspective studies of microlensing with Radioastron facilities were discussed (Zakharov (2006a)). Observations of shadows could give a real chance to observe "faces" of black holes of black holes and confirm general relativity predictions in the strong gravitational field, and to obtain new constraints on alternative theories of gravity.

Müller & Camenzind (2004) classified different types of spectral line shapes and described their origin. Zakharov (2006b) and Zakharov & Repin (2005, 2006) clarified their conclusions about an origin of doubled peaked and double horned line shapes. Based on results of numerical simulations we showed using a radiating annulus model that double peaked spectral lines arise for *almost any* locations of narrow emission rings (annuli) (except closest orbits as we could see below) although Müller & Camenzind (2004) concluded that such profiles arise for relatively flat spacetimes and typical radii for emission region about 25 r_g. We did not impose assumptions about an emissivity law; we only assume that the radiating region is a narrow circular ring (annulus). We used an approach which was discussed in details by Zakharov (1991a); Zakharov (1994a); Zakharov (1995, 2003, 2004, 2005); Zakharov & Repin (1999, 2002, 2003a,b,c, 2004a); Zakharov *et al.* (2003, 2004). The model is based on results of qualitative analysis done earlier by Zakharov (1986, 1988, 1989, 1991b).

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