

thus far has not been incorporated into any contemporary X-ray mission; (b) X-ray continuum fitting, which is already producing useful results; (c) the Fe K line profile, which has also yielded results, although the method is hampered by significant uncertainties; and (d) high-frequency QPOs, which arguably offer the most reliable measurement of spin once a model is established. We now consider each of these in turn.

8.2.1 Polarimetry

As pointed out by Lightman & Shapiro (1975) and Meszaros et al. (1988), polarimetric information (direction and degree) would increase the parameter space used to investigate compact objects from the current two (spectra and time variability) to four independent parameters that models need to satisfy. Such constraints are likely to be crucial in our attempts to model the hard state with its radio jet and the SPL state. However, because of the complexities of the accretion flows associated with these states (§4, §5, & §7) it appears unlikely that their study will soon provide quantitative probes of strong gravity. We therefore focus on disk emission in the thermal state.

The polarization features of BH disk radiation can be affected strongly by GR effects (Connors et al. 1980). The crucial requirement for a simple interpretation is that higher energy photons come from smaller disk radii, as they are predicted to do in conventional disk models (§7). If this requirement is met, then as the photon energy increases from 1 keV to 30 keV, the plane of linear polarization swings smoothly through an angle of about 40° for a $9M_\odot$ Schwarzschild BH and 70° for an extreme Kerr BH (Connors et al. 1980). The effect is due to the strong gravitational bending of light rays. In the Newtonian approximation, on the other hand, the polarization angle does not vary with energy, except for the possibility of a sudden 90° jump (Lightman & Shapiro 1976). Thus, a gradual change of the plane of polarization with energy is a purely relativistic effect, and the magnitude of the change can give a direct measure of a_* .

A model is now available in XSPEC that allows one to compute the Stokes parameters of a polarized accretion disk spectrum (Dovčiak et al. 2004). While the theoretical picture is bright, and very sensitive instruments can be built (e.g., Kaaret et al. 1994; Costa et al. 2001), unfortunately, results to date are meager and there are no mission opportunities on the horizon. Important advances in this promising area could be made by a relatively modest mission given that BHBs in the thermal state are bright.

8.2.2 Continuum Fitting

Pioneering work in fitting the spectrum of the X-ray continuum to measure spin was carried out by Zhang et al. (1997a), and the method was advanced further by Gierliński et al. (2001). Very recently, two developments have allowed this method to be applied more widely and with some confidence, namely: (1) models of thin accretion disks are now publicly available in XSPEC (“KERRBB”, Li et al. 2005; “KY”, Dovčiak et al. 2004) that include all relativistic effects and allow one to fit for a_* ; and (2) sophisticated disk atmosphere models now exist for computing the spectral hardening factor, $f_{\text{col}} = T_{\text{col}}/T_{\text{eff}}$ as a function of the Eddington-scaled luminosity of the disk (Davis et al. 2005).

This method of measuring a_* depends on the properties of thin accretion disks