Time Lags of black hole candidates

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Most black hole candidate X-ray binaries show time lags between softer and harder X-rays. The hard photons seem to arrive up to a few ms after the soft ones for a given Fourier frequency of the perturbation. The energy dependence of the time lags is roughly logarithmic. Up to now most theories fail to explain the observed magnitude of the lags or the observed cross/auto-correlation function.

One recent suggestion has been that the hard X-ray emission in XRBs (as in some AGN) is due to synchrotron radiation from a jet. Inspired by this, we show that the time lags can arise from a simple pivoting power law model, which creates the logarithmic dependence on the photon energy at once. For small variations of the power law index the lags can be derived analytical. They show the qualitative correct behavior of the dependence of the time lag on Fourier frequency. If one assumes variations of the power law index from -1.3 to -1.7 as observed for blazars the model can account for the observed magnitude of the time lags. As a second test we calculated the cross- and auto-correlation functions for our model which show qualitatively the observed behavior. The autocorrelation functions for higher energy have a narrower peak than the lower energy and the cross-correlation function is asymmetric but peaks nearly at zero.

We conclude the pivoting power law model can reproduce many statistical properties of black hole candidate XRBs and may be applicable to AGN.