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Abstract

- We studied black hole binary systems, observed with space based X-ray astronomy satellites like RXTE, Suzaku, and XMM-Newton. One unconfirmed black hole X-ray binary IGR J17497-2821, and two confirmed black hole, high mass X-ray binaries (HMXB) : LMC X-1 and Cyg X-1, are investigated in this thesis. The models are used to understand the structure of black hole surroundings and to explain strong gravitational effect on accretion disk and corona. A broad iron line observed in the energy spectrum is an outcome of a strong gravitational field..

- We analyzed a newly discovered, hard X-ray transient source, IGR J17497-2821, with XMM-Newton and RXTE observations. The system is identified in the hard state during the whole duration of the outburst. The accretion disk is discovered to be truncated at large radii, and the innermost temperature is found to be 0.2 KeV. We applied the DISKLINE model to account for general relativistic effects on the iron line profile, and estimated the innermost radius of the accretion disk, inclination angle, and the iron line energy. The innermost radius calculated from both DISKBB and DISKLINE showed a truncated disk like structure. We have also tested the dependence of DISKLINE and DISKBB parameters on different continuum models like POWERLAW, SIMPL, COMPTT, and NTHCOMP. The parameters of the accretion disk and the broad iron line were not found to be independent of continuum models. The fitting of the PDS requires three Lorentzians. This behaviour is consistent with the previous observations with RXTE. The value of the total integrated rms is as per expectation with the hard

state of the system . We reported that the integrated rms decreases with energy in the 0.3-2 KeV range, and increases above 2 KeV.

- We performed the spectral and temporal analysis of the persistent HMXB system, LMC X-1, with XMM-Newton and Suzaku observations. We have reported the discovery of the QPO and shown that it takes a value around 30 mHz. XMM-Newton and Suzaku shows this QPO when the disk fractions are 35 percent and 60 percent respectively. But XMM-Newton observation does not show any QPO like feature when the disk fraction is 94 percent. We reported that only the strong accretion disk is not responsible for the formation of QPO. We find that the QPO appears only in the presence of both a broad iron line and a strong corona. We performed the energy dependent analysis and reported that the energy band 0.3-2 KeV is dominated by accretion disk photons, does not show any QPO like features whereas the energy bands 2-5 and 5-10 KeV are dominated by photons from the corona and show QPO like features. We argued that the strong corona and the broad iron line has important role in the formation of the QPO. We have applied physical models to interpret the broad iron line and have estimated the innermost disk radius at $2.4^{+0.6}_{-0.2}$ r_g . This value shows that the black hole is of a rotating type.

- We studied the power density spectrum of HMXB system, Cyg X-1, with XMM-Newton observations. The shape of the PDS was found to depend on the under consideration energy band. It flattens as we go from the low energy band to the high energy band. The total integrated rms of the PDS decreases with energy in the LHS whereas in the HSS, the reverse is true.

- Still many features of power spectra like break frequencies, QPOs, different types of noise, etc., have no physical explanation. We have rejected many features because of their low significance (as below 3 σ). With the introduction of new physical models and the development of instrumentation, we will be able to explain the black hole binary systems more deeply. As our Indian space based X-ray astronomy satellite AstroSat has a high energy resolution, high time resolution, and a wide energy band. It can study many features of the source which were not possible earlier due to low resolution or narrow energy band. It can also be used to find the relation between spectral and temporal properties.