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| Title: | A comprehensive study of X-ray Binaries using the data from AstroSat, NICER, NuSTAR and Swift |
| Authors: | Gaur, Vishal (/jspui/browse?type=author&value=Gaur%2C+Vishal) |
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| Abstract: | Galactic neutron star and black hole transients are X-ray binaries that exhibit huge week- to-year-long luminosity increases (“outbursts”) with duty cycles on the order of years. These outbursts are thought to be the result of changes in the accretion rate and are ac- companied by changes in the accretion geometry. In this thesis, we have carried out a comprehensive analysis using the multi-band data for two such systems viz. Swift J0840- 3615 and RX J0209.6-7427. First part of my thesis deals with a study of an X-ray source, RX J0209.6-7427 (J0209) that belongs to a special class of ultraluminous X-ray sources (ULXs) known as pulsating ultra- luminous X-ray sources (PULXs). ULXs are extragalactic off-nuclear X-ray point sources with luminosities exceeding the Eddington limit of a stellar-mass black hole. Although most of these X-ray sources are believed to harbour an intermediate black hole but there exist a handful sources that are found to have a neutron star as a accretor. We have per- formed a detailed timing and spectral study of J0209 using the AstroSat data. Our detailed timing study revealed the evolution of spin period during ∼ 2 d long observation. We found the presence complex structures in the pulse profiles that are strongly energy-dependent. The pulse-profiles changed their shape from double to single-peaked at higher energies, indicating evolution in the beaming pattern. Finally, we also discuss our future plans in this direction. Swift J0840.7-3615 (J0840) is a peculiar X-ray transient discovered on February 5, 2020 with the B URST A LERT T ELESCOPE on-board the Neil Gehrels Swift Observatory. This was first reported as a Gamma-ray burst (GRB), however, intensive follow-up observations revealed that it is not behaving as GRB but an X-ray binary. During the 2020 outburst of J0840, intensive follow-up observations were made with NICER, and Swift. We obtained xiiiTarget of Oppurtunity (ToO) observations with AstroSat and this source was also observed with NuSTAR. In this thesis, we have used multi-band data to obtain insights into the true nature of this source. Our high time-resolution X-ray data did not reveal the presence of any pulsations, excluding its possibility to be an X-ray pulsar. Moreover, a system- atic spectral analysis performed using the data from Swift–XRT and NICER–XTI showed an evolution of photon index (Γ) with time, changing from ∼ 1 to 3 as the outburst de- cayed. Similar evolution of Γ has also been observed in other low-mass X-ray binaries such as MAXI J1957+032, indicating spectral softening as the outburst decays. The maximum X-ray flux recorded with Swift-XRT during this outburst is ∼ 2.4×10 −9 erg s −1 cm −2 . We also investigated into the nature of the accretor using Γ as a tracer of the spectral evolution with luminosity. We found that for the distance of 8 kpc, our results suggests that the source harbors a neutron star. Our UV and X-ray correlation studies suggested the presence of a viscous-heated accretion disc. |
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