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Revealing the spectro-polarimetric insights of black hole X-ray binaries with IXPE and Prospects of XPoSat

We present the results of a comprehensive spectro-polarimetric analysis of nine black hole X-ray binaries namely Cyg X-1, 4U 1630-47, 4U 1957+115, Cyg X-3, LMC X-1, LMC X-3, Swift J1727.8-1613, Swift J151857.0-572147 and GX 339-4 using quasi-simultaneous IXPE, NICER and NuSTAR observations. Polarimetric measurements with IXPE confirm the detection of a significant degree of polarization varying in the range of 1.44 – 21.41% (2 – 8 keV) for all the sources in different spectral states (LHS, HIMS, SIMS, HSS) except LMC X-1. The energy-dependent polarization study imparts a significant ($> 4\sigma$) increase of polarization degree with energy up to $\sim 11\%$ (25%) for 4U 1630-47 (Cyg X-3) whereas marginal ($< 2\sigma$) variation is observed for rest of the sources. A detailed spectro-polarimetric study (2 – 8 keV) and broad-band spectral analysis (0.7 – 60 keV) using the high quality IXPE, NICER and NuSTAR observations further corroborates the detection of polarization from model-dependent approach and reveals the morphologies of distinct spectral states, respectively. In addition, we find a significant correlation between the spectro-polarimetric parameters, tightly connected to the spectral states of the sources. Based on the obtained results, we infer the disc-jet-corona geometry of the sources in different spectral states and the possible origin of the polarized emissions. Finally, we discuss the prospects of India's first X-ray polarimetric mission, XPoSat in the context of IXPE results.

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