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A spectral and timing study of MAXI J1820+070 during it's outburst

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Black Hole X-ray binaries (BHXRBs) represent a unique class of astrophysical systems where a stellar-mass black hole accretes matter from a companion star via accretion disks. The accretion disk emits X-ray and UV because of the radiative losses. The transfer of matter can occur through continuous donor supply or episodic capturing of material from stellar winds, leading to sudden enhancements in X-ray flux known as outbursts. The instabilities in the disk, the geometry of the inner disk, the coupling between the disk and corona, etc, also contribute to the observed variability. The exploration of BHXBs contributes significantly to our understanding of the broader astrophysical landscape. These offer a unique testing ground for theories related to accretion physics, extreme gravity, jet formation, and the evolution of binary systems. Moreover, the BHXBs play a pivotal role in shaping galactic dynamics and evolution in their neighbourhood. Among the myriad BHXBs, MAXI J1820+070 stands out as a particularly intriguing target. This low-mass X-ray binary, located in the constellation Ophiuchus, garnered attention due to its exceptional outburst in March of 2018. The intense luminosity of MAXI J1820+070, which reached a peak X-ray flux of $\sim$ 4 Crab, allowed for detailed multi-wavelength campaigns, facilitating comprehensive investigations into its properties and behaviour. MAXI J1820+070 provides a unique opportunity to deepen our understanding of accretion processes near black holes, enabling the refinement of theoretical models and enhancing our ability to interpret observations across the electromagnetic spectrum. This study presents a comprehensive analysis of the archival X-ray data of \source\ from \nustar, \nicer, and \swiftxrt. The investigation focusses primarily on the system's spectral properties and timing characteristics. Spectral evolution and transitions between the hard and soft states are examined, with key parameters defining these states extracted. The inner disk radius was constrained to $lesssim$ 2.6 ISCO, extending down to 1.5 ISCO before the state transition. The disk temperature steadily increases from 0.71 keV, peaking at 0.8 keV. Our simplistic spectral model prefers different inclinations at various stages of the outburst, varying from $\sim$ 45 to 73 degrees, probably due to the model's limitations. Furthermore, the power-law index was restricted to $\sim$ 1.6 and the coronal electron temperature to $\sim$24-38 keV. We identify the presence and evolution of quasi-periodic oscillations and quantify them through Lorentzian curve fitting. Additionally, we identified hard and soft time lags, varying in amplitude and frequency during the outburst. Together, the spectral and timing results suggest a QPO originating from the corona, with the corona contracting during the hard state and expanding during the state transition. Possible signatures of outflows are detected through absorption features between 6.9-7.3 keV.

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