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Black hole spin–orbit misalignment in the X-ray binary MAXI J1820+070

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The observational signatures of black holes in X-ray binary systems depend on their masses, spins, accretion rate, and the misalignment angle between the black hole spin and the orbital angular momentum. We present optical polarimetric observations of the black hole X-ray binary MAXI J1820+070 with high-precision polarimeter DIPol-UF at the Nordic Optical Telescope, from which we constrain the position angle of the binary orbital axis. Combining this with previous determinations of the relativistic jet orientation, which traces the black hole spin, and the inclination of the orbit, we determine a lower limit of 40 deg on the black hole spin-orbital angular momentum misalignment angle. The misalignment must originate from either the binary evolution or black hole formation stages. If other X-ray binaries have similarly large misalignments, these would bias measurements of black hole masses and spins from X-ray observations. A high misalignment adds complexity to the models of the X-ray and optical quasi-periodic oscillations observed from black hole X-ray binaries in their hard state. We will also discuss the prospect of measuring misalignment using the polarimetric data from the Imaging X-ray Polarimetry Explorer.

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