(Sub)-millimetre Observations of MAXI J1820+070 (ASASSN-18ey) Suggest Jet Quenching on July 6

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*on **9 Jul 2018; 15:18 UT***
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Referred to by ATel #: 11887, 11899, 11936, 12157

Following the report of a hard to soft accretion state transition (ATel #11820) in the currently outbursting candidate black hole X-ray binary, MAXI J1820+070 (ATel #11399, #11400, #11404, #11406, #11418, #11420, #11440), we performed target-of-opportunity observations with the Atacama Large Millimeter/Submillimeter Array (ALMA) and the Submillimeter Array (SMA). We last observed MAXI J1820+070 with both ALMA and the SMA on April 12.

ALMA observations were taken on 2018 April 12 between 08:12-10:36 UTC and on 2018 July 6 between 01:31-06:18 UTC (MJD~58305.063-58305.262), in the 335.5-339.4 GHz and 347.5-351.5 GHz frequency bands. On April 12, the ALMA flux density at 343 GHz was very bright, ~120 mJy. Highly preliminary quality assurance checks on the July 6 observations detected MAXI J1820+070 with peak flux densities of 7.2 mJy (near 03 UT) and 4.9 (near 05 UT) mJy at a representative frequency of 343.5 GHz. We estimate that these preliminary measurements have absolute fluxes only good to ~25%, but that the drop in the flux density over two hours is likely real.

SMA observations occurred on 2018 April 12 between 11:00-20:00 UT and on 2018 July 6 between 09:05 - 11:40 UTC (MJD=58305.378-58305.486). During our observations, the two SMA receivers were tuned to local oscillator frequencies of 223/231 GHz (April 12) and 223/275 GHz (July 6). On April 12, the SMA flux density was ~100 mJy at 227 GHz (where the flux was highly variable during the observation). Stacking the two frequency bands together in the image plane on July 6, we detect a 3 sigma source coincident with the position measured from our previous mm/sub-mm observations (ATel #11440). Fitting a point source in the image plane we measure a preliminary flux density of 2.6 +/-0.8 mJy at 249 GHz.

We see clear evidence for reduced jet flux density values at mm/sub-mm frequencies between April 12 and July 6 observations. Over this same time, Swift/BAT only measured a moderate drop in hard X-rays (15-50 keV; 0.66+/-0.03 counts/cm^2/s on April 12 dropping to 0.21 +/-0.02 counts/cm^2/s on July 5/6 near 23:40 - 07:45 UTC). All measurements of the jets flux density on July 6 are significantly fainter than that predicted by the standard radio/X-ray correlation (f_r ∝

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f_x^0.7) based on their April 12 values. This strongly suggests that the radio jet was quenching on July 6 as the hard intermediate - soft intermediate state transition occurred (ATel #11823).

Radio through mm/sub-mm detections of black hole X-ray binaries typically arise from a compact synchrotron-emitting jet, characterized by a flat to slightly inverted, optically thick spectrum, that can break to a steep, optically thin spectrum at higher frequencies. The spectral break of the jet has been seen to move to lower frequencies as the compact jet is quenched during transitions to softer accretion states (e.g., Russell et al. 2014, MNRAS, 439, 1390). The ALMA and SMA flux densities on July 6 are increasingly more discrepant from those expected from the hard X-ray flux. Moreover, the measurement of the early ALMA flux density is nearly simultaneous with the recently reported ~6 mJy AMI detection towards the end of its monitoring on July 5/6 (ATel #11827). Our best explanations for these data requires that both the jet-power drop (relative to that expected from the accretion rate) and that either: (a) the radio--sub-mm spectrum has transformed from being inverted on April 12 to nearly flat on July 6 or (b) the spectral break moved from above 350 GHz on April 12 to below 350 GHz (possibly to frequencies below the SMA band) on July 6.

We thank the SMA and ALMA staff for rapidly scheduling our observations.

11827 AMI-LA 15.5 GHz observations of radio flaring from the black hole candidate MAXI J1820+070 in transition
11824 Other low-frequency optical QPO-like features in MAXI J1820+070 detected with IFI+IQUEYE@Galileo
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