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ATCA radio detection of the new X-ray transient MAXI J1813-095 as a candidate radio-quiet black hole X-ray binary

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*on **26 Feb 2018; 10:08 UT***
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We observed the new X-ray transient MAXI J1813-095 (ATels #11323, #11326, #11332) with the Australia Telescope Compact Array (ATCA) between 2018-02-22 20:52 UT and 2018-02-23 02:59 UT. Our observations were taken simultaneously at 5.5 and 9 GHz, with a bandwidth of 2 GHz at each frequency. We used 1934-658 for flux calibration and 1819-096 for phase calibration. Data were reduced in CASA version 4.7.0 (McMullin et al 2007). Imaging was carried out using a rubustness of 0 and flux densities were measured by fitting for a point source in the image plane. Due to its compact configuration (750B), we did not include the isolated antenna 6 when imaging, leading to angular resolutions of 108" x 7.31" and 68.4" x 4.63" at 5.5 and 9 GHz, respectively, at a position angle of -177.8 degrees east of north.

We significantly detect MAXI J1813-095 at the position (measured at 9 GHz):
RA (J2000): 18:13:34.073 +/- 0.014
Dec (J2000): -9:32:07.3 +/- 3.7
where the 1-sigma errors are the larger of the statistical error from the fitted position (Declination error) or the theoretical statistical error of centroiding (Beam/2*SNR; Right Ascension error). There may be larger systematic errors that we do not include. Using Galactic disk and bulge stellar populations (Juric et al 2008; McMillan 2011) and excluding the potential effect of any natal supernova kick, a source along this line of sight has a likely distance of 8^+6/-2 kpc (1 σ confidence interval). We measure flux densities of 0.69 +/- 0.06 mJy and 0.47 +/- 0.04 mJy at 5.5 and 9 GHz, respectively, implying a radio spectral index of α= -0.7 +/- 0.2, where $S_\nu \propto nu^\alpha$. Given this spectral index, the radio emission converts to a 5-GHz luminosity of $4*\pi*\nu\ f_\nu\ d^2$ = (3.3 +/- 0.4)E29*$(d/8kpc)^2$ erg/s.

Swift/XRT observed MAXI J1813-095 on 2018-02-21 (between 11:40:06 and 11:58:12 UT) and 2018-02-23 (22:25:00 to 22:44:00 UT), bracketing our radio observation. We extracted the data using the online XRT pipeline (Evans et al. 2009) and fit with an absorbed power-law model. On

2018-02-21 we find a best fit with an N_H of (9.6 +/- 0.2)E21 and a photon index of 1.45 +/- 0.07, providing an unabsorbed 1-10 keV X-ray flux of (7.8 +/- 0.2)E-10 erg/s/cm^2, corresponding to a 1-10 keV X-ray luminosity of (5.95 +/- 0.15)E36*(d/8kpc)^2 erg/s. On 2018-02-23, we find an N_H of (1.1 +/- 0.3)E21^2 and a photon index of 1.5 +/- 0.1, providing an unabsorbed 1-10 keV X-ray flux of (7.9 +/- 0.3)E-10 erg/s/cm^2, corresponding to a 1-10 keV X-ray luminosity of (6.05 +/- 0.15)E36*(d/8kpc)^2 erg/s.

The X-ray luminosities and spectrum are consistent with the source being in the low-Eddington part of the hard state, typical of the early part of an outburst. This state is associated with a compact steady jet, as opposed to jet ejecta (which is associated with the transition between the hard and soft state at higher luminosities). Espinasse and Fender (2018) suggested that radio-quiet hard state black hole X-ray binaries (BHXBs) have steeper indices (α=-0.2+/-0.3) than radio-loud hard state BHXBs (α=0.2+/-0.2). We measure a spectral index that is consistent with the optically thin spectra expected from jet ejecta (α~-0.6), potentially consistent with compact jets in radio-quiet hard-state BHXBs, and inconsistent with compact jets in radio-loud hard-state BHXBs.

Comparing the luminosities to those of hard-state XBs, MAXI J1813-095 is consistent with radio-quiet BHXBs and radio-loud neutron star XBs; however, we caution that this correlation would not apply to jet ejecta. Given the consistency of the X-ray properties, the radio spectral index and the radio/X-ray correlation with the properties of radio-quiet BHXBs, MAXI J1813-095 may be a radio-quiet BHXB.

We thank Jamie Stevens and ATNF staff for making these observations possible.

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