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LOFAR observations of MAXI J1820+070 (ASASSN-18ey) during its recent state transition

ATel #11887; *Jess Broderick (ASTRON), Thomas Russell (UvA), Joe Bright (Oxford), Antonia Rowlinson (ASTRON, UvA), Rob Fender (Oxford), Chris Done (Durham)*
on 25 Jul 2018; 14:28 UT
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Subjects: Radio, Binary, Black Hole, Transient

Referred to by ATel #: [11899](#), [11936](#), [12157](#)

Following reports of rapid X-ray spectral softening and a hard-to-soft state transition (e.g. ATels #[11820](#), #[11823](#)), we observed MAXI J1820+070 / ASASSN-18ey (e.g. ATels #[11399](#), #[11400](#), #[11418](#), #[11420](#)) with the Low-Frequency Array (LOFAR) on 2018 July 7, 10, 11 and 13. Each observation was 48 min in duration, centred at or near transit, preceded by a 10-min scan of the calibrator 3C295. The MJDs corresponding to the on-source times for the target are 58306.935-58306.969, 58309.927-58309.961, 58310.935-58310.968 and 58312.935-58312.968.

Similar to our previous LOFAR observation and detection of this source (ATel #[11609](#)), these high-band (115-189 MHz) observations were reduced with the Prefactor calibration pipeline (e.g. van Weeren et al. 2016, ApJS, 223, 2). A very preliminary reduction with a restricted bandwidth (115-158 MHz) yielded an average angular resolution of about 38" x 22" (average beam position angle 10 deg east of north), and RMS noise levels between 2.4 and 4.9 mJy/beam. MAXI J1820+070 / ASASSN-18ey is detected at the 5.5 sigma level in our first observation, but more marginally in the remaining runs (flux density of peak pixel = 3.0-4.8 x RMS). The flux densities of the target at a central frequency of 136.5 MHz are 27.1 +/- 5.6, 12.0 +/- 3.0, 11.5 +/- 2.7 and 14.7 +/- 5.1 mJy on July 7, 10, 11 and 13, respectively. In all cases, the quoted flux density is that of the peak pixel; uncertainties were calculated by combining the RMS and a 10 per cent calibration error in quadrature. The flux density scale is that of Scaife & Heald 2012 (MNRAS, 423, L30). Further direction-dependent calibration is planned, which will reduce the noise level.

A 15.5-GHz Arcminute Microkelvin Imager Large Array (AMI-LA) observation of this source was taken at the same time as our July 7 observation (ATel #[11827](#)), with a flux density of approximately 1.5 mJy. The instantaneous two-point spectral index, alpha, between 136.5 MHz and 15.5 GHz (flux density S_{ν} proportional to ν^{alpha}) is therefore approximately -0.6 for MJD 58306.935-58306.969, consistent with optically thin synchrotron emission. This spectral index, as well as our low-frequency light curve, suggests that we are observing the decay of the radio flare seen on July 6/7 (ATel #[11827](#)), which followed jet quenching on July 5/6 (ATels #[11827](#), #[11831](#); also see ATel #[11833](#)).

Related

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- [11833](#) Declining near-infrared flux from the black-hole candidate MAXI J1820+070 (ASASSN-18ey) in transition
- [11831](#) (Sub)-millimetre Observations of MAXI J1820+070 (ASASSN-18ey) Suggest Jet Quenching on July 6

A further LOFAR observation took place on July 20 (MJD 58319.900-58319.933), which is still to be reduced at the time of writing, and our final run is scheduled to take place on July 27 (MJD 58326), again centred at or near transit.

We thank the ASTRON Radio Observatory, particularly Roberto Pizzo and Matthijs van der Wiel, for promptly scheduling our LOFAR observations and pre-processing the data.

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- 11823** Continuing NICER observations of the state transition in ASASSN-18ey/MAXI J1820+070
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