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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
 Credential Certification: [Jess Broderick \(broderick@astron.nl\)](mailto:broderick@astron.nl)

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^{α}) 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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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.

- 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
- 11823** Continuing NICER observations of the state transition in ASASSN-18ey/MAXI J1820+070
- 11820** A rapid state transition in MAXI J1820+070
- 11723** Low-frequency optical QPO in MAXI J1820+070 detected with IFI+IQUEYE@Galileo
- 11661** KEGS Discovery of 9 Supernova Candidates in the K2 Campaign 17 field with Pan-STARRS PS1
- 11609** Simultaneous LOFAR and AMI-LA observations of MAXI J1820+070
- 11596** MAXI J1820+070 has optical period of 3.4 hours
- 11591** Further detection of the optical low frequency QPO in the black hole transient MAXI J1820+070
- 11578** Exponential increase in X-ray QPO frequency with time in MAXI J1820+070
- 11576** NICER observations of MAXI J1820+070: Continuing evolution of X-ray variability properties
- 11574** Optical/X-ray Flux Decoupling in MAXI J1820+070
- 11540** VLITE meter-wavelength detection of MAXI J1820+070 at 339 MHz
- 11539** The 30-day monitoring of MAXI J1820+070 at 4.7 GHz
- 11533** A bright mid-infrared excess in MAXI J1820+070
- 11510** Detection of optical and X-ray QPOs at similar frequencies in MAXI J1820+070
- 11490** INTEGRAL observations of MAXI J1820+070: public data products
- 11488** Low-frequency QPOs in MAXI J1820+070 as seen by INTEGRAL/SPI
- 11482** Palomar 60-inch SEDM classification of optical transients
- 11481** MAXI J1820+070: VLT and GTC spectroscopic follow-up shows a significant spectral evolution from the early stages of the outburst
- 11480** ePESSTO spectroscopic classification of optical transients
- 11478** INTEGRAL observations of MAXI J1820+070
- 11462** Near Infrared JHKs observations of the transient MAXI J1820+070 / ASASSN-18ey: Erratum on 2MASS counterpart designation
- 11458** Near Infrared JHKs observations of the transient MAXI J1820+070 / ASASSN-18ey
- 11451** Fast infrared photometry of the black-hole candidate

	MAXI J1820+070
11445	First measurements of linear polarization of MAXI J1820+070
11440	NOEMA Sub-millimetre Detection of MAXI J1820+070
11439	A flat radio spectrum of MAXI J1820+070
11437	Red sub-second optical flaring in MAXI J1820+070 observed by ULTRACAM/NTT
11432	Correlated Optical/X-ray Timing Variations in MAXI J1820+070 found by Swift UVOT and XRT
11427	The hard X-ray spectrum of MAXI J1820+070 observed by Swift/BAT
11426	Detection of 10-msec scale optical flares in the black-hole binary candidate MAXI J1820+070 (ASASSN-18ey)
11425	Optical Spectra of MAXI J1820+070 with Keck
11424	SOAR/Goodman optical spectroscopy of MAXI J1820+070
11423	NICER observations of MAXI J1820+070 suggest a rapidly-brightening black hole X-ray binary in the hard state
11421	Fast optical flaring in the suspected black-hole binary MAXI J1820+070 (ASASSN-18ey)
11420	AMI radio observations of the black hole candidate MAXI J1820+070
11418	Optical observations of MAXI J1820+070 suggest it is a black hole X-ray binary
11406	MAXI J1820+070: Errata and updated XRT Position
11404	MAXI J1820+070: Swift/UVOT counterpart correction
11403	Swift detection of MAXI J1820+070
11400	Optical follow-up of MAXI J1820+070 and possible identity with ASASSN-18ey
11399	MAXI/GSC detection of a probable new X-ray transient MAXI J1820+070
10459	Ongoing radio monitoring of Cyg X-1 with the RATAN-600 radio telescope

[**Telegram Index**]

R. E. Rutledge, Editor-in-Chief

Derek Fox, Editor

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`rrutledge@astronomerstelegam.org`

`dfox@astronomerstelegam.org`

`mansi@astronomerstelegam.org`