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## A bright mid-infrared excess in MAXI J1820+070

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on 12 Apr 2018; 20:57 UT  
Credential Certification: *David M. Russell (dave.russell5@gmail.com)*

Subjects: Radio, Far-Infra-Red, Infra-Red, Optical, X-ray, Binary, Black Hole, Transient

Referred to by ATel #: [11539](#), [11540](#), [11723](#), [12128](#), [12534](#)

MAXI J1820+070 (ASASSN-18ey) is a black hole candidate X-ray binary (e.g. ATel #[11399](#), #[11418](#), #[11420](#)). It is currently in a bright, hard spectral state (ATel #[11423](#), #[11427](#), #[11439](#)). Here, we report photometric mid-IR (5-12  $\mu\text{m}$ ) observations of the source with the VLT Imager and Spectrometer for the mid-InfraRed (VISIR; Lagage et al. 2004, The Messenger, 117, 12) mounted on UT3 of ESO's Very Large Telescope. The observations were made on 2018 April 8 (07:21-08:08 UTC) and April 9 (08:54-09:41 UTC) in clear conditions (MJD 58216-7). We also report on contemporaneous radio and optical data. MAXI J1820+070 is clearly detected (S/N > 200) in all four mid-IR filters. The following preliminary observed flux densities ( $F_{\nu}$ ) were calculated using observations of standard stars taken on the same nights:

Filter - Wavelength( $\mu\text{m}$ ) -  $F_{\nu}$ (mJy; Apr 8) -  $F_{\nu}$ (mJy; Apr 9)  
B11.7 - 11.52 - 376 - 378  
B10.7 - 10.65 - 353 - 368  
J8.9 - 8.72 - 303 - 297  
M-band - 4.85 - 292 - 271

Photometric errors are small but systematic errors are up to ~5-15% due to the limited number of available standard stars. These mid-IR flux densities are amongst the brightest reported in a transient low-mass X-ray binary.

## Related

- 12608** Optical spectroscopy and photometry of MAXI J1820+070 (ASASSN-18ey) during the large multi-wavelength re-brightening of March 2019
- 12596** Optical observations of MAXI J1820+070 confirm the re-brightening
- 12577** AMI-LA and Swift confirm the multi-wavelength re-brightening of MAXI J1820+070
- 12573** Swift observation of the re-brightening in MAXI J1820+070
- 12567** Re-brightening of ASASSN-18ey = MAXI J1820+070
- 12534** MAXI J1820+070 is close to quiescence
- 12157** MAXI 1820+070 has completed the decline from the recent optical re-brightening following the soft to hard transition
- 12128** Optical brightening of MAXI J1820+070 over the soft to hard transition observed with LCO and the Al Sadeem Observatory
- 12068** MAXI J1820+070 continuing its rapid evolution toward the hard state
- 12064** Swift observes MAXI J1820+070 in transition from the soft to the hard-intermediate state
- 12061** AMI radio detection of the black hole candidate MAXI J1820+070 during the soft to hard transition.
- 12057** MAXI/GSC detection of a rapid increase in the hard X-ray flux of MAXI J1820+070
- 11951** Detection of a 55 Hz high-frequency QPO in MAXI J1820+070 with NICER
- 11936** Optical timing observations of MAXI J1820+070 with IFI+IQUEYE and AQUEYE+ soon after state transition
- 11899** Short-lived episodes of emission line splitting in the candidate black hole X-ray binary MAXI 1820+070
- 11887** LOFAR observations of MAXI J1820+070 (ASASSN-

The Arcminute Microkelvin Imager Large Array (AMI-LA) observed MAXI J1820+070 (ATel #11420) on 2018 April 8 (06:43-10:46 UTC) at 15.5 GHz. We reduced the data using the `reduce_dc` pipeline. We then performed cleaning (with natural weighting) and additional flagging in CASA. Using IMFIT in CASA, we measured a flux density of the unresolved point source of  $42 \pm 2$  mJy.

The **Al Sadeem Observatory** (Owner/Co-founder Thabet Al Qaissieh, Director/Co-founder Alejandro Palado, Resident Astronomer Aldrin B. Gabuya) is located in Al Wathba South, outside the city of Abu Dhabi in the United Arab Emirates. We observed MAXI J1820+070 on 2018 April 7 (22:21-22:34 UTC) with the Meade LX850 16-inch (41-cm) telescope with an SBIG STT-8300 camera. 20 images (each 30 sec.) were taken in the 'green' Baader LRGB CCD-Filter (similar bandpass to Johnson V-band). The images were bias/dark-subtracted and flat fielded. We measured a brightness of  $V = 12.05 \pm 0.04$  mag, calibrated using several APASS stars in the field. From our Las Cumbres Observatory (LCO) optical monitoring (ATel #11418) we measure magnitudes (using PanStarrs calibration) of  $g' = 12.09 \pm 0.02$ ,  $r' = 12.14 \pm 0.03$ ,  $i' = 12.09 \pm 0.04$ ,  $y = 12.08 \pm 0.16$  on 2018 April 8 (~7 UTC).

We de-reddened the above flux densities using an extinction of  $E(B-V)=0.163$  (ATel #11418), and constructed the broadband, radio to optical spectral energy distribution (SED; figure linked below). For comparison, we also include a radio, near-IR and optical SED from 2018 March 18 (data from ATel #11439, #11458 and LCO). The mid-IR fluxes clearly represent an excess over the optical emission, and appear to lie close to the extrapolation of the near-IR excess previously reported in ATel #11458. The SED is similar to those of GX 339-4 (Gandhi et al. 2011, ApJ, 740, L13) and MAXI J1836-194 (Russell et al. 2014, MNRAS, 439, 1390) in which the IR was shown to be produced by synchrotron emission from the jet. The SED shape suggests that the jet break between optically thin and partially self-absorbed synchrotron may reside within the mid-IR to far-IR range. Assuming a simple power law, the radio to mid-IR spectral index is  $\alpha \sim +0.3$  (where  $F_\nu \propto \nu^\alpha$ ). By fitting the April 8 VISIR data and y-band point, we obtain  $\alpha \sim -0.7$ .

We encourage coordinated observations during the outburst decay to track the evolution of this spectrum. The LCO observations are part of an on-going **monitoring campaign** of ~ 40 low-mass X-ray binaries (Lewis et al. 2008) with LCO and the Faulkes Telescopes.

### *MAXI J1820+070 light curves and SEDs*

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