A bright mid-infrared excess in MAXI J1820+070


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ATel #11533: A bright mid-infrared excess in MAXI J1820+070

ATel #11533; David M. Russell, M. Cristina Baglio (NYU Abu Dhabi), Joe Bright, Rob Fender (Univ. Oxford), Thabet Al Qaissieh, Alejandro Palado, Aldrin Gabuya (Al Sadeem Observatory, Abu Dhabi), Daniel Asmus (ESO, Santiago & Univ. Southampton), Tomaso Belloni (INAF-OAB), Marion Cadolle Bel (MPCDF), Piergiorgio Casella (INAF-OAR), Chiara Ceccobello (Chalmers Univ. of Technology, Sweden), Stephane Corbel (DAP-AIM, CEA, Paris Diderot Univ.), Maria Diaz Trigo (ESO, Garching), Elena Gallo (Univ. Michigan), Poshak Gandhi (University of Southampton), Jeroen Homan (Eureka Scientific), Karri Koljonen (FINCA, Univ. Turku), Fraser Lewis (Faulkes Telescope Project & Astrophysics Research Institute, LJMU), Sera Markoff (Univ. Amsterdam), James C. A. Miller-Jones (ICRAR-Curtin Univ.), Kieran O’Brien (Durham Univ.), Thomas D. Russell (Univ. Amsterdam), Payaswini Saikia (NYU Abu Dhabi), Gregory Sivakoff (Univ. Alberta), Tariq Shahbaz (IAC & ULL), Roberto Soria (NAOC, Chinese Academy of Sciences & ICRAR-Curtin Univ.), Alex Tetarenko (Univ. Alberta), Mario van den Ancker (ESO, Garching) on 12 Apr 2018; 20:57 UT

Credential Certification: David M. Russell (dave.russell5@gmail.com)


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 μm) 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_ν) were calculated using observations of standard stars taken on the same nights:

<table>
<thead>
<tr>
<th>Filter</th>
<th>Wavelength(μm)</th>
<th>F_ν(mJy; Apr 8)</th>
<th>F_ν(mJy; Apr 9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B11.7</td>
<td>11.52 - 376 - 378</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B10.7</td>
<td>10.65 - 353 - 368</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J8.9</td>
<td>8.72 - 303 - 297</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M-band</td>
<td>4.85 - 292 - 271</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.
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 ± 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 ± 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 ± 0.02, r’ = 12.14 ± 0.03, i’ = 12.09 ± 0.04, y = 12.08 ± 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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R. E. Rutledge, Editor-in-Chief
Derek Fox, Editor
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rrutledge@astronomerstelegram.org
dfox@astronomerstelegram.org
mansi@astronomerstelegram.org