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NICER observations of MAXI J1820+070 suggest a rapidly-brightening black hole X-ray binary in the hard state

ATel #11423; *P. Uttley (University of Amsterdam), K. Gendreau, C. Markwardt, T. E. Strohmayer, P. Bult, Z. Arzoumanian (GSFC), K. Pottschmidt (GSFC/UMBC), P. S. Ray (NRL), R. Remillard, D. Pasham, J. Steiner (MIT), J. Neilsen (Villanova University), J. Homan (Eureka Scientific & SRON), J. M. Miller (University of Michigan), W. Iwakiri (RIKEN), A. C. Fabian (University of Cambridge), for the NICER Team*

on 15 Mar 2018; 14:24 UT

Credential Certification: *Phil Uttley (p.uttley@uva.nl)*

Subjects: X-ray, Binary, Black Hole, Transient

Referred to by ATel #: [11426](#), [11427](#), [11432](#), [11437](#), [11439](#), [11440](#), [11451](#), [11478](#), [11481](#), [11488](#), [11510](#), [11533](#), [11574](#), [11576](#), [11578](#), [11723](#), [11820](#), [11833](#), [12534](#), [12567](#), [12573](#), [12688](#)

NICER observed the new X-ray transient MAXI J1820+070 (ATel #[11399](#), #[11400](#), #[11403](#), #[11404](#), #[11406](#), #[11418](#), #[11420](#), #[11421](#)) on multiple occasions from 2018 March 12 to 14.

During this time the source brightened rapidly, from a total NICER mean count rate of ~ 880 count/s on March 12 to 2800 count/s by March 14 17:00 UTC, corresponding to a change in 2-10 keV modelled flux (see below) from $1.9E-9$ to $5E-9$ erg cm^{-2} s^{-1} . The broadband X-ray spectrum is absorbed by a low column density (fitting the model given below, we obtain $1.5E21$ cm^{-2}), in keeping with the low Galactic column in the direction of the source (ATel #[11418](#); Dickey & Lockman, 1990, ARAA, 28, 215; Kalberla et al. 2005, A&A, 440, 775) and consists of a hard power-law component with weak reflection features (broad iron line and narrow 6.4 keV line core) and an additional soft X-ray component. Approximating the broadband spectrum in XSPEC using a disk blackbody up-scattered into a power-law, all absorbed by neutral gas (tbabs*simpl*diskbb) we find that during March 12-14 the power-law photon index Gamma steepens from 1.54 to 1.62 while the disk blackbody temperature increases from $kT=0.16$ to 0.185, the disk normalization changes from $1.15E5$ to $2.3E5$ and the fraction of disk photons scattered into the power-law drops from 0.47 to 0.38. Note that due to the simplified and exploratory nature of the spectral fit, the best-fitting parameter values given here are intended to be indicative and errors are not quoted.

The light curve shows large amplitude flaring on minutes time-scales, with a broadband power spectrum that can be approximated throughout the observations as either a sum of broad Lorentzians or a doubly-broken power-law, with low-frequency break 0.01 Hz and high frequency break ~ 3 Hz. The integrated 0.1-64 Hz fractional rms is ~ 40 per cent and depends only weakly on energy. At high frequencies, the power spectrum shows hints (4-sigma single trial probability, in the first half of the data only) for a narrow (5 Hz FWHM) QPO at 66 Hz (with

Related

- 12688** Continued Swift Monitoring of the Galactic Black-Hole Binary MAXI J1820+070
- 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 rebrightening
- 12577** AMI-LA and Swift confirm the multi-wavelength rebrightening of MAXI J1820+070
- 12573** Swift observation of the rebrightening in MAXI J1820+070
- 12567** Rebrightening 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 rebrightening 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
- 11960** The 55 Hz signal we detected in MAXI J 1820+070 is not a QPO
- 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

fractional rms of 3% in 0.3-10 keV), which disappears as the source flux increases. Although only a tentative detection, the QPO frequency is intriguing, since QPOs have been observed at a similar frequency in two black hole X-ray binaries (GRS 1915+105 and IGR J17091-3624).

Taken together, the hard power-law spectrum, low temperature disk blackbody and large amplitude broadband power spectrum strongly suggest that the source is a black hole X-ray binary that is rapidly increasing in flux through the canonical hard state. This interpretation is consistent with the optical constraints and radio source detection (ATel #11418, #11420). Given the already high flux and low absorbing column and associated extinction, MAXI J1820+070 offers the possibility of observing a hard state rise and possible state transition of an accreting black hole in unprecedented detail. Due to the rapid rise in flux, we advise urgency in scheduling further multiwavelength observations.

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- 11824 Other low-frequency optical QPO-like features in MAXI J1820+070 detected with IFI+IQUEYE@Galileo
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