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Publication date
2011
Document Version
Final published version
Published in
The astronomer's telegram

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24 Jul 2023; 12:48 UT

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Optical observations of MAXI J0556-332 and an indication of a probable neutron star primary

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*on **20 Jan 2011; 12:59 UT***
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Subjects: Optical, X-ray, Binary, Star, Transient

Referred to by ATel #: 3119, 3327, 3349, 3650, 4524, 8517, 8854, 13631, 14195

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We observed the new X-ray transient, MAXI J0556-332 (ATel #3102, #3103, #3104, #3106, #3110, #3112) with the Faulkes Telescope South on 17 and 18 January 2011 (MJD 55578.4 and 55579.5). On each date, three 200-sec exposures were taken; one each in Bessel V, R, and I bands, totalling six images. The suggested optical counterpart (ATel #3103) was confirmed (ATel #3104) by a brightening and the detection of hydrogen and helium emission lines in its spectra.

We detect the counterpart and report magnitudes (calibrated using several USNO-B1/NOMAD catalogue stars in the field of view) of V ~ 16.7, R ~ 17.0, I ~ 16.5 on 17 Jan and V ~ 16.9, R ~ 17.1, I ~ 16.6 on 18 Jan. These values may suffer from filter-dependent systematic errors of several tenths of a magnitude due to uncertainties in the USNO-B1/NOMAD field star magnitudes. The optical counterpart had therefore continued to brighten by ~ 0.8 mag in the five days between 12 and 17 Jan (ATel #3104), peaking ~ 3 mag above its quiescent level of R ~ 19.9 (USNO-B1). In the 24.9 hours between the observations on 17 and 18 Jan the source faded by 0.18 +- 0.03 mag in V, 0.14 +- 0.04 mag in R and 0.12 +- 0.03 mag in I-band (getting slightly redder as it faded). For comparison, a slightly fainter field star changed magnitude by 0.01 +- 0.04 between 17 and 18 Jan.

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3264 A possible IR counterpart to the transient X-ray pulsar IGR J17480-2446 in Terzan 5
3119 Radio detection of MAXI J0556-332 with the ATCA
3116 Optical observations of MAXI J0556-332 and an indication of a probable neutron star primary
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The nature of the compact object in this X-ray binary is currently unknown (ATel #3112). Russell et al. 2006, 2007 showed from a compilation of 44 X-ray binaries that black hole and neutron star low-mass X-ray binaries (LMXBs) and high-mass X-ray binaries (HMXBs) occupy different regions of an optical/X-ray luminosity diagram (neutron star LMXBs are generally ~ 20 times fainter in optical than black hole LMXBs at the same X-ray luminosity). The X-ray flux measured by Kennea et al. (ATel #3103) was taken just 9 hours before the optical observation reported by Halpern (ATel #3104). We calculate the intrinsic X-ray and optical fluxes at this time accounting for interstellar absorption assuming N_H = 9.8+/-0.6 x 10^20 cm-2 (ATel #3103), the relation between extinction A_V and N_H of Predehl & Schmitt 1995 and the extinction law of Cardelli et al. 1989. Note that a much higher reported value for the neutral hydrogen column N_H (ATel #3106) was later found to be likely unphysical (ATel #3110).

We find that the optical/X-ray ratio of MAXI J0556-332 is typical of a neutron star LMXB at any distance within the galaxy, but is inconsistent with any known black hole source, for any given distance within the galaxy (< 20 kpc). The light curve, optical/X-ray luminosity diagram and finding charts are linked below. If MAXI J0556-332 resides at a distant ~ 20 kpc or further, its optical/X-ray ratio is similar to some black hole LMXBs in the soft state, but the Swift XRT observations at this time indicated the source was not in a soft state (ATel #3103). We can therefore tentatively conclude that the primary is likely to be a neutron star in this system, but type I X-ray bursts or a dynamical mass measurement would be required to confirm this.

We thank the participants of the recent EU-HOU teacher training program for helping with these observations. The Faulkes Telescope observations are part of an optical monitoring project of low-mass X-ray binaries (Lewis et al. 2008). The Faulkes Telescope Project is an educational and research arm of the Las Cumbres Observatory Global Telescope Network (LCOGTN). DMR acknowledges support from a Netherlands Organisation for Scientific Research (NWO) Veni Fellowship. FL acknowledges support from the Dill Faulkes Educational Trust.

	332
3110	Eclipse-like Absorption in MAXI J0556-332
3106	RXTE Observes MAXI J0556-332
3104	Optical Identification and Spectroscopy of the X-ray Transient MAXI J0556-332
3103	MAXI J0556-332: Swift/XRT localization
3102	MAXI/GSC detects a new X-ray transient MAXI J0556-332
3044	Terzan 5 transient IGR J17480-2446: return of thermonuclear bursts or were they always there?
3000	Type-II bursts from the new Terzan 5 transient: a GRO J1744-28 analogue?
2974	Chandra Identification of the Transient in Terzan 5: Not the 2000 Transient.
2958	Discovery of mHz QPOs and burst rate evolution in the active Terzan 5 neutron star transient
2952	D. Altamirano (Amsterdam), J. Homan (MIT), M. Linares (MIT), A. Patruno (Amsterdam), Y. Yang (Amsterdam), A. Watts (Amsterdam), M. Kalamkar (Amsterdam), P. Casella (Southampton), M. Armas-Padilla (Amsterdam), Y. Cavecchi (Amsterdam), N. Degenaar (Amsterdam), D. Russell (Amsterdam), R. Kaur (Amsterdam), M. van der Klis (Amsterdam), N. Rea (CSIC-IEEC), R. Wijnands (Amsterdam)
2946	A Refined Orbital Solution and the Transient Pulsar in Terzan 5 is Not Eclipsing
2940	INTEGRAL and RXTE spectral analysis of IGR J17480-2446, the new transient in Terzan 5.
2939	A preliminary orbital solution for the transient eclipsing pulsar in Terzan 5
2937	Eclipsing X-ray Burster in Terzan 5: Improved Swift Localization
2933	The Eclipsing X-ray Burster in Terzan 5 is Probably Not the 2000 Transient
2932	Discovery of 11 Hz burst oscillations from the 11 Hz Eclipsing Pulsar in Terzan 5
2929	EXO 1745-248 is an 11 Hz Eclipsing Pulsar
2924	Further INTEGRAL observations of the transient X-ray burster EXO 1745-248
2922	Swift follow-up observations of EXO 1745-248
2920	Swift-XRT location of the ongoing Terzan 5 outburst
2919	A hard X-ray transient in the direction of Terzan 5 detected by INTEGRAL

[Telegram Index]

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