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Publication date

2011

Document Version

Final published version

Published in

The astronomer's telegram

[Link to publication](#)

Citation for published version (APA):

Grinberg, V., Boeck, M., Pottschmidt, K., Pooley, G. G., Wilms, J., Nowak, M. A., Cadolle Bel, M., Rodriguez, J., Laurent, P., Marcu, D. M., Uttley, P., Tomsick, J. A., Bodaghee, A., Markoff, S., & Kreykenbohm, I. (2011). Cyg X-1 entered a transitional state, may be on its way from the soft state back to the hard state. *The astronomer's telegram*, 3307. <http://www.astronomerstelegam.org/?read=3307>

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Cyg X-1 entered a transitional state, may be on its way from the soft state back to the hard state

ATel #3307; *V. Grinberg (Remeis/ECAP/FAU), M. Boeck (Remeis/ECAP/FAU), K. Pottschmidt (CRESST/GSFC/UMBC), G. G. Pooley (MRAO), J. Wilms (Remeis/ECAP/FAU), M. A. Nowak (MIT-CXC), M. Cadolle Bel (ESA/ESAC), J. Rodriguez (CEA SAp/Lab. AIM Saclay), P. Laurent (CEA-SAp/Lab. AIM Saclay), D. M. Marcu (CRESST/GSFC/UMBC), P. Uttley (Univ. Southampton), J. A. Tomsick (SSL/UC Berkeley), A. Bodaghee (SSL/UC Berkeley), S. B. Markoff (Univ. Amsterdam), I. Kreykenbohm (Remeis/ECAP/FAU)*

on 27 Apr 2011; 02:04 UT

Credential Certification: [Katja Pottschmidt \(katja@milkyway.gsfc.nasa.gov\)](mailto:katja@milkyway.gsfc.nasa.gov)

Subjects: Radio, X-ray, Gamma Ray, Binary, Black Hole

Referred to by ATel #: [3534](#), [3546](#), [3616](#), [3636](#), [7316](#)

We report on recent RXTE, INTEGRAL, and AMI observations of the HMXB Cyg X-1. After having spent 2006 to mid-2010 in an extraordinarily hard state (Nowak et al., 2011, ApJ 728, 13) the source entered a soft state in summer 2010 (ATel #[2711](#), #[2714](#), #[2715](#), #[2721](#), #[2724](#), #[2734](#), #[2751](#), #[2755](#)) which might now be coming to an end. The Swift-BAT hard X-ray flux started to recover, showing an increasing trend starting around 2011-04-18. Similarly the AMI radio flux recovered from being consistent with zero to almost its canonical hard state value of 15 mJy between 2011-04-09 and 2011-04-25. This picture is supported by our recent pointed X-ray observations:

The 20-500 keV INTEGRAL/ISGRI spectrum (66 ks) on 2011-04-11/12 can be described by a power law with a photon index of 2.63 +/- 0.02, consistent with results from our INTEGRAL Key Programme observations throughout the soft state. The 3-40 keV RXTE/PCA spectra (1.4-2.3 ks) can be described by a broken power law with a break at about 10 keV and photon indices PL1 and PL2 below and above the break, respectively, plus a black body component. We also determined rms variability values (for 0.008-256 Hz; narrower than the 0.002-256 Hz of ATel #[2751](#) due to shorter exposure times) and timelags (for 3.2-10 Hz) from 4.5-5.8 keV and 9.5-15 keV PCA lightcurves. Summary of selected parameters (the disk parameters are not well constrained and therefore not included):

obs start [UT] radio flux [mJy] photon index PL1 soft band rms [%] timelag [ms]

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2011-04-09	nd				
2011-04-12 04:12:32		3.02 +/- 0.12	31.1	-0.3 +/- 0.9	
2011-04-12 05:50:24		3.29 +/- 0.13	20.8	2.2 +/- 1.3	
2011-04-12 07:27:28		2.95 +/- 0.15	26.0	4.5 +/- 1.4	
2011-04-12 09:05:36		3.14 +/- 0.20	28.6	3.5 +/- 1.6	
2011-04-14 07:37:55	6.4				
2011-04-16 08:49:54	5.6				
2011-04-19 11:45:35	5.8				
2011-04-21 08:25:28	8.5				
2011-04-22 02:18:24		2.71 +/- 0.08	20.2	6.8 +/- 1.7	
2011-04-22 03:55:28		2.69 +/- 0.11	23.3	5.0 +/- 1.1	
2011-04-22 05:32:32		2.76 +/- 0.13	22.8	4.6 +/- 1.7	
2011-04-22 05:49:53	6.4				
2011-04-22 07:08:32		2.71 +/- 0.10	15.3	3.5 +/- 1.6	
2011-04-22 08:36:32		2.69 +/- 0.12	20.0	11.6 +/- 2.1	
2011-04-24 02:19:38	6.5				
2011-04-25 08:57:06	12.1				
nd = no detection					

The decreasing photon index between 2011-04-12 and 2011-04-22 (PL1 and PL2 are correlated; Wilms et al., 2006, A&A 447, 245), the comparatively low rms values, the radio flux turn-on/increase, and especially the enhanced timelag on 2011-04-22 are typical indicators that Cyg X-1 has entered a transitional state. The photon index PL1 on 2011-04-22 is consistent with the one measured for the RXTE monitoring observation on 2010-07-04, classified as transitional in ATel #2751. Abrupt parameter changes within the transitional state have been observed PL1~2.5 before (HIMS-to-SIMS-like transition, Boeck et al., 2011, A&A, in prep.): Cyg X-1 might soon reach this parameter regime.

Even if the source fails to reach the full hard state, this episode can be described as a reverse failed state transition, analogous to the previously observed failed state transitions from the hard to the soft state (Pottschmidt et al, 2003, A&A 407, 1039). Further monitoring of Cyg X-1 will be performed within the RXTE Core Program and within the INTEGRAL Key Programme, as well as with the AMI Large Array. We encourage additional multi-wavelength observations in order to reveal a more detailed view of a soft to hard state transition for a persistent source.

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R. E. Rutledge, Editor-in-Chief

Derek Fox, Editor

rrutledge@astronomerstelegram.org

dfox@astronomerstelegram.org