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[Previous | Next | ADS]

VLA radio detection of the newly discovered transient and super-Eddington X-ray pulsar Swift J0243.6+6124

ATel #10946; ***J. van den Eijnden, N. Degenaar, T. Russell, R. Wijnands, J. V. Hernandez Santisteban (University of Amsterdam), G. Sivakoff, C. Heinke (University of Alberta), J. Miller-Jones (ICRAR-Curtin), A. Bahramian (Michigan State University), T. Maccarone (Texas Tech University), J. A. Kennea (Penn State), C. Knigge (University of Southampton)***
*on **10 Nov 2017; 14:12 UT***
Credential Certification: Jakob Van den Eijnden (a.j.vandeneijnden@uva.nl)

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We report the radio detection of the newly discovered transient X-ray pulsar Swift J0243.6+6124 in Director's Discretionary Time observations performed with the Karl G. Jansky Very Large Array (VLA).

We observed Swift J0243.6+6124 on 2017 November 8 from 00:31 UT to 01:30 UT (MJD 58065.04 +/- 0.02) at a central frequency of 6 GHz with a bandwidth of 4 GHz, while the VLA was in B configuration. As primary and secondary calibrators, we observed 3C48 and J0244+6228, respectively. Following standard procedures, we used the Common Astronomy Software Applications package (CASA v4.7.2; McMullin et al. 2017, ASPC, 376, 127) to calibrate and image the data. We used Briggs weighting with a robustness of zero to balance sensitivity and resolution.

We detect radio emission consistent with the reported Swift position of Swift J0243.6+6124 (Kennea et al., ATel #10809). Fitting a point source in the image plane by forcing an elliptical Gaussian fit with the same size as the synthesized beam, we measure a flux density of 76 +/- 7 uJy, where the error is given by the RMS of the image near the source position. This point source fit returns a position of:

RA(J200) = 02h 43m 40.4373s +/- 0.0083s

Dec(J200) = 61d 26m 03.713s +/- 0.018s

This position is 1.1 arc-seconds from the X-ray position reported by Kennea et al (ATel #10809), and falls within the 1.5 arc-seconds 90% confidence uncertainty on the X-ray position.

The radio flux density of the source corresponds to a radio luminosity ($4 \pi D^2 \nu S_\nu$) of 8.7e27

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(D/4.0 kpc)^2 erg s^{-1}, where we assume that the source is located at a distance of 4 kpc as has been reported by Doroshenko et al. (2017, arXiv:1710.10912).

At the time of this radio observation, Swift BAT recorded the source at 1.75 counts s^{-1} within a single Swift orbit. Assuming the NuSTAR X-ray spectrum as reported by Bahramian et al. (2017, Atel #10866), this Swift BAT count rate corresponds to an X-ray luminosity of 5.2e38 (D/4 kpc)^2 erg s^{-1}. As the NUSTAR observation was performed at the start of the outburst, the X-ray spectrum might have changed significantly. To confirm this luminosity estimate, we also fitted the Swift XRT spectrum obtained closest to the radio detection, between 2017 November 09 21:28 UT and 23:13 UT. The spectrum is well described by an absorbed blackbody plus powerlaw model, yielding an 0.5-10 keV X-ray luminosity of 6.5e38 (D/4 kpc)^2 erg s^{-1}. Based on both estimates, Swift J0243.6+6124 appears to have entered a super-Eddington state.

We thank the VLA schedulers for rapidly making this observation possible. Follow-up VLA monitoring has been requested, and Chandra and NuSTAR observations are planned, along with continued monitoring by Swift. Further multiwavelength observations are encouraged.

[**Telegram Index**]

R. E. Rutledge, Editor-in-Chief rrutledge@astronomerstelegram.org
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