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Radio localization of IGR J16597-3704, a candidate neutron star X-ray binary undergoing an outburst in NGC 6256

ATel #10894; *A. J. Tetarenko (Alberta), A. Bahramian (Michigan State), G. R. Sivakoff, C. O. Heinke, A. W. Shaw (Alberta), R. Wijnands, N. Degenaar, T. D. Russell (Amsterdam), J. C. A. Miller-Jones, R. M. Plotkin, V. Tudor (Curtin), J. Homan (Eureka Scientific/SRON), E. Kuulkers (ESA), D. Chakrabarty (MIT), L. Chomiuk, J. Strader, E. Tremou (Michigan State), J. A. Kennea (Penn State), D. Altamirano (Southampton), J. J. M. in 't Zand (SRON), A. Deller (Swinburne), T. J. Maccarone, and L. Rivera-Sandoval (Texas Tech)*
on 26 Oct 2017; 04:43 UT

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Subjects: Radio, Optical, X-ray, Request for Observations, Globular Cluster, Neutron Star, Transient

Referred to by ATel #: [10898](#)

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We report follow-up VLA radio observations of NGC 6256, the globular cluster hosting the newly detected X-ray transient IGR J16597-3704 (ATel #[10880](#), #[10881](#)). We clearly detect and localize the transient. The quasi-simultaneous radio and X-ray emission indicate the source is likely a neutron star X-ray binary. There may be an optical counterpart consistent with the radio position; however, it is not any of the GAIA or 2MASS candidates previously identified (ATel #[10885](#)).

We observed NGC 6256 with the VLA on 2017 Oct 23, with scans on source between 21:01 - 22:42 UTC (MJD = 58049.8757 - 58049.9458), in X Band (8 - 12 GHz), with the array in B configuration.

We significantly detect a radio source in the combined 4 GHz bandwidth centered on 10 GHz, with flux density of $S_{\nu} = 17.7 \pm 4.4$ microJy (1-sigma confidence intervals). The source is located at
RA = 16h 59m 32.9007s \pm 0.0021 s (0.025")
Dec = -37d 07' 14.22" \pm 0.18",
where the elongated beam shape arises from the low declination of the source. This location is \sim 0.5" away from the X-ray position reported from previous Swift observations (ATel #[10881](#)), which is well within the 3.6" Swift X-ray error circle.

Swift XRT observations in photon counting mode, taken both before and after the radio

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10898	Chandra Localization of IGR J16597-3704
10894	Radio localization of IGR J16597-3704, a candidate neutron star X-ray binary undergoing an outburst in NGC 6256
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10881	Swift/XRT observation of IGR J16597-3704
10880	IGR J16597-3704: a new X-ray transient discovered by INTEGRAL

observation (at 2017 Oct 22 20:29:21 - 20:47:29 and Oct 25 07:30 - 07:51 UTC), exhibit similar fluxes and spectra. The Oct. 22 X-ray emission is well-fit ($\chi^2 = 22.4$ for 19 degrees of freedom and a null hypothesis probability of 0.19) by an absorbed power-law with an absorption column density of $(1.47+0.35/-0.29) \times 10^{22} \text{ cm}^{-2}$, photon index of $1.46+0.21/-0.20$, and unabsorbed 1-10 keV flux of $(2.71+/-0.18) \times 10^{-10} \text{ erg/cm}^2/\text{s}$. Here we report 90% confidence intervals and use Wilms, J. et al. (2000, ApJ, 542, 914) abundances and Verner, D. A. et al., (1996, ApJ, 465, 487) cross-sections.

We make a preliminary classification of the source, using the L_r - L_x plane (e.g., Tetarenko et al., 2016, MNRAS, 460, 345; Tudor et al. 2017, MNRAS, 470, 324), assuming a flat radio spectrum to derive the radio luminosity at 5 GHz ($4 \pi d^2 \nu S_\nu$) of $(1.12 \pm 0.28) \times 10^{28} \text{ erg/cm}^2/\text{s} \times (d/10.3 \text{ kpc})^2$ and using the 1.0-10 keV X-ray luminosity of $(3.43 \pm 0.14) \times 10^{36} (d/10.3 \text{ kpc})^2 \text{ erg/s}$, where we adopt the distance of NGC 6256 (10.3 kpc; Harris W.E. 1996, AJ, 112, 1487 - 2010 Edition) for this transient. See figure in URL below. IGR J16597-3704 is an order of magnitude below most radio-quiet black hole X-ray binaries, and is instead consistent with most hard-state neutron star systems (including both atoll sources and radio-quiet AMXPs).

We also examined archival Chandra (PI: Pooley) and HST (PI: Noyola) observations. We have not determined the absolute astrometry of the Chandra data, but we were able to tie the HST F555W image to recent GAIA astrometry, and thus assume it has $< 0.05''$ preliminary absolute astrometry. Although there is an X-ray source about $2.2''$ to the south-west of the source, it appears too distant to be the quiescent counterpart of IGR J16597-3704, given the typical Chandra absolute astrometric accuracy of $0.6''$. There is an HST source $0.29''$ (at 185 degrees E of N) from the reported VLA position. While this lies within the 2-sigma error ellipse on the position, variable optical emission would be needed to confirm it is the optical counterpart. Preliminary optical photometry indicates this optical source was at $m_{F555W} \sim 24.6$ (ABmag) on 2009 Aug 02. The counterpart could also be a source in the error ellipse that is too faint to be detected in the existing HST data.

Additional radio observations are planned, and we encourage further multiwavelength monitoring. We note however that most X-ray instruments (excepting NuSTAR) will enter Sun constrain this week.

We thank the NRAO and Swift staff for rapidly scheduling these observations.

Radio Luminosity vs. X-ray luminosity of X-ray binaries, including IGR J16597-3704

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