ATCA radio detection of the new X-ray transient Swift J1658.2-4242

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*on **19 Feb 2018; 18:20 UT***
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Referred to by ATel #: 11334, 11336, 11342, 11358

Swift J1658.2-4242 is a recently detected X-ray transient (GCN #22416, #22417, ATel #11306). This source has been identified as a potential neutron star Be/X-ray binary (ATel #11311) or black hole X-ray binary (ATels #11306, #11321).

We observed Swift J1658.2-4242 with the Australia Compact Telescope Array (ATCA) between 2018-02-17 19:48:29.9 UT and 2018-02-18 02:29:09.9 UT (MJD 58166.96 +/- 0.14). The observations were taken at four frequencies, 5.5GHz, 9GHz, 17GHz, and 19GHz, with a bandwidth of 2 GHz at each frequency. We used 1934-638 for primary flux calibration, and the nearby calibrator 1714-397 (4.65 degrees away) for phase calibration. The data were reduced and imaged using standard routines in CASA (McMullin et al. 2007). We used a Briggs weighting robustness of 0 to balance sensitivity with resolution, and minimise effects from diffuse emission within the field. The array was in its 750B configuration. We did not include the isolated antenna 6 during imaging.

We significantly detected a radio source at a position consistent with the Swift X-ray and UVOT position (ATels #11307, #11310). Our best radio position (measured at 19GHz) is:

RA (J2000) = 16:58:12.700 +/- 0.004, Dec (J2000) = -42:41:56.09 +/- 0.25 (statistical errors only).

When fitting a point source in the image plane the measured flux densities were:

Frequency (GHz) | Beam Size (arcsec) | Flux Density (mJy)
5.5 | 16.9 x 8.3 | 2.35 +/- 0.17
9.0 | 10.5 x 5.2 | 2.17 +/- 0.15
17.0 | 8.0 x 2.5 | 2.27 +/- 0.09
19.0 | 7.2 x 2.2 | 2.30 +/- 0.15

The radio spectral index of alpha = 0.00 +/- 0.07 (where S_nu $\propto$ nu^{alpha}) is consistent with a flat radio spectrum from a compact jet. The radio emission provides a 5-GHz radio luminosity of (8.8

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+/- 0.7)*1e29*(d/8kpc)^2 erg/s. Based on the Galactic disk and bulge stellar populations (Juric et al 2008; McMillan 2011), a source along this line of sight has a distance of 9.0 +7.0/-1.5 kpc (1 sigma confidence interval); adding in a Galactic halo component would increase the likely distance.

Swift/XRT observations of the were taken a few hours earlier (between 2018-02-17 10:38:02 UT and 2018-02-17 16:43:58 UT; MJD 58166.57 +/- 0.13). We extracted the X-ray data using the online XRT pipeline (Evans et al. 2009). The X-ray data were fit with a highly-absorbed powerlaw model, with an N_H of (1.9 +/- 0.2)E23 cm^{-2} and a photon index of 1.6 +/- 0.1, providing an unabsorbed 1-10 keV X-ray flux of (1.7 +/- 0.2)E-09 erg/s/cm^2. This X-ray flux corresponds to an X-ray luminosity of (1.30 +/- 0.15)*1e37*(d/8kpc)^2 erg/s.

At distances greater than 3kpc, the observed radio and X-ray luminosities of Swift J1658.2-4242 are consistent with a black hole X-ray binary on the radio-quiet branch of the L_r/L_x correlation (above all known neutron star X-ray binaries; see e.g., Tetarenko at al. 2016). Therefore, if the source is more distant than 3kpc, the strength of the radio emission indicates that Swift J1658.2-4242 is likely to be a black hole X-ray binary. However, at closer distances, it could be consistent with a neutron star X-ray binary. We note that there is only a 0.35% probability that Swift J1658.2-4242 is this close given our Galactic structure calculations along this line of sight.

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