A Search for a Radio Counterpart to Swift J174540.7-290015

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A Search for a Radio Counterpart to Swift J174540.7-290015

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We report the results of VLA observations of the Galactic Center X-ray transient Swift J174540.7-290015 on 25 Feb 2016 between 16:28 and 17:09 UT in two frequency bands centered at 6 GHz (C band) and 15 GHz (Ku band) (ATels #8649, #8684, #8689, #8737, #8746). We did not detect a radio counterpart in synthesis imaging or in searching phased array data for a periodic signal. The X-ray source lies close to the Northern arm of Sgr A West, which made removal of diffuse structure necessary to achieve good sensitivity. The Ku and C band observations had an rms of 6 mJy and 53 mJy, respectively, and a peak value of 15 mJy and 115 mJy, respectively, in the vicinity of the GC transient. The peak flux in both bands was not centered on the position of the GC transient but in the adjacent Northern arm of Sgr A West. The flux density of Sgr A* was 0.65 Jy and 1.16 Jy in C and Ku bands, respectively, consistent with past measurements. Simultaneously with the imaging data, we recorded high time resolution data from a single synthesized (phased array) beam at the position of the Swift transient. In both frequency bands, these data were taken using 4096 MHz total bandwidth, 1024 frequency channels, and 250 us time resolution. We searched for dispersed, periodic signals over dispersion measures ranging from 0 to 10,000 pc/cm^-3 and pulse frequency drift (source acceleration) up to 5*10^-5 Hz/s. At both frequencies, pulses from the bright, nearby 3.76-s magnetar PSR J1745-2900 (ATel #5020) were detected, but no other significant periodicities were found. Assuming 10% pulse duty cycle, the 10-sigma flux density limits for the periodicity searches were 30 uJy at C-band and 45 uJy at Ku-band. Ku and C band observations were obtained between 12.952 and 17.048 GHz and between 3.976 and 8.072 GHz, respectively. For cross-correlation and imaging, the data were split into 64 independent frequency windows, each with 128 channels, and in dual circular polarization mode. The VLA pipeline was used to provide basic flagging and calibration. Additional rounds of self-calibration were also performed. Ku and C band images were made

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with baselines of 50 and 20 klambda, respectively, and longer in order to remove extended structure. The Ku band beam size was 4.3 x 0.9 arcsec in position angle 29 deg East of North. The C band beam size was 7.8 x 2.3 arcsec in position angle 22 deg East of North. These observations are consistent with but more sensitive than lower-frequency GMRT observations, which also did not detect a radio counterpart in a periodic search (ATel #8729). Based on the X-ray luminosity and assuming a 10 solar mass black hole, we estimated a radio flux density of 1 mJy if the source were in the low-hard state using the fundamental plane relations. Our limits are not able to exclude this possibility. Current upper limits on radio and X-ray periodicities still leave open the magnetar and the accreting low mass X-ray binary scenarios (both if hosting a black hole or a neutron stars).

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