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A search for persistent radio emission and millisecond-duration radio bursts from SGR 1935+2154 using the European VLBI Network

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on ***6 Jun 2020; 06:39 UT***
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Subjects: Radio, Soft Gamma-ray Repeater, Fast Radio Burst

We report on real-time European VLBI Network observations (e-EVN) of SGR 1935+2154 on 13 May 2020, following the recent bright radio burst detection (ATel #13681, ATel #13684). SGR 1935+2154 is a recently active Galactic magnetar (GCN #27657, ATel #13675, ATel #13678, ATel #13748) that emitted a bright radio burst on 28 April 2020 with properties similar to what is seen in extragalactic fast radio bursts. A simultaneous short, hard X-ray burst (ATel #13685, ATel #13686, ATel #13687, GCN #27669) was also detected.

We observed SGR 1935+2154 with the EVN at L-band (1.66 GHz) from 01:00 to 09:00 UT. The data were recorded with eight 16-MHz subbands and full polarisation. The participating telescopes were Westerbork (Netherlands; using the single-dish RT1), Effelsberg (Germany), Onsala (Sweden), Torun (Poland), Hartebeesthoek (South Africa) and Irbene (Latvia). These observations resulted in a synthesised beam of 3.8 mas x 22.2 mas with a position angle of 77.1 degrees. The total on-source time was 5.7 hr, which resulted in a target image rms noise level of 19 uJy/beam. No radio emission was detected above the 6-sigma threshold of 95 uJy/beam, within +/- 1.5 arcseconds of the position of SGR 1935+2154 (note the 90% confidence level uncertainty on the position is 0.7 arcseconds; Israel et al. 2016).

We simultaneously recorded high-time-resolution filterbank data with the Effelsberg telescope and PSRIX pulsar backend. The data were recorded with a total bandwidth of 156.25 MHz, with a time and frequency resolution of 102.4 us and 0.49 MHz, respectively. We found no millisecond-duration bursts above a S/N threshold of 7 in the 4.3 hr of data recorded by the pulsar backend. Taking the typical Effelsberg gain and system temperature (1.54 K/Jy and 20 K, respectively),

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this corresponds to a fluence upper limit of 0.2 Jy ms.

We also performed a periodicity search, using the dispersion measure determined from the bright L-band burst detected by STARE2 (332.7 pc/cc; Bochenek et al. 2020), and the rotational period measured from NuSTAR data (P = 3.247331(3) s; ATel #13720). Assuming a duty cycle of 10%, and a minimum detectable S/N of 15, we find no periodic emission above 0.05 mJy.

Acknowledgements: We thank the EVN PC for approving these e-EVN ToO observations. The European VLBI Network (EVN) is a joint facility of independent European, African, Asian, and North American radio astronomy institutes. The observations presented here were obtained under the project code RN001.

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