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

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),
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.

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13686 bright short x-ray counterpart of the Fast Radio Burst from SGR 1935+2154
13685 AGILE detection of a hard X-ray burst in temporal coincidence with a radio burst from SGR 1935+2154
13684 INTEGRAL IBIS and SPI-ACS detection of a hard X-ray counterpart of the radio burst from SGR 1935+2154
13684 Independent detection of the radio burst reported in ATel #13681 with STARE2
13682 AGILE observations of the SGR 1935+2154 “burst forest”
13681 A bright millisecond-timescale radio burst from the direction of the Galactic magnetar SGR 1935+2154
13679 SGR 1935+2154: Swift detection of enhanced X-ray emission and dust scattered halo
13678 Burst forest from SGR 1935+2154 as detected with NICER
13676 A Forest of Bursts from SGR 1935+2154
6376 Upper limits on the pulsed radio emission of SGR 1935+2154 from the Ooty Radio Telescope and the Giant Meterwave Radio Telescope
6371 Parkes upper limits on the pulsed radio emission of SGR 1935+2154
6370 Chandra discovery of 3.2s X-ray pulsations from SGR 1935+2154
6299 SGR 1935+2154 Swift-BAT archival data search
6294 Newly discovered SGR 1935+2154: Swift observations