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GMRT pulsar search towards SNR G15.4+0.1

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Abstract. We report here on the first dedicated simultaneous imaging and pulsar observations carried out with the GMRT at 610 and 1400 MHz towards the supernova remnant (SNR) G15.4+0.1, the possible counterpart of the very high energy (VHE) source HESS J1818−154. Preliminary analysis suggests absence of pulsations towards the centroid of HESS J1818−154, with upper limits of 0.6 and 0.3 mJy at 610 and 1400 MHz, respectively.

Keywords : ISM – supernova remnants – G15.4+0.1, pulsars – general

1. Observations of SNR G15.4+0.1/HESS J1818−154

Very high energy (VHE) γ-ray emission was recently detected from supernova remnant (SNR) G15.4+0.1 (Hofverberg et al. 2011). The VHE emission is center dominated with an extent of about 8'.5, smaller than the radio shell of the SNR (∼15'). This fact led to the speculation that the VHE radiation is originating from a yet unknown pulsar wind nebula (PWN), making SNR G15.4+0.1 a probable candidate for a composite SNR.

We have carried out simultaneous imaging (sampling time: 16 s) and pulsar observations (sampling time: 61 μs) over 33 MHz bandwidth towards SNR G15.4+0.1 at 610 and 1400 MHz with the GMRT, using the centroid of HESS J1818−154 as phase centre. Total integration time on the source was 240 and 260 minutes at 610 and 1400 MHz, respectively. Pulsar data were obtained with a narrow beam phased array (PA) as well as wide beam incoherent array (IA) mode. Three known pulsars, PSRs J1645−0317, J1939+2134 and J1901−0906 were observed for estimating the sensitivity of pulsar observations.

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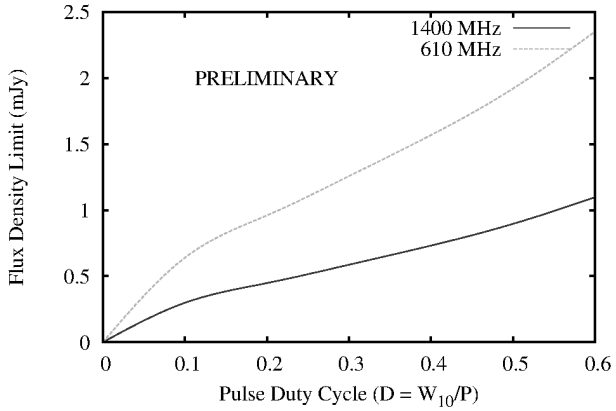

Figure 1. Upper limits on the pulsar flux density as a function of the pulse duty cycle. The pulse duty cycle is defined as the ratio of the width of the pulse at 10% of the peak (W_{10}) to the period of the pulsar (P).

The pulsar search was carried out using SIGPROC (`www.sigproc.sourceforge.net`) on a high performance computing cluster having 64 dual core processors at NCRA. The range of trial dispersion measure (DM) was $0 - 1200$ and $0 - 400$ pc cm^{-3} for 1400 and 610 MHz, respectively. The pulsar search for PA data has been completed while the IA data are currently being analysed.

Recent work by Abramowski et al. (2013) suggests the presence of an X-ray PWN in the centre of SNR G15.4+0.1. On the basis of preliminary data analysis, no pulsations were detected towards the centroid of HESS J1818−154, with upper limits of 0.6 and 0.3 mJy at 610 and 1400 MHz, respectively for a duty cycle of 10% (Fig. 1).

HI absorption measurements towards SNR G15.4+0.1 have helped in estimating the distance to the SNR to be 4.8±1.0 kpc (Castelletti et al. 2013). In addition, ^{13}CO data taken from the Galactic Ring Survey (GRS) show two clumps of molecular material; one positionally associated with HESS J1818−154 and the other with the brightest northern border of the SNR shell (Castelletti et al. 2013). Calculations show that the average density of the molecular gas is sufficient to produce the detected γ-ray flux, thus favouring a hadronic origin for the VHE emission.

References

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