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

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Abstract. We report here on the first dedicated simultaneous imaging and pulsar observations towards the supernova remnant (SNR) G15.4+0.1, the possible counterpart of the very high energy (VHE) source HESS J1818−154. The observations were carried out using the Giant Metrewave Radio Telescope (GMRT) at 610 and 1400 MHz. Preliminary analysis of data 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. Analysis of data with a larger beam is in progress, which may confirm the presence of a putative pulsar and its wind nebula if it is offset from the centroid of HESS J1818−154.

Keywords. (ISM:) supernova remnants, (stars:) pulsars: general, (stars:) pulsars: individual (J1645−0317, J1939+2134, J1901−0906)

1. Introduction

VHE γ-ray emission was recently detected from SNR G15.4+0.1 (Hofverberg *et al.* 2011). The new source was identified as HESS J1818−154. The VHE emission is center dominated with an extent of about 8'.5, smaller than the radio shell of the SNR (∼10'). This fact led to the speculation that the VHE radiation is originating from a yet unknown pulsar wind nebula (PWN), making G15.4+0.1 a probable candidate for a composite SNR.

We have carried out simultaneous imaging and pulsar observations over 32 MHz bandwidth towards SNR G15.4+0.1 at 610 and 1400 MHz with the GMRT, which has the unique capability for such observations. The centroid of the source HESS J1818−154 (α_{J2000} = 18h 18m 3.4s, δ_{J2000} = -15° 27' 54"), marked with a cross symbol in Figure 1, was used as the phase centre for our radio observations. Total integration time on the source was 240 minutes and 260 minutes at 610 and 1400 MHz, respectively. Imaging data were sampled every 16 s, while the pulsar data were sampled every 61 μs. Pulsar data were obtained with a narrow beam phased array (PA) as well as wide beam incoherent array (IA). Three known pulsars, PSRs J1645−0317, J1939+2134 and J1901−0906 were also observed for estimating the sensitivity of pulsar observations.

The imaging data were analysed using the NRAO Astronomical Image Processing Software (AIPS) (www.aips.nrao.edu). 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.

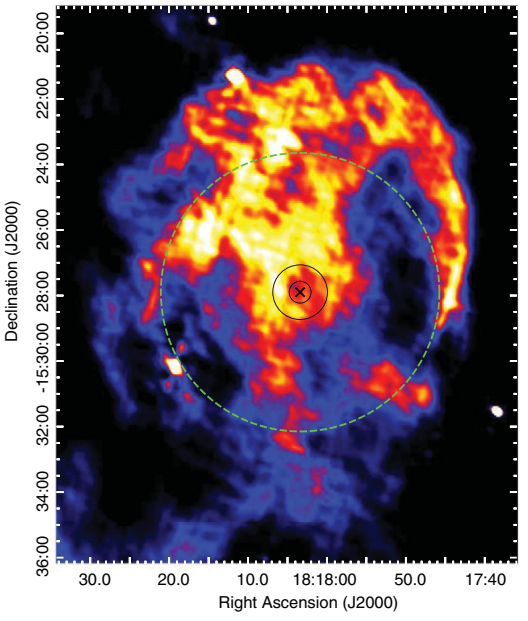

Figure 1. GMRT image of SNR G15.4+0.1 obtained at 610 MHz. The synthesized beam size is 5". The cross and the outermost dashed circle indicate the centroid and the extent of HESS J1818−154, respectively. Inner smaller and larger black circles denote the PA beam sizes at 1400 (40") and 610 MHz (100"), respectively.

2. Results and Discussion

A deep high resolution image of SNR G15.4+0.1 obtained from new GMRT data at 610 MHz is presented for the first time in Figure 1. This image reveals a morphology similar to the previously published lower resolution images at 330 and 1400 MHz (Brogan *et al.* 2006, Helfand *et al.* 2006). Higher resolution and more sensitivity have brought out greater details of radio emission from this SNR. Our preliminary pulsar search did not detect pulsations near the centroid of the VHE source. We estimate the flux density of a putative pulsar to be lower than 0.6 and 0.3 mJy at 610 and 1400 MHz, respectively, assuming a 10% duty cycle, in 1' radius from the centroid of the VHE source. IA observations cover the entire SNR and pulsar search in these data is currently in progress.

Multi-band observations of PWNs are useful to better understand the emission processes responsible for VHE emission and extend our comprehension of the complex acceleration processes involved. In particular, radio measurements are very important to constrain the proposed dynamic and evolutionary models of a PWN.

References

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