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The GMRT frequency spectrum of Wolf - Rayet Galaxies

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Abstract. In this paper we discuss the observed spectral energy distribution from 150 MHz to 10 GHz in a sample of five Wolf-Rayet (WR) galaxies using data obtained from the GMRT and literature. The distance to the galaxies in our sample range from range from 4 - 60 Mpc and optical size from 0.8′ - 9′. The WR galaxies are typically star-burst galaxies exhibiting spectral features typical of WR stars. While the higher frequency (ν >1.4 GHz) spectra have been found to be flatter compared to normal spiral galaxies, the low radio frequency spectra of the few galaxies that have been studied are found to exhibit a variety of shapes requiring a range of physical mechanisms giving rise to the emission, absorption and energy loss mechanisms to be active. We present the low radio frequency spectra of these galaxies, with a view to obtain the non-thermal spectral indices from model fitting and the influence of the environment.

Keywords : galaxies – Wolf - Rayet – radio continuum – radio spectra

1. Introduction

WR stars are massive stellar systems and presence of large number of these stars in a galaxy are indicative of young star-bursts. These galaxies exhibit properties similar to Blue Compact Dwarf (BCD) and star forming dwarfs allowing the results to be combined to increase our understanding of these intriguing systems. Deeg et al. (1993) studied a sample of HII galaxies down to 325 MHz and found that a variety of spectral shapes were exhibited by integrated emission from the galaxies when the low frequency observations were included. At higher frequencies (> 1.4 GHz) WR galaxies have a flatter spectrum compared to spiral star-burst galaxies (Beck et al. 2000).

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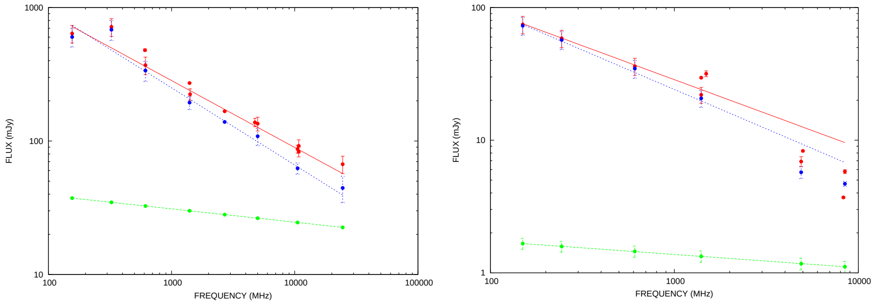

Figure 1. Integrated radio spectrum of NGC 4449 (left) and Mrk 1089 (right). The data points <1.4GHz is from this paper. The red line represents the total, the blue one the non-thermal and the green line the thermal components. By a power law fitting we get $\alpha_{nth} = -0.45(0.02)$ for NGC 4449 and $\alpha_{nth} = -0.59(0.04)$ for Mrk 1089.

The study of a few BCDs by Ramya et al. (2011) at low GMRT frequencies resulted in two main types of spectral shapes which they suggest is indicative of environmental effects.

2. Results and discussion

The spectra of the five galaxies follow a power law down to 150 MHz. Sensitivity issues at 150 MHz detected only the peak emission from the centre of NGC 4214 explaining the 'virtual turnover'. All our galaxies are in group environment and hence seem to follow the relation put forth in Ramya et al. (2011) on BCDs that the spectra of galaxies in groups are likely subjected to continuous external trigger resulting in a power law spectrum with the continuum emission encompassing the entire optical galaxy. The integrated spectral index for four galaxies is close to −0.5. The thermal fraction was extrapolated from the Hα maps from literature and resulted in non-thermal spectral indices ranging from −0.5 to −0.9.

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