

Abstract

This thesis presents the first arcsec resolution observations of two nearby spiral galaxies- IC 342 and NGC 628, using LOw Frequency ARray (LOFAR). Low frequency (145 MHz) continuum observations trace older, low energy electrons in the galaxy via radio synchrotron emission. These electrons are ones that have travelled away from their points of origin (supernovae) and are present in the extended disks and haloes of the galaxies. Low frequency surveys also help us understand the properties of warm ionized mediums of galaxies with the help of free-free absorption of flux by the ionized gas. First part of my thesis presents Factor, which is the novel algorithm used to calibrate and image the galaxies using LOFAR visibilities. Images of the two face-on star forming spiral galaxies are presented at various resolutions. This is followed by an analysis of the spectral index distribution in the galaxies obtained between the LOFAR maps and VLA¹ maps of 1.49 GHz for IC 342 and 3 GHz for NGC 628. Correlations between spectral index values and the levels of star formation are obtained with the help of Far Infra Red, H-alpha emission and thermal radio emission maps, which trace the regions of star formation in galaxies. Thermal fractions required to explain the spectral indices seen are calculated. The values of thermal fraction needed to explain the flat spectral index values seen in the central part and arms of IC 342 seem unphysical. This leads to the explanation that IC 342 suffers from higher levels of thermal absorption due to higher star formation rates. On the other hand, NGC 628 does not seem to suffer much from thermal absorption owing to its lower levels of star formation. Low frequency observations are also ideal to study diffuse magnetic fields in galaxies. The technique of RM Synthesis is adopted to obtain the parallel component of magnetic fields (while its perpendicular counterpart can be calculated from the synchrotron emission flux density). As a result of wavelength dependant depolarization, diffuse polarized emission cannot be detected for either of the two galaxies.

¹Very Large Array