LOW RADIO FREQUENCY SIGNATURES OF INTERACTIONS IN GALAXIES

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Abstract

Disk galaxies in small groups and cluster outskirts show peculiar low radio frequency continuum and 21cm HI morphologies which can be used to differentiate between hydrodynamic and tidal interactions. In this poster, we discuss NGC4254, Holmberg124 and Holmberg377 which we have observed using GMRT. The radio morphology is distorted due to interaction. While we believe ram pressure stripping is responsible for the radio continuum envelope around NGC 4254, the members of Holmberg 124 are influenced by both tidal interaction and ram pressure stripping. A radio continuum bridge connects the two members of Holmberg 377, a signature of tidal interaction.

1 NGC 4254 - case of ram pressure stripping

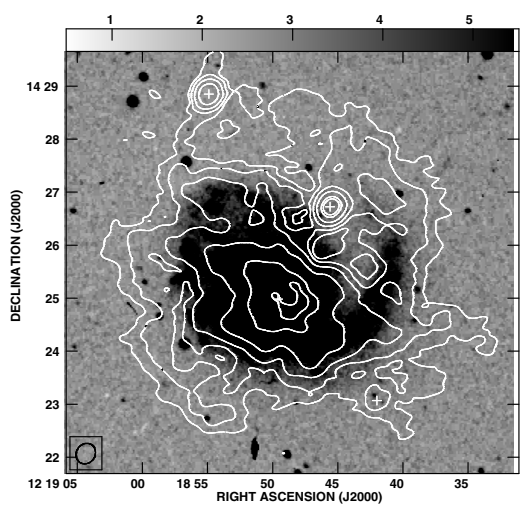


Figure 1: NGC 4254 - an almost face-on galaxy located in the outskirts of the Virgo cluster. The contours of 240 MHz radio continuum from GMRT are superposed on the DSS grey image. The rms noise on the 240 MHz image is 0.8 mJy. Note the structured extended envelope around the optical disk. Note that for most face-on galaxies the extent of the radio continuum emission is either equal to or smaller than the optical extent of the galaxy.

The 240 MHz image of the almost face-on disk galaxy NGC 4254 located on the outskirts of the Virgo cluster shows an extended envelope surrounding the optical disk (see Fig. 1). which has a steeper spectrum

compared to the radio emission coincident with the optical disk[1]. No star formation is associated with this envelope. We believe that the extended emission arises in a cone which is formed behind the galaxy by the stripped gas as the galaxy falls towards the cluster centre in the south-east direction ploughing through the intracluster medium [1]. The extended emission is similar to what has been seen in simulations of such stripping events. Since the galaxy is believed to be entering the cluster and is still in a tenuous region of the cluster, the stripped gas is still associated with the galaxy and gas depletion is yet to occur. The galaxy is in the initial stages of gas stripping. Various signatures of tidal interaction have been observed for this galaxy by other authors.

2 Holmberg 124 - case of tidal and ram pressure stripping

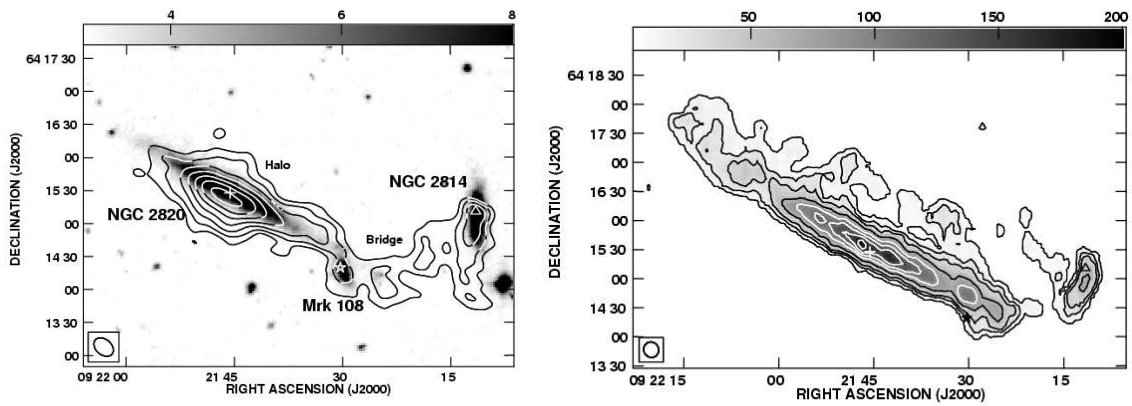
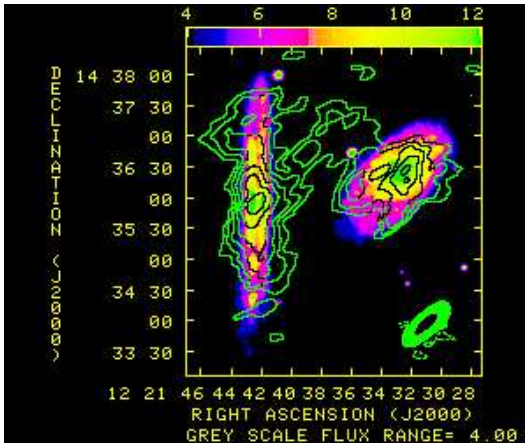


Figure 2: Holmberg 124 - a poor group of four late type galaxies - three of these are shown here. Left panel shows the contours of the 330 MHz radio continuum superposed on the optical DSS image. Note the bridge of emission connecting NGC 2820 with Mrk 108 and NGC 2814 - a clear signature of tidal interaction between the galaxies. The right panel shows the HI column density map of the three galaxies. The HI is extended and a loop of emission can be seen the north of NGC 2820 which we believe is due to ram pressure stripped HI gas. The fourth member of this group which is to the south (not shown in the figure) also shows distorted radio continuum and HI morphologies. Figures from [2].

A multifrequency radio study of Holmberg 124 [2], a poor group consisting of four late type members have resulted in interesting inferences. The radio continuum morphology (see Fig. 2) shows the presence of a bridge connecting the member galaxies, a clear signature of tidal interaction [3]. Additionally both the radio continuum and HI 21cm of NGC 2814 (Fig. 2) shows a depression to the north which we believe is due the pressure exerted by the intragroup medium on the interstellar medium of NGC 2814. Moreover the HI distribution of the dominant member NGC 2820 shows a large one-sided loop to the north (see Fig. 2;right panel) which we believe is stripped HI gas due to the pressure of the intragroup medium as the galaxy moves to the south-east which, incidentally shows a smooth swept-up boundary [2].

3 Holmberg 377 - case of tidal interaction

The optical emission from this pair of galaxies is confined to the disk of the galaxies and no obvious sign of interaction is visible other than enhanced star formation in one member. However, the radio continuum image in Fig. 3 reveals the presence of a bent bridge connecting the two galaxies [4]. Since a bridge connecting two galaxies is a classical signature of tidal interaction [3], this is a case where tidal interaction has modified



HOLMBERG377-DSS & 325MHZ

Figure 3: Holmberg 377 - the contours of 330 MHz radio continuum observed with GMRT are shown superposed on the optical DSS map in colour of the pair of disk galaxies. Notice the radio continuum bridge connecting the two members - a clear signature of tidal interaction.

the radio morphology of the galaxies but there is no signature of any hydrodynamic interaction. This pair of galaxies are located on the periphery of the Virgo cluster.

4 References

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