THE RADIO EMISSION OF INTERACTING GALAXIES

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Gravitational interaction is a straightforward interpretation of some of the peculiar optical morphologies shown by galaxies. There have also been attempts to study the effects of a gravitational interaction on the radio continuum emission. Statistically, the central radio sources (inner 1 kpc) in interacting spiral galaxies are about three times stronger than in isolated spirals; on the other hand, the intensity of the extended emission does not seem to be affected (Stocke, 1978; Hummel, 1981). Peculiar radio morphologies are not a general property of interacting galaxies, since in the complete sample studied by Hummel (1981) of spirals with a probability ≥ 0.8 of being physically related to their companion, less than 5% have a peculiar radio morphology.

Even in the few cases where an unusual radio morphology has been seen, gravitational interaction is not always the most attractive explanation. We present here VLA observations of the radio structure in three galaxies where the peculiar radio morphology is well established. In at least one of these (NGC 4438) the radio structure is better interpreted in terms of interaction with a diffuse intergalactic gas rather than in terms of a galaxy-galaxy interaction.

NGC 4038/39 (Arp 244, the "Antennae"): The figure shows the distribution of the continuum emission at 20 cm. The bulk of the radio emission coincides with the dusty region between the galaxies. The two discrete radio sources near the optical positions are presumably nuclear sources or their remnants. The extended emission shows considerable structure. There are three separate components in the southern part and a kind of plateau that extends to the northern nuclear source. No emission was detected from the optical "tails" at a level of 1 mJy/beam.

NGC 4410/IC 790 (see photograph in Stocke et al. 1978): We show the continuum map at 20 cm convolved to a resolution of 20"x20". The radio emission is spread over an area of 40x100 kpc (D=74 Mpc, assuming H=100 km/sec/Mpc), while the associated galaxies are optically compact, their sizes are about 10 kpc. A nuclear radio source is associated with NGC 4410a, a ring galaxy with a small bulge within the ring. At high resolution this source is a double with a separation of 0.5 kpc at PA 90°. The eastern galaxy NGC 4410b shows no radio emission. The extended emission

D. S. Heeschen and C. M. Wade (eds.), Extragalactic Radio Sources, 93–94.

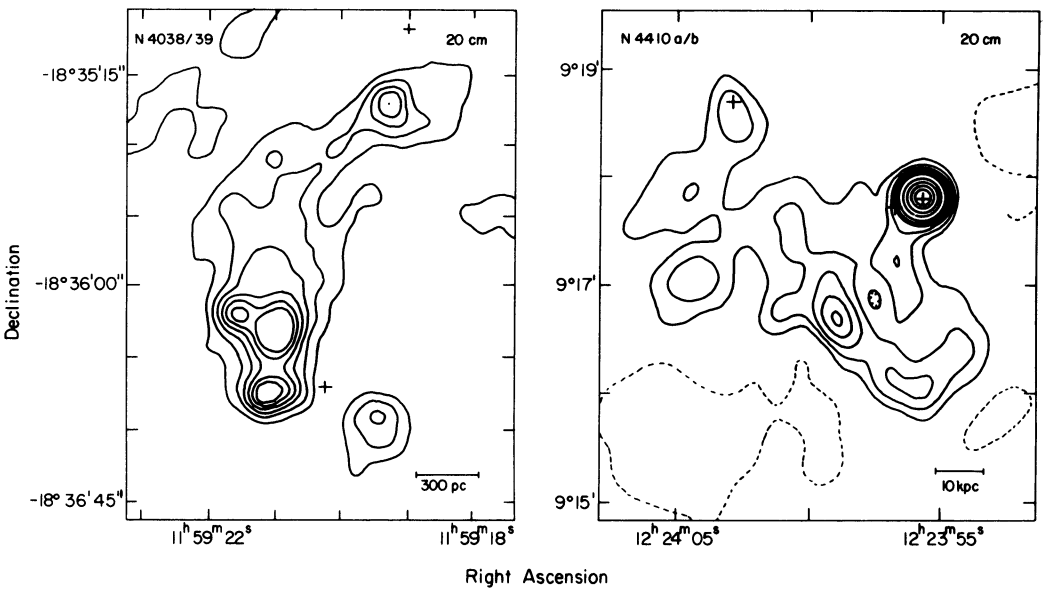

Figure: NGC 4038/39, cnt=2, 4, 6, 8, 10, 12 mJy/beam, beam=6"x6"; NGC 4410a/b, cnt=-1.5, 1.5, 2.5, 3.5, 4.5, 5.5, 7.5, 10, 12.5, 15, 17.5 mJy/beam, beam=20"x20". Optical positions of the galaxies are indicated by +.

shows a ridge of about 100 kpc in length displaced to the south of NGC 4410a/b by about 30 kpc. The emission associated with IC 790 suggests a head-tail morphology. A faint optical bridge, visible on the PSS, connects NGC 4410, IC 790 and an anonymous galaxy further to the northeast, suggesting a dynamical interaction involving these galaxies.

NGC 4438 (Arp 120): Observations with the Westerbork array showed that the centroid of the extended radio emission in this galaxy in the center of the Virgo cluster is displaced by about 4 kpc from the optical nucleus and central radio source, probably as a result of the interaction with the diffuse intergalactic medium in the cluster (Kotanyi et al., 1982). The high-resolution VLA map of the central source in the galaxy shows that this has a peculiar structure as well. The source is elongated in PA 124° and has a projected size of 1x0.3 kpc. The orientation shows no relation with either the optical major axis or the direction from the optical nucleus to the extended radio component (PAs of resp. 30° and 250°).

References

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