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RESUMO - NOTAS / ABSTRACT - NOTES

A VLA map at 1.4 GHz is presented of NGC3309, one of a pair of giant elliptical galaxies dominating the centre of the Hydra cluster (Abell 1060). The galaxy shows an S-shaped radio source similar to M84 in Virgo and NGC708 in Abell 262. The small size and low luminosity of these radio sources could be due to a recent tidal interaction responsible for their S-shape.

OBSERVAÇÕES/REMARKS

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NGC3309: AN S-SHAPED RADIO GALAXY IN A NEARBY CLUSTER

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RESUMO. Apresentamos uma imagem VLA de NGC3309, em 1.4 GHz, uma das componentes do par de galáxias gigantes elípticas dominando o centro do aglomerado de Hydra (Abell 1060). A galáxia exibe uma radiofonte em S, semelhante a M84 em Virgo, e a NGC708 em Abell 262. Sugere-se que as pequenas dimensões e as baixas luminosidades destas radiofontes seriam devidas a interações de maré recentes, responsáveis pela sua forma em S.

ABSTRACT. A VLA map at 1.4 GHz is presented of NGC3309, one of a pair of giant elliptical galaxies dominating the centre of the Hydra cluster (Abell 1060). The galaxy shows an S-shaped radio source similar to M84 in Virgo and NGC708 in Abell 262. The small size and low luminosity of these radio sources could be due to a recent tidal interaction responsible for their S-shape.

Key words:

I. INTRODUCTION

Radio galaxies were thought, soon after their discovery, to be exceptional and unusual phenomena. We know today that this is not true. Every giant elliptical galaxy can in principle harbour a radio galaxy, even at very low luminosity. Table 1 shows a list of the nearest clusters of galaxies. In virtually all of them the central dominant galaxy, always a giant elliptical, is a radio galaxy. The sources occur in four different morphological types: diffuse, amorphous sources (noted D), bent sources of the wide-angle head-tail type (B), narrow-angle head-tail sources (U) and S-shaped sources. These sources can be divided roughly in two groups according to luminosity. In the high luminosity group we find the diffuse and the head-tail sources typical of clusters of galaxies. The head-tail sources are often very large and are likely to be due to motion of the galaxy through the cluster, which would also make them look less luminous than they would be otherwise. The diffuse sources found in the central galaxies are amorphous or with little structure and of small size, possibly as the result of confinement. At the low end we find three weak sources which are different from the former. Two of them were known previously, M84 in Virgo (Laing and Bridle 1987) and NGC708 in A262 (Parma et al. 1986), both northern clusters. These sources instead of a U-shaped bending are S-shaped. Their size is also much smaller. The third is in Hydra, a southern cluster, in fact the nearest in the original Abell catalogue. Due to its southern declination its radio emission was little known until the VLA became available.

II. THE OBSERVATIONS

Fig. 1 shows a map of a central portion of the Hydra cluster made at the VLA. The map shows an S-shaped source associated with the giant elliptical galaxy NGC3309. A previous map at higher resolution by Lindblad et al.(1985) showed the presence of a pair of faint jets and low surface-brightness lobes misaligned with the jets. The S-shaped lobes seen in the present map are even dimmer and in combination with the high-resolution map suggest a helical torsion of the source axis. The brightness decreases abruptly at the end of the jets and again at the end of the inner lobes.

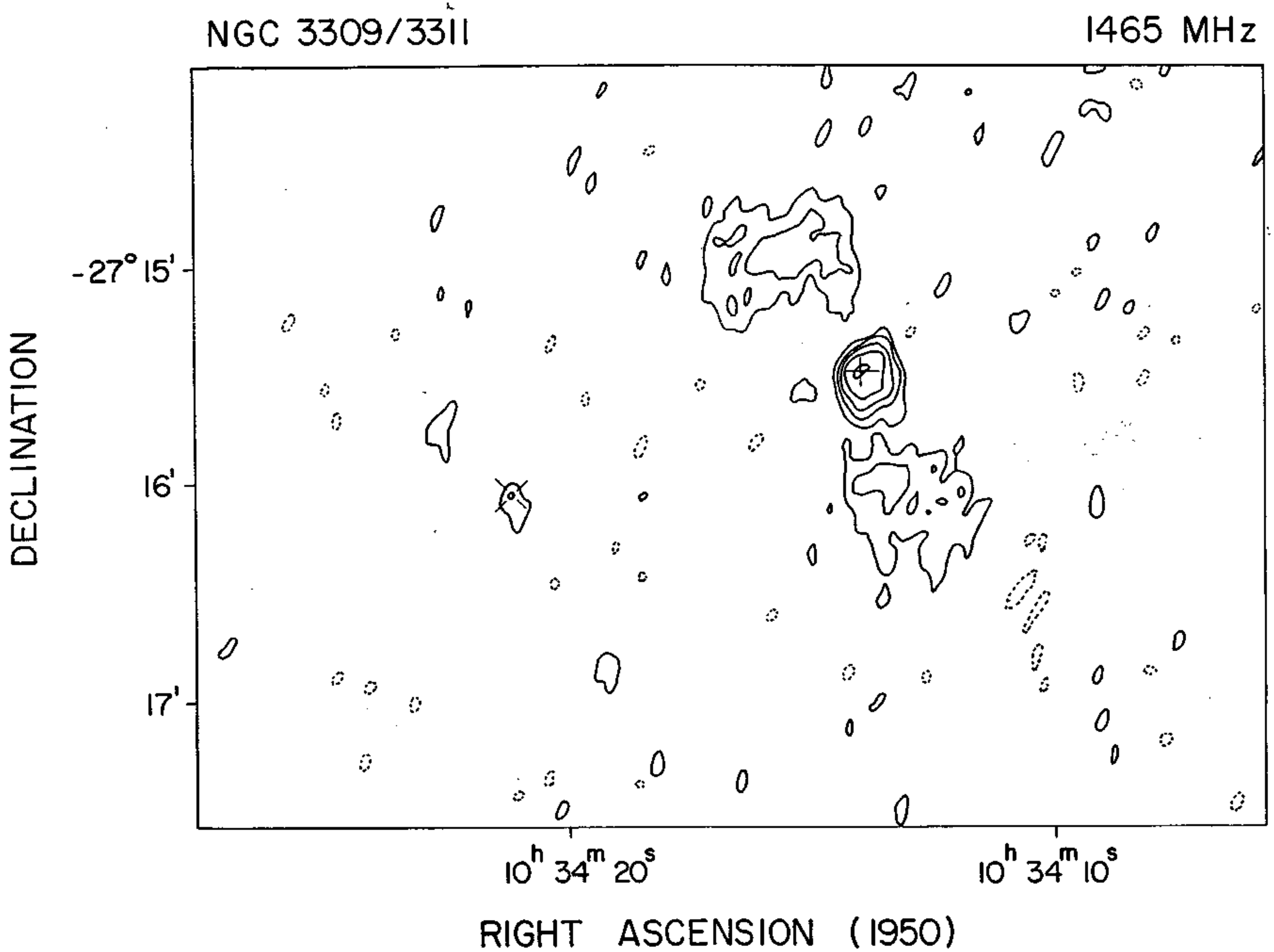

Fig. 1. VLA map at 1.4 GHz of the centre of the Hydra cluster showing the galaxies NGC3309 (+) and NGC3311 (x). The beam size is 3" x 6" (p.a. 17 deg.) and the rms noise is .06 mJy/beam. The lowest contour is .15 mJy/beam and the levels increase by a factor of 2 (negative dashed).

Table 1. Radio sources in the nearest clusters of galaxies.

Cluster	z	Radio source	Radio luminosity at 1.4 GHz log(P/10**26 W/Hz)	Shape
Virgo	.0037	M87 (Virgo A)	-2.40	D
		M84	-4.25	S
Centaurus	.0087	N4696	-3.51	D
Hydra	.0114	N3309	-5.44	S
A3565	.0121	I4296	-3.06	B
A3574	.0141			
A3627	.0143	1611-608	-1.5	B
		1611-605	-2.7	U
A262	.0161	N708	-4.7	S
A3537	.0167	1258-321	-3.7	
A194	.0178	N547 (3C40)	-2.7	B
Perseus	.0183	3C84 (Per A)	-2.35	D
		3C83.1	-2.58	U

NGC3309 is the member of a pair of giant elliptical galaxies in the centre of Hydra. The other member, NGC3311,shows some of the properties of a cD galaxy. The two galaxies have a redshift difference of 300 km/s hence they might be bound and orbiting around a common centre. The extensive X-ray halo associated with the cluster is centred on NGC3311 (Fitchett and Merritt 1988) which is therefore probably the more massive of the two galaxies. Our map shows a weak central source associated with NGC3311 confirming the detection by Lindblad et al. Faint lobes also begin to appear at a detection level of 4 rms.

III. DISCUSSION

Now it is remarkable that three of the nearest clusters harbour an S-shaped source in their centre. By extrapolation we might speculate that this kind of source is common in clusters. In fact the source in Hydra is the faintest in Table 1. The S-shaped lobes would not be easily detected already in Perseus, the nearest cluster showing a well-known head-tail source.

Another interesting point arises by examining the map closer. The source in NGC3311 has very nearly the same size and orientation as that in NGC3309. This kind of "sympathy" is already known from a spectacular example, 3C75 in A401 (Owen et al. 1985). Though very few examples of near pairs of radio galaxies are known, these examples suggest that physically related giant elliptical galaxies tend to produce similar radio sources. We are then tempted to imagine that the sources have a common reservoir e.g. of gas whose angular momentum determines the orientation of the radio sources.

An additional remarkable property common to the three S-shaped sources in Table 1 is that they are not associated with central, single giant elliptical galaxies. M84 in Virgo and N708 in A262 are each a member of a group with several galaxies of comparable brightness in contrast to central dominant powerful radio galaxies like Virgo A and Perseus A which are relatively solitary and which show the confined amorphous shapes. The S-shapes could then be due to the dynamical influence of the neighbour galaxies. Tidal interactions with companions of comparable or greater mass could cause variations in the direction of the radio.axes (Wirth et al 1982; Hunstead et al. 1984) though the precise mechanisms are not clear so far. This mechanism suggests an explanation for the low luminosity of these sources in analogy with the argument proposed by Leahy (1984) to explain the genesis of a class of head-tail sources from a population of sources with an intrinsic potential for much higher luminosity. The small size and luminosity of the S-shaped radio sources could be due to the impermanence of the radio axis e.g. like a garden sprinkler spreading its stuff so thin that it becomes invisible.

An alternative is that the small size and luminosity are signs that these sources have formed recently. In this respect it is interesting that both M84 and NGC708 have dust lanes in their inner regions. A dust patch has been noted in NGC3311 by Lindblad et al. who refer to the possibility of dust in NGC3309 as well. Such features could be possibly explained as the fate of the cooling flow gas, but they are easier accounted for as a result of a recent encounter with a gas-rich galaxy. In Hydra the obvious candidate for triggering the radio emission in NGC3309 would be the giant spiral galaxy NGC3312 which shows signs of a strong recent perturbation.

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