GAS, DUST AND RADIO EMISSION IN ELLIPTICAL GALAXIES

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ABSTRACT. CCD data are used to compare the isophotes, colour and dust-content of radio ($10^{21}<P_{5GHz}<10^{24}WHz^{-1}$, H_o = $75kms^{-1}Mpc^{-1}$) and radio-quiet ellipticals. Radio ellipticals are round but not spheroidal, reddened and occasionally have disturbed dust lanes. X-ray emission correlates with both radio emission and shape. Detailed investigations of dust in NGC 1316 reveal a possible nuclear gas disc orthogonal to the radio jet.

RADIO ELLIPTICALS - ROUND BUT TRIAXIAL: Disney et al (1984) showed that radio ellipticals are significantly rounder than radio-quiet ellipticals. Highly accurate ellipticity data from CCD observations (Sparks et al. 1985, S85) confirm this. Fig. 1 shows the distribution of median axial ratios of radio ellipticals and comparison distributions. A lack of exactly E0 galaxies and the existence of isophotal twists both indicate that the true shape is not spheroidal - radio ellipticals are tri-axial with varying axis ratios or are somewhat distorted. 69% show twists > 2^o (typically 10^o), compared to 33% of the radio-quiet ellipticals, a difference significant at the 5% level.

DUST: S85 described a powerful new method for searching for dust in elliptical galaxies, the (B-model I) method. Some 25% of ellipticals have dust lanes, which tend to have a disturbed appearance when found in radio-ellipticals. An overall reddening of the radio ellipticals was found, which could not be attributed to discrete dust features.

Fornax A: Fig. 2 shows a (B-model I) map of NGC 1316. Notice the inner dust feature essentially perpendicular to the radio jet. Hitherto, it was thought that NGC 1316 violated the correlation that radio structure lies perpendicular to any dust lane present (Kotanyi and Ekers 1979). Physical properties of individual dust clouds are similar to the averaged properties of the cool interstellar medium of our galaxy, and are consistent with the dust arising from the disrupted remains of a merged spiral galaxy.

COLOUR: Sparks (1983, S83) found radio-ellipticals are redder than radio-quiet ellipticals. By ranking the galaxies of S83 in optical

T. de Zeeuw (ed.), Structure and Dynamics of Elliptical Galaxies, 425–426.

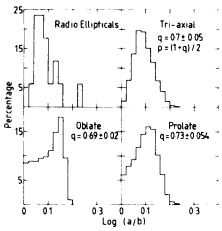

Fig. 1: Axial ratio distributions for 17 radio ellipticals and ensembles of triaxial ellipsoids, intrinsic axis ratios 1:p:q (1≤p≤q).

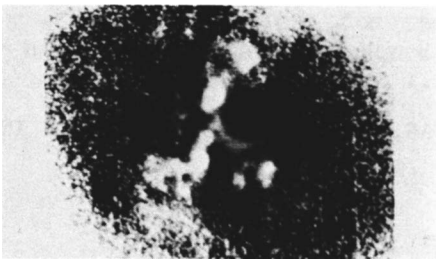

Fig. 2: (B-model I) image of dust in NGC 1316. Areas of extinction and reddening appear bright.

luminosity and applying the Sign test, it may be seen that absolute magnitude effects do not cause this. The sequence SO_1 to SO_3 is a sequence of early-type galaxies with increasing dust content. Classifications of the **Revised Shapley-Ames Catalog of Bright Galaxies** were used to find that mean values of A (see S83) for the SO_1, SO_2 and SO_3 galaxies are 0.04±0.01, 0.07±0.03 and 0.16±0.03 respectively. The difference between the dusty SO_3 and the others is much the same as between radio and radio-quiet elliptical galaxies, supporting the hypothesis that dust causes the reddening.

X-RAYS: X-ray satellites have provided direct observations of hot gaseous atmospheres within elliptical galaxies. Various correlations have been examined between X-ray and other properties for the galaxies studied by Forman et al (1985). Rounder galaxies are more X-ray luminous and there are correlations between X-ray and optical luminosity, radio power and $(B-V)_T^0$. Partial correlation (Macklin 1982) indicates that the correlation between X-ray and radio luminosity may not be due entirely to a mutual correlation with optical luminosity. Controlling for this and distance, the significance level of the X-ray/radio correlation is 5% (24 galaxies, all ellipticals). Similarly the correlation between X-ray luminosity and shape for ellipticals has a 1% significance level.

CONCLUSION: The data suggest that activity in elliptical galaxies is caused by accretion of gas onto the nucleus. The massive, more spherical radio ellipticals contain denser, more massive gaseous atmospheres which may be thermally unstable. Cooling gas could provide fuel for the active nucleus and, if dusty, redden the galaxy. A less common fuelling mechanism is gas accreted from outside the galaxy, recognized by the disturbed dust lanes of some radio ellipticals.

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