OPTICAL KINEMATICS OF STRONG RADIO GALAXIES

S. M. Simkin
Department of Physics and Astronomy,
Michigan State University

Recent spectroscopic measurements of 5 strong radio galaxies showed that approximately 50% of these objects had internal gas velocities which were notably non-circular [1]. To investigate this, more detailed observations were done for the galaxies in question. Examination of these results suggests that the non-circular velocities tend to fall into a pattern. All of the objects have one kinematical component which fits the classical picture of "circular rotation". This occurs in BOTH the stellar and ionized gas and displays MUCH HIGHER peak velocities than are found in E galaxies [1]. In addition, all of the objects studied possess a second ionized gas system at a different velocity from that of the rotating gas. Finally, at least one of the objects has an envelope of stars which is either not rotating or has a very different kinematic major axis from that of the stellar population in its inner regions.

The observations were done with the Hale 5m telescope and SIT spectrograph during Jan 1980 and 1981. The measurement and reduction procedures (including effects of instrumental errors) are fully discussed in reference 1. The objects observed were 3C98(ED3), 3C184.1(D3-4), 3C218(cD2), and 3C390.3(cD?).

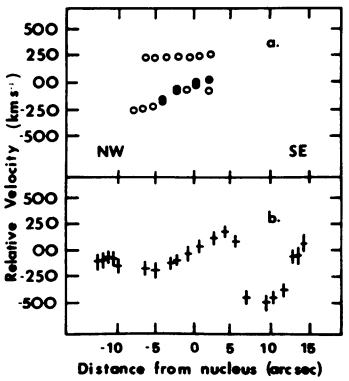

Fig. 1, Hydra A.
(a) ionized gas (b) stars

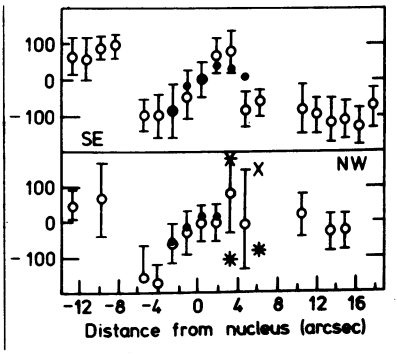

Fig. 2, 3C98, filled circles-stars; other symbols, gas

E. Athanassoula (ed.), Internal Kinematics and Dynamics of Galaxies, 313–314.

To date, the most complete analysis available is for the cD galaxy Hydra A (3C218). The velocity field of this object along the "major axis" is shown in Fig. 1. The two sets of data (stars and gas) have been normalized to coincide at the point 0,0. The ABSOLUTE velocities of these two systems are determined to no better than 75 km/sec. The RELATIVE accuracy of the velocities in one group (emission line or stellar) is shown by the error bars on the plots. The three kinematical features noted above are all present in Fig. 1. Both the stars and gas appear to be in rapid rotation near the nucleus with the second ionized gas system redshifted with respect to the nucleus. Since the absolute values of the absorption line and emission line velocities may differ by as much as 75 km/sec (at the one sigma level), it is possible that the "rotating" gas system (the lower velocity points in Fig. 1a) is associated with the group of low stellar velocities on the SE side of the galaxy (Fig. 1b). These points represent the systemic velocity of a second "knot" in the envelope of Hydra A which may be a "secondary nucleus"[2] or may be simply another cluster galaxy.

The other galaxy for which detailed information is available is 3C98. Velocities for the stars and gas in this object are shown in Fig. 2. Fig. 2a is for PA 115 deg and Fig. 2b for PA 180 deg. ("major axis" is 130 deg[1]). Again there is a region of rapid rotation near the nucleus and an outer region where the gas velocities seem to reverse sign. There are no stellar velocities available yet for this outer region. Finally, preliminary reductions show that two other objects (3C184.1 and 3C390.3) exhibit the same behavior, to wit: an inner region in rapid rotation and a second gaseous region with distinctly non-circular velocities. In addition, such anomalous velocities are also seen in NGC 1275.[3,4]

The complex velocity structure of these objects is so different from that usually found in rapidly rotating (Sa) systems without powerful radio activity that it seems likely that it is associated with the nuclear activity of these cD galaxies. Schweizer (this Symposium) has championed the view that such velocity fields are the signature of two galaxies in the process of merging. Indeed, Kent and Sargent[4] interpret the velocity field of NGC 1275 in this way. However, there are no obvious signs of recent mergers for any of the radio galaxies discussed here. In addition, some barred galaxies also have similar velocity fields. Regardless of the precise mechanism producing these anomalous velocity fields, it is clear that they imply an underlying galaxy structure which is similar to that needed to induce gas infall into the nucleus. The anomalous velocities, then, may well be evidence that the "Monster" is being fed.[5] Thus, more careful study of the phenomenon may well provide clues about the chronology and ecology of this activity.

REFERENCES

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