news and views

Giant extragalactic radio sources

MANY of the powerful extragalactic radio sources have dimensions much larger than those of the active galaxies which have supplied the vast energies required. In the case of the brightest radio source for example, Cygnus A, most of the radio emission originates, not in the galaxy associated with the source, but in two symmetrically disposed regions, one on either side of it. The peaks of maximum radio brightness are located about 100 kiloparsecs (equivalent to 3×10^5 light years) from the galaxy, the radius of which is only about 10 kpc. Such objects are the most common type of powerful extragalactic radio source found in source surveys although, as compared with the space density of ordinary galaxies, they are very rare indeed.

Detailed radio studies of the structures of these objects have been made possible by the development of the large aperture synthesis telescopes, first at Cambridge and more recently in The Netherlands (the Westerbork Synthesis Radio Telescope, WSRT). Several hundred of the brighter ones have been mapped with an angular resolution of 23″ and a smaller number with higher angular resolution, that of the Cambridge 5 km telescope being 2″ at a wavelength of 6 cm. There is no detailed source model which commands universal acceptance since the radio maps have revealed difficulties with each of the models proposed. All models, however, postulate the presence of magnetic fields within the components to produce the synchrotron radio emission, and of cold intergalactic gas in the vicinity of the sources to account for the complex radio structures observed.

Until now the maximum overall dimensions of these radio sources have been thought to be about 1 Mpc, which is the characteristic scale of clusters of galaxies rather than of galaxies themselves. Many radio sources are known to lie close to the centre of clusters of galaxies and for a while it has looked as if there might be a relationship between these two scales particularly since there is good evidence, from X-ray observations, for the presence of hot diffuse gas in clusters. If this relationship were true, however, it would be disappointing from the cosmological point of view because one might have hoped to use the radio components of the largest double radio sources as probes of the diffuse intercluster gas where most of the mass of the Universe may well reside.

On page 625 of this issue of *Nature*, Willis, Strom and Wilson report very interesting observations made with the WSRT and show that radio sources with physical sizes greater than 1 Mpc do indeed exist: the radio sources 3C236 and DA240 are extended, with total physical sizes, projected on to the celestial sphere, of 5.7 and 2.0 Mpc respectively. Credit for drawing attention to these objects goes to workers at the National Radio Astronomy Observatory (Bridle, Davis, Fomalont and Lequeux, *Astr. J.*, **77**, 405: 1972) who, in a definitive survey of bright radio sources at 1,420 MHz, found them to lie in "confused" regions and were unable to decide whether the radio sources in close proximity on the sky were physically related or simply chance associations of unrelated objects. In the first two cases studied by Willis, Strom and Wilson, the maps show unambiguously that these sources are in fact associated and form components of extended double radio sources on a scale much larger than has been known before.

These observations are important for cosmologists, cosmic ray physicists and for the student of the physics of extragalactic radio sources. For the cosmologist there is the prospect of probing the intercluster gas and setting direct limits to the pressure of such gas. For the cosmic ray physicist, there is now the direct evidence that clouds of cosmic ray electrons can be ejected beyond the confines of a cluster of galaxies in times much shorter than cosmological time scales.

For the radio source theorist, these objects stimulate new speculations. First, nobody has ever been clear about the ultimate fate of a powerful double radio source. The present observations suggest that in some cases the components expand, preserving the relativistic particles within their lobes, until very late stages in their evolution. Second, the observation of polarised radio emission from the components of DA240 indicates surprisingly low densities of cold matter inside the components. Third, and perhaps most interesting, there is the observation of a compact double radio source associated with the parent galaxy in the case of 3C236. It is usually assumed that these components are moving away from the nucleus of the galaxy in opposite directions. The axis of this compact double is almost perfectly aligned with the axis of the giant double source components. On any theory of the extensive components, the latter must be able to 'remember' for hundreds of millions of years the direction in which to supply energy. Similar phenomena have been known before—in the radio galaxies Centaurus A and 3C66 for example—but 3C236 is probably the clearest case yet. Observations of Cygnus A forced Hargrave and Ryle to conclude that a continuous supply of energy over tens of millions of years is essential if one is to account for the structure of the components, but present observations are evidence that a continuous supply of energy may occur for even longer, in the oldest sources. These new observations, and others in progress at Westerbork, will therefore be seized upon by cosmologists and cosmic ray physicists, and will provide yet another link in the chain of our understanding of the physical evolution of extragalactic radio sources.

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Organisation of sequences of rRNA

THAT the sequences of both 28S rRNA of the large ribosome subunit and 18S rRNA of the small subunit are contained in a single precursor has been known for some time; for this constitutes one of the rare cases where a synthetic system was defined first with eukaryotic and only later with prokaryotic cells. The size of the precursor varies; in HeLa cells it sediments at 45S, so that only 56% is conserved in the form of mature rRNA sequences, but in *Xenopus* it is smaller (2.7×10^6 daltons instead of the mammalian 4.1×10^6 daltons) and almost 80% is conserved. The processing