

NATIONAL RADIO ASTRONOMY OBSERVATORY
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To: Bob Havlen
From: Alan Bridle *A.B.*
Subject: Material for annual report

Bridle has continued work on the systematic properties of jets in extragalactic sources, using data on over 160 jets from his own and other observers' studies. The character of the jets changes from being predominantly two-sided and dominated by perpendicular (presumably azimuthal) magnetic fields in weak sources to being one-sided and dominated by parallel (longitudinal) fields in powerful ones. The transition occurs at the same intrinsic luminosity as that from class I (edge-darkened) to class II (edge-brightened) structure in the classification scheme of Fanaroff and Riley. The incidence of jets in complete samples of powerful radio galaxies is much lower than that in weak radio galaxies or in radio quasars. An article reviewing jet systematics is being prepared, in collaboration with R.A.Perley (NRAO).

Bridle and Perley have used the VLA in its C and D configurations at 20cm, 18cm and 6cm to study the faint, diffuse emission of the very large radio galaxy NGC6251. A counterjet, between 40 and 200 times fainter than the well-studied main jet, has been mapped. Its rough S symmetry relative to the main jet provides new constraints on models for energy transport in NGC6251. Bridle and Perley have also mapped the radio galaxy 3C219 with high dynamic range using the VLA at 20cm and 6cm, detecting an elongated knot opposite a gap in the previously known one-sided jet. If the knot is part of a counterjet, Doppler favoritism cannot explain all of the intensity asymmetries in this source.

Bridle, E.B.Fomalont (NRAO), G.G.Byrd (Alabama) and M.Valtonen (Turku) have mapped the unusual radio galaxy 3C288 with high dynamic range at 20cm and 6cm. The source contains a short two-sided jet and two extended emission regions with very unusual properties. The large scale structure resembles a twin radio trail, but several tongues of emission protrude from it in unexpected directions. The polarization properties of the source are radically different on its two sides, one being strongly polarized and the other not. Models for these unusual characteristics are being considered.

Bridle and R.A.Laing (RGO) are analyzing VLA maps of the weak radio galaxy 3C272.1 identified with the Virgo cluster elliptical M84. A twin jet emerges at right angles to a central dust lane and along the minor axis of an extended X-ray source at the center of the galaxy. If the jets are perpendicular to the dust lane in three dimensions, the brighter is on the side which would be receding from us in the standard outflow model. Their intensity asymmetry cannot therefore be ascribed to Doppler favoritism in this model. On a larger scale, the source bends first into a C shape, then deflects again to align with the minor axis of the stellar population of M84. Large-scale gradients in the Faraday rotation measure across the source have been detected; their symmetry with respect to M84 suggests that they arise in a magnetoionic medium in the elliptical galaxy. The radio source structure appears to be determined by a mixture of static and dynamic pressures resulting from its interactions with the atmospheres of M84 and of the Virgo cluster.

SCIENTIFIC PLANS - A.H.BRIDLE

Studies of the internal structures of kpc-scale radio jets in galaxies using the VLA will be continued, emphasising the relations between jet collimation, transverse and longitudinal intensity profiles, and magnetic field uniformity and orientation. The goal of this work is to constrain models of confinement, particle acceleration and magnetic field structures in the energy transport "pipelines" within extragalactic radio sources.

The geometrical and brightness symmetries of the pc and kpc scale jet and counterjet in the radio galaxy NGC6251 will be examined using both the VLA and an ad hoc VLB array. This work (with R.A.Perley) will help to discriminate between relativistic-jet and intrinsic interpretations of asymmetries in extragalactic jets.

Multifrequency observations of the lobes of several extended radio galaxies will be used to derive synchrotron emissivity and magnetic field distributions across these structures for comparison with models of particle transport from the ends of the jet "pipelines". Existing NRAO Astronomical Image Processing System (AIPS) software will be modified to determine spatial power spectra of individual lobes for comparison with theoretical predictions.

A numerical model for the synchrotron emission of relativistic electrons moving in various three-dimensional magnetic field configurations postulated to exist in extragalactic sources, treating finite Faraday depths, will be interfaced with AIPS to permit direct comparison of such theoretical brightness and polarization distributions with VLA images using identical resolution limits.

The mapping of radio structures of 1100 extragalactic sources selected in an unbiased manner at 408 MHz (the B3 catalog) will be continued. This is a long-term project (with B.G.Clark and R.A.Perley) to provide comprehensive and uniform VLA observations of a large complete sample for various statistical studies.

The total and polarized structures of two aligned neighbors of 3C130 will be examined in detail with the VLA to determine whether the large-scale similarities of the three sources are best explained by common environmental factors in the 3C130 cluster, gravitational lensing by the Perseus supercluster, or by simple coincidence.