A.H.Bridle Scientific Plans 1990-1991

20 August 1990

I intend to develop objective ways to categorize the range and distribution of structural scales that are manifested in the radio lobes of strong extragalactic sources observed with the VLA. New tools are urgently needed to quantify the properties of multiple "hot spots" and complex filamentation that have been revealed by recent well-sampled high-dynamic-range VLA images of radio galaxies and quasars. Methods based on reverse Fourier transformation of the images of individual lobes, on two-dimensional structure function analyses, and on brightness-gradient (Sobel) filtering of VLA images will be developed and compared.

These methods will then be used to search for objective distinctions between the properties of jetted and unjetted radio lobes in powerful extragalactic sources. They will also be used to characterize complex radio structures for comparison with the predictions of numerical MHD models of energy transport and synchrotron emission in radio lobes.

I also intend to make VLA observations to elucidate the origin of fine structure in the radio jets and lobes in the powerful radio galaxies 3C219 and 3C353. Competing models of the "partial" or "disappearing" jets in 3C219 have been given, based in one case on episodic outbursts in the nucleus and in another on adjustments to lack of force balance within a steady jet. These models may in principle be tested and distinguished by new higher-resolution VLA observations of putative shock structures within and around these jets. Models of the bright and (possibly) dark filamentation in 3C353 based on plasma instabilities or on the anisotropic cooling of the emitting particles may also be tested at higher angular resolutions than are now available from VLA imagery of the source. New VLA observations at 5, 8 and 14 GHz will therefore be proposed for these sources, in concert with a program of 3-d numerical MHD modeling of related phenomena using the ZEUS code at NCSA.

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A.H.Bridle published preliminary results of an analysis of jet-counterjet relationships in powerful classical double radio galaxies and quasars, based partly on work done with D.Hough (JPL/Trinity U.), J.Burns (NMSU/UNM), C.Lonsdale (Haystack) and R.Laing (RGO). He found that the detectable counterjets in powerful "classical double" radio sources are opposite "bent or broken" segments of the main jets in the same sources. The observed jet-counterjet intensity ratios may therefore be more sensitive to details of the interactions between the jets and their environment than to bulk relativistic effects. This greatly complicates, and may preclude, attempts to use jet/counterjet intensity ratios to test "unified models" of radio galaxies and quasars. The "flip-flop" interpretation of jet one-sidedness is not encouraged by the observations, because they contain examples of compact hot spots in "unjetted" lobes.

Bridle, with D.Clark (NCSA), J.Burns (NMSU/UNM), R.Perley and M.Norman (NCSA) has continued studies of the "disappearing" jet and counterjet in the powerful radio galaxy 3C219. This work is aimed at distinguishing the "born-again" relativistic jet model for such features from models in which the prominence of a nonrelativistic jet is enhanced by shocks while the jet reaches force balance with the ambient medium. Numerical models of steady and unsteady jet propagation made using the ZEUS-2D code at NCSA have been compared in detail with multi-frequency VLA observations of 3C219. Studies of the spectra and prominence of the radio hot spots, and of the intensity and polarization structures of shock structures in the jets and in the ambient medium, have been identified as possible discriminants between these alternatives.

Bridle, with C.Williamson (U.Illinois) and S.Baum (NFRA,Dwingeloo) is analyzing multi-configuration VLA obervations of the bright radio galaxy 3C353. This double radio galaxy contains a rich variety of features, including an intricate network of high-contrast, highly-polarized filaments filling both radio lobes. There is also an unusual "cold spot" several kiloparsecs in width whose properties change little, if at all, with observing frequency between 1.4 and 14 GHz. Detailed multi-frequency imaging, radiometry and polarimetry of this complex source are continuing.

A.H.Bridle material for 1990 BAAS report.

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