NUMERICAL SIMULATIONS OF EXTRAGALACTIC JETS IN AN INHOMOGENEOUS ENVIRONMENT

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We have simulated the passage of an extragalactic jet through a medium containing an ensemble of cool, dense clouds. The hydrodynamic code uses the second-order Godunov method of Falle (Falle 1991, van Leer 1979) in three-dimensional, cartesian coordinates. We have estimated the synchrotron emissivity and used this to produce synthetic radio maps. The results are reminiscent of structures seen in many extragalactic radio sources.

There are several lines of evidence to indicate the presence of cool, dense clouds in extragalactic radio sources.

- Polarization maps of radio sources show significant inhomogeneity on scales of less than 5kpc (Pedelty *et al* 1989).
- Line emission at optical wavelengths is observed from regions along the edges of jets, at the outer edges of bends and near knots (Wilson 1993), aligned with the radio axes (Dunlop & Peacock 1993) and associated with the regions of depolarization.
- X-ray observations show that radio galaxies and quasars often lie in the centres of rich clusters with dense, rapidly cooling IGM (Crawford & Fabian 1993), in which cold clouds can condense (Fabian 1993).

The clouds in our simulation have a density contrast of 50 times the ambient medium, and are distributed at random positions in the grid, with a fixed volume filling factor (0.2) and a power law distribution of radius up to a fixed maximum size (7 cells). The computational grid is 90 × 90 × 90 cells, notionally representing a region of 9kpc^3. The jet has a Mach number

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of 10 and a density contrast of 0.01. We assume that jet and clouds are in pressure balance with the ambient material. We have chosen conditions in the ambient medium to be consistent with observations.

The plots show the logarithm of total density in the central plane of the computational grid and radio emission on a linear scale integrated through the grid. As the jet progresses through the grid it can be seen to collide with clouds, producing prominent hotspots in the radio emission. In earlier simulations we have studied the collision of jets with individual clouds (Higgins, O'Brien & Dunlop 1995). These show the deflection of the jet and hotspots giving enhanced emission at the point of deflection.

These spots persist as the jet moves past each cloud and encounters further obstructions. They fade as the clouds are eroded by the passage of the jet. Meanwhile new hotspots form at new encounters, and deflected jet material percolates through the ambient medium, producing filamentary and foamy shock structures. The result is a jet that is made visible by a series of irregular knots, with a crooked ridgeline, multiple hotspots at the head of the jet and filamentary diffuse bridges and lobes.

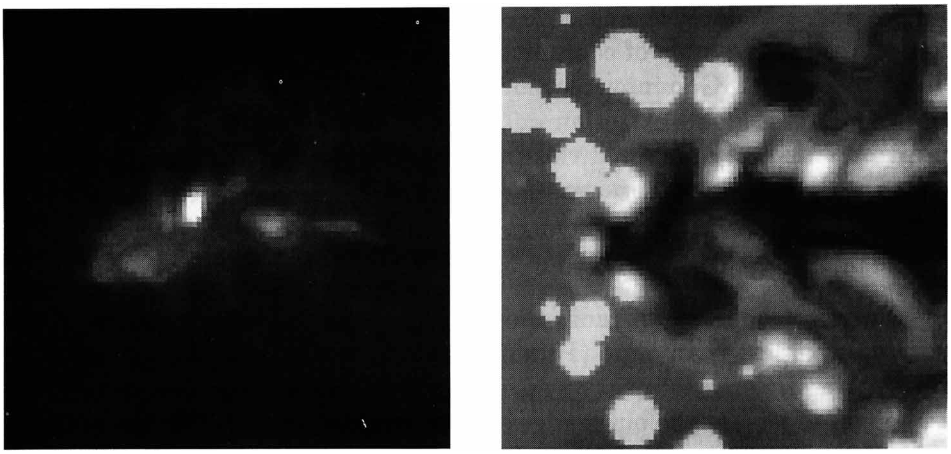

Figure 1. Density and Synchrotron Emission at 48,000 years

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