12.06

SPH Simulations of Beam Asymmetries in Radio Galaxies

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We have refined our SPH code to attack the problem of hot spot and beam asymmetries in the propagation of radio jets in external media. The first step was to realize that for large-scale simulations, the problem takes an exceedingly long run time. Hence we have experimented with several timestep schemes and examined their performance in the context of timestep sub-cycling. In problems like this one where a small region of the flow can reduce the timestep significantly, computational efficiency can be vastly improved by a timestep sub-cycling scheme. Also, for SPH, a proper set of algorithms for evolving the fluid boundaries didn't exist in the literature. Thus, computations involving fluid boundaries usually had the boundaries come crashing in within a few hundred timesteps. We have evolved methods for treating the boundaries in a high order continuitive way. These will be presented too.

We will then make an application to modelling hot spots in radio galaxies. We will discuss possible mechanisms for the formation of multiple hot spots. We will examine the cause for these hot spots in the context of beam instabilities and also in the context of a rotating central engine. Also, we will consider the interaction of the beam with a clumpy environment as frequently occurs in high redshift quasar environments.

12.07

Filaments in the Radio Source Fornax A

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The giant radio source, Fornax A, has been imaged using the VLA with 14″ resolution (corresponding to 2.2 kpc) at the frequencies of 0.3, 1.4, 1.6 and 4.9 GHz. The radio lobes contain a wealth of filamentary structure, both large-scale and small-scale. There is a 'vortex' pattern in the western lobe and a 'triangular' pattern in the eastern lobe. The radio emission from the filaments is about 20% linearly-polarized and the projected magnetic field lies along the filament axis.

The formation and stability of filaments in radio lobes are not understood and a variety of models have been proposed. We have estimated the properties of the filaments and the surrounding medium in Fornax A from the radio, optical and x-ray data and have compared them with the existing models.

12.08

VLA Imaging of Large Scale Radio Filaments in 3C353

Alan H.Bridle, Christopher E.Williamson (NRAO)

The radio galaxy 3C353 (1717-00) is the fourth brightest extragalactic radio source in the 3CR catalog, after Cygnus A, Virgo A and Hercules A. Its absolute radio power (4.5 x 10^{25} W Hz^{-1} at 1.4 GHz) is just above the range where the transition from edge-darkened (FR I) to edge-brightened (FR II) morphology normally occurs in radio galaxies. It is identified with an elliptical galaxy at a redshift of 0.03, arguably a member of a poor cluster.

Despite its angular size (4.8 arcmin) and strength (57 Jy at 1.4 GHz) this radio source has received little attention because it is too close to the celestial equator to be imaged easily with most synthesis radio telescopes. We present the first detailed radio images of 3C353, from VLA multi-configuration data with matched resolutions (FWHM 1.4 arcsec = 580 pc for H_0 = 100) at 1.38, 1.67, 4.9, 15 and 22 GHz. These high-quality images reveal a wealth of complex radio structure, dominated by a striking pattern of bright and dark filaments throughout the Eastern lobe and an unusual pattern of filamentation in the Western lobe. The main radio jet and parts of the counterjet are both detected. The main jet appears center-darkened for part of its length. Both radio lobes contain hot spots that are well resolved on images obtained with 0.45 arcsec (200 pc) FWHM, and have structures suggestive of shocks and secondary flows. The properties of the filaments, jets and hot spots are compared with those of the radio galaxies Cygnus A and Fornax A when imaged with the VLA at the same linear resolution.

12.09

What are the GHz-Peaked-Spectrum Sources?

C. P. O'Dea and S. A. Baum (NFRA, Dwingeloo NL)

There is a class of very powerful, ultracompact radio sources whose radio spectra peak in the region near 1 GHz (the GPS sources). These radio sources are hypothesized to be very young classical double radio galaxies which are seen during the first $\sim 10^4$ yrs of nuclear activity.

Our recent optical and radio results have shed new light on these objects. We find that $\sim$ 60% of the objects identified with galaxies show evidence for recent interaction in the form of significant distortion of the optical isophotes and/or the presence of close companions. This is about twice as frequent as found in samples of classical double radio galaxies. Our multifrequency VLA measurments of 15 GPS sources show that the fractional polarizations are extremely low $\lesssim$ 0.5% (see also Rudnick and Jones 1982). At least some sources have very high Faraday rotation measures [up to $\sim$ 7000 rad m^{-2} corrected to the rest frame of the source]. These sources also have very steep low frequency turnovers in their radio spectra suggesting that they are very tightly confined. In the few cases so far where extended emission has been detected, it tends to be weak and diffuse.

Our discovery of extended emission associated with GPS sources suggests that at least some of them are not nascent radio galaxies, though it is possible that the activity is repetitive. In this hypothesis, the extended emission would represent the relic of a previous epoch of nuclear activity. We also consider a picture in which the host galaxy of the GPS source has recently acquired a large amount of gas and dust from a companion. In this scenario, this infalling gas has smothered the radio source, confining it to the nucleus, cutting off the supply of energy to the extended radio structure, and producing the observed low polarization and large rotation measures.

12.10

The Clumpy Medium Around Distant Radio Galaxies

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We present VLA radio observations at λ6cm and λ20cm wavelength for a sample of distant ($z \equiv 1$) and luminous ($L_{178MHz} \equiv 2 \times 10^{27}$ W/Hz) 3C radio galaxies, chosen for strong nuclear or extended optical emission lines. The derived rotation measure and depolarization distributions are patchy on scales from <5 to >50 kpc, leading us to a