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COMBINED–ARRAY IMAGING OF EXTRA–GALACTIC RADIO SOURCES

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INTRODUCTION

The resolving powers of existing telescope arrays are quite different. For example the extended new MERLIN at 5 GHz readily yields maps of ~ 50 mas resolution compared with the VLA ~ 350 mas, WSRT ~ 4000 mas, EVN ~ 5 mas, global VLBI ~ 1 mas, etc. This means that images obtained with these instruments yield information on different scales that sometimes appear unrelated. However, the need to have structural information on intermediate scales demands that data from different arrays be combined to make a single image. This is particularly important in extra–galactic radio sources where the relationship between core–jet features on different scales (parsec and kiloparsec) and the connection between small–scale and extended features need to be established.

By combining uvdata from two or more arrays we can routinely make images that represent a balance between the capabilities of the combined arrays, (e.g. VLA + MERLIN, MERLIN+VLBI, VLA+WSRT etc) at cm wavelengths. In order to do this, one has to overcome a number of calibration and mapping difficulties (see Zhang et al. 1991; Akujor et al. 1992, in prep.).

METHOD

1) The cordinate system of the telescopes should be the same. If they are not, then they should be recalculated within the same cordinate system. This is important in MERLIN/VLBI where the telescope cordinates have a systematic difference.

2) The data sets must be set to the same reference epoch by applying the required rotation correction due to precession. This is unneccessary for simultaneous observations.

3) Due to different sensitivities of the antennas as in VLBI/MERLIN, errors in telescope tracking and gain calibration dominate for high signal to noise data. We take care of this by assigning appropriate weights to the data.

4) For non–simultanoeous observations, core varibility will be taken into consideration by subtracting the flux density difference in the UV plane before combination.

5) The data should be referred to a common phase center (position), and can then be aligned by self–calibration. A common phase center is best defined if there is an overlap in the uv plane, e.g. a common baseline. MERLIN data should normally be self–calibrated with the VLA data.

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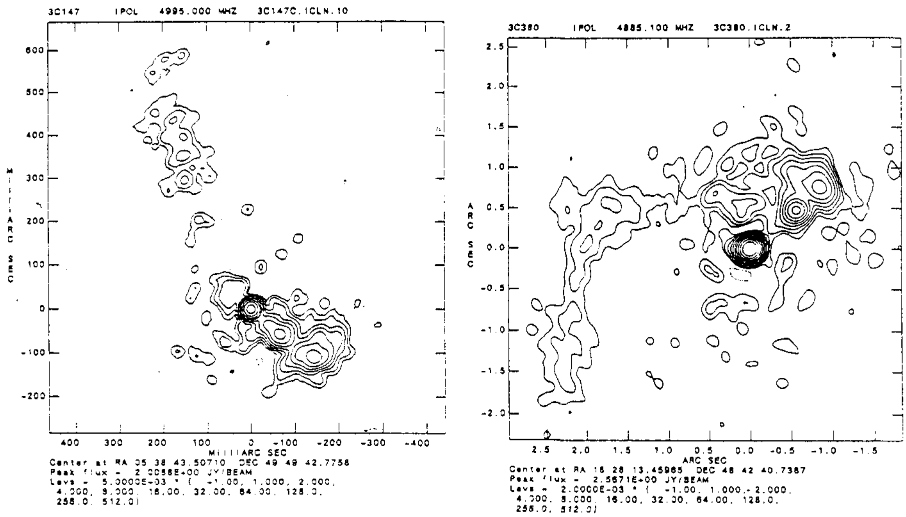

FIGURE I A combined MERLIN–EVN map at 5 GHz of 3C147 (beam is 25 mas) and a combined VLA–MERLIN map of 3C380 (beam is 150 mas)

POSSIBILITIES FOR MM–ARRAYS

The mm–arrays also have different resolving powers. For example, the millimeter array at Nobeyama has an optimum resolution of ~ 4 arcsec at 115 GHz compared with ~ 2 arcsec at Owens valley (Padin et al. 1991) and 1 arcsec expected at NRAO's mm–array (Brown 1991). As the data acquisition becomes standardised it should be routine to combine data from these arrays to make maps of intermediate resolution. This would be particularly useful for structural comparison at similar resolution at 115 and 350 GHz

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