METER WAVE INTERFEROMETRY

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There are many outstanding astrophysical problems which are best studied at meter wavelengths. However this part of the spectrum has not been fully exploited for astronomical observations for several reasons. Firstly, the arrays at cm wavelengths provide higher resolution. Secondly, the level of man-made radio interference is very high at the longer wavelengths in industrialised countries, although it is not so high in countries such as India. Finally, the phase variations caused by the ionospheric irregularities are quite severe at meter waves, particularly for a large array ($\sim \lambda/35$ rad.km^{-1}).

Recent developments of self-calibration and closure-phase techniques have provided a revolutionary breakthrough for interferometric data processing in the presence of atmospheric phase variations (Cornwell and Wilkinson, 1981). However, the large field of view of each element of the interferometric array poses two very severe constraints for data processing: (a) the need for a three-dimensional rather than the usual 2-D Fourier transform due to the "w" term for a large non-EW array such as the VLA at 327 MHz and (b) the wavefront is not isoplanatic, i.e. phase variations are not only functions of time but also of the position of each source in the field of view. Schwab (1983) proposed the division of the field of each antenna into m cells, but this increases data processing nearly m times. Using the MX task for AIPS, maps are being made for 327 MHz observations at the VLA following a Hybrid approach in which maps are being analyzed over only a square degree in the first instance and a larger mosaic is patched up subsequently. Subrahmanya (1988) has recently proposed that the ionospheric region corresponding to the field of view of the array be divided into m cells, which minimizes the number of unknown variables. It seems that the new generation of relatively low cost parallel/distributed processing/vector machines and also new algorithms may allow achievement of high dynamic range over a wide field of view of a meter wave interferometer.

A Giant Meterwave Radio Telescope (GMRT) is being set up at Khodad, about 80 km north of Pune in India, for high resolution mapping of galactic and extragalactic radio sources. One of the primary aims of the telescope is to search for the highly redshifted 21 cm spectral line emitted by neutral hydrogen clouds to determine the epoch of formation of galaxies.

GMRT will consist of 34 fully-steerable parabolic dishes of 45 m diameter each. A novel design has been adopted for the dishes. Sixteen of these would be placed in a compact central array of about 1 km in size, including nine forming a 3×3 grating to facilitate deep searches for new pulsars. The other 18 antennas will be placed along the arms of a Y-shaped array with each arm extending to about 14 km. GMRT is being designed to operate at

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six different frequency bands between 38 and 1420 MHz. The reflecting surface of the dish will be made of a mesh of stainless steel wires of 0.55 mm diameter. The size of the mesh in the central part will be 10 ×10 mm, in the middle 15 ×15 mm and in the outer part it will be 20 ×20 mm. The surface accuracy of the reflecting surface will allow operation up to about 1420 MHz. The multi-frequency operation is planned by mounting the different fe and low noise eds RF amplifiers on a rotatable turret placed near the focal point of the dish. Optical fibre links will be used to distribute coherent local oscillator signals to all the antennas and to bring received antenna signals to a central laboratory. A 256- channel FFT unit with a bandwidth of 16 MHz placed after each antenna (with > 35 dB sideband rejection) followed by a complex correlator (FX system) is planned to cross-correlate outputs of all the 34 antennas for both polarizations, providing about 560,000 complex outputs. Of these, a maximum of 140,000 channels will be available for recording after rejection of any channels in which radio interference is present.

GMRT will be a versatile instrument for radio astronomy research. It is to be completed by 1992.

References

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