Dual polarized broadband dipole antenna feed with conical reflector for uGMRT

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The Giant Metrewave Radio Telescope (GMRT) is an international facility for Radio Astronomy, operational since 2002. It consists of 30 fully steerable prime focus feed parabolic antennas, each of 45 m. diameter, spread over an area with an effective radius of nearly 15 km, and covering frequencies in the range of 150 MHz to 1420 MHz. Though meant primarily as an aperture synthesis instrument, antenna arrays can be formed out of the 30 dishes, where separate sub-arrays can work on different frequency bands concurrently.

To meet the requirement of seamless frequency coverage from about 50 MHz to 1500 MHz, we have designed and developed wide-band feeds of an octave or more bandwidth, to efficiently cover this range. New feeds are designed and developed to cover the following bands: 130-260 MHz, 250-500 MHz and 550-900 MHz.
For 120-240 MHz coverage, the basic design of the Kildal Feed (dipole-disk feed) is being adopted, with the following major design changes: (i) sleeved cross dipoles for larger BW (ii) provision of 2 beam-forming rings for better polarization features over a larger BW and (iii) an optimized reflector. After extensive astronomical tests with prototypes of this feed on 4 GMRT antennas, this feed has now been mass produced and installed on all 30 GMRT antennae.
For 250-500 MHz, the prototype feed that has been designed and tested employs a crossed-dipole with a conical reflector. Test results indicate a good BW ratio of 1:1.8 for a return-loss of -10 dB or less, with the following radiation properties: (1) good pattern symmetry over the frequency band of 250-500 MHz and fairly good match of E and H plane patterns (on the primary lobe, especially within the angular spread of - 62.5 to + 62.5 deg., being the edge-angle of the GMRT's parabolic dish) over 250 to 500 MHz (2) a cross-polar minimum of -27 dB at 327 MHz and -15.5 dB at 250 as well as 500 MHz. After extensive astronomical tests with prototypes of this feed on 3 GMRT antennas, this feed has now been mass produced and installed on all 30 GMRT antennae.
A scaled version of this crossed-dipole with a conical reflector for 550-900 MHz coverage has been designed and developed, Test results indicate a good BW ratio of 1:1.8 for a return-loss of -10 dB or less, with good pattern symmetry over the frequency band of 550-850 MHz. After extensive astronomical tests with prototypes of this feed on 3 GMRT antennas, this feed has now been mass produced and installed on all 30 GMRT antennae.

This paper describes the dipole antenna design aspects like simple dipole, dipole with sleeves, dipole with flat reflector, dipole with conical reflector and dipole wth beam forming ring (s), which were designed and implemented at GMRT observatory.
This paper also describes the future cone-dipole design for 900-1500 MHz, which provides very good return loss performance (<-10 dB) and with uniform edgetaper ~ 12 dB throughout the band.

Successful completion and deployment of these wideband feeds on all 30 antennas will make the GMRT a very sensitive and versatile instrument for a variety of new science in astronomy.

References

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