The €10 Ultra-Wideband, High-Gain, Sparse Antenna

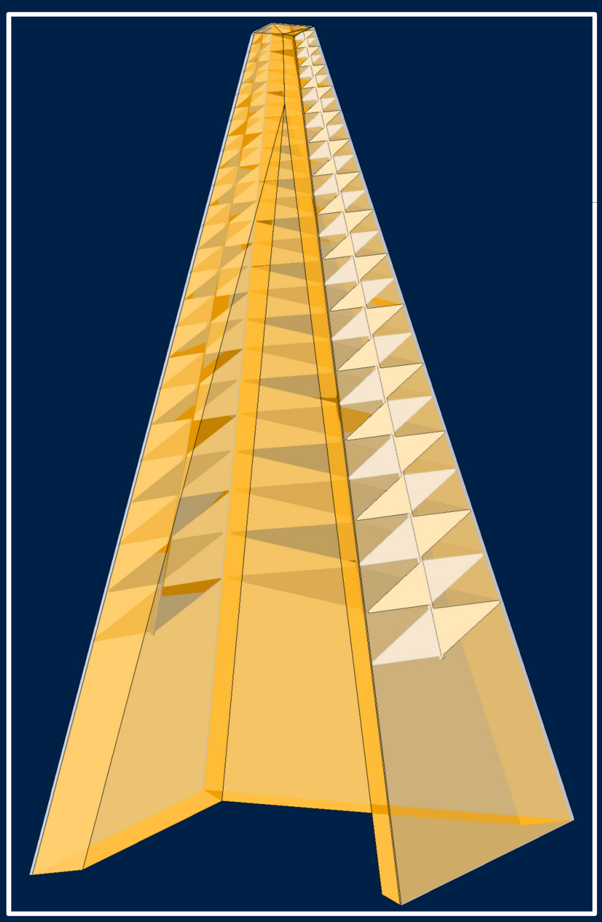
S. Schediwy[1], D. Price[1], J. Cook[2], P. Grimes[1], M. Jones[1]

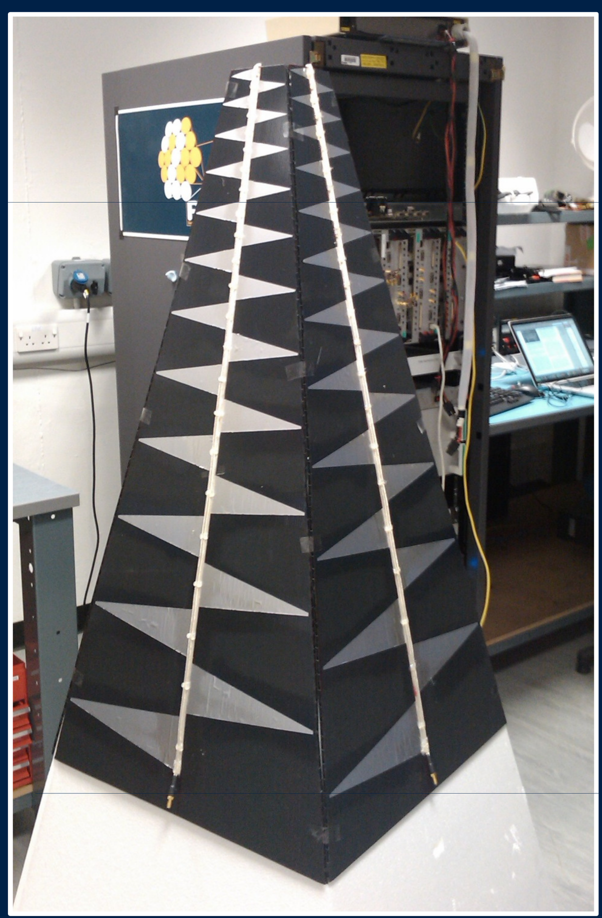
Corresponding email: schediwy@physics.ox.ac.uk,
1 – University of Oxford, 2 – The Cherwell School,

We present the design and performance of a dual-polarisation, ultra-wideband, high-gain, sparse antenna constructed for under €10. The frequency range of the antenna is between 300 MHz and 1.50 GHz with a half-power beamwidth of around 45°. Constructing a sparse aperture array with this antenna would result in a greater collecting area at lower frequencies as compared to dense array or a dish. For spectral line surveys this equates to greater sensitivities at higher redshifts. For neutral atomic hydrogen (HI) surveys with the SKA this results in increasing the total number of detections, currently around 1 Billion galaxies (Myers 2009), and expanding the range of detection.

Design and Manufacture

The antenna is based on a dual-polarisation stacked, log-periodic dipole array design. Each side consists of two layers of metal foil separated by a hollow plastic sheet. The 50Ω microstrip transmission line is a metal strip separated by layer of plastic dielectric.



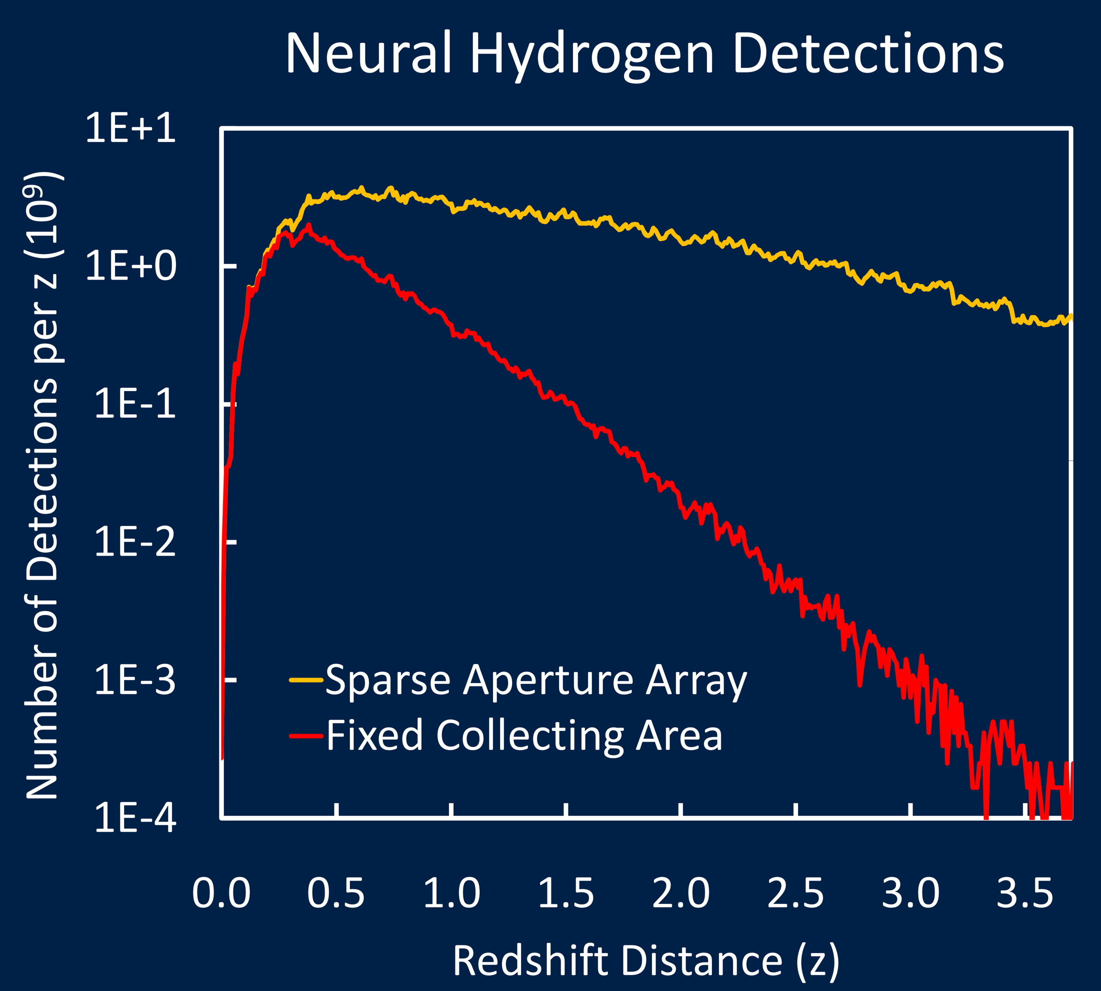


Sparse Aperture Arrays

When used in a sparse aperture array, the effective area of the antenna is at its maximum value across the entire frequency range; increasing from 0.02 m^2 at 1.50 GHz to 0.5 m^2 at 300 MHz (Schediwy 2009).

Implications for Surveys

A HI survey (Abdalla 2010) conducted with a sparse aperture array would have over 20 times the sensitivity for sources at a redshift of z = 3.7 (300 MHz). Both dense aperture arrays and a dish receivers have a fixed collecting area and therefore do not exhibit this characteristic.



The extra sensitivity at higher redshift, results in the detection of several billion HI sources and shifts the mean detection distance to greater redshifts.

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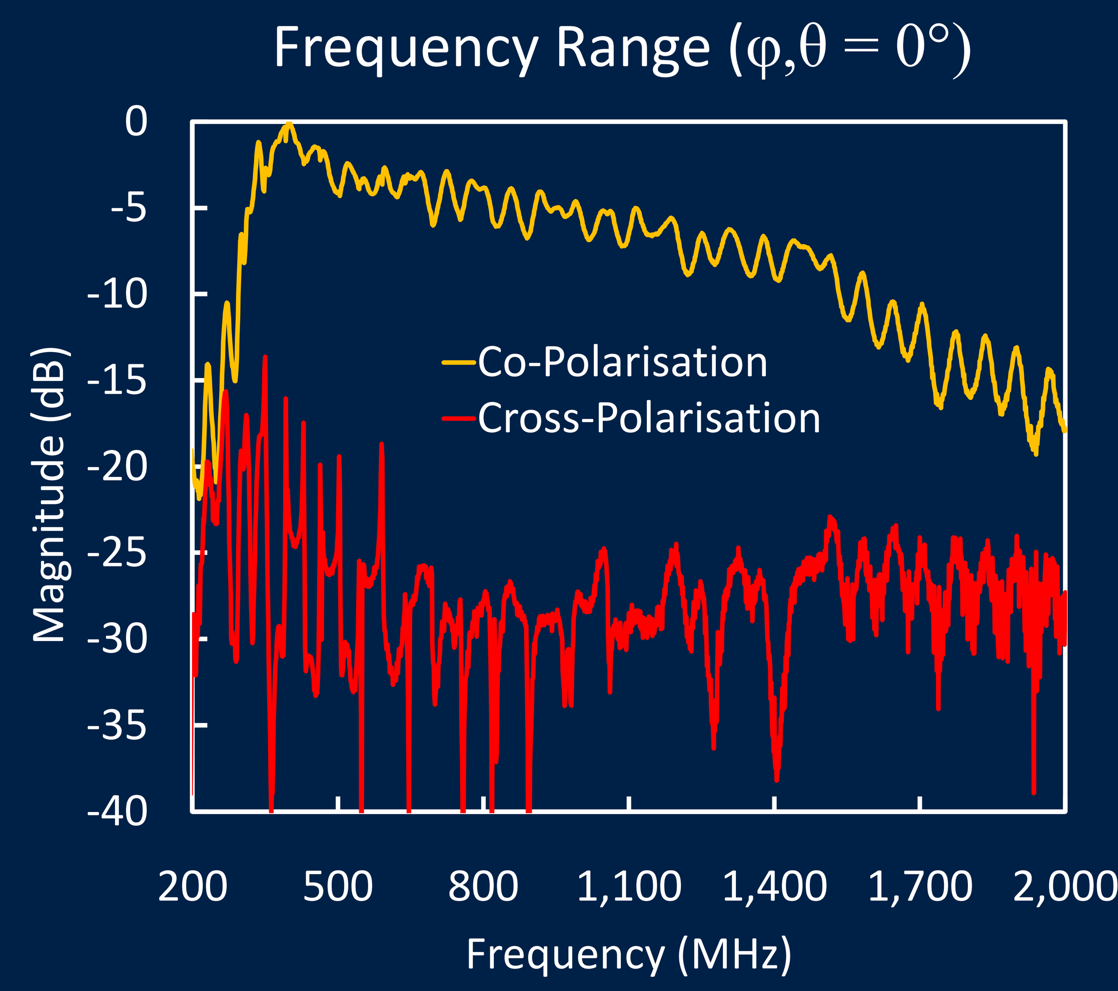
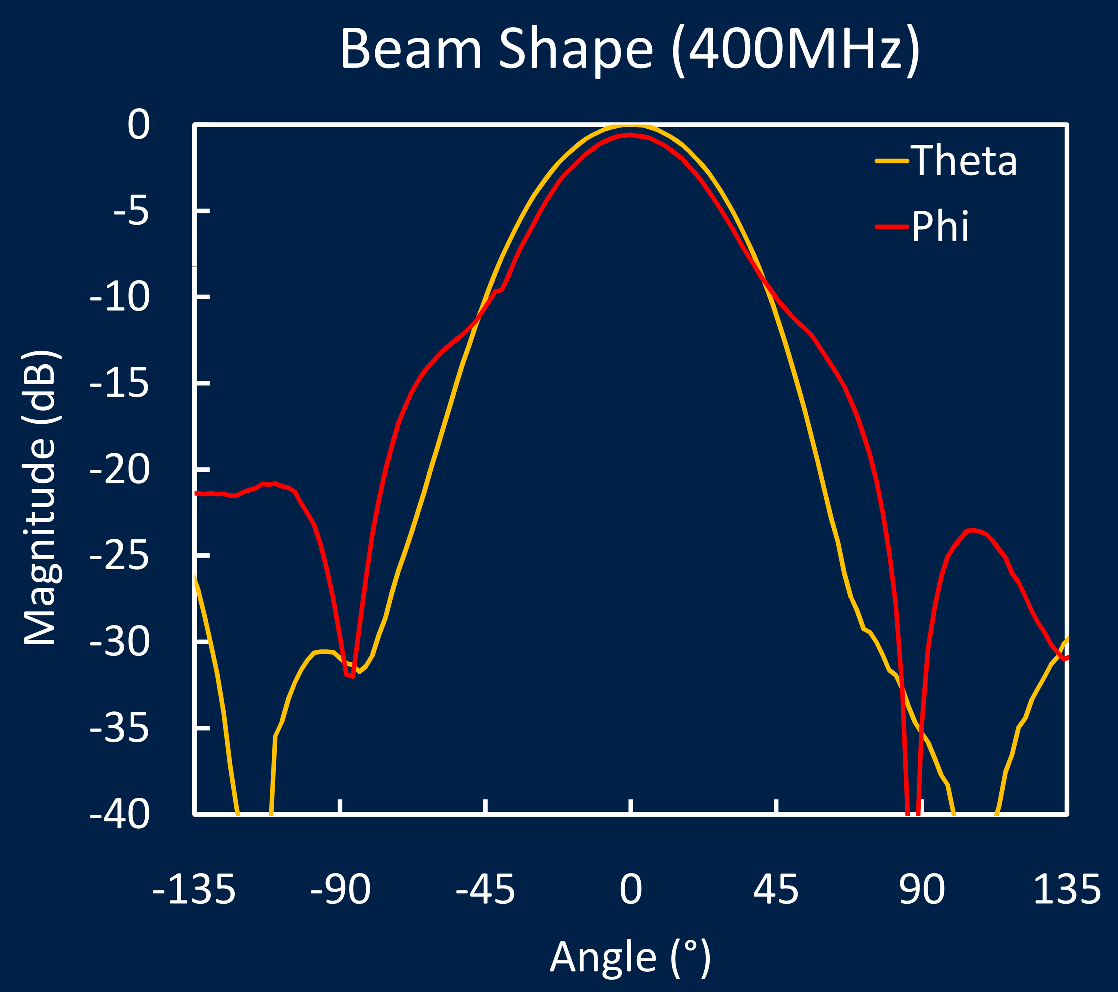
Results and Performance

The transmission power has a slope of around 7dB between 300 MHz and 1500 MHz, with ripples of around 3dB. The cross-polarisation isolation is about -25dB at $\varphi,\theta = 0°$, increasing to a maximum of -15dB at ±20°. The half-power beamwidth is about 45° with a variation of less than 5° across the frequency range.





Further Work

Need to; build and include cost of a matched amplifier, solve impedance mismatch issue, and prove functionality of sparse aperture arrays.

References

S. Myers, F. Abdalla, C. Blake, et al. arXiv:0903.0615v1

F. Abdalla, C. Blake, and S. Rawlings. Mon. Not. R. Astron. Soc. 401 (2010) 743–758.

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