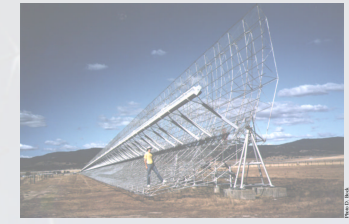


Prototype SKA Technologies at Molonglo:

2. Antenna and Front End



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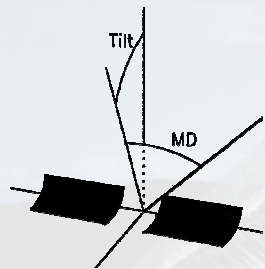
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Abstract

We propose to prototype SKA technologies on the Molonglo radio telescope, enabling the telescope to operate over the frequency range 300-1420 MHz. The telescope collector consists of two 778 m x 12 m cylindrical parabolic reflectors, currently operating at 843 MHz. The front end of the instrument will demonstrate wide band line-feed and low noise amplifier technologies. These are discussed along with the collector performance at 1420 MHz, the synthesised beam shape for a promising configuration of line-feed patches, and the radio-frequency interference environment at Molonglo.

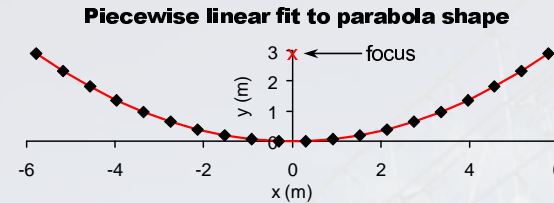
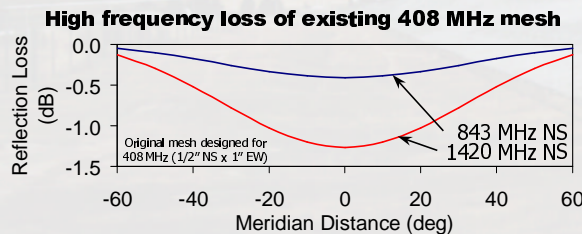
Collector

The telescope's collector consists of two cylindrical paraboloids, 778m x 12m, separated by 15m and aligned east-west (total area 18,000 m²). The telescope is steered by mechanical rotation of the cylindrical paraboloids about their long axis, and by electronic delays of the feed elements along the array. The resulting 'alt-az' system can follow fields south of declination -30 ° for ±6 hours.



Beam Steering Geometry
MD: Meridian Distance.

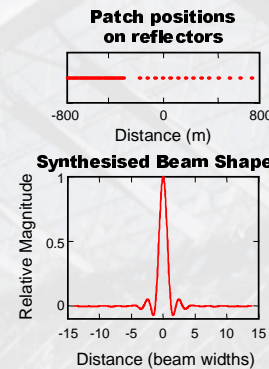
The original parabola shape was designed to be accurate for operation at 1.4 GHz. The reflecting mesh was designed for operation at 408 MHz and will need to be replaced for operation above ~1 GHz.



Mesh supported at 0.6 m (2 ft) intervals in x direction. Each section gives the same error for a linear fit to a parabola. Gives a total of 0.1 dB loss at 1420 MHz.

Beam Shape

The synthesised beam shape for a possible configuration of antenna patches on the telescope is shown. This configuration has a contiguous patch covering a third of the telescope area for forming 1.3' beams for pulsar or SETI searches. The remaining part of the telescope is more sparsely covered (with positions calculated from a simple grading function) to give good imaging resolution.



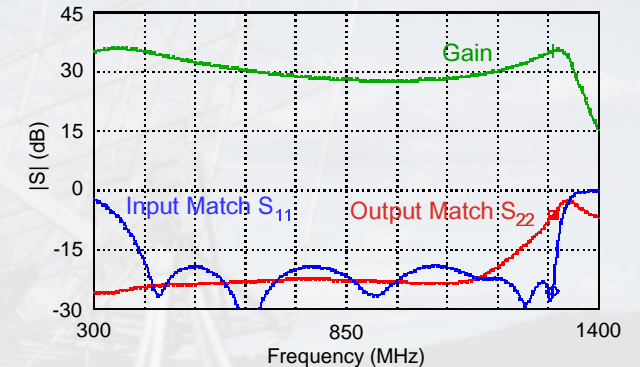
Feeds

A wideband feed is required to cover the complete 300-1420 MHz band, with optimum performance required at the higher frequencies. A linear array of Vivaldi antennas, such as the 750-1500 MHz array used in the ASTRON THEA project, may be suitable for this purpose. At lower frequencies, increased sky noise and continuum confusion allow for more tolerance in the feed performance.

LNA

Shown below is the simulated performance of a wide band (400-1200 MHz) ambient temperature low noise amplifier (LNA), based on the 50Ω two-stage HEMT 843 MHz LNA used on the existing telescope. The anticipated noise temperature of the LNA is ~20K. It is likely that the frequency range can be extended to cover 300-1420 MHz, with design simplifications possible for higher input impedance. This discrete component based LNA provides a useful starting point for migration to MMIC design for mass production.

Performance of 40-1200 MHz LNA



RFI

The telescope is located in the Molonglo valley, about 40 km from Canberra (population ~300,000). The figure below shows the low level of radio frequency interference (RFI) at the site, particularly above ~1 GHz. RFI mitigation techniques are discussed further in the poster: Satellite Signal Decorrelation in an Interferometer, Mitchell et al.

RFI at Molonglo 20-1500 MHz 25 June 2001

