

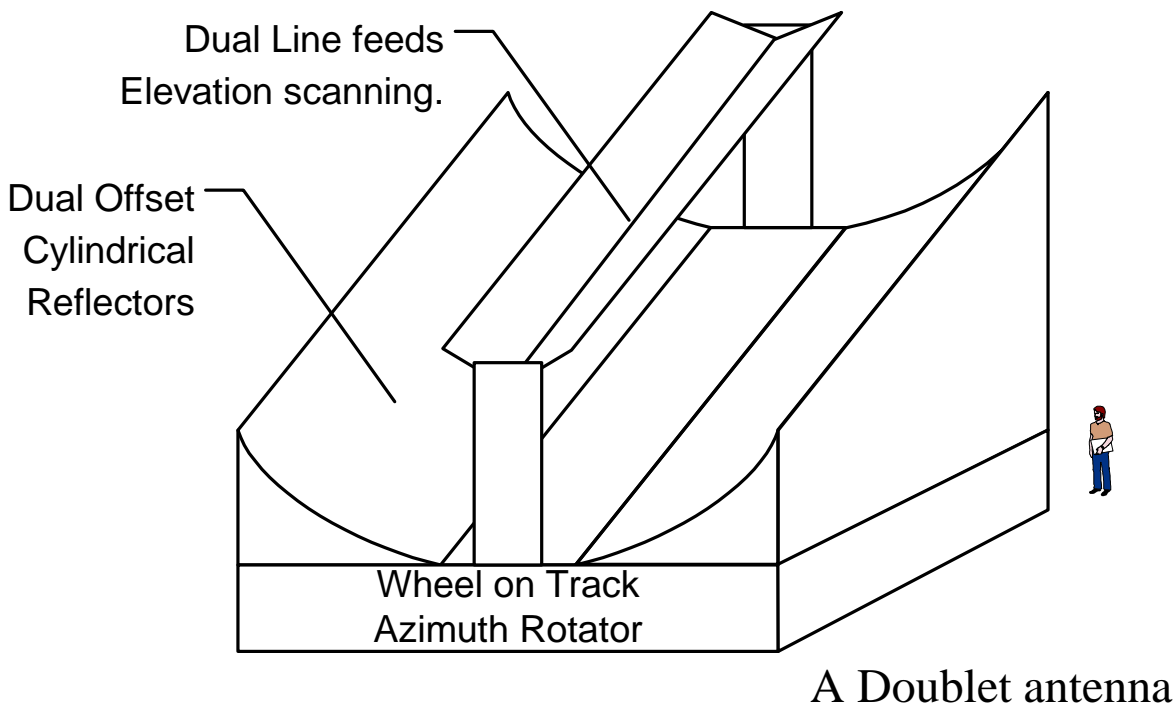
The Cylindrical Reflector Doublet Antenna Revisited

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Description

The cylindrical reflector doublet antenna achieves full sky coverage by tilting the reflector at a fixed angle and using a line feed to scan from the horizon to zenith. In azimuth the beam is positioned mechanically by rotating the whole antenna. In the Doublet proposed by James and Parfitt¹ the two offset reflectors are mounted on a single backing structure. The use of offset reflectors eliminates blockage and enables the use of several offset feeds to provide both instantaneous azimuth coverage and full frequency coverage from 0.1 to above 10GHz.



Operational Advantages

- MULTIBEAMING
 - Elevation multi beam forming with array line feeds
 - Limited multiple beams in azimuth using several offset line feeds
- ADAPTIVE NULL STEERING
 - Quality of cancellation proportion to degree of freedom
 - First line of defence against interference
 - Does not degrade T_{sys}
- POSSIBLE SINGLE UNIT ARRAY STATION
 - Collecting area of 2000m² practical

¹ James, G.M. & Parfitt, A.J., 'A Low-Cost Cylindrical Reflector For The Square Kilometre Array', in Perspectives on Radio Astronomy: Technologies for Large Antenna Arrays, (eds.) Smolders & van Haarlem, ASTRON, 1999

Astronomy Advantages

- WIDE BANDWIDTH CONSTANT COLLECTING AREA
 - High frequency to 10GHz and above
 - Low frequency 100MHz with 15m reflector
- FULL SKY COVERAGE
 - Mechanical azimuth steering
 - Electronic scanning zenith to horizon
- HIGH SURFACE BRIGHTNESS SENSITIVITY
 - Due to reduced shadowing,
Antenna has low and constant profile, does not tilt
Antennas can be closer together more than doubling
the surface brightness sensitivity
 - Inter line feed correlation
High isolation between line feeds allows cross correlations
with baselines ~5 to ~70m
- DUAL POLARISATION with good purity

Mechanical Advantages

- LOW COST
 - No towers or counterweights
 - Minimal backing structure with multipoint support
 - Ease of mechanical maintenance,
main mechanical components at ground level
- HIGH FREQUENCY SURFACE
 - Easily achievable high surface accuracy,
curvature in one direction
 - Easy to align surface
 - Reasonable feed costs at 10 GHz
 - No gravity deflections
- HIGH WIND RESISTANCE

Limitations – not really

- LIMITED INSTANTANEOUS SKY VISIBILITY
 - But necessary for high frequency operation to limit feed numbers
 - Still have large Field-of-View but not whole sky
 - Instantaneous multiple beams possible over part sky. Up to 1000 deg²
- LARGE, MOVING PHYSICAL STRUCTURE
 - Must have movement for full sky visibility
If high frequency operation desired
 - This design reduces movement to single Azimuth drive
No other option simpler except phased arrays
 - Azimuth drive is the lowest cost option