Performance of the L-Band Feed

Rick Perley

Goals

In-situ testing of the feed to determine five key characteristics as a function of frequency:

1. Efficiency
2. Spillover
3. System Temperature
4. Beamshape and sidelobes
5. Focus curve

Method

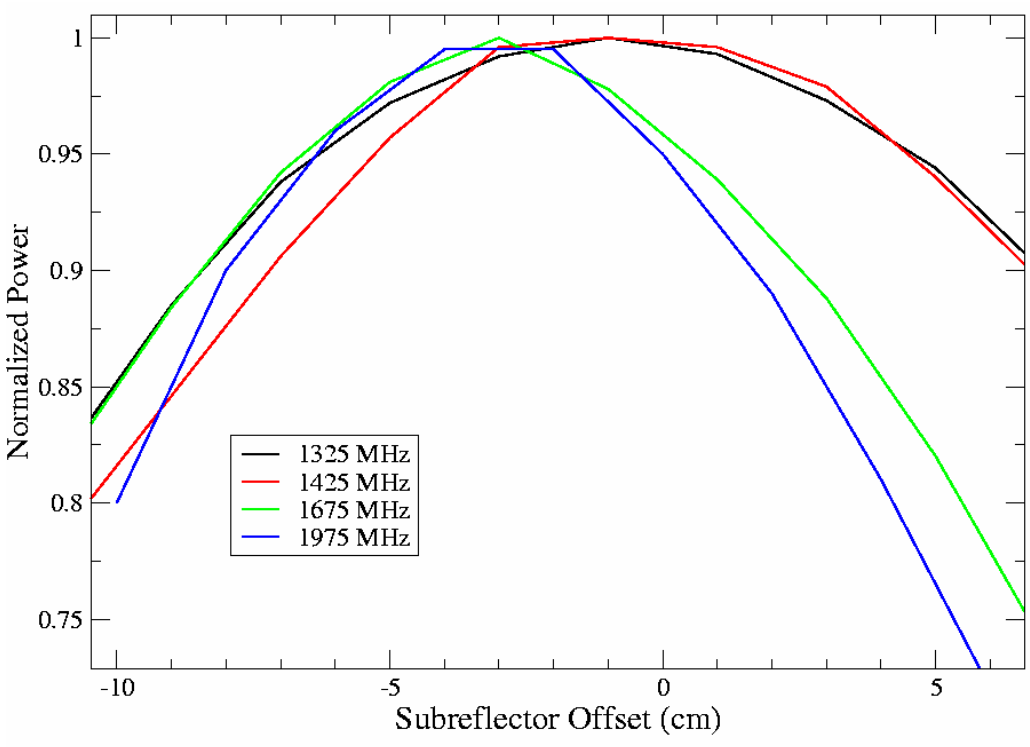
- Because full system not available, we used a total power meter, with data recorded on the laptop ‘Millhouse’.
- With no LSC converter available, we were limited to frequencies/bandwidth set by available RF filters.
  - 1325, 1425, 1665 with good sensitivity.
  - 1975 MHz with reduced (but sufficient) sensitivity.
- Observations from 1000 to 1300 MHz not possible.
- Efficiency, beam characteristics, and focus determined by observations of Cygnus A.
- Spillover function and zenith system temperature determined by tipping scans, from zenith to the elevation limit of 8 degrees.

Calibration

- Calibration (and determination of system temperature) done with hot and cold loads:
  - Hot Load: absorber covering the feed horn. Temperature measured by a thermometer in the middle of the absorber.
  - Cold Load: Cold sky at vertical.
- From these two measurements, we can determine the gain slope (converting mW to K), and the receiver temperature.
- Linearity of system checked by internal switched noise diode – at 0.1 Hz.
- Reality check on procedure by comparing lab measures of noise diode temperatures with our determination.
- As 'cold' load temperature is not known, we must assume a value. We used T_r + 10 K.
- Error in results caused by this assumption is small.

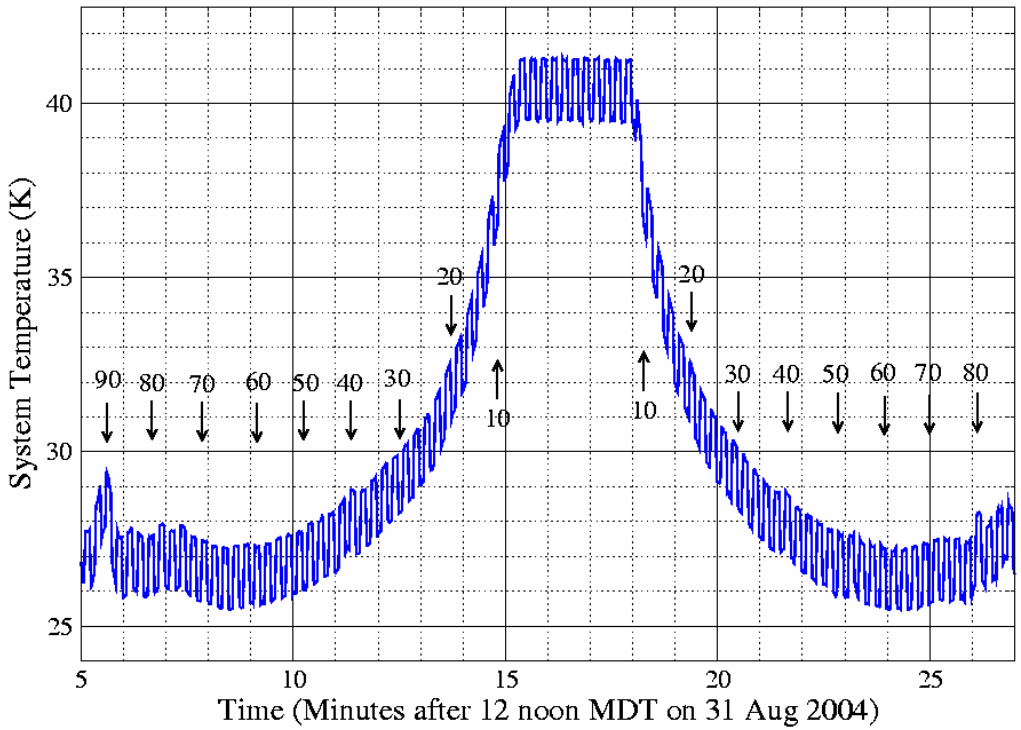
Focus Curve

- Focus curve shown.
- Expected ~2cm variation of subreflector position seen.
- Negligible loss of efficiency for broadband observations from use of single median position.



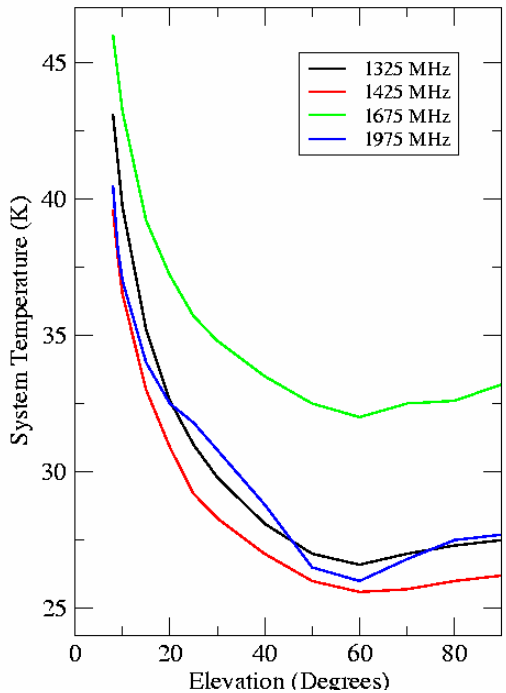
Spillover and T_{sys}

- Tip curve shown.
- Gives zenith system temperature and spillover function.
- Shows good system temperature at zenith (26 K), and low spillover.
- Much better than current VLA feed.

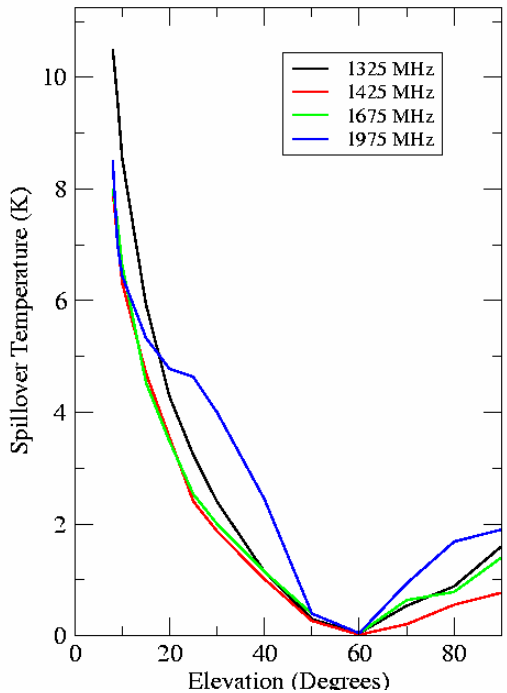


Spillover

- Shows the results at four frequencies.
- Spillover similar at all frequencies, but higher at low frequencies.
- Observations below 1.3 GHz not possible yet.



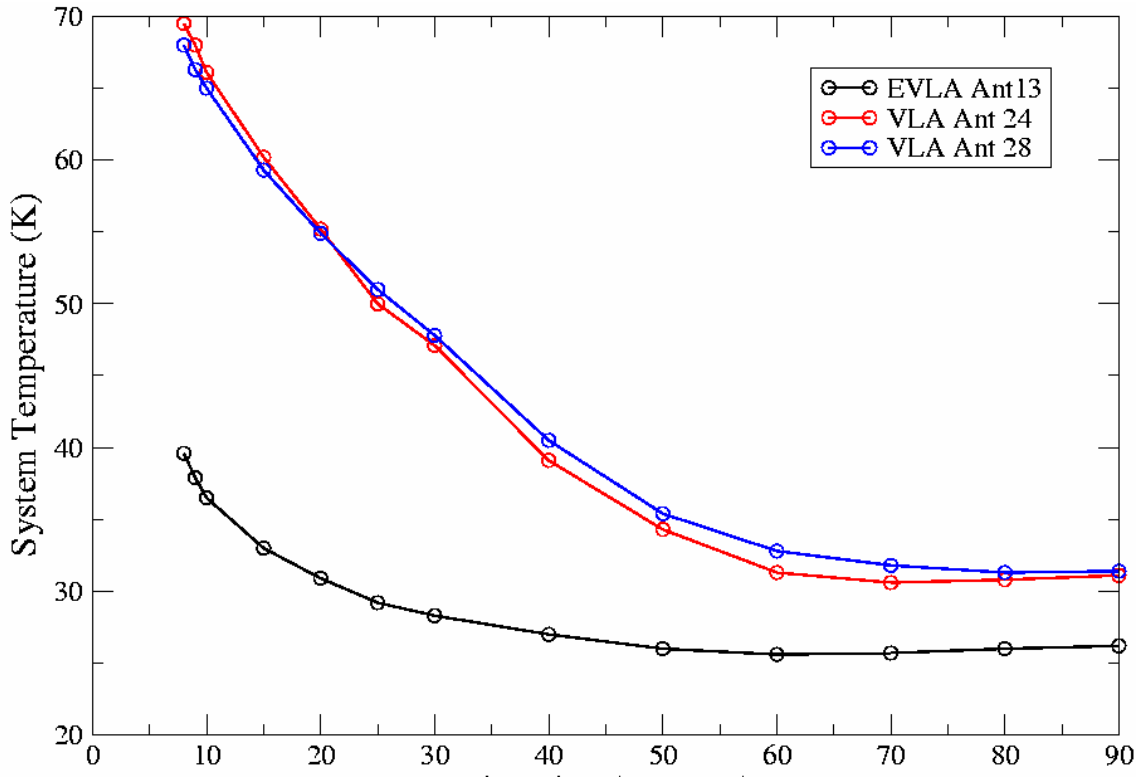
Total System Temperature



Excess Spillover Temperature

EVLA and VLA Sensitivity Comparison

- EVLA spillover and Tsys much better than VLA.
- Improved Tsys and reduced spillover due to removal of lens.



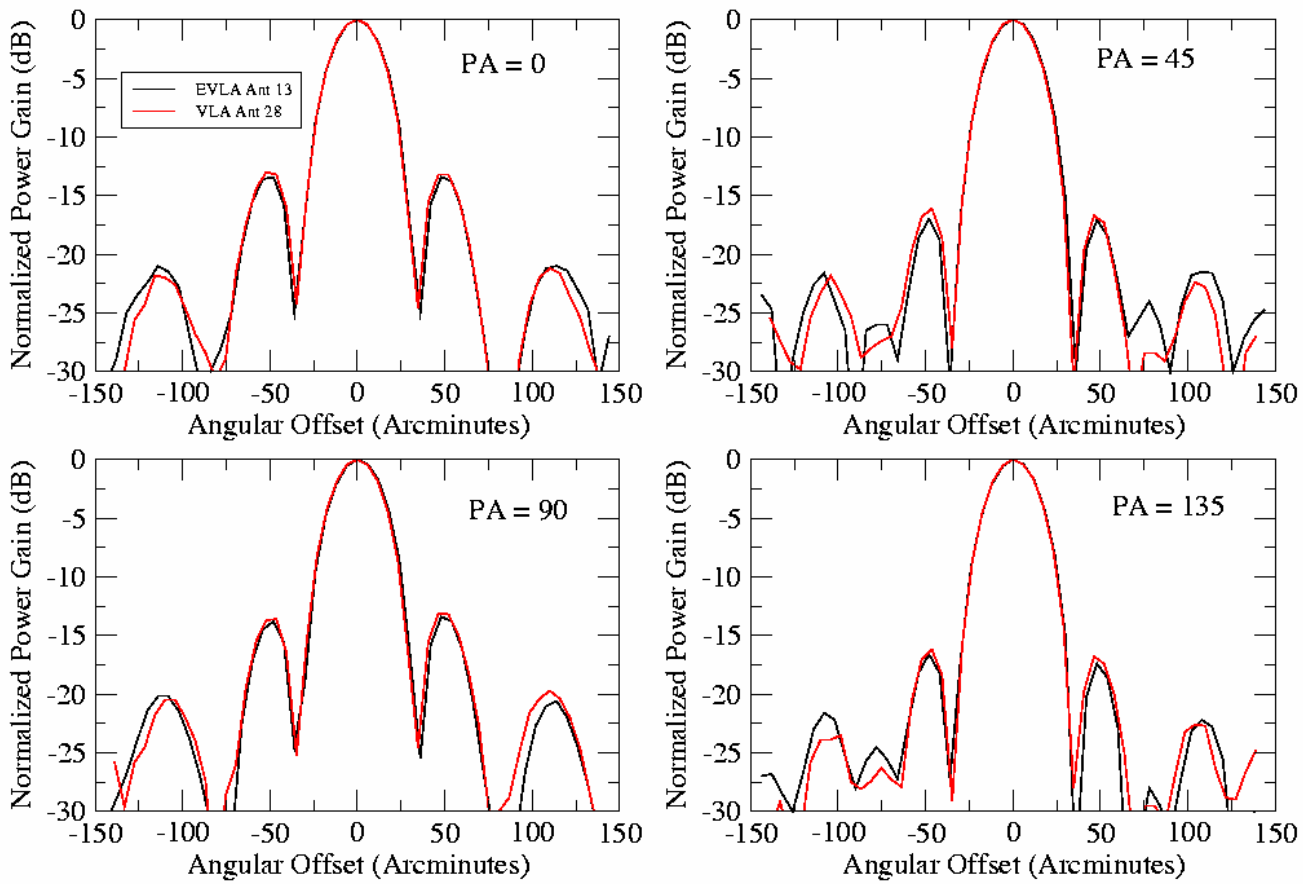
Efficiency

- Results are in the table below:
- Accuracy should be good – error less than 2%.
- No correction for pointing or resolution required.

Frequency	T_{cyg}	S_{cyg}	ε
1325 MHz	135	1680	0.45
1425	121	1558	0.43
1675	102	1315	0.44
1975	109	1101	0.56

Beam Shape

- The EVLA and VLA beamshapes are almost identical



Sensitivity Comparison

- The SEFD (inversely proportional to G/T) for this feed is better than the existing feed.
- With its wide bandwidth, and low spillover and Tsys, it meets the requirements.
- Relatively low efficiency apparently an inevitable consequence of limited available space.