Performance of the C-Band Feed

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Goals

- Goals the same as for L-Band – determination of:
  - Efficiency
  - Zenith system temperature
  - Spillover characteristics
  - Beamwidth and sidelobe structure
  - Focus position
- All of these characteristics are to be measured as a function of frequency across the band.
Method

- Same total-power method as used for the L-Band tests.
- Important improvement: the LSC converter was available, allowing us to test performance at a wide range of frequencies from 3976 to 8072 MHz.
- The tests were done in Nov/Dec. 2004, and in early Feb, 2005.
- Most important new problems were in correcting for Cygnus A size and antenna pointing errors.
Calibration

• The same ‘hot load, cold sky’ calibration technique for L-Band was employed.
• Calibration assumed the cold load temperature as \( T_r + 10 \text{ K} \)
• A 5 K variation in this (i.e., 5 K or 15 K) results in an error of <1% in the efficiency and about 1.5% in the spillover contribution.
• Linearity assured to <1% by measurement of internal noise diode contribution.
Results -- Focus

- Focus curve very beneficial to wide-band astronomy!
- When in median position, focus loss less than 10% at low frequency end and negligible elsewhere.
C-Band: Spillover

- Differential spillover is higher than VLA system by ~8 K
- But it is only a problem below 15 deg elevation.
- Spillover is greater at low frequencies, by ~5 K.
- Optimize sensitivity by scheduling!
C-Band: Efficiency

- Efficiency measured by Cygnus A observations.
- Corrections for pointing error and resolution were required.
- Pointing errors determined with each observation.
- Error in efficiency about 2% for low end, to perhaps 5% at high end.
- Also used 3C295 at 4850 MHz – gave ε = 56%.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>T_{Cyg}</th>
<th>S_{Cyg}</th>
<th>ε</th>
</tr>
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<tbody>
<tr>
<td>3976 MHz</td>
<td>49 K</td>
<td>495 Jy</td>
<td>.55</td>
</tr>
<tr>
<td>4850</td>
<td>37</td>
<td>389</td>
<td>.56</td>
</tr>
<tr>
<td>5000</td>
<td>36</td>
<td>375</td>
<td>.54</td>
</tr>
<tr>
<td>6024</td>
<td>34</td>
<td>297</td>
<td>.65</td>
</tr>
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<td>7048</td>
<td>27</td>
<td>243</td>
<td>.62</td>
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<tr>
<td>8072</td>
<td>24</td>
<td>204</td>
<td>.64</td>
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</tbody>
</table>
Sensitivity

- As the EVLA OMT is not ready yet for testing, we used a cooled VLBA system to measure system sensitivity at 4850 MHz.
- Should be a good predictor of final EVLA sensitivity performance.
- We measured a zenith Tsys = 23.5 K, far better than the current VLA value of 50 K.
- Presuming 1.5 K atmosphere, 2.75 K CMB, and 5 K spillover, T_{rec} \sim 14 K.
- Lab measurement of T_{rec} = 18 K, but this includes a small unaccounted contribution from the cold load cable.
C-Band: Beamshape

- Measurements at 4850 and 6024 MHz
- Sidelobes are slightly lower than VLA.
- Some asymmetry is seen – likely due to horn alignment.
- Beam is circular to 1%.
- Beamsize is slightly greater than VLA.
C-Band: Bottom Line

• This is a superb feed!
• The SEFD is ~235 Jy – half the current VLA value, and ~10% less than the project book requirements.
• The only negative is the increased spillover – this is only relevant at very low elevations, (where nobody should be observing unless they really have to).
• We’ll take it!