EVLA Front-End CDR

On the Sky Tests

Proof of the Pudding …

- Engineering can't rest until the scientists are happy!
- To have happy scientists, the telescope performance must meet the basic requirements.
- Extensive testing is ongoing to test on-the-sky performance.

System Temperatures

- Hot/Cold load tests done at L, C, K, and Q bands.
- For L and C, cold load was on sky – requires spillover assumption.
- For K and Q, liquid nitrogen cold load permits full calibration.
- For all bands, sky dips from 90 to 8 degrees done to measure spillover contribution.

Tsys Results: L and C Bands

- L-Band (antenna 13,with prototype horn).

Freq (MHz)	Tsys
1325	27
1425	26
1675	32

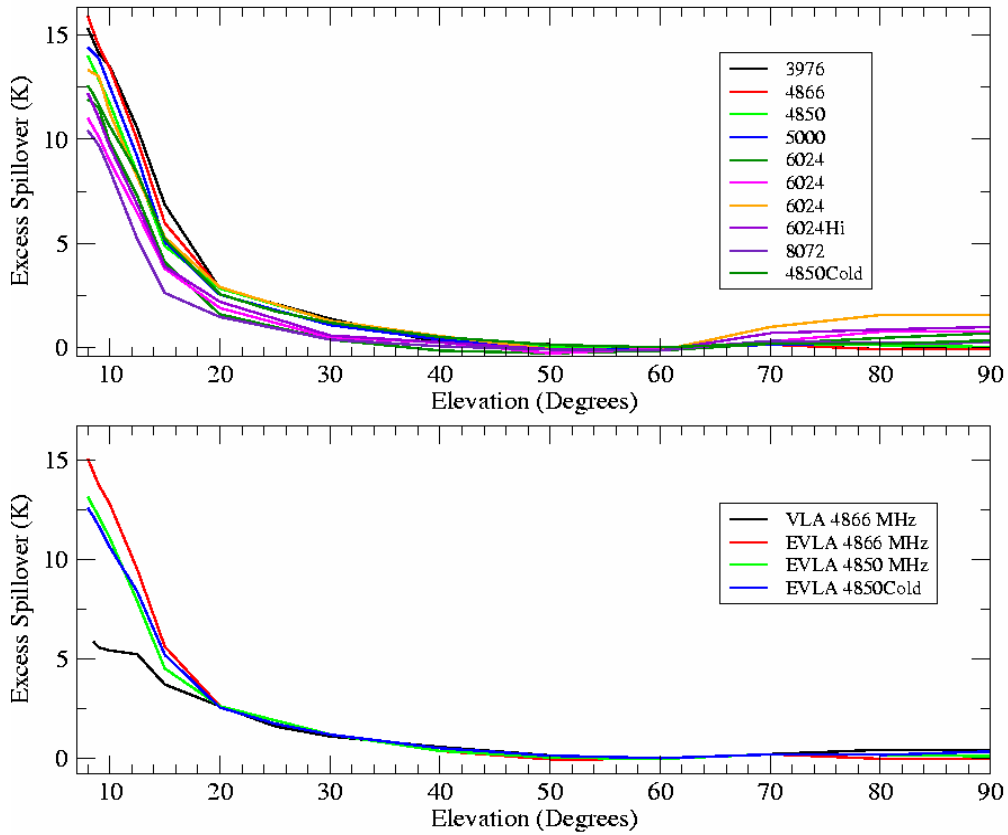
- C-Band (antenna 14, using VLBA polarizer)
  - At 4850 MHz, Tsys = 23K

C-Band Variation with Elevation

C-Band Tip Results

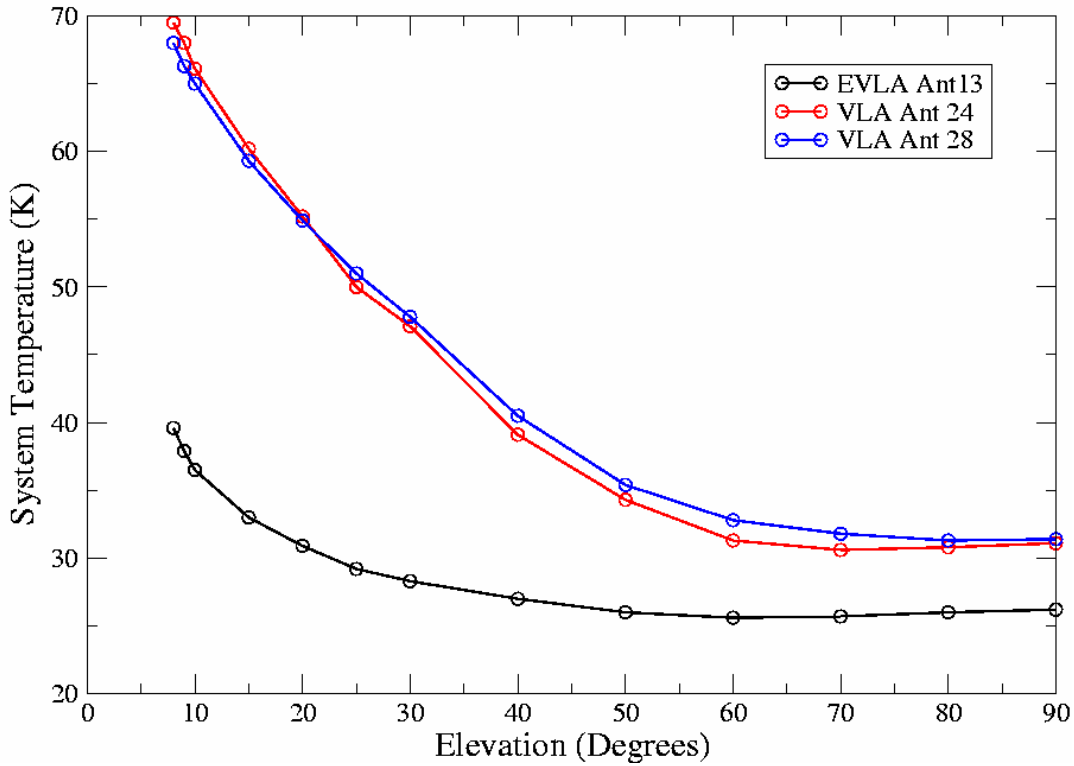
• Spillover contribution varies very little for elevations above 20 degrees.

EVLA spillover below 20 degrees greater than narrowband VLA feed.



L-Band Elevation Dependence

- EVLA L-Band system has greatly superior elevation performance!



System Temperatures K and Q Bands

- On antenna 14, a complete set of measurements were possible.
- Tsys is for the zenith, under dry conditions.

Freq.	Tr	Tsys
18440	23	44
23560	15	47
26120	19	44
40368	23	60
43440	32	70
48048	39	95

L-Band Polarization

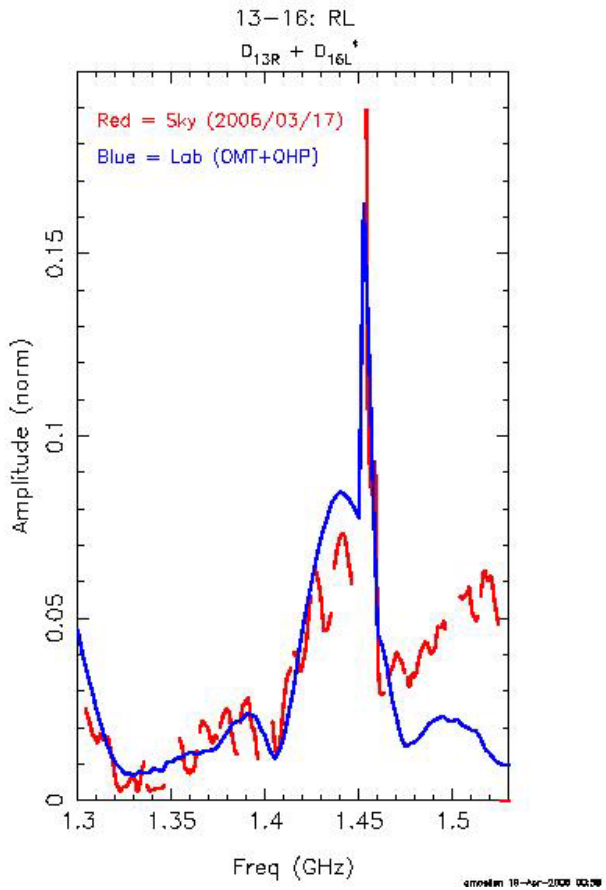
- Requirements are set to give a spurious linear polarization of <5%
- The major spurious polarization contribution is due to the sum of two complex `D' terms:

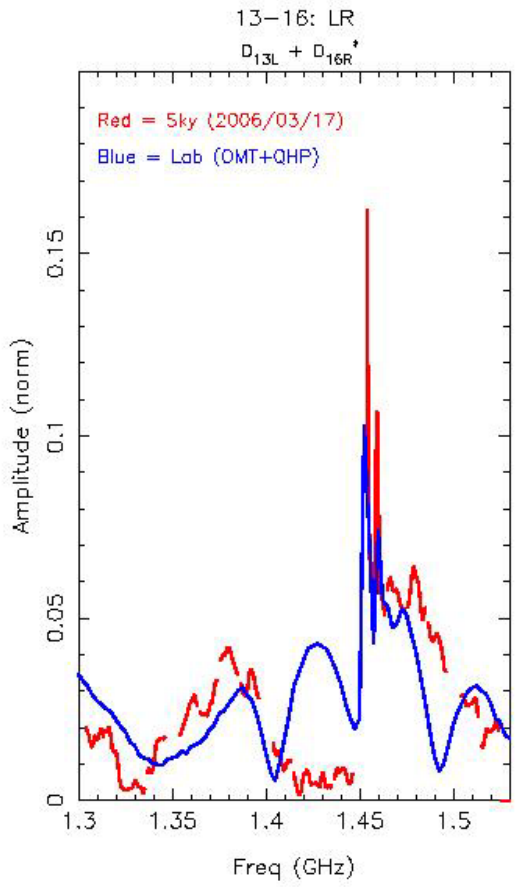
$$\mathbf{R_{rl} = I(D_{r1} + D^*_{l2})}$$

- The `D' value is due to amplitude and phase imbalances.
- The sum can be made close to zero with good design. (But small |D| is better!)

L-Band Results

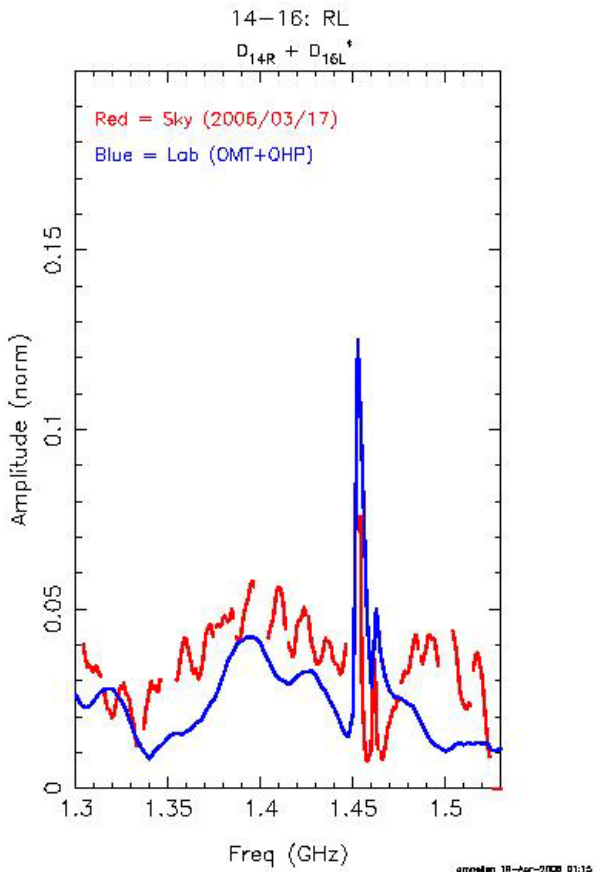
- Antennas 13-16 with VLA OMT.
- Red = on-sky measurements
- Blue = Prediction from Lab measurements
- Spike near 1450 MHz due to ‘suck-outs’ in VLA OMT.

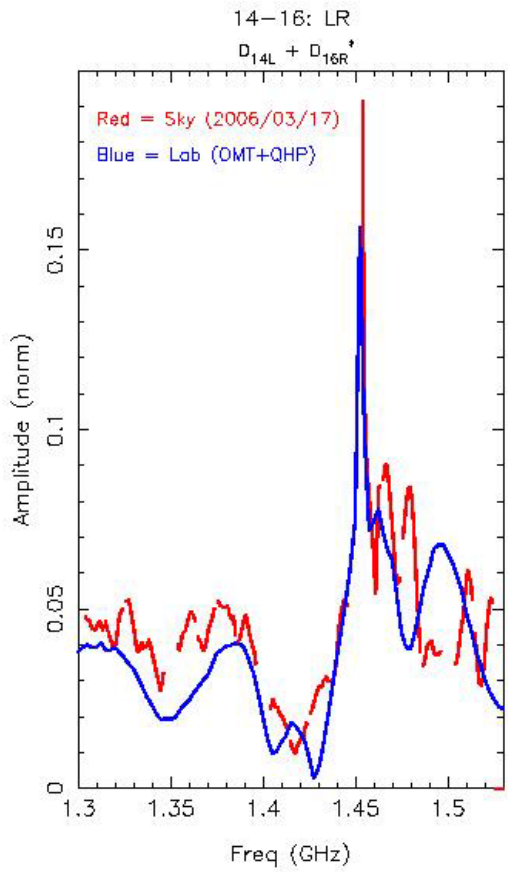




More Results

- Antennas 14 x 16.
- Higher polarization on-sky is expected, as contribution of antenna itself is not in lab measurements.
- High values near 1460 MHz due to VLA polarizer, and will be eliminated with new design



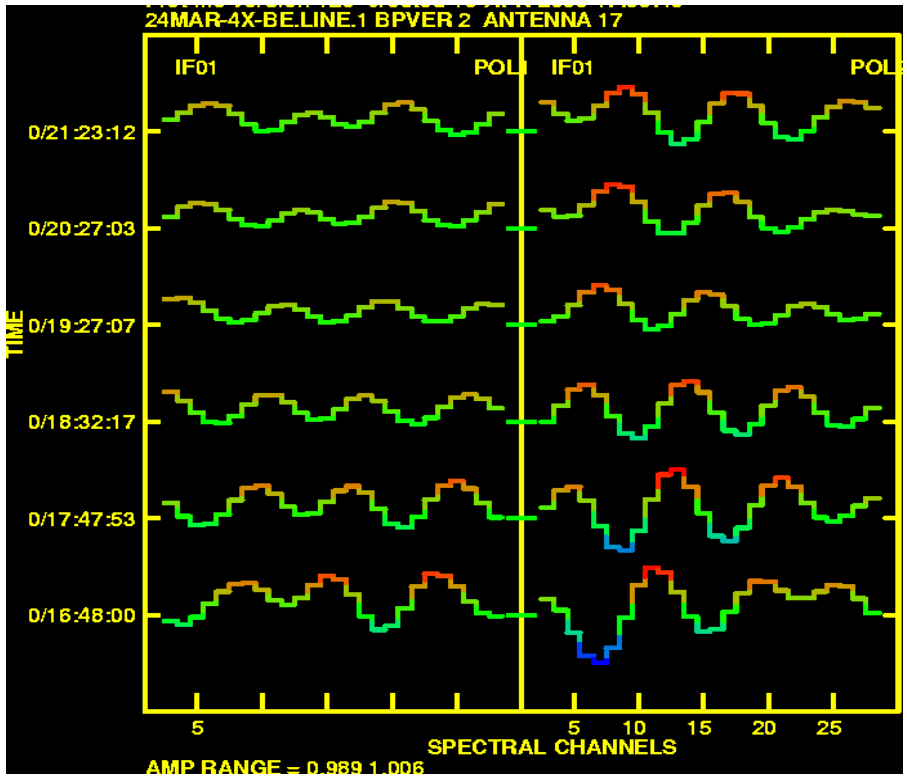


Bandpass Stability

- Requirements are that bandpass amplitude be stable to .01% over timescales of 1 hour, on frequency scales < 0.1% of the RF frequency.
- Bandpass phase stability better than 0.007 degrees on same scales.

VLA Amplitude
Differential Hourly Snapshots

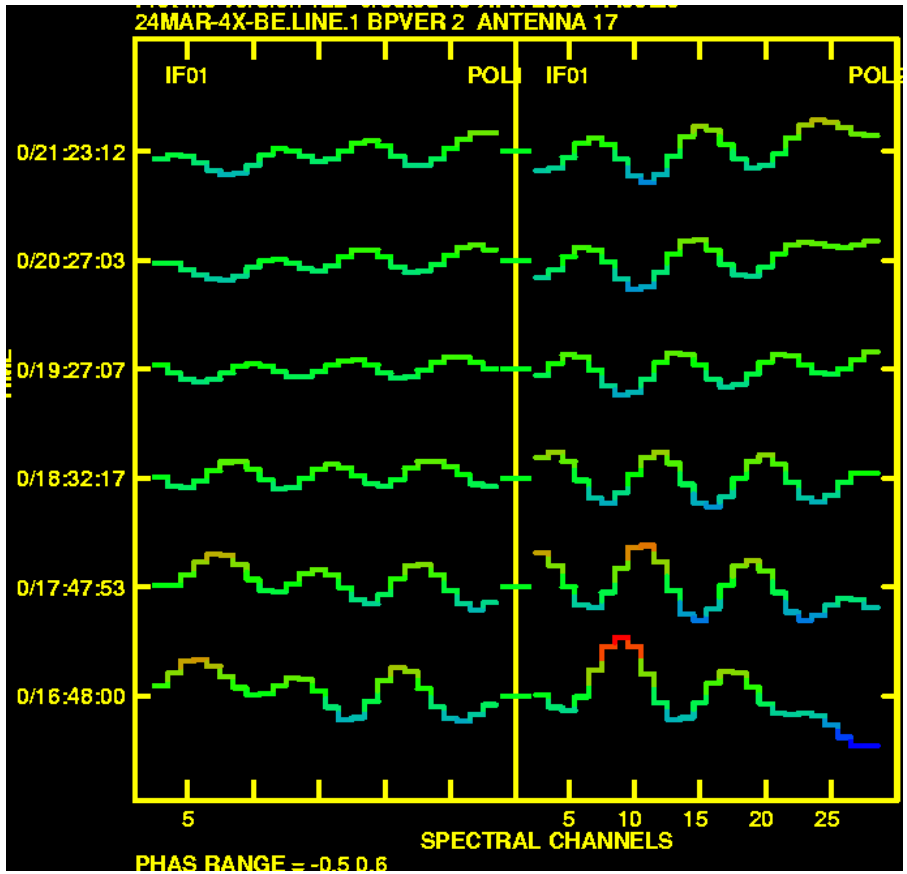
- VLA antenna 17 amplitude.
- Ripple due to waveguide reflections.
- Magnitude ~ 0.5%
- Typical for all VLA antennas.



RCP LCP

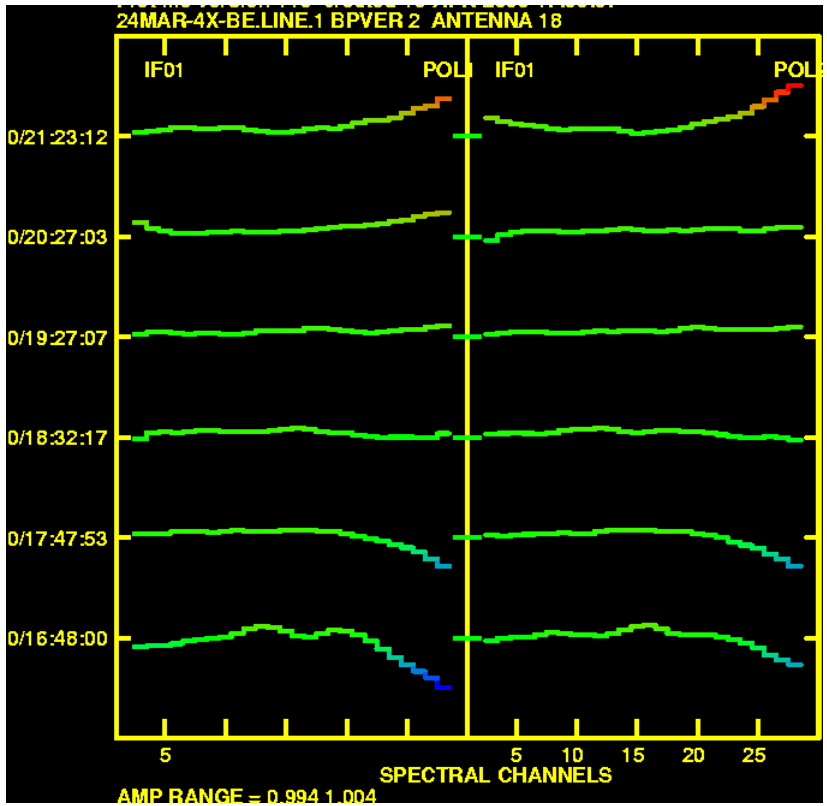
VLA Phase

- Showing VLA ripple in phase.
- Magnitude ~ 0.5 degrees.



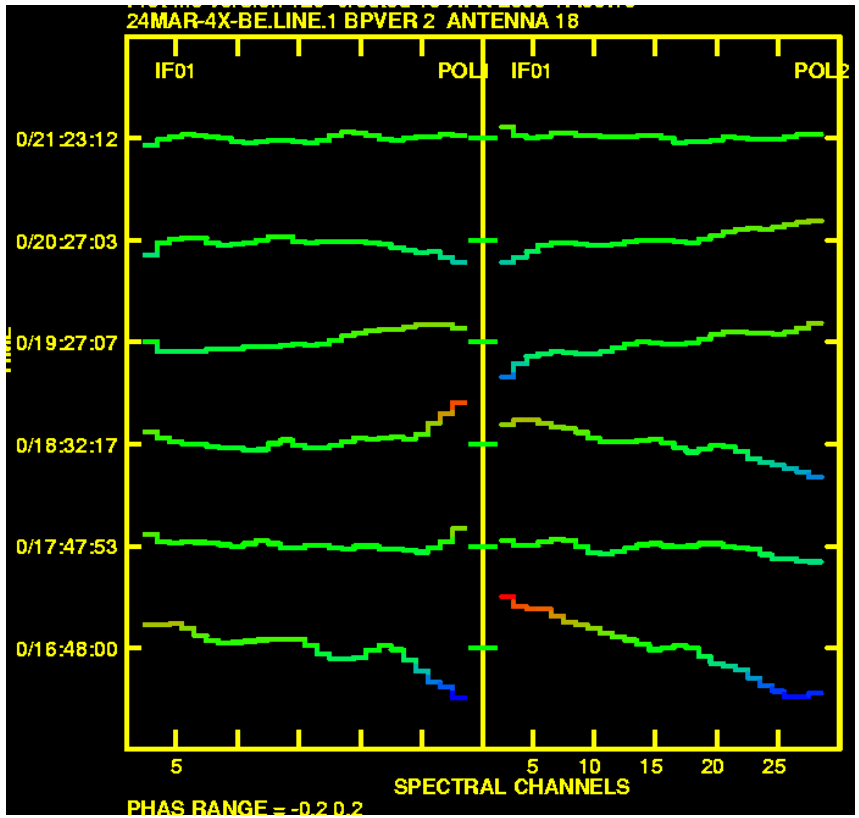
EVLA Antenna 18 Amplitude Results

- Amplitude stability excellent.
- No sign of VLA's 3 MHz ripple.
- Full range is 0.4%.
- Away from baseband edge, range is ~.05%.
- Variation likely due to VLA baseband filter.



EVLA Antenna 18 Phase

- Hourly observations of bandpass at X-band.
- Mean bandpass removed.
- BW is ~10 MHz
- Phase peak range 0.2 degrees.
- Away from baseband edge, phase range is 0.04 degrees.
- Instability origin unclear, but unlikely to be FE.



RCP LCP

Some Conclusions

- Tsys meeting (or beating!) specs at all bands.
- L-band elevation performance superior to VLA.
  - Other bands elevation performance acceptable.
- L-band cross-polarization from hybrid looks good – but full frequency range tests needed with new OMT in place.
- Bandpass shape/stability much better than VLA, but not at spec level yet.
  - Limiting factor likely VLA's baseband filters. Final tests must wait for WIDAR correlator.
- Scientists are (or will be) happy!