The EVLA Project

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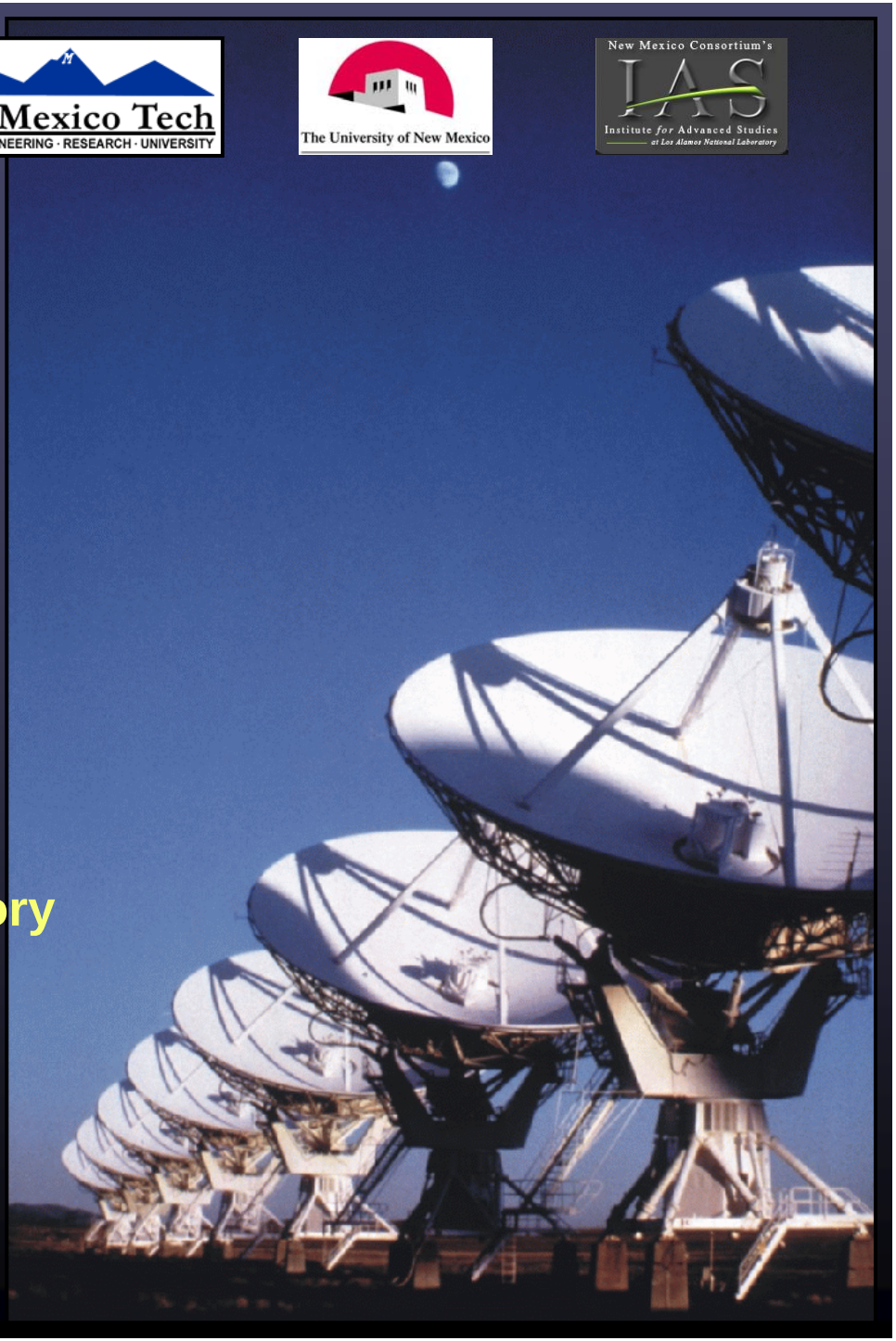
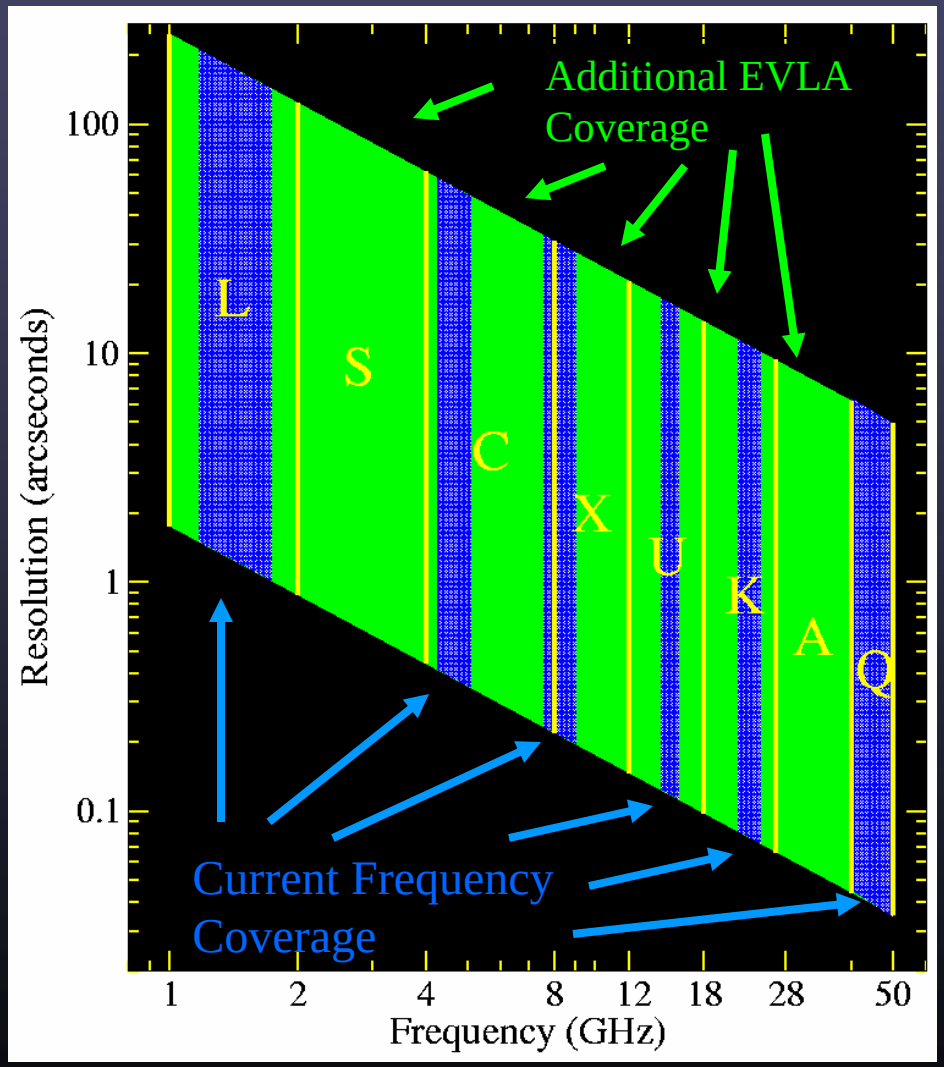


EVLA Project Goals

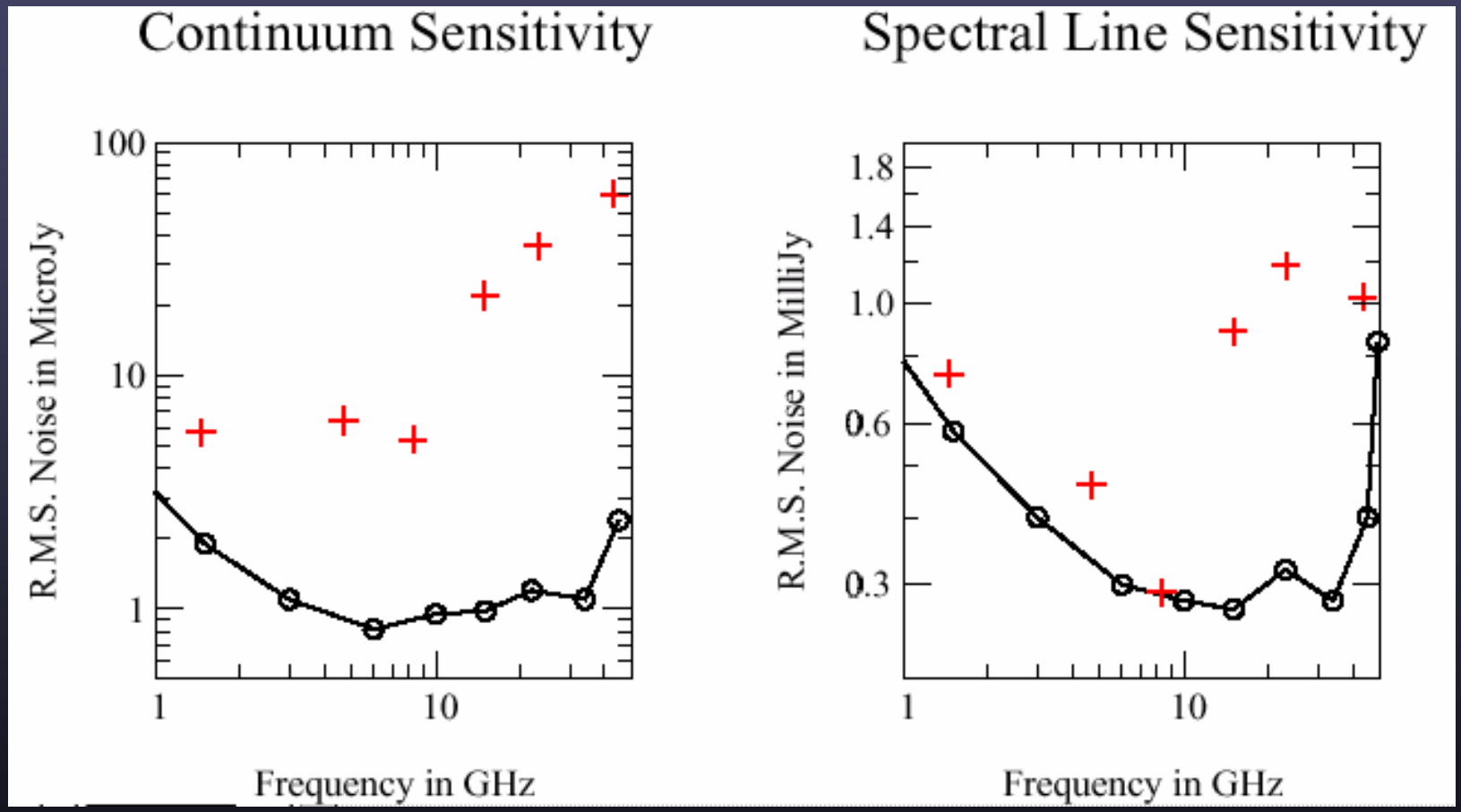
- Fundamental Goal: By building on the existing infrastructure, multiply ten-fold the VLA's observational capabilities.
- Full frequency coverage from 1 to 50 GHz.
  - 8 frequency bands with cryogenic receivers.
  - Two independent simultaneously available frequency pairs, with no tuning restrictions.
- 1 μJy point-source continuum sensitivity (most bands)
- New correlator with 8 GHz/polarization capability
  - 16384 minimum channels/baseline, with full polarization.
  - Full recirculation capability for expanded frequency resolution.
  - 128 independently digitally tunable frequency slots.
- Noise-limited full-beam imaging in all Stokes parameters
- Completion by 2012.

Frequency - Resolution Coverage

- A key EVLA requirement is continuous frequency coverage from 1 to 50 GHz.
- This will be met with 8 frequency bands:
  - Two existing (K, Q)
  - Four replaced (L, C, X, U)
  - Two new (S, A)
- Existing meter-wavelength bands (P, 4) retained with no changes.
- Blue areas show existing coverage.
- Green areas show new coverage.
- Two independent frequency tunings can be placed *anywhere* in the selected band (or bands).



Sensitivity Improvement : 1-σ, 12 hours



Red: Current VLA, Black: EVLA Goals

EVLA Performance Goals

The EVLA's performance is vastly better than the VLA's:

Parameter	VLA	EVLA	Factor
Point Source Sensitivity (1-σ, 12 hours)	10 μJy	1 μJy	**10**
Maximum BW in each polarization	0.1 GHz	8 GHz	**80**
# of frequency channels at max. bandwidth	16	16,384	**1024**
Maximum number of frequency channels	512	4,194,304	**8192**
Coarsest frequency resolution	50 MHz	2 MHz	**25**
Finest frequency resolution	381 Hz	0.12 Hz	**3180**
(Log) Frequency Coverage (1 – 50 GHz)	22%	100%	**5**

The total cost for this >10-fold improvement is ~$94M – about 1/3 the cost of the VLA.

What is the EVLA Not Doing?

- Expanding to provide 10 times the current best resolution (the New Mexico Array).
  - Lost: A ~few Kelvin brightness sensitivity at milliarcsecond resolution capability provided by the full EVLA.
- A super-compact configuration, for low surface brightness imaging (the 'E' configuration).
  - This ~$6M component could easily and quickly be done as a standalone project. (Lost: 10 μK brightness sensitivity on 12 arcsecond scale at 34 GHz).
- A sub-1 GHz facility. The VLA's optics system makes it very difficult to implement an efficient wide-band low-frequency capability.
  - All proposed methods to do this require extensive design and development – for which we have no budget.

The Eight Cassegrain Frequency Bands

Band (GHz)	System Temp (K)	Aperture Effic. (%)	IF BW (GHz)	Digitization
1-2	28	.43	2x1	2 x 2GS/s x 8bits
2-4	25	.60	2x2	4 x 2 x 8
4-8	24	.60	2x4	4 x 4 x 3
8-12	34	.65	2x4	4 x 4 x 3
12-18	35	.65	2x6	6 x 4 x 3
18-26.5	45	.55	2x8	8 x 4 x 3
26.5-40	50	.45	2x8	8 x 4 x 3
40-50	60 - 95	.30	2x8	8 x 4 x 3

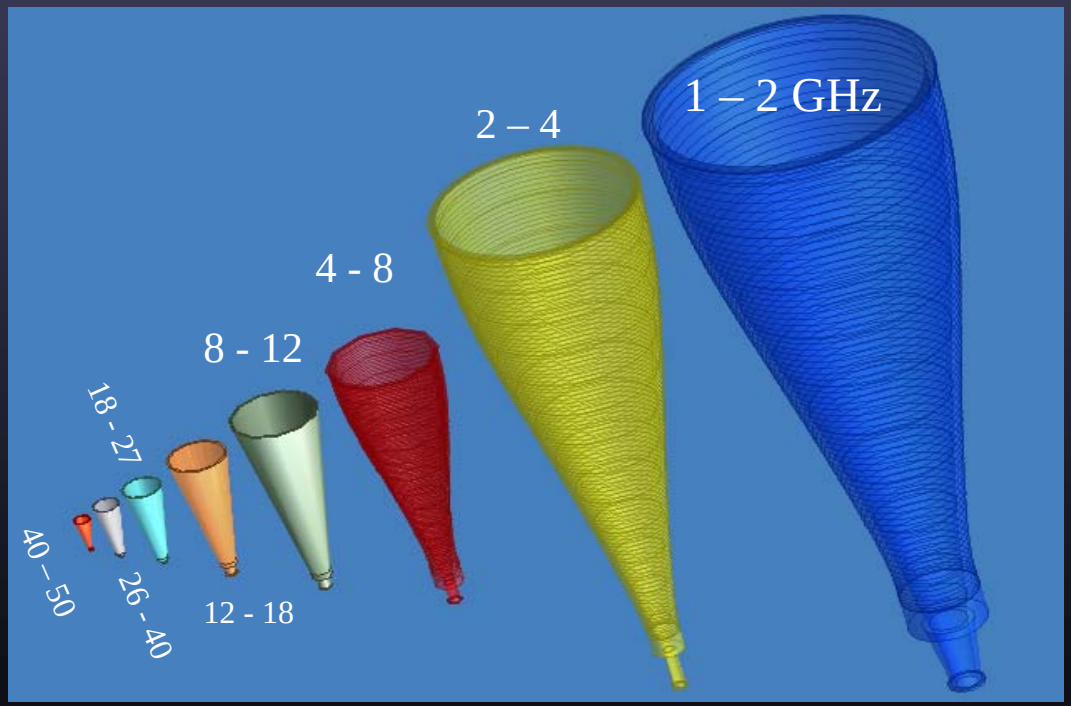
Blue = System tested and in place, or under installation.

Green = Prototypes to be tested in 2008.

Red = Deferred to end of project

EVLA Feed System

All eight Cassegrain feeds are compact or linear taper corrugated horns with ring loaded mode converters

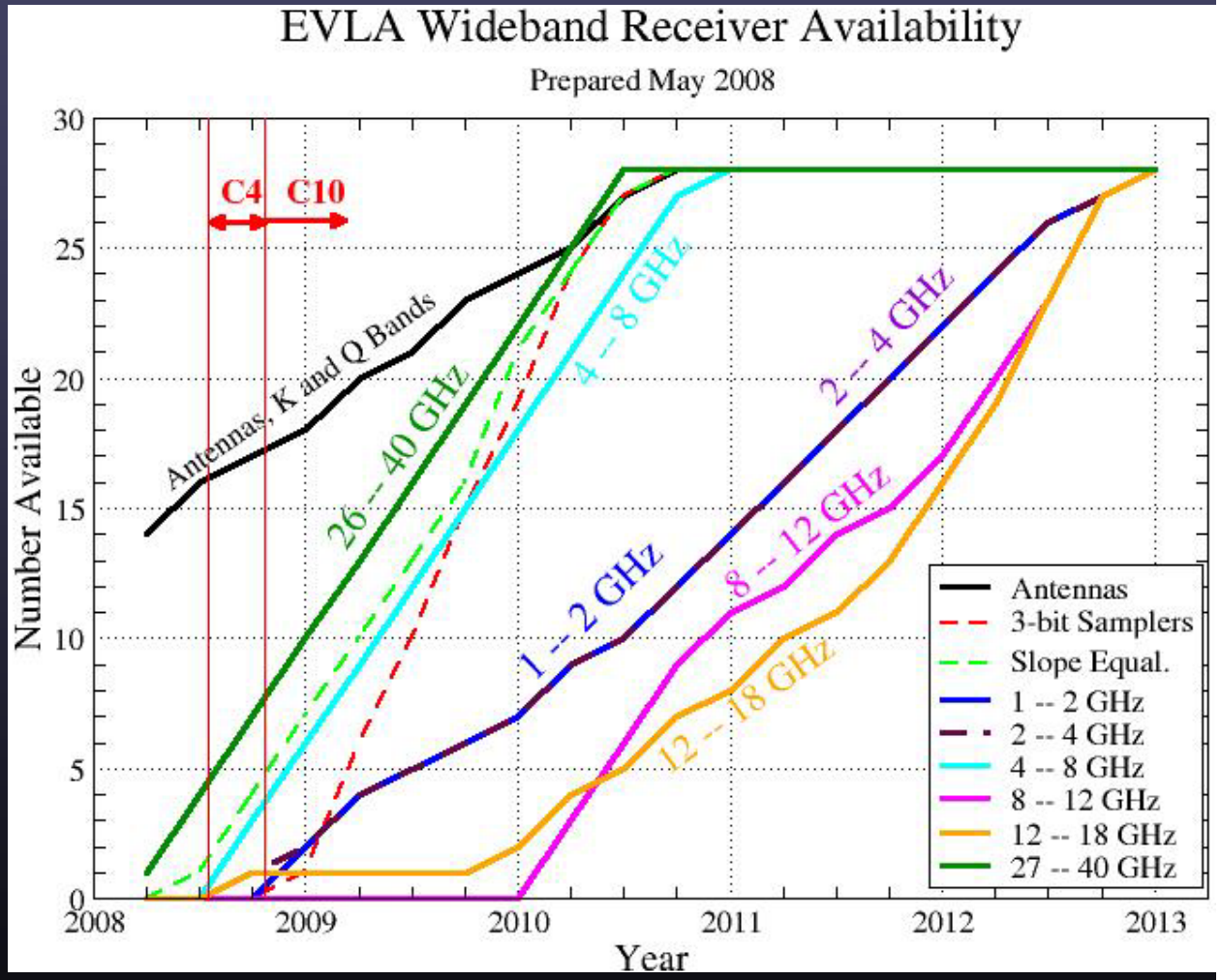


Today's EVLA Status

- 15 VLA antennas now converted to EVLA standards
- All of these are back in the array for regular observing.
  - All returned antennas can observe at the 'old standard' bands, except at U-band (15 GHz).
  - Temporary narrow-band receivers [L (1.3 –1.8 GHz) and C (4.5 – 5.0 GHz] are being retrofitted to their full-tuning capabilities: 1 – 2, and 4 – 8 GHz.
  - K (18 – 27 GHz) and Q (40 – 50 GHz) bands have full tuning capability now.
- The next retrofitted antenna should 'fringe' today, and be back in the array next week.
- The remaining 12 antennas will be upgraded at a rate of 6/year, completing in 2010.
- Nearly all technical issues resolved.

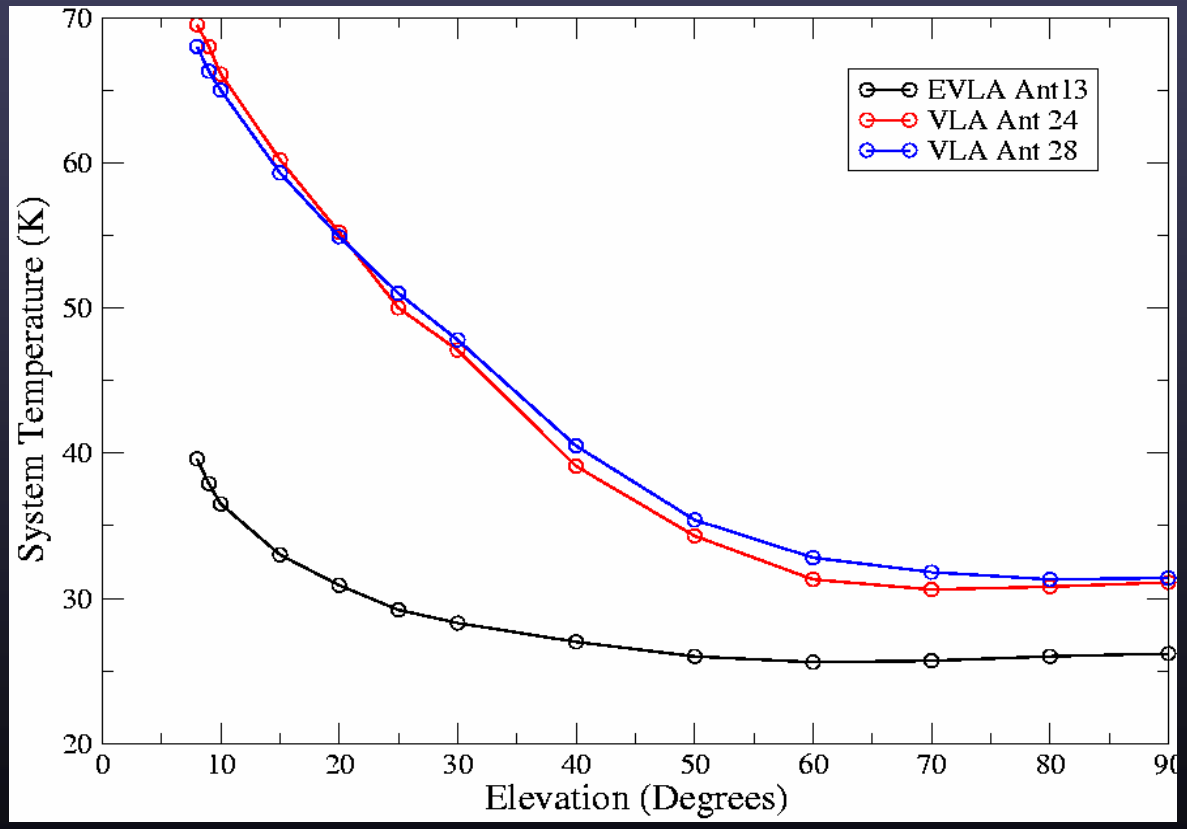
Full-Band Tuning Timescale

- The old correlator will be employed until the WIDAR correlator achieves full 27-antenna capability – mid 2009.
- Old correlator's limitations remain:
  - 50 MHz BW
  - 16 to 512 channels
- Full band tuning available now, on schedule shown here.



EVLA and VLA Tsys at L-Band

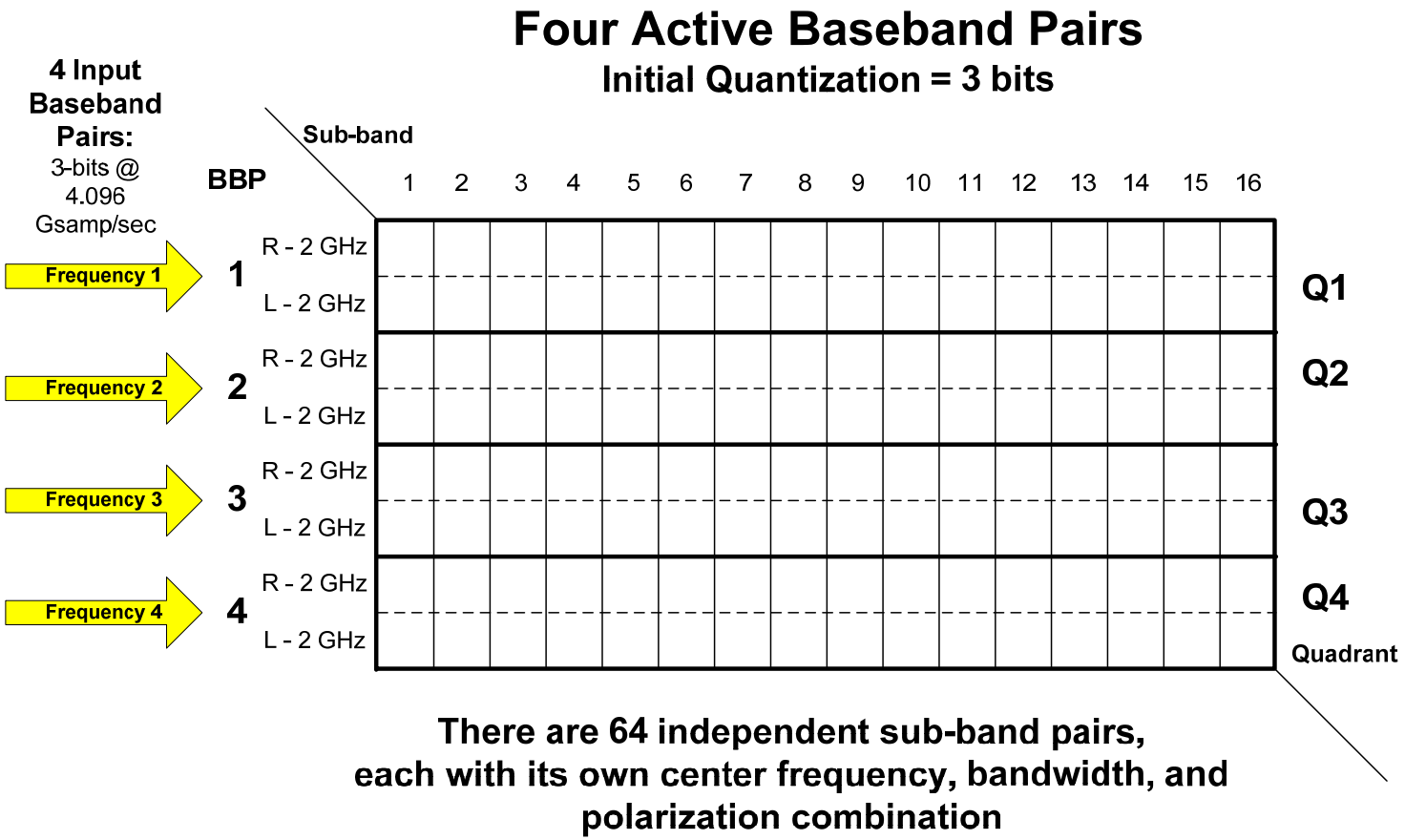
This shows the great improvement in spillover performance of the new L-band (1 – 2 GHz) feed.



WIDAR Correlator

- Design and construction of correlator by the DRAO correlator group (Penticton, BC, Canada).
- All costs covered by Canadian NRC.
- WIDAR accepts 8 inputs, of up to 2 GHz BW each, normally configured as four input (R,L) pairs.
- Their design is an extraordinarily flexible machine allowing for up to 64 independently defined (in frequency and bandwidth) sub-band pairs within the input bandwidth.
- Each digitally-defined sub-band pair has 256 channels, to be distributed amongst 1, 2, or 4 polarization products.
- Recirculation provided for increased frequency resolution.
- Vast number of ways to share resources internally, trading inputs, or sub-band pairs, or polarization, for more channels.
- Full polarization, pulsar modes, phased array, VLBI-ready, extensive subarraying, etc.
- I have a (detailed) correlator document for those interested.

Correlator Resource Allocation Matrix
IQ = 3



- Each sub-band pair has 256 spectral channels in this configuration.
- Each sub-band pair is independently tunable with BW = 128, 64, 32, … .03125 MHz.

Major Future Milestones

- Test 4-station prototype correlator on the sky — July – Oct. 2008
  - Four antenna test and verification system
  - Not available for science
- Testing of 10-station correlator: — Oct ’08 – Sept. 09
- Full Correlator Installation — Jan ’09 – Dec ’09
- VLA’s correlator turned off — Sept. 2009
  - New correlator capabilities will be much greater
  - About 5 VLA antennas will not be useable (temporarily)
- Resident Shared Risk Observing Begins — ~December 2009
- Last antenna retrofitted — Sept. 2010
- Last receiver installed — Sept. 2012