The EVLA: A North American Partnership

Expanded Very Large Array

NRAO

Associated Universities, Inc.

NSF

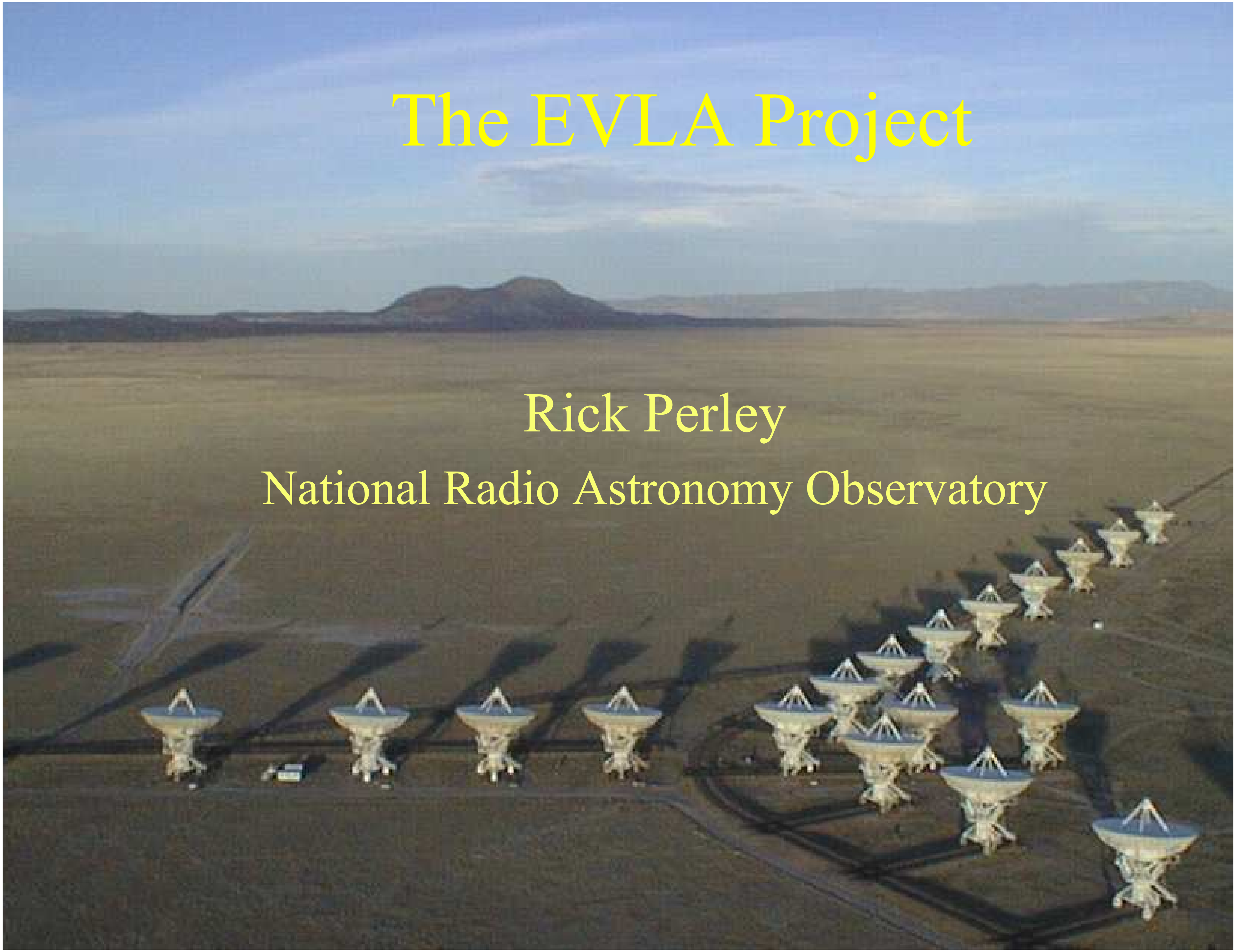
NRC · CNRC
Herzberg Institute of Astrophysics

National Research Council Canada

Conseil national de recherches Canada

CONACYT
Consejo Nacional de Ciencia y Tecnología

The EVLA Project on the Web
http://www.aoc.nrao.edu/evla/


The EVLA Project
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The Very Large Array (VLA)

- The VLA is the world's premier imaging radio telescope:
  - It is the fastest, most sensitive, most flexible, most productive radio telescope in the world – as it was in 1980.
  - So – what's the problem?
- Today's astronomy requires a much more powerful and flexible radio telescope than the VLA.
- No significant technical upgrades since VLA's completion – its 1970s technology severely limits scientific capability.
- Modernization of the electronics and signal processing can vastly increase the VLA's scientific capabilities.

The EVLA Project – Leveraging the VLA

- The EVLA Project:
  - builds on the existing infrastructure - antennas, array, buildings, people - and,
  - implements new technologies to produce an astronomical facility whose top-level goal is to provide:
- **Ten Times the Astronomical Capability of the VLA.**
  - Sensitivity, Frequency Access, Image Fidelity, Spectral Capabilities, Spectral Fidelity, Spatial Resolution, User Access, Data Products
  - On a timescale and cost far less than that required to design, build, and implement a new facility of equal capability.
- 2000 AASC gave EVLA Project its 2nd highest ranking for ground-based projects.

EVLA : Cost and Timescale

- An initial proposal (EVLA-I) to NSF was submitted in 2000.
  - Goal: To multiply tenfold or more all VLA capabilities, except spatial resolution.
  - Funding started in 2001 following NSB approval.
  - Completion by 2012.
- EVLA-I is a cooperative project:
  - $57M from NSF, over eleven years
  - $15M from Canada, (correlator, designed and built by HIA/DRAO)
  - $2M from Mexico, and
  - $8M from re-directed NRAO operational budget.
- A second proposal (EVLA-II) was submitted in April 2004.
  - Goal: To improve tenfold the spatial resolution.
  - $115M, over 7 years.
  - The NSF has recently (Dec 2005) declined to fund this proposal.

EVLA-I Performance Goals

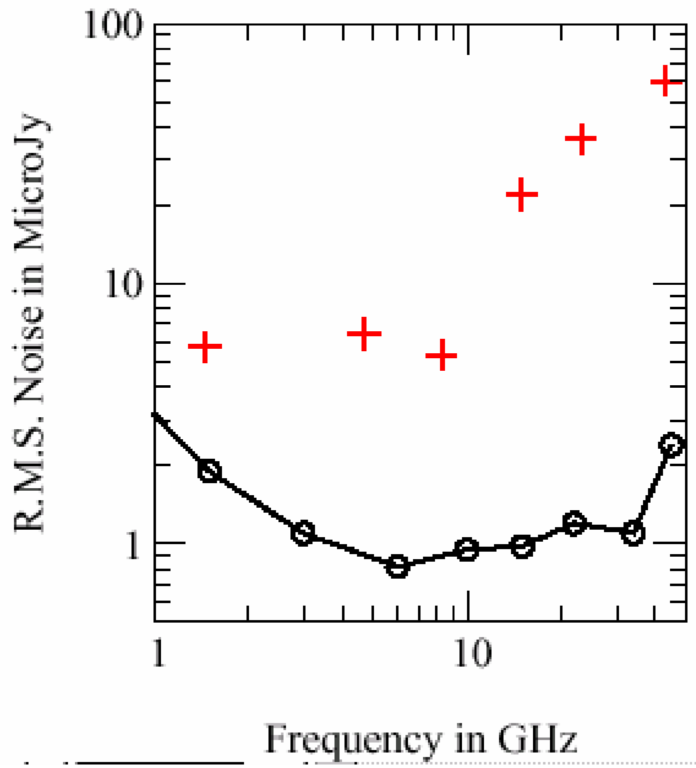
The EVLA will vastly increase the VLA's capabilities.

Parameter	VLA	EVLA-I	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

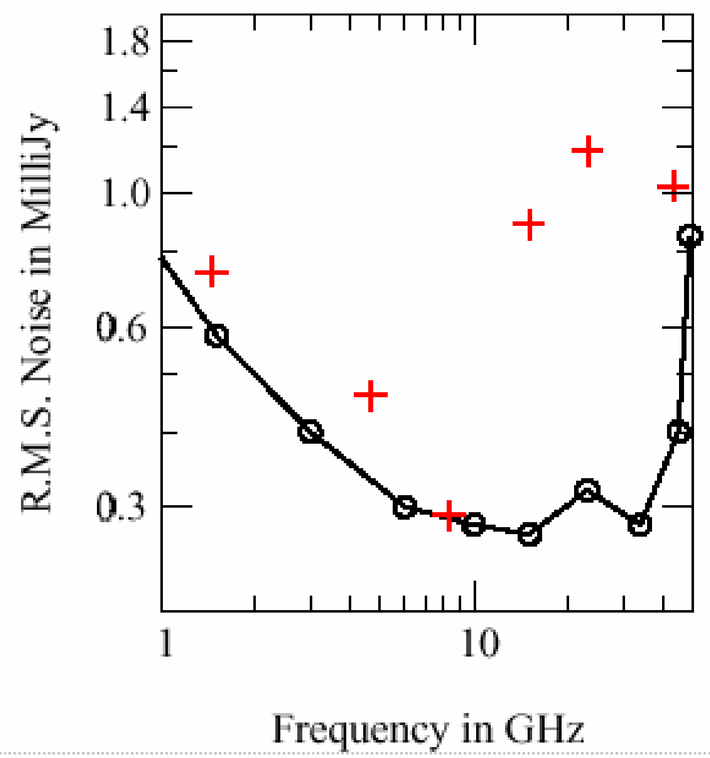
These fantastic improvements come at a cost less than ¼ the VLA capital investment, with no increase in basic operations cost!

Point-Source Sensitivity Improvements : 1-σ, 12-hours

Continuum Sensitivity



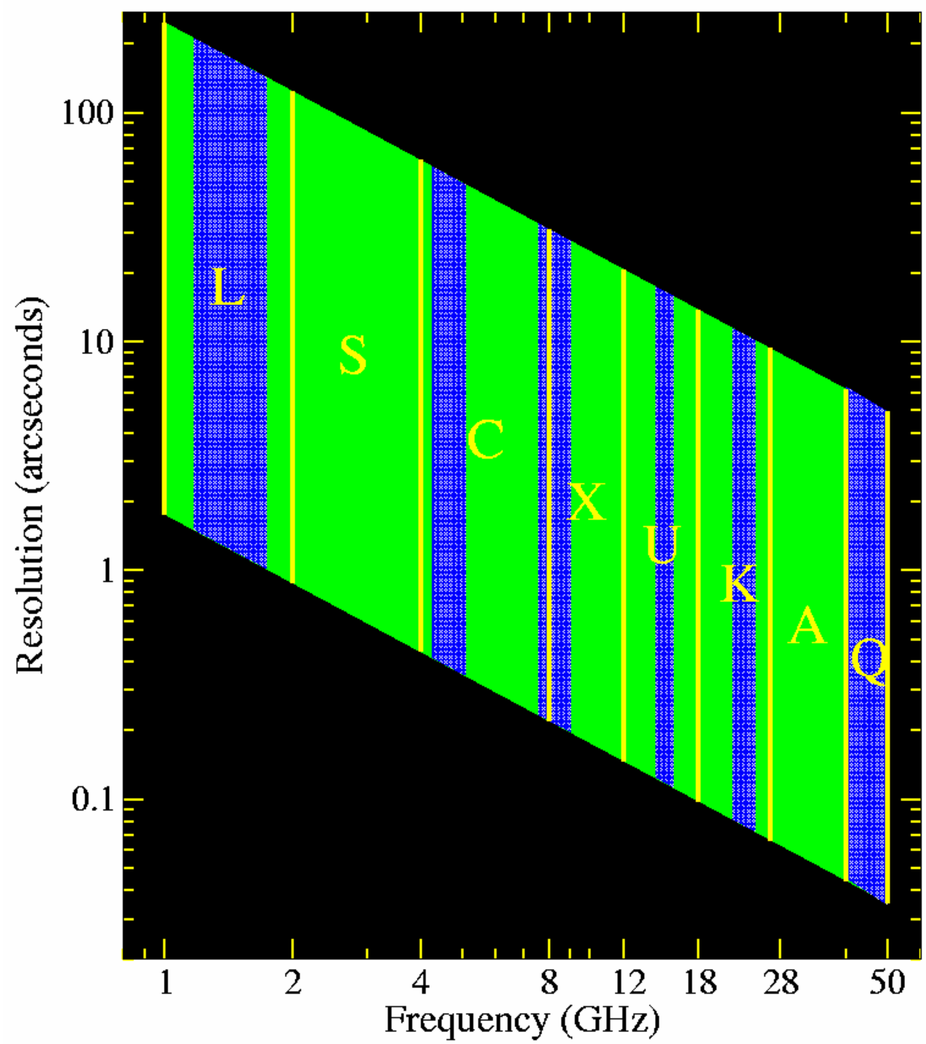
Spectral Line Sensitivity



Red: Current VLA, Black: EVLA Goals

Frequency - Resolution Coverage

- Continuous frequency coverage from 1 to 50 GHz a key EVLA requirement.
- Blue area shows current VLA frequency -resolution coverage.
- Green area shows future EVLA coverage.
- Yellow letters and bars show band names and boundaries.
- Two low frequency bands (74 and 327 MHz) omitted



Key New Capabilities

Spatial Imaging Fidelity	10^6
Spectral Imaging Fidelity	10^5
Spectral Stability	10^{-4}
Spectral Flexibility	Can zoom in on regions of interest
Fast Time Recording	100 msec as installed, 2.6 msec possible
Pulsar Capabilities	1000 bins of 200 μsec width, 15μsec possible
Polarimetry	Full Stokes, full beam, noise limited

- New "end-to-end" data management to provide, for all astronomers:
  - Dynamic scheduling of the telescope – to optimize efficiency
  - Automatic default image generation
  - Full archive, open access to all astronomers
  - New improved post-processing

Project Status

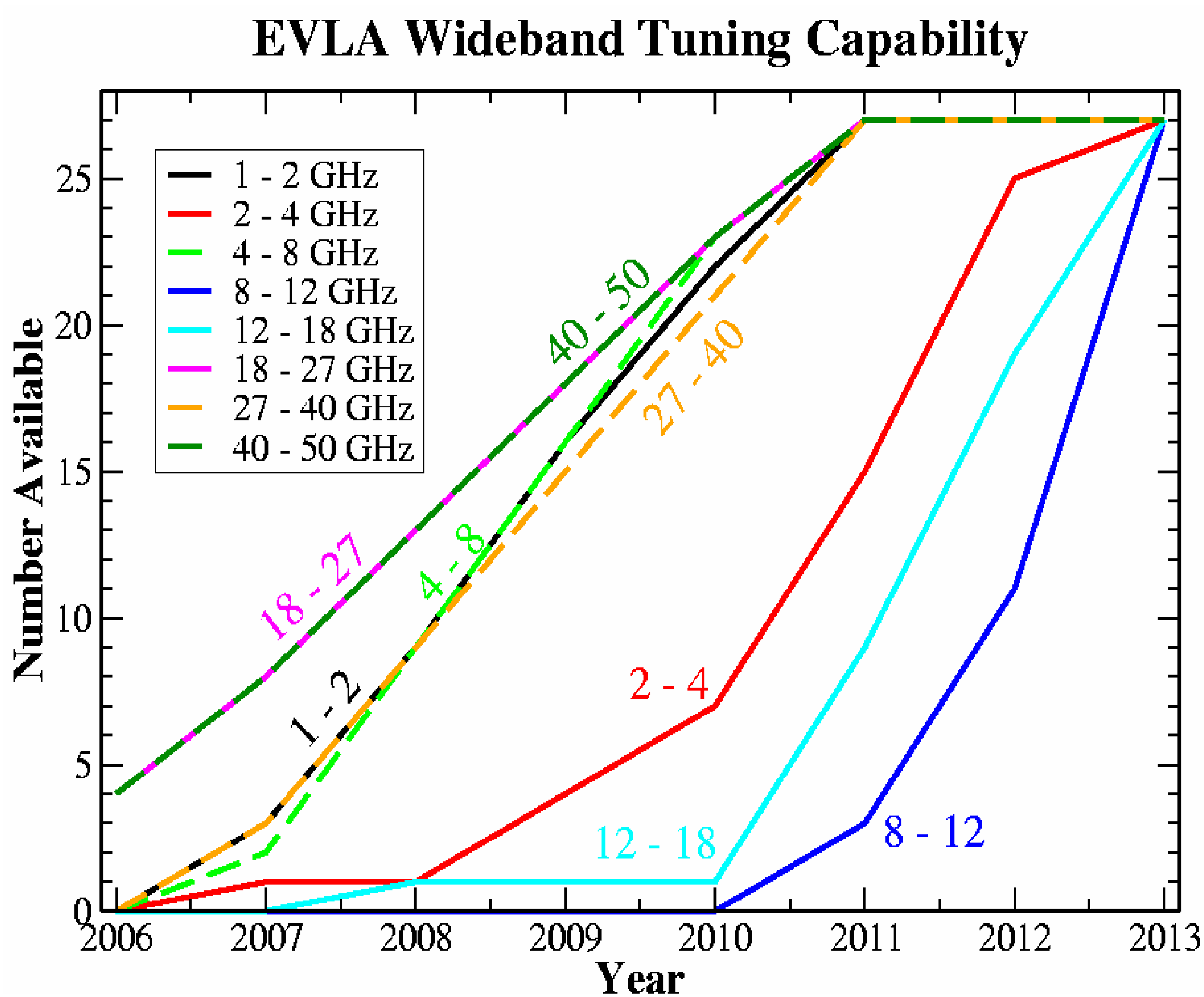
- Four antennas currently withdrawn from VLA service, and being outfitted with new electronics.
  - Two antennas undergoing intensive testing, will be returned for VLA observing by spring.
  - All four back in service by mid-2006.
- Antennas will be cycled through the conversion process at a rate of four to five per year.
- Except for special testing, no more than three antennas will be out of service at any one time during construction phase.

Major Future Milestones

- Test prototype correlator — mid 2007
  - Four antenna test and verification system
  - Not available for science
- Correlator installation and testing begins: — mid 2008
  - Capabilities will rapidly increase until mid 2009.
- Correlator Commissioning begins: — mid 2009
  - VLA’s correlator turned off at this time
  - New correlator capabilities will be much greater at this time.
- Last antenna retrofitted — 2010
- Last receiver installed — 2012

New Capabilities Timescale

- The old correlator will be employed until the new correlator achieves full 27-antenna capability – mid 2009.
- Full band tuning available before 2009, on schedule shown here.



EVLA Science

- The EVLA will enable fabulous new science, as illustrated by the examples in the following three short talks.
  - Peter Dewdney: Science Impact of the EVLA's Supercomputing Correlator
  - Mark Reid: Star Formation and Galactic Center
  - Dale Frail: The EVLA: An NSF Facility for High Energy Astrophysics