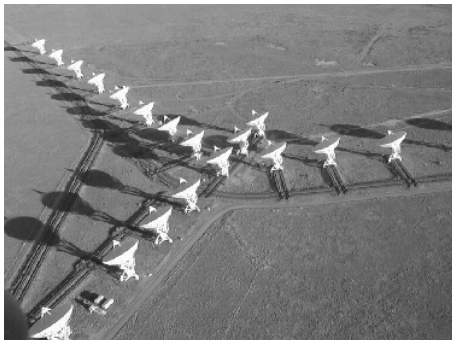

VLA
EXPANSION
PROJECT

Expanded
Very Large Array

The Very Large Array Expansion Project

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A Pathway to the SKA?

Rick Perley, EVLA Project Scientist

NRAO is a facility of the National Science Foundation
operated under cooperative agreement by Associated Universities, Inc.

EVLA Project Definition and Goals

- Expand the scientific capabilities of the VLA by an order of magnitude or more in all major observational capabilities.
- Do this by employing existing technologies with the existing site, antennas, infrastructure
- Complete this expansion in a timely manner – the end of this decade.

EVLA Project Definition and Goals

- Major areas for ‘expansion’ are:
  - Sensitivity
    - Typically 1 microJy (rms) in 12 hr.
  - Frequency Coverage
    - Complete frequency coverage between 1 and 50 GHz, possible extension to ~ 300 MHz.
  - Correlator Capabilities
    - Orders of magnitude increase in capability.

EVLA Project Definition and Goals

– Resolution

- Addition of new stations at distances up to ~300 Km
- Eventual incorporation of the VLBA

– Operations and Data Management

- A comprehensive approach to user interaction with the instrument and its data products.

EVLA Project Phases

- The VLA Expansion Project is divided into two major phases:
  - Phase I: Bandwidth expansion, frequency coverage (1 – 50 GHz), new correlator, FO data transmission, operations, data management.
  - Phase II: Physical expansion with new stations, frequency coverage (0.3 – 1 GHz), ‘E’-configuration.
- These phases can be implemented in parallel.

EVLA Performance

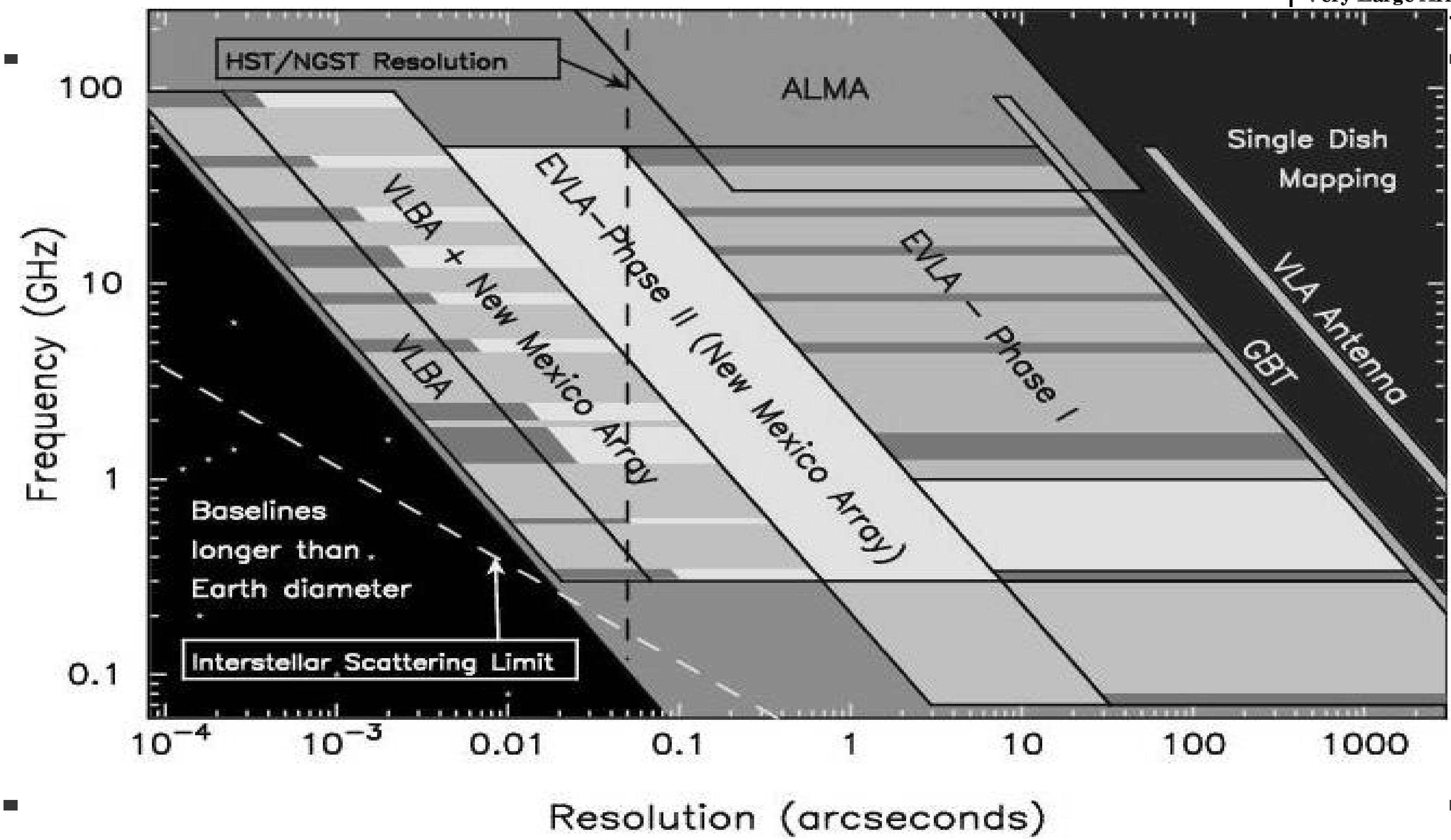
Parameter	Current VLA	Phase I	Phase II
Point Source Sensitivity	10 microJy	0.8 microJy	0.6 microJy
Maximum Bandwidth (per pol.)	0.1 GHz	8 GHz	8 GHz
# of independent baseband pairs	2 (sort of)	2	2
# of frequency channels @ max. BW	16	16384	16384
Maximum # of frequency channels	512	262144	262144
Maximum frequency resolution	381 Hz	~ 1 Hz	~ 1 Hz
(Log) Freq. Coverage (0.3 – 50 GHz)	25%	75%	100%
# of Baselines	351	351	666
Spatial Resolution (@ 5 GHz)	0.4 arcsec	0.4 arcsec	0.04 arcsec

EVLA Performance

The expected A_e/T_{sys} is (27 current antennas):

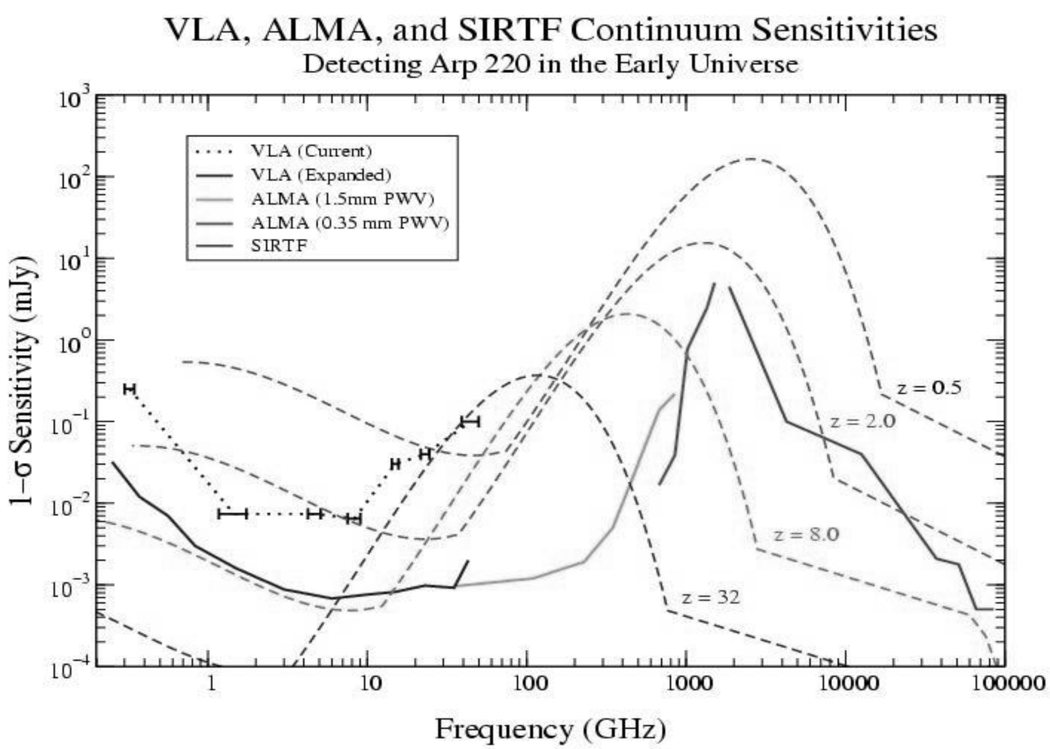
Band (GHz)	1.5	3	6	10	15	23	34	45	90
Ae/Tsys (m^2/K)	260	285	255	220	185	125	115	70	10?

EVLA Performance



9 July 2001

EVLA Performance



EVLA Project Status

- Recent Key Events:
  - 1995: Formal development begins.
  - May 2000: Project obtains very high recommendation from Decadal Panel.
  - May 2000: Proposal for Phase I submitted.
  - Dec 2000: NSF Site Visit to Socorro.
  - Feb 2001: Supplementary Materials submitted to NSF.

EVLA Project Status

  - May 2001: Peter Napier named Project Manager
  - May 2001: D&D funds available ($3M)
- Future Key Events:
  - Fall 2001: Development of Phase II proposal will begin.
  - Fall 2001: Project to be presented to NSB for formal approval for construction (Phase I).

EVLA Project Status

- Phase I Summary: (FY2000 dollars)
  - Total cost: $76.2M
    - NSF new funding: $49.9M
    - NRAO ‘redirection’: $14.3M
    - Canadian Partner: $10.0M
    - Mexican Partner: $ 2.0M
  - Project Duration: 9 years.

EVLA Project Status

- Current Funding Profile:
  - $5M/yr.
  - The NSF has this in its 2002 request.
- Project acceleration?
  - We would like to implement a 7-year plan, to complete 2 years earlier, and save ~$2M.

EVLA Phase II Definition

- Phase I goals, budget, timescale, and plan are all fairly well established.
- For Phase II, only general goals are known:
  - Ten times existing resolution, with high fidelity
  - Inclusion of VLBA antennas
  - Addition of lower frequencies (below 1 GHz)
  - Addition of lower resolution configuration.

EVLA Phase II Definition

- The first goal is the primary component of Phase II. Others are secondary, and may not ultimately be included.
- Some/all of these goals complement those of other existing or planned instruments:
  - GMRT, LOFAR, ATA, eMERLIN, SKA.
- There is/will be a complex interaction between these projects.

Phase II Issues

- Before Phase II can be clearly defined, many issues need clarification:
  - – Science Goals
  - – Timescale
    - How quickly should the NRAO move to begin/complete Phase II?
      - – ‘Fast Track’ preference – begin now, complete by 2010.

Phase II Issues

- Technology is available now
- Science awaits!
- Central site already established
- Satellite site location/acquisition can begin now
- A proposal for funding can be written quickly, once key technical questions are settled.

– Cost: An 8-station (25-meter antennas) expansion roughly estimated at $70M.

Phase II Issues

– Technical Questions:
  - Number of stations (strawman = 8)
  - Composition of stations
    - – Single-dish (simple, well understood, sufficient, expensive)
    - – Array (not simple, may not be sufficient, could be cheap)
  - Frequency coverage (of new stations)
    - – Strong preference to reach 50 GHz, to match VLA.
    - – Strong preference to reach 100 GHz, to match VLBA.

Phase II Issues

– Technical Questions: (other components)
  - Comparison of ‘E’-configuration performance to that of other instruments (VLA-D, ATA, GBT, etc.)
  - Composition of ‘E’-configuration:
    – Dense pack of existing VLA antennas?
    – Array of smaller antennas (a la ATA?)
  - Extension to below 1 GHz:
    – Requires modification of VLA’s quadrupod structure and removal of present subreflector.

Phase II Issues

- Phase II studies – needed to answer these questions.
- Frazer Owen is heading up siting, configuration, communications studies and planning.

Listening to the People

- Developing the Phase II proposal will require strong input and involvement of the entire astronomical community.
- To encourage this, we are planning a series of workshops to discuss, define, and plan the Phase II concept.
- The first will be held in Socorro, Aug 23 – 25.
- Michael Rupen is in charge of this meeting.

Connecting the EVLA to the SKA

- The EVLA is not in competition with the SKA.
- We see the EVLA as a required step to the SKA:
  - Demonstrating the science potential.
  - Exploration of high fidelity imaging.
  - Maintaining and expanding the (young) user base.
  - Exploring the implementation of new technologies.
  - A test-bed for software and data management.
  - Encouragement of SKA development.

Connecting the EVLA to the SKA

- Can the EVLA be a Roadway to the SKA?
  - The Southwest US is a good site for the SKA
    - Relatively empty
    - Mountainous terrain provides shielding
    - RFI environment not severe
    - Strong infrastructure and communications already in place.
    - Excellent human resources available.

Connecting the EVLA to the SKA

- With prompt development of Phase II, (and possible inclusion of the LOFAR project), the critical and fundamental components of site selection, land acquisition, data communications, and human resources will soon be in place.
- Having this could make selection of the SKA site very simple.