EVLA Planning Workshop: Defining the Second Phase

Answers from the Scientific Working Group on Star Formation and Planets

23-25 August 2001

I. The New Mexico Array (A+ Configuration)

A. What are the key science drivers for the NMA?

The possibility of imaging thermal phenomena (dust, ionized gas) at 10 mas scale is very exciting for the field of star formation since we will be able to reach key physical scales (planet formation, jet collimation) and we will see objects evolve in timescales of months or years.

The key science drivers will be:

•Holes and gaps in protoplanetary disks at 1 AU scale

•Imaging of the evolution of thermal jets at 1-10 AU scale

•We will be able to resolve binaries and multiple systems

•The precise astrometry will allow the study of ejection and/or merging in multiple systems

•Hypercompact H II regions

•Relative astrometry in same field of masers and thermal sources

•In combination with other wavelengths (i. e. X-rays), it will be possible improve understanding of massive star formation

•Near-earth asteroids with radar

B. Should we build the NMA?

Yes (by unanimous decision)

C. Within the scope of this project, is the baseline plan of 8 new antennas plus PT/LA about right?

Yes, although this question has many ramifications

D. What is the required maximum frequency?

50 GHz

D2. Would you be willing to trade frequency coverage for collecting area?
(freq. coverage here refers to max. freq., not bandwidth)

No, we want to reach 50 GHz

E. How important is "stand-alone" NMA operation? I.e., should we ensure good sensitivity & imaging capability (and what is "good") when the NMA is operating independently of the VLA/VLBA?

   For this group, the NMA should be presented as an instrument that will work most of the time as part of the VLA or of the VLBA. We believe that the stand-alone should be deemphasized

F. What field-of-view is required for the NMA? (as a function of frequency)

   Same as a VLA antenna

G. Rank the relative importance of:

- getting the NMA done as soon as possible ==¿ using traditional antenna technology (25m dishes)
- developing new technology specifically for the EVLA-II, to increase its capabilities (e.g., to give more collecting area)
- developing new technology related to SKA, even if this is not optimal for the EVLA itself (i.e., think of the EVLA as a working scientific array built on the way to SKA)

   The first option is the most important (25m dishes). However, NRAO should leave the door open to prototyping SKA-related arrays

II. Integrating the VLBA with the (E)VLA

A. How far should we go in integrating the VLBA with the VLA, as part of EVLA-II?

   We feel no urgent need for full integration of VLA+NMA+VLBA. We see mostly a VLA+NMA *or* NMA+VLBA operation.

III. The E Configuration

A. What are the key science drivers for the E configuration?

   •Imaging of low brightness structures in line and continuum

   •Study of molecular clouds in NH_3, SiO, CH_3CN, etc.

   •Zeeman effect

   •Need to understand environment (H II region→PDR→ISM)

   •Comets

   •Jupiter and Venus

B. Should we build the E configuration?

   Yes, but science case is not as strong as for NMA.

   We encourage NRAO to continue development for VLA-E+GBT observations

B2. If we build the E configuration, which approach seems most appropriate:

* 500m max spacing: ~ 9 new pads, cheap
* 300m max spacing: ~ 15 new pads, matches configuration sequence
* 200m max spacing: ~ 27 new pads, as dense as we can get
* other

The 300m option seems the best compromise (Kogan's E3)

C. How important is shadowing (i.e., observing low declinations)?

It is important since many star-forming regions and the planets can be at low declinations.

We recommend looking at north-south distribution of configuration to minimize shadowing.

D. What frequency range is required?

Up to 50 GHz

IV. Low Frequency Expansion (300–1000 MHz)

A. What are the key science drivers for low frequencies on the EVLA?

•Synchrotron emission from Jupiter and possibly Venus and Neptune

•Studies of sub-surface structure in Moon, Venus, and possibly Mars

B. Should we provide this improved low frequency (300–1000 MHz) capability?

This is a low priority for this group. NRAO should first assess the possible impact in the high frequency operation, possibly building a prototype. We also recommend exploring possible collaborations with GMRT

C. What frequencies must be covered?

Above 1 GHz

V. Connections to Other Initiatives: how does the EVLA fit in with other major astronomical facilities coming on-line over the next decade(s)?

A. What should be the plan for radio astronomy in the next several decades, and how does the EVLA fit into that plan?

The (E)VLA is the workhorse of the the radio interferometric community. The EVLA should get done as soon as possible.

The EVLA is key in keeping community enthusiastic about interferometry and in training students that will use ALMA, SKA, ATA, and other arrays.

B. How should the EVLA relate to LOFAR?

No frequency overlap. Very complementary.

C. How should the EVLA relate to the SKA?

The SKA parameters remain to be defined. For example, the highest frequency to reach will mean very much for the EVLA. If SKA only reaches (let's say) 10 GHz, we may have the EVLA operating in the 10-50 GHz window well into the future.

The infrastructure of the EVLA should be used for prototyping SKA elements. It should also be kept in mind that the EVLA may evolve into SKA.

VI. What items could be moved from EVLA-II into EVLA-I?

The E configuration seems appropriate.

We give lower priority to the low frequency expansion because of possible impact in high frequency operation.