

National Radio Astronomy Observatory

Charlottesville, Virginia

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To: Distribution
 From: S. Weinreb
 Subject: A Millimeter-Wave Array Development Plan

- I. This memo is an attempt to describe the tasks, manpower and funds required prior to construction funding of a millimeter-wave array. As ground rules I assume:
- 1) The earliest year for construction funds is 1988 (after the VLBA funding is complete).
 - 2) A proposal is needed by mid-1986; the cost, performance, and system design must be known by then.
 - 3) Detailed design will begin in 1987 (or in the year prior to expectation of construction funds).

In summary, the required manpower (MY = man-years) and funds are as follows:

	<u>CY84</u>	<u>CY85</u>	<u>CY86</u>	<u>CY87</u>
<u>MY</u>	2.5	5	7.2	7.8
<u>\$k</u>	\$125	350	500	500

A breakdown of these requirements among tasks and types of manpower is given in Table I.

II. Task Description

- 1) Coordinate project - One-half time effort of a senior scientist for four years is needed to liason with the scientific community, decide specifications, and coordinate the development tasks.
- 2) Configuration and site study - Another half-time effort for three years is needed to model the array performance, choose a configuration, analyze atmospheric data, and choose a site.

- 3) Construct atmospheric sensors - Two months of engineering, six months of technician, and \$75k are needed to construct three tilting 230 GHz radiometers with simple data recording systems. These would be used to give long term statistics of atmospheric opacity and variability at three sites over a three-year period.
- 4) Structures study - One-half time of a mechanical engineer for three years plus \$200k of contract study or consultants is estimated to perform conceptual design and costs of a multiple-reflector control element, portable outer reflectors, and a transport vehicle.
- 5) Multi-beam optics study - A total of 1.16 man-years and \$100k is estimated to plan a feed and subreflector system to accommodate multi-beaming and quick change of frequency.

The following three tasks denoted by * are common to support of the 12-meter telescope and have not been included in array development costs.

- 6) SIS front-end development* - One engineer and one technician for four years and \$270k will be devoted to development of two generations of SIS receivers for the 70 to 280 GHz range.
- 7) 2.5K refrigerator development* - One-half a technician for three years and \$100k of consultants or contracts will be devoted to development of a small capacity, reliable refrigeration system.
- 8) Prototype correlator* - A hybrid filter-bank/digital correlator covering 1 GHz bandwidth with 2048 channels will be constructed with a total of 2 MY engineering, 2 MY technician, 1 MY programmer, and \$90k.
- 9) Wideband IF development - A total of 1/2 MY engineering and \$100k will be devoted to extending the bandwidth of 10K noise temperature IF amplifiers from 0.5 to 2 GHz.
- 10) Prototype interferometer - An advanced technology interferometer should be constructed to field test new concepts to be used in the array, give experience to the design team, and evaluate atmospheric effects. This would involve either building two elements at the chosen site or adding a single element to the 12-meter on Kitt Peak. The antenna size and system complexity should be chosen consistent with a total budget of \$500k and two engineers, two technicians, and a programmer for two years.
- 11) Design array - In the year preceding construction funds, two electronic engineers, a mechanical engineer, a programmer, a scientist, and \$500k of outside contracts should be

devoted to detailed design of electronics, antennas, building, and a computer system. This is probably not sufficient to complete the design but will allow construction of longer delivery items to start promptly with availability of construction funds (hopefully, in 1988 with project completion by 1991).

Attachment

TABLE I

MILLIMETER ARRAY DEVELOPMENT PLAN

TASK	Submit Proposal			Funds Start
	1984	1985	1986	1987
Coordinate project	1/2 S			
Configuration/site study	1/2 S			
Construct 3 atmos. sensors	1/6 E + 1/2 T ↑ \$75k			
Structures study	1/2 M	200k		
Multi-beam optics study	1/6 E 50k	1/2 E 50k		
SIS front-end dev.*	1 E + \$60k	1 T \$60k	\$70k	\$80k
2.5K refrig. dev.*	1/2 T 30k	1/2 T 30k	1/2 T 40k	
Prototype correlator*	(1 E + 1 T + 1/2 P 10k)	80k		
Wideband IF dev.		1/3 E 100k		
Prototype interferometer		(2 E + 2 T + 1 P 500k)		
Design array				2 E + M + P + S 500k
TOTAL	1.0 S, .3 E 0.5 M, 0.5 T	1.0 S, 1.8 E 0.5 M, 1 T 0.5 P	1.0 S, 2.5 E 0.5 M, 2 T 1 P	1.5 S, 3 E 1 M, 1 T 1.5 P
12-Meter Support	\$125k	\$350k	\$500k	\$500k
	\$100k	\$170k	\$ 70k	\$ 80k

* denotes task funded as 12-meter support.

S = scientist

M = mechanical engineer

T = technician

E = electrical engineer

P = programmer