VLB ARRAY MEMO No. 210

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March 16, 1983

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Dear Tom:

Alan Bridle has made a detailed cost comparison of the VLBA and CLBA (VLBA Memo No. 189). The most important and also the most difficult to understand discrepancy is in the cost of the individual antenna elements. Although the specifications for the VLBA and CLBA differ, this does not appear to account for the cost differences. Since we may anticipate that a major question for the coming discussions of the VLBA and CLBA collaboration will be the choice of antenna size and minimum wavelength, it is important that we understand why the present estimates differ.

In the VLBA proposal, we estimated a total cost of $17,500 K for 10 25m antennas, or $1,750 K per element, each good to 43 GHz ($\lambda/16$ and 1/10 HPBW pointing accuracy). Including the cost of foundations, subreflector and vertex house cover, which are budgeted separately in the VLBA proposal, raises the price to $17,600 K.

The CLBA proposal gives C$(3,248 K) per antenna = US$2,600 K per element for a 32 m antenna good to 22 GHz. There appears to be two problems; one in scaling the size from 25m to 32m, and the other in raising the operating frequency from 22 to 43 GHz.

Antenna Size. We have been told that TIW estimates a cost reduction by only a factor of 1.24 in going from 32m to 25m, whereas normal scaling laws would indicate a ratio of $(32/25)^{2.55} = 1.88$. (A recent JPL study supports the applicability of this law).

It has been suggested that the TIW 32m antenna is particularly cost effective because the design and tooling already exists. But the total engineering and development costs for a new antenna should only be about $1 million, and amortized over 8 antennas; this would only add a bit over $100 K to the cost of each element. The actual cost difference would probably be much less since the antenna you want exceeds the normal TIW specs, and considerable design and structural analysis might be required to meet your specs.

Frequency Limit. B. Andrew told us that a recent TIW estimate indicated a cost of US$3.6 million for each of 14 25m antennas good to 43 GHz. Correcting for a 1983-1982 inflation of 5% gives a 1982 price of $3.42 million. This may be compared with the TIW estimate for a 25m antenna good to only 22 GHz of $2.6 million/1.2 or $2.1 million. We do

not understand the apparently large increase in cost corresponding to this change in minimum operating wavelength. It should be noted, however, the VLBA uses $\lambda/16$ = .45 mm rms = 0".018, whereas the CLBA apparently uses 0".015.

Both Canadian and U.S. radio astronomers recognize the merits of increased sensitivity (larger antennas) and higher resolution (shorter wavelengths). The difference in emphasis of the VLBA and CLBA apparently reflects the different estimates in the two countries of how antenna costs vary with size and operating wavelength. This must be resolved before we can have a meaningful discussion of a VLBA/CLBA collaboration.

The other major discrepancy is in the area of feed fabrication. I understand that the Canadian estimates for feed construction are based on the cost of replicating the VLA feeds in Canada. Peter Napier, however, points out that the VLBA has a larger subreflector and thus smaller feeds, which should be cheaper to fabricate.

Sincerely,

K. I. Kellermann

KIK/bbs
xc: A. Bridle
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