April 19, 1983

Minutes of VLBA Feed Subgroup Meeting - 13 April, 1983. P. J. Napier

The following points came out of the discussion between M. Balister, S. Weinreb, C. Moore, R. Fisher, A. Moffet and P. Napier.

a) The required frequency coverage was reviewed. The only change to the bands given in Fig. IV.3 of the May 82 VLBA proposal is at λ 6cm. The current requirements are listed below.

| FREQUENCY GHz | BANDWIDTH MHz | %BANDWIDTH | COMMENTS |
|---|---|---|---|
| .330 | 30 | 10 | Prime focus |
| .610 | 60 | 10 | Prime focus |
| 1.35-1.75 | 400 | 26 | Cover both H and OH |
| 2.3 | 250 | 11 | Dual frequency operation with 8.0-9.0 GHz. |
| 4.8-6.1 | 1300 | 24 | Optimize performance in 4.8-5.1 GHz band. |
| 8.0-9.0 | 1000 | 12 | Dual frequency operation with 2.3 GHz. |
| 10.1 - 11.1 | 1000 | 9 | |
| 15.4 | 1000 | 7 | |
| 21.3 - 25.6 | 4300 | 18 | Cover $H_2O$ and $NH_3$ |
| 42.5 - 43.5 | 1000 | 2 | |

b) It was agreed that manual intervention on the antenna should not be required to change between these frequency bands. Manual intervention should be considered only as a last resort because some antennas (such as those close to the VLA) will probably not have permanent personnel.

c) The original requirement for dual frequency operation with 2.3/8.5 GHz feeds has increased to include 5/22 GHz and 10/43 GHz. A request for 22/44 GHz has also been heard. (after this meeting Craig Walker called to say that at the Washington VLBA meeting on 8 April a triple-frequency requirement eg. 2.7/10/43 GHz was suggested to allow the removal of ionospheric effects from phase referencing experiments).

d) The current concept of a VLA-style offset shaped geometry has several problems in meeting requirements (a), (b) and (c) above.

d.1) The narrow-band in-phase - aperture corrugated horns currently proposed for all frequencies above 1.75 GHz can only marginally achieve 10% bandwidth. This is because the feed pattern will need to be approximately -14dB down at the edge of the subreflector at the lower end of the band so, if the pattern narrows significantly at the top end of the band, the pattern first null or sidelobe may fall on the subreflector reducing efficiency. Both the 4.8-6.1 GHz and 21.3-25.6 GHz feeds will have to be wide band designs which have their phase center near the throat. This is probably tolerable for the 21.3-25.6 GHz feed which is physically small but is a problem at 4.8-6.1 GHz because the feed will cause blockage if it has to project too far forward of the other feeds. It is not clear yet whether a wide band design is needed for the 8.0-9.0GHz feed. It is probable that some mislocation of the feed phase centers can be accommodated by refocussing the subreflector.

d.2) The dichroic plate approach to obtaining the dual-frequency performance required in (c) above does not have sufficient bandwidth to allow the plates to be left permanently in-place over the feed. for the 8.0-9.0 GHz and 21.3-25.6GHz feeds. The 0.1 dB insertion loss bandwidth of a dichroic plate is 200 MHz (2.5%) at 8.5 GHz. We must either provide very expensive automated moving mechanisms or put up with the need for manual intervention for frequency changing.

d.3) It seems unlikely that the feed circle can stay at the size proposed (85 cm radius) for the following reasons. The S band ellipsoid will have to be longer than currently proposed, broadband feeds are much larger than narrow band feeds, dichroics are required for more bands. The effect of increasing the feed circle will be increased blockage and poorer polarization purity.

e) The current concept for the feed system was chosen with no detailed consideration of any other possible system. In the time remaining before a commitment must be made we should consider other possible approaches. Some other approaches are:

e.1) Canadian design: Feeds clustered close to antenna axis, tiltable subreflector.

e.2) Australian approach: Very broadband feeds covering two observing bands in one feed.

e.3) Quasi-optical approach: Place 1.35-1.75 GHz/2.3 GHz feed on axis with a movable quasi optical reflector above it to direct the signal to the other feeds.

f) The present budget is very tight. There is no allowance for the cost of the shaped reflector profile design, broadband rather than narrow-band feeds or more dichroics.

g) Next meetings: 4 p.m EST, 27th April, Phone 203-797-9080. Topics:

Other possible feed systems

Meeting 4:00 p.m. EST, 11th May, Phone 203-797-9080. Topics:

Proposed development and construction plan, manpower, budget.

PJN/ef

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