NATIONAL RADIO ASTRONOMY OBSERVATORY
Charlottesville, Virginia

November 21, 1985

MEMORANDUM:

TO: Distribution

FROM: S. Weinreb

SUBJECT: Questions Regarding Array Feeds for Multi-Beaming of Reflector Antennas Used in Radio Astronomy

On the attached page I have written down the questions that need to be answered to develop advanced multi-beaming techniques. I see this as the next technology frontier in radio astronomy and believe it is analogous to the state of aperture synthesis twenty-five to thirty years ago. The physics is all known, but there is much to learn to make an optimum implementation.

I will try to get some more help to work on this problem full-time (perhaps a visiting engineer), but perhaps some of you will also think out these questions in your spare time.

Attachment

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QUESTIONS REGARDING ARRAY FEEDS FOR MULTI-BEAMING OF REFLECTOR ANTENNAS USED IN RADIO ASTRONOMY

S. Weinreb

November 20, 1985

1) Should the feeds be located in the image plane where the power received by each feed gives a pixel of the image or in a visibility plane where each pair of feeds gives a Fourier component of the image?

2) In either case, what form should the feed take? Should it consist of an array of smaller elements (which may overlap adjacent feeds) or single larger elements? Should the feeds utilize planar or horn technology?

3) How can the feeds be integrated with emerging millimeter-wave technology such as superconducting junctions and planar Schottky-diodes? How is the I.F. or detected output coupled out of the feed array?

4) What is the relation between number of significant pixels, number of receivers, and sensitivity?

5) What is the effect of utilizing amplifiers or mixers with gain before combining feed elements? If a mixer is used, how is the image separated and local oscillator injected?

6) In view of limitations of superheterodyne receiver cost, what can be achieved by simple detector-video amplifier continuum receivers? (Recent developments show SIS detectors to have high continuum sensitivity, but their use would preclude cross-correlation processing.)

7) What intervening optics (sub and tertiary reflectors, lenses, etc.) should be used to accommodate a feed array to a paraboloidal reflector?

8) Can the feed array be also used to correct for aberrations in the main reflector?

9) Do these techniques have any bearing on the millimeter-wave array we are planning?