MILLIMETER ARRAY
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Concept of a Compound Millimeter Array

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Since my document on the concept of a millimeter array (Millimeter Array Memo Series number 1), I feel our ideas on the form of such an array have advanced quite a bit. In this memo I will outline what I see as the current state of thoughts on the subject. What I will outline below is what I consider to be the working idea for the array. I have discussed this idea with a large number of people over the last year and almost everyone seems to like it. However, it is just a working idea not something set in concrete. If and when other ideas occur they should be compared with this one.

The one of the most important conflicts in designing an array for millimeter wave astronomy is between collecting area and sensitivity to low surface brightness. Detection, high resolution, and calibration pushes one toward large elements for the array. On the other hand, sensitivity to low surface brightness and field of view pushes toward very small antennas. My solution to this in MA memo number 1 was to build two arrays, one of ten meter dishes and one of three meter antennas. The problem with that idea is that the three meter antennas are limited to fairly large spacings by shadowing. In various discussions and presentations, Ron Ekers has pointed out that could be solved by mounting all the dishes on a surface whish could itself be tilted to an angle perpendicular to direction of the source being observed. After all that is what one does with a single dish. This concept avoids shadowing and allows the dishes to be placed much closer to one another, improving sensitivity to low surface brightness.

Thus what I would like to propose now is a compound array consisting of a movable array of ten meter antennas combined with a multimirror telescope with a large number of three meter antennas. Each of the three meter antennas would have its own receivers and would be pointed independently. A conceptual picture of such an array is shown in the figure.

The multimirror telescope would have several different modes of operation. First for low surface brightness mapping, the multimirror system would be used as a stand alone array. For 24 three meter dishes as shown in the figure, the telescope would have the field of view of a three meter, the maximum resolution of a twenty-five meter and the collecting area of a fifteen meter antenna. Of course, the resolution could be decreased by the standard technique of tapering the u-v data before mapping.

Second, the multimirror telescope could be used for detection and calibration with the ten meter telescopes. In this mode all the IF's from the three meter antennas would be summed (as we now do with the VLA for VLBI) and the output correlated with each of the ten meter antennas. This would maximize the array collecting area and give us a baseline to each of the ten meter antennas with a higher sensitivity.

Third, the multimirror telescope could be used as a single dish. Beam switching or frequency switching should be possible.

Fourth, a super low resolution mapping mode should be possible in which each of the three meter dishes is pointed in a slightly different direction.

Fifth, a mode may be possible in which groups of four three meter dishes could be correlated with each of the ten meter dishes.

In modes 1), 3) and 4) it should be possible to use the ten meter antennas for another project.

The ten meter antennas would be transported using vechicles with rubber tires. Thus more flexible configurations would be possible. A very compact configuration would be used for low resolution work and to fill out the u-v coverage obtained with the multimirror telescope. My current idea is to put all the ten meter antennas in a clump about 100 meters in diameter. In addition to a circular clump there would be an elliptical clump stretched north-south for observations at low decinations.

For higher resolution observations the array would probably be arranged in a wye like the VLA. If we locate on the VLA site we will probably extend the largest configurations along the VLA arms in order to use the land we currently own.

<u>Problems to be Addressed</u>

Clearly with any new type of design there exist problems which need to be addressed. First the concept of a multimirror element needs to be studied by a structural engineer. While it seems likely that such a design is possible, we need to look at the details to be sure.

Second, the number of elements will probably be limited by the correlator. Thirty-six three meter dishes would be better on the multimirror element than twenty-four. Thus the correlator design interacts strongly with multimirror design.

Clearly other details are problems (e.g. receivers, optics, beam patterns). Also this concept needs to be compared with a single antenna with multiple beams.