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On November 15th, 1997 the Millimeter Array Advisory Committee (MAC) met in Chicago with representatives from NRAO to discuss technical and scientific issues raised by the proposed 50/50 merger of the Large Southern Array (LSA) planned by European astronomers with the Millimeter Array (MMA) planned by US astronomers. Based on a combination of MMA memos, MDC working group reports, and other presentations at this meeting, the MAC recommends the following:

- 1) We strongly and unanimously recommend collaboration with the Europeans.

This merger will result in a much more powerful instrument than we could possibly build alone. The target collecting area increases by more than a factor of three, from 2000 to 7000 square meters. The combination of US and European technical and scientific ideas will result in a more powerful instrument and the best scientific research. This merger will satisfy the NSF requirement for an international partnership. While we recognize that such a collaboration will inevitably lead to a more complicated management structure, we believe that the positive aspects of such a collaboration far outweigh the possible negative aspects.

- 2) We recommend against a heterogeneous array.

Because a heterogeneous array requires more up-front money to design two different antennae and more expensive operating costs to maintain and transport two different kinds of antennae, we believe that we would not be getting the best scientific instrument for the available money. We are not convinced that a heterogeneous array enables science that could not be done with a homogeneous array. Imaging is generally more difficult with a heterogeneous array.

- 3) We unanimously recommend that NRAO and the European partners focus a design effort on a dish of 12m diameter, giving careful consideration to the use of active metrology to achieve the surface accuracy (25 microns rms) and pointing (1/30 of the primary beam at 300 GHz) specifications. On a time scale of about 6 months, the results with both passive and active metrology, should be reviewed by the MAC and other relevant groups (MDC, European committees) to decide if the 12m design is acceptable.

The imaging issues do not seem to change enough for dishes in the range 10m to 12m to clearly distinguish one size over the others for a fixed collecting area of 7000 square meters. However, the committee was very concerned about the large number of antennae required to achieve the targeted 7000 square meter collecting area with antennae as small as 10m. With 10m dishes, at least 90 antennae would be required, with a commensurately larger number of receivers, cryogenic systems, correlator chips and interconnections, antenna stations, and power consumption during operation. If 12m antennae meet the specifications, we believe that they will be able to do substantially the same science

that smaller dishes can do, while making some other science easier.

- 4) We believe that the "fall-back" issue should not dominate discussion about dish size.

We are encouraged by progress on support in Europe for this merger.

Even if the European collaboration fails, NSF presumably would require NRAO to find another partner.

Further, it appears that one can expect to build on the order of 25x12m dishes with \$200M (if we have to go alone). This number provides enough baselines to achieve good image quality, as we know from the VLA.

- 5) We recommend keeping options open regarding a potential cooperation or collaboration with the Japanese LMSA project as well as the the potential incorporation of other international associate partners.
- 6) The MAC recommends that anomalous atmospheric refraction not be included in the pointing error budget of antenna designs.

If the estimate for the median anomalous refraction is included in the overall pointing budget, it will drive the antenna pointing specifications to an untenable level. Our view is that projects that require the very best pointing will have to be done when anomalous refraction is exceptionally low, or if this proves impractical a means of correcting for the refraction will have to be implemented.

- 7) In the context of an international partnership, attention needs to be focused on defining the management structure of the MMA/LSA project. The MAC particularly recommends establishment of a single international advisory committee, with balanced representation of the various disciplines within astronomy, that would advise the combined MMA/LSA management.

Our experience shows that advisory panels work best when they work together. Separate advisory panels for each side would be prone to slow the decision-making process and make consensus more difficult to achieve.

- 8) The MDC has played and continues to play a critical role in the development of the MMA project and we recommend that this important group, with its wide range of experience and expertise, continue to be an integral part of this project, whether it is internationalized or not.
- 9) We recommend that an international meeting be held sometime within the next 12 to 18 months. The collaboration and antenna design issues should be clearer before the workshop is held. Issues like the configurations, receiver suite, etc. should still be open to discussion and the antenna design and institutional arrangements should be reviewed. This meeting should include a meeting of the international advisory committee, but it may also involve a larger group.

We believe that the workshop held in Tucson was very important in pin-pointing array design features required to achieve the range of science that the MMA is expected to address. If an international collaboration goes forward, it is crucial that both communities agree on common goals and strategies for achieving them.

- 10) We strongly recommend that software design and development for the MMA/LSA be placed on an equal footing with receivers, antennas, electronics, etc. As with the other groups, it should have a timeline and be periodically reviewed to determine if the timeline is being adhered to.

Experience with AIPS++ has shown that such an approach is necessary.

- 11) Finally, we commend NRAO on its willingness to pursue this

collaboration and the efforts of those working to make it
a reality.

We recognize that those who have been working on the MMA design faced considerable stress in having to adjust to new demands and new ideas about designs. The international working group on antennas has made remarkable progress, and the science working groups have reached out to the larger communities to solicit their advice.