October 29, 1982

Dr. L. P. Bautz, and
Dr. F. S. Johnson
National Science Foundation
1800 G Street, N. W.
Washington, D. C. 20550

Dear Drs. Bautz and Johnson:

We are a group of millimeter wave astronomers meeting at Bell Laboratories to consider the future of millimeter wave astronomy in the United States. This field, particularly interstellar molecules, has been one of the most active and productive areas of astronomy over the past decade. It was pioneered and developed almost entirely in the United States. At this point, there exists a unique opportunity to build upon this major strength, an opportunity which will be lost if action is not initiated. The Field Committee Report to the National Academy of Science assumed that at least one major instrument (the 25 Meter Antenna) would be built in this area and therefore did not recommend another major facility. In spite of the fact that the science in the Field Report stressed the growing importance of studies of star formation and galactic evolution, areas in which millimeter astronomy plays a vital, indeed a unique role, there are now no current plans in the U.S. to build any such instrument. The 25 Meter Antenna was dropped partly as a result of similar large instruments being built overseas in Europe and Japan. Although the 25 Meter would have been a world leading instrument when first proposed, its time has passed.

The scientific justification for an advanced millimeter project is stronger than ever. Millimeter technology in the U.S. has progressed greatly since the mid 70's when the 25 Meter was first proposed. Advances in receiver sensitivity and reliability as well as decreased cost now would permit a large millimeter array to be constructed. The feasibility of millimeter interferometry has been demonstrated at Berkeley and Caltech. At this meeting we have discussed both the science and the technologically feasible instrumentation, and concluded that a millimeter wave aperture systhesis instrument should be planned immediately. We have developed an overall outline for the instrument which is scaled down from the Very Large Array. It would have approximately 30 small aperture, low-cost antennas, roughly 6 meters in diameter with a maximum baseline of less than 3 km. We expect that this project although more than an order of magnitude improvement over the 25 Meter in almost every way technologically and scientifically, could be produced for less than the cost of the 25 Meter, with possibly very low operating cost. It is also an order of magnitude improvement over any instrument proposed in the world for most problems of interest, and will be complimentary to infrared

space astronomy projects. The cost of this instrument will be greatly reduced by capitalizing on the substantial aperture synthesis technology at the Very Large Array.

The scientific importance of this facility is as great as any other proposed facility at radio or other wavelengths. With the capability of making optical quality images this instrument will lead to fundamental advances in major areas of astrophysics. Some of the most significant are:

Star and Planetary Formation

At maximum spacing the image resolution (0.2") will be 20 astronomical units, less than the size of the solar system. This will allow us to obtain a picture of the dynamical processes taking place during the formation of stars and solar systems.

Structure, Evolution and Dynamics of Galaxies

The instrumental sensitivity will allow immaging (between 1-4 arc second) of Giant Molecular Clouds (the active gas in galaxies) in both the disks and nuclei of external galaxies. These are the most massive objects in galaxies and the technique discussed here is the only method of studying them.

Cosmology

Measurement of the dimunition of the microwave background combined with the X-ray emission from distant clousters of galaxies should allow an unambiguous determination of the expansion rate of the universe, H (Hubble Constant) and the deceleration parameter q_0 which determines whether the universe is open or closed.

This sytem ultimately would be capable of operating between wavelengths of 1mm and 1 cm, but initially by concentrating on the spectroscopically rich region between 2.5 and 4mm, the scientific return will be optimized for minimal cost.

We plan to have a second meeting to initiate a more detailed study of this instrument.

Sincerely,

Copy to
G. Field, F. Press, M. Roberts
and G. Keyworth

Signatories to letter to F. S. Johnson from the October 28-29 meeting of millimeter-wave astronomers at Bell Labs.

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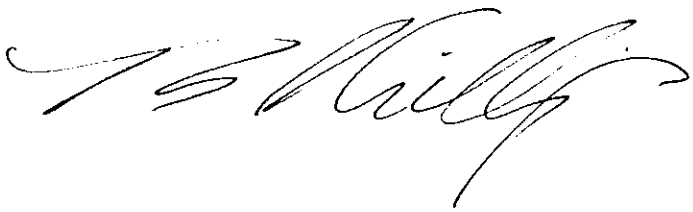

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