

December 27, 1983

To: VLBA memo series  
From: Mark Reid and Jim Moran  
Re: 6 GHz VLBA receivers

We strongly urge that a 5 cm receiver (covering at least 5.9-6.1 GHz) be included as a design specification for the VLBA, rather than an optional capability as suggested in memo 295. A 6 GHz capability has, until very recently, been assumed, as part of the 5 GHz system, in all plans for the VLBA. It is specifically mentioned on page I-8 of Volume 1 of the array proposal. The primary motivation for a 6 GHz capability is to observe the  $2\pi^{3/2} J=5/2$  excited transitions of the OH molecule. It is important to study this OH transition for two reasons:

(1) It offers the strongest OH masing transitions after the 1.6 GHz transitions. This allows one to study maser processes under different excitation conditions in the same source. Such studies may be crucial to the as yet unanswered question of how OH masers are pumped.

(2) In contrast to the 1.6 GHz OH masers, the 6 GHz masers exhibit fairly clear Zeeman patterns. This can be exploited to map the full 3-dimensional magnetic field patterns in the immediate vicinity of newly formed stars. Magnetic fields almost certainly play an important role in star formation, and VLBA observations of the 6 GHz excited OH transition seem to be the best method of obtaining information to bridge the huge gap in physical conditions between interstellar and stellar densities.

To date, only 2 successful VLBI observations at 6 GHz have been conducted (Knowles et al 1973, Ap. J. (Lett), 180, L117; and Moran et al 1978, Ap. J. (Lett), 224, L67). The Moran et al observations used only 3 antennas--NRAO 43m, ARO 46m, and NRL 26m--with restricted polarization capabilities and poor receivers. Even so, very exciting results were obtained, including the first clear demonstration of multiple Zeeman pairs in one source. More work has yet to be done, not because of lack of interest, but because of a combination of poor receivers available on a very limited number of telescopes and the intrinsic weakness of most sources (typically  $<10$  Jy).

The scientific problems discussed above can only be studied with a large array of telescopes with sensitive receivers and full polarization capabilities--i.e., the VLBA. The 6 GHz receivers would make it possible to explore a nearly virgin field of study; few of the proposed VLBA receivers can make that claim. We feel that it is very important to emphasize new areas of research with the VLBA and not to be satisfied just enhancing our current capabilities.