11. Microwave and Millimeter Wave Techniques

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11.1 Research Objectives

National Science Foundation (Grant AST79-20984)
National Aeronautics and Space Administration (Contract NAS5-25543)
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The principle emphasis is twofold: first, we are developing reliable, low-noise, wide-band receiver technology, and second, the Very-Long Baseline Interferometry technique (VLBI) is being extended to the use of orbiting antennas (OVLBI). An additional requirement in receiver work that has been more frequently needed than in the past is greater freedom from adjacent-band interference, and protection against burnout from high-power rf sources. At wavelengths longer than 1 cm, we are emphasizing the development of cooled transistor receivers, using GaAs-FET transistors, while at millimeter wavelengths we are placing the strongest effort into cooled mixer devices. The principle projects are the following:

1. A cooled 7-mm mixer has been completed, giving instantaneous 1 GHz band-width centered at 43 GHz. The first model is in use at the Haystack Radio Observatory, and has proven to be highly reliable. The single-sideband excess noise is about 250 K.

2. Work is continuing on the development of a 15 GHz cooled GaAs-FET amplifier, having an instantaneous bandwidth of 1 GHz and excess noise lower than 100 K. The first model, a room-temperature prototype, gave $T_N \simeq 300$ K, and was over 1 GHz wide to 3 db points. Cooled amplifiers, aimed at testing GaAs-FET noise theory, are under construction. These will be 3-stage, of stripline configuration, using bare chips. The micromanipulation techniques for fabrication have been perfected.

3. Development studies of an orbiting VLBI station (OVLBI) are under way, in cooperation with the Marshall Space Flight Center at Huntsville, and with Cal Tech's Jet Propulsion Laboratory. Three concepts are being studied: an inexpensive shuttle-mounted test version, using a 15-meter

deployable antenna, a free-flying satellite in an eccentric orbit, and a feasibility test that would make use of the TDRSS system.