THE RADIO ASTRONOMY PROGRAM AT THE
UNIVERSITY OF MICHIGAN

The radio astronomy project at the University of Michigan began this spring with support from an ONR contract. The broad purpose of the program is the development, construction, and operation of equipment to record the radio frequency spectrum of the sun and of galactic and extra-galactic radio sources over a wide frequency range, and the interpretation of these records. The initial phase of the program emphasizes the development of equipment designed to study the active sun, principally the bursts and outbursts from active regions in the solar atmosphere using sweep-frequency receiver after the manner of J. P. Wild in Sydney, using, however, somewhat higher frequencies. The second phase of the program will be the construction of equipment at the centimeter wavelengths to study not only the active sun but galactic and extra-galactic radiation.

A radio observatory site has been chosen fifteen miles northwest of Ann Arbor near the University of Michigan's Portage Lake Observatory which has proven to be within a convenient distance for access by graduate students. Roads, power, water, control house, etc., are now being developed at the site where a 28-foot radio telescope will be installed this fall. The telescope will be mounted equatorially and be capable of full sky coverage. For solar burst studies three synchronized sweep-frequency receivers will be used with this telescope. The receivers will be capable of mechanically scanning from 100 to 600 mc/s (3 to 0.5 meters wavelength), ten times every second. Receiver outputs will be displayed on oscilloscopes and photographed. In addition, one or more single frequency receivers will be used to make simultaneous measurements of the state of polarization of the solar bursts.

Observations of the radio-frequency spectrum will be closely coordinated with optical observations carried out concurrently at the McMath-Hulbert Observatory where the study of solar flares has been a major field of research during the past twenty years.

The second phase and major effort of the program will be concentrated at the centimeter wave region or high-frequency end of the radio spectrum. In order to study spectra of galactic and extra-galactic radiation and solar bursts at these wavelengths it is necessary to have a moderately large precision paraboloid. At the moment we are considering a steerable paraboloidal reflector with full sky coverage useful up to 10,000 mc/s, or 3 cm wavelength. Funds are now available to obtain such an antenna with a diameter of at least 60 feet. It is planned to use traveling-wave tube receivers for solar burst spectra observations eventually over the range of 5,000 to 10,000 mc/s. These high frequencies originate in the chromosphere close to the origin of optical emissions from solar flares. Since at centimeter wavelengths solar bursts intensities are usually less than a few times that of the quiet sun, large antenna gains are needed for spectral studies. Large antenna gains require beam-widths smaller than or comparable to the solar disk. This means that the noise background against which bursts are detected is determined by the solar flux and not by receiver noise. Thus, future developments in receivers will not help much, since the signal to noise ratio is directly proportional to antenna area and is largely independent of receiver noise. With an array of four small horns at the focus of a 60-foot reflector it is possible to obtain the location of an isolated radio burst to a fraction of a beam-width. In principle, we can locate an isolated solar burst at 3 centimeters, of average intensity, to a fraction of a minute of arc. It is therefore possible, in principle, to obtain at centimeter wavelengths both burst position location and dynamic burst spectra with one large antenna.

Later in the program, it is planned to make burst polarization studies at the centimeter wavelengths as well as at the meter wavelengths and eventually to operate a 21-centimeter hydrogen-line receiver. The centimeter wave studies of the galaxy will involve principally the measure of intensity, position, approximate size, and, consequently, spectra of thermal and non-thermal sources.

Thus in summing up, we can say that the initial and major effort of the University of Michigan's radio astronomy program is directed toward dynamic spectra studies of the active sun, both at meter and centimeter wavelengths, and the galactic studies at centimeter wavelengths.

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