FINAL REPORT

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The problem of detecting low frequency signals on satellites and in measuring the properties of the local plasma involved a new series of technological and theoretical problems.

One simple directive antenna structure is the travelling wave V-antenna. The travelling wave is created by a proper terminating impedance. The theoretical prediction of the driving point impedance and the radiation pattern of this structure has formed the main part of the first year of study. These parameters are important in interpreting terminal measurements for the detection of cosmic radio signals. The solution of the optimum configuration of the structure for the best overall directivity and bandwidth is also an integral part of the study. Along with the proceeding program a more general research program was initiated in the field of plasma coated antennas. This research was concerned with the effect of the so-called "plasma sheath" on the properties of the antenna. The simplified problem of a linear cylindrical antenna surrounded by an inhomogeneous isotopic plasma was studied. The formation of the actual plasma coating was investigated in detail to determine the actual density variation in the sheath. The scattering problem was considered for an incident plane wave.

The fundamental longwire travelling wave antenna of the special type employed in the V-antenna is only theoretically understood for operation only at specific frequencies over the useful frequency range. Only a homogeneous isotopic medium was considered. Two reports were published on the results of the theoretical research in the first year of the study: "Theory of Dielectric Coated Linear Antennas" (Sci. Report No. 1), and "Theory of the Resistively Loaded Travelling Wave V-antenna" (Sci. Report No. 2).

The theoretical determination of the effective area of the satellite borne V-antenna is dependent on the radiation and circuit properties. The circuit properties depend on the current along the antenna. Before the V-antenna circuit properties can be determined, the properties of the single leg must first be computed. The single leg computations were performed during this period. They show the variation of the antenna current with the load resistor and frequency. The optimum value of R can be determined from these calculations. A new theory has been developed during this period for the driving point impedance of the complete V-antenna based on the current on one leg. The solution is based on the antenna integral equation.

Measurements on the antenna terminals also include effects due to the coupling between the transmission line and the antenna. The theoretical junction corrections have been derived which indicate that corrections must be applied to high frequency models (600 Mc/s) but that the corrections are much less important in the 1 - 10 Mc/s range.

Expressions have been derived for the spatial temperature distribution of the radio astronomical source as measured at the antenna terminals. A complete report on the driving point admittance, optimum load resistances, base corrections, and temperature of a wide variety of V-antennas including the RAE-antenna are found in Scientific Report No. 3.

The theoretical investigation of the impedance properties of a plasma filled capacitor was undertaken by Mr. Hi-Dong Chai. The material appeared in a Ph.D. thesis at this University. The analysis is useful not only for laboratory experiments on antennas immersed in a magneto-ionic medium but also for direct rocket and satellite measurements of spacial properties.

A general theory for the simple functional representation of currents on electrically long linear antennas was initiated. The theory would be useful in the theoretical analysis of space antennas and arrays. A general representation of the antenna currents overcomes restrictions on the theory of the V-antenna which was analyzed only for specific operational frequencies. This work was terminated prematurely by the unexpected four month late cancellation of the grant.

Personnel

Dr. Sheldon S. Sandler	-	Prinicpal Investigator
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Reports

Sc. Rpt. No. 1, "Theory of Dielectric Coated Linear Antennas," May 1, 1964 (M. Islam).

Sc. Rpt. No. 2, "Theory of the Resistively Loaded Travelling Wave V-Antenna," July 14, 1964 (S. Sandler).

Sc. Rpt. No. 3, "Radiation and Circuit Properties of the Resistively Loaded Travelling Wave V-Antenna," July 15, 1966 (S. Sandler).

Thesis: "The Plasma Filled Capacitor," June 1968 (H. D. Chai).