ABSORPTION AND SCATTERING BY SMALL PARTICLES; STRUCTURE OF THE INTERNAL AND NEAR FIELDS

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This paper concerns work completed or in progress on computing the electric fields induced by radiation incident on small particles. Emphasis has been on the fields inside and near the particles when the incident radiation is in an absorption band of the bulk material. This work has been presented, published and submitted for publication as follows.

T.B.A. Senior and H. Weil, "Structure of Polarition Modes," Proceedings of the 1983 CSL Conference on Observation Research, submitted Sept. 1983.

H. Weil and T.B.A. Senior, "Structure of Surface Polarition Modes In and Near Small Particles," National Radio Science Meeting (USNC/URSI, IEEE) Boulder, CO; presented Jan. 1984.

H. Weil, T.B.A. Senior and T. M. Willis III, "Internal and Near Fields of Small Particles Irradiated in Spectral Absorption Bands," submitted to Journal of the Optical Society of America, Sept. 1984.

Related work based on the same integral equation and theoretical-numerical techniques is in progress to determine the effects on scattering and absorption of isolated surface irregularities, of surface roughness and of periodic surface microstructure. In all this work rotational symmetry of the particles has been assumed in order to keep the mathematics "relatively" simple.

A completely different integral equation based method has been applied to the study of scattering and absorption by thin flakes of arbitrary shape. The entire flake is small compared to the free space wavelength. Here the thickness effects are approximately taken into account by incorporating them into an impedance boundary condition on an equivalent zero thickness flake. This simplification is what permits the analysis to be applied readily to non rotationally symmetric shapes. The following two publications have so far resulted and work is still in progress.

T.B.A. Senior and M. Naor, "Low Frequency Scattering by a Resistive Plate," IEEE Trans. AP-32, pp 272-275, March 1984.

T.B.A. Senior and D. A. Ksienski, "Determination of a Vector Potential," Radio Science, 19 pp 603-607, March-April 1984.

The latter paper deals with the fact that the standard low frequency scattering theories fail in the case of open surfaces (ie, two dimensional objects representing a discontinuity in space) and are inconvenient for solid objects. The problem of the open surface was solved and an improved

method of solution for solid objects was also developed. The two methods were presented in the paper by Senior and Ksienski.

All the above work is for Rayleigh particles, all dimensions small compared to λ, the incident wavelength. To study the effects of having one dimension comparable to the wavelength we are investigating the scattering, absorption and internal fields for thin circular disks as the disk radius a varies from $a << \lambda$ to $a \sim \lambda$. To do this we have revised and extended a moment method due to C. M. Chu and H. Weil (Applies Optics 19, pp 2066-2071, June 15, 1980). The original Chu-Weil formulation was not accurate when $a << \lambda$ mainly because the basis functions were inappropriate in that case; it also did not completely compute the internal fields but only the coefficients for an expansion of the internal fields in terms of the basis functions. A modified and expanded set of basis functions has been introduced and the program rewritten to account for this change and to compute the internal fields. This work is largely completed but the final computing programs are undergoing more testing.