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SESSION E:*
THEORY II

E.1

TRANSPORT THEORY

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Abstract—The usual theories of electrical conductivity suffer from a number of weaknesses. A more general theory will be described which gives the entire density matrix of a system of charge carriers in the steady state. It will be shown that the usual theory is valid under certain limiting conditions, but that in general there are rather complicated corrections to it.

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† This paper was read by W. Kohn.

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E.2

THE SCATTERING MECHANISM OF CARRIERS ON PHONON AND LATTICE DEFECTS

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Abstract—We have studied the scattering mechanism of carriers by phonons, and by neutral and charged defects.

The free path, and the mobility of electrons scattered by lattice vibrations both depend upon the kinetic energy of the electrons and on the thermal motion of the crystal lattice. In order to separate the influence of the two variables, we investigated:

(1) The dependence of the mobility on the degree at degeneration (i.e, on the concentration of carriers) at constant temperature. In this way, we found that in bismuth and lead telluride, the free path of carriers is independent of their kinetic energy. As for the temperature dependence of the mobility of strongly degenerated carriers with a kinetic energy independent of temperature, we found that at low temperature the free path is inversely proportional to temperature, and at high temperature to the square of the temperature. The last result could be explained only by the inclusion of two-phonon processes at a high concentration of phonons.

(2) The scattering on neutral and ionized impurities. We have found in both cases that the mobility of electrons is strongly influenced by defects localized in the positive ion sublattice, while defects localized in the anion sublattice have little importance. An opposite regularity has been found for holes. In the case of neutral impurities in accordance with the theory of ERGINSOY, the scattering