NOTES ON THE QUANTUM THEORY AND RELATIVITY

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It has been shown by A. Sommerfeld that the fine structure of the lines of the Balmer series of the hydrogen and helium spectrum can be explained by a simultaneous application of the quantum theory and of relativity to the elliptic orbits of the electron revolving around the nucleus. The mass of the electron varies in its stationary elliptic motion according to the expression given by relativity, but during the jump of the electron from one stationary orbit to another one the mass is supposed to be constant in spite of the fact that this motion is accompanied by radiation, i. e., by emission of energy, and that the emission of energy is accompanied by a loss of mass of the radiating system, according to the equation

$$dm = \frac{dE}{c^2}$$

which holds in relativity as well as in classical electrodynamics if we assume an electromagnetic momentum in a beam of light. When the electron jumping from one orbit to another one loses energy $\triangle E = E_b - E_e = hv$, then it should also lose mass $\triangle m = \frac{hv}{C^2}$ in a discontinuous process. These masses $\triangle m$ would be the smallest particles at present suggested by our theories. It is surprising that they do not make themselves felt in the theory of the fine structure of the helium and hydrogen lines, nor in the doublets of the Roentgen spectra, where they are of considerable magnitude. There is probably a compensation in the mass.

A second remark is related to the previous one. The quantum theory and the theory of relativity seem to be at variance. The experimental basis of the quantum theory is much broader than that of the general theory of

relativity. It may be that between the quantum theory and the generalized phenomenological theory of the electromagnetic field there exists a relation similar to that between the kinetic theory of the gases and the phenomenological gas equation pv=RT. What becomes of the four dimensional continuum of space and time if it has to be atomized or quantified?