LETTERS TO THE EDITOR

Prompt publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the eighteenth of the preceding month, for the second issue, the third of the month. Because of the late closing dates for the section no proof can be shown to authors. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

Communications should not in general exceed 600 words in length.

Interpretive Remarks Bearing on the Metrical Field Associated with Heavy Particles

A detailed balance of energy and angular momentum in the process of beta-decay has for some years appeared to demand the existence of a neutrino body. The beta-ray theory involving the simplest assumptions as to the form of the neutrino interaction with the particles known to participate in the process has at least qualitative success in predicting the form of the beta-ray distribution. The saturation properties of the nuclear forces suggest likewise an exchange interaction between the heavy particles lending further support to the neutrino postulate. There is as yet, however, no evidence from direct observation substantiating the hypothesis; presumably because the neutrino does not make itself evident by a large interaction with the matter it traverses. To the neutrino, if it exists, have been ascribed the following characteristics:[1]

No charge,
Mass very small compared to electron mass, probably zero,
Spin $\frac{1}{2}\hbar$,
Fermi statistics,
Magnetic moment less than 1/7000 Bohr magneton, if any,
No detectable effects in free space.

We thus know a considerable amount about the neutrino, sufficient indeed to construct a usable model of this entity.

It is the purpose of this note to suggest the identification of the neutrino model with certain solutions of the field equations of the general relativity theory. As a particular component of the (nonstatic) metrical field of a disintegrating nucleus the neutrino finds a mode of description which is not in contradiction with any of the above requirements. Einstein and Rosen,[2] particularly, have described such solutions, but heretofore no physical identification has been provided for them. The form of the solutions imply the radiation of energy (and possibly also angular momentum) from a system whose internal configuration is changing rapidly.

The question of the *intensity* of these "gravitational waves" is, however, a critical one as energies of millions of electron volts are involved. One is forcibly inclined in meeting this apparent difficulty to suppose that the large nuclear forces extend into asymptotic interactions at great distances, which there become recognized as forces of gravitation! The change in the energy configuration within the nucleus on the conversion of a neutron into a proton would on this basis be accompanied by the appearance of a negatron and a large perturbation of the metrical field corresponding to the neutrino. The problem of the interaction thus seems to go back to a correct formalizing of the field equations for the interacting particles, where quantum and electromagnetic properties are not neglected as in the usual macroscopic theory. When and if such a unified field theory becomes available we may anticipate answers to such important questions as the origin of the "extra" magnetic moment of the proton and the spin dependence of the heavy particle interaction.

Finally the remark may be made that if it should be demonstrated that the neutrino is actually nonexistent this knowledge would render logically inapplicable to nuclear phenomena not only quantum mechanics in its present form, but also the general theory of relativity.

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[1] H. A. Bethe and R. F. Bacher, Rev. Mod. Phys. **8**, 189 (1936).
[2] A. Einstein and N. Rosen, J. Frank. Inst. **223**, 43–54 (1937) have described the solutions of the field equations corresponding to a "damped" physical system and have given them rigorous form for the case of cylindrical waves. It is to be noted that the equations provide solutions corresponding to both receding and approaching waves which may be interpreted respectively as neutrinos and antineutrinos.

The Isotopic Constitution of Tungsten

Over a year ago, the ions from a spark between tungsten electrodes were analyzed by the mass spectrograph, and it was found that on seven photographs with long exposures a faint isotope at mass 180 appeared in addition to the four strong ones at 182, 183, 184 and 186 observed by Dr. Aston. The tungsten used, however, had several of the light elements as impurities and also showed faint lines at 185 and 187 which were probably due to a trace of rhenium. On this account it was thought desirable to examine other samples of tungsten to confirm the existence of the isotope at 180. This has now been done, at the urging of Dr. L. Alvarez, who inquired as to the possibility of an isotope at 180. With pure tungsten electrodes, six photographs have been made showing the isotope at 180, and by varying the time of exposure, its intensity was estimated as approximately one one-hundredth of that of the isotope at 183. In the earlier photographs, the faint isotope was also found on two photographs of doubly charged ions, on two of triply charged ions, and on one of quadruply charged ions. Thus there can be no doubt that tungsten has a fifth faint stable isotope at mass 180.

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