NEUTRINO AND THE CHANGING OF CONCEPTS

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In 1955 the author drew up a theory on beta emission based on the concept that the neutrino rest mass was equal to that of the electron. This was based on the physical laws of invariance, neutrino being the isotopic spin invariant of the electron. Also on the constancy of e/m, measured by Thomson and also of e, measured by Millikan which proves that mass does not exist below the level of the electron, as no sub-electrons have any possibility of existence. This paper was finally published in the Pakistan Journal of Science, Vol. 8, No. 3, May 1956.

The author referred the theory to the late Professor E. O. Lawrence, who was kind enough to refer it to experts. Some interesting correspondence was exchanged and it was finally conceded that the neutrino mass could be 1/50 × mass of electron as against Pauli's concept of its being 1/2000th of the mass of the electron. For obvious reasons, the author could not change his view.

The mass of the neutrino was evaluated by J. J. Sakurai (Physical Review letters, June, 1, 1958 and its elaboration later) based on H^3 - Hc^3 mass difference, utilising parity non-conservation and measureng accurately the shape of the beta spectrum near the end point. He came to the conclusion that the mass of the neutrino could not exceed 1 kilo electron volts, that is 1/500 × mass of the electron, provided the law of conservation of mass and energy held good.

On the other hand, the work of Lee and Yang on the non-conservation of parity in weak interactions by itself, should create an imbalance on the two sides of the mass-energy equation, if the neutrino is non-vanishing, which it is. That meant a breakdown in the law of conservation of mass and energy and, if it was so, as it is, why could not neutrino equal the mass of the electron, in keeping with the laws of invariance and indirect evidence from Thomson's and Millikan's experiments.

Further, as mentioned in the letter to the late Professor Lawrence, the mass difference of the neutron and proton was so much and the computation of mass-engergy in the equation and the way neutron breaks up left one in little doubt that the neutrino, the smallest neutral particle of matter, could belong to the electron - positron family.

In another publication (Pakistan Journal of Science, Vol. 10, No. 1, January 1958), the author examined the problem from another angle. The uncertainty principle was applied for two simultaneous events (electron - neutrino exchange to establish n - p forces) and an approximate relationship was developed :

$$R_{e,\nu} \simeq \frac{h^2}{m^2c^2}$$

where c was relatable to m. The above relationship could not be discarded on the theory of dimensions because: (a) there could be slight, though very slight difference in the speed of e and ν, (b) the relationship was for two particles and not one, possibly moving skew - symmetrically to the line of reference even though it defined the inter-nucleonic distance all right.

Based on the consideration that e and ν mass were equivalent, the value of c came to be 10^8cm./sec., e_m being 9×10^{-28} g./sec. In other words, by the process of *reductio-ad-absurdum*, there was a breakdown of the law of conservation of mass and energy in nuclear fields, which is 10^{36} times the corresponding gravitational field. At very high temperatures, the thermodynamical kinetic motion of the nucleons, weakened this field and brought it well within the realm, where the law is an accepted basis of nuclear physics. Similarly, in strong interactions.

The author can make a reference to Einstein's *Treatise on Relativity* (Princeton University Press) and mention that the law of conservation of mass and energy was derived from the consideration that if the field equations were satisfied and the variation was a transformation variation, all the terms vanish, so that the field equations imply the equation $(g^{ik}\, \delta U^s{}_{ik})_\mu = 0$

With the simplest special choice of ξ^i independent of the X, leads to the four equations:

$$I^s{}_{ik} \equiv (g^{ik}\; U^s{}_{ik\lambda})_\mu = 0$$

These can be interpreted as the equations of conservations of momentum and energy.

On the other hand, applying the method of enumeration to determining the strength of the system of equations and taking into account the fact that all the U* obtained from a given U by λ - transformation represent the same U - field, we get $Z_d = 42$ as against $Z_d = 12$ for pure gravitational field. Thus the field equations of the non-symmetric field are considerably weaker than those of the pure gravitational field.

In the general theory of relativity, therefore, the system of equations defining the law of conservation of mass and energy is very unlikely to hold good in the nuclear fields, which are 10^{36} times stronger than the corresponding gravitational field. A new system of equations has, therefore, to be developed, based on the characteristics of the nuclear forces and Einstein's own suggestion to: (a) increase the dimension of the continuum, (b) introduction of fields of different kind, and (c) introduction of field equations of higher order. Then alone the field equations should define mass - energy relationship in nuclear fields.

For this reason the unitary equation is highly unlikely to be formulated—we have two sets of physical phenomena to be defined and, to the author's view, another set of equations has, to be developed from the general theory of relativity to define the inside-the-nucleus phenomena (and even non-conservation of parity in weak interactions).

This is of considerable importance, on the practical side, in nuclear reactors. By feeding the current produced by the reactor to produce strong electrostatic fields around the fuel rods to reduce the nuclear field, even intermittently, it could be possible to excercise fuel economy and also to produce power reactors from less enriched fuel.

The economic and scientific implication of this concept is expected to have a revolutionising influence on reactor technology.

The extent of deviation in the special theory of relativity will be defined (not determined because of the very small energy of the neutrino to account for spin and statistics in beta emission) by the difference in the beta spectrum curve and the ideal straight line.