C.E.R.N.

THE LARGE HADRON COLLIDER

AND

SUPER-LUMINAL NEUTRINOS

David J.M. Short

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The recently published results of experiments carried out at CERN where neutrinos have been emitted from the LHC and have now been relieved at a detector some 770 kms. distant from the emitting source have produced results which appear to show that the velocity of the neutrinos exceeds “c” albeit only some 6 n.s.

Of course these results were always likely to be highly controversial and to raise the usual, somewhat gleeful, press speculation that “Einstein is proved wrong” etc. and in view of this anticipated speculation the authors of the experiment took the unusual step of publishing their results and at the same time inviting critical comment on the results and on the methodology of the experiment.

Needless to say this invitation has resulted in a large response from the scientific community which has taken the challenge seriously not least because of the large number of readings taken by the detector and the fact that the experiment has been repeated and has been found to produce an identical result to the first experiment.

Clearly, if the results of the experiment were found to be incontrovertibly correct the the whole foundations of Special and General relativity would be found to be insecure and the same applies to those relativistic effects pertaining to quantum mechanics and it is therefore of the greatest importance that every aspect relating to the interpretation of the results of the experiment be examined and the purpose of this paper is to try to interpret the results within the bounds of existing relativity theory in the following manner:-

Firstly we need to establish the velocity of a neutrino of mass “m” and energy “E”.

From the expression :-

$$E = mc^2 / \left(1 - \frac{(mc^2)^2}{E^2}\right)^{\frac{1}{2}}$$

we can solve for velocity and get:-

$$v = c\left(1 - \frac{(mc^2)}{E^2}\right)^{\frac{1}{2}} \qquad \text{Equ. 1.}$$

Here we note that as the energy increases, the velocity approaches the value “c”.

When $E \rangle\rangle mc^2$ Equ.1. may be re-written using the binomial expansion as:-

$$v = c\left(1 - \left(\frac{(mc^2)}{2E^2}\right) + ...\right)$$

Now, calculating the time needed for a particle to travel a distance “d” we can write:-

$$t = \frac{d}{c}\left(1 - \frac{\left(mc^2\right)^2}{2E^2} + ...\right)^{-1} \approx \frac{d}{c}\left(1 + \frac{\left(mc^2\right)}{2E^2}\right) \qquad \text{Equ. 2.}$$

Equ. 2. is a standard expression from relativity theory and of course the result is limited by the limiting velocity "c" of the moving particle. But our purpose here is to examine the effects on the relativistic reference frame and the do this we can re-write the second part of Equ. 2. and substitute "c" with "v", "v" being some superluminal velocity) as follows :-

$$v = \frac{d}{t}\left(1 + \frac{\left(mc^2\right)^2}{2E^2}\right) \qquad \text{Equ. 3.}$$

And solving for "t" we obtain:-

$$t = \frac{d}{v}\left(1 + \frac{\left(mc^2\right)^2}{2E^2}\right) \qquad \text{Equ. 4.}$$

From which we infer that with increasing velocity, time slows down in complete accordance with special relativity.

Similarly, and again re-arranging Equ. 3. we obtain:-

$$d + tv\left(1 + \frac{\left(mc^2\right)^2}{2E^2}\right) \qquad \text{Equ. 5.}$$

And solving for "d" and inserting the solution from Equ. 3. we can again infer that as "t" deceases with increased velocity so does "d" decrease proportionally to "t".

With regard to the L.H.C results as referred to above in Equs. 3, 5, and 5 it should be noted that these all derive from Equ. 1. which is written from the point of view of a stationary observer at the point of emission of the beam of neutrinos and therefore we can infer that the distance between the origin of the neutrino beam and the detector is shortened as far as the observer is concerned and similarly that the time interval between the two events is similarly shortened and we submit that this phenomenon accounts for the disparity of the super-luminal readings obtained form the L.H.C.

In the foregoing we have assumed that the mass of the neutrino is $1.78x10^{-37}$.

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