NEWTON'S INVARIANT MASS HAS REMAINED INVARIANT

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3rd June 2016

ABSTRACT. Contemporary mainstream physics has accepted special relativity to be a fully tested and verified theory. The internet has been full of references for experiments that purportedly verified special relativity. This article argues that many of these experiments purportedly verifying special relativity are irrelevant as evidence; a commonly quoted example being the Kaufmann, Bucherer and Neumann experiments. On the contrary, there is only one lone uncorroborated experiment that shows some evidence of the validity of special relativity - the 1964 experiment of William Bertozzi of the MIT; for the matter, the experiment provides only a weak evidence with 10% accuracy. If a lone experiment were sufficient as evidence in science, then the *1989 Pons & Fleischmann experiment* could have won the experimenters a Nobel Prize in physics - they did not. The author proposes a simple experiment that could decide incontrovertibly between the two competing mechanics, the old Newtonian mechanics or the "*newer*" special relativity - by just directly measuring the velocity of electrons ejected in natural beta decay. To date, despite the simplicity of the experiment, no one has performed the experiment.

1. INTRODUCTION

It is almost universally accepted today that mass is *relativistic*; it varies with velocity as opposed to the original concept in Newton's *Principia* where mass is simply an invariant "*quantity of matter*". Together with the current universal acceptance of relativistic mechanics, it is also universally accepted that Newtonian mechanics is not the correct mechanics to fully describe physical nature; the fact that it was not being detected as incorrect is due to coincidental serendipity - the correct relativistic mechanics approaches the Newtonian limit as speed approaches zero. So the *incorrectness* of Newton mechanics could not be detected in the past as the technology was not there then to distinguish any relativistic deviations due to the speed of macroscopic bodies being very small compared to the speed of light.

Contrary to such perceptions, Newtonian mechanics is not in the least *"incorrect"* - Newtonian mechanics is as valid today as it was when Newton first wrote the *Principia.* Despite the fact that relativistic mechanics is today universally accepted and practiced, Newtonian mechanics is still a full and correct mechanics. Contrary to the present widespread belief, Newtonian mechanics has not been incontrovertibly refuted empirically:

Key words and phrases. Einstein, relativity, special relativity, relativistic, mass, invariant, experiment, Kaufmann, Bucherer, Neumann, W. Bertozzi, light speed, FTL, faster than light speed.

To date, Newtonian mechanics has not been incontrovertibly refuted by experiment.

We will discuss this in more details below.

2. The Current Status of Special Relativity Versus Newtonian Mechanics

A very good idea of how the present mainstream physics world views the status of special relativity versus Newtonian mechanics may be found from the following snippets:

- From Marion & Thorton, *Classical Dynamics*[7], Sec 14.1:"In section 2.8 it was pointed out that the Newtonian idea of the complete separability of space and time and ***the concept of the absoluteness of time break down*** when they are subject to critical analysis. The ***final overthrow of the Newtonian system*** as the ultimate description of dynamics was the result of several crucial experiments, culminating with the work of Michelson and Morley in 1881 - 1887...This (a fundamental reorganization of the structure of dynamics) was provide during the period 1904 - 1905 by H. Poincare, H. A. Lorentz and A. Einstein, who formulated the theory of relativity in order ***to provide a consistent description of the experimental facts***".
- Professor Gerard 't Hooft, Nobel Laureate and current Editor of Foundations of Physics. Foundations of Physics has an open policy of not accepting any paper that questions the validity of the relativity theory. It would reply to the effect that special relativity is one of the best tested and verified physics theory.
- Gordon Kane, in the introduction to his book *Modern Elementary Particle Physics*[8], wrote: "The theory fully incorporates special relativity"; the *theory* here means the Standard Model of particle physics.

The book by Marion & Thornton is a well recognized text that has served many generations of undergraduate students. Gerard 't Hooft and Gordon Kane are physicists with high standings. From the views as presented in the above snippets, it is conceivable that many unwary students of physics would form the view that special relativity has incontrovertibly been tested and verified, conclusively replacing Newtonian mechanics - that Newtonian mechanics has finally been "*overthrown*" as the correct physics describing the "*experimental facts*" of the natural physical world. This article presents a clear argument that shows such a view is untenable - Newtonian mechanics is far from having been overthrown.

3. Electromagnetic Mass

The acceptance of special relativity came about with the discovery of the electron by J.J. Thomson in 1897 and the later attempts to build model of the electron to explain inertia mass; that it has an electromagnetic origin. There was also a prevalent view that, ultimately, inertia mass would be shown to be electromagnetic in nature and mechanics would be subsumed within electromagnetism. Such models beginning with J.J. Thomson

predicted that electromagnetic mass is not an invariable, but varies with velocity - thus the beginning of relativistic mass. The purported experimental confirmations of such mass varying with speed began with the experiments of Kaufmann[1], Bucherer[2] and Neumann[3] in the beginning of the 20th century. They measured the so called charge-mass e/m ratio and found that it varies with speed. As all evidence seems to indicate charge cannot be variable, it was taken to mean that it was mass that varies with speed. From then on, the notion a a relativistic mass contradicting the invariant mass of Newton began and it gradually gained universal acceptance as being the correct concept of mass.

4. Experimental Verification Of Special Relativity

Although the Wikipedia cannot be taken as an authoritative source for citations by the academia, it nevertheless could be the first source of reference in this internet age. It has pages on the experimental verification of special relativity and such entries do have a significant impact in forming the public's view on the relativity theory. These pages have a long lists of experiments purportedly verifying special relativity. The Kaufmann, Bucherer and Neumann experiments (the KBN experiments) in the beginning of the 20th century are some of those which have always been represented as conclusive experimental verification of relativistic mass; therefore, indirectly, also verifying special relativity . In no way could such a conclusion be justified.

Electromagnetic mass came about from the proposed electromagnetic models of the electron. There were competing models, mainly the models of Abraham and Lorentz-Einstein. But mass, whether that of Newton or from the new models, is only a concept with a definition. As there was no way then to directly measure the speed of electrons, the variation of the so called mass with velocity was done indirectly from electric and magnetic deflections of the electrons and based only on theoretical assumptions. Notwithstanding, there are other serious logical contradictions in the supposed experimental verification that mass varies with speed.

A scientific theory primarily has its structure as concepts, hypotheses and definitions. With the components of the structure of a theory, the method of logical deductions are applied giving the predictions and consequences of the theory. Experiments are designed to test such predictions and consequences of the theory. A theory is accepted as correct and validated when the result of the experiments are in agreement with the predictions of the theory.

Firstly, experiments only put to test the predictions of a theory; definitions of concepts are not testable.

> ***Experiments in science is only for verification of a theory's prediction, not its definitions.***

The transverse and longitudinal electromagnetic mass of those earlier models were only definitions arrived at through the models. As such, the concept that such mass may be experimentally proven to vary with speed is logically flawed - they were only indirectly demonstrated through some manner of experimentation.

Secondly, those early models were attempts to to explain the inertia mass of the electron to have an electromagnetic origin due to the "*self-energy*" of the electrons as it moves through the aether, but they have no relationship whatsoever with special relativity as we understand today - special relativity is not formulated based on the electron. Those experiments were irrelevant to special relativity, much less as experimental verification of special relativity. Neither do such models have any relevance to the Newtonian concept of an invariant mass.

> ***The experiments of Kaufmann, Bucherer and Neumann have absolutely no bearing on special relativity nor with Newton's concept of an invariant mass.***

Classical Newtonian mechanics has been the only mechanics from Newton's times for almost three centuries. It was only in 1905 that Einstein introduced special relativity as a *"better mechanics"* to replace Newtonian mechanics. So the physics world was presented with two competing versions of natural mechanics to choose from; the natural world may only accommodate one natural mechanics - one would be accepted while the other dismissed.

Let's examine the old Newtonian mechanics and the new relativistic mechanics.

(1) Newtonian mechanics.
It is completely expressed in Newton's three laws of motion together with axioms about absolute Euclidean space and absolute universal time. It has the concept of mass being invariant. The definition of momentum is $p = mv$; m being the invariant mass. The definition of force is $f = mass \times acceleration$. Through the work-energy theorem, kinetic energy is given by :

$$K = \frac{1}{2}mv^2 \tag{1}$$

(2) Relativistic mechanics.
It is derived from the two postulates of Einstein's special relativity. It is based on Minkowski's spacetime and not the space and time of Newtonian mechanics. It adopts a new definition of momentum: $p = \gamma mv$; where $\gamma = 1/\sqrt{1 - v^2/c^2}$. The new definition of momentum may alternatively be interpreted as giving a new concept of mass with a new definition of relativistic mass as : $m = m_0/\sqrt{1 - v^2/c^2}$; m_0 being the invariant rest mass. A new definition of force is also defined: $f = \frac{d}{dt}(\gamma mv)$. Through the work-energy theorem, kinetic energy is given by:

$$K = (\gamma - 1)m_0c^2 \tag{2}$$

m_0 being the rest mass, the same as the mass of Newtonian mechanics;c is the constant speed of light in vacuum. [1]

[1] the author has a paper [6] that shows this formula for relativistic kinetic energy evaluates only to a pure number giving a fictitious value, not one with real physical units, e.g the SI unit of Joule.

So now the physics world has to make a choice between the old mechanics and a new mechanics. As we have shown above, many of the earlier so called experiments verifying special relativity cited in the Wikipedia are irrelevant. So what experiment is there to be conducted that would decide which of the two mechanics is correct?

4.1. **The 1964 William Bertozzi Experiment** [5]**.** With two competing mechanics, we are presented with two formulas for kinetic energy, formula (I) and (II) above; but only one may be accepted. W. Bertozzi of the MIT conducted an experiment that was supposed to conclusively decide which of the two mechanics was correct. He accelerated electrons to relativistic speed and made some direct measurements of the speed of electrons using the time-of-flight method for some of his data points. So some of the relevant data points indeed were true direct measurements of the electron velocity. For those data points, he did a calorimetric measurements of the electron's kinetic energy by stopping them in an aluminium barrier so that the kinetic energy is converted to heat energy; the heat was found by measuring the rise in temperature in the aluminium. This manner of calorimetric measurement of the electron's kinetic energy is one of only two acceptable methods that could be considered a direct measurement of energy (the other is through conversion of kinetic energy to radiant energy and to calculate the radiant energy; this method is not feasible here). So kinetic energy too is directly measured for some of the relevant data points. His conclusion was that the data clearly correlated well with relativistic kinetic energy, within an error of 10%. The data clearly do not correlate with the kinetic energy formula of Newtonian mechanics. So it seems a clear incontrovertible decision may now be made - Newtonian mechanics has been dismissed and relativistic mechanics is the only likely correct natural mechanics. Is it so?

There is this cold fusion saga:

> *Wikipedia - "In 1989 Martin Fleischmann (then one of the world's leading electrochemists) and Stanley Pons reported that their apparatus had produced anomalous heat (excess heat) of a magnitude they asserted would defy explanation except in terms of nuclear processes. They further reported measuring small amounts of nuclear reaction byproducts, including neutrons and tritium. The small tabletop experiment involved electrolysis of heavy water on the surface of a palladium (Pd) electrode".*

The experiment could have ushered in a new age of cold fusion with the potential as a limitless source of energy. Because of the remarkable nature of the experiment, the two experimenters could also be said to be deserving of a Nobel Prize in physics. Did they win any award? No. There was no headlines around the world announcing the arrival of a new cold fusion era. The world of physics did not rely on a lone experiment to decide if really a new cold fusion era had arrived. Many of the laboratories around the world quickly attempted to replicate the *Pons Fleischmann experiment* in order to corroborate the initial results. Most of these attempts failed to get the same initial result as *Pons & Fleischmann*. The general conclusion finally was that

the initial experiment was invalid. No announcement of a new cold fusion era was made. The saga shows:

> ***A lone experiment cannot be taken as incontrovertible evidence validating a scientific theory.***

But then what about the lone W. Bertozzi experiment of 1964? It alone decided in favor of relativistic mechanics and dismissed as incorrect Newtonian mechanics which has never been found to fail in a single instance in the past 300 years. To date, after a full five decades, no one has attempted to replicate the Bertozzi experiment nor has any alternative experiment been designed and performed to settle conclusively if Newtonian mechanics has finally failed.

> ***Newtonian mechanics has been dismissed based only on a lone uncorroborated 1964 experiment by William Bertozzi.***

With Newtonian mechanics being finally pronounced "*overthrown*", it is a virtual endorsement of special relativity being the only correct natural mechanics of physical nature. It is now common and widespread to find mentions in physics lectures that Newtonian mechanics is only "approximately correct", being what special relativity approximates to at small everyday speed.

One has to ask how such a great faith has been placed on a lone uncorroborated experiment that billions of dollars have been spent building the particle accelerators of CERN which gave rise to our new particle physics era and the Standard Model founded on relativistic mechanics[6].

5. A Simple Beta Particle Experiment That Could Be Done

We have heard enough of the claims that relativistic mechanics has been fully integrated into the Standard Model of particle physics and that the experiments being carried out by the CERN physicists are proofs in themselves that relativistic mechanics works, and works splendidly so - and have worked for many decades - and so they say. It has been pointed out that no particle has ever been detected to go faster than light in the many experiments that CERN have conducted and this fact has been offered as an incontrovertible evidence supporting of special relativity; it is a prediction of special relativity that no mass particles may go faster than the speed of light. But then, ***what is true inside the core of a particle accelerator may not be true outside of the particle accelerator***. However, there is a simple experiment that could easily be done that could incontrovertibly prove which of the two mechanics is correct. This experiment is very simple by today's technological standard and it is also an easily replicable experiment. The experiment is this:

Many radioactive elements undergo natural beta decay ejecting electrons with a range of energies ranging from zero to a definite maximum or endpoint energy. Many radioactive elements have endpoint energies greater than 0.26 MeV. For such relativistic electrons, the prediction of Newtonian mechanics is that they would go faster than the light speed. On the contrary, the prediction of special relativity is that no electron could go faster than the light speed. So the experiment is simply to allow such electrons

to travel freely for a certain distance within a vacuum and to measure the time of flight of the electrons. When sufficient number of measurements are made, the experiment should find electrons that either go faster than light speed - if Newtonian mechanics is valid. On the contrary, if relativistic mechanics is valid, electrons would be detected to go at almost the limit of light speed c, but never breaching it. It this manner, the experiment would clearly show which of the two competing mechanics is the correct natural mechanics and which is invalidated - incontrovertibly.

To date, despite its simplicity, no one has conducted the experiment.

6. Conclusion

Contrary to what has been widely proclaimed, special relativity has not been conclusively verified. Neither has Newtonian mechanics been repudiated by experiments. The only experiment that has been proffered as an experimental verification of special relativity is the lone uncorroborated 1964 experiment of William Bertozzi. A lone experiment that has not been corroborated by other independent physicists cannot be taken as incontrovertible evidence in support of any theory. The conclusion is that it is still an open question which of the two competing mechanics is the correct mechanics of the natural physical world, a choice between the old classical Newtonian mechanics or the relativistic mechanics of special relativity.

Newtonian mechanics is found on the concept of an invariant mass which is a measure of *quantity of matter*. Such a concept of mass as an invariant *quantity of matter* has been out of favor for a long time; it survives if Newtonian mechanics remains vindicated. It has to be discarded if Newtonian mechanics fails.

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