.

CHEMICAL ANALYSIS OF PLAIN DISTILLED WATER MAY REFUTE MASS-ENERGY EQUIVALENCE OF E=MC^2

CHAN RASJID KAH CHEW

17 December 2019

ABSTRACT. Despite E= mc^2 being a foundational equation of modern physics, it has not been experimentally verified. Though four eminent physicists claimed *'A direct test of E=mc2'* (Nature 2006) giving verification accurate to 1:10^6, the experiment was not any verification of E=mc^2, but rather an alternative experiment to deduce the mass of the neutron. Instead of the usual deuteron interaction, they used the nuclear interaction involving sulfur ^{32}S and silicon ^{28}Si. The claim of accuracy of 1:10^6 is about the comparison of the new value with the accepted value of the mass of the neutron. This paper shows that a chemical analysis (with a good analytical balance) of the mass composition of oxygen and hydrogen in plain distilled water may show that the law of conservation of mass is universally valid without the need for the hypothesis of mass-energy equivalence; this would also imply an unequivocal refutation of the equation E=mc^2. Such an experiment could easily be carried out by any laboratory in today's universities. The experiment should be simple and straightforward, yet its outcome may have enormous consequences for the world of physics.

1. INTRODUCTION

It may be said that the equation E=mc^2 is the most important equation in all of physics. This equation is the basis of the principle of mass-energy equivalence. It also leads to the energy momentum equation of relativistic mechanics $E^2=(pc)^2+(m_0c^2)^2$ which underlies the foundation of modern high energy physics including the particle physics of the Standard Model and all of nuclear physics. If these equations fail, then the hypothesis of mass-energy equivalence too would be invalidated and the whole of modern physics would collapse. Such a scenario is beyond imagination.

The equation E=mc^2 is well known. It seems to have been fully accepted with no one interested ever to raise any doubts about its validity. What is not well known is that the equation has not been experimentally verified. The author has a paper [1] which elaborates on this issue. This is despite a group of four eminent physicists

Key words and phrases. mass spectrometry, Penning trap, Einstein, special relativity, atomic mass, Prout's hypothesis, law of mass conservation, mass-energy equivalence, E=mc2.

who claimed to have done a *'A direct test of E=mc2'* (Nature magazine 2006) [2] which gives it an accuracy close to 1:10^6. I think the experiment would by now be an embarrassment to the physicists involved as - for whatever reasons - they misinterpreted the very experiment which they set up. The experiment was never anything close to any test of $E=mc^2$. It was just another experiment to deduce the mass of the neutron relying on the very principle of mass-energy equivalence. There is an accepted deduced mass of the neutron based on the binding energy involving the deuteron. What the new experiment did was to use an alternative nuclear interaction instead of the usual deuteron interaction. They use neutron capture by sulfur ^{32}S and silicon ^{28}Si and then deduced the neutron mass through computations involving the binding energies. The accuracy obtained of *'one-part-per-million'* is the accuracy of their new deduced neutron mass as compared to that of the accepted value - nothing at all about verifying $E=mc^2$ accurate to one part per million. The current situation is that Einstein's special relativity and $E=mc^2$ have been fully incorporated into modern physics despite the equation being not experimentally verified. This issue should be of the utmost of concern to the physics community.

2. A Revival Of Law Of Mass Conservation Would Refute $E=mc^2$

In the 19th century, the early chemists who studied the chemical composition of compounds found some patterns regarding the atomic mass of the elements. Atoms have masses that are close to whole numbers as compared to the atomic mass of hydrogen. The English chemist William Prout in 1815 and 1816 published papers that proposed the *'Prout's hypothesis'*, that elements are composed of whole numbers of atomic hydrogen as the basic constituent. This imply that the atomic mass of elements would be whole numbers as measured in our current unified atomic mass units. This would be consistent with the law of mass conservation, that mass cannot be created nor destroyed. All these changed after Einstein introduced special relativity in 1906 which lead to the equation $E=mc^2$ and the principle of mass-energy equivalence. The notion of mass-energy equivalence eventually gained full acceptance. This happened after the invention of mass spectrometry which became the principle technique to measure atomic mass replacing the traditional chemical method using the scale balance. Today - for whatever reasons - the chemical method to measure atomic mass has been totally abandoned.

The author in his paper [3] has shown that mass spectrometry cannot measure atomic mass accurately. The US NIST (National Institute Of Standards And Technology) database of atomic masses are all measured experimentally with the Penning trap, an instrument based on mass spectrometry. The Penning trap is touted as a most advanced instrument capable of the highest precision ever for measurement of atomic mass; it claimed a precision as high as $1{:}10^{10}$; but precision is not the same as accuracy.

The Penning trap is designed based on the Lorentz magnetic force law and it assumes that the law is an exact mathematical relation which it is not. The Lorentz magnetic force law is only an approximate law. What mass measurements which the Penning trap gives are not true atomic mass, but approximate predictions of atomic mass based on the Lorentz magnetic force. The measurements made would differ by a slight amount from the mass number of an atom - a whole number. This slight difference in mass came to accepted to be correct and was referred to as *'mass defects'* of atoms. It is these mass defects which is the cause of violation of mass conservation in nuclear interactions - mass could be *'lost'* in nuclear interactions. The huge amount of energy released in nuclear fission was then ascribed to the conversion of the *'mass loss'* to energy using the equation $E=mc^2$. With mass-energy equivalence being fully accepted, the law of conservation of mass was deemed to have been refuted. In its place, the conservation law has been extended to a law of mass-energy conservation. The author has a paper [4] which argues that mass conservation without mass-energy equivalence is the correct universal conservation law.

It is difficult to directly verify the validity of $E=mc^2$, but we know that mass-energy equivalence as implied by the equation means a refutation of the law of mass conservation. Mass conservation and mass-energy equivalence are mutually contradictory - only one of them could be valid, not both. This fact could be used in experiments designed to investigate the validity of $E=mc^2$.

2.1. **Mass Ratio Of Oxygen/Hydrogen In Water.** Water has the formula H_2O. If water is formed from the isotopes ^{16}O and ^{1}H, the mass ratio of O/H in this water could be found by chemical analysis of its mass composition. The atomic masses of ^{16}O and ^{1}H as found in the 2012 NIST tables are: 15.99491461957(19) and 1.00782503223(9) (the figures in the brackets represent the error in the last digits). If the atomic masses as given in the NIST tables are correct (measured using the Penning trap), then a chemical analysis of the mass ratio of O/H should give a value consistent with: 15.99491461957/1.00782503223 or 15.87072567961(30). The analytical balances of today are capable of measuring mass with an accuracy of $1{:}10^5$ for some mass range. If the NIST masses are correct, then the experiment should give a figure of about: 15.87072(15) for accuracy of $1{:}10^5$. If the law of mass conservation is the correct universal conservation law, then the atomic mass of any nuclide is simply its mass number in unified atomic unit - a whole number (there is not even a need to do any measurement for atomic mass). In this case, the analysis of the mass composition of the water as above should give a figure of about: 16.00000(16).

So the experimental result of the experiment as above would give either one of the two values: 15.87072(15) or 16.00000(16). Without fail, a good analytical balance could easily distinguish between the two values which have a relatively huge difference of 0.12928. If the experimental result gives the ratio of O/H to be 16.00000(16), it would be an unequivocal verification that the law of mass conservation is correct. As mass conservation and mass-energy equivalence are mutually contradictory, it would mean an unequivocal refutation of mass-energy equivalence and the equation $E=mc^2$. On the other hand, if the resulting figure were to be 15.87072(15), it would be a clear refutation of the law of mass conservation. In this case, the experiment would be a validation of the NIST values of atomic masses for precision of $1:10^5$. This experimental result would still not be an experimental verification of the equation $E=mc^2$. The equation would still remain unverified.

Although the above experiment is for chemical analysis of water formed from pure isotopes of ^{16}O and ^{1}H, using plain distilled water would not make any difference to the experiment. Oxygen in nature has three stable isotopes: ^{16}O 99.76%, ^{17}O 0.04% and ^{18}O 0.2%. For hydrogen, it has two stable isotopes: ^{1}H 99.98% and deuterium ^{2}H 0.02%. We may assume that ordinary water has the pure isotope ^{16}O and hydrogen having the natural composition of ^{1}H 99.98% and deuterium 0.02%. The O/H ratio for this would be 16/(1*0.9998+2*0.0002) or 15.99680. The difference between 16.00000 and 15.99680 is insignificant for the purpose of our experiment.

3. Conclusion

Physics experiments of today often require funding going into the millions of dollars and even billions for some major experiments. The chemical analysis of distilled water to determine the oxygen and hydrogen composition by mass using an analytical balance should be a fairly straightforward experiment. Most laboratories in today's universities would not have difficulty to perform such a simple experiment - a simplest of experiment by today's standards, yet one which may have an outcome with enormous consequences in the world of physics.

REFERENCES

[1] Chan Rasjid Kah Chew. Mass Energy Equivalence Not Experimentally Verified. http://vixra.org/abs/1810.0003.
[2] Simon Rainville, Maynard Dewey, H.G. Borner, M. Jentschel. World Year of Physics: A direct test of E=mc2. Nature 2006. DOI: 10.1038/4381096a
[3] Chan Rasjid Kah Chew. Is Mass Spectrometry Accurate? http://vixra.org/abs/1809.0491.
[4] Chan Rasjid Kah Chew. Coulomb Electric Gravity And A Simple Unified Theory (SUT). http://vixra.org/abs/1808.0211.

Email address: `chanrasjid@gmail.com`
URL: `http://www.emc2fails.com`

SINGAPORE