.

PROPOSED DESIGN OF WATER ELECTROLYSIS EXPERIMENT THAT MAY REFUTE MASS-ENERGY EQUIVALENCE OF E=MC^2

CHAN RASJID KAH CHEW

14 Nov 2021

Abstract. This paper is a continuation of a previous paper of the author[1] which explains how a chemical analysis of the ratio by weight of ^{16}O and ^{1}H in plain water (the presence of different isotopes of O and H would not affect the experiment) could decide if the hypothesis of mass-energy equivalence based on E=mc^2 is verified or refuted; a refutation would mean a full revival of the classical law of conservation of mass without any need of mass-energy equivalence consideration. The proposed experiment is by electrolysis of water as an aqueous solution of potassium sulfate. Oxygen produced at the anode is trapped while the hydrogen produced at the cathode are allowed to escape freely. With three weighing with an analytical balance in vacuum, the ratio of O/H could be determined with a high degree of accuracy. The mass-energy equivalence principle accepted in present day physics may be said to be the foundational assumption in present day physics. If it fails, then current high energy physics would collapse. This includes the Standard Model of particle physics widely promulgated by CERN and much of all modern physics. The irony is that mass-energy equivalence and the equation E=mc^2 have never been experimentally verified. This has been explained in detail in the author's other paper [2].

1. Introduction

This paper is a continuation of a previous paper of the author[1] which explains how a chemical analysis of the ratio by weight of ^{16}O and ^{1}H in plain water (the presence of different isotopes of O and H would not affect the experiment) could decide if the mass-energy equivalence of E=mc^2 is verified or refuted; a refutation would mean a full revival of the classical law of conservation of mass without any need of mass-energy equivalence consideration. The hypothesis of mass-energy equivalence is a central theme in present day modern physics. If it fails, then almost all of current high energy physics would collapse. This includes the Standard Model of particle physics widely promulgated by CERN and much of all modern physics. The irony is that mass-energy equivalence and the equation E=mc^2 have never been experimentally verified. This has been explained in detail in the author's other paper [2].

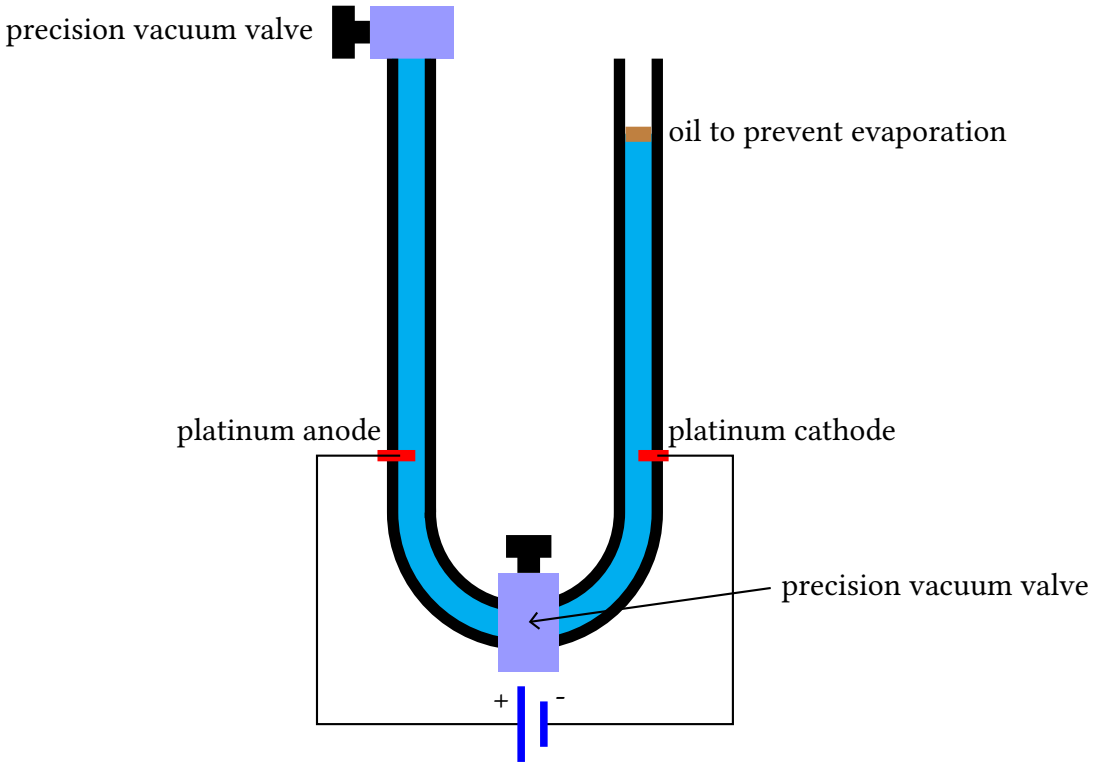
Key words and phrases. Einstein, special relativity, mass energy equivalence, e=mc2, conservation of mass, Lorentz force law.

Currently, the mass of nuclides is determined using the Penning trap, supposedly the most precise weighing technique ever invented to measure atomic mass. The author has explained in his other paper [3] that the Penning trap is a weighing method that has not been calibrated. Whatever precision achievable with the Penning trap is irrelevant unless it has been calibrated, and calibrated with the traditional scale balance. It is an irony in mass metrology that, despite the very advanced technological achievement of our present age, there is still no substitute for this traditional scale balance as the one and only method of calibration for all other method of weighing techniques - the traditional balance scale is the standard reference for weighing mass. It is a natural constraint that physical nature has dictated concerning mass measurement. The high reputation of the Penning trap does not exempt it from the scrutiny of the humble scale balance handed down us since the time of Archimedes of ancient Greece.

In the early days when the atomic weights of elements were examined, it was noticed that the atomic weights of elements tend towards a whole number relative to the atom of hydrogen. This whole number rule was known as *"Proust's hypothesis"*. In the early 1920s, mass spectrometry became popular and finally accepted; atomic mass was then determined through measurement using mass spectrometry. The atomic mass of elements as determined by mass spectrometry was found to contradict Proust's hypothesis; the hypothesis was quickly dismissed. In its place, mass energy equivalence based on $E=mc^2$ became the rule. The difference in atomic mass from its whole number mass number became accepted as a *"mass defect"*, a defect that was introduced to explain the high binding energy of the nucleus of atoms. But mass spectrometry is all wrong simply because it assumes the Lorentz magnetic force law:$F = q(\mathbf{v} \times \mathbf{B})$ to be valid as an exact mathematical relation; it is not. In fact, even the Lorentz magnetic force law has never been experimentally verified. The so called mass defect of nuclides is a systemic error contribution from mass spectrometry itself. Mass spectrometry - together with the Penning trap - is not an accurate method to measure mass of nuclides. It gives only an approximate mass of the nuclides! The true mass of any nuclide could only be weighed by the traditional scale balance, the same scale balance used by Archimedes.

2. Electrolysis Of Water

The analysis of the O/H composition of oxygen to hydrogen in water can be done through the electrolysis of an aqueous solution of potassium sulfate; the electrolysis results only in splitting the water producing oxygen and hydrogen without changing the amount of the salt. The atomic masses of ^{16}O and ^{1}H as found in the 2012 NIST tables are: 15.99491461957(19) and 1.00782503223(9). If the NIST values are correct, the ratio O/H should give a value consistent with 15.87072567961(30). With our analytical balances that could weigh to accuracy $1{:}10^5$, we should be able to have O/H to be



;

FIGURE 1. Stainless steel apparatus for electrolysis of aqueous solution of potassium sulfate. Two arms of tube joined to a precision vacuum valve making a total length of 50cm. The inner bore is 7mm diameter, tube thickness 1mm. Initial amount of solution trapped 40cm. The platinum electrodes are insulated from the tube. Total weight of apparatus before electrolysis should be below 200g. Voltage should be high enough to give a current of 1A.

15.8707(2). If the classical mass conservation law is correct, the experiment would give O/H to be 16.0000(2) as the atomic mass of any nuclide is just the mass number in unified atomic mass unit, a whole number. The uncertainty of 0.0002 to the difference 0.12928 is 1:650, a huge figure that may accommodate a fairly large margin for experimental accuracy. This proposed electrolysis of water experiment could easily be achieved with a high degree of accuracy and the result should clearly show if the hypothesis of mass-energy equivalence is verified or refuted.

2.1. **The Apparatus.** The experimental setup is in Figure 1. The electrolysis of water splits water. Oxygen gas would be produced at the anode and hydrogen at the cathode. The idea is to trap the oxygen produced but allowing the hydrogen to escape freely. With three weighing done in

a vacuum chamber[1], the amount of oxygen produced, the amount of water electrolyzed and split could be found. The difference would then give the amount of hydrogen produced. The two precision vacuum valves are needed as the weighing has to be done in a vacuum. When the electrolysis is completed, the apparatus with the trapped oxygen has to be weighed in vacuum. During the air extraction process, the closed bottom valve would prevent the oxygen gas from expelling the solution through the open end of the tube. The valves have to be able to prevent oxygen gas or the solution to leak through when the pressure difference reaches 1atm.

2.2. **The Experimental Procedure.** An analytical balance in vacuum is used for weighing; such balances can give a readability of 0.01mg. The steps to be taken for the experiment are:

(1) Filling the tube with an initial amount of electrolyte - The apparatus has to be filled with an initial amount of electrolyte with the upper valve closed such that no air is trapped below the upper valve. If we then weigh the apparatus, it would give the weight of the apparatus plus the electrolyte. The apparatus has to be properly cleaned for weighing. Before weighing, a small amount of machine oil is added to the open arm of the tube. The oil layer formed will prevent water evaporation during the air extraction process and also during electrolysis (the weight of this oil layer will not enter into our calculations as we only need the differences in the three weight values). The apparatus is allowed to be dried by leaving it alone for some time before weighing.
(2) The electrolysis - Electrolysis would begin when a sufficient dc voltage is connected to the electrodes. For every 4.6g (12cm) of water split, 4.0g (8cm at NTP) oxygen would be produced and trapped. The electrolyte level on the cathode side would dropped by about 4cm. The rate of electrolysis of water is about 3.0 amp-hr/gram. With a current of 1A, the time taken would be 14hr. When the electrolysis is completed, the apparatus is weighed. This weight is the total weight of the oxygen, the remaining amount of electrolyte and the apparatus.
(3) Weighing after releasing the oxygen - After the above weighing, the oxygen gas is released allowing it to escape. If the apparatus is now weighed, it would give the weight of the remaining electrolyte and the apparatus only - without the oxygen. To prevent the evaporation of water during the evacuation of the air, a thick layer of machine oil has to be added to the anode arm of the tube through the valve. The weight of oil used has to be known accurately. To do this, a small amount of oil is put into a small glass beaker and

[1]small commercial vacuum chambers are available designed specially for doing weighing giving a vacuum of 0.01atm; https://www.weighingreview.com/company/radwag-balances-and-scales

weighed. A sufficient amount of the oil is then poured through the upper valve into the tube to form a thick covering layer. The apparatus is then weighed together with the beaker with the remaining amount of oil. This weight found less the weight of the beaker of oil would give the weight of the apparatus and the remaining amount of the electrolyte.

2.3. **Calculating The O/H Ratio.** From the above three steps, we have the following weights:

$w1$; weight of apparatus + initial amount of electrolyte

$w2$; weight of oxygen + apparatus + remaining amount of electrolyte

$w3$; weight of apparatus + remaining amount of electrolyte

$w4 = w2 - w3$; weight of oxygen produced

$w5 = w1 - w3 - w4$; weight of hydrogen produced

The ratio by weight of oxygen to hydrogen in water is w4/w5. As there are two atoms of hydrogen to every atom of oxygen in water, the ratio O/H of the atomic mass of ^{16}O to that of ^{1}H is given by 2w4/w5.

3. Conclusion

The mass-energy equivalence of $E=mc^2$ would be verified if the value of O/H is found to be 15.8707(2). Otherwise, if the value is 16.0000(2), it would mean an unequivocal repudiation of mass-energy equivalence and $E=mc^2$. Such an experimental outcome would mean that the classical law of conservation of mass is upheld.

References

[1] Chan Rasjid. Chemical Analysis Of Plain Distilled Water May Refute Mass-Energy Equivalence Of $E=mc^2$. http://vixra.org/abs/1912.0378

[2] Chan Rasjid. Mass Energy Equivalence Not Experimentally Verified. http://vixra.org/abs/1810.0003

[3] Chan Rasjid. Nuclear Binding Energy Fails (Is Mass Spectrometry Accurate?). http://vixra.org/abs/1809.0491

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

Singapore