Atomic orbit energies an alternative calculation deduced from the theories of Einstein, Mach and de Broglie [1]

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ABSTRACT. Many historical works on Einstein describe his approval of Mach's philosophy and de Broglie's particle wave theory. Einstein's belief that Mach's Principle should be incorporated into his relativity theories was never accepted and Einstein eventually abandoned the idea, but with some reservations. However, this report will show that Einstein was correct in his desire to incorporate Mach's theory into his relativity theories and the proof can be found in the relativistic velocities of atomic orbits. Some important implications arise ; for example, relativistic velocities differ whether a particle has gained or lost rest mass energy and Louis de Broglie's original atomic orbit model favors that of other theories.

RÉSUMÉ. Nombreux sont les travaux historiques sur Einstein qui décrivent son approbation de la philosophie de Mach et de la théorie ondulatoire de l'électron de de Broglie. La conviction d'Einstein comme quoi le principe de Mach doit être introduit dans la relativité ne fut jamais acceptée et Einstein finalement abandonna l'idée, mais avec quelques réserves. Néanmoins, ce travail montre qu'Einstein avait raison dans son souhait d'introduire la théorie de Mach en relativité, et la preuve peut être mise en évidence avec les vitesses relativistes des orbites atomiques. Diverses conséquences importantes en découlent ; par exemple, la vitesse relativiste diffère si la particule a gagné ou perdu de l'énergie de masse au repos et le modèle des orbites atomiques de Louis de Broglie penche pour d'autres théories.

[1] Editor's note : the general principles used in this article may appear too stringent to some readers, but we have decided to publish it in view of our general policy of freedom of thought, and of the results, which seem interesting.

1 Introduction

Ever since Einstein published his papers on Special Relativity [1,2] there have been many scientists who have not been fully satisfied with the theory. Perhaps most noteworthy is Walter Ritz, who collaborated with Einstein in 1909, and more recently the late Professor Petr Beckmann, who was the founder of the journal *Galilean Electrodynamics,* the principal aim of which is to refute Einstein's Special Theory of Relativity. From time to time other scientific journals have accepted articles critical of Special Relativity, and associations have been formed by philosophically minded groups who do not wholly accept the concept of space-time and the rejection of absolute space and absolute velocity, as upheld by the Special Theory of Relativity. One such organization is the Natural Philosophy Alliance, which boasts an impressive list of members.

However, scientists and philosophers who believe that Einstein's Special Theory of Relativity is one of the greatest achievements in science and irrefutable, by far outnumber those who are not convinced of its validity. Further, the relativistic velocity equations have been proven repeatedly in high energy particle accelerators.

I believe that for many scientists Special Relativity is difficult to understand except with respect to solving the equations. There is no doubt that Einstein's energy-velocity equation is valid and indisputable, and one of the greatest achievements in science. Why therefore, is there still scope for debate? It is the elimination of absolute space and absolute velocity or, in other words, the rejection of Mach's Principle [3,4], that Einstein himself was forced to discard, which creates the conflict. It was in fact Einstein's mathematics teacher, Herman Minkowski [5], who introduced the purely mathematical concept of space-time, which discarded absolute space and absolute velocity, which Einstein reluctantly accepted [6].

2 Mach's Principle

It is possible to verify that Einstein was correct in believing that Mach's Principle should be incorporated into his relativity theory. Mach's Principle requires that inertia of mass and consequently potential energy of inertial mass must be generated by the rest of the Universe. In mathematical terms Mach's Principle can be written as $\phi_{univ} = GM_{univ}/R = c^2$ where ϕ_{univ} is the cosmic gravitational tension or the amount of energy per mass generated by the Universe; G

is the gravitational constant; c the speed of light; R the absolute distance to the center of mass of the system and M_{univ} the total mass of matter within the radius of curvature R. Technically, Mach's Principle can be applied to the Earth and the solar system by simply using $\phi_{sol} = GM_{sol}/r = v^2$ where r is the distance to the center of mass of the solar system and M_{sol} the mass of the solar system within r. The gravitational tension ϕ_{sol} at the orbital radii r of the different planets equals the square of their orbital velocities. Mach's Principle can be further extended to our galaxy or to clusters of galaxies and ultimately to the Universe as a whole, at which point $\phi_{univ} = c^2$.

This leads to a velocity effect peculiar to Mach's Principle. For example, should we want to sling the Earth in its orbit at r_2 out to the orbit of Mars at r_3, then the amount of kinetic energy that needs to be added to Earth is $\Delta E = \frac{1}{2}m(\phi_2 - \phi_3)$, where m is the Earth's mass and ϕ_2 and ϕ_3 the gravitational tension of the solar system at r_2 and r_3 respectively. The difference in orbital velocity is thus $\Delta v = \sqrt{\phi_2} - \sqrt{\phi_3}$. However, decreasing the Earth's orbit by the same amount of energy, $\nabla E = \Delta E$ to a smaller radius r_1 means a loss of potential energy (∇E =loss of energy) in the form of friction and radiation or $\nabla E = \frac{1}{2}m(\phi_1 - \phi_2)$, and the difference in orbital velocity becomes $\nabla v = \sqrt{\phi_1} - \sqrt{\phi_2}$. Note, that when $\Delta E = \nabla E$ then $\Delta v \neq \nabla v$, which is a consequential effect of Mach's Principle.

The Special Theory of Relativity has so far ignored the above effect, since it considers matter at relative rest (thus the term rest mass energy $E_0 = m_0 c^2$) and cannot deduct velocities from rest or zero velocity. It can only accurately be applied to velocities that are produced by an increase in rest mass energy or $E_0 + \Delta E$. Einstein's relativistic velocity equation can be written in a Mach's format as

$$\Delta v = \sqrt{\phi_{univ} - \phi_{univ}\left(\frac{E_0}{E_0 + \Delta E}\right)^2}. \tag{1}$$

In cases where energy is lost to radiation such as when electrons are captured in high speed atomic orbits, Einstein's relativistic equation becomes obsolete and must be replaced by a second equation that can be used in cases where loss of rest mass energy occurs, such as $E_0 - \nabla E$ or

$$\nabla v = \sqrt{\phi_{univ} - \phi_{univ}\left(\frac{E_0 - \nabla E}{E_0}\right)^2}. \tag{2}$$

This becomes evident if we apply both the above velocity equations to the inner orbits of atoms and compare the results to published measured values that currently appear in *The Handbook of Chemistry and Physics* (under Ionization energies or Ionization potentials of the Elements).

3 Louis de Broglie's atom

The circumference of the innermost atomic orbit as determined by Louis de Broglie's wave theory is

$$\frac{\frac{1}{2}h\nabla v}{\nabla E} = \frac{Zq^2}{4\varepsilon_0 \nabla E}, \qquad (\tfrac{1}{2}\text{wavelength}) \tag{3}$$

and solving for ∇E by inserting ∇v from Equation (2) we obtain

$$\nabla E_e = E_0 \left[1 - \sqrt{1 - \left(\frac{Zq^2}{2\varepsilon_0 hc}\right)^2}\right] \times \frac{m_n}{m_n + m_e}, (\text{Joules}) \tag{4}$$

where Z is the atomic number; E_0 the electron's rest mass energy; q the electron's electric charge; ε_0 the permittivity constant and h Max Planck's constant. The term, $m_n/(m_n + m_e)$ where m_n and m_e are masses of the atomic nucleus and electron respectively, reduces the orbital energy to that of the electron only. For example, Z=29 (Cu) yields a $\nabla E_e/q = 11573.35\ eV$ or $5.7\ eV$ higher than the published data.

Inserting Δv for $Z = 29$ from Einstein's Special Relativity Equation (1) into the above de Broglie Equation (3)

$$\Delta E_e = E_0 \left[\left(\frac{1}{\sqrt{1 - (Zq^2/(2\varepsilon_0 hc))^2}}\right) - 1\right] \times \frac{m_n}{m_n + m_e}, (\text{Joules}) \tag{5}$$

results in a critical error of 274 eV higher than published data which has prompted investigators to introduce several correction factors such as the Dirac-Fock correction [7]; self energy correction [8]; Uehling vacuum polarization correction [9]; higher order vacuum polarization correction [10] and nuclear size correction *etc.*, in order to match the measured values.

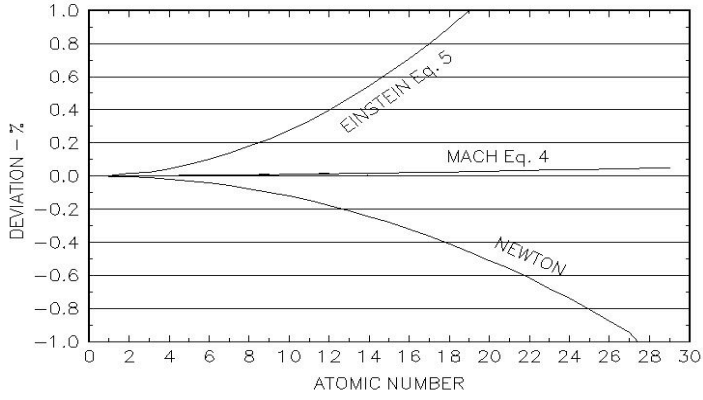

Fig. 1 : Deviation in percent between measured values and results obtained from Equations (4) and (5). Also shown are values obtained from Newton's non-relativistic Equation $\Delta E = {}^1\!/_2 mv^2$.

The curves in Fig. 1, compare measured values to results predicted by Einstein's special relativity equation (5) and modified by Mach's Principle equation (4). Also shown are calculated values using Newton's non-relativistic energy-velocity relation $\Delta E = {}^1\!/_2 mv^2$. The curve produced by applying Mach's principle reveals a minute deviation from the measured values which can be explained (without proof) by a small Compton red shift of $\nabla\lambda = (1 - \cos\alpha)h/(m_e c)$ in the spectroscopic measurements. The angle of deflection $\alpha = \cos^{-1}\left[(0.0197565\ \log eV_1) + 0.89794\right]$ decreases with photon energy which is consistent with optical spectroscopy using gratings. Another explanation might be internal scattering of photons leaving the atom, see Fig. 2.

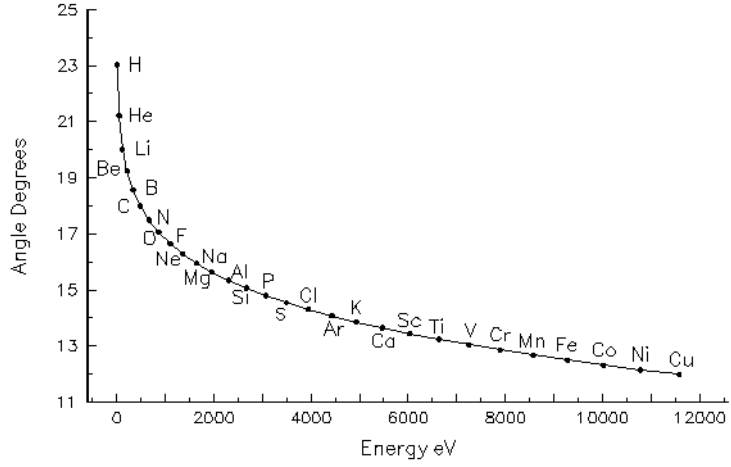

Fig. 2 : Compton scattering angle for the different elements

4 Conclusions

My personal conclusion is that the mathematics of Einstein's Special Theory of Relativity is only correct for cases of relative increase in rest mass energy, as in particle accelerators for example, and that Mach's Principle should be included in the theoretical interpretation of the theory to account for the energy-velocity relationship in cases where rest mass energy is lost, such as in atomic orbits. The agreement between Equation (4) and measured values (corrected for Compton red shifts), see Fig. 3, should prove this point where the accuracy of the equation based on de Broglie's atomic theory brings out the signal to noise ratio of the measurements.

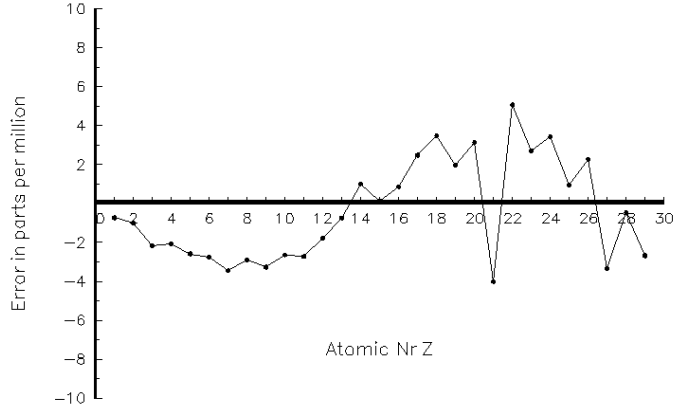

Fig. 3 : Difference in parts per million between measured values (corrected for Compton red shifts) and the theoretical values from Equation (4).

It is remarkable that Mach's Principle has to be invoked in order to explain relativistic atomic orbits when Mach himself did not believe in atoms while Einstein, on the other hand, who was first to prove that atoms exist (Brownian movement and the photoelectric effect) chose to abandon Mach's Principle. However, without the advantage of Louis de Broglie's original atomic model this paper would not have been possible.

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