ABSOLUTE MOTION AS THE PHYSICAL STATE OF BODIES

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Abstract. According to the theory of relativity as established before the 1900s, the mechanical and electromagnetic phenomena that occur in systems in inertial motion do not contain the information needed to detect absolute motion. Today we know two state variables, which depend on the motion state of a body that appear in measurements: one of them is mass, which changes with respect to velocity or kinetic energy; the other is radiation frequency, which characterizes the inner state of atoms, and also changes with respect to velocity. Going back to the equation $m = E/c^2$ deduced by Poincaré, the body absolute motion and absolute velocity can be deduced from the true mass change and true frequency change. As a first step, in the course of studying the changes of physical states in connection with kinetic energy, it was established that a limit exists for those parameters of the body which change with respect to velocity in case of the state of absolute rest, devoid of translational motion. On these grounds, as a second step, the dynamic definition of absolute rest was formulated. As a third step, the relationship between the body absolute velocity and mass change was deduced knowing the limits. Conclusion: a body absolute velocity can be determined from its gravitational mass measured at various velocities or from the values of radiation frequency, which changes in inverse proportion.

1. Introduction

In the early 1900s, as a result of the unsuccessful experiments to discover the nature of the body in absolute rest, physicists found that it was time to conclude the study of absolute motion with the special theory of relativity.

Before the conclusion of the studies, in 1901 W. Kaufmann published [1] the result of his measurements, in which he establishes that the mass of an electron is a function of its velocity, or kinetic energy. In his view, the variation is apparent, because only the inertial resistance, or the inertia of the electron changes. His apprehension still divides physicists. (The uncertainty is due to the fact that there is no apparatus that could verify such a small weight change under laboratory conditions.) Some believe virtual change is legitimate; others believe it is actual change. (Einstein [2] argued for actual change as he established that: if only inertial mass changed then objects would free-fall differently in accordance with their energy. This would however be in contradiction with observations.[1]) The question

[1] "2. **On the Gravitation of Energy** One result yielded by the theory of relativity is that the inertia mass of a body increases with the energy it contains; if the increase of energy amounts to E, the increase in inertia mass is equal to E/c^2, when c denotes the velocity of light. Now is there an increase of gravitating mass corresponding to this increase of inertia mass? If not, then a body would fall in the same gravitational field with varying acceleration according to the energy it contained."

may be resolved by a phenomenon discovered later, in which the radiation frequency of atoms also changes with velocity in inverse proportion to the change in mass. The Hafele-Keating atomic clock experiment [3] proves the actual change in radiation frequency for motions of various velocities and various kinetic energies; while it has been proven before for other types of energy changes. As an indirect proof, the result supports the notion that the mass change accompanying changes in velocity is also an actual change. From now on, the latter conception will be applied. According to the initial understanding, the mass change is an observation specific to the electron, which is considered the smallest elementary particle. However, the outcome of subsequent measurements with other particles (such as atoms containing neutrons) has shown that it can be applied in a general sense.

In the subject of absolute motion, we will study systems in steady straight-line inertial motion with reference to a body in absolute rest, that devoid of translational motion. There are two approaches to the definition of absolute motion:

— Deducing it from the velocity-dependent changes of physical phenomenas. In this case, a body in absolute rest is not a requirement; just recall the considerations in connection with absolute temperature. (The experiments of Galilei performed on stationary and moving ships follow this course.)

— Considering the motion with reference to a body (or ether) that based on certain conceptions is in absolute rest (for example, Michelson experiment).

The first approach will be the subject of the following study.

The proportional relationship between energy and mass is described by the equation $E = mc^2$ (where E is energy, m is mass, and c is the speed of light). The relationship was introduced in 1900 by H. Poincaré [4], who derived the equation from the conservation of impulse. By applying it, we can avoid the logical contradiction with a subsequent conclusion having the same final result, which is considered a consequence of the theory of relativity.

Mass and energy will be analyzed as two separately conserved quantities. The domains of the energy and mass applied in the equation are known. Given that observations have shown that mass can only have positive values, the domain of mass is:

$$m = [\,0, +\infty) \tag{1}$$

Due to the $E = mc^2$ relation, the domain of m also defines the limits for E:

$$E = [\,0, +\infty) \tag{2}$$

(Negative energy would lead to negative mass, which would be in contradiction with observations.)

Energy and mass both represent absolute values because of their lower bounds imposed by nature.

Hereafter this attribute will be emphasized in the notations:

$$E_A = m_A\, c^2 \tag{3}$$

where "$_A$" denotes absolute. Why

- does, or
- would conclude

absolute motion from the velocity-related actual change in the mass of a body?
The purpose of this study is to demonstrate this conception. In the following deduction, the theorems of conservation of momentum, energy, and mass will be applied. The principle of relativity is not among the requirements to be fulfilled.

2. Separation of straight-line kinetic energy

The indubitably discernible signs of a body, manifested in interactions, make it possible to distinguish various energy types $(E_1, E_2, E_3, ...)$. As a result of separating the total absolute energy (E_{AT}) of the body into component energy types,

$$E_{AT} = E_1 + E_2 + E_3 + \cdots + E_n \tag{4}$$

An experiment can be limited to investigating only the changing own values of straight-line kinetic energy to be represented by E_1, provided that the other energy types of the body originating from other than straight-line motion remain at constant values in the course of the experiment, that is,

$$E_2 + E_3 + E_4 + \cdots + E_n = C_E \tag{5}$$

In this case, the total energy of a body constituting a *partially isolated system* can be broken down as follows:

$$E_{AT} = E_1 + C_E \tag{6}$$

The total energy (E_{AT}) of a body is proportionate to its total mass (m_{AT}); therefore, if such energy is broken down into components, it will result in breaking down the mass of the body into corresponding components:

$$E_{AT} = m_{AT}\, c^2 \tag{7}$$

$$E_1 + E_2 + E_3 + \cdots + E_n = m_1 c^2 + m_2 c^2 + m_3 c^2 + \cdots + m_n c^2 \tag{8}$$

The total mass of the experimental body in detail will be as follows:

$$m_{AT} = m_1 + m_2 + m_3 + \cdots + m_n \tag{9}$$

In this manner, the change of the value of either inertial or gravitational mass (m_1) can be investigated as limited to the straight-line motion of a body if the masses originating from other than straight-line motion are kept at constant values in the course of the experiment. This condition has already been formulated above by such energy values being constant.

$$m_2 + m_3 + m_4 + \cdots + m_n = C_m \tag{10}$$

Therefore the mass of a body constituting a partially isolated system will be the aggregate of a variable and a constant:

$$m_{AT} = m_1 + C_m \tag{11}$$

3. Definition of absolute rest

In the course of an experiment, the physical values characteristic of a body including gravitational mass will change in a theoretically measurable manner if the body is put into steady straight-line motion - in ideal circumstances - by dynamic interaction on the surface of a scale located in standstill in an inertial frame. (Fig.1)

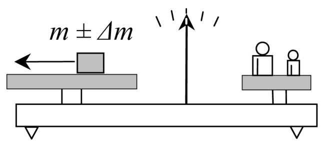

Figure 1. The Principle of the Measurement (outline)

As the measurement process does not entail any dynamic impact if a negligible change of gravitation potential is assumed, that is, static mass measurements are performed, therefore *absolute mass changes are measured* in the course of scaling. (A body located on a scale is only apparently in rest if taken macroscopically; component particles are actually in the course of various types of motion with considerable velocity.)

The change in state of motion caused by interaction is coupled with mass and energy changes; the gravitational mass of a body continuously increases if it is accelerated to a speed near the velocity of light $m_1 \to \infty$; and decreases if it discharges its energy from straight-line motion to its environment $m_1 \to 0$. However, a reduction of the mass of a body, with its other energies being constant, is only possible until a limit value is reached: until it has transferred all its energy and corresponding mass related to straight-line motion to its environment, meaning that they are reduced to zero: $E_1 = 0$; $m_1 = 0$.

As $m_{AT} = m_1 + C_m$, the mass of the body will assume its constant value when $m_1 \to 0$:

$$m_{AT} = \lim_{m_1 \to 0}(m_1 + C_m) = C_m \tag{12}$$

In the case of straight-line motion, this minimum mass is ($C_m = min$).

The lower limit value is similar in straight-line kinetic energy, if $E_1 \to 0$, the lower limit value of E_{AT} will be:

$$E_{AT} = \lim_{E_A \to 0}(E_1 + C_E) = C_E \tag{13}$$

This is when the pointer of the scale indicates the lowest value in the course of the experiment. In the event that the speed of the body further changes, its mass will increase; in case of any reduction, the existence of negative mass, and therefore, negative energy would be presumed, which has not been experienced. In our present knowledge, the inertial motion of a body cannot change to the detriment of other types of energy according to the law of conservation of such motion. (Theorem of center of mass)

Given that the real straight-line motion of a body is a consequence of straight-line kinetic energy (E_1) and its mass attribute (m_1) — as preconditions for this type of motion, — the values of which are absolute values, its velocity will also have an absolute value ($\mathbf{v_A}$), the lower limit value of which is:

$$\mathbf{v_A} = \lim_{E_1, m_1 \to 0} \mathbf{v_A}(E_1; m_1) = 0 \tag{14}$$

In order to specify minimum weight, measurements of changes in gravitational mass should be performed in various spatial directions and with different velocities of the experimental body. The lower limit value as specified ($E_1 = 0$; $m_1 = 0$) is coupled with zero value straight-line motion, which is nothing else but the state of absolute standstill of the body. (This is only identical with the state of rest in a system if such system is also in absolute standstill.) The velocity measured between is *the absolute velocity of the system*, the motion of the system being *absolute motion*.

4. Absolute rest as a physical state of bodies

Traditionally, the straight-line motion of bodies has only been possible to be characterized with reference to bodies in other inertial motion. After discovering energy, energy types, and their mass attributes, however, the physical characteristics of the motion of a body have been supplemented by these new parameters. A body reaches a new straight-line motion state through an acceleration process. During the the acceleration its physical state will proportionally change. Based on our present knowledge, a body may only be in absolute steady straight-line motion if it has the required kinetic energy ($E_1 > 0$) and its mass attribute ($m_1 > 0$).

A body comes to absolute standstill, that is, its straight-line motion ceases to exist if the value of its energy and mass is reduced to a minimum (lower limit) while its energies and their mass attributes induced by other than straight-line motion are constant. ($E_1 = 0$, $m_1 = 0$) [5]

According to energetic considerations, steady straight-line motion should be taken as absolute motion as a consequence of energy conservation (and mass conservation).[2]

5. The relation between absolute velocity and mass change

It can be deduced from the equation $m_A = E_A/c^2$ that the actual absolute value of the body mass depends on absolute velocity. The change appearing in the measurement results is, therefore, the consequence of this process.

Let us pick a body of absolute rest mass m_{A0}, which gains a straight-line kinetic energy of $\triangle E_{Akin}$ at the expense of the work of an external force $\mathbf{F}$.

If a body's total absolute energy is E_A, its mass m_A can be calculated by using the equation $m_A = E_A/c^2$ regardless of the kind of the energy. Considering the lower limit deduced earlier, the straight-line kinetic energy can be defined with the mass change. If a body of absolute rest mass m_{A0} gains a velocity of $\mathbf{v_A}$, then its straight-line kinetic energy

[2] Leibniz: "I grant there is a difference between an absolute true motion of a body, and a mere relative change of its situation with respect to another body. For when the immediate cause of the change is in the body, that body is truly in motion; and then the situation of other bodies, with respect to it, will be changed consequently, though the cause of that change be not in them." (Leibniz's 5$^{\text{Th}}$ letter to Clarke)[6]

is manifested by an increase in its mass. The change in the absolute value of the kinetic energy means an energy increase proportional to the mass increase.

$$E_{Akin} = (m_A - m_{A0})\, c^2, \tag{15}$$

where m_A is the absolute value of the mass of a body moving with absolute velocity $\mathbf{v_A}$ >0. After a displacement of d$\mathbf{s}$ under the constant external force $\mathbf{F}$, the change in mass is (Fig.2):

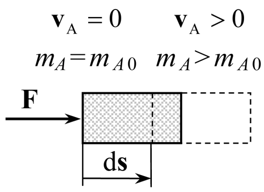

FIGURE 2. Outline for the deduction

$$c^2\, \mathrm{d}m_A = \mathbf{F}\, \mathrm{d}\mathbf{s} = \mathbf{F}\, \mathbf{v_A} \mathrm{d}t. \tag{16}$$

According to Newton's second law, however, the force acting upon the body is the time derivative of momentum, that is:

$$\mathbf{F} = \frac{\mathrm{d}}{\mathrm{d}t}\, (m_A \mathbf{v_A}). \tag{17}$$

Substituting this into (Eq.16):

$$c^2 \mathrm{d}m_A = \frac{\mathrm{d}}{\mathrm{d}t}(m_A \mathbf{v_A})\mathbf{v_A} \mathrm{d}t = \mathbf{v_A}^2 \mathrm{d}m_A + m_A \mathbf{v_A}\, \mathrm{d}\mathbf{v_A} \tag{18}$$

and separating the variables:

$$c^2 \mathrm{d}m_A - \mathbf{v_A}^2 \mathrm{d}m_A = m_A \mathbf{v_A} \mathrm{d}\mathbf{v_A} \tag{19}$$

$$\frac{\mathrm{d}m_A}{m_A} = \frac{\mathbf{v_A}}{c^2 - \mathbf{v_A}^2} \mathrm{d}\mathbf{v_A} \tag{20}$$

since $\mathbf{v_A} = 0$ given $m_A = m_{A0}$, the result of the integration is:

$$\int_{m_{A0}}^{m_A} \frac{1}{m_A} \mathrm{d}m_A = \int_{\mathbf{v_A}=0}^{\mathbf{v_A}} \frac{\mathbf{v_A}}{c^2 - \mathbf{v_A^2}}\, \mathrm{d}\mathbf{v_A} \tag{21}$$

...

$$m_A = \frac{m_{A0}}{\sqrt{1 - \frac{{v_A}^2}{c^2}}} \tag{22}$$

6. Radiation frequency and absolute velocity

Let us consider the change in radiation frequency as a consequence of the energy and mass change following acceleration. Measurements have shown that frequency f_A and mass change in inverse proportion [7,3]. As a consequence of the way mass changes, the frequency takes on its maximum value in the state of absolute rest. Because of the inverse proportion, the relationship between radiation frequency and absolute velocity is as follows:

$$f_A = f_{A0}\sqrt{1 - v_A^2/c^2} \tag{23}$$

where f_{A0} is the radiation frequency of a source in absolute rest, and f_A is the radiation frequency when it is moving at an absolute velocity of $v_A > 0$.

A chart shows the changes in absolute velocity, mass and radiation frequency of a body in the state of inertial motion in the plane of drawing. (Fig.3)

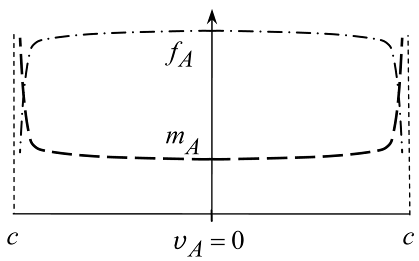

Figure 3. Change of m_A and f_A as function of absolute velocity (v_A)

Analyzing the transverse Doppler shift Ives-Stilwell [7] discovered that a real shift occurs in the radiation frequency of atomic clocks that move at different speeds. During the measurement of transversal Doppler shift - apart from the phenomenon of aberration - there is no apparent shift in frequency arising from the difference in speed between the source and the observer. A part of the motion considered to be close to linear motion in the Hafele-Keating experiment is comparable with the Ives-Stilwell experiment. In both cases atomic clocks reached a new steady rate during an acceleration process. These two independent measurement procedures confirm the real shift in frequency based on the velocity of the atomic clocks.

In an inertial system moving with an unknown velocity, the change in frequency is described by the following formula, while other factors affecting to frequency are constant: $f = f_0\sqrt{1 - v^2/c^2}$. f_0 radiation frequency of the atom at rest in the system, v velocity of the atom, c speed of light.

According to the formula it may be concluded that in the case of speeds approaching the speed of light, the rate of decrease in frequency has a growing importance in atomic clocks. Going the other way, in the case of speed reduction the frequency of the atomic clock increases with decreasing differences. Knowing the connection between velocity and frequency, the frequency of resting and moving clocks in a wagon moving at speed v_x can be determined without taking measurement (Fig.4). In the K system of Ives-Stivell, K' (v_x), $-v$ and $+v$ velocities and frequencies are known. It may be concluded that in the wagon the frequencies of clocks moving at speed $|-v| = |+v|$ display an asymmetric divergence in comparison with clocks at rest v_x.

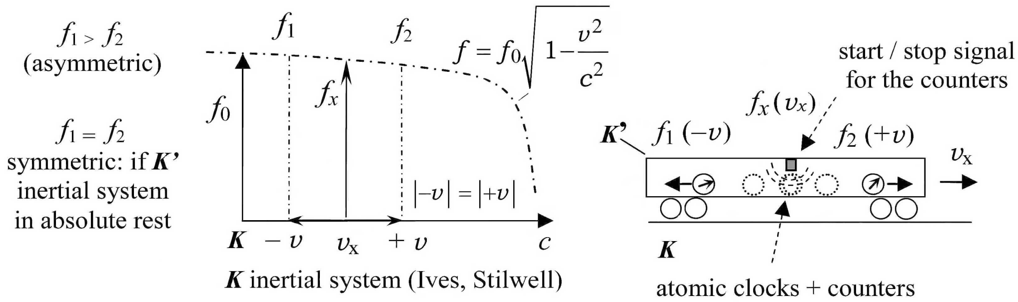

FIGURE 4. Ives-Stilwell experiment consequences

The counters used in the clocks can be activated with a start signal, and stopped with a stop signal after covering a distance as far as possible. After stopping the clocks, the values on the counters can be compared. Bigger atomic frequencies belong to bigger clock frequency and vice versa. Based on the experiment carried out in the isolated system of the wagon, the frequency of the clock approaching the speed of light decreases, while the frequency of the clock moving away increases. From the measurement results, the movement of the isolated system (the wagon) and its direction may be determined.

This result contradicts to the principle of relativity and postulate of the theory of relativity, which states that the movement of an isolated system undergoing inertial motion cannot be detected by any kind of experiment.

If motion exists at a lower speed than the unknown velocity of the motion in the system of Ives-Stilwell, a system performing inertial motion must be supposed where the frequency of the clock at rest is higher. This is true as long as getting to a system in which the frequency of the clock at rest shows a maximum value. If there is no such system, in the experiments the clock would approximate the speed of light while the frequency increases continuously. But this contradicts the Ives-Stilwell experiment and other observations which state that approaching the speed of light results in a decrease in the clock frequencies.

A continuous decrease in the asymmetry of frequencies suggests that the frequency of the clock at rest reaches its maximal value as the direction-dependent difference disappears and symmetry can be observed. Speed reduction is possible only until it reaches a motion-free state. Attaining the upper limit of frequency and symmetry onset can happen only when the inertial system with $v_A = 0$ velocity reaches a state of absolute rest. The connection between frequency and velocity is described by the following formula: $f_A = f_{A0}\sqrt{1 - v_A^2/c^2}$ (Fig.3.)

The absolute rest state of the clock is not a requirement for determining the absolute velocity. Knowing the formula the absolute velocity can be calculated from the frequencies measured at different relative velocities.[3]

In the above mentioned experiment the counters record the number of oscillations while the times and distances measured are equal. The use of counters for the clocks allows the observer to assess the phenomenon independently of the effect of his position and movement. Hence there is no difficulty in reading the moving clocks and the inclusion of acceleration processes in measurement results is avoidable -as a result "pure states" of inertial motion can be analyzed.

A body coming to absolute rest can be defined with radiation frequency as follows:

A body comes to absolute rest, that is, its straight-line motion ceases to exist if its radiation frequency reaches its maximum (upper limit) while its energies and their mass attributes induced by other than straight-line motion are constant. ($E_1 = 0$; $m_1 = 0$)

7. Conclusions

Transfer the absolute velocity dependent mass change into the motion equations of mechanics and electrodynamics. After the mathematical processing it can be predicted where noticeable changes could be observed.

Newton:

$$\mathbf{F} = \frac{\mathrm{d}}{\mathrm{d}t}\,(m\mathbf{v}), \text{ where } m = \text{constant}. \tag{24}$$

Absolute motion:

$$\mathbf{F} = \frac{\mathrm{d}}{\mathrm{d}t}\,(m_A\mathbf{v}), \text{ where} \tag{25}$$

$$m_A = \frac{m_{A0}}{\sqrt{1 - \frac{{v_A}^2}{c^2}}}\,. \tag{26}$$

(Celestial mechanics is a prominent field when it comes to observations such as the perihelion motion of planets or the annual fluctuation of the axial rotation of the Earth.)

$$\mathbf{F} = G\frac{m_A M_A}{r^2}\frac{\mathbf{r}}{r}, \tag{27}$$

where G constant of gravitation, $r = m - M$ distance, and

[3] 1. Clocks in the state of absolute rest allow a new understanding of absolute space.

2. The lack of knowledge of the absolute velocity impeded the application of a single (absolute) time in systems moving with different velocities. All the correlations of absolute velocity are known, which in an arbitrary moving system help arbitrary determine the real difference between local clocks and the clocks in the state of absolute rest.

$$m_A = \frac{m_{A0}}{\sqrt{1 - \frac{v_{A(m)}}{c^2}^2}}, \quad M_A = \frac{M_{A0}}{\sqrt{1 - \frac{v_{A(M)}}{c^2}^2}}. \tag{28}$$

Studying the frequency change with atomic clocks makes it possible to perform sensitive measurements under laboratory conditions. Experiments suitable to prove the phenomenon of absolute motion can be designed and performed with atomic clocks.

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