**Exploration**

# Physical Vacuum as a Distorting Mirror

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## Abstract

In this paper, the author considers the interaction between matter and the vacuum. It is suggested that the change of space-time in modern physics is only a change of space-time standard and the values of mass and energy are relative to ground state of vacuum. Therefore, modern physics may only describe the images of truth in a distorting mirror and the physical vacuum is this distorting mirror.

**Keywords**: Space, time, mass, ground state, theory of relativity.

## 1. Introduction

Space, time and mass are the most fundamental physical quantities in non-relativistic classical physics, where the standards of space and time are always the same everywhere, and the mass is an inherent attribution of matter. But three physical quantities become dynamic parameters in modern physics. For instance, in theory of relativity, mass, space and time vary with velocity and gravitational potential, and the space-time can be bent by gravitational field. For this reason, the descriptions in non-relativistic classical physics are considered approximate, and the descriptions in modern physics are considered more accurate.

However, we pointed out previously that more accurate quantitative descriptions in modern physics do not necessarily reflect deeper truth[1]. In this paper, we further consider the influences of vacuum on space, time, mass and energy and point out that these influences cause the physical quantities to deviate from their original values. Therefore, what modern physics may only describe the images of truth in a distorting mirror and the physical vacuum is this distorting mirror.

## 2. The essential differences of absolute and relativistic space-time

Newtonian space-time theory is called absolute space-time theory. Newton said[2]:

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> I do not define time, space, place and motion, as being well known to all. Only I must observe, that the vulgar conceive those quantities under no other notions but from the relation they bear to sensible objects. And thence arise certain prejudices, for the removing of which, it will be convenient to distinguish them into absolute and relative, true and apparent, mathematical and common.

Obviously, Newton considered that the absolute space-time theory is "as being well known to all", it is like an axiom, and Newtonian physics was just established on the basis of this axiom. There are absolute space-time as well as relative space-time in the absolute space-time theory. Measurement is a course of comparison between measuring tool and measured body, and the absolute space and time can not be measured directly because they have nothing to do with matter. Therefore physical space-time are all the measurable relative space-time, and the absolute space-time is abstracted from relative space-time. Then, what is most basic characteristic of absolute space-time theory? It is the invariability of space and time standards, which leads up to respective independence of space and time, and both of them have nothing to do with material environment. Owing to the invariability of space and time standards, everywhere we can establish a rigid three dimensional coordinate system and one dimension time axis, which are just a mathematical expression of a relative space-time in the absolute space-time theory. The mathematical expression of absolute space-time theory is the Galilean transformation, in which we can prove easily that the intervals of space and time are invariant, namely the invariability of space and time standards.

Physical space-time are all the measurable relative space-time, their value would have closely relation to measuring tools. The measuring-rods and clocks can vary with the temperature, which cannot be believed that is the change of space and time. The standards of space and time were defined by light in modern physics. For example, a metre, the SI unit of length, being the length of the path traveled by light in vacuum during a time interval of $1/(299{,}792{,}458\times10^{8})$ second, where the length of the path traveled by light in vacuum during a time interval of one second is always 299792458 meters whether it is fast or slow, the light speed turns into an invariable defined speed. The modern physics is just established on the basis of such a space-time standard, or modern physics takes light as the measure of space-time. Such defined space-time standards can suit well with actuality because light velocity is the known most quick velocity spreading information. Here as showed by the theory of relativity, the standards of space and time can change, which is believed universally by physicists that this change is the change of space-time itself. Actually we can make such a understanding that it is only a change of space-time standard, space-time can not change itself because it is without shape and size.

Taking a change of the space-time standard as a change of space-time itself is a practicable mathematical model, but the physical quantities deviated from their original meaning.

Some can say that nothing is real besides observable things in physics, absolute matter, space and time are the unmeaning. This word is wrong. Absolute concepts such as matter, space and time are the abstracts of essential attribute of things, although they are the unmeasured, yet they even the more true and meaningful than measurable relative concepts. Quantum mechanics shows that any conservation law corresponds to a invisible quantity. For instance, the energy conservation

corresponds absolute time; the momentum conservation corresponds absolute spatial location etc.. The conservation laws of energy and momentum have universality, those corresponding relations are the reflection of objectivity of absolute concepts.

## 3. The physical mechanism of relativistic space-time theory

Relativistic space-time theory is the foundation of modern physics, in which space-time can vary with velocity and gravitational potential. What is the physical mechanism of these changes? This question cannot be answered within relativity itself because it is like a system of mathematical axiom that derived a series of formulas from several principles, but does not relate to their physical mechanism. Indeed, Wang[3] commented that the essence of relativity is the effect of cosmic background field but the latter is concealed such that the theoretical question of relativity cannot be studied and answered from the angle of matter.

What is the cosmic background field matter? It is the physical vacuum. The original meaning of vacuum is a space without object (the matter with mass), but modern physics showed there are vacuum tunneling effect, vacuum phase change, vacuum condensation, vacuum domain structure etc. in a vacuum, which indicate that the vacuum is like a medium, and it is a physical reality[4]. The discovery of Casimir effect[5,6] confirmed that the physical vacuum is a matter and is not a void space. The object is a matter with mass, and physical vacuum is a matter without mass.

The theory of relativity, in fact, showed the hidden interaction between object and physical vacuum. We call the macroscopic physical vacuum Ether, and proposed the theory of compressibility ether[7], which is a supplement for the theory of relativity, whose physical mechanism，including the essence of Lorentz invariability of vacuum, can be revealed on the basis of ether. We pointed out that absolute and relativistic space-time theories are two different space-time theories in nature. in the absolute description based on the absolute space-time theory, the ether is a compressible superfluid; the distribution of its density is closely related to the objects in the unified ether ocean of the cosmos; an object is the core of a ether density wave-packet, and its mass center is the point of maximal value of the ether density.

While in the relativistic quantitative description, the ether was treated as the four dimensional space-time continuum, which is homogeneous and isotropic everywhere because relativistic space-time standard can vary with ether density: the unit length is proportional to an interval between two adjacent particles of ether fluid, and the unit time is proportional to the time interval that the light travels through an interval of particles of ether fluid, then where the density of the ether is greater, a measuring-rod become shorter, and a clock runs more slowly. Therefore the essence of relativistic space-time is a matter, and the relativistic bend of space can be considered that is the bend of this matter. In the view of absolute space-time theory, the relativistic bend is a mathematical description of ether density's rate of change. The corresponding relationships between quantitative and absolute descriptions are as follows: the absolute value of the

gravitational potential corresponds to the ether density; the mass corresponds to the increment of the ether density; and the energy corresponds to the increment of the ether pressure. When an object is moving, the ether around it is only waving and without ether wind.

Now the physical mechanism of relativistic phenomena can be described, they result from the variability of the ether density: if an object moves in a compressible ether, its own density of ether wave-packet is increased such that its length standard becomes shorter, and its time standard becomes slower; because the ether density corresponds to the gravitational potential, therefore the standards of length and time can vary with gravitational potential.

The theory of quantum field considers that a vacuum is the ground state of quantum field. We call the vacuum where an object is located Ground State, which is local and is varied because the distribution of ether density is non-uniform in vacuum. Different ether density corresponds to different ground states, and the standards of length and time can vary with ground states.

## 4. Mass varying with ground state

At first the mass is defined by Newton: "the quantity of matter is the measure of the same, arising from its density and bulk conjunctly."[2] There are two meanings in this definition, first, it indicated the essence of mass that represents the quantity of matter, which refferred to object of course; second, it explained the measure, the mass is the product of density and bulk.

Newtonian mass' essence was accepted widely by people. He proposed method measuring mass with density and bulk has certain practicability. Nevertheless people, in fact, determine mass generally through interaction, such as using gravitation and Newton's second law, which are indirect methods and would deviate from mass' original meaning more or less.

There are closely relations between mass $m$ and energy $E$: $E = mc^2$, where the $c$ is light velocity. As is known to all, the energy of a body is different in different frame of reference, or the energy has relativity. The theory of relativity showed that also the mass has relativity: the mass can vary with relative velocity $v$ between two frames of reference or gravitational potential $\varphi$ where it is located:

$$m = \frac{m_0}{\sqrt{1 - v^2 / c^2}} \qquad (1)$$

$$m = \frac{m_0}{\sqrt{1 + 2\varphi / c^2}} \qquad (2)$$

The meaning of Eq.(1) is that when an object is moving in a compressible ether, its density increment of ether wave-packet itself is higher than it is at rest; and the meaning of Eq.(2) is that the mass of an object can vary with gravitational potential in its ground state due to the ether density, which corresponds to the gravitational potential. For instance, two objects M, N, their

masses are the same in same ground states; and their masses are different when they are separately in different ground states. As fig. 1 shows, the observer on the object M considers that the ether densities are all the b everywhere including where the N is located in vacuum, but the mass of N becomes bigger.

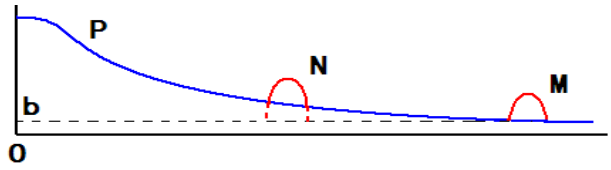


**Fig. 1. Illustration of mass varying with ground state.** The x-axis represents radius of vector; the y-axis represents the ether density or absolute value of the gravitational potential; a heavenly body is located at the point O, and its gravitational potential distribution of sphere symmetry is showed as the blue long curve P; the two red short curve M, N are the ether density wave-packets of two bodies.

The relativity of energy is quite obvious, while the relativity of mass is concealed comparatively because the ratio of mass to energy is $1/c^2$, so that it is difficult to be detected. Relativistic mass corresponds to the increment of the ether density; and relativistic energy corresponds to the increment of the ether pressure, both of them are relative to ground state, which is a starting point of energy as well as a starting point of mass. Therefore mass and energy are the accompanying relationship, having mass must have energy; having energy must have mass. The annihilation of positive and negative particles, not that the mass transform into the energy, but that the mass and energy of the positive and negative particles transform into the mass and energy of the photons. The mass is as conservation as energy. The relativity of mass and energy do not affect their conservation because the conservation refer to a closed system in one ground state.

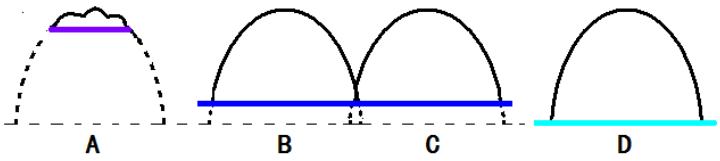


**Fig. 2. Illustration of mass of a nucleon in different ground states.** The green line represents the ground state outside an atomic nucleus; the blue line represents the ground state within an atomic nucleus among nucleons; the purple line represents the ground state within a nucleon; A, B, C, D represent the nucleons in different ground states. The higher energy level of the ground state, the less a nucleon's mass seems.

There are further instances to explain the change of mass along with ground state. As fig. 2 shows, the mass of a free nucleon D is higher than nucleons B or C within an atomic nucleus; and the mass of nucleon A is far higher than the mass sum of three quarks composed nucleon A, which results from the difference of ground states. There is a case in point: the highness of Mt.

Everest, is 8844.43 meters relative to sea level, and is about 4000 meters relative to the Tibetan plateau, even is several hundred meters relative to adjacent valley of it because it is only very small part of whole mount. Therefore different ground states are different energy levels as a whole, it is discrete in microscopic system, and it is continuous in macroscopic system, which is showed as fig. 3. The mass in modern physics varying with ground state already deviated seriously from its original meaning that represent object's quantity.

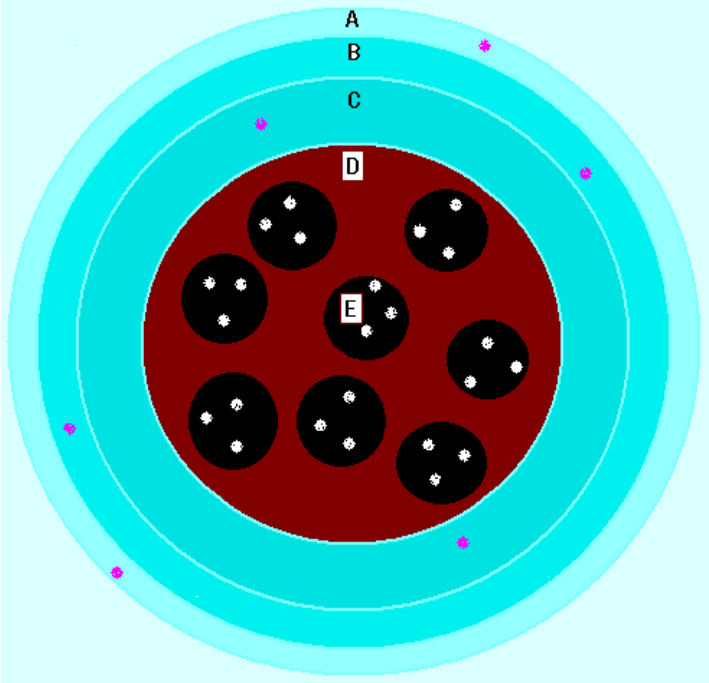


**Fig. 3. Illustration of ground state in an atomic nucleus within and without.** The different blue colors represent different energy levels outside an atomic nucleus; the brown represents the ground state within an atomic nucleus among nucleons; the black represents the ground state within a nucleon; the white points stand for the quarks; the red points stand for the electrons.

## 5. Conclusion

In this paper, we have considered the interaction between matter and the vacuum. As shown above, the change of space-time in modern physics is only a change of space-time standard and the values of mass and energy are relative to the ground state of vacuum. Therefore, modern physics may only describe the images of truth in a distorting mirror and the physical vacuum is this distorting mirror.

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