

# Mass-Energy Equivalence Versus Higgs Mechanism

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**To cite this article:**

Amrit Srečko Šorli. Mass-Energy Equivalence Versus Higgs Mechanism. *American Journal of Modern Physics*. Special Issue: Insufficiency of Higgs Mechanism. Vol. 7, No. 4-1, 2018, pp. 1-4. doi: 10.11648/j.ajmp.s.2018070401.11

Received: June 14, 2017; Accepted: June 19, 2017; Published: July 11, 2017

**Abstract:** In Einstein Relativity mass of a given particle is related to the amount of the energy that is incorporated in the particle. Relation between mass  $m$  of the particle and energy  $E$  of the particle is expressed in famous formula  $E=mc^2$ . Higgs mechanism open in physics new view on mass of the elementary particles, namely, that a given field which has appeared after Big Bang has given mass to the elementary particles. From the view of mass-energy equivalence, Higgs mechanism view on mass has several drawbacks. Furthermore Higgs boson is an artificially man made flux of energy with extremely small lifetime and does represent a direct prove for the existence of Higgs field.

**Keywords:** Mass of Elementary Particles, Mass-Energy Equivalence, Higgs Boson, Higgs Field

## 1. Introduction

The very idea that some field should exist which gives mass to the elementary particles is not in accord with mass-energy equivalence. The Higgs mechanism view on mass of elementary particles has origin in misunderstanding what is mass of a given particle. According to Einstein formula mass of a given particle is proportional to its energy which is expressed in formula:

$$E = mc^2 \tag{1}$$

The formula can be written also as follows:

$$m = \frac{E}{c^2} \tag{2}$$

For example, mass of the proton  $m_p$  is corresponding to the amount of the energy  $E_p$  which is incorporated in the proton. Mass of a given particle and energy of a given particle can be transformed into each other, basically they are made out of the same “stuff”. Mass is energy and energy is mass. There is not appropriate to think, that mass of a given particle in order to exist require existence of some hypothetical field, named “Higgs field”.

A proton exists in space which has its energy density. In empty space energy density of quantum vacuum has the

value of Planck energy density  $\rho_{PE}$  :

$$\rho_{PE} = \frac{m_p \cdot c^2}{V_p} \tag{3}$$

Proton is diminishing Planck energy density in its centre according to the following formula:

$$\rho_{qvE} = \rho_{PE} - \frac{mc^2}{V} \tag{4}$$

where  $\rho_{qvE}$  is the energy density of quantum vacuum in the centre of proton  $V$  is the volume of proton  $\rho_{PE}$  is Planck energy density.

Out of formula (4) we can get: [1]

$$\frac{(\rho_{PE} - \rho_{qvE}) \cdot V}{c^2} = m \tag{5}$$

where  $m$  is the mass and represents the amount of energy of quantum vacuum which is structured in a proton.

Out of (5) we can get:

$$(\rho_{PE} - \rho_{qvE}) \cdot V = mc^2 \tag{6}$$

Out of (6) we get enlarged Einstein formula: [2, 3].

$$E = mc^2 = (\rho_{PE} - \rho_{qvE}) \cdot V \quad (7)$$

In formula (7) the right side is the missing part of the Einstein formula and is expressing relation between mass of the physical object and diminished energy density of quantum vacuum in its centre. Mass  $m$  represent the amount of energy of quantum vacuum, which is structured in a given

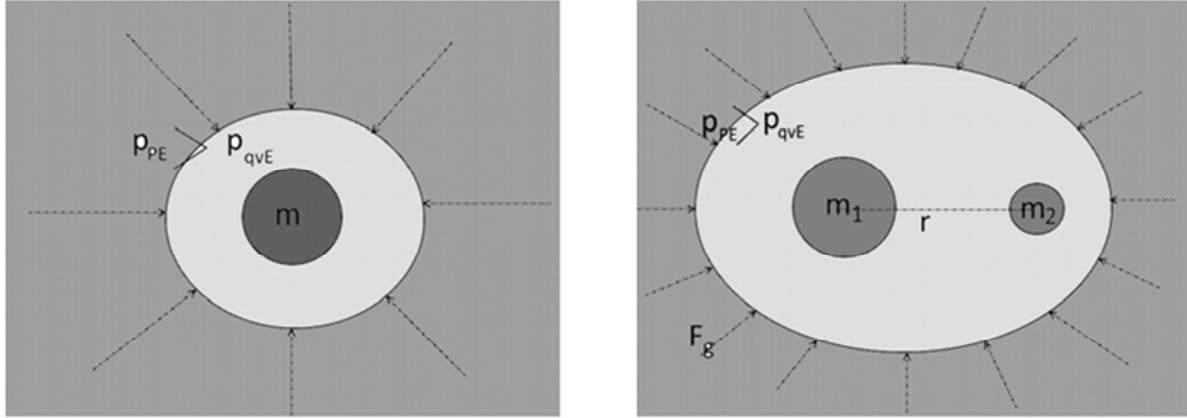


Figure 1. Inertial mass and gravitational mass.

Inertial mass and gravitational mass are two terms for the same physical phenomenon which is the quantum vacuum pressure towards the centre of a given particle or massive body. Particles and massive bodies exist in quantum vacuum and they cannot be examined separately from the diminished energy density of quantum vacuum which they create. Inertial mass  $m_i$  or gravitational mass  $m_g$  of a given massive particle or massive body is equal to the amount of energy of a given particle or massive body:

$$m_i = m_g = m \quad (8)$$

## 2. Higgs Field Insufficiencies

Higgs field does not interact with gluons which represent 99% of proton mass. The energy of 2 upper quarks and 1 down quark is large enough to cover about 1% of the proton mass. The rest of the proton's mass has its origin gluons which represents a serious weakness of the Higgs mechanism, because the binding energy of the gluons represents 99% of the proton mass. Higgs mechanism does not explain equality of inertial mass and gravitational mass which are one of the main achievements of Einstein's Relativity Theory. Higgs boson is artificially made particle. Its existence in the universe in its natural state is not proved and will probably never be proved. On the base of artificial made particle no consistent hypothesis can be made. Higgs boson is not the direct proof for existence of Higgs field which should give mass to the massive particles. In physical universe phenomena of mass and gravity always appear together. Higgs mechanism deals only with mass and is taking not in account gravity. Higgs mechanism does not provide physical parameters of Higgs field. There is not clear, what is the physical basis of the Higgs field. For

particle or massive body. Higher energy density of quantum vacuum is pushing towards the centre of a given particle or massive body where energy density is lower. This difference between outer and inner energy density generates inertial mass and gravitational mass of a given particle or massive body.

example Quantum Electrodynamics for example explain well what is electromagnetic quantum vacuum and how its works.

## 3. Mass, Rest Mass, Relativistic Mass, Inertial Mass, Gravitational Mass

Let's examine the relation between, mass, rest mass, relativistic mass, inertial mass, gravitational mass and energy of a given massive particle. R. I. Kraphko is pointing out: "Mass takes the place of inertial mass in modern physics textbooks. It seems to be wrong [4]. Kraphko is right. Mass means amount of energy incorporated in a given massive particle. Inertial mass means the diminishing of quantum vacuum energy in the centre of a given massive particle which causes that particle has resistance to motion or to be put in motion.

Let's take proton for example: mass of the proton is the amount of energy which is incorporated in the proton. Mass and energy of the proton are related with the formula:  $E = mc^2$ . Mass of the proton is its rest mass. In this sense rest mass means the amount of energy incorporated in the proton. Relativistic mass is the mass (in the sense of incorporated energy) when proton is moving with high speed. When proton is moving with high speed it additionally absorbs energy of quantum vacuum which is its kinetic energy. Proton is diminishing Planck energy density of quantum vacuum in its centre exactly accordingly to the amount of its energy. This is expressed in formula (7). Proton's inertial mass and proton's gravitational mass both have origin in the dynamics between proton mass  $m$  and diminished energy density of quantum vacuum. We cannot approach proton separately from the quantum vacuum in

which proton exists. They are always together; actually they are one phenomenon which we divide only in the theoretical models in order to understand the phenomena of mass, inertial mass and gravitational mass.

Area of diminished energy density of the proton is causing higher quantum vacuum pressure from outside which is "pushing" the proton from all directions to stay in the given position. This is proton inertial mass. Gravitational mass has the same origin as inertial mass: it is the result of dynamics: "proton – diminished energy density of quantum vacuum". The very idea that inertial mass and gravitational mass have origin in some particular fields (Higgs field, gravitational field) which exist apart from the quantum vacuum, seems theoretical failure. This theoretical failure is somehow "covered" by CERN team with discovery of Higgs boson which is not more than characteristic flux of energy released by collision of two protons. The starting idea of Peter Higgs that fermions get mass from some field seems wrong. In physics mass means amount of energy that is incorporated in a given massive particle. Fermions have their own energy which is their mass according to the formula  $E = mc^2$ . When we understand that mass of fermions is their energy there is no need to think about the origin of their mass. They have mass because they have energy. Matter and energy are two different forms of the same "stuff".

This "stuff" is electromagnetic quantum vacuum of QED. When you add to the model of QED Planck energy density of quantum vacuum [3], you see that inertial mass and gravitational mass of physical objects from the micro to the macro scale have origin in dynamics between objects mass (mass as amount of energy) and correspondent diminished energy density of quantum vacuum.

Also photon has energy and can be seen as having mass in the sense of Einstein formula  $E = mc^2$ . Sure, photon has no rest mass, photon is the wave of electromagnetic quantum vacuum.

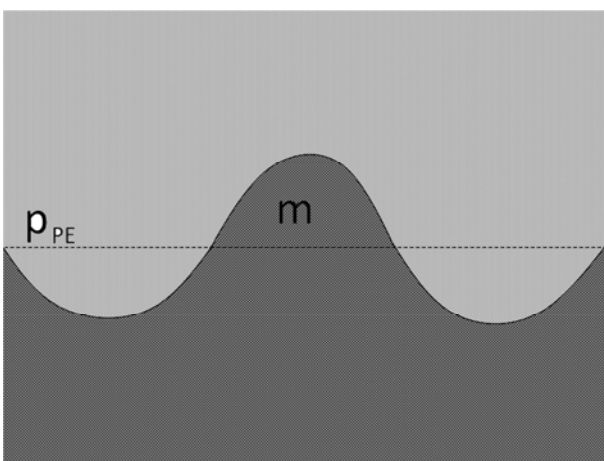


Figure 2. Photon mass.

Combining formulas  $E = mc^2$  and  $E = h\nu$ , we get mass of the photon is:

$$m = \frac{h\nu}{c^2} \quad (9)$$

Recent research suggests that matter (for which is characteristic that it has rest mass) is made out of light [5]. In this perspective massive particles can be seen as different structures of massless particles. Proton and neutron are the only elementary particles for which we can say that they have rest mass. We cannot use term "rest mass" for quarks, because quarks alone do not diminish energy density of quantum vacuum. Quarks have their energy, but they do not have rest mass. The composition of quarks and gluons builds proton which has rest mass.

#### 4. Higgs Mechanism Model Is not Falsifiable

Albert Einstein used to say: *Everything should be made as simple as possible, but not simpler*. Higgs mechanism does not pass Occam's razor principle. It is complicated in a sense that some particles are interacting with the Higgs field and another are not interacting. The statement, "Higgs field is giving mass to the massive particles", is not falsifiable. Also the statement, "Higgs boson is the ripple of Higgs field", is not falsifiable.

In CERN experiment are colliding about hundred millions of pairs of protons each second and only few collisions produce Higgs boson. What about other pairs collisions? Why only 1 in ten billion of collisions produce Higgs boson? These are questions which will remain unanswered forever because the Higgs mechanism is not a falsifiable model.

Further on, the result of our research is that a given signal can move only in space and time is the numerical order of its motion. This means that CMBR signal cannot move from some remote physical past to the present moment of measurement. CMBR signal has the origin in the quantum vacuum where is always NOW [6,7,8,9]. Also result of other research confirms, Big Bang Theory seems false, universal space is infinite and universe did not start from singularity [10]. Considering Big Bang Theory is not an adequate model of the universe, the Higgs field could not appear in a certain time after Big Bang. This is another serious inconvenience of Higgs mechanism.

#### 5. Conclusions

Mass-Energy Equivalence does not require a particular field that would give mass to the elementary particle. Mass of massive particles has origin in their energy. The Higgs mechanism introduces a new view on mass which is not in accord with mass-energy equivalence. We have to distinguish in physics between mass as the amount of energy incorporated in a given physical object (which we also call rest mass) and inertial mass and gravitational mass which have origin in the dynamics between given physical object mass and corresponding diminished energy density of quantum vacuum.

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