Difference between QED and QCD

Article · April 2017

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Difference between QED and QCD

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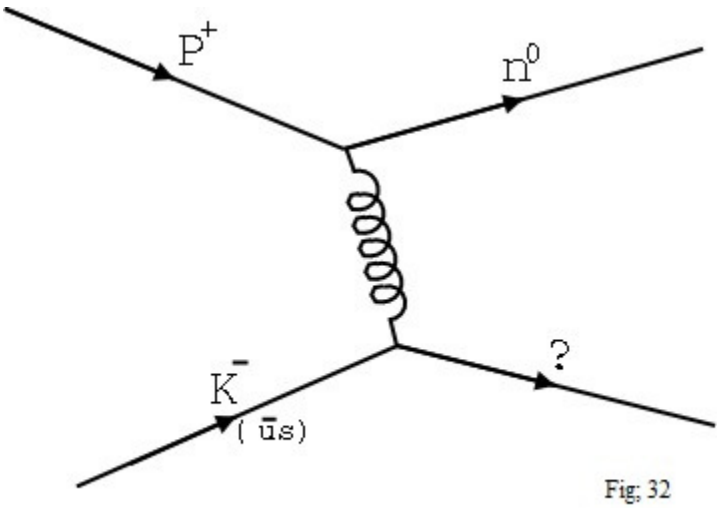
March. 4, 2017

"From the properties of the strong interaction it is possible to predict exactly what the unidentified particle will be - this is not possible with the weak interaction where flavour is not conserved."[1]



Fig; 32

http://pfnicholls.com/physics/Feynman6.png

[1] - This is my answer to question "What exactly is the difference between QED, QCD, Electroweak theory, Standard model, Quantum field theory and how are they related together?"

https://www.quora.com/What-exactly-is-the-difference-between-QED-QCD-Electroweak-theory-Standard-model-Quantum-field-theory-and-how-are-they-related-together

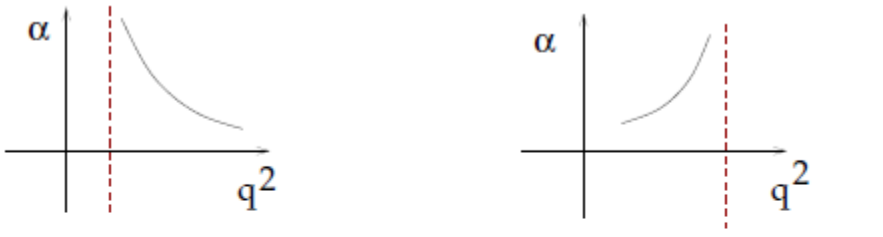
Difference between QED and QCD

In dealing with the interaction between charged particles (especially, two same charged particles) two case are remarkable and reviews.

1- Production binding energy between charged particles, especial in structure of nucleons.

2- Input and output particles in interaction charged particles process.

Two above cases, in two separate theories of quantum electrodynamics (QED) and quantum chromodynamics (QCD) are investigating. The difference between the two theories is related to the coupling constant of QED (alpha) and QCD interactions is referred to the Landau pole that is shown in following picture:



QCD *QED*

Fig; 33

Landau pole pictures in QCD and in QED.

https://www-thphys.physics.ox.ac.uk/people/FrancescoHautmann/Ralhep/ralss10_p.pdf

Picture: page 62 of An Introduction to QED & QCD

Viktor T. Toth, answered to the difference between QED and QCD… "The Standard Model of particle physics is the combination of electroweak theory and QCD in the form of a unified theory obeying a complex set of symmetries. This theory describes all the known fields and all the known interactions other than gravity."

Physics has encountered numerous problems and unanswered questions. Some physicists believe that by combining general relativity and quantum mechanics, these problems may be resolved and the unanswered questions will be answered.

In all of these efforts, the classical physic has been ignored, while nature is unique and all physical phenomena, from the microscopic or the macroscopic ones are obeying the same law. In generally, to combining QED and QCD, we cannot ignore gravity and following questions:

1- In quantum electrodynamics (QED) a charged particle emits exchange force particles continuously. This process has no effect on the properties of a charged particle such as its mass and charge. How is it explainable? If a charged particle as a generator has an output known as a virtual photon, what will be its input?

2- How two same charged particles repel each other in great distance and absorb each other at a very small distance.

Difference between QED and QCD

First of all, it should be noted that there is no force in the classic sense in nature. In Standard Model of particle, particles of matter transfer discrete amounts of energy by exchanging bosons with each other.

Due this reason, a fundamental force is just binding energy between fermions such as quarks. This binding energy is electromagnetic energy that is called photon. In quantum mechanics, tiny packages of electromagnetic energy called photons and the force carrier for the electromagnetic force (even when static via virtual photons). But there is difference between real photon (package wave of electromagnetic energy) and virtual photon that the force carrier for the electromagnetic force in CPH Theory.

There are many articles that show, photon has upper limit mass and electric charge, which are consistent with experimental observations. Theories and experiments have not limited to photons and graviton will also be included. For gravity there have been vigorous debates about even the concept of graviton rest mass.

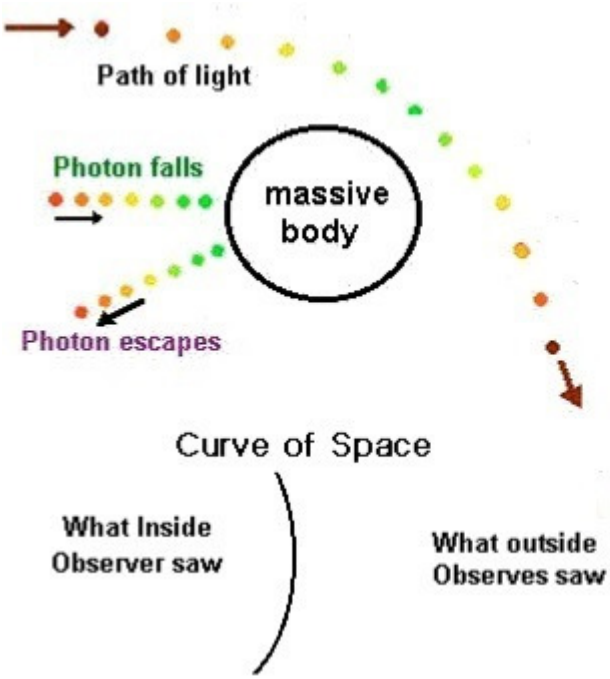
In recent decades, the structure of photon is discussed and physicists are studying the photon structure. Some evidence shows the photon consists of a positive and a negative charges. In addition, new experiment shows that the probability of absorption at each moment depends on the photon's shape, also photons are some 4 meters long which is incompatible with unstructured concept.

For study and understanding the photon structure we need to describe relation between frequency and energy of photon. The change of frequency of the photon in the gravitational field has been demonstrated by the Pound-Rebka experiment. When photon falls a distance equal y toward the earth, according to conservation law of energy we have:

Color-charges and magnetic-color

A photon with the lowest possible energy also carries electric and magnetic fields. Therefore, the features of gravitons entered into the structure of the photon must behave in a way that along with explaining the energy of photon, describes increasing in intensity of electric and magnetic fields. In other words, some of these gravitons cause increasing the electric field of photon and some other gravitons increase the intensity of magnetic fields. Also, not only a photon at lowest level of its energy is formed by some of the gravitons, but also its formed members have electric and magnetic properties that is called color-charge and magnetic-color in CPH theory. The next step is to specify color-charges and magnetic-colors in which it is obtained by paying attention to at least change in energy of photon in a gravitational field while moving into blue shift of gravity.

Difference between QED and QCD



$$hv' = hv + mgy = hv + \left(\frac{hv}{c^2}\right)gy$$

$$v' = \left(1 + \frac{gy}{c^2}\right)v$$

Gravitons bend the space, in gravitational blue-shift, gravitons enter to photon structure and in red-shift photons decay to gravitons

Fig; 1

By producing positive and negative electric fields, two magnetic fields are produced around the electric fields do form. Therefore, it will be made two groups of magnetic-colors. So CPH matrix is defined as follows:

$$CPH = \begin{bmatrix} \kappa G^+ & \kappa G^- \\ G_m^+ & G_m^- \end{bmatrix} \quad (4)$$

G^+ is positive color charge?
G^- is negative color-charges
Right rotation color-magnetic G_m^+
Left rotation color-magnetic G_m^-

CPH matrix shows the least magnitude energy of a photon.

Sub-Quantum Energy (SQE)

We use CPH matrix to define positive and negative sub quantum energies as follow: The first column of CPH matrix is defined positive sub quantum energy and the second column of CPH matrix is defined negative sub quantum energy, so;

Difference between QED and QCD

$$\text{Positive Sub Quantum Energy: } SQE^{+} = \begin{bmatrix} \kappa G^{+} \\ G_m^{+} \end{bmatrix}$$
$$\text{Negative Sub Quantum Energy: } SQE^{-} = \begin{bmatrix} \kappa G^{-} \\ G_m^{-} \end{bmatrix} \quad (5)$$

Positive and negative sub quantum energies are shown as follow:

$$\text{Positive Sub Quantum Energy; } SQE^{+}: \triangleright$$
$$\text{Negative Sub Quantum Energy; } SQE^{-}: \triangleleft$$

The amount of speed and energy of positive and negative sub quantum energies are equal, and the difference between them are only in the sign of their color-charges and magnetic-color flow direction.

Virtual photons

There are two types of virtual photons, positive and negative virtual photons which are defined as follows:

$$\text{Positive virtual photon; } k \triangleright = \gamma^{+}$$
$$\text{Negative virtual photon; } k \triangleleft = \gamma^{-} \quad (6)$$

Where k is a natural number

A real photon is formed of a positive virtual photon and a negative virtual photon:

$$\gamma^{+} + \gamma^{-} = \gamma$$
$$(n \triangleright + n \triangleleft) = n(\triangleright + \triangleleft) \; or \; n|\triangleright\rangle + n|\triangleleft\rangle = \gamma \quad (7)$$
$$\gamma^{+} = k \triangleright, \; \gamma^{-} = k \triangleleft \rightarrow \gamma = \gamma^{+} + \gamma^{-}$$

Where, n , k are natural numbers. So far, the production of electromagnetic energy (photons) was described by using gravitational blue-shift, in reverse phenomena photons decay to negative and positive virtual photons. In redshift, virtual photons also decay to positive and negative sub quantum energies (*SQE*s), and sub quantum energies (SQEs) decay to color-charges and magnetic-colors, too. Color-charges and magnetic-colors away from each other, lose their effect on each other and become gravitons. In addition, there is a relation between the number of SQEs in structure of photon and energy (also frequency) of photon.

Difference between QED and QCD

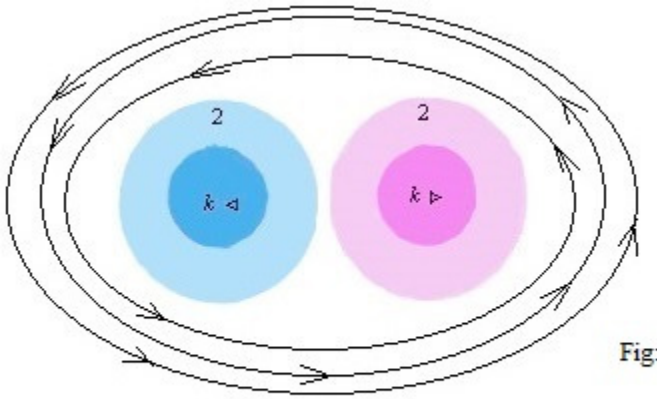


Fig: 3

A photon is formed of $k \triangleright + k \triangleleft$, but magnetic fields around $k \triangleright$ and $k \triangleleft$ prevent them from this combination

So, photons are combination of positive and negative virtual photons. Photon is a very weak electric dipole that is consistent with the experience and these articles are asserted. In addition, this property of photon (very weak electric dipole) can describe the absorption and emission energy by charged particles.

http://web.mst.edu/~gbert/INTERACT/intermol.HTML Fig31

The combination of atoms or ions is no longer a pair of ions, but rather a polar molecule which has a measureable dipole moment.

Relation E=mc^2, photon structure and dipole moment of atoms show there is a closely likeness between matter and energy.

Sub Quantum electrodynamics

Consider a charged particle (e.g. an electron) that creates an electric field around itself and constantly is spreading (propagating) virtual photons. The domain of propagation of this electric field is infinity. According to well-known physical laws, there is no change in the electrical charge and mass of charged particle by emitting virtual photons that carries electric force (and it carries electrical energy too). Therefore, we have a permanent machine in which we know its production,

but we do not know about its mechanism and consumable and there is no information in this case. Just it is said that there is an electric field around any charged particle. How is created this field, what is its interaction with other electrical and non-electrical fields, including gravity, nothing is said, namely, there is no explanation.

Here according to the negative and positive sub quantum energies, the mechanism for generating electric fields, the dynamics of attraction and repulsion between charged particles are analyzed.

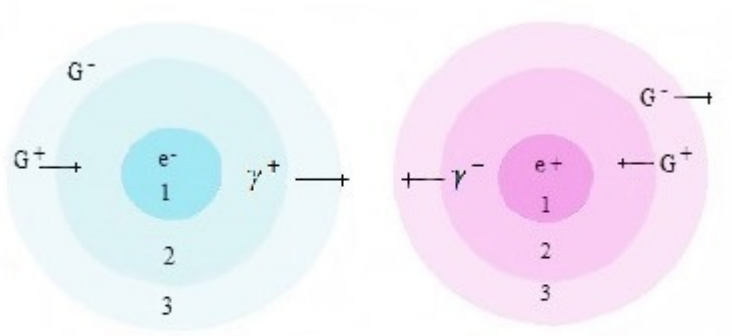
Electron is a set of negative color-charges that are preserved by electromagnetic field due to its surrounding magnetic-colors. This rotational sphere (spinning electron) is adrift (floating) in a sea of gravitons and as it already was explained, gravitons are converted to positive and negative color charges in vicinity of electron. There is same explanation for positron. Electron effects on existing color-charges around itself by having two special properties. Electron has continuous spinning state that can create an electric field that is formed of moving color-charges, then magnetic-colors are produced and then conditions are prepared to produce sub quantum energies. Positive color-charges are absorbed towards electron, but magnetic field around it is repellent of positive color-charges. By spinning movement of electron, a number of positive color charges are compacted and converted to positive virtual photon y (+) and are repelled by its surrounding magnetic field. As the same way, positron absorbs negative color-charges and its surrounding magnetic field compacts negative color-charges and propagates it as negative virtual photon y (-). Therefore, we can define an operator that expresses the process of producing positive virtual photons by electron. If we show this operator as follow that effects on electron and it is respect to time of y (+), it means that it creates the carrier of positive electromagnetic force, then we have:

$$\frac{d}{dt} \lhd s(G^{+}) = a \rhd = \gamma^{+} \qquad (11)$$

Where a, is a natural number. As the same way, positron behaves like electron that is similar to a generator and it produces and propagates negative virtual photons (Figure) and then we have:

$$\frac{d}{dt} \rhd s(G^{-}) = a \lhd = \gamma^{-} \qquad (12)$$

Difference between QED and QCD



Electron and positron are attracted each other by positive and negative virtual photons

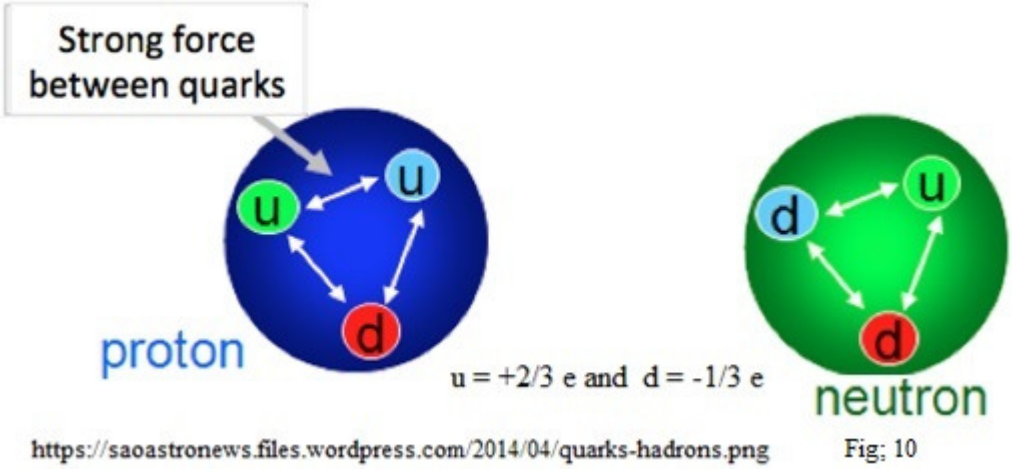
Fig: 4

When y (+) from the electron reaches to area 2 of positron, it combines with y (-) a real photon is created and positron accelerates toward the electron. The similar mechanism happens for electron.

Sub Quantum Chromodynamics

As we know in quantum mechanics, there is a strong interaction in nucleus of an atom and its range is short and less than the radius of an atom. Carrier of the strong interaction force that is called gluon is a particle with spin one (spin of photon is one, too).

Proton is formed of 3 quarks, two up quarks (u) with (+2/3) electric charge and a down quark (d) with (-1/3) electric charge P(udu) while neutrons comprise up-down-down, N(udd). The subject that how two quarks gather together with homonymous charged particles is a problem that still there is some theoretical problems and intuitive justification about that in modern physics that can be consistent with experiments.



https://saoastronews.files.wordpress.com/2014/04/quarks-hadrons.png Fig; 10

Difference between QED and QCD

Protons and neutrons are hadrons, each comprising three quarks. Protons comprise up-up-down quarks, while neutrons comprise up-down-down. All hadrons are held together by the strong nuclear force. (Credit: Swinburne Astronomy Online)

The explanation is given in modern physics is that boson (gluon) with spin one is carrier of color charge force between quarks and it is stronger than electric force. However, the reason and mechanism of strong interaction is easily explainable by using sub quantum energies.

Electric charge of proton and anti-proton is equal to electric charge of electron and positron respectively. Independent of proton and anti-proton mass, we have the following expressions in this process about color-charge conservation:

Pair production and decay of "electron-positron"

$$E = k(\triangleright + \triangleleft) \rightarrow e^+ + e^- = (e^+ = k \triangleright) + (e^- = k \triangleleft) = k(\triangleright + \triangleleft)$$

$$e^+ + e^- \rightarrow 3\gamma = 3\left(\frac{k}{3}\triangleright + \frac{k}{3}\triangleleft\right) = k(\triangleright + \triangleleft)$$

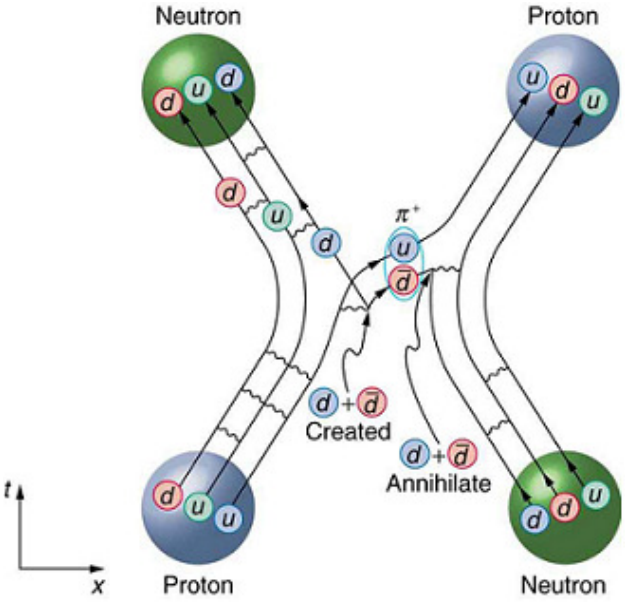
$$k \triangleright = e^+, \qquad k \triangleleft = e^-$$

$$u = \frac{2}{3}k \triangleright, \qquad d = \frac{1}{3}k \triangleleft$$

$$\bar{u} = \frac{2}{3}k \triangleleft, \qquad \bar{d} = \frac{1}{3}k \triangleright$$

Fig: 36

Difference between QED and QCD



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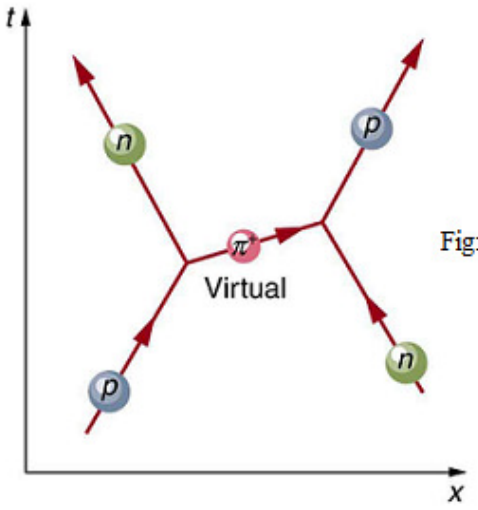


Fig: 34

Right side: the Feynman diagram is the same interaction

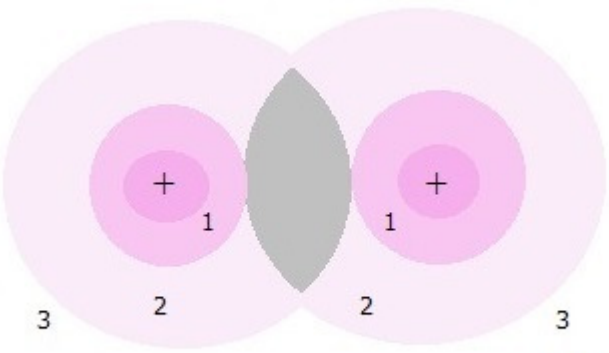
Left side: shows the quark and gluon details of the strong force interaction

The strong force is complicated, since observable particles that feel the strong force contain multiple quarks.

In general state, we suppose that two electric charged particles A and B, (both of them with positive charge), lie in a bigger distance of the radius of proton. As explained in the previous section, each positive charged particle repels positive color-charges and absorbs negative color -charges. The magnetic field around it compacts these negative color-charges and emits it as negative virtual photon in the space. When the distance between these two particles is high (more than the radius of nucleus of atom), before that emitted negative photon y(-) reaches from second particle to first particle, repelled positive color-charges by first particle have left the environment (they have got away from the charge surroundings). While in short distances, the repelled positive color-charges by a particle combines with negative color-charges around another particle and create electromagnetic energy.

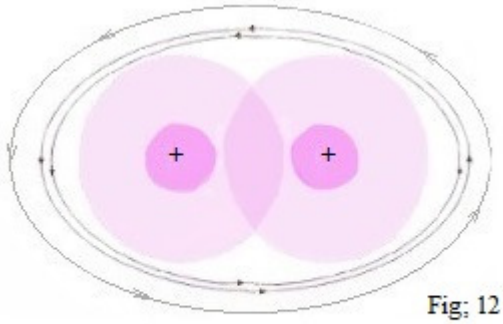
Suppose that the particle A produces a negative virtual photon y(-) in the time dt, it repels a number of positive color charges that can produce a positive virtual photon y(+). If we consider the distance between these two particles, supposing speed of y(-) is at least equal to speed of light c, if $d > cdt$, the repelled positive color-charges by each particle is ineffective on negative color-charges around the second particle. If $d < cdt$, the mechanism of attraction and repulsion of color-charges by each particle interfere with the mechanism of the other particle, positive and negative color-charges are converted to electromagnetic energy and these two particles absorb each other. Because if $d < cdt$, the binding energy between two particles A and B is stronger than repulsive electrical force between them.

Difference between QED and QCD



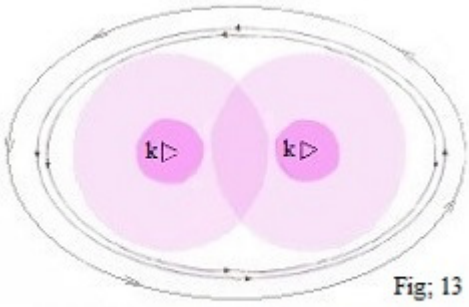
Interconnect two positive charged particles Fig; 11

Nuclear fusion in the center of stars is repeating this process. When two homonymous charged particles became close enough to each other , their magnetic fields are united and keep togther these homonymous charged particles like plasma of charged particles (following figures). In the center of the stars, due to high speed (transitive energy) of nuclues of atoms, they come close enough together and protons (in fact quarks) fall in each other color-charges areas and provide the necessary binding energy and nucleuses do fusion. There are many protons (in fact quarks) in a heavy nucleus, the number of quarks can have common color-charges area and absorb each other.



Fig; 12

The magnetic field around two same charged particles

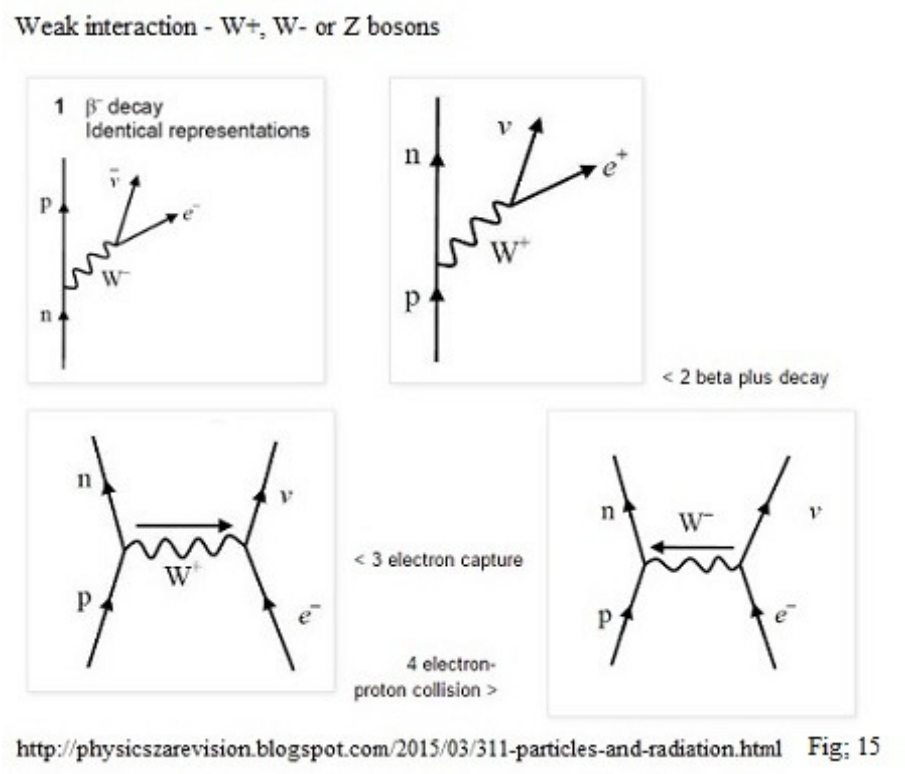


Fig; 13

Magnetic field around two same *SQEs*.

Difference between QED and QCD

But if d = cdt, then the electrically charged particles are neural with respect to each other (following figure), which can produces vector bosons (weak nuclear interaction), so behavior of electromagnetic and weak nuclear interactions are very similar. This process can be used to explain the weak interaction as follows:

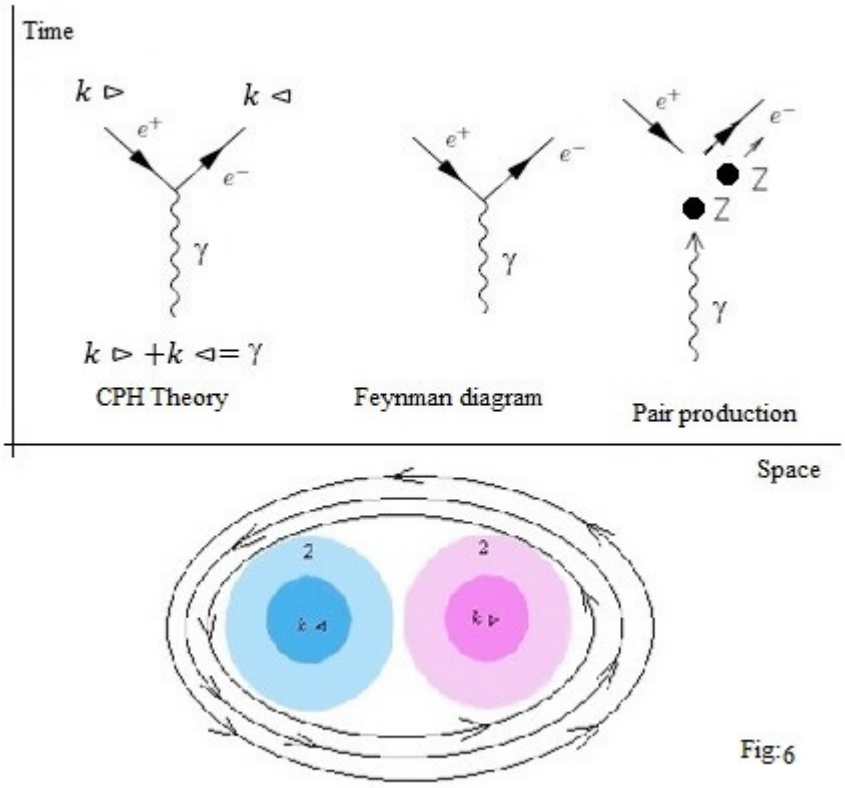


http://physicszarevision.blogspot.com/2015/03/311-particles-and-radiation.html Fig; 15

Paying attention to internal structure of photon is very useful and important for better understanding of QCD and QED. Mass-energy equivalence includes the concepts and applications beyond the concept of converting mass to energy and vice versa. Something that occurs from the interactions between quarks in the structure of protons is the logical result of the interaction between positive and negative sub quantum energies in the structure of photon. In addition, during conversion of energy into mass, properties of interactions between positive and negative sub quantum energies are transferred from structure of the photon to particles and anti-particles. The same process that happens for two non-homonymous charged particles (in the nucleus of atoms) in center of stars, happens for formation of the negative and positive virtual photon by negative and positive sub quantum energies.

Difference between QED and QCD

Positive and negative sub quantum energies are shown as follow:



The photon collisions with nucleus, photon disintegrates and converts to electron and positron

Attention to photon structure and using new definitions for graviton, charged and exchange particles, will change our perspective on modern physics. It also provides us with a new tool to be able to overcome physics problems in a better way. This approach will show us how particles are formed and when physical symmetries are broken spontaneously.