Symmetry aspect of Confined Quantum Field Theory

Mohammad Fassihi

(Confined Quantum Field Theory Research)

mohammadfassihi@gmail.com

Abstract; Relation between conserved quantities in physics and symmetries of space-time is well established by Noether`s theorem. We develop this fact in Confined Quantum Field Theory by stating that conserved quantities in physics are in fact breaking of the symmetries.

Introduction;

Confined Quantum Field theory is a fundamental theory with many aspects. A total and comprehensive description of this theory is almost impossible in a single article. This theory is presented and discussed in many seminars and conferences, which one can observe its reflection in the proceeding of the conferences. Starting with ref [1] which was the formal presentation of this theory. There focus is on divergent problem in quantum field theory.
It is customary to avoid divergence in quantum field one apply cut-off which is a pragmatic method without any physical explanation. By assuming that all state functions have compact support. The scattering process becomes more manageable. Since energies over a bounded domain is finite and finite functions integrated over bounded domain always gives finite result. Therefore there would be no divergence and no renormalization is needed.
To assume that all state functions have compact support even in the free state, irritate many. Specially those who follow quantum ritual without questioning.
The new way of managing the scattering in quantum created a new enthusiasm which was reflected in the EDS05/Accueil - Rencontres de Blois, ref [2]. Of course a scattering theory in which all cross-sections are bounded is very promising, since all the integrations are over well-defined bounded domain. But it comes in conflict with the huge and ineffective existing calculating machinery. This conflict is reviewed in the Universalities in the Complex Science, ref [3].

Of course the essential and central point in Confined Quantum Field Theory is not ended with the questions in scattering theory but more fundamental consequences. When we apply general relativity (relation between the metric of space and energy density), we do not receive some significant effect. But if we assume that the domain of quantum is bounded then we get a change in the radius of the confinement due to the energy density. This also changes the scattering cross-section. In ref [4] Computational Quantum Field Theory - of ICHEP 2004 the focus is on asymptotic freedom, which is the shrinking of the cross-section due to the higher energy.
It is not difficult for the reader to observe that generally particles with higher energy occupy a smaller space. Just look at light and the photons. The photons with higher energy are able to penetrate through smaller holes or gaps and slits. This is manifested in the “squeeze of photon” experiment. This experiment deal with the case that the hole or gap is small enough such that the photon cannot passes without collision with the wall of gap and therefore it is scattered in all directions. This experiment says that in fact the size of photon is measurable. The relation between

the size of support of state function and the particles energy radically changes the pictures of the electrons in the solid state ref [5]. Of course to see the elementary particles as a bounded manifold is not easy to digest for the people grown with the standard quantum, it is to say (A point particle that is also wave and with some probability can be anywhere). In fact a bounded manifold can represent all experimentally observed properties of a particle. The article “why the light changes direction in entering the water” ref [6] deals with this problem.

Strong and weak breaking of symmetry.

Existence of physical objects is in fact breaking the symmetry of the space-time. A flat undisturbed space-time contains no physical objects and thereby no energy. This opposes in fact the standard statement of quantum that undisturbed space-time namely vacuum should poses energy. A general approach to represent a physical object in space-time is to introduce a manifold embedded in the space-time. A manifold has two distinct properties, topology and metric. Weak breaking of the symmetry is the case when the metric represents by continuous and differentiable function. And strong breaking of the symmetry corresponds to the discontinuity. This is the mathematical base and starting point of Confined Quantum Field Theory. Originally Confined Quantum Field Theory defined to be a quantum field in which all the state functions have compact support. The compactness of the support of the state function follows although from the more general approach in which the elementary particles are bounded manifolds. That the manifold equipped with other topology and metric embedded in flat space is equivalent with strong breaking of the flat space-time symmetry at the boundary of the manifold. A particle in physics is just field with strong breaking of the symmetry at the boundary.

Qualitative and quantitative aspect of breaking the symmetry.

Qualitative aspect is the topology we assign to the manifold and quantitative is the metric of the manifold. When we relate energy to the breaking of the symmetry of the flat space then the quantity of the energy naturally is a measure of this deviation. These two aspects summarized in saying that basic and elementary particles in physics are bounded manifold with the topology assign the type of particle and metric the energy density.

More about physics.

At the moment the most reliable base to stand on is the conservation of energy or no energy no physical object. All physical elementary objects as electrons and photons have internal structure. Therefore cannot be a mathematical point. An isolated mathematical point has no physical meaning. Therefore we must assume that elementary particles cover some part of the space. This disturbance of the space cannot be overall and therefore must be confined. Shortly all elementary particles are confined field.

What is quantum then?

In Confined Quantum Field Theory the quantum object is nothing but a connected field captured in a bounded domain. If we relate to this domain a topology and metric it is capable to present all the physical properties and dynamic we observe in the experiments.

Already ancient Greeks spoke of the atom or the indivisible which still is central in what quantum is. If we think about an elementary particle as a bounded manifold with its metric related to energy density to divide means to create discontinuity in the manifold. This demands infinite energy and is not physical. Of course there are particles that we in laboratory divide and create new particles, but particles are not from the beginning single connected manifold with continuous differentiable metric overall. Look for example at a photon. We cannot simply take part of the energy of a single photon. In contact with a charge particle the whole photon absorbs or if there is no place for all its energy the charge particle reject it. Therefore the simple answer to the question “What is Quantum” is that quantum is “confined field”. Of course all fields do not need to be confined. When we defined a particle as confined field represented by bounded manifold, the particle due to its nature disturb its surrounding and create fields like electric, magnetic or gravitational. These fields do not have compact support and goes in a classical way to zero at infinity. In Confined Quantum Field Theory we do not have any contradiction between classical field and quantum field. Quantum field is just a field which is confined, like a photon.

Conservation of energy in the quantum.

Conservation of the energy is basic even in the quantum. In Confined Quantum Field Theory elementary particle as electron is a bounded manifold and photon a sub-manifold. When an electron accelerates emits electromagnetic energy in form of photon. If we think of electron as a point and not a manifold we will get a lot of problem. This was in fact the wrong picture in the beginning that physicist had. Assuming electron a point particle going around the nuclei in the same way that earth goes around the sun. An electron in the bounded state is a connected manifold covers some space around the nuclei, therefore energy stays inside the domain of manifold and we do not have electromagnetic emission.

Since both electrons and photons are bounded manifolds and not simply points in space, they cover some part of space that we may call support of theirs states function which in Confined Quantum Field Theory are compacts domain. A short time after acceleration of the electron the two domains have overlap and the separation of the electron and photon is not completed. If during this short time the electron receives retardation the photon goes bake to its original position. This may give false signal that during this short time the energy was not conserved.

Internal symmetries in Confined Quantum Field Theory.

The topology of the manifold represents the kind of particle and the metric the energy density. This means that we cannot change the nature of the particle just by injecting energy to it. Topology on the other hand is very general and can accommodate any kind of physical properties. In order to go from abstract topology towards more structural mathematic, we can introduce sets of fibers. Topology basically is the way points are positioned towards their neighbors. Therefore we introduce

sets of lines or fibers connecting neighboring points. By choosing specific sets of fibers we are able to give structure to the manifold to represent a specific particle.

Invariance and conserve quantities in the confined field.

Experimentally we know that spin of a particle do not depends on the energy of the particle. This is although true for other invariance. Mass of electron and other elementary particle (neglecting relativistic effect) stay the same as we increase or decrease their energy. All this kind of values belongs to the topology of the manifold. Topology that obliges sets of fibers to go around the manifold a few turns to come to its original point is a kind of symmetry that very well define a spin. Total length of such fibers is a good candidate for the mass and so on.

Relation between radius of confinement and energy.

We connected the curvature of the space-time and energy density. Suppose locally in one direction we can approximate the curvature as e^{iax} . This is an oscillating curve which oscillates stronger with greater value of a . Let's study a piece the curve in one period which is $\left[0, \frac{2\pi}{a}\right]$. The energy density is proportional to the second derivative of the curve thereby proportional to a^2. Integrating the energy density over a period we get a proportionality of energy with the value a^2 . Observe that integration of energy density is over the path in the quantum domain. The length of these paths is a conserve quantity and do not depends on radius of confinement. This is therefore other quantities than energy like magnitude of spin, mass and so on is independent of the energy of the particle. But the length of domain related to the flat space is $\frac{2\pi}{a}$ which in fact inverse proportional to the value a. This explains why the radius of confinement decreases with increase energy. The fact that the radius of confinement of the quantum space decreases with higher energy is crucial in applied physics. It is not so difficult to observe particle with higher energy like high energy photon can penetrate into smaller slit without colliding with its walls. This fact establishes a new foundation in applied solid state and ultimately explains superconductivity and superfluity

Conclusion

We have two type of symmetry breaking when we defined an elementary particle as bounded connected manifold. First symmetry breaking of the flat space by introducing the manifold which defines the energy and momentum. The second breaking the symmetry by inside structure of the manifold which define inside conserve quantities as spin, mass and so on.

Ref [1]; The Tenth Marcel Grossmann Meeting, Confined quantum field theory, M. Fassihi.

Ref [2]; EDS05/Talks – lpnhe, Rencontres de Blois

Ref [3]; Universalities in the Complex Science, Pinnacle Advanced Physics (ISSN: 2360-9443)

Ref [4]; Computational Quantum Field Theory - of ICHEP 2004, Confined quantum field theory fassihi

Ref [5]; Confined Quantum Field Theory, Ashcroft mermin solid state physics exam…

Ref [6]; why the light changes direction in entering the water, Journal Of Applied Science, VOL 2 ISSUE 1 January 2016 Paper 2 (Find the article with ISSN or contacting mofassihi@gmail.com)