# The electric charge

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*In physics most phenomena in the microcosm have some kind of an explanatory description. But at the smallest scale size there exists no description of an underlying "tangible" explanatory structure. That is why the description of the origin of the electric charge is more or less limited to a link to particles that carry the electric charge.*

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## Introduction

Coulomb's inverse-square law shows a remarkable resemblance with the inverse-square law of universal gravitation. Unfortunately the model of Newtonian gravity is derived with the help of the phenomenological point of view (the mutual relation between matter objects). Figure 1 shows the same Newtonian gravity but now as a vector influence in vacuum space by the basic quantum fields (QFT) around matter objects.[1] The reasoning is simple, different vector fields can be merged but multiple scalar fields or multiple 3D topological fields do not exist at the smallest scale size.

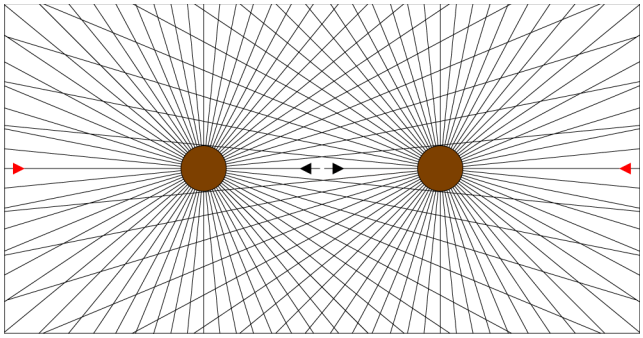

*figure 1*

There is an important difference between the electric charge and the gravitational force. Particles with opposite electric charges attract each other and particles with the same electric charge repel each other. The electric charge isn't part of quantum field theory. It is classic physics. That is why it is reasonable to search for the origin of the electric charge with the help of the model of quantised space.

References:
1. Art Hobson (2013); "*There are no particles, there are only fields*". American journal of physics 81, 211. DOI: 10.1119/1.4789885. https://arxiv.org/ftp/arxiv/papers/1204/1204.4616.pdf

## Energy concentration

The positive electric charge (+*e*) is "carried" by the proton and the negative electric charge (-*e*) by the electron. Both opposite charges are equal to each other and differ only in the way the charges behave in an electromagnetic field.

But the proton and the electron have quite different masses so we cannot speculate that the electric charge originate from the amount of mass of both particles. But if the positive and negative electric charge represent equal influences that only differ in the direction of the influence, it is reasonable to conclude that both charges must represent a duality created by the electromagnetic field.

The electric charge of the proton represents one half of the duality. Therefore it is evidently to examine opposite (geometrical) properties of the proton and electron that mirror each other. This is reasonable because the electron and anti-proton share the same electric charge. The proton and positron (anti-electron) share the positive electric charge.

If an proton and an anti-proton annihilate each other, the energy manifests itself by a couple of high energy electromagnetic waves. An indication that the difference between a particle and its anti-particle is caused by the opposite direction of their spins (rotation-like energy transfer).

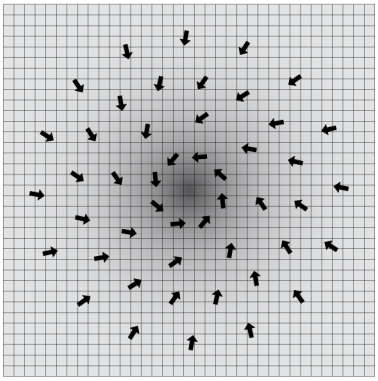

*figure 2*

Every unit of quantised space changes its shape synchronous with all the other units and the amount of topological deformation is quantised (the Planck constant).[2] The consequence is that the pass on of a large amount of topological deformation by a unit will have a much longer duration than the pass on of just 1 quantum of energy by another unit. Units don't deform in the direction of a higher amount of topological deformation without a "push" from the opposite direction. In other words, an evolving concentration of energy creates rotation-like energy propagation around its centre (see the schematic figure 2).[3]


Reference:

2. S.E. Grimm (2020); "*On the construction of the properties of discrete space*". https://zenodo.org/record/3909268
3. S.E. Grimm (2024); "*On resultant motion in discrete space*". https://zenodo.org/record/11193931


**The vectors of the strong nuclear force**

The proton is a rest mass carrying particle. It means that if we subtract the energy of the motion of the proton from its total amount of energy there is still an amount of energy left. To "dissolve" the rest mass of the proton we have to annihilate the proton with an anti-proton.

It is thought that the rest mass of the proton is directly related to the decrease of the radius of a scalar of the Higgs field. The consequence is the vectorisation of the flat Higgs field around the proton.[2] Figure 3 shows in a *schematic* way a proton (1) and the created vectors by the decreased scalar (white circle) in the centre of the proton.

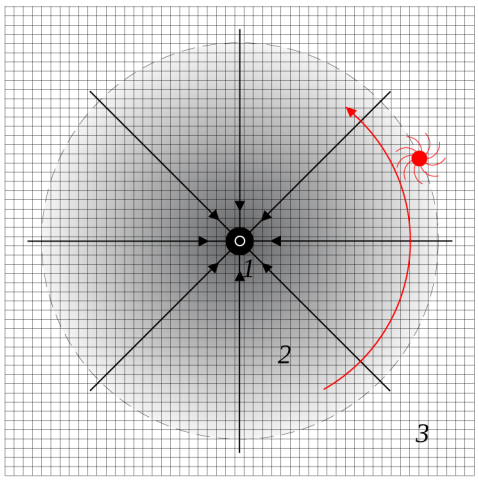


*figure 3*

All the internal changes of the energy concentration of the proton (mass) are synchronised with the changes of every unit of the structure of quantised space. The consequence is that the pass on of the fixed amounts of topological deformation of the units that represent the concentrated energy of the proton are forced by the vectors of the strong nuclear force that originate from vacuum space around (black arrows) to propagate in a semi-closed loop.[4]

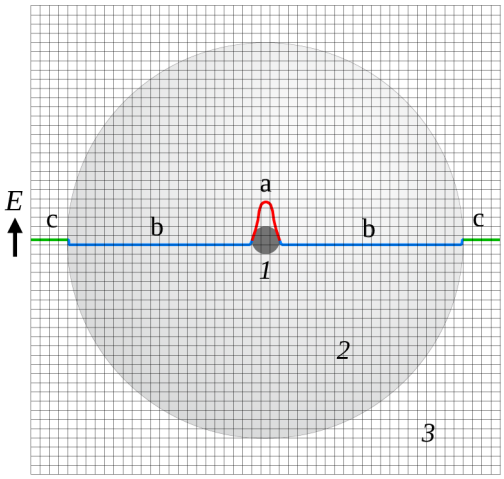


*figure 4*

Unfortunately, the relation between the amount of mass of the proton and the electron – actually the variable property of the universal electric field – is about 1836 : 1. So it is difficult to imagine how both particles together form a duality of mutual equal influence. The only straightforward duality is the equivalence of the surplus of energy of the proton and the deficit of energy in vacuum space around the proton (law of conservation of energy). See figure 4.

Figure 2 shows that a concentration of energy is an evolving step by step process that isn't chaotic at all. Not at least because the rate of change ($t_q$) and the amount of change ($h$) of all the involved units are the same. So if there is too much turbulence from vacuum space around it is hard to imagine the concentration of energy will result in a rest mass carrying particle. It also questions the supposed stability of the local deficit of energy around the proton.

Every electromagnetic wave is a propagation of a sequence of a surplus and deficit of topological deformation. That is why the effective energy of an electromagnetic wave is half its wave length. It suggest that at the moment a Hydrogen atom emits an electromagnetic wave, the deficit of energy around the nucleus (the proton) exists. Besides that, figure 2 shows that the increase of a local concentration of energy results in a rotation-like energy (quanta) propagation around the concentration of energy. This is comparable with the energy distribution and resultant motion in our solar system (see figure 5).

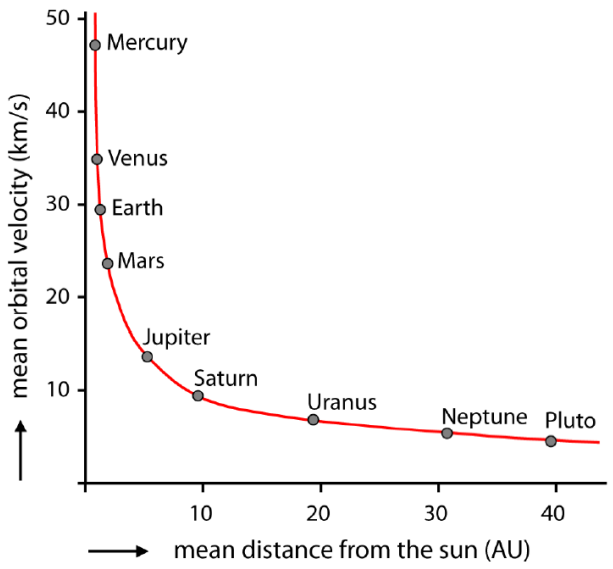


*figure 5*

Kepler's diagram shows the mean orbital velocity and the mean distance from the sun of all the planets in the solar system. Stars originates from a contracting and rotating cloud of dust and at the start the protostar is surrounded by a rotating disk of grains of dust, molecules, etc. The consequence is that the graph (red) in figure 5 reflects the distribution and resultant motion of the energy of vacuum space around the star.[3] Figure 5 doesn't prove the existence of a deficit of energy, but it is a strong indication.

Figure 3 is a schematic drawing. In other words, the vectors of the strong nuclear force don't match with the real vectors because the whole volume around the proton is vectorised. The vectors are responsible for the compactness of the proton (1). But these vectors are super positioned on the vectors of the magnetic field (2, 3). The consequence is that the units around the proton are constantly "pushed" to deform in the direction of the proton. The result is a shift in the energy density[3] of the volume around the proton. It is drawn as a gradient of the grey scale in figure 3.

Figure 3 shows the direction of the propagation of energy around the proton (red arrow) and the consequence is the creation of an eddy (in fluid dynamics termed vortex). Because at the edge of the rotation-like region around the proton (2) is vacuum space (3) and the energy of the universal electric field don't show the same resultant motion.

References:

4. S.E. Grimm (2024); "*Motion and forces*" https://zenodo.org/record/14268861

**Synchronized propagation of energy**

The duality of the electric charge suggests that the proton and the electron are mutual connected. That seems to be ridicule because of the difference between the respective masses. However, every unit of quantised space deforms with the same fixed amount of topological deformation, the Planck constant ($h$). The topological deformation of all the units is synchronised too because every unit has an invariant and equal volume and *every unit shares its surface area with the adjacent units around*. In other words, all the changes have the same duration, the constant of quantum time ($t_q$). So it is difficult to deny that there exists a mutual connection. However, the question is if there also exists an equal mutual connection at the atomic scale size.

Both the proton and the electron have a magnetic field and both particles have the angular momentum spin ½. A spin ½ means that the particle must rotate two full turns (720°) before it has the same configuration as at the start. Figure 3 shows the origin of spin ½ because the proton is "rotating" around its kernel (white circle) and the electron is rotating at the edge of the deficit of energy (the red eddy at 2). The consequence is that the electron doesn't exceed the speed of light. See this video (after 3:30).

There are experiments that an electron of a Helium atom is replaced by an anti-proton and it still "orbits" the nucleus (anti-protonic Helium). Indicating that the electric charge is directly related to the direction of the rotation of the proton and electron (and the anti-proton and positron).

The conservation of momentum is twofold. It envelopes the conservation of the amount of energy (universal electric field) and the conservation of the total amount of the direction of the motion of the energy (vector fields). So if the proton is a surplus of energy that rotates in a certain direction, the related deficit of energy must somehow compensate for the rotation of the proton; energy transfer in the opposite direction (observable as the influence of the electron in relation to the electromagnetic field).

Conclusion: the duality of the opposite electric charges ($+e$ and $-e$) reflect the conservation of momentum because the electric charge of an atom as a semi isolated system is electrically neutral.