The Physics of Superconductivity and Related Phenomena

By

Daniel L. Burnstein

This article assumes a basic understanding of quantum-geometry dynamics. The reader should minimally have read *An Axiomatic Approach to Physics*. For detailed explanation of the concepts of QGD, please refer to the relevant sections of *Introduction to Quantum-Geometry Dynamics*. You can also browse through the articles on the website.

If each of the axioms of QGD corresponds to a fundamental aspect of reality and if the set of all axioms of QGD is complete, then all physical phenomena can be described and the descriptions follow naturally from the axiom set. We have shown that QGD describes and explains a number of physical phenomena as well as make unique and readily testable predictions.

Now we will show how QGD describes and explains superconductivity and will conclude with testable predictions.

We have seen how the electromagnetic effect results from the interaction between charged polarizing particles (what is usually call charged particles) and free $preons^{(+)}$ which move through a region of quantum-geometrical space neighbouring them.

According to QGD, electrons are composite particles made from $preons^{(+)}$ moving in closed helical paths. This regular motion of $preons^{(+)}$ within the electron's structure allows for sustained directional gravitational interactions with free $preons^{(+)}$ along the direction of motion of the electron's component $preons^{(+)}$ and as a result affect the direction of free $preons^{(+)}$ neighbouring region; thus polarizing it (figure 1). Since the electric charge we associate with electrons and other charged particles results from their interaction with neighbouring free $preons^{(+)}$, thus are not intrinsic to the particles, QGD uses the expression *polarizing particle* rather than *charged particle*.

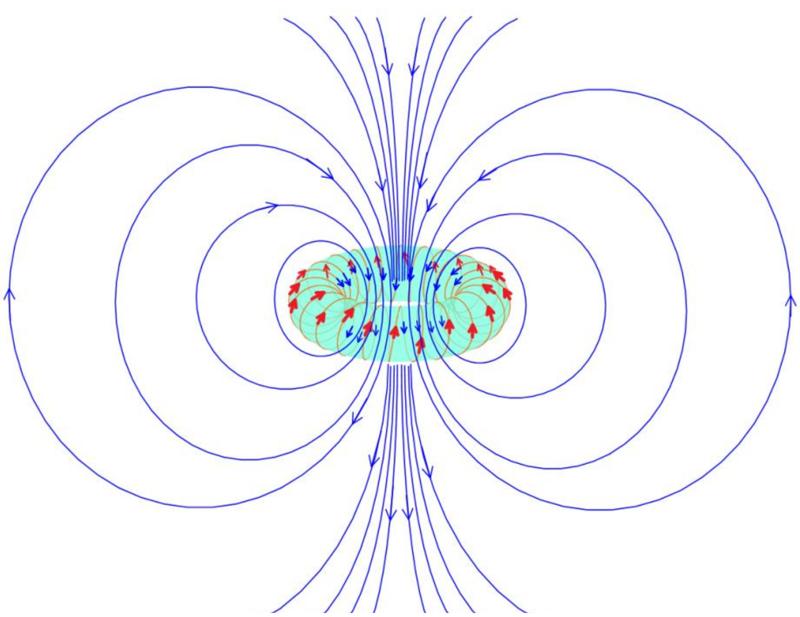

Figure 1

It is important to keep in mind that when QGD refers to gravity, it is not only referring to the weak attraction between massive structures at large scales, but also gravity to at the microscopic scale.

We recall that gravity emerges naturally from the axiom set of QGD which it mathematically describes by the equation $G(a;b)=m_a m_b\left(k-\frac{d^2+d}{2}\right)$ where m_a and m_b are the masses of two objects a and b in $preons^{(+)}$ and d is the quantum-geometrical distance measured $preons^{(-)}$ (or preonic leaps) and constant $k=\left|\frac{g^+}{g^-}\right|$ where g^+ and g^- are the fundamental units of p-gravity and n-gravity; the fundamental forces associated with and acting respectively between $preons^{(+)}$ and $preons^{(-)}$.

Note: *The actual value of k has yet to be determined exactly but by resolving the equation for gravity for distance at which gravity is equal to zero, that is, for the minimum distance at which galaxies appear to move away from each other, that is when $k>\frac{d^2+d}{2}$, we find $k\approx 10^{116}$.*

QGD's gravitational interaction equation implies that when d is large, the magnitude of the gravitational interaction is as observed at the macroscopic scales, which is closely approximated by Newton's law of gravity. Thus classical gravity corresponds to solutions of the gravitational interaction equation for sufficiently large values of d . But when distances are short, even though the masses of the interacting particles are relatively small, the magnitude of the gravitational interaction is orders of magnitude greater than which is observed at large scales.

In fact, in close proximity, gravitational interaction is the interaction that binds $preons^{(+)}$ into particles such as electrons, positrons, neutrinos and photons. At slightly larger distances, it allows polarizing particles to interact with neighbouring free $preons^{(+)}$ changing their directions and forming what we call a magnetic field.

The changes in the direction of the free $preons^{(+)}$ interacting with a polarizing particle is described is given by $\vec{P}'_{p^{(+)}}=\vec{P}_{p(+)}\vec{+}\Delta\vec{G}\left(e^-;p^{(+)}\right)$ where $\vec{P}_{p(+)}$ is the momentum vector of a $preon^{(+)}$ $p^{(+)}$ interacting gravitationally with an electron e^- resulting in a momentum vector $\vec{P}'_{p^{(+)}}$. The operation $\vec{+}$ is the direction sum which reflects the invariability of the $preons^{(+)}$ fundamental momentum. That is $\left\|\vec{P}'_{p^{(+)}}\right\|=\left\|\vec{P}_{p(+)}\right\|=c$. Thus the deflection of a free $preon^{(+)}$ depends on the gravitational interaction between it and electron, itself dependant the mass of the electron and $preon^{(+)}$ and the distance between them.

Figure 2 illustrates the polarization of a neighbouring region by a single electron.

When the electrons of large material structures are similarly oriented the polarizing effect is multiplied creating a proportionally larger magnetic field. Polarized $preons^{(+)}$ that form a magnetic field move in both direction as indicated by the double arrows in figure 2. QGD explains that the dynamic structure of the electron causes the magnetic field on one side of the electron to be slightly greater than other.

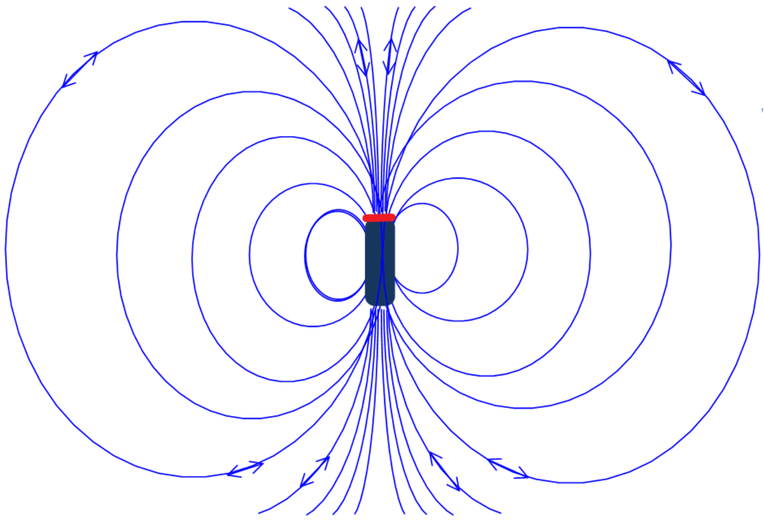

Figure 2

An implication of the above explanation is that since the polarization of a region is due to the gravitational interaction between electrons (or other polarizing particles) and free $preons^{(+)}$, and since QGD implies that gravity is instantaneous, than so must be the formation of a magnetic field. If QGD's description of this electromagnetic effect is correct, the speed of propagation of the Coulomb field must also be instantaneous. This prediction of QGD has been experimentally tested in 2012 (see article here). The experiment, repeated in 2014, confirmed the 2012 results. The paper written by the team who conducted the experiment is available here on arXiv and awaits publication.

From Introduction to Quantum-Geometry Dynamics, we know that a single polarizing particle generates a magnetic field such that $0<\left\|\vec{P}_{R_{e^-}}\right\|<m_{e^-}$, where $\left\|\vec{P}_{R_{e^-}}\right\|=\sum_{i=1}^{m_R}\vec{c}_i$ and m_R is the number of $preons^{(+)}$ crossing the neighbouring region R (this can be correctly interpreted as mass of R). Knowing that any change in momentum of a particle or structure must be an integer multiple of its mass, that is $\Delta\left\|\vec{P}_{e^-}\right\|=qm_{e^-}$ where the expressions on the left and right represent units of momentum (a unit of momentum is the momentum necessary to overcome one unit of n-gravity), the net momentum of the magnetic field generated by an electron is smaller than the minimum allowable change in momentum. Therefore the electron is unaffected by its own magnetic field.

The situation is different when two electrons are close enough for their magnetic fields overlap.

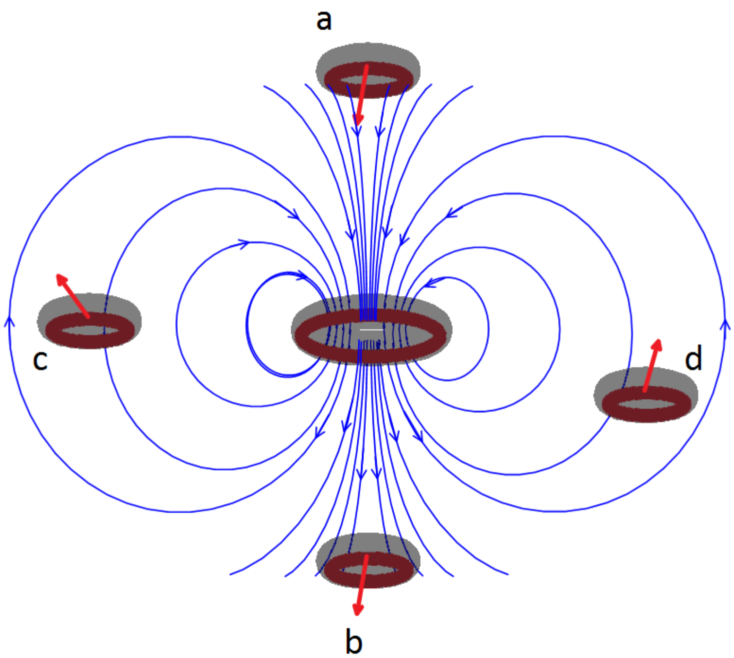

Figure 3

In figure 3, we see how the magnetic field of the electron in the center can affect an electron coming in close proximity. Depending on the position of the second electron relative to the first, it will be either repelled (position a), attracted (position b) or deflected (position c or d).

Note: That electrons can attract each other the way an electron and a positron do may appear to contradict experimental observations but according to QGD's axioms, all particles are made of $preons^{(+)}$ *so that all that distinguishes an electron from a positron is the orientation of the helical trajectories of their components* $preons^{(+)}$*. An electron can behave like a positron which orientation is reversed and vice versa (this is discussed in detail in Introduction to Quantum-Geometry Dynamics).*

So, we know that electrons that come into proximity will interact with each other's magnetic field. One side of the electron interacts only with part of the magnetic field induced by the other causing an asymmetrical distribution of polarized $preons^{(+)}$, increasing the number of free $preons^{(+)}$ moving in one or the other direction between the electrons. And if the electrons are close enough (how close depends on factors explained below), the net momentum of the magnetic field in the neighbouring region of each of the electrons becomes greater than minimum allowable change in momentum.

Motion of Electrons of Current Moving Through a Conductor

The electrons in an electric current moving through conductor interact with each as described above. They are accelerated and decelerated (mostly decelerated since electrons of a current move towards atomic electrons of the conducting material) by discrete changes in momentum or $\Delta\left\|\vec{P}_{e^-}\right\| = qm_{e^-}$. We know that when $\left\|\vec{P}_{R_{e^-}}\right\| < m_{e^-}$, the momentum of the electron is unaffected, but what happens when but what happens when $\left\|\vec{P}_{R_{e^-}}\right\| > m_{e^-}$ but $\left\|\vec{P}_{R_{e^-}}\right\| \neq qm_{e^-}$

that is when $\left\|\vec{P}_{R_{e^-}}\right\| = qm_{e^-} + r$ where r is the remainder of the Euclidian division or

$\frac{\left\|\vec{P}_{R_{e_1^-}}\right\|}{m_{e_1^-}} = q + r$?

QGD optics explains the system will resolve itself by having e_1^- emit a photon which momentum is exactly equal to r or $r = \left\|\vec{P}_\lambda\right\|$. It follows that the amount of energy lost when an electrical current gores through a conductor is $\sum_{i=1}^{n} r_i = \left\|\sum_{i=1}^{n} m_{\lambda_i}\vec{c}_i\right\| = \sum_{i=1}^{n}\left\|m_{\lambda_i}\vec{c}_i\right\|$ where n is the number electron interactions. So the lower r is, the less energy loss and the better conductor the material is. Conversely, the higher r is, the more energy is lost and the more resistance to conductivity the material must be.

The photons emitted through the mechanism we described will be absorbed by the material, raising its temperature and/or emitted as light which colours depend on the momentum of the photons (wave optics interprets higher momentum photons as having higher frequency).

Note that when applying the general principles outline above to predict the behaviour of systems, factors such the density and momentum of the electrical current, the number and position of the atomic electrons, the chemical composition and molecular structure of the material will also affect the number of interactions and must be taken into account. Conversely, measures of the momentum of photons emitted can inform about the composition and structure of the material (see Mapping the Universe or the section Emission Spectrum of Atoms in Introduction to Quantum-Geometry Dynamics).

The Relation between Temperature and Superconductivity

We have seen how the momentum of an electron changes when interacting with a magnetic field. We also know that the momentum of the magnetic field of a region of quantum-geometrical space depends on the gravitational interaction between an electron (or other charged particle) and the free $preons^{(+)}$ the region contains. Being gravitational in nature, the interaction that induces a magnetic field depends on the mass of the interacting object. The interacting objects here are not electron-electron interactions, but electron-polarized $preons^{(+)}$ interactions. Thus the momentum induced by a magnetic field is proportional the density of $preons^{(+)}$ in the region R which relation is expressed by $\Delta\left\|\vec{P}_{e^-}\right\| \propto \frac{\sum_{i=1}^{m_R}\left\|\vec{c}_i\right\|}{Vol_R}$.

Those familiar with QGD may have noticed the similarity between the expression on the right of this last equation and QGD's definition of temperature $temp_R = \frac{\sum_{i=1}^{n} \|\vec{a}_i\|}{Vol_R}$ where n is the number of free particles a_i. Since in close proximity the particles a_i contained within R are $preons^{(+)}$ then $m_R = n$ and $\frac{\sum_{i=1}^{m_R} \|\vec{c}_i\|}{Vol_R} = \frac{\sum_{i=1}^{n} \|\vec{a}_i\|}{Vol_R}$.

It follows that the number of $preons^{(+)}$ of R whose trajectories brings them simultaneously in close enough proximity for absorption by the electron is proportional the density of $preons^{(+)}$ in R hence proportional to the temperature of R. That is: $\Delta\left\|\vec{P}_{e^-}\right\| \propto \frac{\sum_{i=1}^{n} \|\vec{a}_i\|}{Vol_R}$.

Now, if R' is a neighbouring region of e^- which is close enough so that all the $preons^{(+)}$ it contains can be simultaneously absorbed, then $\Delta\left\|\vec{P}_{e^-}\right\| = \frac{\sum_{i=1}^{n} \|\vec{a}_i\|}{Vol_{R'}} - r$ and, as we have seen earlier, then for $temp_{R'} = \frac{\sum_{i=1}^{n} \|\vec{a}_i\|}{Vol_{R'}} < m_{e^-}$ electrons do not interact magnetically, hence the momentum of electrons in a current is encounter no resistance. Therefore QGD predicts that an essential condition for a material to become superconductive is when $temp_{R'} < m_{e^-}$.

Note: When the temperature is below the threshold above, Coulomb fields become undetectable.

Predictions

As often emphasized in earlier articles on QGD, any number of theories can explain *a posteriori* the behaviour of dynamic systems. To establish its validity and set apart from other theories, a theory must make unique and testable predictions.

From the discussion above and from the principles of QGD optics, we know that an essential condition for a material to become superconductive is that. $temp_{R'} < m_{e^-}$ Below this threshold, the equation $\left\|\vec{P}_{R'}\right\| = qm_{e^-} + r$ is reduced to $\left\|\vec{P}_{R'}\right\| = r$ which implies three possibilities.

The first is that electron will simply reflect the $preons^{(+)}$ which simultaneously come into absorption proximity to the electron.

The second and most interesting prediction, is that an electron of other polarizing particle may absorb the $preons^{(+)}$ and restore equilibrium by emitting a photon λ having equal momentum, that is such $\left\|\vec{P}_{\lambda}\right\| = r$. This implies that it is theoretically possible to convert the momentum of $preons^{(+)}$ into photons.

The effect of such mechanism may already have been observed for large polarizing structures such as heavy atomic nuclei. It is conceivable that since the density magnitude of a magnetic field depends on the mass of the polarizing particle, and since the minimum allowable change in momentum is large for a nucleon, allowing for a large value of r , that it may contribute to gamma photons. If correct, the mass of a nucleus, for example, emitting gamma photons through this mechanism would be conserved.

More importantly, this mechanism would be also contributes to the structuring of $preons^{(+)}$ into photons and neutrinos in stages of the universe following the initial stage.

That the mechanism may play a role in beta radiation, as QGD optics may suggest, is also a possibility that needs exploring.