Three condensed matter surprises

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December 5, 2019

Abstract

Various anomalies supporting TGD vision are accumulating also in condensed matter physics. In this article I discuss 3 anomalies. The first anomaly provides support for the view that photons are not point-like objects. Second anomaly violates Anderson theorem for BCS superconductors provides support for TGD based view about high Tc super-conductivity. Third anomaly breaks so called Wiedemann-Franz law stating that good conductors are also good heat conductors with electric and heat conductivity proportional to each other.

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1 Introduction

Various surprising findings supporting TGD vision are accumulating also in condensed matter physics. In this article I discuss 3 anomalies.

The first finding is in conflict with QFT assumption that photons are point-like objects. As a beam of photons enters lattice, they split to pairs of entangled photons. The surprise was that the members of pairs can emerge from different points with mutual distance up to 10 nm. This provides support for the TGD prediction that particles and also photons are not point-like objects.

Second anomaly violates Anderson theorem for BCS superconductors stating that non-magnetic perturbations do not affect super-conductivity. What has been however observed that the addition of Cobalt atoms to iron high Tc superconductor destroys the superconductivity. Also the gradual addition of Co modifies the so called energy gap. TGD based view about high Tc super-conductivity can explain the finding.

The third anomaly breaks so called Wiedemann-Franz law stating that good conductors are also good heat conductors with electric and heat conductivity proportional to each other. It is known that electron flow in correlated manner. The forced coherence and synchrony induced by quantum coherence of magnetic body could explain the finding.

2 TGD inspired explanations for the findings

I learned about 3 surprising findings related to condensed matter physics and defying standard quantum theory and having a natural explanation in TGD framework.

2.1 The strange behavior of light

Light does not behave quite in the manner expected (see `http://tinyurl.com/sjc9rpu`). What was studied was splitting of photons to entangled pairs of photons in the crystal beam entering a crystal. Quantum field theory based on the idea of completely point-like particle predicts that photon pairs should be created at single point. What was observed that members of entangled photon pairs can be also created at separate points. The distances of these points can be about 1/100 microns- which happens to the size scale of cell membrane and fundamental scale in living matter. This length scale is about 100 times the atomic length scale.

Researchers argue that this findings supports new kind of Uncertainty Principle. I do not feel quite easy with this proposal unless it is taken to mean that particle has geometric size to be distinguished from Compton length.

1. In TGD Universe geometric size would be due to the fact that particles are not point-like but correspond to 3-D surfaces whose "orbits" define basic building bricks of space-time as 4-D surface in 8-D space-time $H = M^4 \times CP_2$. Particles can exiss superpositions of their variants with different size scales.

2. p-Adic physics for various primes p fusing together with real number based physics to what I call adelic physics would provide physical correlates of cognition and sensory experience. The number theoretic vision assigns to each particle extension of rationals characterized by so called ramified primes, which are excellent candidates for defining preferred p-adic length scales. The dimension n of extension defining a measure for algebraic complexity and serving as a kind of universal IQ has interpretation as effective Planck constant $h_{eff}/h_0 = n$ so that a connection with quantum physics - or rather its TGD based generalization - emerges.

3. p-adic mass calculations rely on p-adic length scale hypothesis stating that primes near powers of 2 are especially interesting physically and massive elementary particles and also hadrons correspond to this kind of primes. p-Adic mass scale would be proportional to $p^{1/2}$.

A lot of new physics is predicted.

1. TGD predicts scaled variants of strong and weak interaction physics corresponding to different values of p and LHC provides handful of bumps having identification as scaled variants of ordinary hadrons and having mass which is 512 higher [K1].

2. For given particle several mass scales are in principle allowed. Quite generally, particle can correspond to several p-adic primes and therefore can exist in states with different masses differing by power of $2^{1/2}$. The existence of this kind of states in the case of neutrinos would solve some problems related to neutrinos and their masses.

3. In the case of massless particles different p-adic mass scales do not mean that masses are different (or more precisely, the masses depend on p but are extremely small and below measurement resolution so that mass differences cannot be detected). The p-adic length scale defines the geometric size of the particle as 3-surface to be distinguished from quantum size defined by Compton length. Quantum classical correspondence (QCC) strongly suggests that these two scales are same or at least closely correlated.

The hierarchy of Planck constants $h_{eff} = n \times h_0$ having an interpretation in terms of dark variants of ordinary particles predicts second kind of scale hierarchy.

1. The mass of the dark variant of elementary particle would not differ from the mass of ordinary particle but Compton size for a dark particle is proportional to n - a good guess is that $n = 6$ would correspond to ordinary particle and ordinary value h of h_{eff}.

2. The scales defined by dark matter hierarchy could relate to p-adic length scales. There could be kind of resonance coupling for massless particles: dark massless particle labelled by n and particle labelled by p-adic prime p could transform to each other with high rate if the p-adic and dark length scales are nearly the same. This could be very relevant for biology.

The experimental findings could be understood if photons can correspond to several p-adic length scales. The length scale 10 nm defining the upper bound for distance between members of entangled photon pair in experiments would correspond to p-adic length scale $L(151)$, which corresponds to Gaussian Mersenne prime $p = (1+i)^{151} - 1$. A simple model for photon could be as a closed flux tube like structure of this length. Also $k = 157, 163$, and 167 define Gaussian Mersenne primes, which is a number theoretical miracle. What is fascinating that these scales are fundamental biological length scales assignable to the basic structures of DNA.

2.2 New surprises related to super-conductors

So called Anderson's theorem applying to the conventional super-conductors (BCS) states that the addition of non-magnetic impurities does not destroy super-conductivity. It has been however found (see `http://tinyurl.com/vq2do7f`) that this is not the case for iron based high Tc super-conductors. This gives a valuable hints in still-continuing to attempts to understand high Tc super-conductivity.

I have been preaching for fifteen years new kind of super-conductivity explaining high Tc superconductivity making living systems high Tc superconductors [K2, K3].

1. The TGD view about magnetic fields differs from Maxwellian view. The counterparts of Maxwellian magnetic fields are flux quanta, flux tubes or sheets realized as space-time surfaces (or regions of them). Besides counterparts of ordinary magnetic fields there are also monopole flux tubes and they appear in all scales and form the basis of entire TGD view of Universe. They carry dark matter as $h_{eff} = n \times h_0$ phases and for large value of $h_{eff} > h$ there is quantum coherence in long scales making possible super-conductivity along dark magnetic flux tubes. This could explain also high Tc superconductivity in iron based super-conductors.

2. What was found that the addition of Cobalt atoms destroys the super-conductivity by inducing quantum phase transition. Anderson's theorem for ordinary super-conductivity however states that non-magnetic perturbations do not affect superconductivity. In TGD framework the natural interpretation would be that the quantum phase transition reduces the value of $h_{eff}/h_0 = n$ and thus also the quantum coherence length meaning that flux tube length is reduces and super-conductivity is possible only in short scales. Note that dark matter is identified as phases with non-standard value of h_{eff} different from h.

3. Also the nature of so called energy gap assignable to super-conductors was modified as Cobalt atoms were gradually added to destroy super-conductivity. This is not surprising if the value of h_{eff} was reduced. The reduction of h_{eff} in general decreases energies for other parameters kept constant and now it would mean reduction of energy gap and loss of superconductivity.

2.3 Conductors of electricity, which are poor conductors of heat

The so called Wiedemann-Franz Law states that good conductors of electricity are also good conductors of heat. The two conductivities are proportional to each other. The metal found 2017 however violates this law (see `http://tinyurl.com/w4t9vdx`) Vanadium dioxide VO_2 transforms from insulator to a conductive metal at 67 degrees Celsius. The experimenters argue that this property could make possible new technologies. For instance, conversion of wasted heat from engines could be transformed to electricity.

Electrons are found to move in coordinated, synchronous manner and this would explain the reduction of heat conductivity to 1/10 of the expected value. There is no super-conductivity however. TGD explanation would be in terms of coherence and synchrony induced from the quantum coherence of dark phases of matter having $h_{eff}/h_0 = n$ residing at the magnetic body of the system controlling it.

This forced coherence would be also crucial in living matter: ordinary living matter would not be quantum coherent but the magnetic body carrying dark matter would force the coherence. In fact, all self-organization processes could involve magnetic body and dark matter.

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Articles about TGD