International Journal of Modern Physics B
Vol. 31, No. 25 (2017) 1745009 (5 pages)

DOI: 10.1142/S0217979217450096

Towards a physical lattice model for the atom and implications for high-Tc superconductivity

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Accepted 11 July 2017
Published 8 August 2017

Starting from Cook's model [D. N. Cook, *Models of the Atomic Nucleus* (Springer, Berlin, 2006)], we proposed a non-Archimedean approach to show that we can transform his purely mathematical model into a physical one. In the first stage, we kept the f.c.c. lattice model surrounded by a vapor phase from which we can only extract "symmetric" entities (quantons?) which are the electrons. This in our opinion gives a much better global view of what the atom could be. When assembling the nuclei into a lattice, there is reciprocal influence between the vapor phase and the lattice. Consequently, superconductivity occurs when temperature decrease brings to freezing the vapor phase and when the "crystallization" of the vapor phase gives some symmetric tiling of the volume around the lattice, thanks to Curie's theorem. Looking for high temperature superconductivity therefore is equivalent to finding symmetric crystallization of the vapor phase. In that sense this pleads for the use of heterogeneous materials in the "crystal grid" and the case being play with impurities. We do not see any limit, thanks to our model, for high and even very high temperatures for superconductivity.

Keywords: Non-Archimedean geometry; cook lattice model of the atom; high temperature superconductivity.

1. Introduction

In Ref. 1, Cook discusses the different models describing the nucleus and shows from Chapters 1 to 8 that they are mainly contradictory and do not explain experimental facts. In Chapters 9 and 10, he proposes a new purely mathematical model which

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seems to be able to perfectly match with reality. The main question, we shall answer is whether this mathematical model can be turned into a physical one. The answer is yes, implying the dramatic change in the approach. We shall then improve the model in order to capture the electronic part of the atom in a coherent whole linked to the nucleus. Finally, we shall apply our new model to a breakthrough approach of superconductivity.

2. Cook's Model

If there are more than 20 models of the nucleus, there only are four big families. The way these families have been thought and designed, makes them contradictory. As an example, we shall cite the liquid drop model and the independent particle ones.[1] Moreover, there are experimental facts that these models cannot explain such as the dissymmetry obtained when fission of nuclei occurs. To fix such problems, Cook proposes a purely mathematical model based of a geometric f.c.c. lattice which is isomorphic to the quantum states of the Schrödinger equation describing the independent particle model. It seems that this purely mathematical model has great potential to overcome the difficulties for fitting with experiments. However, it does not rely on any physical reality. Our first goal here is to make it a physical model.

3. Our Model of Physics

Einstein[2] together with Hilbert suggested, through the theory of general relativity, that depending on the scale we consider, the geometry at stake could be non-Euclidean. We propose to do exactly the same, but with a much more dramatic breakthrough than the one of stepping from Euclidean to Riemannian geometry. Indeed, referring to Hilbert,[3] and noticing that physicists play with untold axioms (namely, the ones of the geometry they are working in), we simply propose to consider our world as being based on non-Archimedean geometry. We already have justified such an approach in Ref. 4. This gives birth to an infinite sequence of scales, infinitesimal relative to each other, which can, within their order of magnitude, be considered as "locally" Archimedean. For measuring magnitudes, whereas this is less general than intrinsic non-Archimedean geometry, we suggest to use the field of surreal numbers discovered by John Conway in 1974.[5] This field is not a set but a proper class, which is much more satisfactory to describe our physical world.[4]

Consequentially, this calls for the re-introduction of eather according to the Einsteins view. Such approach considers fields having a physical ground through infinite bunches of eather particles which are localised in the infinitesimal volumes such as a sphere of $1/\omega$ radius, where ω is the first transfinite ordinal of Cantor.The probabilities in our model verify the well known Kolmogorov axioms of probability, which predict better fit with experimental data then the modern quantum physics models (Refs. 6 and 8) physics models (6).

Finally, we introduce a new least action principle based on Pierre Curie's theorem (1894),[4] which basically says that symmetry is the realm of stability whereas if something "happens", it must be caused by some dissymmetry. A stable system will tend to go symmetric. In such a world, symmetries must be seen as dynamic and so imply motion simply because according to general relativity we have to work in a 4D space including time! A system cannot be stable without motion in it (to some extent).[4]

4. The Physical Model of the Nucleus

Our model is very simple given the one of Cook! Indeed, the nucleons for us are volumes containing aether particles and are stable/symmetric. They are physically linked by aether "tubes" as shown in Fig. 1.

Fig. 1. (Color online) A physical lattice model.

The nucleons are linked through the blue tube which is made of aether particles. Aether can have exactly the same states as matter in our world, that is, solid, liquid, gas or plasma. The blue tube can be hollow and solid with exchange of aether particles between both nucleons and allowing exchange between, say, protons and neutrons, the case being as suggested by Cook.

5. A Global View of the Atom

Even in Cook's model, the electrons are almost independent of the nucleus and their role in the whole atom is very simple, too simple in our opinion! We prefer to consider the nucleus as, say, a condensed ball, the case being made of an f.c.c. lattice with a fluidic phase around it. Our least action principle imposes that any extraction of this fluid must be stable (at our scale) so that an electron is a symmetric bunch of aether particles. The electric charge is the effect, viewed from the outside, of the internal symmetry to the electron. This is the same for the proton. For the neutron, we refer the reader to Ref. 4, because it is stable in the nucleus and not a free particle. So, in our model, the atom is a whole and the electrons, their behavior, are linked to the very structure of the nucleus.

6. A First Model for Superconductivity

Let us consider a lattice of nuclei. Their assembly will go together with the assembly of their fluidic peripheral phase. Depending on the geometric structure made of the nuclei (nuclei lattice), will depend the behavior of the fluidic surrounding structure and probably partly vice-versa. When the temperature decreases, we suggest that the fluidic phase should "freeze" and to some extent "crystallize". This would result in small tubes in which aether particles would keep on circulating. Now, crystallization will occur through symmetry by our least action principle. Since the grid around the lattice of atoms will be symmetric, by Curie's theorem, it will create no effect; hence, there will be no resistance. It can be shown that such a model can quite explain all the effects seen, including the magnetic ones.[7] It also clearly shows that the transition temperature will depend essentially on the nuclei structure and the lattice of nuclei which is obtained.

7. A Second Model for Superconductivity

We keep the same model as the preceding one except the fact that the fluidic phase will not freeze into tubes, but that the transport of current from one point to another occurs through the propagation of patterns within the fluid. These patterns must tile the fluidic volume. If, as a first approximation, we consider the fluid mainly as a surface, depending on the surface at stake (for thin films it is a plane, for a wire it is a cylinder), we shall have different possibilities of tiling (remember that tiling is linked to the groups of symmetries of a surface). If we look at a thin film, there are 17 possibilities for the group of symmetries whereas on a sphere there are 14. While the tiling is imperfect, there is a resistance (not complete symmetry).

Now, when the temperature decreases, the tiling, which was loose, is going to be tighter, up to having a perfect symmetric tiling. If this happens, then the transition occurs! In such a case, the current propagation occurs like a wave through the "rigid" tiling.

But we potentially have much more. Indeed, in Ref. 4, we suggest that at small "Archimedean scale" the local geometry could be hyperbolic. This changes dramatically the potential view we can have. Indeed, as far as our model can be a good picture of the reality, this would mean that the number of different superconductivity phenomena would be linked to the number of groups of symmetry for tiling a surface. In Euclidean geometry, as we already said, we would have 14 types for spheres whereas we would have 17 for thin films. But if the local geometry is hyperbolic, we would have infinity! Testing, say, for thin films, if we have more than 17 different types of superconductivity would be an important clue about what the geometry at stake is.

Finally, we assumed that the fluid was a surface. It is of course a volume. This brings to bigger and different possibilities for the tiling since the symmetry groups are different then. However, we expect such volume effect to be secondary and will be experimentally detected in the upcoming time. If this is the case, this should give rise to a new kind of very sensitive sensors.

What needs, however, be further considered is the 4D space comprising volumes.

8. High Temperature Superconductivity

Given the two preceding paragraphs, superconductivity only depends on the way crystallization is going to occur when the temperature decreases: Symmetric (superconductivity) or dissymmetric (no superconductivity). The point is to obtain high temperature freezing on the one hand and symmetric freezing on the other. Let us make a parallel with super cooled water. Let us imagine that a lattice of nuclei would have it surrounding vapor phase super cooled. Now, if we add "something", the vapor is going to instantaneously freeze. If, in addition, the freezing is symmetric, then we shall have superconductivity. Always with the parallel of water, we know that pure water freezes at about $-50°C$. In practice it freezes at $0°C$ because of "impurities". Replicating such scenario for freezing the vapor phase around a crystal grid should allow expectations for great improvement in the temperatures at which we get superconductivity. Finding the right impurities in some way brings to finding the Grail. . . !

9. Conclusion

Starting from Cook's model, we proposed a non-Archimedean approach to show that we can transform his purely mathematical model into a physical one. In the first stage, we kept the f.c.c. lattice model surrounded by a vapor phase from which we can only extract "symmetric" entities which are the electrons. This gives a much better global view of what the atom could be in our opinion. When assembling the nuclei into a lattice, there is reciprocal influence between the vapor phase and the lattice. Then superconductivity occurs when temperature decrease brings to freezing the vapor phase and when the "crystallization" of the vapor phase gives some symmetric tiling of the volume around the lattice, thanks to Curie's theorem. Looking for high temperature superconductivity therefore is equivalent to finding symmetric crystallization of the vapor phase. In that sense this pleads for the use of heterogeneous materials in the "crystal grid" and the case being play with impurities. We do not see any limit, thanks to our model, for high and even very high temperatures for superconductivity.

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