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Research Article

On the Experiment that Could Answer the Question Whether the Like Charged Particles, with Relative Velocity Close to Zero, Repel or Attract?

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Abstract

This paper considers the conditions of an experiment with results which could answer unambiguously the following question: do like charged particles repel or attract when the magnitude of their relative velocity is close to zero? The answer to this question will either confirm the validity of Coulomb's law, which states that the like charged particles always repel, or the validity of hypothesis by Gustav Theodor Fechner, which was proposed in 1845, and stated that like charged particles with relative velocity close to zero, attract.

Keywords: Bound pairs of charged particles, Charged particle, Cold fusion, Condensate, Coulomb law

1. Introduction

The main theoretical problem to explaining Cold Fusion is the Coulomb repulsion of the slow particles participating in the process. The major difference between the nuclear fusion which occurs at high temperature and Cold Fusion is the relative velocity of particles participating in the reaction. In plasma nuclear fusion at high temperatures, particles are initially fast, whereas in Cold Fusion they are slow. But as the fast, like-charged particles approach one another, the simultaneous decrease of their relative velocity and of the distance between them occurs along with their Coulomb repulsion. Therefore, both decreased distance between particles and their decreased relative velocity can switch the Coulomb repulsion of protons to nuclear attraction. Separating one process from the other and determining the major reason that forces the protons to attract during the fusion process is not possible.

In mathematics, there are two types of knowledge about the properties of mathematical objects: the first is a hypothesis and the second is a theorem. The hypothesis is a statement of properties of mathematical objects, which is not proved by strict logical statements accepted in the mathematical community. A theorem is a statement of

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properties of mathematical objects proved by strict logical statements accepted in the mathematical community. There are theorems proved by using those proved before. There are theorems proved in assumption that the hypothesis used for proving is valid. The latter types of theorems are called "candidate theorems", which become theorems after the hypotheses are confirmed.

In physics, as well as in mathematics, there are also two types of knowledge about the properties of physical objects and the processes in which they participate: the first is a hypothesis and the second is a law. The physical hypothesis is a statement about the properties of a physical object or a process in which it participates, that has not been proved experimentally, according to the rules accepted in the physical community. The physical law is a statement about the properties of a physical object or a process in which it participates, proved experimentally, according to the rules accepted in the physics community. The physical law is a statement about the properties of a physical object or a process in which it participates, proved experimentally, according to the rules accepted in the physics community. There are physical theories using physical laws proved before. There are physical theories using hypotheses that assumed valid. The latter types of theories are the physical "candidate laws", which become laws after the hypotheses used in them are proved.

In mathematics, if the practical use of a hypothesis results in a contradiction, it is considered erroneous and does not become a theorem. In physics, there is a different way of using hypotheses in theories. If the practical use of a theory, which previously described the reality properly, results in a contradiction, then the hypothesis on which this theory is based, is not yet considered erroneous. An experiment is required in order to recognize the hypothesis as erroneous, and it must prove the invalidity of hypothesis unambiguously. Whether the required experiment can be performed depends on technological ability. Therefore, in practical physics, scientists use hypotheses which describe reality properly in certain cases and are considered laws. The Coulomb law is that kind of hypothesis.

2. Coulomb's Law and Fechner's Hypothesis

The Coulomb law is a law of interaction between the immobile charges. It was formulated at the end of 18th century while studying the interaction of two electrically charged balls, but not the interaction of two electrically charged elementary particles. When Charles-Augustine de Coulomb proposed the law, immobility was accepted at zero magnitude of relative velocity of bodies. This interaction was investigated, while the motion velocity of elementary particles in these bodies was not considered. The electrically charged substance in electrified bodies was considered immobile. However, today we have enough experimental facts to allow the conclusion that all bodies observable in nature consist of particles, and the particle's dynamic systems form these bodies, and that all particles, both atoms and molecules themselves and free electrons and protons in these dynamic systems, possess different kinetic energies, and hence, different magnitudes of velocities relative to one another, even if the temperature of these systems approaches absolute zero. No experiments confirming the validity of Coulomb's law for two like charged elementary particles, with a magnitude of relative velocity is close to zero, have been carried out. Therefore, Coulomb's law in its current formulation is an experimentally unproved hypothesis. Coulomb's law is applied in many physical theories that are used in the research of fundamental properties of interaction between the electrically charged elementary particles. That is why the experimental validation of Coulomb's law for interaction of elementary charges with relative velocity close to zero is a necessary condition for the practical use of all theories based on the Coulomb law.

When Ampere formulated the law of interaction of electric currents, it became clear that the interaction of electric charges depends on their velocities, and the Coulomb forces underwent modifications. In the second half of the 19th century the theory of interaction of electrically charged particles, which was developed by Wilhelm Eduard Weber on the basis of modified Coulomb forces, depending on the distances between particles and their first and second derivatives with respect to time [1,2], was the most widely accepted interpretation. At that time, Weber assumed that the Coulomb law is valid for charged particles immobile relative to each other. As this theory was criticized, other attempts to explain interactions of moving electric charges using the modified coulomb forces were undertaken [3,4]. However, in the 20th century the separation of forces acting between the charged elementary particles by two types, the Coulomb and magnetic ones, became generally recognized. All later theories that used Coulomb forces to model dynamic systems of elementary particles, including Weber's theory, assumed that the Coulomb law is valid for charged particles that are immobile relative one another, and no alternative hypotheses were considered.

A hypothesis stating that like charged particles attract in certain conditions, which depends on motion velocities of particles, was advanced by Gustav Theodor Fechner in 1845, before Weber published his theory. Considering the interaction of elements of current, he made the following two assumptions [5]:

(1) Each action of a current element might be considered as a combination of actions of a positive particle and a negative, equal to it in its strength, that simultaneously pass the same element of space in the opposite directions.
(2) According to first assumption, the interaction of two current elements can be presented based on the assumption that similar types of electricity act attractively on one another if they move in the same direction or to the same vertex of an angle, whereas dissimilar ones attract if they move in the opposite directions or if one of them approaches the vertex of an angle while the other one moves away from it.

Pursuing the logic of his hypothesis with respect to the interaction of charged particles of two elements of current, Fechner concluded that "similar particles attract if they move in the same direction and repel if they move in the opposite sides" [5].

As follows from Fechner's reasoning, if magnitudes of velocities of particles relative to immobile parallel elements of current were equal, then the relative velocity of like charged particles, which move in the same direction, equals zero. According to Fechner's hypothesis, the particles will attract. According to Coulomb's law, they will repel. Therefore, Fechner's hypothesis contradicts Coulomb's law for like charged particles immobile relative to one another. As demonstrated above, the Coulomb law in its present wording should be considered a hypothesis until it is verified experimentally. Therefore, today we have two alternative hypotheses, neither of them verified experimentally.

3. Fechner's Hypothesis in Modern Conditions

Physicists of the 19th century had much less experimental data than we have today. Today the level of experimental and theoretical physics allows us to ask the following question:

Do the like charged particles repel or attract if the magnitude of their relative velocity is close to zero?

We can ask this question by analyzing the dynamics of charged particles in the processes that occur:

(1) at low temperatures:
   (a) formation of condensate of bound pairs of electrons in superconductors [6];
   (b) formation of the so-called ionic "crystal beams" when the beam of ions is cooled with the beam of electrons [7];
(2) in atomic nuclei:
   (a) formation of bound pairs of protons, which is confirmed by the kinematics of double-proton decay [8];
   (b) evaporation of nuclear fluid, which is similar to liquid-to-gas phase transition of nuclear and classical fluids in the drop nuclear model [9].

Proceeding from the analysis of these processes, we can conclude the following:

(1) At low temperatures of the substance, and hence, at low magnitudes of their relative velocities, electrons may attract, form the bound pairs and be in the gaseous or liquid state. As the temperature of the substance rises, the magnitudes of relative velocities of electrons increase as well, and electrons begin to repel one another.
(2) At low temperatures, and hence, at low magnitudes of their relative velocities, positive charged particles may attract one another.
(3) In the atomic nuclei, positive charged particles may attract, form bound pairs and be in the gaseous or liquid state. As the temperature of nucleus rises, the magnitudes of positively charged particles' relative velocities increase as well, and positively charged particles begin to repel one another.

Based on these three conclusions, we can reformulate Fechner's hypothesis on the attraction of like charged particles by making the following assumptions:

(1) With magnitudes of relative velocities close to zero:
   - electrons attract one another,
   - protons attract one another.
(2) With magnitudes of relative velocities that increase starting from certain values:
   - electrons repel one another according to Coulomb law,
   - protons repel one another according to Coulomb law.

These assumptions contradict Coulomb's law as a law of interaction of two like charged elementary particles, where the magnitude of relative velocity equals to zero.

4. On the Conditions and Feasibility of the Experiment

In order to either confirm or deny the assumptions made in the previous chapter, an experiment that could clearly answer the following question is required:

Do the like charged particles repel or attract if the magnitude of their relative velocity is close to zero?

Answering this question, we should observe the interaction of like charged particles under the following conditions:

(1) It should be possible to slow down the relative velocities of particles to the values close to zero.
(2) Particles should be localized in the vacuum.
(3) It should be possible to change the distances between the interacting particles.
(4) The velocity of particles relative to surveillance instruments should be much less than the speed of light in the vacuum.

The first condition is the most important part of the proposed experiment. The second is required to eliminate the influence of other elements on the interaction of like charged particles if the presence of these elements might explain the attraction of particles (e.g., the influence of atoms of superconductor crystal lattice during the formation of electron condensate). The third condition is necessary in order to exclude the possible explanation of particles' attraction by the distance between them reduced to certain values (for instance, the nuclear forces might be such explanation). The fourth condition is required in order to eliminate the possible explanation of particles' attraction by relativistic effects (e.g., a self-focusing of a beam of relativistic particles).

In theory, all these conditions can be fulfilled. The results of analytical and numerical studies of charged particles' motion trajectories during their interaction with two coaxial charged circles located at some distance from one another were performed in the paper [10], and reveal the following possibilities:

- the continuous localization and accumulation of like charged particles, which initial conditions of motion relative to the charged circles are strictly determined, in the vacuum between the charged circles at the strictly defined circular trajectories without changing the electrostatic field of circles if the charge of particles is of the same sign as that of circles;
- keeping the like charged particles localized for a long period of time;
- shortening the distances between the neighboring particles localized at the same circular trajectory and the reduction of magnitudes of their relative velocities by increasing the number of particles localized at this trajectory.

Observing the dynamics of a certain number of like charged particles localized at the certain circular trajectory, one could verify either the Coulomb law or Fechner's hypothesis by answering the following question:

Do the like charged particles repel or attract if the magnitude of their relative velocity is close to zero?

If the particles repel, then no anomalies in particles dynamics that would contradict the Coulomb law will be observed. If particles attract, then the formation of bound pairs of like charged particles and a condensate of these pairs will probably be observed, just like it occurs with electrons in superconductors or protons in atomic nuclei.

5. Conclusion

If the experiment confirms Fechner's hypothesis on the attraction of like charged elementary particles if the magnitude of their relative velocity approaches zero, then this fact may become a starting point not only for the theoretical explanation of Cold Fusion phenomena but also for the description of many other physical phenomena. In this case, the electrostatic trap, which theory is presented in [10], the nuclei of various elements will probably be synthesized from the same nuclei, for example, those of helium. A radioactive element, from which alpha particles are emitted with the same in moduli velocities, may be the source of helium nuclei. The less the initial velocity of particles, the smaller can be the dimensions of the electrostatic trap. Obviously, this experiment will not be simple or easy-to-do. It will require knowledge and experience of similar experiments. However, the cost of performing it may be not so high since there is no need for a particle accelerator and a trap that should hold the particles possessing high kinetic energies.

If the experiment confirms Fechner's hypothesis, then this fact will allow for the following assumptions:

- the switching from the Coulomb repulsion of protons to their nuclear attraction is the result of reduction of their relative velocity, not the distance between them;
- the protons of the atomic nucleus, as well as those of the proton condensate, are slow, and the increase of their relative velocity causes the decay of the nucleus, or the evaporation of the proton condensate, when the attraction of protons switches to their Coulomb repulsion while their relative velocity increases.

The process of mass evaporation of the proton condensate will be a Coulomb explosion of protons, which are located very close to one another. The technology of proton condensation will allow to accumulate the kinetic energy of protons. The energy of proton expansion during the evaporation of condensate will depend on the distance, at which the protons are in the condensate. As soon as the protons, which velocity relative to the condensate is higher than the critical value, appear in the surface layer of the proton condensate, they will repel from the whole volume of condensate according to the Coulomb law and pass their kinetic energy to the substance surrounding the condensate. If we launch this technology to the near-Earth space and condensate the protons of solar wind, we could use the proton condensate both as a source of energy and as a raw material for the synthesis of nuclei of various chemical elements.

I believe that people in the electric power industry, and researchers studying nuclear synthesis who have the necessary experience and material resources should try to answer this question:

Do like charged particles repel or attract if the magnitude of their relative velocity is close to zero?

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