International Journal of Latest Research in Engineering and Technology (IJLRET)
ISSN: 2454-5031
www.ijlret.com || Volume 06 - Issue 06 || June 2020 || PP. 16-21

Geometry, Quantum Mechanics and low Energy Nuclear Transmutations

Christos D. Papageorgiou
Dept. of Electrical & Electronic Engineering, National Technical University of Athens, Greece

Abstract: Quantum mechanics Geometry generated potentials in Curved conducting wires strips or paths are related with various peculiar phenomena as exploding wires and exploding Li-ion batteries. The proposed theory can be used in exploration of low energy nuclear transmutation devices. The origin of the so called cold fusion is possible to be connected with these phenomena.
Keywords: Schrödinger equation. Stark effect, exploding wires, , exploding batteries, low energy nuclear transmutations

1. Introduction

Our Universe a 4-dimentional space-time continuum is obeying the laws of Physics under the limits of its Geometry. However Universe spatial Geometry is Euclidean and 3-dimensional.

Therefore, Newton's (Gravity) and Coulomb's (Electricity) forces are square inverse functions of distance. In empty space gravitational and electromagnetic waves travel with the speed of light.

Einstein, in his General Relativity equations, predicted that the 4-dimensional space-time continuum of our Universe is affected by Gravity, hence Gravity and Geometry in our Universe are related.

Maxwell's Electromagnetic equations are compatible to the geometry of a 4-dimensional space time continuum of special relativity, thus Electromagnetism and Geometry are also related.

The relation between Quantum Mechanics, and its respective Schrodinger equations, with Geometry is more complicated. However, it was evident that Geometry plays an important role especially in cases that the Geometry of the phenomenon is not a planar one.

As an example we refer to an early application of Schrodinger equations for the study of electrons surrounding the atomic nucleus. There due to spherical geometry of the model, apart from the Coulomb's potential Z/r related to a Coulomb force of inverse square dependence with the distance, it seems appeared a non-conventional geometric potential of the form l(l+1)/r^2 also acting on the electrons, where l is the angular quantum number . This geometric potential is peculiar because its respective force on the electron should be of an inverse cubic form of its distance from the nucleus.

More recently [11] the behavior of free electrons inside curved quantum wires brought in light a similar relation between Quantum Mechanics and Geometry by the appearance of a non-conventional Geometric potential depending on the local radius of curvature R of the curved linear wire of the form of $1/4R^2$.

As it is presented in this paper, this geometric quantum mechanical potential could be the origin for some unexpected phenomena such as Li-ion battery explosions.

Nevertheless, this geometric origin phenomenon could possibly be useful for the invention of low-cost nuclear transmutation devices, for non-radioactive nuclear energy generation, free of C02 greenhouse gases.

In section 2 we present the theory of transient behavior of free electrons inside a linear conducting wire, under the application of a sudden external voltage pulse.

In section 3 we propose a theoretical model for induced Electric field in conducting wires and surfaces. We observed anomalous energy release and strong explosions on conducting wires due to a strong Stark effect and the phenomenon is presented in various applications (Z-pinch machines implosion, water drill) and relative experiments, including the historic proposed physical interpretations of it. Moreover we compare the exploding wire phenomenon with recent similar results from Coulomb's explosions.

In section 4 we examine the role of curvature of quantum conducting wires or paths and its respective Geometry induced potential that appeared to make a difference in the energy release during the experiments leading to the lowering of the energy eigen-value of the fundamental harmonic.

In sections 5 an analysis of phenomena related to the accidentally formed curved lithium threads (dendrites) inside the Li batteries is presented, and their explosions due to their nuclear transmutations are observed.

In section 6 we propose to use the curved geometry potential phenomenon in conducting wires or threads in order to design proper devices of low-cost nuclear transmutation and energy generation.

We also present the idea that the so-called cold-fusion phenomena, which appeared accidentally in several relative experiments, could possibly be connected to Quantum mechanical and electrochemical effects, related with accidental free electron concentrations, on tiny curved geometry conducting paths inside drills on the Palladium electrodes.

2. The transient behavior of free electrons in a linear conducting wire and the Stark effect

Any conductive thin wire can be considered approximately as a one-dimensional straight line quantum container in which its free electrons are allowed to move under the quantum-mechanical laws defined by Schrodinger equation and limited by the boundaries of the thin wire.

Any instantaneous external electrical voltage pulse acting on a thin conducting wire will create an instantaneous appearance of the harmonics electric currents that will be created in the thin wire or otherwise make it operate as a transient electromagnetic antenna.

Let as assume that we discharge a capacitor on a thin wire-antenna resulting as the application of a voltage V (t) on it. This wire- antenna will operate for an infinitesimal initial period of time under the influence of the initial voltage V (t = 0).

The oscillations of the free electrons in the thin wire-antenna will be defined by their quantum behavior within the wire-antenna, while the magnitudes of the resulting oscillating current harmonics will depend on the magnitude of the initial instantaneous voltage V (t = 0).

After the initial instantaneous appearance of standing waves in this thin wire, it will eventually become an ordinary electrical conductor discharging the capacitor bank. The conducting wire can generally be considered electrically equivalent to a complex impedance and the electric current through it can be calculated as a function of the applied of this voltage V (t>0).

Thus the infinitesimal initial instantaneous currents in the conductor depends only on the quantum oscillations of the free electrons inside the conductor and the initial instantaneous voltage V (t = 0). Furthermore the electric current after the initial shock is determined by the electromagnetic behavior of the thin conducting wire under the influence of V (t).

The strongest standing wave is the first harmonic that has the form $I(x,t) = I_0 \sin(kx) \cdot \exp(j2\pi ft), with \quad k = \pi / 2L, \; f = frequency \quad where \quad L \geq x \geq 0$ where L is the conductor's length and is maximized in the middle of the conductor.

This means that in the middle of the straight linear thin conducting wire for an infinitesimal period of time, strong oscillating currents will appear, i.e. free electrons will move periodically towards its middle point, creating a relatively high concentration of negative electric charge in its middle.

The concentration of electrons can create, if it exceeds a certain limit, a strong instantaneous electrostatic field which can partially or completely strip the nuclei of the adjacent conductors of the conductor from the electronic cloud surrounding them, i.e. the transiently concentrated free electrons in the middle point can create huge local electric voltage potentials, acting on their nearby atoms trapped in the lattice. Such a very strong Coulomb's potential can be the cause of a tremendous Stark effect [1] on nearby atoms.

In such a case, there is a high probability for some of the atomic nuclei to be temporarily stripped of all their electrons and in the absence of a shielding barrier the probability of them being affected by rapidly moving electrons in their vicinity also increases. We anticipate that the mechanism of paradoxical low energy nuclear reactions and transmutations can be explained as a Stark effect where some strongly repelled electrons by the free concentrated electrons from the middle of the wire are colliding statistically with naked atomic nuclei of atoms of the metallic lattice.

We have also noticed similar strong disintegration phenomena appearing also on experiments with metallic strips. Although the eigen-functions of two-dimensional metal traps in three dimensional spaces, of arbitrary boundaries are not known, we can assume that there will be several points of strong free electron concentration that are capable of creating strong Stark effects and the anticipated nuclear transmutations.

3. Exploding wires under transient voltage pulses and Stark effect

When a relatively high-voltage electric pulse, usually generated by discharging a series of capacitors, through a thin conductive wire (usually copper), two different phenomena can occur.

The first phenomenon occurs when the intensity of the electric pulse is strong but is below a limit so the conductive wire is simply separated in two equal parts, as if its two parts received a strong longitudinal repulsive force.

The second phenomenon occurs when the voltage of the electric pulse is very strong and is even more bizarre where neutron release occurs, indicating the presence of nuclear transmutations so the wire explodes violently and fragmented.

In previous papers [2,3] Papageorgiou and Raptis reported a theoretical model and a number of experiments with a very low internal resistance generator of high instant power electrical pulses but low energy content, causing fragmentation of long thin, copper wires. The aim of these experiments was originally to provide a sufficient explanation of the acclaimed "longitudinal forces" supposedly falling outside of classical Maxwell electrodynamics. Also in [4] Papageorgiou and Raptis examined the case of exploding batteries as a special case of exploding wires.

Taylor [5] performed certain experiments and observed the plasma formation around exploding copper wires and tried to explain the type of current flow including the plasma conductivity.

Wienterberg [6] was the first to propose an unorthodox interpretation of the released energy in terms of an excited quantum vacuum. The argument was based on a direct comparison between certain phenomena akin to Sonoluminescence which have had already been tested with success as a possible means for fusion. Wienterberg had also proposed a similar model for a controlled fusion reactor based on very high current pulses.

Regeneration of interest in exploding wires came from plasma physics where some devices with similar properties were used for decades. Better known as the Z-pinch devices [7], they were first introduced as a means to find experimental data necessary in the efficient design of thermonuclear weapons.

Recent reports [8] show that there is still hope that with sufficiently high currents the plasma produced by the explosion could reach pressures and temperatures necessary for a controlled nuclear fusion reactor.

I believe that for very strong high energy voltage pulses the disintegration phenomena in Z-pinch machines, although the proposed theories of implosion (or Sonoluminescence) are not satisfactory, do not influence the effectiveness of the devices.

However I believe that the phenomenon of the explosion and fragmentation of conducting wires under the application of strong voltage pulses from the discharge of capacitors can only interpreted correctly by considering the deep nature of the metal conductors as a quantum free electron tanks.

As was shown in the previous section due to the initial transient free electron quantum originated currents inside thin conducting wire, there will be a respective transient electric charge concentration in the center of the thin wire and due to Stark effect [1] nuclear transmutations may take place.

Assuming the wire is copper, the copper atom will become nickel atom. However, the stable isotope of nickel that will result from the mutation has fewer neutrons than the original copper atom, so the rearrangement that will occur in the nucleus will leave excess energy that manifests itself as an explosion and fragmentation of the wire.

An explosion can also occur in a column of heavy water placed in a conducting metal pipe open at one end on which a strong electric pulse is applied. As a result of the explosion, half of the heavy water is ejected, due to nuclear transmutations in the center of the heavy water column. The ejected heavy water has a tremendous speed capable of piercing a metal several centimeters thick. This proves, after all, that the assumed nuclear transmutation takes place in the middle of the heavy water column as our theory for the phenomenon predicts.

The transmutation in their heavy water experiments was the reason that Vigier and Rambaut proposed a patent called "method and device for producing fusion energy from heavy water" [9].

We notice also that similar nuclear fission phenomena are appearing in the so called Coulomb fission, where strong Coulomb electric fields are caused with various technological apparatus, in order to create Stark effect exploitation, the more common of which are referred in existing literature as "Coulomb Explosions" [10].

4. Geometry induced potential in one dimensional curved conducting wire

In a relatively recent series of publications Stockhofe and Schmelcher [11] as well as Zambetaki et al., [12] and J. K. Pedersen et al., [13] proposed a treatment of the Schrodinger equation in a curvilinear coordinate system for one-dimensional quantum waveguides. Linear thin conducting antennae can be considered as one dimensional quantum traps acting as an electromagnetic waveguide resonator, i.e. their free electrons form standing waves trapped inside their one-dimensional curved linear space. This consideration can be used in order to define the fundamental and the rest modes of distribution of the standing wave currents, of any arbitrary shape linear antennae under a proper frequency excitation.

We examine this recently introduced case of the Schrodinger equation on a curved one dimensional conducting path as a thin conducting wire or thread.

The Schrödinger spatial equation for a curved one dimensional (thin) wire, without any external voltage, developed along its length *s* where $0 \le s \le L$ is given by

$$\partial^2 y(s) / \partial^2 s = -k^2 \cdot y(s), Where: k^2 = \left(\frac{1}{4R^2(s)} + \varepsilon \right)$$

In the equations, the standard curvature $\sigma(s)$ is connected to the local radius *R* via the relation $\sigma(s) = 1/R(s)$. This, homogeneous second-order ODE can be solved easily if R is constant along the curved wire. Constant curvature means that the wire should be straight linear, circular or helical. In these cases the calculation of the eigen-values of the $y(s)$ is simplified and for each eigen-value its respective eigen-function of the $y(s)$ can be also calculated.

It will be shown that for special shaped circular quantum wires the fundamental "Energy" of their excitation, related to its minimum eigen-value, can be reduced significantly.

By standard texts the probability function $y(s)$ defined by the previous second order differential equation of constant curvature R and length L can be expressed in a sinusoidal form of function as follows :

$y(s) = A\sin(ks)$ where: $k^2 = \left(\frac{1}{4R^2} + e\right) = \frac{1}{4R^2} + E \cdot m / 2\hbar^2$

Moreover it is known that the function of the current along the conducting wire can be calculated by the relation: $I(s) = c \cdot y(s)\frac{\partial y(s)}{\partial s}$ *where* $c = cons\tan t$

Thus the boundary conditions of the second order differential equation will be defined by the zero values of the current at its end points, $I(s=0) = 0, I(s=L) = 0$

Thus the following relations are derived:

$$y(s=0) = 0 \quad and \quad \frac{\partial y}{\partial s}(s=L) = 0 \rightarrow Ak\cos(kL) = 0$$
$$or \quad y(s=L) = 0 \quad \rightarrow Ak\sin(kL) = 0$$

Thus the eigen-values are given by the formula $k \cdot L = n \cdot \pi / 2$, and the minimum eigen-value will be:

$kL = \pi/2$ *i.e.* $k = \pi/2L$ *thus*:

$$I(s) = c \cdot y(s)\frac{\partial y}{\partial s}(s) = c(\pi/2L)A^2\sin(s\pi/2L)\cdot\cos(s\pi/2L) = c(\pi/4L)A^2\sin(s\pi/L)$$
$$I(s) = I_0\sin(s\pi/L), with \quad I_0 = c(\pi/4L)A^2$$

The minimum energy for the fundamental current harmonic can be calculated by the equation:

$$\left(\frac{1}{4R^2} + \varepsilon_{\min}\right) = k^2 = \frac{\pi^2}{4\cdot L^2} Thus \quad \varepsilon_{\min} = \frac{\pi^2}{4L^2} - \frac{1}{4R^2} \quad \varepsilon_{\min} > 0$$

If we assume that $L \rightarrow \pi \cdot R, \varepsilon_{\min} \rightarrow 0$ for an almost semi circle shaped planar conducting wire the necessary minimum energy excitation $\varepsilon_{\min} = E_{\min} \cdot m / 2\hbar^2$, in order to appear the first current harmonic is negligible.

This fundamental standing current component will be of the form:

$I(s,t) = I_0\sin(ks)\cdot\exp(j2\pi ft), with \quad k = \pi/2L = \sqrt{\varepsilon_{\min}}$ *and* f = *frequency*

Any transient external voltage pulse excitation above a threshold, exerted on a thin curved conducting wire, could create the fundamental transient standing wave on its enclosed free electrons. The standing transient motion of free electrons will decay due to scattering effects of the free electrons with the metallic lattice, referred macroscopically as Ohmic losses.

However this standing wave of free electrons, under certain conditions, can generate nuclear transmutations in the center of the wire, due to Stark effect, as was described in the previous section.

Let us note that the threshold voltage is lowered in case of properly curved conducting wires or paths.

This property is the reason of Li battery explosions as it will be shown in the next section 5.

Moreover I believe that this phenomenon can be used in order to invent and design devices for low cost nuclear transmutation as it will be presented in the section 6.

5. LI-ion Batteries strong explosions

The batteries which had accidental explosions are exclusively Li-ion batteries. No other kind of batteries had any explosion ever. The massive application of Li-ion batteries to small devices (smart-phones, tablets, e-cigarettes etc) has brought in light this unexpected behavior of certain batteries of this kind.

Unfortunately the short-circuit theory presented as a possible reason of the explosions do not explain the phenomenon. Explosions of batteries of small portable devices on the ground usually have mild consequences (injuries) although recently at least one deadly explosion was reported in the USA [14].

However the corresponding explosions on portable electronic devices brought by passengers or crew members on aircrafts may have tragic consequences. There are several indications that a battery explosion has already been suspected as the main reason for a deadly plane crash of one aircraft [15].

In order to eliminate the explosions we should understand the deep physical nature of this kind of batteries and define the physical explanation of the phenomenon. Recently, the phenomenon of thermal runaway and subsequent explosion in Li-ion batteries was investigated at Department of Energy's& SLAC National Accelerator Laboratory [16] and in MIT [17] and results revealed a complex picture due to the formation of dendrites from Li metal fibers.

Hence It is now clear that the explosions of Li-ion batteries are related to Lithium threads (dendrites), formed into the mass of these batteries, when an accidental abrupt flashing even very small voltage is applied on them. My view is that the cause of strong explosions is the nuclear transmutation of these thin conducting threads of pure Lithium (dendrites) and the extremely high thermal exploding power produced by it.

I strongly believe that in pure Lithium curved threads (dendrites), shaped inside the Li-ion batteries, nuclear transmutation may be generated that under certain circumstances may create very strong explosions. If the pure Lithium threads are straight, there are no explosions and if they do appear, they will be of negligible power. If the Lithium threads are curved, the explosions can become very strong even for negligible voltage excitations.

As it was shown in previous section (4) if the Lithium threads are almost semicircles, all energy accumulates in the first harmonic that generates large temporal accumulation of electric charge (free electrons) in the center of the thread and there is a very high probability of a nuclear transmutation and consecutive explosion, i.e. the reason for the explosion as was previously presented is the Stark effect [1] phenomenon created by the sudden instantaneous accumulation of electric charge (free electrons) at the center of the threads that could create nuclear transmutations.

In case of SAMSUNG smart-phone (Note 7) explosions [18] I believe that they were related to the curved lower edges of their batteries, that probably in a small number of them, facilitated the formation of curved lithium threads.

In order to minimize the consequences of the strong explosions in aircrafts, I believe that it is necessary to ban pilots from carrying small electronic devices (smart-phones, tablets etc) with Li-ion batteries inside the cockpit.

I believe that the long-term solution to the explosions is to manufacture free of explosion Li-ion batteries in a way that at least prevents the formation of curved threads of pure Lithium inside their body.

6. Low energy nuclear transmutation generation devices

Taking into consideration the previous sections analysis it was evident that in curved quantum conducting wires or threads even a very small external voltage pulse (of negligible electric energy) can under proper conditions generate a transient free electron current of the fundamental mode inside it.

This has as a consequence a temporal concentration of free electrons at the middle of the conducting wire or thread with a probability of nuclear transmutations of relatively higher energy generation.

It is evident that proper devices using this method can be a very promising path towards the invention of low cost low energy machines that could cover the humanity's energy needs and put an end to the use of fossil fuels.

In their paper Krivit and Ravnitzky [19] in Scientific American titled "It's not Cold Fusion but it's Something" they support their experimental findings of nuclear transmutation phenomena in the so called area of cold fusion.

Taking into consideration that in several experiments, related to the so called cold fusion, nuclear transmutation and excess thermal energy was generated, it is clever to start designing relative devices that should include Palladium metallic parts and lithium salt solutions.

We anticipate that the so called cold fusion phenomena, appeared accidentally in several relative experiments, could possibly be connected to Quantum mechanical effects in accidentally formed tiny curved geometry conducting paths or drills inside the Palladium electrodes of the experiments.

The first successful device with repeatable positive results will be the starting point of a new era of low-cost low energy nuclear transmutation machines without any harmful radioactivity and no greenhouse gas emissions.

7. Conclusions

By the previous analysis it becomes evident that the curvature effect results in a kind of amplification of the free electron concentration phenomena. The resulting lowering of the energy eigen-value is also suggestive of the fact that lower external energy source can now more easily excite the fundamental mode. However, we cannot actually know how large a part of the externally supplied energy will be effectively coupled to this mode on a realistic macroscopic long thin conductor given the extreme out-of-equilibrium conditions of the high power pulses used in relative experiments.

The main assumption to be further tested with subsequent experimentation is that given the curvature induced lowering of the eigen-energy for the fundamental mode, and the concentration of the free electron density near the center, even low energy excitations with very instant high power can cause the appearance of huge local electrical voltage field, of purely Coulombic nature, near the point of maximum concentration, due to the rapid removal of the previous electrostatic equilibrium and the Stark effect.

Similar effects should be anticipated in the case of thin metallic stripes of any shape, at least in the case of a curvature present along one of their Euclidean axis only.

From this special behavior of curved linear or strip conducting paths due to Geometry and quantum mechanics, I am suggesting to give a chance in the research of this area related to low energy transmutations, while today's main interests are focused on high energy fusion utilizing heavy and high cost devices like Tokamaks, high energy lasers and accelerators.

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