ISSN 2229-5518

THE FULL LORENTZ FORCE FORMULA REPOSIBLE FOR TURBULENCE IN SOLIDS AND FLUIDS AND EXPLAINED FARADAY'S PARADOX

Asya S Skal

P.O. Box 1836,Ariel 44837, Israel

Abstract

According to the literature, the conservation of momentum equation needs to be coupled with the mass conservation equation [1]. However they cannot create a coupled system of equations of motion because they ignored third Newton law. The conservation of momentum equation is a Newton's second law of motion, whereas conservation of mass belongs to kinematics. No one motion in nature can be described only by Newton's second law without Newton's third law [2] Coupling NS equation with diffusion equation we obtained the new fundamental equation of turbulent phase transition in both solids and fluid [3], which consists of two non-linear terms which consists of two Lorentz forces: usual backside force and a new longitudinal force, that responsible for turbulence and explained Faraday's paradox.

Analytical Green function solution of the NS equation gives formula for the Hall coefficient. Computer simulation show smoothness far from threshold but near turbulent phase transition appear extremely singularities: hot and special points, which very important in engineering construction because may make disaster and were described in our papers of vector percolation.

The second Lorentz force was never found experimentally because it may appears or disappears or change direction, so researchers need to know exactly where to look.

Key words: Spatial Navier Stokes equation, time-independent part of diffusion of momentum equations, time dependent part of diffusion equation, full Lorentz force, two Hall coefficients, longitudinal force.

1. Introduction

In 1892, Hendrik Lorentz derived the modern day form of the empirical formula for the electromagnetic force which includes the contributions to the total force from both the electric and the magnetic fields that now bears his name. However this force incomplete because it incapable of performing a work, classical theory cannot claim to be responsible for net energy transfer emission or absorption,e.g., heating of food in a microwave oven and warmth near a stove From Ampere through Maxwell until the present day, there have been persistent experimental claims that when current flows in a metallic conductor, there are some forces acting along current streamlines which subject the conductor to tensile stress, which are capable of performing work in the direction of the current flow. Linear Maxwell electrodynamics does not include theory of turbulence and therefore fails to explain very large net energy transfer such as anomalous absorption in laser fusion, free electron laser gyrotron, which is electron cyclotron maser, laser-plasma acceleration, ultra-strong spontaneous emission and so on because a magnetic Lorentz force is perpendicular to the current direction and cannot transfer energy.

ISSN 2229-5518

The typical acceleration gradient in present day high energy acceleration is about 29 MeV/m. With such an acceleration gradient, it is too costly to build a high energy accelerator of 10 TeV. Thus, in a practical sense, high-energy physics must come to an end [4] unless a new physical mechanism having a high acceleration gradient is explored. This new physical mechanism of turbulent phase transition (the longitudinal Lorentz force) - was stagnated in NS equation for almost 200 years. The Clay mathematical Institute calls the NS equations as one of the seven most important open problems in mathematics. This article present analytical solution of the NS equation.

The first Lorentz force formula is following from empirical statement in the uniform electric and magnetic fields and cannot be strongly derived from linear Maxwell equations. In agreement with the conventional views of electromagnetic theory, all the forces which act on a current carrying metallic conductor are perpendicular to currents streamlines. However, over the years, from Ampere through Maxwell until the present day, there have been persistent claims that when current flows in a metallic conductor, there are some forces acting along current streamlines, which subject the conductor to tensile stress, and which are therefore capable of performing work in the direction of current flow.

2. The Navier Stokes equations are the full Lorentz force formula

Linearizing NS equation, one cut all information of turbulence, whereas leaving nonlinear terms one obtain situation of non-convergence in numerical calculation. Any convective flow, whether turbulent or not, will involve nonlinearity It was shown in paper [3] that NS equation must be coupled with diffusion equation, instead of mass conservation equation [1].

The conservation of momentum and mass equations cannot satisfy a dynamics equilibrium condition because they belong to different branches of fluid mechanics. Whereas the conservation of momentum are dynamical equations, the conservation of mass is a kinematical equation. Kinematics deals with mere geometry of motion without reference to the applied forces, whereas dynamics deals with the applied forces that produce changes in the motion of the fluid.

Coupling diffusion and NS equations one have obtained a new fundamental equation of turbulent phase transition in fluid and a new conductivity in a weak and strong magnetic field equation in solids, which correspond exactly to the full Lorentz force formula

$$j(r) = \boldsymbol{\sigma}(\mathbf{r})\nabla\varphi(\mathbf{r}) + \boldsymbol{\sigma}(\mathbf{r})\mathbf{R}(\mathbf{r})\mathbf{H}\times\mathbf{j}(\mathbf{r}) + \boldsymbol{\sigma}(\mathbf{r})\mathbf{R}(\mathbf{r})\left(\mathbf{j}(\mathbf{r})\cdot\mathbf{H}\right)\mathbf{sign}(\nabla\left(\mathbf{H}\cdot\mathbf{e}_j\right))\mathbf{e}_j \quad (1)$$

If the current density change to fluid density q(r) and a magnetic field H to Vorticity then the full equation for fluid motion can be written as

$$q(r) = Q(r)\nabla\varphi(r) + Q(r)R(r2)\backslash\Theta(r)\times q(r) + Q(r)R(r)\nabla q^2(r)/2 \qquad \textbf{(2)}$$

The first electrodynamics Lorentz force is

$F^1_L = j(r) = \sigma(r)\nabla\varphi(r) + \sigma(r)R(r)H\times j(r)$ …(3)

Whereas the second Lorentz force is last term in eq.(1)

The first hydrodynamics Lorentz force formula can be presented as

$\mathbf{L_{hyd}} = q(r) = Q(r)\nabla\varphi(r) + Q(r)R(r)\Theta(r)\times q(r)$ (4)

where e_j is a unit vector in the velocity direction and R(r) is Hall coefficient for fluid and the second hydrodynamics Lorentz force is a last term of eq.(2). where e_j is a unit vector in the velocity direction and R(r) is Hall coefficient for fluids.

3. Analytical solution of Navier Stokes equations is the Hall coefficient

In the case of applying electric field along axis 'x' and measuring Hall coefficient along 'y' axis when the magnetic field H_z is applying along 'z' axis, the effective Hall coefficient $R_e(r)$ can be expressed as

$R^{eff}(p)=\iiint R(r)(j_{0,x}(r)[H \times j_{0,y}(r)])/(^{UxUy}\sigma^{eff}{}_x\sigma^{eff}{}_y H_z L dV)$... (5)

with boundary conditions along the x-axis for potential difference U_x, and U_y for potential difference along y axis and corresponding effective conductivities whereas L is the length of the sample along the magnetic field H_z.

Thus the effective Hall coefficient can be calculated from two Ohm current densities $j_{0,x}(r)$ and $j_{o,y}(r)$, that was obtained by computer calculation without a magnetic field. Equation (5) leads to approximate formula for the Hall current that is proportional to the Lorentz force as

$j_{Hall} \propto L_{1,2} \propto Const\, j^2$ ………(6)

4. Faraday experimentally found the second Lorentz force in solids

In 1892, Hendric Lorentz presented the modern day form of the empirical formula for the electromagnetic force, which includes the contribution to the total

force from both the electric and magnetic fields that now bears his name.

ISSN 2229-5518

However, the backside Lorentz force is understood to be the empirical statement in a uniform electromagnetic field. James Clerk Maxwell successfully unified electricity and magnetism into electromagnetism in the 1800s, but these equations do not seem to admit force fields as solutions.

Let us consider the wire which includes a galvanometer. When Faraday leaved the wire alone and moved the magnet the galvanometer showed current. He discovered that moving the magnet under the wire- one way- has the same effect as moving a wire over the magnet- the other way. But then the magnet is moved one no longer the usual Lorentz force on the wire. This is new effect that Faraday found. The current is produced by second Lorentz force. He observed the same effect if instead of a magnet he used a coil of wire in which there is a current. If one moves the wire past the coil there will be a current through the galvanometer. If one move the wire past the coil there will be a current through the galvanometer, or also if we move the coil past the wire. If we change the magnet ric field of the coil not by moving it, but by changing its current, there is again an effect in the galvanometer. For example, if one has a loop of wire near a coil and keep both of them stationary but switch off the current, there is a pulse of current through the galvanometer. When one switch the coil on again, the galvanometer kicks in the other direction. Faraday's complete discovery was that emf's can be generated in the wire in three different ways: by moving the wire (an usual Lorentz force), by moving a magnet near the wire (a second Lorentz), or by changing the current in near the wire (a second Lorentz force). The most puzzling case is third one, when a magnetic field disappears and emf appears. This is result of gradient of a magnetic field, the last term of eqx(1). The amount of emf is given by simple rule and have the same value in each case because the module of both Lorentz forces are equals. We begin with studying the way longitudinal stress actually arises.

5.The electromagnetic and hydrodynamics Lorentz forces in

dense plasmas

A) region of a strong magnetic field

Kim (1994) [4] called a longitudinal force a non-Lorentz force because the classical theory cannot claim that the usual Lorentz force is responsible for net energy transfer, for emission or absorption, e.g. the heating of food in a microwave oven and warmth near a stove. The full Lorentz force of Equation (1) can answer these questions without any contradiction with classical concepts because one has deal with non-uniform electromagnetic fields in all these experiments and the longitudinal force do appear.

B) region of a weak magnetic field

Nasilowski (1961, 1964) [5] performed experiments with electrodynamics' wire explosions. When subjected to a current pulse of sufficient magnitude, a thin wire disintegrated into pieces while in solid state. When the segments were investigated it was found that the breaks were due to tensile stress; a minimum current was needed to shatter the wire. He found experimentally that the longitudinal force is proportional to the square of the current, which corresponds exactly to our Green function solution (Skal, 2002) [1]

Graneau (1985) [6] suggests that the longitudinal force may be similar to the force (v x B),which is in good agreement with our result where the both force look similar.

The possibility of actually weighing the repulsion between different parts of a circuit was investigated by Cleveland (1936) [7]. Since then, many experiments have been performed to measure the force that one part of a conductor exerts on another part. A current pulse imparts momentum on the moving pi-frame, which is carefully measured. Precise measurements have been made by Moyssides [8] and Peoglos (1988) [9]. The total force seems to be correctly given by the Lorentz force. Their result mathematically prove Equation (1), because two terms are approximately equivalent.

The existence of the longitudinal force raises the question of possible applications of these phenomena. Some interesting applications such as

ISSN 2229-5518

metal punching, water-jet propulsion, high-current limiting, explosion motor can be found in literature (Lochte-electrodynamics fusion and novel application, the electrodynamics by Holtgreven and Atomk, 1989) [10].

Conclusion

The new part of Lorentz force will be very useful in interaction of electromagnetic fields with matter, in concepts of simple charged particles and electromagnetic fields, in calculating the field momentum of moving charge and electromagnetic mass, in atomic physics and physics of high energy. Professor Heisenberg asked: "When I meet God, I am going to ask him these questions: Why relativity? Why turbulence? I really believe he will have an answer for the first."

Our answer for the second question is very simple. The full Lorentz force is responsible for turbulence. The lateral part creates circulation (Hall current) above and below the threshold, but only the longitudinal part creates turbulent phase transition.

ACKNOWLEDGEMENT

I would like to gratefully acknowledge the useful comments and conversation with Dr. Igor Grebnev. I am also very grateful for the help and assistance of Professor Charles Duke, Dr. Lechem Israel and Dr. Amber Avigail.

REFRENCES

1. Fefferman C L “Existence and smoothness of the Navier Stokes Equation” Clay Masthematical Institute press. June, 2013

2. Skal AS (2011) ‘Does a physically reanable solution of the Navier Stokes equation exist?”,Journal of Engineering and Technology Research vol. 3(6). Pp 168-170, June , 2011. (see online
At http//www.academicjournals.org/JETR

3. Skal A.S “The New Fundamental Equation of Turbulent Phase Transition”

American Journal of Mathematics and Statistics p-ISSN: 2162-948X e-ISSN: 2162-8475 2012; 2(1): 13-15 doi: 10.5923/j.ajms.20120201.03

4. Kim SH (1994). 'A Non-Lorentzian Force Stronger than the Lorentz

ISSN 2229-5518

Force', APEIRON, Nr. P.19

5. Nasilowski J (1961). 'Phenomena Connected with the Disintegration of "Conductors Overloaded by Short-Circuit Current Przeglad Elektrotechniczny;'Unduloids and striated Disintegration of Wires Exploding Wires', W.G. 397- 403.
6. Graneau P (1985). Ampμere-Neumann electrodynamics of metals Hadronic Press, Mass; . Graneau P (1989). 'Electrodynamic seawater jet: An alternative to the propeller?' IEEE Trans. Magn. 25: 3275-77.
7. Cleveland FF (1936). 'Magnetic forces in a rectangular circuit' Phil.Mag. 21: 416-425.
Chase HM, Plenum NY, Forrest FC (1964). Magnetic forces in a rectangular circuit Phil.Mag. 21: 416-425
8. Moyssides, Paul G., (1976) 'Experimental Verification of the Biot-Savart-Lorentz and the Ampere Force Laws in a Closed Circuit, Revisited',I.E.E.E Trans. Magn., V.25.
9. Peoglos V (1988). 'Measurement of the magneto-statics force of a current circuit on a part of itself', J. Phys. p.1055-1061.
10. Lochte-Holtgreven, W. Atomk, (1989), p.4298-4306, p.4307-4312, p.4313-4321 (3 Articles).