Theoretical and Experimental Research on Field Propulsion Using the Developments of the BSM-Supergravitation Unified Theory

Stoyan Sarg, PhD
Toronto, Ontario, Canada
s.sarg@helical-structures.org sto.sarg@gmail.com

The Basic Structures of Matter - Supergravitation Unified Theory (BSM-SG) is based on an alternative space concept. The developed models provide a vision for the possible material structure of the elementary particles and the superfine structure of the physical vacuum called the Cosmic Lattice (CL). The properties of the CL elementary node and its interaction with the elementary particles give clues to the connection between gravity and inertia on one side and the electric and magnetic fields on the other. Mass appears to be not equivalent to matter but its measurable parameter, so it could be changed by proper modulation of the parameters of the physical vacuum. BSM-SG predicts an unique gravito-inertial effect which was verified by experiments and was called Stimulated Anomalous Reaction of Gravity (SARG). It is activated by a Heterodyne Resonance Method invoking Quantum Mechanical interactions between oscillating ion-electron pairs and the space-time continuum. The SARG effect occurs in properly activated neutral plasma. It could be used for acquiring new technology for space drives referred as Field Propulsion.

1. Introduction

Massless propulsion is a space drive mechanism in which only an EM field is involved. One particular effect known as the Biefeld-Brown effect [1] has been known for many years. In the past 15 years, research on massless propulsion has intensified. The articles and conference reports on this issue are usually referenced under names such as antigravity, electrogravity, electrokinetics, magnetohydrodynamics, electrohydrodynamics, electropropulsion, plasma drive and so on. [2,3,4,5] Currently, ongoing space projects exist in the USA and Europe. [6,7] The physical mechanism of the observed propulsion effect, however, has not been understood and expectations have not been reached. The author of this proposal realized that success in this field requires better understanding of the relations between gravity and inertia on one side and the electrical and magnetic fields on the other. Contemporary physics does not provide a satisfactory solution to this problem. After years of extensive theoretical search the author of this proposal arrived at useful physical models that are able to provide the relation between these fields in an understandable way. One of the major predictions from his theoretical treatise "BSM – Supergravitation Unified Theory" (BSM-SG) [8,9] is the possibility of controlling the gravitational field acting on a material object by properly modulating the parameters of the physical vacuum.

2. A New Theoretical Approach

The Basic Structures of Matter - Super Gravitation Unified Theory (BSM-SG) [8] shows the relation between the forces in Nature by adopting the following ideas:

- Empty Euclidian space without any physical properties and restrictions
- Two fundamental particles (FPs) of superdense matter with vibration frequencies at Planck's scale range
- A Fundamental law of Super Gravitation (SG) - forces between FPs are inversely proportional to the cube of the distance in pure empty space.

Driven by the SG law, an enormous quantity of the two fundamental particles, with vibrational energy above some critical level, is able to congregate into self-organized hierarchical levels of geometrical formations.

According to BSM-SG, a self-organized process in a supermassive astronomical object of primordial matter leads deterministically to crystallization of sub-elementary particles called twisted prisms that are embedded in the elementary particles. The evolution of the process leads to creation of a Cosmic Lattice (CL) space with quantum properties and the formation of a galaxy. The individual nodes of CL space are flexible and comprised of 4 prisms of the same type. The two types of CL nodes are alternately arranged with gaps between them due to the nature of the SG law. Fig. 1 shows a mockup of the CL structure.

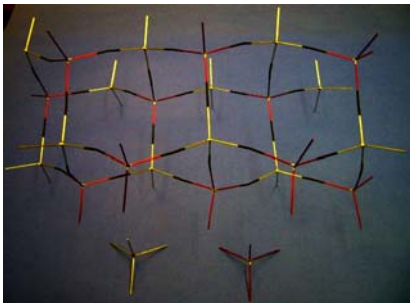

Fig. 1. Mockup of the CL structure. Individual CL nodes formed by 4 prisms are separated by gaps (black line)

The CL node possesses 2 sets of symmetrical axes: one orthogonal *xyz* and another one along the 4 prisms axes called *abcd*. The distance between CL nodes along xyz axes is estimated to be 1.097×10^{-20} (m). The return SG forces (defining the stiffness of

CL structure) along the abcd axes are thousands of time stronger than the return forces along xyz axes. This permits complex 3D oscillations of the CL node. The analysis of these oscillations under SG forces unveils two cycles – a proper resonance one with a frequency of $\nu_R = 1.0926 \times 10^{29}$ Hz and a cycle of a Spatial Precession Momentum with a frequency equal to the experimentally estimated Compton frequency $\nu_c = 1.236 \times 10^{20}$ Hz (§2.11.3, Chapter 2, of BSM-SG). [9] The stiffness of the CL structure in the *abcd* directions is much stronger than in the *xyz* directions. For this reason the propagation of the EM field involves mainly oscillations along *xyz* axes. The propagation of the SG forces along the *abcd* axes of the CL nodes (stronger stiffness) is manifested as the familiar Newtonian gravitation. The static and dynamic properties of the CL node permit understanding of the physical relation between gravity and inertia on one side and the electrical and magnetic fields (including EM field and light) on the other.

Using the unveiled structure of the electron [10] the main parameters of the CL space are derived:

- **Static CL pressure, P_S**

$$P_S = m_e c^2 / V_e = 1.3736 \text{x} 10^{26} \text{ N/m}^2 \quad (1)$$

- **Dynamic CL pressure, P_D**

$$P_D = h\nu_c / cS_e = 2025.8 \text{ N/m}^2\text{-Hz} \quad (2)$$

- **Partial CL pressure, P_P**

$$P_P = P_S \alpha v / c; \quad \text{for } v = \alpha c, \; P_P / P_S = \alpha^2 / \sqrt{1-\alpha} \quad (3)$$

where: c – speed of light, m_e – mass of the electron, V_e - impenetrable volume of electron structure, S_e – surface of the electron structure, α - fine structure constant, υ - electron velocity, h – Planck constant, $\nu_c = 1.236 \times 10^{20}$ Hz - Compton frequency.

The static pressure defines the Newtonian mass as a pressure exercised on the impenetrable volume of the elementary particle structure.

The Dynamic CL pressure defines the Zero Point Energy of Dynamic type (ZPE-D) envisioned by Quantum Mechanics. It is responsible for the existence of the Electrical and Magnetic fields.

The Partial CL pressure is related to the confined motion of the electron with one of its quantum velocities, in which the signature of the fundamental Fine Structure Constant plays a role. The analysis in BSM-SG Chapter 10 allowed identification of the relation between the gravitational and inertial mass of the elementary particle. The derived results are transferred also to atoms, molecules and solid objects.

The equation of static pressure and the structure of the electron permitted derivation of the mass equation for a stable elementary particle with impenetrable volume V_H.

$$m = \left(P_s / c^2\right) V_H = \frac{2h\nu_c{}^4 \left(1-\alpha^2\right)}{\pi \alpha^2 c^5} V_e \quad (4)$$

Eq. (4) shows that the mass of the particle could be changed by changing the Static CL pressure P_s. From the right side of Eq. (4) we see that such change is possible if the light velocity is changed. For this purpose the superhigh Compton frequency ν_c must be reached by proper Quantum Mechanical (QM) interaction.

The analysis of the CL node dynamics leads to the conclusion that the nodes are self synchronized with the phase of a vector called Spatial Precession Momentum (SPM) propagated with the speed of light. The frequency of the SPM vector in a rest frame is equal to the Compton frequency. The self synchronization appears as spontaneous recombining of Zero Point waves with length equal to a whole number of Compton's wavelengths. This feature is responsible for the constant speed of light and also plays an important role in the propagation of gravity.

- **Conclusion:** If the self synchronization of the CL space local zone is asymmetrically disturbed around a material object - particle , atom, molecule, gas, or a solid body, a gravitational sink will be created in which this object will fall. Consequently, we need to invoke interactions at Compton frequency ν_c.

The derived physical model of the electron presented in Chapter 3 of the BSM-SG book [9] and published in Physics Essays in 2003 [10] allows envisioning of a technical method for invoking such an interaction. It has been found that the electron has oscillating properties at the Compton's frequency that, in the frame of a moving electron, is estimated to be independent of its velocity. At the same time, the unveiled electron structure exhibits a screw-like motion. This motion, combined with the oscillation properties, leads to prefered velocities at which the QM interaction with the physical vacuum (CL structure) is stronger. They correspond to electron energies of 13.6 eV, 3.41 eV, 1.51 eV and so on. The optimal quantum interaction, however, occurs at energy of 13.6 eV corresponding to an electron velocity of 218,978 km/s. The BSM-SG models predict that when the electron is bound to an accelerated positive ion the electron's trajectory is a helix. Then the bound ion-electron pair may move with significantly lower velocity, while the electron moves with one of its quantum velocities, preferably the optimal one corresponding to 13.6 eV. In the case of a hydrogen ion (proton), the ion to electron mass ratio is 1836, while their magnetic moment ratio is 1/1519. Consequently the magnetic field of the electron moving in a helix will largely dominate the magnetic field from the proton. This will assure not only a stable motion of an individual ion-electron pair but also a stable motion of a cluster comprised of such pairs (this effect is observed by some researchers). At the same time, the dominating mass of the ion will not allow a fast acceleration of the pair in comparison to the free electron. Investigating many prior art experiments on EM activated plasma, the author found a signature of the predicted oscillations. In an external AC electrical field, such ion-electron pairs perform a reversible motion limited by the free path between collisions. The latter depends on the gas pressure, but the oscillating pair seems to have an increased free path.

It was predicted and found experimentally that QM interaction with the physical vacuum takes place in the moment of directional reverse of the ion-electron pair, but this usually occurs for a determined number of cycles. At that particular moment, a spin change of the electron occurs that is a type of QM effect.

The described physical mechanism of QM interaction is called a Heterodyne Resonance Mechanism, while the technical method of its activation is called a Heterodyne Resonance Method. [9, 12] The most important feature of this mechanism is that QM interactions at the superhigh Compton frequency can be triggered by

an AC field in the accessible frequency range from 2 to 100 kHz. The optimal activation voltage and frequency depends on the working gas pressure and the geometry of the electrode system. The frequency of reversible motion of the ion-electron pair, however, is in the MHz range and depends on a number of parameters including the type of gas and pressure. The activation of the Heterodyne Mechanism requires an electrical pulse with amplitude above some threshold limit. It could be activated also by a DC pulse. At normal air pressure, usually a high voltage (HV) AC or DC pulse is required. The optical signature is a glow discharge, but in the case of the Heterodyne Mechanism, it has a few distinctive features.

1. The applied AC field (in kHz range) only activates the Heterodyne Mechanism while the frequency of the reversible motion of the pairs is much higher (in MHz range)
2. When activated by a HV DC pulse, the power consumption is much smaller
3. The Heterodyne Mechanism is located in the glow discharge surrounding the cathode

Fig. 2 illustrates the traces of the reversible motion of ion-electron pair activated by an AC field.

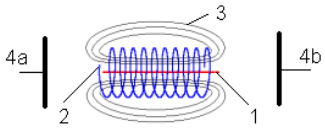

Fig. 2. Traces of the reversible motion of ion-electron pair
1 – ion trace, 2- electron trace, 3 magnetic field, 4a and 4b – electrodes

3. Experimental Research

The glow discharge has been known for more than a hundred years. Despite the advances in Plasma Physics, some features bothered the theoreticians and experimenters for many years. In the last two decades, the research has been focused on a glow discharge at normal pressure. [2,3,4,5,6,7] The author analyzed many experiments from a point of view of BSM-SG theory and provided his own experiments. His research work includes experiments at partial vacuum and at normal air pressure. The purpose of the partial vacuum experiments was to identify the predicted Heterodyne Resonance mechanism by observing its detectable signatures. The purpose of the experiments in normal air pressure was to identify the gravito-inertial effect.

Fig. 3 shows the optical signature of the Heterodyne Resonance mechanism invoked in a cell filled with oxygen at pressure of 12 mbar.

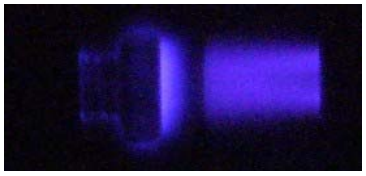

Fig 3. Optical signature of the Heterodyne mechanism

The applied voltage is DC but with an arrangement of inductance involved in the resonance with the oscillating ion-electron pairs. [12] Its optical signature is the glow discharge that envelopes the cathode (the left side electrode in Fig. 3). The anode is at the right side of the column separated by a gap (known as the Faraday gap) from the cathode glow.

Note that the glow surrounding the cathode appears also in a region where the applied electrical field is zero. This is so because the process is accompanied by longitudinal waves the direction of which is normal to the surface of the electrode. They were first observed by Nikola Tesla, while their theoretical treatment is provided by Vlaenderen [13] and Butusov. [14]

For observing the predicted spin change of the electron, a test with active feedback was arranged. [12] The signature of the spin change for a hydrogen gas in partial vacuum is apparent from the observed waveform shown in Fig. 4a and the spectrum shown in Fig. 4b.

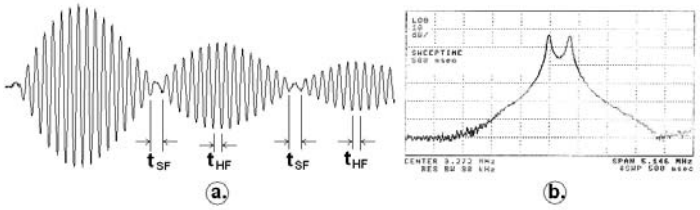

Fig. 4. **a** – waveform, **b**- spectrum. Signature of electron spin change: $t_{SF} \triangleright t_{HF}$ from **a** and the two peaks in the spectrum shown in **b**

The Heterodyne Resonance Mechanism invoked by EM activated plasma surrounding an object causes a change of gravity. If the plasma envelope is asymmetrical, a gravity sink appears. This is a gravito-inertial effect called "Stimulated Anomalous Reaction to Gravity" (SARG). [15] When combined with a magnetic field with a proper configuration, the gravitational and inertial mass of the object will be changed. This change will affect also the surrounding gas molecules. As a result, the invoked motion will exhibit less air turbulence. Fig. 4 shows a simple plasma actuator for demonstration of the SARG gravito-inertial effect.

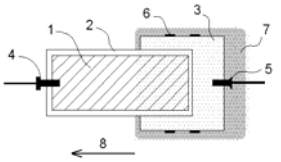

Fig. 5. Plasma actuator demonstration of SARG effect.[11,12]

Fig. 6 shows one of the permanent motion experiments demonstrating the SARG effect.

Fig. 6. Rotating plasma thrusters [12,16]

Other demo experiments with different arrangements are posted on Youtube. [16] In one of them, the plasma actuator was enclosed in a transparent cylinder in order to eliminate the possible influence of ion wind. An application for invention based on the discovered SARG effect was submitted to CIPO, Canada

on 26 Aug 2008. [11] Fig. 7 shows a possible shape of a spacecraft with a Field Propulsion based on the SARG effect. The activated plasma is external. One essential difference from the vacuum experiments is that the plasma is not activated by opposite electrodes. However, the longitudinal waves play an important role in invoking the Heterodyne mechanism in this case. This requires a specific design of the electrode system, the means for plasma activation, and proper selection of the materials. The effect will be more efficient when pre-activated plasma is ejected. Such kind of spacecraft may travel even better in deep space. The weight of needed gas in comparison with the weight of the spacecraft is quite small.

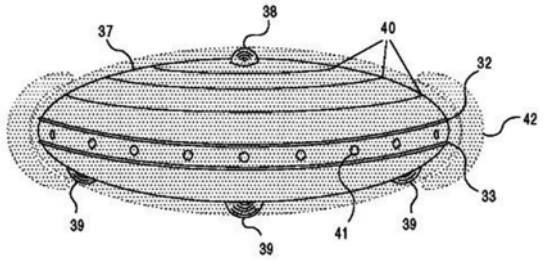

Fig. 7. Shape of a spacecraft with a Field Propulsion system [11,12]

The efficiency is highly dependent on the selected type of working gas. A proper mixture with a buffer gas is preferable. Spacecrafts based on Field Propulsion may have a variety of shapes. Options with internal plasma are also possible but the efficiency of the Field propulsion would be much lower. Combined options of internal and external plasma and spacecrafts with different shapes are also possible.

4. Conclusion

Field Propulsion based on the SARG effect is a new kind of propulsion mechanism distinguishable from the jet propulsion system. According to BSM-SG theory, if the activated plasma uniformly surrounds the spacecraft, its inertial mass should be reduced. Then we may speculate that it could be accelerated with less energy in comparison to the case of classical acceleration. Experiments and observations indicate that the disturbed self synchronization requires a finite time for restoration. Then for acceleration with reduced mass, the spacecraft must be initially surrounded symmetrically by strong plasma and then by asymmetrical plasma for obtaining a fast acceleration with reduced energy. For a spacecraft with external plasma in combination with a properly configured magnetic field and design, the crew probably will not feel the acceleration. Additionally, the spacecraft will not exhibit turbulence like the classic jet aircrafts because the mass of the surrounding air molecules will also be affected. A signature of reduced turbulence was first discussed by the former NASA scientist Paul Hill. [17] Recent NASA research on atmospheric glow discharge confirmed this effect without explanation of its physics. Newton's third law should not be valid for this kind of propulsion. Newton's second law should be valid but considering a reduced mass.

For a few reasons, including harmful biological effects and EMI noise, the Field Propulsion cannot be considered as a replacement of commercial aircraft based on jet propulsion. Its major advantages are for interplanetary and deep space travels.

Acknowledgements

I appreciate the useful discussions with my colleagues and collaborators, including Andrew Michrowski from the Planetary Association for Clean Energy, Canada [18] and William Treurniet, Ottawa, Canada. My special thanks go to Nikolaos Balaskas, York University, Canada, for the useful information and encouragement in my experimental research.

References

[1] T. T. Brown, US Patents: 1,974,483; 2,949,550; 3,018,394; 3,187,206; 3,022,430

[2] J. R. Roth et al., Paraelectric Gas Flow Accelerator, US Patent 6, 200,539 B1

[3] J. R. Roth, "The atmospheric uniform glow discharge (OAUGDP) – a platform technology for the 21st century", invited plenary talk at the 33rd IEEE International Conference on Plasma Science, Travers city, MI, June 4-8, 2006.

[4] S. Roy, Electric Propulsion Device for High Power Applications, US Patent 7,506,497 B2

[5] F. Massiness et al., Experimental and theoretical study of a glow discharge at atmospheric pressure controlled by dielectric barrier, J. Appl. Phys, **83**, 2950-2957, (1998)

[6] M. G. Millis **&** E. W. Davis, *Progress in Astronautics and Aeronautics Series*, 227, Published by AIAA, © 2009, ISBN-13: 978-1-56347-956-4

[7] Smart-1 Satellite based on electric propulsion (ESA.com) http://www.space.com/common/media/video/player.php?videoRef=LS_090519_Space-Engines.

[8] S. Sarg, "New Approach for Building of Unified Theory", http://lanl.arxiv.org/abs/physics/0205052 (May 2002)

[9] S. Sarg, **Basic Structures of Matter –Supergravitation Unified Theory**, Trafford Publishing, 2006, ISBN 1412083877 (books review in "Physics in Canada,", **62** (4) (July/Aug 2006).

[10] S. Sarg, "A Physical Model of the Electron according to the Basic Structures of Matter Hypothesis", *Physics Essays*, vol. 16 No. 2, 180-195, (2003); http://www.physicsessays.com.

[11] S. Sarg, Method and Apparatus for Spacecraft Propulsion with a Field Shield Protection, Patent application in Canada (File No. 2,638,667 from 26 Aug 2008).

[12] S. Sarg, **Field Propulsion by Control of Gravity: Theory and Experiments**, ISBN 9781448693085, amazon.com.

[13] K. J. van Vlaenderen and A. Waser, "Electrodynamics with the scalar field, www.aw-verlag.ch/EssaysE.htm also with slight adaptations: van Vlaenderen Koen and A. Waser, "generalisation of classical electrodynamics to admit a scalar field and longitudinal waves", Hadronic Journal **24**, 609-628 (2001)

[14] K. P. Butusov, "Longitudinal Waves in Vacuum: Creation and Research", New Energy Technologies, Sep-Oct 2001, pp. 46-47.

[15] S. Sarg, Gravito-inertial Propulsion Effect Predicted by the BSM - Supergravitation Unified Theory, 27 Annual SSE Meeting, June 25-28, 2008, Boulder, CO, USA

[16] youtube.com (keywords: SARG propulsion, SARG antigravity)

[17] Paul Hill, **Unconventional Flying Objects a Scientific Analysis**, ISBN 1-57174-027-9, Hampton Roads publishing Company Inc, Charlottesville, VA

[18] PACE, Canada, http://pacenet.homestead.com.