

About Strange Effects Related to Rotating Magnetic Systems

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Abstract

The basic hypothesis of Topological Geometro-Dynamics (TGD) is that space-time is representable as a 4-surface in 8-dimensional space $M_+^4 \times CP_2$. The notion of many-sheeted space-time forced by this hypothesis implies numerous new physics effects including gravitational anomalies, the possibility of negative energy space-time sheets making possible over unity energy production and classical communications to the geometric past. An essential element is the new view about the relationship between inertial and gravitational energy. The geometrization of the classical gauge fields in turn predicts the existence of long range color and electro-weak gauge fields, in particular classical Z^0 field, which gives rise to macroscopic effects resembling those assigned usually with torsion fields. These fields are assignable to dark matter hierarchy rather than ordinary matter. In this article the strange findings about the physics of rotating magnetic systems are discussed in order to illustrate the new physics predicted by TGD.

In the beginning of the year 2002 I learned about strange effects related to rotating magnetic systems, and the model for these effects

has evolved (and is still evolving) gradually during the year 2002 via trial and error process. Several new physics effects seem to be involved.

1. Explanation for the effective weight loss

The rotating magnetic system develops em and Z^0 charges and experiences the classical em and Z^0 electric forces created by Earth so that the effective weight is reduced or increases (depending on the direction of rotation) as much as 35 per cent. The charging is due to the flow of electrons and possibly also exotic neutrinos from the rolling magnets to the surrounding air induced by the radial electric and Z^0 electric fields generated by the Faraday effect inducing vacuum charge density (not possible in Maxwell's electrodynamics). The fact that critical frequencies are different for clockwise and counter clockwise spontaneous rotation implies that classical Z^0 force and exotic neutrino currents could be present.

2. Spontaneous acceleration

The spontaneous accelerating rotation above critical frequency can be understood as being to a Lorentz torque acting on the radial Ohmic em and Z^0 currents in rollers and roller ring. Above the critical frequency the Lorentz torque, which is proportional to rotation frequency, becomes larger than frictional torque, and spontaneous accelerating rotation becomes possible due to the positive feedback. Energetic constraints imply negative feed back and the modelling of this "back reaction" leads to a model of the system based on butterfly catastrophe in Thom's classification of elementary catastrophes and allowing also to understand the effect of the load. Rather precise estimates for the parameters result and allow to quantify the role of classical Z^0 force.

3. Zero point kinetic energy of electrons as basic energy source

The radial ohmic current of electrons leaking from the atomic space-time sheets of rollers to the space-time sheet of environment explains the presence of plasma around the system. The ionization of the molecules could be caused by the electrons from rollers gaining keV energy as they drop from atomic space-time sheets of rollers to the space-time sheets of the environment. The associated liberation of zero point kinetic energy provides a possible source of energy allowing making the system an over unity device.

The transformation of the Lorentz torque on conduction electrons to a torque on roller can be understood if the zero point kinetic energy of the photon emitted in the dropping of electron is absorbed by the atom in the outmost layer of the rotating magnet: the energetics works for Fe and Ti layers.

The molecules of the surrounding air could make transitions to higher energy states and also ionize by emitting phase conjugate (neg-

ative energy) photons absorbed by the dropping conduction electrons. Also the dropped highly energetic electrons can cause this.

A remote metabolism based on the emission of negative energy (phase conjugate) microwave "dark" photons with large value of Planck constant absorbed by dropping electrons could be a further mechanism. The energy needed to generate magnetic walls and the kinetic energy of electronic Cooper pairs in collective cyclotron states at magnetic walls could come from the remote metabolism involving also an angular momentum transfer. The absorbed phase conjugate photons would have energy of order keV and would result by the de-coherence from dark cyclotron photons emitted from magnetic walls having the same energy but microwave wave length (this is possible because the value of \hbar is large for dark photons). This would explain the cooling of the air around the system. Also a remote magnetization of $J = 2$ electron Cooper pairs at the space-time sheets of magnetic walls could result in this manner.

4. The material composition of the Searl device

The latest progress relates to the understanding of the role of material decomposition of the Searl device (layered Nd-nylon-Fe-Ti structure. The model the current flow equilibrium for the 4-layered cylindrical structure gives detailed quantitative picture about how charge accumulates in the interiors of layers and to the layer-layer boundaries emerges. The key finding is that the small electrical conductivity of air requires in the flow equilibrium that the electric field at the outer boundary of titanium layer is amplified by a factor of order 10^8 to a field which is by a factor of order 10^3 higher than the critical field inducing di-electric breakdown in air so that the simple model fails. The huge increase of the electric field requires an accumulation of positive charge at Ti-air boundary and explains why the air must be ionized but not its mechanism based on the dropping of electrons to larger space-time sheets.

The four-layered structure is used also for the stator: this can be understood if the magnetic field of stator also rotates as is suggested by the fact that its return flux goes through the rollers. The rotation of the stator magnetic field leads to a simple model for the classical behavior of the roller system as a dynamical equilibrium in which the electrostatic torque generated by the rotation of the stator and roller charge distributions induced by Lorentz torque on conduction electrons vanishes as rollers rotate with the same velocity as the charge distribution in the stator.

5. Quantum criticality, replication, and optimization

The replication of the experiments of Godin and Roschin has turned out to be difficult. The formation of the magnetic walls means the

emergence of long length scale fluctuations with coherence length much longer than the size of the system. Hence a quantum critical phenomenon seems to be in question and this could explain why the replication of the experimental findings has turned out to be so difficult. There are indeed many conditions to be satisfied. The distance between magnetic walls must correspond to the radius of the stator in resonance. This length scale also corresponds to the wavelength of dark microwave photons emitted in cyclotron transitions and the energy of these photons must also correspond to a zero point kinetic energy liberated as electron drops to larger space-time sheet.

The fact that continual di-electric breakdown is involved means second kind of criticality and the requirement that liberated zero point kinetic energy in the dropping of electron corresponds to the ionization energy of titanium atom for $n = 3$ valence electron makes also the phenomenon quantum critical.

Perhaps the most important manner to optimize the functioning of the device would be based on the condition of quantum criticality some of whose aspects are now understood. Hall effect for the radial Ohmic current plays a key role in generating torque and this raises the question whether quantum Hall effect at low temperatures involving increases of conductivity by 13 orders of magnitude could maximize the torque.

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1 Introduction

The basic hypothesis of Topological Geometroynamics (TGD) is that space-time is representable as a 4-surface in 8-dimensional space $M^4 \times CP_2$. The notion of many-sheeted space-time forced by this hypothesis implies numerous new physics effects.

The first prediction is the possibility of gravitational anomalies. For instance, the space-time sheet of system can feed the gravitational flux to several larger space-time sheets and when the distribution of the fluxes is non-standard, anomalous gravitational behavior results. Note that the change of gravitational mass alone without a change in the distribution of gravitational flux between different space-time sheets does not imply effects as long as the idealization as a test particle makes sense.

TGD predicts also the possibility of negative energy space-time sheets having non-standard time orientation. The implications are numerous. Negative energy topological light rays are expected to be accompanied by negative energy negative energy photons identifiable as phase conjugate photons. The generalization of four-wave mechanism involving generalization of standing waves emerges and provides a mechanism of remote metabolism in which system sucks energy from environment by sending negative energy particles such as phase conjugate photons. The geometric time reversal of second law is a signature of the process and the decay of system looks like self-assembly from the point of view of observer with standard arrow of geometric time. Generalized four-wave mechanism provides also a model over unity energy production and classical communications to the geometric past. In TGD inspired theory of consciousness and bio-matter this mechanism is central and underlies the models of metabolism, intentional action, and long term memory.

The phase conjugate hypothesis generalizes to the case of fermions and leads to the hypothesis that fermions and anti-fermions have opposite sign of energy. This guarantees that fermionic vacuum energy which otherwise diverges is vanishing. This inspires the hypothesis that the total quantum numbers of the Universe vanish. The assumption is consistent with the

crossing symmetry of elementary particle physics and makes sense macroscopically if gravitational energy is identified as the difference of inertial energies of positive and negative energy matter. Vacuum extremals can be interpreted as space-time surfaces with vanishing inertial energy but non-vanishing gravitational energy density given by Einstein's equations. The resulting cosmology is maximally predictive. Note that the generation of vacuum extremals in general increases the gravitational mass of the system and this effect could be taken as a signature of the effect. The instability of the vacuum extremals against generation of inertial mass by sending either positive or negative inertial energy to environment implies a change of inertial mass of associated system which could also serve as a signature of the effect.

The geometrization of the classical gauge fields in turn predicts the existence of long range color and electro-weak gauge fields, in particular classical Z^0 field, which gives rise to macroscopic effects resembling those assigned usually with torsion fields.

In the beginning of the year 2002 I learned about strange effects related to rotating magnetic systems, and the model for these effects has evolved (and is still evolving) gradually during the year 2002 via trial and error process. Several new physics effects seem to be involved.

a) The rotating magnetic system develops em and Z^0 charges and experiences the classical em and Z^0 electric forces created by Earth so that the effective weight is reduced or increases (depending on the direction of rotation) as much as 35 per cent. The charging is due to the flow of electrons and possibly also neutrinos from the rolling magnets to the surrounding air induced by the radial electric and Z^0 electric fields generated by the Faraday effect inducing vacuum charge density (not possible in Maxwell's electrodynamics). The fact that critical frequencies are different for clockwise and counter clockwise spontaneous rotation implies that classical Z^0 force and exotic neutrino currents must be present.

b) The first guess is that only the magnetic fields of rollers rotate and the spontaneous accelerating rotation above critical frequency could be understood as being due to a Lorentz torque acting on the radial Ohmic em and Z^0 currents in rollers and roller ring. This of course requires that this angular momentum is somehow transferred to the angular momentum of rollers.

Later it became clear that Lorentz torque might be only a control tool forcing electrons in rotating motion. If also the magnetic field of the stator rotate as one might expect if its return flux flows through the rollers, also the stator would contain a radial current and a flow equilibrium in which

radial current flows from the stator to rollers could establish itself. It would induce opposite charges to the stator and rollers. Since electron charge distributions rotate and are not expected to possess a full rotational symmetry, an electrostatic torque is generated and vanishes if rollers rotate with the same velocity as electrons in the stator. This situation is still completely classical and requires an external force to compensate for the dissipative losses.

Above the critical frequency the torque, which is proportional to rotation frequency, becomes larger than frictional torque, and spontaneous accelerating rotation becomes possible due to the positive feedback.

The radial ohmic current of electrons leaking from the atomic space-time sheets of rollers to the space-time sheet of environment explains the presence of plasma around the system. The ionization of the molecules is caused by the electrons from rollers gaining keV energy as they drop from atomic space-time sheets of rollers to the space-time sheets of the environment. Energetic constraints imply negative feed back and the modelling of this "back reaction" leads to a model of the system based on butterfly catastrophe in Thom's classification of elementary catastrophes and allowing also to understand the effect of the load. Rather precise estimates for the parameters result and allow to quantify the role of classical Z^0 force.

The mechanism transforming the torque on conduction electrons of the radial ohmic current to the torque on roller and providing the kinetic energy for for the roller relies on the absorption of the photon emitted in this process by a lattice atom which is Ti atom in the experiments of Searl. The energetics comes out correctly.

c) The radial ohmic current of electrons leaking from the atomic space-time sheets of rollers to the space-time sheet of environment explains the presence of plasma around the system. The ionization of the molecules is caused by the electrons from rollers gaining keV energy as they drop from atomic space-time sheets of rollers to the space-time sheets of the environment.

d) A remote metabolism based on the emission of negative energy (phase conjugate) microwave photons and realized in terms of the generalized four-wave mechanism based on magnetostatic waves provides the energy needed by the accelerating system and explains the cooling of the air around the system and the formation of magnetic walls as a remote spontaneous magnetization of $J = 2$ electron Cooper pairs at the space-time sheets of magnetic walls. The energy liberated in this process is utilized as rotational energy whereas the generation of electron spin compensates the angular momentum gained by the rollers during spontaneously accelerated rotation. Magnetic

walls can be regarded as the counterpart of the magnetic body playing a key role in TGD inspired model of living matter.

e) One ends up with quite precise ideas concerning optimization and possible variants of the Searl device. Hall effect for the radial Ohmic current plays a key role in generating torque and this raises the question whether quantum Hall effect at low temperatures involving increases of conductivity by 13 orders of magnitude could maximize the torque.

For some time I believed that the reduction of the inertial mass gives rise to a spontaneous accelerated rotation of the rollers by pirouette effect: also the generation of gravitational mass was necessary in order to understand the qualitative behavior. The required reduction of inertial mass is however measured in kilograms and means generation of corresponding positive inertial mass outside the system: this seems implausible. This does not however exclude the generation of gravitational mass in much smaller scale defined by the magnetic energy density of the magnetic walls appearing in the system.

2 Summary about the New Physics effects predicted by TGD

The basic new physics effects predicted by TGD relate to the many-sheeted character of space-time, to the new view about the relationship between gravitational and inertial energy, to the possibility of negative inertial energies and reversal of geometric arrow of time, and to the classical long range electro-weak and color fields.

2.1 The new view about the relationship between gravitational and inertial energy

At the level of quantum physics negative energy photons would correspond to a system quantized in such a manner that both bosonic and fermionic annihilation and creation operators have changed their roles. Negative energy photons and fermions do not correspond to (non-existing) "anti-photons" and anti-fermions. Using the terminology of Dirac's bra-ket formalism: negative energy systems are like bras if positive energy photons are kets. Kets and bras correspond to Hilbert space and linear functionals defined in it. The space of bras is actually not equivalent with that of kets but in a well defined sense a more general concept. This conforms with the role of negative energy space-time sheets in TGD inspired theory of consciousness. One can

distinguish between ordinary phase of matter and phase conjugate phase. In ordinary phase matter has positive energy and antimatter negative energy. In phase conjugate matter the roles of matter and antimatter have changed.

In quantum field theories time reversal transforms creation operators for fermions to creation operators for anti-fermions. Vacuum state is not changed. Time reversal in TGD sense would transform ket vacuum to bra vacuum so that the earlier creation operators annihilate the new vacuum state and genuine negative energy states result. This would suggest that negative energy states are something genuinely new and a genuine outcome of the many-sheeted space-time concept allowing either bra and ket type vacuum at a given space-time sheet. It has become that this view explains elegantly the matter-antimatter asymmetry whose origin is one of the deepest problems of cosmology.

The new view leads also to an elegant understanding of the problematic issues related to the relationship between inertial and gravitational energy [D3, D5, D4]. TGD predicts an exact conservation of inertial and the most elegant and economic theory results when the net inertial energy of Universe vanishes. This view is certainly consistent with the crossing symmetry of elementary particle physics allowing to interpret particle reactions as a creation of states with vanishing net quantum numbers from vacuum, with outgoing particles representing negative energy states.

The non-conservation of gravitational energy is an empirical fact in cosmological scales and the identification of the gravitational energy as the difference of positive inertial energy of matter and negative inertial energy of antimatter implies that gravitational energy density is non-vanishing and non-conserved. This resolves also the puzzle caused by the prediction that net inertial energy density vanishes in TGD inspired cosmology.

This picture leads to a rather detailed view about cosmology. The so called cosmic strings, which gradually transform to magnetic flux tubes with increasing thickness (and weaker magnetic field strength), are the key players of TGD inspired cosmology in all length scales. Magnetic factors have the same role also in TGD inspired biology. Since matter and phase conjugate matter correspond to a different direction of the arrow of geometric time, one can say that phase conjugate matter, which is mostly inside negative energy cosmic strings and magnetic flux tubes, obeys the second law of thermodynamics in a time reversed direction in geometric sense. Entropy increases but the process proceeds towards geometric past so that the resulting decay looks like self assembly from the point of view of an observer consisting of positive energy matter. Cosmic evolution would be a homeostasis in which two opposite tendencies tending to increase and reduce entropy are

competing. Second law in the standard form would apply only to the positive energy half of the Universe so that Universe would not be approaching heat death as the usual belief goes.

The vanishing of the inertial mass of a system leads to rather dramatic effects if positive energy and negative energy systems can form bound states, since this kind of system would be "feather light" although it still has non-vanishing gravitational mass. Even tiniest force could kick this kind of system to motion. If positive and negative energy systems do not form bound state they behave like their own independent subsystems and Equivalence Principle is satisfied in a good approximation. The formation of bound states of positive and negative inertial energy systems could provide a road to a new energy technology and perhaps even allow to create matter from vacuum by space-time engineering by generating vacuum extremals which represent space-time sheets with vanishing density of inertial energy.

2.2 Generalized four-wave mechanism as a basic mechanism of remote metabolism

Generalized four-wave mechanism provides a concrete realization for the more general time mirror mechanism underlying remote metabolism and many other mechanism important for the functioning of the living matter in TGD Universe. Generalized four-wave mechanism also provides a connection with the existing physics of phase conjugate waves.

2.2.1 Time mirror mechanism

Time mirror mechanism could make possible new technologies such as instantaneous remote energy utilization, instantaneous active remote sensing, and instantaneous communications over arbitrarily long distances. Time mirror mechanism is an essential element in the models of remote metabolism, long term memory, intentional generation of motor actions, sensory perception, and remote mental interactions. What happens that negative energy topological light rays propagating to the direction of the geometric past are reflected back in time direction and return as positive energy topological light rays (photons could accompany the rays).

This apparently paradoxical sounding language makes sense since the experienced time corresponds to a sequence of quantum jumps recreating space-time surface again and again and the correspondence between these times follows from quantum-classical correspondence: the contents of conscious experience in the essentially four-dimensional classical universe are

dominated by contributions, which are sharply localized with respect to the geometric time. This creates the illusion that the classical universe is 3-dimensional. It is essential that the field equations determining the space-time surfaces as field analogs of Bohr orbits are not fully deterministic. Only this makes it possible for the classical dynamics to mimic the non-deterministic quantum dynamics.

Negative energy topological light rays can induce the dropping of ions from atomic to larger space-time sheets. The liberated zero point kinetic energy means that the system can act as an over-unity energy source. Negative energy topological light rays, presumably having phase conjugate laser waves as standard physics counterparts, would be accompanied by negative energy photons and these would induce the dropping of charged particles to larger space-time sheets without emission of photons. The experiments of Feinberg, in particular the experiment in which a chicken was irradiated by phase conjugate laser waves, demonstrate that the system was transparent to phase conjugate laser waves at visible lengths. Indeed, if the phase conjugate photons have negative energies above the thermal energy, say at energies corresponding to visible wave lengths, there is no excited atomic system able to absorb negative energy photons inducing the return to the ground state.

The pairs of atomic and larger space-time sheets can act as many-sheeted population inverted lasers with frequencies which are universal constants of nature, and defined as differences of zero point energies whose values are predicted by the p-adic length scale hypothesis. If the intensity of the negative energy photons is above some critical value, the particles in the excited state of the many-sheeted population inverted laser drop to the ground state in a cascade like manner (the probability of dropping of charged particle is proportional to the number of charged particles already present at larger space-time sheet and thus to the intensity and duration of negative energy topological light ray irradiation). The time reflection thus involves an amplification and negative energy photons serve only the role of controller. The system becomes over-unity energy source making possible remote energy utilization.

2.2.2 Four-wave interaction and time mirror mechanism

Four-wave interaction is the basic mechanism producing phase conjugate laser waves, and TGD approach leads to a generalization of this mechanism [K4]. Four-wave interaction becomes the basic mechanism of intentional action and is behind the basic biological and brain functions like (actu-

ally remote) metabolism and long term memory. The findings of Tiller [1] about physical correlates of intentional action find a nice explanation in this framework.

There are several open questions about four-wave interaction. Could four-wave interaction or its generalization provide a deeper understanding of the scaling law of homeopathy stating that low and high frequencies appear in pairs [K5]? Could the basic function of probe and conjugate beams be the amplification of the standing wave interference pattern by remote metabolism? Does the standing wave formed by the reference beams serve as a kind of standardized hologram? Is it possible to generalize the notion of hologram in order to get rid of the reference beams?

The standing wave interference pattern represents a synchronous oscillation of the entire system and would be an excellent physical correlate for the ability of living organisms to act as coherent wholes. The standing wave resulting as the interference pattern of waves propagating in opposite directions would serve kind of a standardized hologram parameterized by the wavelength λ_h . The interference pattern can be also kicked into a motion by Lorentz boost, and the propagation velocity of the interference pattern is an additional characteristic of the pattern.

Probe and phase conjugate beams in four-wave interaction could in turn be interpreted in terms of remote metabolism. System sends negative energy topological light rays (or massless extremals, MEs) to the geometric past and receives as a response positive energy MEs, and amplification can occur in this process so that negative energy signal serves only a role of control signal. Its generation would utilize the energy provided by the remote metabolism. The emission of negative energy ME would switch on the positive energy laser of the geometric past generating probe beam. The energy source could be system in its geometric past or some system in the environment.

Standing wave is basic element of the mechanism and its generation would require energy obtained by emitting phase conjugate photons. Standing wave need not result only as an interference of classical em wave propagating in opposite directions, but could correspond to any standing wave. Plasma resonances are an especially interesting candidate for a standing wave since plasma frequency does not depend on wave vector at all in lowest approximation. This means that there is no dispersion and the pattern formed by plasma waves is oscillatory. I have indeed proposed that this kind of plasma wave patterns are in key role in living matter. Besides electromagnetic plasma wave patterns also classical Z^0 plasma waves are possible if nuclei possess anomalous Z^0 charges as suggested in [F8, F9]. The plasma wave pattern would get the energy of its self-organization by sending (say)

negative energy photons.

One can imagine a metabolic hierarchy which is obtained by a time reversal from the dissipation hierarchy for which energy from long length scales gradually dissipates to short length scales. The dissipation of the energy of a hydrodynamic vortex by the gradual decay to smaller vortices is a basic example of this process. Now this kind of process would be replaced by a self-assembly starting from the most energetic level and involve radiation of phase conjugate waves with decreasing frequency scales. The lowest level would correspond to ordinary metabolic mechanism, magneto-static waves could be at the next level and the counterparts of magneto-static waves for Cooper pairs at magnetic flux tubes could be also present and correspond to very low frequencies.

In living matter metabolic energy feed corresponds to the "pumping" and drives protons back to the atomic space-time sheets, and the same would be true now. This hints to a somewhat pessimistic conclusion from the point of view of over unity enthusiast: if the system gains its energy by dropping its own protons to larger space-time sheets, it cannot work for too long. This might relate to the continually occurring optimistic reports about free energy production followed by silence. The point of over unit technology would not be however tapping endlessly energy about vacuum but the possibility of remote metabolism which could make un-necessary for system to carry energy storages with itself and allow extreme flexibility and instantaneous generation of energy when needed.

2.3 The classical Z^0 fields as TGD counterpart for torsion fields

TGD predicts the existence of classical long ranged fields identified in terms as space-time correlates of scaled down copies of ordinary weak bosons [F9] identifiable as various forms of dark matter. Already low energy hadrons and nuclei involve dark forms of valence quarks and nuclei also exotic quarks with masses in MeV range. Exotic quarks couple to light variants of weak bosons with weak length scale L_w of order atomic length scale. Nuclei can develop anomalous weak isospin. Entire hierarchy of scaled down variants of weak bosons is unavoidable prediction of TGD if one takes quantum classical correspondence seriously. This means that under certain circumstances also Z^0 electric fields can cause detectable effects. For instance, the TGD based explanations of the tritium beta decay anomaly [6] and the anomalous variation of the radio active decay rates [8] involve the interaction of small sized objects with weak fields.

Even local Z^0 neutrality of condensed matter, which could be due to dark neutrino screening, does not exclude the possibility of Z^0 magnetic fields. Thus rotating macroscopic objects could generate Z^0 magnetic fields and the claimed properties of the torsion fields [9, 10] are very much like those of Z^0 magnetic fields. In particular, also classical Z^0 field has parity breaking axial coupling to elementary particles, and large parity breaking effects are predicted (chiral selection in living matter has explanation along these lines).

The generation of classical Z^0 magnetic field might be involved with the large parity breaking observed in the experiments of Roshchin and Godin [2] (the critical rotation velocities were different for clockwise and counter-clockwise rotations). Note however that also the sign of vacuum charge density involves parity breaking effect irrespective whether em or Z^0 field is in question. It is however clear that the radial electric fields generated by rotation can only serve as a seed for the em and Z^0 charging of the roller system inducing the effective loss of weight in the Earth's em and Z^0 fields. What happens is that radial ohmic currents of electrons and neutrinos are created and this leads to the em and Z^0 charging of the system and therefore to the effective loss of weight in the em and Z^0 electric fields of Earth. It is also possible that flux structures carry combination of magnetic and Z^0 magnetic fields and the strange shell like magnetic field structures could be accompanied also by Z^0 magnetic fields.

2.4 Gravitational anomalies and many-sheeted space-time

TGD space-time is many-sheeted surface in $H = M_+^4 \times CP_2$, which can be regarded as the future light-cone of Minkowski space with points replaced with CP_2 having size about 10^4 Planck lengths. One can visualize the space-time sheets as almost parallel pieces of plane glued together by wormhole contacts and also connected by join along boundaries bonds¹. The distance between the sheets is of order CP_2 radius. This makes possible anti-gravitation like effects since a macroscopic object (itself a space-time sheet containing hierarchy of smaller space-time sheets glued to it) can feed its gravitational flux to several space-time sheets. A modification of the standard distribution of gravitational flux between various space-time sheets could produce gravitational anomalies at a given space-time sheet, in particular modify the effective gravitational mass.

What about the effects of redistribution on gravitational flux on the

¹For illustrations see my home page <http://www.helsinki.fi/~matpitka/illua.html>.

motion of the system?

a) Newtonian intuition would suggest that the gravitational force experienced by the object is replaced with

$$F_{gr} = \sum_i \frac{M_i}{M} F_{gr,i} , \quad (1)$$

where the summation over space-time sheets is understood. This means that the simple Newtonian picture fails and the determination of the gravitational constant can give varying values.

b) In relativistic picture the motion in absence of external forces occurs along geodesic lines or rather, tubes made out of them. The distribution of gravitational fluxes would mean a fractal superposition of geodesic motions in different length scales. As far as the motion of given space-time sheet X^3 as seen from imbedding space level is considered, the largest space-time sheet receiving gravitational flux determines the rough pattern of motion and smaller space-time sheets add smaller details to it. The redistribution of gravitational gauge fluxes can only affect the initial values of three-momenta at a given space-time sheet X_i^4 .

The original hypothesis was that the redistribution of gravitational flux could dominate the change of weight as it is manifested in the motion of the system according to Newtonian intuition in rotating magnetic systems. It however turned out that the generation of em and Z^0 charges and interaction with the Earth's corresponding fields explain dominant part of the weight change and also the spontaneous acceleration.

2.5 Questions related to the vacuum charge densities associated with rotating systems

The experiments of Faraday related to a rotation of cylindrical magnet with conductor disk attached rigidly on its top, are not well known to average physicist [28]. The outcome these experiments was that radial electric field is generated between the rim and axis of the rotating conducting disk. This effect does not follow from Faraday's law of induction and is not satisfactorily understood in Maxwell's electrodynamics and it is somewhat surprising that Faraday's experiment has not received more attention.

2.5.1 A mere rotation of a 3-surface carrying magnetic field generates vacuum charge density

One can understand the generation of the radial electric field in Faraday's experiment by assuming that the rotation of the rotating system corresponds geometrically to a rotating 3-surface carrying magnetic field. The induction of the potential difference could be regarded as a direct evidence for 3-space as 3-surface concept! The mere rotation of 3-surface very probably does not give rise to absolute minimum of Kähler action but it could be that the actual absolute minimum is obtained as a small deformation of the orbit of rotating 3-surface.

One reason why for the presence of the radial electric field is that it guarantees stability of the rotating condensed matter in conducting disk.

a) Assume that rotating Faraday disk generates vacuum charge density the sign of which depends on the direction of rotation. The reason for the generation of the electric field could be the stability of the condensed matter: rotating nuclei suffer magnetic force $e\mathbf{v} \times \mathbf{B}$ and the Coulombic force created by the radial electric field cancels this force.

b) Charge density can be calculated as divergence of the radial electric field compensating magnetic Lorentz force. The required electric field has the magnitude

$$E = \omega Br , \quad (2)$$

where r is radial cylindrical coordinate. The corresponding charge density is given by

$$n_V = \frac{\omega B}{e} . \quad (3)$$

[The units $\hbar = c = 1$ are used].

c) It seems that the required charge density n_V cannot be due to a rearrangement of the density of the conduction electrons since in this case there would be large parity breaking differentiating between two rotation directions. Thus some kind of vacuum polarization effect must be in question. In standard physics vacuum polarization effects are purely local and it is difficult to see how one could generate macroscopic polarization effects. In TGD however point like particles are replaced by 3-surfaces and vacuum polarization could thus generate new space-time sheet.

2.5.2 Does charge conservation require that new space-time sheet is created when vacuum charge density is generated

In TGD particles are not point like but correspond to 3-surfaces so that vacuum polarization typically leads to a generation of double-sheeted space-time surfaces carrying opposite classical quantum numbers such as charge and energy. Charge conservation requires that the two space-time sheets carry opposite charge densities. Since the distance of the space-time sheets in CP_2 direction is of order CP_2 length about 10^4 Planck lengths, the generation of the new space-time sheet with opposite charge density can be indeed regarded as a local vacuum polarization mechanism.

Besides vacuum bubble interpretation also energetic considerations suggest that the new space-time sheet has negative time orientation since only in this case the creation of the new space-time sheet does not cost energy. It however increases the energy of the material space-time sheet and this might give clue to the understanding of what is involved with the explanation of over unity devices involving rotating magnetic systems. Needless to say, the instability of the vacuum against generation of negative energy space-time sheet in principle could make possible generation of entire galaxies from vacuum: human kind or our followers might some day take the role of God!

2.5.3 Does the generation of vacuum charge density relate to the generation of # contacts

Vacuum charge density at given space-time sheet could be realized in several manners.

a) The field equations associated with the absolute minimization of Kähler action allow vacuum charge densities unlike vacuum Maxwell equations. The reason is that primary dynamical variables are not the Maxwell gauge potentials defined by the induced Kähler form but imbedding space ($H = M_+^4 \times CP_2$) coordinates in terms of which the induced Kähler form defining classical Maxwell field, is expressible. Electromagnetic field is superposition of Kähler field and certain component of CP_2 spinor curvature. In the approximation that gravitational effects are neglected, field equations reduce to empty space Maxwell's equations locally and it is not clear whether rotating 3-surface suitably deformed could correspond to a solution of field equations. Charge conservation requires that opposite charge density is realized to the space-time sheet at which the space-time sheet of the rotating cylinder feeds its gauge fluxes via wormholes. This space-time sheet could be also material space-time sheet having positive time orientation so that

the generation of the gauge fields would require energy.

b) Charge density could be also understood as resulting from the wormhole throats feeding electric flux between two space-time sheets: the two throats have opposite gauge fluxes behaving effectively as classical charges by Gauss's Law. The basic rule of the game is that wormhole contacts are reside on the boundaries of the space-time sheets and can give rise to effective surface charge densities only. Wormhole contacts at boundaries are certainly present and feed gauge fluxes between space-time sheets. Thus charge density in the interior cannot correspond to wormhole contacts if this rule is OK. Wormhole contacts correspond at quantum level parton pairs. Partons are assignable to the light-like 3-D causal horizons associated with wormhole contacts [F6]. If the time orientations of the space-time sheets are of opposite sign these parton pairs can have vanishing net inertial energy. The density of these parton pairs could serve as a correlate for vacuum charge density. It should be noticed that around $\#$ contacts modelled as CP_2 type extremals the CP_2 projection of space-time surface is necessarily $D \geq 3$ -dimensional so that vacuum extremals cannot be in question.

c) The splitting of the wormhole contacts is possible and can give rise to fermions carrying there electroweak quantum numbers on the resulting boundaries of the holes of a split wormhole contact. For instance, electron-positron pairs could be created. It seems most natural to assume that resulting fermion pairs are ordinary fermions and electron-positron pairs are the simplest possibility. One can of course question the assumption that electrons are 'ordinary'. For closed space-time sheets this is certainly not the case but now new space-time sheet has boundaries and is much like material space-time sheet but possibly having finite time duration. Therefore a reasonable *working hypothesis* is that electrons and positrons created in this manner behave like ordinary electrons and positrons except that the sign of energy is different at the new space-time sheet. It is quite possible that the rotating 3-surface, which is the first guess for the space-time surface describing rotating system, is not imbeddable globally and that the failure of the imbeddability at 3-dimensional surfaces gives rise to boundary components with size of order CP_2 size and identifiable as elementary particles.

3 About strange effects related to rotating magnetic systems

The inspiration for writing this section (rewritten for many times when I am writing this) came from the publication of Godin and Roshchin in Russian

journal *New Energy Technologies* [2], which A. V. Frolov kindly sent to me. The article gives very valuable quantitative information about the anomalies related to the rotating magnetic systems.

A tentative conclusion about the strong parity breaking effects involved is that classical Z^0 force must play an important role in the effect, and perhaps give a dominating contribution to the effect. The rotating magnetic system develops vacuum em and Z^0 charges by a mechanism discovered already by Faraday and not consistent with Maxwell's theory. This charge turns out to be too small to induce effective weight change. The radial em and Z^0 electric fields however induce radial ohmic electron and exotic neutrino currents and the leakage of corresponding charges from the system. The resulting charges couple to the Earth's electric and Z^0 electric fields. The sign of the em (unlike Z^0) force depends on the direction of rotation and this explains parity breaking effect. The generation of charge explains the plasma phase and the resulting Lorentz force explains the mechanical stability of the rollers in Searl's original device against a centrifugal acceleration. The Lorentz torque experienced by the ohmic currents implies spontaneous accelerated rotation above a critical frequency determined from the condition that the Lorentz torque proportional to frequency is larger than the friction torque.

An alternative explanation for the spontaneous rotation would be in terms of the reduction of inertial mass of the rotating magnetic system, which combined with angular momentum conservation would explain elegantly the spontaneous accelerated rotation of the system as a pirouette effect. Also the redistribution of the gravitational flux of the system between larger space-time sheets must be assumed. The required generation of gravitational mass from vacuum is measured in kilograms and seem to be unrealistically high.

This argument does not exclude the generation of gravitational mass from vacuum in smaller amounts. The generation of inherently unstable vacuum extremals self-organizing to positive and negative energy space-time sheets might be involved. Therefore one must consider seriously the possibility that positive and negative energy inertial energy is created from vacuum in amounts determined by the density of magnetic energy associated with the strange magnetic walls accompanying the system. Interestingly, for vacuum extremals Z^0 and em field are proportional to each other: $Z^0 \simeq -8\gamma$ so that it might be possible to understand also the generation of classical Z^0 fields and Z^0 magnetization of the system.

The new view about energy has led to a variant of the generalized four-wave mechanism based on magnetostatic waves as a manner to suck energy from environment. This mechanism could provide the kinetic energy for the

accelerated magnetic system.

3.1 The experiment, the observed effects, and their interpretation in TGD framework

It is convenient to start with a brief description of experiment, observed effects, and their interpretation in TGD framework.

3.1.1 The experiment

The experiments of Roshchin and Godin [2, 16] involve a magnetic system consisting of ring like stator magnet and rotor consisting of 23 cylindrical magnets (rollers) in ring along the rim of the stator and free to roll along the rim. The outer radius of stator was .5 m. The air gap between stator and roller surfaces was $\delta = 1$ mm. According to [16], the ratio of the radius or roller to stator radius was taken to be an integer N not smaller than 12 in order to make possible magnetostatic resonance.

The entire system rested on a platform carried by springs so that the possible changes in the weight of the system could be deduced from the change of the equilibrium position. The weight of the system with the platform included was 350 kg.

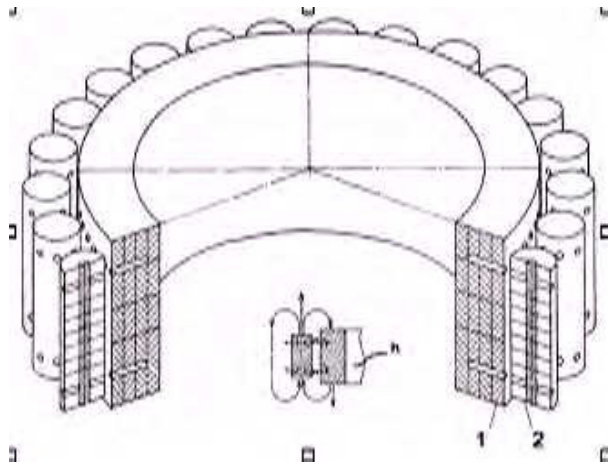


Figure 1: Variant of one-ring converter (figure 25 in [16]).

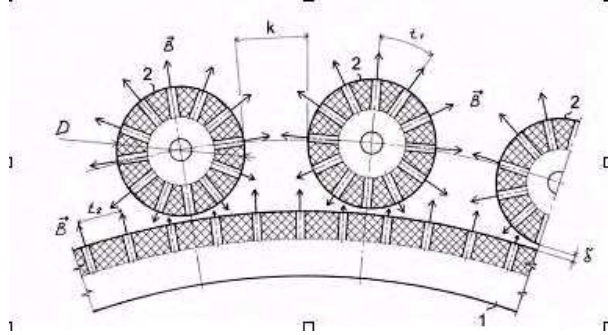


Figure 2: The general view of the converted and its platform (figure 26 in [16]).

The roller and stator carry magnetic fields which are in opposite directions. Both consist of segments which are rare earth magnets (neodymium): the total amounts of neodymium used to construct stator and rotor magnets were 110 and 115 kg. The strength of the residual induction was 1 Tesla. The magnetic field was not precisely vertical since cross-magnetic inserts having a flux vector of 1.2 Tesla orthogonal to the primary magnetization vector were added on both the stator and rollers. The distance between roller and stator inserts was same and there were 12 inserts per roller (and hence $N \times 12 \geq 12^2$ inserts for stator). The natural guess is that the function of the resulting periodic gradients in magnetization helps to make the stator and rotor magnets to a kind of magnetic cogwheels forcing smaller magnets to roll rather than only rotate without translational motion since slipping would generate a torque. More details about the magnetic structure of the stator and roller magnets can be found in [16].

The system contained arrangement allowing to arrange a high voltage of 20 kV between stator and rotor with plus pole corresponding to stator. This voltage is much higher than the voltage caused by the rotation measured in volts.

3.1.2 The observed effects

Several strange effects were observed and it seems that TGD based model is now sufficiently well understood to explain them. Figure 3.1.2 (figure 28 of [16]) representing the relative weight loss $\Delta G/G_0$ for *clockwise* rotation

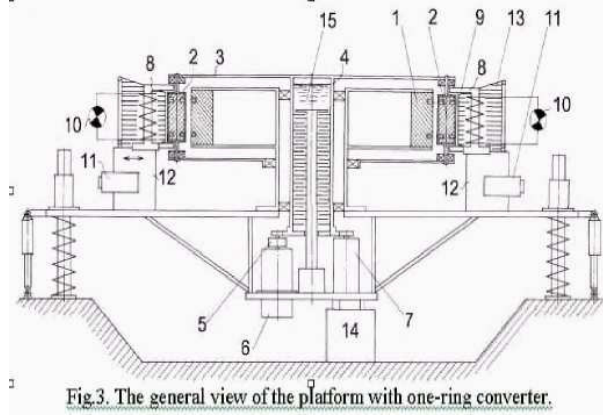


Figure 3: Magnetic inserts could make possible magnetic cogwheel mechanism (figure 27 in [16]).

as a function of rotation frequency f gives a good overall view about the situation.

a) In the initial situation rotor magnets were rotated using electric motor. Above some critical clockwise rotation velocity the system started to lose weight. The displacement meter started to detect the change of weight at 200 rpm. The gradient $\frac{d(\Delta G/G_0)}{df}$ satisfied everywhere the condition

$$\frac{d(\Delta G/G_0)}{df} > 0 ,$$

and below 550 Hz the it was increasing as the inspection of the graphical representation of [16] shows. At 550 rmp the system starts to accelerate spontaneously and the electric motor was decoupled. At 550 rpm the weight loss is 30 per cent and in the interval 30-31 per cent the rotation speed accelerates to about 600 rpm. The gradient of the weight loss $\Delta G/G_0$ as function of rotation frequency f became very small at 550 rmp.

For the reasons of mechanical stability a gradually increasing load is coupled to system so that the angular acceleration is reduced and the curve for $\Delta G/G_0$ as function of f develops a shoulder. The replacement of continual acceleration with a shoulder is basically due to the load. The maximum weight loss was 35 per cent and reached at about 600 rpm above which the experimentation was not possible due to the problems with the mechanical stability. The load was increased in units of 1 kW up to 7 kW. A load larger

than 7 kW results in a gradual decrease of the rotation speed and an exit from the self-sustained mode. Note that mass equivalent for the generation of energy with the rate of 7 kW is 7.8×10^{-13} kg/s.

The coupling of 20 kV voltage affects the diagram characterizing the rotation velocity as a function of weight loss by increasing the value of rotation velocity for a given weight loss as also the coupling of load does. In the presence of voltage with output power 7 kW the rotation frequency begins to decrease at the maximum weight loss of 35 per cent from 600 rpm whereas the effective weight remains constant down to 400 rpm.

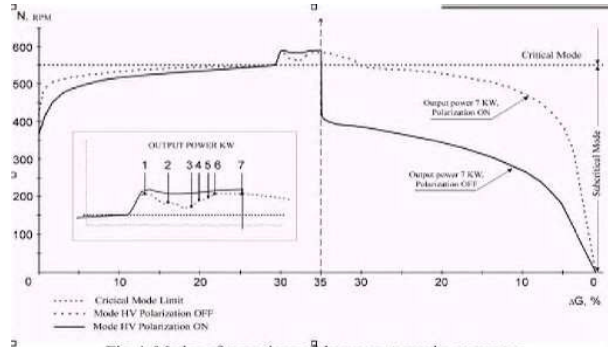


Fig. 4. Modes of operations of the magnet-gravity converter.

Figure 4: The development of the change of weight as function of rotation frequency (figure 28 in [16]).

b) There is a strong parity breaking breaking involved. Depending on whether the direction of rotation is clockwise or counter clockwise weight is reduced or increases. The critical mode appears around 550 rpm for a clockwise rotation and around 600 rpm for a counter clockwise rotation. Searl has reported also the modification of radioactive decay rates in the vicinity of the Searl device. The presence of classical Z^0 (and possibly W) besides em force could explain this kind of effects. It must be noted that already the generation of the radial vacuum electric field in the roller magnet means spontaneous parity breaking. The mere electromagnetic charging of the rollers in the Earth's electric field cannot however explain the different critical rotation frequencies for the two rotation directions.

c) During the self-sustained mode a cooling of the environment in the vicinity of the magnetic system is observed. A stable fall of the common temperature 22 C of laboratory by 6-8 degrees was observed. This suggests

violation of the second law. The sucking of energy from environment by a phase conjugate mechanism could be involved. That phase conjugate waves are involved was proposed also in the article of Dr. Paul la Violette [17]. Phase conjugate microwaves generated by magnetostatic waves are the best candidate for the generalized standing waves (actually rotating around stator magnet). The reason is that for sufficiently long wavelengths the dispersion relation does not depend on wavelength so that arbitrary wave pattern repeats itself periodically with a frequency which is expressible in terms of Larmor frequencies of electron in the fields defined by the magnetization and by the external field (now the field of roller inside stator).

d) In a dark room corona discharges are observed around the converter rotor as a blue-pink glowing luminescence and a characteristics ozone smell. The cloud of ionization covers the area of a stator and rotor and has therefore a toroidal shape. Also a series of horizontal yellowish-white luminescent bands spaced along the height of the roller surface and separated from one other by about a roller radius were observed. This suggest a high voltage electron discharge from the surface of the roller magnets. It was however not accompanied by sounds characteristic of arc discharge, which suggests an emission coming from a larger surface rather from a point source.

The plasma could be due to the electromagnetic charging of the the rollers. Roller system would consequently experience the force caused by the Earth's em and Z^0 electric fields implying the effective loss of weight. The radial electric field generated by Faraday effect in rotating systems could induce an Ohmic current leading to a partial leakage of the charge to the space-time sheets of environment: part of charge would flow to larger space-time sheets associated with the rollers and would only induce a many-sheeted polarization of the roller system.

The luminescence resembles high voltage microwave induced luminescence observed prior to the point of electrical breakdown. Microwave radiation associated with the self-organizing magnetostatic waves might be in question. For electrons in a field of 1 Tesla the frequency of these waves is around Larmor frequency $f_L \simeq 12$ GHz and corresponds to a wavelength of about 2.5 cm. The ionization of the air suggested by the presence of blue light perhaps identifiable as electronic excitation line of ionized N_2 molecule, requires the presence of electrons with energies of order keV.

e) Concentric magnetic walls with a reduction of temperature inside them begin to appear at 200 rpm. The strength of magnetic field depends approximately linearly on the rotation speed and increases up to .05 Tesla. The maximal temperature drop is 8 C. The walls are separated by a distance of about .5 m which is the radius of the stator and the thickness of the wall

is about 5-6 cm.

Intriguingly, the Larmor frequency for the maximal .05 Tesla magnetic field associated with walls corresponds to .6 GHz and wavelength of .5 meters, the radius of the stator. Hence this magnetic field strength might relate to a microwave resonance at cyclotron frequency and with a wavelength equal the radius of the stator, and somehow providing the energy needed by the system accelerating spontaneously. Lowest cyclotron transitions and spin flip transitions inside magnetic walls would have this frequency naturally and the magnetic walls would appear at the nodes of the waves.

The direction of the magnetic field inside the walls coincides with the direction of the magnetic field created by rollers and is same as the direction of the return flux of the magnetic field of stator+roller system. The interpretation as a spontaneous magnetization associated with the Cooper pairs forming a Bose-Einstein condensate at the space-time sheet of the magnetic wall allows to understand the spontaneous acceleration of the rollers. Remote metabolism in which phase conjugate microwaves induce spontaneous magnetization liberating energy takes care of energetics. The rollers generate angular momentum by transforming the electronic spin and angular momentum to the angular momentum of the roller and compensate the lost spin by spin flips accompanied by a remote spontaneous magnetization of the magnetic walls to achieve angular momentum conservation. Also the rotation of electrons in the magnetic fields of the rollers could be effective generator of recoil angular momentum.

The thickness of the magnetic walls about 5-6 cm is somewhat larger than the roller radius 3.7 cm and twice the wavelength 2.5 cm of the microwaves possibly generated by self-organizing magneto-static waves at Larmor frequency and rotating around the stator. The Larmor frequency associated with magnetic walls when spontaneous rotation starts corresponds to a wavelength of .5 m which brings in mind resonance mechanism. The generalized four-wave mechanism involving microwaves at both 2.5 cm and .5 m wavelengths strongly suggests itself as a mechanism making possible the spontaneous acceleration. Magnetostatic waves generated in stator are good candidates for a building block of the mechanism.

3.1.3 The minimal model explaining the effects

The basic question is whether both the reduction of the inertial mass, increase of effective gravitational mass, and classical em and Z^0 forces are needed. The minimal model involves only the classical em and Z^0 forces.

- a) The fact that the sign of the weight change depends on the direction

of rotation suggests a large parity breaking effect. Already the mechanism generating radial electric field induces spontaneous parity breaking and ordinary charging and Earth's electric field might explain the effect. The effect has however a slightly different dependence on rotation frequency for two rotation directions and this requires the presence of also Z^0 field. The presence of the repulsion or attraction due to the classical em and Z^0 electric fields of Earth on the rotator having em and Z^0 charges increasing with rotation frequency f is a good candidate for the explanation of the strong parity breaking. These forces would be induced by the radial em and Z^0 electric fields induced by the rotating Z^0 magnetic field created by the spinning rollers and inducing in turn radial ohmic currents of electrons and neutrinos from rollers and hence em and Z^0 charging of the system. The basic test of the model is to look how electric in the vertical direction affects the behavior of the system.

b) The spontaneous acceleration might rely on a variant of so called ball bearing motor mechanism [17]. The radial current of Z^0 charge due to Z^0 Faraday effect flowing through the space-time sheet containing Z^0 magnetic field of the roller ring suffers a Lorentz torque in the magnetic and Z^0 magnetic fields. Similar em torque appear in the space-time sheets of rollers. When the rotation velocity is so high that the resulting torque proportional to rotation frequency is larger than the frictional torque, the system starts to accelerate. Together with Faraday effect this leads to a positive feedback loop. This mechanism explains also the different critical angular velocities for clockwise and counter clockwise directions of rotation and provides the most economical model for the Searl effect.

3.2 The electric fields associated with rotating magnetic fields

The radial electric fields associated with rotating magnets were discovered already by Faraday. The direction of field depends on the direction of rotation and field gives rise to charge density. This means strong parity breaking effect difficult to understand in standard physics framework. Also classical Z^0 fields are involved and the idea that the radial Z^0 electric field generates neutrino flow to larger space-time sheets and thus a net density of Z^0 charge turns out to be key element in the model of Searl device.

3.2.1 Are the rotating magnetic systems consistent with Maxwell's equations?

Faraday's observation that rotating magnetic generates radial electric field $E = \omega\rho B$ is only marginally consistent with Maxwell's equations due the presence of a charge density which changes sign when the direction of rotation is changed. In TGD these fields are possible.

TGD allows purely geometric vacuum charge densities with no elementary particles acting as charge carriers. In particular, if ones 'kicks' a 3-surface containing a constant magnetic field into a rotational motion, vacuum charge density results. This is seen by considering a simple model for the imbedding of a magnetic field $B_z(\rho)$ as an induced gauge field in $M_+^4 \times S^2$, where S^2 is a geodesic sphere of CP_2 . In spherical coordinates $(\cos(\Theta), \Phi)$ for S^2 the electromagnetic component of CP_2 spinor connection is

$$A_\Phi = \cos(\Theta) \quad (4)$$

apart from a multiplicative numerical constant. The induced em gauge potential is

$$A_\mu = A_\Phi \partial_\mu \Phi \quad (5)$$

as a projection of the component of the spinor connection to the space-time surface. In cylindrical coordinates (t, z, ρ, ϕ) for M_+^4 one has for the imbedding of magnetic field as an induced gauge field

$$\cos(\Theta) = f(\rho) \ , \quad \Phi = n\phi \ , \quad B_z(\rho) = \partial_\rho A_\phi = \partial_\rho f n \ , \quad (6)$$

where n is integer. Note that the imbedding necessarily fails at some critical radius since $\cos(\Theta)$ cannot be larger than one: this is nothing but topological field quantization of magnetic field to flux tubes.

When the magnetic 3-surface is 'kicked' to a rotating motion one has

$$\cos(\Theta) = f(\rho) \ , \quad \Phi = n(\phi - \omega t) \ , \quad (7)$$

and an electric field

$$E_\rho = \partial_\rho A_t = -\omega\rho B \quad (8)$$

is generated.

The condition $E_\rho = vB = \omega\rho B$, which can be interpreted as the vanishing of the net Lorentz force locally, gives rise to a vacuum charge density

$$\rho_{vac} = \nabla \cdot E = -\omega B \quad (\text{in units } \hbar = c = 1) \quad (9)$$

The sign of the vacuum charge density depends on the direction of rotation. This means a large parity breaking effect. It is very difficult to understand how the sign of the charge density could depend on the direction of rotation if charge carriers were ordinary elementary particles. Thus this effect, observed already by Faraday, seems to be in conflict with Maxwell's theory and to support TGD.

Charge conservation requires that the radial electric gauge flux of vacuum goes somewhere at the boundary of the magnet space-time sheet. The only possibility is that a new space-time sheet is generated parallel to the magnet space-time sheet (unless it exists already). The electric flux runs through wormhole contacts or join along boundaries bonds to this space-time sheet and back in radial direction at the second space-time sheet. If this space-time sheet has negative time orientation (guaranteeing that the sign of the electric field as tensor component F_{0r} changes), it has also negative energy, and energy conservation requires that the rotating system gets positive compensating energy.

3.2.2 The fields associated with the rolling magnets

At theoretical level the situation in the case of magnets rolling along the rim of stator ring does not differ essentially from the simpler case if one neglects the effects caused by absolute minimization of Kähler action. One can also apply the description below to the calculation of both em and Z^0 fields. Z^0 electric fields are present only in a system perform rolling motion. In the following only the electromagnetic case is discussed.

The rolling magnet is described by a space-time sheet containing an axial magnetic field and characterized by the mapping of M_+^4 to S^2 , where S^2 is a geodesic sphere of CP_2 . M_+^4 has local cylindrical space-time coordinates (t, z, ρ, ϕ) and S^2 spherical coordinates $(u = \cos(\Theta), \Phi)$.

a) A stationary system non-rotating cylindrical magnet corresponds to the surface

$$u = f(\rho), \quad \Phi = n\phi .$$

In this case the magnetic field is of form

$$B = n\partial_\rho u .$$

For a set of parallel magnets one must find imbedding for the superposition of the magnetic fields and the expression generalizes to

$$B = \frac{\partial(u, \Phi)}{\partial(\rho, \phi)} ,$$

which is just the Jacobian for the mapping from x-y-plane to S^2 defined by the matrix of partial derivatives.

b) The rotating, but not rolling magnet, is obtained by the replacement

$$t \rightarrow t, \rho \rightarrow \rho, \phi \rightarrow \phi - \frac{\omega}{n}t = \hat{\phi} .$$

The magnetic and electric fields are obtained by a standard tensor transformation formula for antisymmetric space-time tensors and one has in the case of single magnet

$$B = \frac{\partial(u, \Phi)}{\partial(\rho, \hat{\phi})} , \quad E = B \frac{\partial(\rho, \hat{\phi})}{\partial(\rho, t)} = \frac{\omega}{n}B .$$

c) The rolling magnetic system is obtained from the stationary one by kicking the space-time sheet to a rolling motion

$$u = f(\hat{\rho}), \quad \Phi = n\hat{\phi} ,$$

where one has

$$\rho \rightarrow \hat{\rho} = \sqrt{(x - x(t))^2 + (y - y(t))^2} , \quad \phi \rightarrow \hat{\phi} = \arctan\left(\frac{(y - y(t))}{(x - x(t))}\right) - \frac{\omega}{n}t .$$

The motion of the center of mass of roller along a ring of radius R is given by

$$(x(t), y(t)) = R \times (\cos(\Omega t), \sin(\Omega t)) .$$

In the rolling coordinate system there is only magnetic field $\hat{B}(\hat{\rho}, \hat{\phi}) \equiv \hat{B}$ present, and one can obtain the magnetic and electric fields in stationary system by tensor transformation formulas:

$$B(\rho, \phi) = \hat{B} \frac{\partial(\hat{\rho}, \hat{\phi})}{\partial(\rho, \phi)} ,$$

$$E(\rho, \phi) = \hat{B} \frac{\partial(\hat{\rho}, \hat{\phi})}{\partial(t, \phi)} ,$$

For $\Omega = m\omega$, m integer, the electric and magnetic fields are period with respect to time with frequency ω and one can expect resonance effects.

3.3 A classical model for the weight change and spontaneous acceleration involving only em and Z^0 fields and Faraday effect

The assumption about the reduction of inertial mass by one per cent needed to explain the spontaneous acceleration seems hard to take seriously, and one must ask whether less exotic mechanisms generating the spontaneous acceleration could be imagined.

In the article of LaViolette [17] a modification of the so called ball-bearing motor effect combined with the Faraday effect is discussed as a positive feedback mechanism leading to the angular acceleration of the system. Ball bearing motor contains an inner conducting cylinder able to rotate and coupled to the wall of the outer cylinder by ball bearings, which do not slide with respect to the inner cylinder. When a radial voltage gradient exists between the cylinders, a radial current j flows through the bearings and Lorentz force

$$F = \int_{bb} j \times B dV \sim IBV_{bb}$$

acting on bearing in a tangential direction is generated and creates a torque $\tau = F(R + r)$, where R and r are the radii of the inner and outer cylinder (subscript bb refers to ball bearing in the formula). The current keeps the cylinder in a rotating motion if given an initial torque.

The idea described in [17] is that one can regard the rotating rollers as a single rotating ring and that Faraday effect generates also now a radial electric field $E = v \times B$ through the ring. The estimate for the corresponding maximum voltage through the roller is

$$V = \pi B f ((R + r)^2 - R^2) .$$

For $f_{max} = 23 \times 10$ Hz, $R = .5$ m and $r = .07$ m, and $B = 1$ Tesla this gives $V = 2$ Volts. Using the estimate $R = 460 \mu\text{Ohm}$ for the resistance

of the roller, one finds that the current is about $I = 4300$ A. Using the previous formula one can make an order of magnitude estimate for the resulting torque on single roller as $\tau \sim IBrR \sim 140$ Nm. The sign of the torque changes with the direction of rotation and conforms with the fact that angular acceleration is observed for both directions of rotation.

On the other hand, from the observed angular acceleration during the spontaneous acceleration one obtains the estimate for the torque suffered by single roller:

$$\tau \sim M_r r^2 2\pi \frac{\Delta f}{\Delta t} ,$$

where one has $\Delta f \sim 45$ rpm and $\Delta t \simeq 5$ sec. For the roller mass $M_r \sim 100$ kg/23 this gives $\tau \sim .45$ Nm, which is by two orders of magnitude smaller than the first estimate. Something goes wrong.

One can indeed criticize the model. The assumption that all the angular momentum gained by the electron current is transferred to the roller is probably wrong. The extreme situation is that the current flows out freely through the boundaries of the roller and roller itself receives no angular momentum. A more serious objection is following. The net radial current associated with single spinning but non-rolling roller vanishes: why shouldn't the radial electric field of the roller simply rotate around the stator so that no radial electric field would be generated?

3.3.1 A general model for the observed change of the effective weight change below critical velocity

A general model for the effective weight change relies on the following assumptions (in the following the units $\hbar = c = 1$ are used).

- a) There are classical em and Z^0 forces present due to the approximately constant radial em and Z^0 electric fields of Earth besides the elastic force of springs with elastic constant k .
- b) The inertial mass and gravitational masses of the system can change.
- c) The gravitational acceleration due to the Earth's gravitational field can suffer a reduction $g \rightarrow \epsilon g$, $\epsilon \leq 1$ due to the redistribution of the gravitational flux between space-time sheets.

1. General parametrization of the model

The following set of equations represents a parametrization for this picture.

- a) The em and Z^0 forces experienced by unit em and Z^0 charge per given

$$F_{em} = eE_{em} \ , \ F_Z = g_Z E_Z \ .$$

Here g_Z corresponds to Z^0 coupling constant strength α_Z is related to the fine structure constant $\alpha_{em} = e^2/4\pi$ by

$$\alpha_Z = \frac{g_Z^2}{4\pi} = \frac{\alpha_{em}}{\sin(\theta_W)\cos(\theta_W)} \ , \ \alpha_{em} \simeq \frac{1}{137} \ , \ \sin^2(\theta_W) \simeq .23 \ . \quad (10)$$

is Z^0 coupling strength.

b) At the equilibrium height h the acceleration a vanishes, and one has

$$a = -\epsilon(f)g + \frac{Q_Z(f)g_Z E_Z + Q_{em}(f)eE_{em}}{m(f, \pm)} + \frac{kh}{m(f, \pm)} = 0 \ . \quad (11)$$

It is assumed that inertial mass can change in the process so that one has $m = m(f, \pm)$. This gives for the equilibrium height h the expression

$$h(f, \pm) = \epsilon(f) \frac{m(f, \pm)g}{k} \pm \frac{Q_Z(f, \pm)g_Z E_Z + Q_{em}(f, \pm)eE_{em}}{k} \ . \quad (12)$$

$Q_{Z/em}(f, \pm)$ refers to the absolute value of the Z^0/em charge.

If one erratically (at least in TGD Universe) assumes that only ordinary gravitational force is present, one would have

$$\begin{aligned} \frac{\Delta[m_{eff}(f, \pm)]}{m_0} &= \frac{k\Delta h(f, \pm)}{m_0 g} \\ &= \left[\epsilon(f) \frac{m(f)}{m_0} - 1 \right] \mp \frac{Q_Z(f, \pm)g_Z E_Z + Q_{em}(f, \pm)eE_{em}}{m_0 g} \ , \end{aligned} \quad (13)$$

2. What information one can deduce from the graph of rotation frequency as function of relative weight change?

Consider now what conclusions one can make from the graph of the rotation frequency f as function of relative weight change $\Delta G/G_0$ depicted in figure 3.1.2.

a) The fact that the spontaneous acceleration starts at the same value of effective weight change for both directions of rotation supports the view that

the change of inertial mass is negligible, at least below the critical rotation frequency. If there is no redistribution of the gravitational flux neither below the critical frequency, one has

$$m(f, \pm) = m_0 \text{ and } \epsilon(f) = 1 \text{ for } f < f_{cr}(\pm) . \quad (14)$$

b) Below the critical mass change of ∓ 30 per cent the situation is completely symmetric in both cases unless the functions $Q_{Z/em}(f, +)$ and $Q_{Z/em}(f, -)$ are different: this cannot be the case since the critical frequencies are different. The fact that the values of critical weight changes are same means that the value of the absolute magnitude of $em+Z^0$ force are in the role of the critical quantity. On basis of the behavior of the these functions below the critical frequency, it seems safe to assume that they can be regarded as almost constant above $f_{cr}(\pm)$.

c) The observed graph of rotation frequency f as a function of $\Delta G/G$ has a step around f_{cr} which develops to a shoulder: frequency grows first rapidly whereas the weight change remains practically constant. The development of shoulder is due to the addition of a load taking the energy otherwise available for a spontaneous acceleration and generating a torque. The simplest explanation for the spontaneous acceleration involves only classical em and Z^0 Faraday effect and generalization of the ball bearing motor effect.

3.3.2 TGD variant of ball bearing effect

The Lorentz torque giving rise to ball bearing effect involves two contributions. The first contribution corresponds to a radial electron current moving in a radial electric field associated with rollers. Second contribution becomes from Z^0 current induced by the radial Z^0 electric field associated with the space-time sheet of the roller ring. This current consists of electrons and neutrinos. Electronic part experiences both the magnetic field of roller and Z^0 magnetic field of the roller ring.

1. *The Lorentz torque associated with the roller*

Also the electrons of the radial Ohmic current of the roller experience in magnetic field of the roller a torque in the axial direction. If the angular momentum of the roller is conserved, an opposite torque affecting the roller itself should be generated. If the electronic current changes its direction from radial to slightly non-radial in the magnetic field (essentially Hall effect), the electrons leaking out from the roller leave it non-radially and carry out net torque so that compensating torque affects the roller system. When electrons

do not leak out but are reflected back at the atomic space-time sheets the resulting current experiences torque which tends to cancel the torque. If a reflection of the current at the boundary occurs to larger space-time sheet this does not occur and a net torque results. It is convenient to introduce a parameter, call it ϵ , to characterize what part of electronic torque gives rise to a torque acting on the roller.

Using Ohm's law, one can write the torque in the form

$$\tau_{em} = \epsilon \int_{roller} j \times B dV = \epsilon \sigma_e \omega B^2 \times \frac{2\pi}{3} (r_o^3 - r_i^3) h . \quad (15)$$

where r_o and r_i are the inner radii and h the weight of the roller. ϵ is the factor telling which part of the electric torque is transformed to a torque affecting on the roller. ω refers to the rotation frequency of the roller.

If the only contribution to the torque is electromagnetic, one cannot understand the asymmetry with respect to the direction of rotation. The radial Z^0 electric field is proportional to ω^2 since Z^0 magnetic field is generated by rotation and proportional to ω and this would explain the asymmetry. The fact that em contribution must dominate in torque gives a rough estimate

$$\epsilon \sim \frac{1}{5}$$

by using a direct estimate of torque from the observation angular acceleration during the period when spontaneous acceleration occurs freely.

2. The Lorentz torque associated with the roller ring

In TGD framework the roller ring as a single system would correspond to a larger space-time sheet and the magnetic fields of rollers are not at this space-time sheet. The spinning rollers however create a Z^0 magnetic field at the space-time sheet of the roller ring and the rotation of the rollers around the stator generates a radial Z^0 electric field via Z^0 Faraday effect. If electrons feed their Z^0 electric flux to this space-time sheet, they experience the classical Z^0 force, the torque due to both magnetic and Z^0 magnetic fields as well as the ordinary dissipation. Same applies to neutrinos. If the currents in question are not able to leak out freely from the roller space-time sheet, some fraction of the torque on current carriers acts on the roller itself and induces a spontaneous acceleration. The neutrino contribution to the radial current could dominate since $Q_Z(e)$ is roughly 1/50 times smaller than $Q_Z(\nu)$.

The predicted torque can be written as

$$\begin{aligned}
\tau_Z &= (\epsilon_e F_e + \epsilon_\nu F_\nu) \times r , \\
F_e &= \sigma_e \int_{roller} \frac{Q_Z(e) g_Z}{e} E_Z \times [B + Q_Z(e) B_Z] dV \\
F_\nu &= \sigma_\nu \int_{roller} Q_Z(\nu) E_Z \times Q_Z(\nu) B_Z dV .
\end{aligned} \tag{16}$$

Here one has $E_Z = v \times B_Z$ and r denotes position vector from the origin of stator. The parameters $\epsilon_e < 1$ and $\epsilon_\nu < 1$ characterize the fraction of the torque on current carriers transmitted to a torque acting on the roller.

The sign of the em contribution depends on the direction of rotation whereas Z^0 contribution is of the same sign since already B_Z is proportional to the rotation velocity. Since spontaneous angular acceleration starts at different critical frequencies, τ_{em} must dominate over τ_Z , which is however present and for which the em Lorentz force acting on electron must dominate.

Electron's Z^0 coupling is by a factor $\sim 1/50$ weaker than em coupling. For $B_Z \simeq .4$ Tesla to be deduced from the model for magnetic walls the em Lorentz force dominates and gives a contribution which is of same sign for both directions of rotation. For $\epsilon_e = \epsilon$ the ratio of electromagnetic torque deduced above and Z^0 Lorentz torque would be very roughly of order

$$\frac{\tau_Z}{\tau_{em}} \sim Q_Z(e) \times \frac{r}{R} \simeq .08 .$$

where $r/R \simeq .1$ has been used. This is consistent with the difference $(f_{cr,+} - f_{cr,-})/f_{cr,+} \simeq 1/11$.

Neutrino current gives a contribution changing sign with the rotation direction and thus cannot give the dominant part to the Z^0 torque. This gives

$$\epsilon_\nu \leq \epsilon_e \frac{\sigma_e}{\sigma_\nu} \frac{Q_Z(e) e B}{Q_Z(\nu) g_Z B_Z} .$$

If neutrino conductivity scales as $\sigma_\nu/\sigma_e \simeq m_e/m_\nu \sim 5 \times 10^6$ then the estimate $\epsilon_\nu \sim 10^{-9}$ follows for $g_Z B_Z \simeq .4$ Tesla. Experimental data do not allow to deduce whether exotic neutrino current is present or not.

The voltage of $U = 20$ kV between stator and the electrodes at the outer rims of the rollers has an observable effect of order few per cent on the rotation velocity. If this situation is comparable to the discussed one, one must have

$$\epsilon_e < \frac{10^{-7}}{x} ,$$

where x is the fraction of voltage U over the roller. It is not clear from [16] whether the voltage is over distance r ($x = 1$) or $R + r$ ($x = 1/11$). This estimate is quite different order of magnitude as the estimate for $\epsilon_e \sim 1/5$ characterizing the Lorentz torque generated by the radial current in the roller. This suggests that the two situations are quite different.

This is indeed the case: the point is that both the stator and rollers are surrounded by a copper foil which acts as a Faraday cage meaning that the voltage at the surface of the foil is constant and the electric field created by 20 kV voltage does not penetrate inside. The rollers and stator behave effectively like electrodes of a capacitor.

3.3.3 The model for positive feedback neglecting "back reaction"

It is good to start with a model neglecting the negative feedback due to energetic constraints and indicated by the fact that 7 kW load leads to a slowing down of the system. Hence only positive feedback is present and can be modelled explicitly.

The first observation is that friction implies the presence of a torque which can be modelled in the lowest approximation as being proportional to the rotation frequency ω :

$$\tau_{fr} = Ik\omega . \quad (17)$$

Note that ω is 23 times the rotation frequency Ω of the roller and $230 \times 2\pi$ Hz for $\Omega = 10 \times 2\pi$ Hz. Assuming that the induced Z^0 magnetic field is proportional to ω , the angular acceleration can be parameterized as

$$\frac{d\omega}{dt} = \frac{\tau}{I} = P_3(\omega) = a\omega + b(\omega^2 + \frac{1}{\omega_{cr}}\omega^3) - k\omega . \quad (18)$$

Here the term $a\omega$ corresponds to a purely electromagnetic torque resulting from the radial ohmic current inside roller, the term proportional to b to the two Z^0 magnetic contributions, whereas the term $k\omega$ corresponds to the friction. Z^0 term dominates for $\omega \gg \omega_{cr}$. One can pose as a convention the conditions

$$b \geq 0 , \quad \omega_{cr} \geq 0 . \quad (19)$$

1. *Qualitative behavior of the system*

The qualitative behavior of the system can be deduced from quite general arguments generalizing in a straightforward manner to the more realistic case.

a) The equilibrium points (stable or unstable) correspond to the zeros

$$P_3(\omega) = \omega \left[a - k + b\left(\omega + \frac{1}{\omega_{cr}}\omega^2\right) \right] = 0 \quad (20)$$

of the third order polynomial appearing at right hand side of Eq. 18 representing vanishing net torque.

b) The first zero is $\omega = 0$: for $a - k > 0$ this zero is unstable since Lorentz torque wins friction torque in linear approximation and the system begins to accelerate. According to Searl, his own device indeed starts to spontaneously accelerate and would thus correspond to this situation. For $a - k < 0$ friction torque wins and the system comes to rest unless the initial rotation frequency is above critical frequency. The device of Godin and Roschin corresponds to this situation. Searl's device requires that the friction is reduced sufficiently and the magnetic field is strong enough. The use of electromagnets instead of ferromagnets might allow to achieve this situation. The increase of electrical conductivity has the same effect. What is interesting is that quantum Hall effect involves increases of conductivity by thirteen orders of magnitude as the strength of the magnetic field is varied. The explanation is in terms of fusion of the magnetic flux tubes to walls at certain critical field strengths: along these current can run freely without sticking around single flux tube. Whether something similar might occur now in low temperatures in radial direction, is an interesting open question.

c) The two other zeros correspond to the roots of the second order polynomial appearing in the above equation.

i) If the roots are real, they correspond to two critical frequencies ω_{\pm} . Suppose that the roots are of different sign: $\omega_+ > 0$ and $\omega_- < 0$. This requires $a - k < 0$. The system studied by Godin and Roschin corresponds to this kind of situation. If $|\omega| \leq |\omega_{\pm}|$ holds true the system decelerates to $\omega = 0$. The rotation with frequency ω_{\pm} does not represent a stable situation and a slight increase of the frequency above $|\omega_{\pm}|$ implies a spontaneous acceleration without limit, which represents an unrealistic feature of the model.

ii) Roots can be also of same sign: this requires $a - k > 0$. In this case a spontaneous acceleration without limit occurs always for the other rotation

direction. For the other direction it occurs without limit only above the root with a larger magnitude. In the region between ω_+ and ω_- deceleration occurs until the smaller root is achieved. Below the smaller root the system accelerates to the smaller root. Hence the rotation with the smaller rotation frequency represents a stable situation.

iii) If the roots are complex, the system accelerates without limit for both directions of rotation. The reason is that $a - k > 0$ is necessary to achieve this situation.

2. Quantitative analysis

Consider now the quantitative analysis of the model neglecting the "back reaction". The roots of the second order polynomial correspond to an unstable motion with a constant rotational velocity and are given by

$$\omega^2 + \omega_{cr}\omega + \frac{(a-k)\omega_{cr}}{b} = 0 . \quad (21)$$

This gives

$$\begin{aligned} \omega_{\pm} &= -\frac{B}{2} \pm \frac{1}{2}D , \\ D &= \sqrt{B^2 - 4C} , \quad B = \omega_{cr} , \quad C = \frac{(a-k)\omega_{cr}}{b} . \end{aligned} \quad (22)$$

There are three different cases depending on whether the discriminant $D = B^2 - 4C$ is positive or negative or zero.

$D > 0$ case

This situation corresponds to

$$a - k < \frac{b\omega_{cr}}{4} . \quad (23)$$

and means that critical frequencies ω_{\pm} are real.

Solving the differential equation in this case gives

$$\frac{\omega}{\omega(0)} \times \left[\frac{\omega - \omega_+}{\omega(0) - \omega_+} \right]^{\frac{\omega_-}{D}} \times \left[\frac{\omega - \omega_-}{\omega(0) - \omega_-} \right]^{-\frac{\omega_+}{D}} = e^{(a-k)t} . \quad (24)$$

One can distinguish between two different cases corresponding to the sign of $a - k$.

a) For $a - k < 0$ ω_+ and ω_- have different sign. The magnitude of the critical frequency is different for the two different directions of rotation as observed in the experiment of Godin and Roschin and this is due to the torque suffered by Z^0 ohmic electron current $j = \sigma_e E_Z$ in the ordinary magnetic field.

For $|\omega(0)/\omega_{\pm}| < 1$ the system decelerates to $\omega = 0$. For $|\omega(0)/\omega_{\pm}| > 1$ $|\omega|$ becomes infinite in a finite time at the limit

$$t \rightarrow t_{\infty} = \frac{1}{b(a-k)} \log \left[\frac{(\omega(0) - \omega_+)}{\omega(0)} \times \left(\frac{\omega(0) - \omega_-}{\omega(0) - \omega_+} \right)^{-\frac{\omega_-}{\omega_- - \omega_+}} \right] \quad (25)$$

The spontaneous acceleration without limit occurs for both clockwise and counter clockwise rotation but the values of the parameter t_{∞} are slightly different:

$$t_{\infty,+} - t_{\infty,-} = \log \left[\frac{1-x}{1+x} \right] \frac{1}{b(a-k)}, \quad x = \frac{\omega_+}{|\omega(0)|}. \quad (26)$$

b) For $a - k > 0$ the roots are of same sign and smaller frequency corresponds to a stable situation to which system either accelerates or decelerates. The larger rotation frequency is unstable and an acceleration without limit occurs above it. In this kind of stationary situation friction and Lorentz torque compensate each other. For other rotation direction spontaneous acceleration without limit occurs always. This situation could correspond to Searl's device.

$D < 0$ case

This situation corresponds to

$$a - k > \frac{b\omega_{cr}}{4}. \quad (27)$$

It can occur only for $a - k > 0$. In this case the roots ω_{\pm} are complex, and one can express the solution in the form

$$\frac{1}{x} \times (X + Y) = e^{(a-k)t},$$

$$\begin{aligned}
X &= \log \left[\frac{\omega}{\omega(0)} \times \left(\frac{\omega^2(0) + \omega(0)\omega_{cr} + x}{\omega^2 + \omega\omega_{cr} + x} \right)^{1/2} \right] \\
Y &= -\left(\frac{D}{4}\right)^{3/2} \times \left[\arctan \left[\frac{\omega + \omega_{cr}}{|\frac{D}{4}|} \right] - \arctan \left[\frac{\omega(0) + \omega_{cr}}{|\frac{D}{4}|} \right] \right] \\
x &= \frac{(a-k)\omega_{cr}}{b} , \quad D = \omega_{cr}^2 - 4x < 0 .
\end{aligned} \tag{28}$$

A spontaneous acceleration without limit occurs always and $\omega = \infty$ is achieved in a finite time

$$\begin{aligned}
t_\infty &= \log \left[\frac{1}{x} (X(\infty) + Y(\infty)) \right] , \\
X(\infty) &= \log \left[\frac{(\omega^2(0) + \omega(0)\omega_{cr} + x)^{1/2}}{\omega(0)} \right] \\
Y(\infty) &= -\left(\frac{D}{4}\right)^{3/2} \times \left[\frac{\pi}{2} - \arctan \left[\frac{\omega(0) + \omega_{cr}}{|\frac{D}{4}|} \right] \right]
\end{aligned} \tag{29}$$

$D = 0$ case

For $D = 0$ one has $\omega_+ = \omega_-$ and an exponential acceleration without limit results:

$$\omega = \omega(0)e^{(a-k)t} . \tag{30}$$

The model discussed is certainly unrealistic. In particular, the prediction that infinite value of ω is reached in a finite time interval is non-sensible.

3.3.4 The model taking into account the "back reaction"

The model just described is an idealization.

a) Fast rotation would induce so strong a centrifugal force that it would overcome the mechanical constraints and the radial Lorentz force experienced by the rollers in the magnetic field of the stator. Acceleration to an infinite velocity in a finite time would require an infinitely high power feed at the limit and the effectiveness of the remote metabolism poses a restriction here. Godin and Roschin found that the load above which the system starts to decelerate is $P_{max} = 7$ kW. From this one can estimate the maximum

power feed from remote metabolism to the accelerating system using the condition

$$P_{max} = I\omega_{max}\frac{d\omega}{dt} = I\omega_{max}\left[(a-k)\omega_{max} + b(\omega_{max}^2 + \frac{1}{\omega_{cr}}\omega_{max}^3)\right] \quad (31)$$

b) The negative feedback resulting from the finite efficiency of metabolism can be modelled by adding to the equation of motion negative feedback term, a kind of analog of "radiation reaction" for linear motion. The simplest guess is that the negative feedback term is proportional to the time derivative of the angular acceleration:

$$\begin{aligned} \tau_{fb} &= -t_0\frac{d^2\omega}{dt} = t_0\frac{d(\frac{d\omega}{dt})}{d\omega}\frac{d\omega}{dt} = -t_0P_3(\omega)\frac{dP_3}{d\omega} . \\ P_3(\omega) &= (a-k)\omega + b(\omega^2 + \frac{1}{\omega_{cr}}\omega^3) . \end{aligned} \quad (32)$$

The net angular acceleration can be written as

$$\frac{d\omega}{dt} = P_3(\omega)\left[1 - t_0\frac{dP_3}{d\omega}\right] = P_3(\omega)\left[1 - (a-k)t_0 - 2bt_0\omega - \frac{3bt_0}{\omega_{cr}}\omega^2\right] \quad (33)$$

c) During spontaneous acceleration a load increasing in steps of 1 kW is added to the system. The simplest model for the load is as a friction term. The assumption that the torque describing the presence of load is of the form

$$\tau_L = -Ik_L\omega . \quad (34)$$

means only a modification of the friction coefficient k : $k \rightarrow k - k_L$. The power used by the load is given by

$$P_L = \tau_L\omega = Ik_L\omega^2 . \quad (35)$$

Applying this equation to the stationary situation $\omega = \omega_{1\pm}$ one can deduce the value of k_L .

$$k_L = \frac{P_L}{I\omega_{1\pm}^2} . \quad (36)$$

The resulting equations of motion are integrable. Besides the roots of $P_3(\omega)$ defining stable or unstable orbits for which the angular acceleration vanishes, the roots of $dP_2/d\omega$ define additional orbits of this kind when real. The roots are given by

$$\omega_{1\pm} = \frac{\omega_{cr}}{3} \left[\pm \sqrt{1 + 3 \times \frac{k + k_L - a + \frac{1}{t_0}}{\omega_{cr} b}} - 1 \right] \quad (37)$$

For

$$k + k_L - a \geq \frac{\omega_{cr} b}{3} - \frac{1}{t_0}$$

(in particular for $k + k_L - a > 0$) the roots are real and represent stable orbits stabilized by the negative feedback and representing asymptotic situation in the case that the system starts to spontaneously accelerate above $|\omega| > |\omega_{\pm}|$. For sufficiently small values of t_0 the condition for stable orbit is satisfied always. This condition guarantees also the physically natural condition $|\omega_{1\pm}| \geq |\omega_{\pm}|$. Also for $a - k > 0$ one expects that t_0 is for purely physical reasons so small that roots are real so that stable orbits result.

More explicitly, the equations of motions read

$$\begin{aligned} \int \frac{d\omega}{P_5(\omega)} &= \omega_{cr} t , \\ P_5(\omega) &= \frac{3b^2 t_0}{a\omega_{cr}^2} \omega(\omega - \omega_+)(\omega - \omega_-)(\omega - \omega_{1+})(\omega - \omega_{1-}) \equiv A^{-1} \prod_{k=1}^5 \frac{\omega - \omega_k}{\omega_{cr}} , \\ A &= \frac{a}{3b^2 \omega_{cr}^3 t_0} , \end{aligned} \quad (38)$$

and give

$$\begin{aligned} A \times \log \left[\prod_{k=1}^5 \left[\frac{\omega - \omega_k}{\omega(0) - \omega_k} \right]^{c_k} \right] &= \omega_{cr} t , \\ c_k &= \prod_{l \neq k} \frac{\omega_{cr}}{\omega_k - \omega_l} . \end{aligned} \quad (39)$$

Note that one has $\sum_k c_k = 0$, which implies that the argument of logarithm approaches constant for large values of ω . Depending on the initial conditions and the sign of $k - a$ the system approaches the limit $t \rightarrow \infty$ either $\omega = \omega_{1\pm}$ or $\omega = 0$.

3.3.5 Catastrophe theoretic model for the dynamics of Searl device

Rene Thom's great achievement was the topological classification of different very rapid, almost discontinuous, catastrophic changes appearing in potential flow dynamics [18]. The value of the catastrophe theory is that it gives an overall view of the dynamics of a complex non-linear system. The form of equations of motion is precisely the canonical form of equations to which catastrophe theory applies as such.

The dynamics of the system can be regarded as a potential flow with the torque derived from a potential function $V(\omega)$. Taking "back reaction" into account one has

$$\begin{aligned} \frac{d\omega}{dt} &= \frac{dV(\omega)}{d\omega} , \\ V(\omega) &= \int P_3(\omega)d\omega - t_0 \frac{P_3^2}{2} , \\ P_3(\omega) &= (a - k - k_L)\omega + b\left(\omega^2 + \frac{1}{\omega_{cr}}\omega^3\right) , \\ \int P_3(\omega)d\omega &= \frac{1}{2}(a - k - k_L)\omega^2 + \frac{1}{3}b\omega^3 + \frac{1}{4}\frac{b}{\omega_{cr}}\omega^4 . \end{aligned} \quad (40)$$

The limit when the back reaction is not taken into account corresponds to the limit $t_0 = 0$. In this case the potential function is fourth order polynomial in ω and corresponds to the cusp catastrophe. In the general case the potential function is sixth order polynomial in ω so that the dynamics of the model corresponds to the butterfly catastrophe. Cusp and butterfly and swallowtail represent basic catastrophes with one behavior variable in Thom's topological classification of catastrophes [18].

1. Cusp catastrophe as a model for the system without back reaction

In order to understand the character of the butterfly catastrophe it is good to start from the cusp catastrophe which describes sudden changes in a bistable system described by a potential having the canonical form

$$V(x) = \frac{x^4}{4} - ax - b\frac{x^2}{2} .$$

There is one behavior variable x and two control parameters a, b . The system allows in the generic case three equilibrium points as roots of $dV/dx = 0$. Two of them are stable and one unstable. The illustration of the cusp catastrophe is provided by the figure 3.3.5.

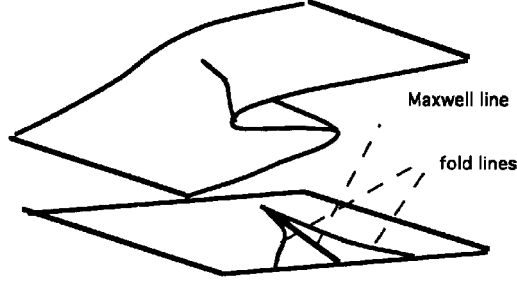


Figure 5: Cusp catastrophe

Searl device without back-reaction would be described by the dual of the dual cusp catastrophe allowing one stable point and at most two unstable points for given values of the parameters corresponding.

The potential function $V(\omega)$ is not quite the same form as for the canonical form of the cusp catastrophe but can be transformed to it by a linear change of the behavior variable.

a) Introduce first the dimensionless variables

$$\omega \rightarrow \hat{\omega} \frac{\omega}{\omega_{cr}} , \quad t \rightarrow T = b\omega_{cr}t , \quad (41)$$

transforming the potential to a dimensionless function of a dimensionless argument

$$\begin{aligned} \frac{d\hat{\omega}}{dT} &= \frac{d\hat{V}(\hat{\omega})}{d\hat{\omega}} , \\ \hat{V}(\hat{\omega}) &= \frac{V}{b\omega_{cr}^3} = \frac{1}{2}(\hat{a} - \hat{k})\hat{\omega}^2 + \frac{1}{3}\hat{\omega}^3 + \frac{1}{4}\hat{\omega}^4 , \\ \hat{a} &= \frac{a}{b\omega_{cr}} , \quad \hat{k} = \frac{k + k_L}{b\omega_{cr}} . \end{aligned} \quad (42)$$

b) This form differs from standard from only by the fact that also $\hat{\omega}^3$ term is present and the absolute value of $\hat{\omega}$ appears in the linear term. By performing the transformation

$$\hat{\omega} \rightarrow \Omega = \hat{\omega} + 1 \quad (43)$$

this term disappears and one obtains

$$\begin{aligned} \frac{d\Omega}{dT} &= \frac{dW(\Omega)}{d\Omega} , \\ W(\Omega) &= \frac{1}{2}(\hat{a} - \hat{k})(\Omega - 1)^2 + \frac{1}{3}(\Omega - 1)^3 + \frac{1}{4}(\Omega - 1)^4 , \\ &= -A\Omega - \frac{B}{2}\Omega^2 + \frac{1}{4}\Omega^4 + \text{constant} , \\ A &= \frac{a - k - k_L}{\omega_{cr}} , \quad B = -1 - \frac{a - k - k_L}{\omega_{cr}} . \end{aligned} \quad (44)$$

This is the canonical form of the cusp catastrophe potential. In the canonical representation of the cusp catastrophe Ω is referred to as a state variable whereas A and B as control variables. A is called the normal factor and corresponds now to the external load. Its variation over a critical value in the region $B > 0$ induces a rapid catastrophic reduction of Ω . B is known as the splitting factor and corresponds now to the variable $a - k$: the catastrophe can occur only in the region $B > 0$ where the fold appears: in recent case this corresponds to the condition

$$\frac{a - k - k_L}{\omega_{cr}} < -1 . \quad (45)$$

$a - k - k_L$ is indeed negative in the experiment of Godin and Roschin.

2. Butterfly catastrophe as a model for the system with back reaction

Butterfly catastrophe has one behavior variable, which is now ω , and 4 control parameters so that the graph of the function $dV/d\omega = 0$ represents a four-dimensional surface in the 5-dimensional space spanned by ω and control parameters. Butterfly catastrophe models a situation in which there are at most three stable equilibrium points instead of two as in the case of cusp catastrophe. A typical application is a qualitative model for the sudden changes in the distribution of opinions (hawks, doves present already for the cusp plus liberals). In the case considered the three stable situations correspond for $k + k_L - a > 0$ to $\omega = 0$ and $\omega = \omega_{1\pm}$ whereas the roots ω_{\pm} corresponds to unstable intermediate situations.

The canonical form of the potential for butterfly catastrophe is

$$V(x) = \frac{x^6}{6} - ax - b\frac{x^2}{2} - c\frac{x^3}{3} - d\frac{x^4}{4} \quad (46)$$

and one ends up to this form by performing a scaling and shift of ω in the same manner as in the case of cusp. The projections of the bifurcation set of the butterfly catastrophe to (a, b) plane for some values of parameters c and d are given in figure 16 of [18]. The most concrete representation is in terms of the behavior of the graph of a potential as a function of control parameters for which maxima correspond to unstable and minima to stable equilibria. Catastrophes correspond in this representation transformation of real roots to complex roots or vice versa.

The model predicts that in the experiment of Godin and Roschin the system should end up to a stable situation even without load (unless the system becomes mechanically unstable). The experiments of Godin and Roschin [16] demonstrate the slowing down of the system for the maximal critical load 7 kW (see figure 3.1.2) and from the maximal rotation velocity of 600 rpm. The interpretation is that the addition of the load reduces the value of $\omega_{1\pm}$ to value below 600 rpm. Slowing down is caused by the fact that the stable orbit $\omega = \omega_{1\pm}$ becomes unstable due to a fusion of the maximum ω_{\pm} and minimum $\omega_{1\pm}$ of the potential so that two real roots disappear and only 3 real roots remain and the system begins to slow down to the stable root $\omega = 0$ (possibly stabilized by the load).

The condition $\omega_{1\pm} = \omega_{\pm}$ reads as

$$\frac{1}{3} \left[\pm \sqrt{1 + 3 \times \frac{k + k_L - a + \frac{1}{t_0}}{\omega_{cr} b}} - 1 \right] = \frac{1}{2} \left[\pm \sqrt{1 + 4 \frac{k + k_L - a}{\omega_{cr} b}} - 1 \right], \quad (47)$$

and allows to relate the parameter k_L characterizing the load to other parameters.

3.3.6 Time evolution of the em charge of the roller

The model predicts how the electromagnetic charge of the roller evolves in time. Suppose that the outflow of the electronic charge is proportional to the overall strength of the electric field generated by the electromagnetic Faraday effect as the the assumption that a radial Ohmic current $j = \sigma E$ is generated inside the roller. This assumption is the only one possible in single-sheeted

space-time, and in TGD framework it means that the ohmic current does not flow back to the larger, non-atomic space-time sheets associated with the roller. It will be found that the assumption is unrealistic.

1. *Differential equations for the charge of the roller*

Since the electric field generated by em Faraday effect is proportional to ω , the general form for the differential equation governing the time development of the net em charge of the roller is

$$\frac{dQ_{em}}{dt} = a\omega(t) . \quad (48)$$

Note that ω corresponds to the rotation velocity of the roller having maximum value of about $230 \times 2\pi$ Hz.

One can solve this differential equation by transforming it to a differential equation with respect to ω giving

$$\frac{dQ_{em}}{d\omega} = a\omega \times \left(\frac{d\omega}{dt}\right)^{-1} . \quad (49)$$

a is dimensionless constant. At velocities much below the critical velocity, where external torque τ dominates, one has

$$\frac{dQ_{em}}{d\omega} = aI \frac{\omega}{\tau(t)} . \quad (50)$$

For instance, for constant torque Q_{em} would increase as ω^2 . This kind of behavior is consistent with the observed accelerating growth of the weight change (proportional to Q_{em} as a function of frequency).

Above the critical velocity one can write

$$\frac{dQ_{em}}{d\omega} = a \frac{\omega}{P(\omega)} , \quad (51)$$

where one has

$$\begin{aligned} P(\omega) &= P_3(\omega) , \text{ or} \\ P(\omega) &= P_3(\omega) \left(1 - t_0 \frac{dP_3(\omega)}{d\omega}\right) \end{aligned} \quad (52)$$

depending on whether one takes into account "back reaction" or not.

1. *Em charge for a system without "back reaction"*

For the system without "back reaction" em charge remains finite:

$$\begin{aligned} Q_{em}(\omega) &= Q_{em}(\omega(0)) + \frac{a}{b} \frac{\omega_{cr}}{\sqrt{D}} \times \log \left[\frac{(\omega - \omega_+)}{(\omega - \omega_-)} \times \frac{(\omega(0) - \omega_-)}{(\omega(0) - \omega_+)} \right] , \\ D &= \omega_+ - \omega_- = \sqrt{B^2 - 4C} . \end{aligned} \quad (53)$$

Consider first the case when the roots are real ($D > 0$). For large values of ω the charge grows with a logarithmic rate as a function of ω and approaches to a constant value. This behavior is consistent with the observed slowing down of the weight loss above critical rotation frequency. When the roots are complex ($D < 0$), one can cast the expression for the charge in the form

$$\begin{aligned} Q_{em}(\omega) &= Q_{em}(\omega(0)) + \frac{a}{b} \frac{\omega_{cr}}{\sqrt{|D|}} \times [\phi(\omega) - \phi(\omega(0))] , \\ \phi(\omega) &= 2 \times \arctan \left[\frac{\sqrt{|D|}}{2\omega - \omega_{cr}} \right] . \end{aligned} \quad (54)$$

A analogous formula applies in the case of Z^0 charge: now however Z^0 electric field is of same sign for both directions of rotation and this means that the sign of the weight change is same for both directions of rotation. This excludes Z^0 force as the dominant contributor to the effective change of weight.

3. *Em charge for a system with "back reaction"*

Above the critical rotation frequency the model taking into account the back reaction gives

$$\begin{aligned} \frac{dQ_{em}}{d\omega} &= \frac{a\omega_{cr}^2}{3b^2t_0} \frac{1}{(\omega - \omega_+)(\omega - \omega_-)(\omega - \omega_{1+})(\omega - \omega_{1-})} \equiv A \prod_k \frac{\omega_{cr}}{\omega - \omega_k} , \\ A &= \frac{a}{3b^2\omega_{cr}^2 t_0} . \end{aligned} \quad (55)$$

Integration gives

$$Q_{em}(\omega) = Q_{em}(\omega(0)) + A \times \log \left[\prod_k \left(\frac{\omega - \omega_k}{\omega(0) - \omega_k} \right)^{c_k} \right] ,$$

$$c_k = \prod_{l \neq k} \frac{\omega_{cr}}{\omega_k - \omega_l} . \quad (56)$$

Note that one has $\sum_k c_k = 0$. When the system approaches $\omega_{1\pm}$ the value of the charge becomes infinite which is an unrealistic prediction. The prediction however suggests that the loss of effective weight could overcome gravitational force.

During the spontaneous acceleration the system should approach to constant rotation velocity $\omega_{1\pm}$ fixed by the value of the load. $d\omega/dt = 0$ at $\omega_{1\pm}$ implies that $dQ/d\omega$ is infinite and the curve representing ω as function of $\Delta G/G_0$ should become horizontal. This indeed holds true in a good approximation.

4. Many-sheetedness is needed

The model cannot be correct as such. The failure of the model in both cases is that the predicted magnitude for the maximal charge outflow is by several orders of magnitudes higher than needed to explain the weight loss. The net rate of charging given by the difference of the radial currents at the outer and inner surfaces would be

$$\frac{dQ}{dt} = \sigma\pi \left[E(r_{out})r_{out}^2 - E(r_{in})r_{in}^2 \right] = \sigma\pi\omega B \left[r_{out}^3 - r_{in}^3 \right] . \quad (57)$$

The voltage over the individual roller ring due to Faraday effect is about .55 V for the maximum rotation frequency of about 230 Hz of the roller. From the estimate 460 μOhm for the resistance of the roller one can deduce the value of σ of neodymium as $\sigma \sim 10^3 \text{ Ohm}^{-1}\text{m}^{-1}$, the radial current would be roughly 2000 A. This current generates a net positive charge of $10^{21}e$ per second in the roller, and means a generation of 10^{-6} elementary charges per nucleon per second.

A convenient reference of comparison is provided by the ratio of $eE/m_p g$ of the electromagnetic force caused by Earth to the gravitational force in the case of proton. For the upper bound $E = 10^4 \text{ V/m}$ for the Earth's radial electric field at the surface of Earth the ratio is about 10^{11} and 10^9 for the lower limit of $E = 10^2 \text{ V/m}$. If the em charge of the roller generated by Ohmic electron currents flowing out in the radial electric field created by Faraday effect is responsible for the change of the weight then the em charge generated per nucleon during second should be of order 10^{-10} . This fraction is by a factor 10^4 smaller than the charge implied by the Faraday effect assuming that all Ohmic current leaks out. Many-sheeted space-time concept suggests that the charge returns back to larger space-time sheets

associated with the roller so that the net charge of the roller increases much slower than in single sheeted space-time. The simplest manner to model this kind of behavior is to assume that only a fraction $\epsilon \sim 10^{-4}$ of the Ohmic current leaks out from the system.

5. *The effect of 20 kV voltage*

For a clockwise rotation and in the presence of 20 kV voltage with output power 7 kW the rotation frequency begins to decrease at the maximum weight loss of 35 per cent from 600 rpm. The effective weight remains constant down to 400 rpm. Without voltage this is not the case. A possible interpretation consistent with the model for the em charging is that the value of em charge becomes maximal and is not appreciably affected by the reduction of the rotation velocity reducing the vacuum electric and Z^0 electric fields. This should relate somehow to the presence of the conducting copper folio around the rollers and stator carrying opposite surface charges. The presence of the folio and voltage would not allow the electrons dispersed in the environment of the rollers to readily flow back to the rollers.

The 20 kV voltage and possible accompanying Z^0 voltage would take care that the rollers remain em and Z^0 charged even when the radial electric fields generated by the rotation weaken. The gradual increase of the load in units of 1 kW reduces rotation speed in absence of 20 kV voltage but not appreciably in its presence.

3.3.7 Estimates for the parameters of the model

The crucial question is whether the parameters that are zero in the absence of the classical Z^0 force are large enough to allow the catastrophe theoretic interpretation. The following estimates demonstrate that this is the case if the rollers behave as Z^0 paramagnets in the sense that the small Z^0 magnetic field H_Z created by the rotational motion generates much stronger neutrino Z^0 magnetization M_Z . The parameter μ_Z defined by the condition $B_Z = H_Z + M_Z = \mu_Z H_Z$ is of order 10^{11} and this is basically due to the smallness of the neutrino mass ($m_\nu \sim 2 \times 10^{-7} m_e$).

A convenient manner to characterize the situation is to compare the ratios τ_i/I , where $i = 1, 2, 3$ refers to the component of the torque proportional to ω^i . Since the "back reaction" term does not dominate, it is enough to perform the estimates by neglecting its presence.

The moment of inertia of the roller with respect to the rotation axis is given by

$$\begin{aligned}
I &= \rho_m \int \rho^2 dV = \frac{\pi}{2} \rho_m r_o^4 h (1 - x^4) , \\
x &= \frac{r_i}{r_o} \simeq 0 .
\end{aligned} \tag{58}$$

Here $r_o = 3.7$ cm and $r_i = .5$ cm denote the outer and inner radii of the roller and h its height. In the following the approximation $x \simeq 0$ is used to simplify the formulas.

Consider now various contributions to the torque.

a) The purely electromagnetic contribution to the torque corresponds to the linear term in ω and is given by

$$\frac{\tau_{em}}{I} = \frac{\sigma}{\rho_m} B^2 \omega . \tag{59}$$

Note that the purely electromagnetic acceleration does not depend on the scale of the system.

b) The Z^0 Lorentz force experienced by purely electromagnetic part of electronic Ohmic current and em Lorentz force experienced by Z^0 part of electronic Ohmic current contribute torques $\tau_{em,Z}$ and $\tau_{Z,em}$ proportional to ω^2 in the approximation that Z^0 magnetic field is proportional to ω . The basic formulas are

$$\begin{aligned}
\tau_{em,Z} &= \int (j_{em} \times B_Z) \times r dV , \\
\tau_{Z,em} &= \int (j_Z \times B) \times r dV , \\
j_{em} &= \sigma v \times B , \quad j_Z = \frac{g_Z Q_Z(e) \sigma}{e} v \times B_Z
\end{aligned} \tag{60}$$

The Z^0 magnetizing field H_Z is created by Z^0 current

$$j_Z = n_Z \langle Q_Z \rangle g_Z v , \quad v = \omega \rho, \tag{61}$$

where n_Z is the density of average Z^0 charge $\langle Q_Z \rangle$. $H - Z$ can be deduced from $\nabla \times H_Z = j_Z$. To estimate numerically the ratios it is convenient to express n_Z as

$$n_Z = \frac{\epsilon}{a^3} ,$$

where $a = 10^{-10}$ meters defines atomic size scale. $\epsilon = 1$ would correspond to a Z^0 charge $\langle Q_Z \rangle$ per atomic volume.

Assuming Z^0 paramagnetism this gives

$$\begin{aligned} B_Z &= \mu_Z H_Z , \\ H_Z &= n_Z \langle Q_Z \rangle g_Z \omega \frac{\rho^2}{2} . \end{aligned} \quad (62)$$

Using the approximation

$$E_Z \simeq \Omega(R + r_o) B_Z = \frac{\omega}{23} \times \mu_Z H_Z \quad (63)$$

for the Z^0 electric field, one can derive the expressions for the ratios $\tau_{em,Z}/\tau_{em}$ and $\tau_{Z,em}/\tau_{em}$ at reference rotation frequency ω_0 , which can be taken to be $\omega_0 = 2\pi \times 230$ Hz. This gives

$$\begin{aligned} \frac{\tau_{em,Z}(\omega_0)}{\tau_{em}(\omega_0)} &= \frac{1}{3} \times x \times X , , \\ \frac{\tau_{Z,em}(\omega_0)}{\tau_{em,Z}(\omega_0)} &= \frac{R + r_o}{r_o} \frac{6}{5 \times 23} \simeq \frac{66}{135} , \\ x &= \frac{Q_Z(e)g_Z^2}{e} , \quad X = \mu_Z \epsilon \langle Q_Z \rangle \frac{\omega_0 r_o^2}{B a^3} . \end{aligned} \quad (64)$$

The power of the parameter

$$X = \frac{2B_Z(r_o)}{g_Z B}$$

characterizes the relative magnitudes of different powers of ω in τ . X is proportional to the parameter $\omega_0 r_o^2$, which suggests that the critical rotation frequency scales as

$$\omega_0 \propto \frac{1}{r_o^2}$$

in the scaling of the system whereas Larmor frequency would scale as $1/r_o$. This holds true if friction force is proportional to the mass of the system so that $k \propto 1/r_o^2$ holds true.

c) The electronic ω^3 contribution $\tau_{Z,Z}$ can be derived from the general formula

$$\begin{aligned}\tau_{Z,Z} &= \int (j_Z \times B_Z) \times r dV , \\ j_Z &= \frac{g_Z Q_Z(e) \sigma}{e} \times (v \times B_Z) .\end{aligned}\quad (65)$$

Also neutrinos could contribute to Ohmic Z^0 current. The fact that the critical frequencies differ by about 10 per cent for the two rotation directions means that ω^2 term must be comparable to ω^3 term. This means that the possible contribution of neutrinos cannot be much larger than the electronic contribution.

The ratios $\tau_{Z,Z}/\tau_{em}$ and $\tau_{Z,Z}/\tau_{em,Z}$ are given by

$$\begin{aligned}\frac{\tau_{Z,Z}(\omega_0)}{\tau_{em}(\omega_0)} &= \frac{1}{23 \times 7} \times \frac{R + r_o}{r_o} \times x \times X^2 , \\ \frac{t_{Z,Z}(\omega_0)}{\tau_{em,Z}(\omega_0)} &= \frac{5}{7} \times X .\end{aligned}\quad (66)$$

Consider now quantitative estimates.

a) Since the parity breaking given by ω^2 term is of order 10 per cent, the order of magnitude estimate

$$X \sim 10$$

follows and gives

$$\mu_Z \epsilon \langle Q_Z \rangle \sim 10 \frac{B a^3}{\omega_0 r_o^2} ,$$

$$B_Z(r_0) \sim 5 g_Z B .$$

Not surprisingly, the induced Z^0 magnetic field B_Z must be of the same order of magnitude as the ordinary magnetic field. Together with

$$x = \frac{Q_Z(e) g_Z^2}{e} \simeq 10^{-2}$$

this means that third order term is of order ten per cent from the linear term when the "back reaction" is not taken into account.

b) For $\mu_Z = 1$ the requirement $X \sim 10$ would give $\epsilon \sim 10^{-3}$. This is certainly an unrealistic value of Z^0 charge density since even very small

strengths of the Earth's Z^0 electric field would give to large changes of effective weight. The theory of paramagnetism generalizes in a straightforward manner to the case of Z^0 paramagnetism due to the unpaired neutrino spins. Z^0 magnetization density and μ_Z in the thermal equilibrium are given by

$$\begin{aligned}
M_Z &= n_\nu \tanh\left(\frac{\mu_{\nu,Z} H_Z}{T}\right) \times \mu_{\nu,Z} \simeq n_\nu \times \frac{\mu_{\nu,Z} H_Z}{T} \times \mu_{\nu,Z} , \\
\mu_Z &\simeq n_\nu \times \frac{\mu_{\nu,Z}}{T} \times \mu_{\nu,Z} , \\
\mu_{\nu,Z} &= \frac{g_Z Q_Z(\nu)}{2m_\nu} .
\end{aligned} \tag{67}$$

The linear approximation holds true for $\mu_{\nu,Z} H_Z Z / T \ll 1$. From the previous estimate one has $B_Z \sim B$, which gives $\mu_{\nu,Z} H_Z / T \sim 10^{-3}$ at the room temperature. n_ν denotes the density of unpaired neutrino spins: the first guess is that there is roughly one unpaired neutrino spin per atomic volume. This would give $\mu_Z \sim 10^{11}$ and $\epsilon = 10^{-13}$. The estimate looks rather reasonable and the presence of unpaired neutrino spins might relate to the Z^0 charging of the rollers.

3.3.8 The condition that Z^0 charge can cause appreciable effects

One can also estimate also the amount of Z^0 charge needed to generate a weight change comparable to the electromagnetic weight change. One can deduce an expression for the Z^0 charge per nucleon (neutron or proton) by expressing the total mass as $m_0 = N m_p$:

$$\frac{Q_Z}{N} = Q_Z(p) \frac{\Delta G}{G_0} \frac{m_p g}{g_Z Q_Z(p) E_Z} . \tag{68}$$

At the right side appears the ratio of the gravitational force to classical Z^0 force experienced by proton.

A reasonable looking lower bound for Q_Z follows from the requirement that the Z^0 electric force experienced by proton in the Earth's magnetic field is not stronger than the electric force so that one would have the constraint

$$\frac{g_Z Q_Z(p) E_Z}{m_p g} < 10^{11} .$$

The proton's Z^0 charge is $Q_Z(p) \sim 1/50$. From this a lower bound for the Z^0 charge per nucleon follows

$$\frac{Q_Z(f_{cr})}{N} = \frac{\Delta G_{cr}}{G_0} \frac{m_p g}{g_Z E_Z} > .30 \times 5 \times 10^{-10} = 1.5 \times 10^{-10} . \quad (69)$$

Roughly every tenth billionth neutron would be unscreened. The result seems rather reasonable.

To my best knowledge in the construction of Searl the rollers were not constrained in any manner to the system. The requirement that the centrifugal acceleration does not throw the rollers away gives an additional constraint to the theory. Em force or directed radially inwards could explain the stability. The stability condition reads as $mv^2/R \leq QvB$ and gives

$$\frac{Q}{N} \geq \frac{m_p f}{2\pi B} . \quad (70)$$

For $B = 1$ Tesla and $f = 10$ Hz this gives $Q/N \geq 5.6 \times 10^{-11}$. A possible interpretation for the plasma around the rotor is as electrons flown out of the rollers.

3.3.9 Explanation of the coronal discharge

The presence of the coronal discharge with the characteristic ozone smell around the rotor in the experiments of Roshchin and Godin [2] has pink-blue color. This suggests that the light results from atomic or molecular transitions. Gas discharge tubes and so called sprites and elves associated with certain type of lightnings exhibit also red and blue light (see [11] and TGD based model of this phenomenon in [H4]. In the case of sprites red and blue light results from the electronic excitations of N_2 molecules and blue light from the collisions of electrons or N_2 molecules exciting N_2^+ ions. Similar mechanism could be at work also now. N_2 molecules and N_2^+ ions would be ions of the surrounding air and one should understand the origin of electrons.

Unfortunately, it is quite not completely clear from [16] whether the luminescence was present only when 20 kV voltage was present. In this case one could understand the phenomenon as a dielectric breakdown. In the case that the luminescence was present also in the absence of 20 kV potential the explanation of the phenomenon should relate to the outflow of electrons from the rollers as Ohmic currents.

One can imagine several candidates for the explanation of this phenomenon and the situation is still somewhat unsettled.

a) The first and wrong guess is that the acceleration of charged particles in the radial electric field generated by the rotation alone gives them enough energy so that they can ionize the air. The energy gained by an electron moving freely in the radial electric field is $\Delta E = eB\omega\rho^2/2$. For $B = 1$ Tesla, $\rho = .1$ meters and $\omega = 20\pi/s$ this gives energy which is about .6 eV, which cannot cause ionization. When friction is taken into account, the estimate for the average kinetic energy gained between two successive collisions is $\Delta E = eEl$, where $l = 1/n\sigma$ is the free path of the charged particle in the magnet. From the estimates $\sigma \sim 10^{-20} m^2$ (geometric cross section for atom), $n_0 = 10^{30}/m^3$ for the order of magnitude of the density of the condensed matter, it is clear that the energy is quite too low to cause ionization.

b) The leakage of the electrons of the Ohmic current to the space-time sheets of environment involves dropping from atomic space-time sheets to larger space-time sheets. In this process they would liberate their zero point kinetic energy. This process would also occur only during the rapid acceleration. For an electron the dropping from the atomic space-time sheet this energy is about 1 keV so that X rays are liberated. These X rays would ionize the air and generate highly energetic electrons, which in turn make collisions with N_2 molecules and N_2^+ ions and generate electronic excitations producing the pink-blue glow. For ions the zero point kinetic energies are below .5 eV (proton's zero point kinetic energy). This process is indeed expected to occur near the boundaries of the rolling magnets.

This process allows also the following interpretation. The time reversal involves phase conjugates of microwaves and perhaps also radiation at other wavelengths. Phase conjugate waves correspond to photons with negative energy. Therefore one might see the emission of X ray as a process in which negative energy X ray is emitted from the region containing the luminous plasma and absorbed by the electron dropping to the larger space-time sheet. The time reversed process could start already from the excitation of the molecules of air by the emission of negative energy photons and end with the emission of negative energy X ray inducing the dropping of the ion to the magnetic flux tube. This picture would conform with the claimed absorption of energy from the environment in the rotating magnetic system and the decrease of entropy. TGD indeed predicts that the second law of thermodynamics holds true only above p-adic time scale characterizing the system and that below p-adic time scale the arrow of the geometric time can change (that p-adic numbers are not well ordered conforms with this). Even the spontaneous acceleration of the rolling magnets could be interpreted as a dissipative slowing down in an appropriate time scale.

c) Godin and Roschin [16] compare the phenomenon to a high voltage microwave induced di-electric breakdown. The transversal electric fields associated with the topological light rays serving as correlates for the negative energy microwave photons emitted by the magnetostatic wave pattern could define the high voltage making possible the acceleration of electrons to kilovolt energy range so that they can ionize the surrounding air. The appearance of yellowish-white luminescent bands with distance of about roller radius 3.7 cm along the height of the roller surface have been reported and might relate to the dependence of the magnetostatic wave patterns on the vertical coordinate. The variation might relate to the local variation of the magnetostatic resonance frequency caused by the non-isotropic character of the magnetization in the vertical direction in turn causing the variation of dominant microwave frequency and the associated transversal voltage.

3.3.10 Critical question: Could Lorentz torque serve only as a control mechanism?

Year of two after the construction of the model above I learned that the Lorentz torque might serve as a relatively weak control action only. The point is that the magnetic field of the stator rotates with that of rollers and the fact that the magnetic flux in the rollers corresponds to the return flux of stator magnetic field suggests this. In this kind of situation a radial current is established also in the stator. The radial ohmic currents in the stator and rollers are directed inwards/outwards or vice versa in this kind of situation so that the radial current from stator can flow to rollers. A flow equilibrium could result providing rollers and stator with opposite charges.

Lorentz torque forces the electrons to a rotational motion in both stator and rollers. If the distributions of the electronic charge density is not fully rotationally symmetric this implies an electrostatic torque which could force the rollers to a rotational motion. In this kind of situation Lorentz force would serve in the role of control knob inducing much stronger torque. The catastrophe theoretic model discussed above could still serve as a satisfactory model for the situation although originally constructed assuming that only roller magnetic fields rotate. Later a detailed model for the flow equilibrium is discussed allowing to gain some insights about the significance of the material composition of the system.

3.4 The role of the material composition of the system

The proposed model is certainly far from a complete description.

- a) The description does not distinguish between Searl device and a much simpler rotating cylindrical magnet.
- b) No consideration is given to the materials used in the device.
- c) It has been also assumed that the radial ohmic current flows freely in and out from the roller. This need not be the case so that only a polarization implying no effective weight loss could occur.

The elegant experiments carried out by Samuli Penttinen (personal communications) with simpler systems involving essentially rotating cylindrical magnets has given important clues about the additional features that might be essential for the functioning of the Searl device and its modifications. Samuli also realized that the nylon layers used in the rotating magnets could serve as charge reservoirs and this could be important for the functioning of the system.

3.4.1 Polarization viz. net charging

The experiments with rotating magnets demonstrated that the weight loss does not occur in systems involving only single rotating magnet or several of them on top of each other. This can be understood if the system only polarizes: the radial ohmic current would gradually generate constant charge density inside the system and a compensating surface charges at the outer (and possible inner) surfaces of the rotating magnet (say cylindrical shell). What is required is net charging and flow equilibrium in which di-electric breakdown (indicated by the ozone smell) occurs continually.

3.4.2 Material composition of the system

Both the stator and rollers have a four-layered Titanium-iron-nylon-neodymium structure (titanium being the outermost layer) in the device of Russians. Both iron and titanium are magnetic materials and good conductors. It is however not clear why just iron and titanium should be used besides neodymium and nylon.

Consider next the possible function of the nylon layer which does not carry magnetic field.

- a) Cylindrical layers made of nylon are known to be capable of developing very high polarization charges in an external electric field. Also high friction charges are generated in structures consisting of nylon.
- b) Cylindrical nylon layers start to rotate if the electric field is created by oppositely charged charge-carrying structures parallel to plane orthogonal to the axis of the cylinder and at opposite sides of the cylinder and

not tangential to the cylinder. The rotation is due to the net torque generated by the Coulomb interaction between induced charges and the opposite charges carried by the structures is non-vanishing. In the device of Godin and Roschin it is difficult to imagine that torque could be generated by electrostatic forces.

c) Searl believed that nylon layer serves as a kind of control gate guaranteeing continual flow of electric charge in radial direction from neodymium magnet instead of a pulsed flow. Pulsed flow might be interpreted in terms of a generation of high polarization surface charge followed by a dielectric breakdown reducing the charge to a small value after which it takes time to get back to the criticality. In flow equilibrium nylon layer would receive the radial ohmic current from neodymium and transfer it to iron. By its properties nylon could serve as a high capacity charge reservoir so that the dielectric breakdown at the surface of the roller would not lead to a dramatic reduction of the net charge and a continual criticality could be achieved.

d) Nylon is an organic material and one cannot exclude the possibility that this might be crucial for the functioning of the device. For instance, plasmoids are generated in microwave oven if one burns organic material such as match in the oven. It might be just the organic character of nylon which allows dropping of electrons to larger space-time sheets in the dielectric breakdown.

3.4.3 Quantum criticality

It is known that the experiments are difficult to replicate. A possible explanation is that the phenomenon is quantum critical and occurs in a narrow range of physical parameters. Quantum criticality would most naturally correspond to a criticality against dielectric breakdown involving dropping of electrons to the larger space-time sheets making possible over unity energy production. The radial ohmic current and net positive charge stabilized by nylon layer would guarantee that this situation prevails. Critical fluctuations have typically a coherence length and the generation of magnetic walls could be interpreted as critical fluctuations.

3.4.4 Model for flow equilibrium

In order to get a quantitative picture it is good to examine explicitly what happens in flow equilibrium.

1. *The conditions characterizing flow equilibrium*

Assume that layers contain rotating magnetic field. As will be found, this does not necessarily require that the layer rotates. In flow equilibrium current from layer below equals to the current to layer above so that one has the conditions

$$\dot{j}_{air,-} = \dot{j}_{Ti,+} \quad \dot{j}_{Ti,-} = \dot{j}_{Fe,+} \quad \dot{j}_{Fe,-} = \dot{j}_{nylon,+} \quad \dot{j}_{nylon,-} = \dot{j}_{neod,+} \quad .(71)$$

Here the subscript $+/-$ refers to the outer/inner boundary of the layer.

2. Charges in the interiors of layers and corresponding electric fields

The values of the charges generated inside the layers and the surface charges at their boundaries can be deduced from flow equilibrium conditions.

a) In equilibrium the electric field inside given layer is the sum of the rotationally generated component $E_{Fara} = \omega \rho \times B$ and the static component $E_{stat} = \lambda_{below}/\rho$ generated by the net charge in the layers below:

$$E = E_{stat} + E_{Fara} \quad .(72)$$

The net static electric field due to the positive charge density generated by Faraday effect is always outwards directed and does not depend on the direction of rotation unlike the direction of E_{Fara} . b) The positive charge per unit length in the interior is given by

$$\lambda(t) = \int \nabla \cdot j_{Ohm} = 2\sigma_{layer}S_{layer}B \int \omega(t)dt \quad , \quad (73)$$

where $S(layer)$ is the area of the layer. For the net field $\sigma_{layer}S_{layer}$ is replaced by sum over the contributions of layers below it.

The static electric field created by a given layer is

$$E_{stat} = \frac{2}{\epsilon_0} \sigma_{layer}S_{layer} \times \frac{2B \int \omega dt}{\rho} \quad .(74)$$

The charge and the field increases without limit in absence of dielectric breakdowns. Note that the ratios of static electric fields are given by the ratios of quantities $\sigma_{layer}S_{layer}$ of various layers. From the table below it is clear that iron neodymium) layer contains the highest (lowest) charge and generates the strongest (weakest) field.

This formula dictates the charges of the magnetic layers but says nothing about the charge of the nylon layer expected to act as a charge reservoir. Assuming that nylon layer contains a constant charge density, the situation is mathematically similar to that for magnetic layers but the prediction of the value of charge density in flow equilibrium would require a model predicting the maximal charge stored by the nylon layer.

3. Charges at the boundaries of layers

In flow equilibrium the ohmic current flowing from layer below equals to the ohmic current entering to the layer above. This gives

$$E_{above,-} = \frac{\sigma_{below}}{\sigma_{above}} E_{below,+} . \quad (75)$$

The subscript $+/-$ refers to the top/bottom of the layer.

d) The difference of the normal components of electric fields determines the density of the surface charge ρ_s accumulating at the boundary between the layers

$$\rho_s = \rho_s = \frac{E_{above,-} - E_{below,+}}{\epsilon_0} = \frac{\sigma_{below} E_{below}}{\sigma_{above} \epsilon_0} . \quad (76)$$

The ratio of fields E_+ and E_- in a given layer is given by

$$\begin{aligned} \frac{E_+}{E_-} &= \frac{E_{stat,+} + E_{Fara,+}}{E_{stat,-} + E_{Fara,-}} \\ &= \frac{E_{stat,-} \frac{R_-}{R_+} + E_{Fara,-} \frac{R_+}{R_-}}{E_{stat,-} + E_{Fara,-}} . \end{aligned} \quad (77)$$

At the limit when the static charge of the layer is very large E_{Fara} can be neglected and one has

$$\frac{E_-}{E_+} \simeq \frac{R_+}{R_-} . \quad (78)$$

Integer ratios are obtained in the layered geometries considered.

4. Concrete application of the boundary conditions

These general conditions can be applied to deduce what happens in the flow equilibrium.

a) The conductivities of neodymium, nylon, iron, and titanium are given by the table below

material	neodymium	nylon	iron	titanium	air
$\sigma/10^{-6}\Omega m$	1.6	$(.1 - 5) \times 10^{-6}$	10	2.4	1.5×10^{-8}

b) In the flow equilibrium an electric field at neodymium-nylon boundary at radius $\rho = R_1$ satisfies the condition $E_{nylon,-}/E_{neod,+} = \sigma_{neod}/\sigma_{nylon}$, which is in the range $(0.32 - 16) \times 10^6$ so that the boundary layer contains very strong positive surface charge amplifying the net positive charge of the neodymium layer.

c) In nylon the ohmic radial current is conserved so that the static electric field in nylon decreases as $1/\rho$. Hence in nylon-iron layer at radius R_2 one has

$$\frac{E_{iron,-}}{E_{nylon,+}} = \frac{\sigma_{nylon}}{\sigma_{iron}}, \quad (79)$$

which is in the range $(.1 - 5) \times 10^{-7}$ so that a negative surface charge is generated at this layer whose magnitude is by a factor

$$\frac{\sigma_{neod}}{\sigma_{iron}} \frac{R_2}{R_1} \quad (80)$$

larger than the positive surface charge in layer below. $E_{iron,-}$ can be expressed in terms of $E_{neod,+}$.

$$E_{iron,-} = \frac{\sigma_{neod}}{\sigma_{iron}} \frac{R_1}{R_2} E_{neod,+} . \quad (81)$$

Obviously nylon layer is strongly polarized and carries very strong electric field.

d) In titanium-iron boundary one obtains

$$\begin{aligned} E_{Ti,-} &= \frac{\sigma_{iron}}{\sigma_{Ti}} E_{iron,+} \simeq 4.3 E_{iron,+} = \frac{\sigma_{iron}}{\sigma_{Ti}} \frac{R_1}{R_2} E_{iron,-} \\ &= \frac{\sigma_{neod}}{\sigma_{Ti}} \frac{R_1}{R_2} E_{neod,+} \end{aligned} \quad (82)$$

so that a positive charge density is generated. The ohmic current from iron is by a factor larger about 4.3 than the ohmic current entering to titanium so

that a negative charge density should indeed accumulate at the iron-titanium boundary layer.

e) In titanium-air boundary the application of the continuity conditions together with the fact that the conductivity of air is about $1.5 \times 10^{-8} / \text{Ohmm}$ implies that the electric field in air is by a factor of order 10^8 stronger than in titanium layer so that a very strong positive surface charge should be generated. This positive surface charge might relate to the ionization of air caused by the electron current by the proposed mechanism. Thus it would seem that the most important boundary is titanium-air boundary.

Of course, the application of the conditions in this boundary layer might be too strong an idealization since the following estimate suggests that dielectric breakdown occurs. The Faraday field $E = vB = 2\pi fBR$ at the surface of the system containing rotating magnetic field has for $f = 10$ Hz, $R = .1$ m, $B = 1$ Tesla, the magnitude 2π V/m. This would mean that the electric field in air would be $2\pi \times 10^5$ kV/m. The electric field needed for the dielectric breakdown in air is $E \sim 3 \times 10^3$ kV/m so that the breakdown should occur for the roller system much before the maximum field strength is achieved and the proper description should be based on the notion of continual di-electric breakdown.

3.4.5 Two views about the functioning of the system

The magnetic fields in stator and rollers are in opposite direction. Thus the magnetic flux tubes from the stator should return back along rollers and the flux quanta associated with layers made of particular element could correspond to each other. In this kind of situation one might think that the rotation of the magnetic fields associated with the rollers forces also the magnetic field of the stator to rotate. Otherwise a twisting of the magnetic flux tubes analogous to that occurring at the convection zone of Sun occurs and a periodic process analogous to the formation of sunspots should occur as flux tubes eventually untwist.

The problem is that if the magnetic field of the roller rotates both with respect to stator- and roller axis, a twisting around roller axis still occurs. The only way out seems to be the assumption that the magnetic field associated with the roller resides at two space-time sheets.

a) The first magnetic component rotates only with respect to the stator axis and corresponds to the return flux of the stator.

b) Second component rotates with respect to the roller axis and its return flux flows along the magnetic walls and one would have also an explanation for the appearance of the magnetic walls as a return flux of a magnetic field

created by dropped electrons possessing angular momentum. The electrons from the surface of the stator at almost-contact points with the rollers (at least here) would drop to the magnetic flux tubes carrying the magnetic field rotating with the roller. Hence the formation of magnetic walls would be forced by the dropping process. The first guess would be that the gradual buildup of the walls could mean that the part of the return flux of rollers flowing through stator transforms gradually to a return flux through walls and thus minimizes the losses due to the eddy currents generated by the rotation of the return flux of rollers through stator. The return flux is however parallel to that in rollers so that the guess is wrong.

There are thus two options depending on whether stator magnetic field rotates or not.

1. Magnetic field in the stator does not rotate

Assume first that the magnetic field in the stator does not rotate.

a) Rotating magnetic layers develop a constant density of positive interior charge with a constant rate $d\rho/dt = \sigma\omega B$ by the radial ohmic current. This charge is compensated by a negative surface charge gradually cumulating to the surface of the magnetic layer unless the radial current flows to the nylon layer as in the case of Neodymium. The iron layer above the nylon layer can suck electrons from nylon.

b) The negative charge at the outer surface of a rotating roller induces an opposite polarization charge at the stator surface in the immediate vicinity of the rotating roller. A flow of electrons to the stator can occur in the resulting strong electric field so that the stator develops a negative net charge and roller a positive net charge. The charge flow between roller and stator could involve a dielectric breakdown with dropped electrons at the large space-time sheet carrying the current.

c) Stator-roller polarization does not yet lead to the effective weight loss in the Earth's electric field. This is achieved if di-electric breakdown starts to occur along the entire roller surface and induces a net charging of the stator-roller system and a negative ionization of the air. Di-electric breakdown would start to occur as the roller develops a critical positive charge. Nylon layer would guarantee that a dielectric breakdown occurs continually at the entire roller surface and the charge of the roller would have a constant value in the flow equilibrium.

2. Magnetic field in the stator rotates

If the magnetic field of the stator co-rotates, a radial current is generated also in the stator and the previous general picture applies to it. The overall

radial scale of the stator is larger so that the charging rates for the magnetic layers in the stator would be higher since the areas of layers are larger. Note that the flow equilibrium at the inner surface of the stator (air-Nd boundary) would also give also non-trivial condition. An alternative option would be that a positive surface charge is generated at the inner surface.

There would be two different radial currents if magnetic field has two components at separate space-time sheets. The radial current associated with a space-time sheet rotating with stator would flow inside rollers in the radial direction with respect to rollers apart from a rotation induced by Lorentz force. The radial electronic current flowing at the space-time sheet rotating with the stator would flow inwards and would consist of dropped electrons.

These currents make possible the generation of opposite charges for the roller and stator system and electrostatic forces could guarantee the stability of the rotation of rollers against centrifugal acceleration. In fact, a very rough order of magnitude estimate for the magnetic and centripetal forces demonstrates that the orders of magnitude for the magnetic and kinetic energies of the roller should be same. Magnetic energy is however smaller by several orders of magnitude for reasonable parameter values.

Electrostatic force could induce a torque if the rotational symmetry is broken.

a) The Lorentz torque on the radial ohmic currents causes the rotation of the radial electrons around the stator and rollers in the same direction and could serve in the role of a switch inducing possibly much stronger electrostatic torque.

b) The flow of the electronic charge from the stator to roller at almost-contact points and stator-roller electrostatic interaction would induce a breaking of the rotational symmetry for the rotating charge distributions.

c) One can imagine a situation in which the roller and its electronic charge distribution rotate with the same velocity as the rotationally non-symmetric charge distribution in the stator so that the distribution of Coulomb forces and torques between charge distributions does not change and net force and torque vanish in equilibrium. The deviations from equilibrium by acceleration or slowing down would generate torque.

d) It must be however emphasized that this situation is purely classical. Rotation continues as long as one feeds rotational energy to the system to compensate for the dissipative effects. The spontaneous acceleration of the system is something very different and its energetics requires new physics.

e) In flow equilibrium there must be an electron flow from the hollow air volume inside the stator to the air volumes inside rollers and the expecta-

tion is that a closed current circuit is formed in the flow equilibrium. This mechanism would guarantee that the positive charges associated with various magnetic layers do not grow without limit. The system however loses electrons as they drop to larger space-time sheets if the system accelerates spontaneously and the system develops a positive charge: this charge cannot grow indefinitely. One might hope that the diffusion of electrons from air could compensate for the losses so that the system could effectively act as a perpetuum mobile for some time.

3.4.6 More precise view about the dropping of electrons

The notion of many-sheeted space-time gets quite strong empirical support from the recent findings that nuclear reaction rates depend on the electronic environment and are highest in conductors [22, 23]. The formula explaining the enhancement of the reaction rates is based on the idea that projectile nucleus is accelerated in the Coulomb field of the electronic plasma cloud surrounding the nucleus and causing Debye screening [20, 21]. The model is however in a direct conflict with atomic physics which does not allow the description of atomic electrons below atomic radius using classical thermodynamics.

TGD reproduces the empirically verified formula for the enhancement of the reaction rates by assuming a variant of Trojan horse mechanism according to which the projectile nucleus arrives the target nucleus along a space-time sheet associated with conduction electrons and in this manner overcomes Coulomb barrier [F8]. The assumption that thermal excitations kick the projectile nucleus to the space-time sheet of the conduction electrons produces same formulas as Debye model. There is no need to ad hoc "de-quantization" of atomic physics although one must generalize it to many-sheeted space-time.

This model gives also highly welcome constraints to the model for how electrons are dropped to larger space-time sheets in rotating magnetic systems.

a) The assumption that the conduction electrons drop from "conduction space-time sheets" would explain why the magnets used must be conductors. It would however force to challenge the simple model which assumes that electrons are essentially free. The problem is that Coulombic binding energy with nuclei dominates over the kinetic energy for conduction bands. This means that in the dropping to the space-time sheet of the environment at which Coulomb interaction energy is absent, the energy of the electron would increase so that the process would require energy!

b) The most obvious resolution of the problem would be that the radial electronic current does not correspond to electrons in the ordinary conduction band but to free electrons not feeling the Coulomb attraction of the nuclei. The size of the space-time sheets in question should be atomic, that is correspond to the p-adic length scale $L(k = 137) \simeq .8$ Angstrom. Note that these sheets would be connected by thin join along boundaries bonds to a larger connected structure to make possible the flow of the current. The first thing to come in mind is that This structure directly corresponds to the atomic lattice.

This makes sense if the atomic nuclei feed their electric gauge fluxes to space-time sheets smaller than atomic space-time sheets. The Bohr radius for $n = 3$ electron orbital for Fe with $Z = 26$ is $n^2 a_0 / Z \sim .18$ Angstroms to be compared with the p-adic length scale $L(k = 131) \simeq .1$ Angstrom, so that $L(131)$ is the natural guess for the p-adic length scale associated with bound electrons. For instance, bound atomic electrons could reside at $k = 131$ space-time sheet, conduction electrons at $k = 134 = 2 \times 67$ space time sheet ($p = 67$ is prime), and free electrons of the radial ohmic current at $k = 137$ space-time sheets receiving no electric gauge flux (electronic and nuclear fluxes compensate each other in this length scale precisely).

This picture leads to an additional condition for the model: the material used must be such that free electrons are possible at $k = 137$ space-time sheets. It also predicts that Searl device ceases to work when the free electrons have been depleted from atomic space-time sheets.

3.5 Magnetic fields associated with the Searl device

The magnetic fields associated with the Searl device are highly interesting. The topological quantization of the rotating magnetic and Z^0 magnetic fields might have interesting effects. The magnetic walls are not identifiable in terms of the return flux of the magnetic field of stator+roller system and their proper interpretation should be decisive for the understanding of the functioning of the system.

3.5.1 Magnetic fields generated by the rotating system

The magnetic field associated with the rollers rotates. Also the Earth's magnetic field is associated with a rotating system. Magnetosphere decomposes into a rotating inner magnetosphere and non-rotating outer magnetosphere. The ionic current due to the ions frozen to the magnetic flux tubes is a signature for whether the magnetic field is rotating and means in case of the

inner magnetosphere the presence of ring currents. The radial electric field $E = v \times B$ is in the case of the Earth's magnetosphere of order .02 V/m and much weaker than the radial electric field of about $10^2 - 10^4$ V/cm.

This raises the question whether the rotating magnetic and Z^0 magnetic fields associated with the Searl's machine decomposes into a rotating inner magnetosphere consisting of flux tubes and the non-rotating outer magnetosphere consisting of magnetic walls. As discussed in the Appendix, the $D_{CP_2} \rightarrow 3$ phase transition in which the dimension of the CP_2 projection of the space-time sheets carrying magnetic field increases two to three, implies a qualitative change in the structure of the magnetic field, and might also relate to the generation of the magnetic walls.

In many-sheeted space-time it is not obvious that the magnetic fields of rollers and stator sum up coherently inside the rollers and stator. The generation of magnetostatic waves requires coherent summation and it seems natural to assume that coherent summation occurs inside stator. For rollers coherent summation is not consistent with the idea that rotation corresponds to the rotation of the vector potential defining the magnetic field.

3.5.2 What is the interpretation of the magnetic walls?

As already discussed, the experiments of Godin and Roschin involve also strange magnetic walls and accompanying thermal effects begin to appear at about $f = 200$ rpm at which also the effective weight change becomes detectable. The thickness of walls is about 5 cm and the distance between the walls is about .5 m which corresponds to the outer radius of the stator ring. The height of the walls is at least 12 m and the field intensity stays essentially constant up to 15 m and then weakens rapidly. The maximum value for the magnetic field strength is .05 Tesla at $f = f_{cr} = 600$ Hz. The direction of the magnetic field inside the magnetic walls is upwards. Since the stator magnetic field is directed downwards and its flux dominates over the flux of the roller fields, one could interpret magnetic walls in terms of the return flux of a topologically quantized dipole magnetic field created by the stator-rotor system.

The following observations are crucial hints concerning the formulation of the quantum level model for the spontaneous acceleration of the rollers.

a) For electron possessing only spin angular momentum the Larmor frequency $\omega_L = geB/2m_e$, $g \simeq 2$, associated with a magnetic field of 1 Tesla field corresponds to a wavelength of 2.5 cm, one half of the thickness of the magnetic walls. What looks mysterious is why the thickness of magnetic walls should be twice the Larmor wavelength.

b) The Larmor frequency for the maximal .05 Tesla magnetic field associated with walls corresponds to .6 GHz and wavelength of .5 meters, the radius of the stator. This strongly suggests that some kind of resonance mechanism is involved.

In TGD framework the strange magnetic field structures are identifiable as topological field quanta of the magnetic field somehow generated by the rotating magnetic system. Magnetic walls are present only in the rotating system so that they cannot be solely due to the dipole fields of a non-rotating system.

a) The first identification would be magnetic fields resulting in a spontaneous magnetization of a Bose-Einstein condensate of Cooper pairs of electrons associated with the space-time sheets of the magnetic walls.

b) An alternative identification would be as the flux quanta of both Z^0 and em magnetic fields associated with the rolling cylinders. For vacuum extremals Z^0 field is approximately 8 times stronger than magnetic field and of opposite sign. This would suggest that the return flux of topologically quantized Z^0 magnetic field created by the rotating rollers is in question. The predicted maximal value of Z^0 magnetic field would be about .4 Tesla for vacuum extremals.

One can discriminate between the two proposals by using the fact that the temperature is lower inside magnetic walls.

a) For vacuum extremals the magnetic energy density vanishes inside magnetic walls so that no temperature change should occur. Hence the identification in terms of Z^0 -em magnetic walls does not seem to work.

b) One could try to understand the lowering of the temperature inside the magnetic flux structures in the following manner. In ordinary hydrodynamics the condition $p + \rho v^2/2 = p_0$, where p_0 is pressure in the region where flow velocity vanishes, holds true by energy conservation along flow lines. In magneto-hydrostatics the corresponding condition reads as

$$p + \frac{B^2}{2} = p_0 = nT_0, \quad (\hbar = c = 1) . \quad (83)$$

Here p_0 and T_0 denote the pressure and temperature outside the magnetic flux tubes and the equation $p = nT$ for ideal gas has been used. The equation implies a lowering of the temperature:

$$\frac{\Delta T}{T} = -\frac{B^2}{2p_0} .$$

For a magnetic field strength of order .05 Tesla and pressure of one atmosphere ($10^5 N/m^2$) the estimate for the reduction is $\Delta T/T \simeq 10^{-2}$, which is one half of the reported reduction of temperature $\Delta T/T \simeq 6 K/295 K = .02$. The failure by a factor of two might signal the transfer of thermal energy to the roller system. For spontaneous magnetization the density of magnetic energy need not be even positive so that the thermal energy would be completely transferred to to the rotating system. In any case, the order of magnitude is sensible and does not favor the presence of Z^0 magnetic field.

3.6 Remote energy and angular momentum transfer in rotating magnetic systems

The classical model for the spontaneous acceleration does not explain how the Lorentz torque on electron current is transformed to a torque on rollers. Neither does it explain the origin of the magnetic energy of magnetic walls.

3.6.1 What should one understand?

The mechanism forcing the rotor magnets to roll without slipping is easy to understand. As mentioned already earlier, the periodic deviation of the direction of magnetization from vertical with the same period for the rollers and stator makes the magnets magnetic cogwheels. This guarantees that the rollers roll rather than only rotate since the resulting magnetic torque makes slipping impossible.

The energetics behind the formation of magnetic walls and spontaneous acceleration is however far from clear. Also the generation of angular momentum of the roller should be understood.

a) The formation of magnetic walls requires energy and also the possible Bose-Einstein condensates in possible excited cyclotron energy states require also energy and one should understand the origin of this energy.

b) The proposed classical model for the spontaneous acceleration does not say anything about the detailed mechanisms for how the torque on ohmic current is transformed to a torque on the roller. If the oppositely directed magnetic fields of the stator and roller rotate in the same direction, the flow of electrons from stator to rollers at almost-contact points could break the rotational symmetry and Lorentz torque could serve as a switch inducing electrostatic torque vanishing when rollers rotate with same velocity as charge distributions in dynamical equilibrium. This model explains the rotation of the rollers if one feeds to the system rotational energy compensating for dissipative losses but does not say anything about spontaneously

occurring acceleration which requires a mechanism generating an additional torque.

c) Remote metabolism or remote utilization of energy by sending negative energy phase conjugate photons to a suitable target able to absorb them is basic mechanism in TGD inspired theory of consciousness and of quantum biology and could be at work now. This mechanism could also make possible remote transfer of angular momentum.

3.6.2 How the Lorentz torque on ohmic current is transformed to a torque on the roller?

The proposed classical mechanism assumes that the Lorentz torque on the ohmic current is somehow transformed to a torque on the roller. The classical realization would be by the symmetry breaking mechanism already discussed leading to a situation in which rollers rotate with a constant velocity if rotational energy is feeded to compensate for the dissipative effects. For quantum level mechanism leading to the spontaneous acceleration the transfer of the electronic angular momentum to the roller would most naturally occur as the conduction electrons with net angular momentum drop to a larger space-time sheet and give their angular momentum to the roller. If the dropping is radiationless meaning that the liberated zero point kinetic energy is received by the roller, the mechanism also provides the energy needed by the accelerating motion of the roller.

The mechanism would be analogous to the mechanism in which scattered lattice electron gives part of its momentum and energy to the lattice. The first guess is that the liberated photon with energy $E \leq E_{max} = .94$ keV is absorbed by a titanium atom in the roller. If the electron drops from $k = 137$ to $k = 139$ the liberated zero point kinetic energy is from the proportionality $E_0 \propto 1/L(k)^2 \propto 2^{-k}$ given by $3E_{max}/4 \simeq .705$ eV. The nuclear charge of Ti is $Z = 22$ and electronic configuration is $3d^24s^2$. The binding energy is for the ground state $E(Ti, 1) \simeq 22^2 E_H = 6.5824$ keV and for $n = 3$ state $E(Ti, 3) \simeq E_{Ti}(1)/9 = .731$ keV, which is rather near to the zero point kinetic energy liberated in the dropping of conduction electron from $k = 137$ to $k = 139$ space-time sheet.

For Fe one has $Z = 26$ and the ionization energy from $n = 3$ state is 1.021 keV in the same approximation so that also iron could be considered as the outermost layer. Nd has $Z = 60$ and electronic configuration $4f^46s^2$ and the energy of photon emitted in $n = 4 \rightarrow 5$ transition is 1.1 keV, which seems somewhat too high. If this picture is correct then also the choice of the material in the utmost layer would be one aspect of quantum criticality

and allow to understand why it is so difficult to replicate the experiments.

3.6.3 How the magnetic walls suck energy from the rotating magnetic system

The model is too speculative to allow any strong conclusion about whether the energy is transferred from the rotating system to the magnetic walls of vice versa. It however seems the the most elegant option is that the rotating system provides the energy for the formation of magnetic walls and for the rotation of electrons in the magnetic fields in question.

The transfer of energy could be from the rotating magnetic system to the magnetic walls if the liberated energy is due the dropping of electrons to larger space-time sheets at the boundary of the rotating system and also at the boundary of stator in the case that the corresponding magnetic field rotates. This would explain also the lowering of the temperature in the vicinity of the the system.

A straightforward estimate assuming $N = 30$ magnetic walls with height $h = 15$ m (this is only the lower bound for the height) gives for the net magnetic energy of the walls the estimate $E \sim 10^4$ kJ, which corresponds to the observed maximum power feed of 7 kW for a time interval of 10^3 seconds. After the walls are established the dark electrons or their Cooper pairs rotating in the magnetic field of the walls would receive their energy and angular momentum by time mirror mechanism from the rotating magnetic system.

The most plausible mechanism for the formation of magnetic walls and generation of rotating Bose-Einstein condensates of dark charged particles at the walls is based on remote metabolism. The simplest option is that Cooper pairs of dark electrons at the magnetic walls suck the energy by emitting phase conjugate photons. The dropping of electrons of Ohmic currents to the space-time sheets of the environment liberating energy in keV range should serve as the primary source of energy: this would naturally occur during the di-electric breakdown.

At first it seems difficult to understand how the negative energy microwave photons from the magnetic walls could transform to negative keV photons inducing radiationless dropping of electron to a larger space-time sheet. The large value of $\hbar = n\hbar_0$, n integer [A9], suggests a solution to the problem. If one has $n = E(drop)/E(micro)$, the energy of the phase conjugate dark microwave photon equals to that inducing the dropping of the electron. What would happen is that the dark microwave photon transforms to an ordinary photon without change in energy but a reduction in

wavelength.

For $E(drop) = 1$ keV and $E(micro) = .25 \times 10^{-4}$ eV corresponding to a microwave wavelength $\lambda = 5$ cm one obtains $n = 5 \times 2^{23}$ with 4 per cent accuracy. For $\lambda = .5$ m corresponding to the distance between the magnetic walls $n = 3 \times 2^{27}$ equals to $E(drop)/E(micro)$ with .1 per cent accuracy so that this option is definitely favored. Both integers define Fermat polygon (a polygon constructible using only ruler and compass) and these integers are number theoretically preferred [A9].

Since the wavelength in question should correspond to a size scale of a rotating magnetic system to achieve resonance, the quantization of \hbar and zero point kinetic energy would mean that the effect occurs only for special choices of the scales of the system. This kind of criticality would help to understand why it is so difficult to reproduce the effect and conforms with the intuitive ideas of Searl about the importance of the quantization of length scales characterizing the system.

Obviously it would be very natural for the Larmor wavelength of the magnetic field associated with the walls to correspond to the radius of the stator equal to the distance $d = .5$ m between magnetic walls. In this situation one could interpret the microwave radiation as cyclotron radiation. The original estimates based on the association of $f_c = 300$ Hz to the Earth's magnetic field $B_E = .5$ Gauss indeed led to the estimate $\lambda = .5$ m. Unfortunately, the calculations contained a systematic error since $f_c(p) = 300$ Hz corresponds to .2 Gauss: the estimate for the wavelength would become thus $\lambda = .2$ m.

The discovery of this error forced to reinterpret the effects of ELF radiation on vertebrate brain as being due to cyclotron transitions in dark magnetic field $B_d = 2B_E/5 = .2$ Gauss accompanying the Earth's magnetic field. If one assumes that magnetic walls carrying maximal ordinary magnetic field $B = .05$ Tesla are accompanied by dark magnetic walls satisfying $B_d = 2B/5$, one obtains $\lambda = .5$ m instead of .2 m. As a matter fact, this is not the first time when a calculational error seems to have a beneficial deeper purpose!

3.6.4 Possible other mechanisms for the remote energy and angular momentum transfer

The proposal that rotating magnetic field could receive its energy and angular momentum from the magnetic walls by time mirror mechanism turned out to be short lived. One can however imagine several mechanisms of remote energy and angular momentum transfer from rotating magnetic system

to the magnetic walls besides the one already discussed, and also a mechanism of remote spontaneous magnetization emerges naturally.

a) Remote spontaneous magnetization of Bose-Einstein condensates of Cooper pairs associated with the magnetic walls could feed energy and angular momentum from rollers to walls and possibly also vice versa. Also collective cyclotron states with non-vanishing net angular momentum could be formed via this kind of angular momentum transfer. An essential element would be the conservation of energy and angular momentum and transformation of electron spin and possibly orbital angular momentum due to the rotation in the magnetic field of the wall to the angular momentum of roller.

The remote spontaneous magnetization could compensate a partial loss of roller magnetization and would be achieved by generating phase conjugate microwaves at Larmor frequency corresponding to a magnetic field of $B = .05$ Tesla with wavelength of .2 meters. The dark magnetic field associated with the living matter in the model for the effects of ELF em fields on vertebrate brain relates to the Earth's magnetic field via the relationship $B_d = 2B_E/5$. If the dark magnetic field relates to observed maximal magnetic field by the same scaling factor, the wave length is .5 meters and corresponds to the radius of the stator magnet. If the phase conjugate microwave photons are dark with large \hbar this requires that these photons de-cohere to N ordinary phase conjugate microwave photons absorbed by the stator or rotor magnet. This looks like self assembly to single dark negative energy photon when looked in the normal direction of geometric time.

b) The generalized four-wave mechanism allows much more general standing waves than the usual theory and plasma oscillations and magnetostatic waves are ideal in this respect since their dispersion relation is such that plasma frequency does not depend on wave vector at all. Magnetostatic waves in the stator are good candidates for generating the microwave photons at wavelengths of .5 m responsible for standing wave with magnetic walls at its nodes and for spin flips inside the magnetic walls. The Larmor frequency of electron in the rollers would correspond to a wavelength equal to the thickness of the magnetic walls and the microwaves resulting in spin flips in roller magnets could be responsible for the generation of magnetic walls.

c) The Larmor frequency for the maximal .02 Tesla dark magnetic field associated with walls at critical frequency corresponds to .76 GHz and wavelength of .5 meters, the radius of the stator. Hence this magnetic field strength might relate to a microwave resonance at cyclotron frequency and with a wavelength equal the radius of the stator, and somehow providing the angular momentum needed by the system starting to accelerate spon-

taneously when the resonance condition for wavelength is satisfied. Lowest cyclotron transitions and spin flip transitions inside magnetic walls would have this frequency naturally and the magnetic walls would appear at the nodes of the waves.

d) What comes in mind is the presence of Bose-Einstein condensate of electronic Cooper pairs with spin $J = 2$ created above the critical frequency at the space-time sheets representing magnetic walls and possessing angular momentum opposite to the angular momentum gained by the rollers spontaneously.

i) The spin flips inside rollers transform part of electronic spin to the angular momentum of the roller and tend to change roller magnetization. By the stability of the spontaneously magnetized state, the effect of spin flips on magnetization of the roller is compensated by the reversals of the spin flips.

ii) The compensating spin flips in the roller at the Larmor frequency $f_L = 12$ GHz are accompanied by transverse magnetostatic waves in the stator. The frequency corresponds to the factor

$$\epsilon = \Phi - 1 = \frac{\sqrt{5} - 1}{2}$$

for the magnetic field $H = \epsilon M_0$ of roller inside stator. What is interesting is that Golden Mean appears. Only those regions of the stator, where this condition is satisfied contribute significantly to the spin flips and an optimal distance between rollers and stator is crucial for the mechanism to work. The spin flips are mediated by the emission of microwave photons at 12 GHz frequency.

It is interesting that Golden Mean appears also in another manner in the system. The ratio of the thickness d of the dark magnetic walls (twice the wavelength of 12 GHz microwaves) to the radius R of the stator equals to $1/10$ in a good approximation. These lengths correspond to phase increments of 2π and $2\pi/10$ for the corresponding waves. The phase increment of $2\pi/10$ relates directly to the Golden Mean by $\cos(2\pi/10) = \frac{4-\Phi}{2}$.

iii) The change in the magnetization of the stator is compensated by spin flips and generation of orbital motion of electrons inside dark magnetic walls and now the frequency in question is .6 GHz corresponding to the wavelength .5 m. This explains why spontaneous acceleration starts at critical frequency. The correct prediction is that the magnetization directions of the rollers and magnetic walls must be same.

The Bose-Einstein condensates of Cooper pairs play a central role in the TGD inspired theory of living matter and are made possible by the

many-sheeted space-time concept. Spontaneous magnetization of spin $J = 2$ Cooper pairs of electrons at the space-time sheets of the magnetic walls liberating rotational angular momentum could represent the precise mechanism of spontaneous acceleration. The emission of phase conjugate microwave photons at wavelength of .5 meters by the magnetostatic waves rotating in the stator magnet could induce the spontaneous magnetization, which corresponds to a lower energy than the non-magnetized phase.

3.7 Connection with the dark matter hierarchy

The discovery of years 2004-2005 was that in TGD Universe Planck constant \hbar could be dynamical and quantized and that TGD in principle predicts the spectrum of Planck constant allowing also a well-educated guess of its spectrum. A further proposal is that for a given p-adic prime there could be hierarchy of Planck constants with arbitrarily large values. These ideas have meant breakthrough in interpretational issues of TGD, and as I write this I am still working through the TGD inspired theory of living matter and consciousness armed with this new understanding.

3.7.1 Basic vision about dark matter hierarchy

I will not repeat the basic ideas related to the dark matter hierarchy since they are discussed thoroughly in previous chapters. Suffice it to say that the levels of dark matter hierarchy are partially characterized by a non-negative integer k_d characterizing the value of \hbar as $\hbar(k_d) = \lambda^{k_d} \hbar_0$, $\lambda \simeq 2^{11}$. Also more general values of λ are possible and λ is predicted to be integer valued [A9] with integer values $\lambda = n_F$ corresponding to Fermat polygons defined as n-polygons constructible using only ruler and compass being favored. For these values of n the quantum phase $q = \exp(i\pi/n)$ is expressible in terms of square roots of rationals. The integers n_F are expressible as products $n_F = 2^k \prod_i F_{s_i}$, where $F_s = 2^{2^s} + 1$ is Fermat prime and appears at most once in the product. $s = 0, 1, 2, 3, 4$ gives the lowest Fermat primes 3, 5, 17, 257, $2^{16} + 1$.

Large \hbar phase means that de Broglie and Compton wave lengths as well as corresponding time scales are multiplied by a factor λ^{k_d} . If particle densities are not reduced in the phase transition to the dark matter phase, the quantum sizes of particles, which correspond to sizes of space-time sheets, become so large that particles overlap. The standard criterion implies that macroscopic quantum phases become possible.

The situation in which phases k_d and $k_d + 1$ compete has interpretation in terms of quantum criticality. Poincare invariance implies that four-

momentum and spin are not changed in the phase transition $\hbar \rightarrow \lambda\hbar$. This means that spin is fractionized by $1/\lambda$ factor making possible fractional spins if $\lambda\hbar$ is used as a unit. The concrete interpretation of large \hbar phases at space-time level is following. What happens that space-time sheet becomes analogous to a λ -sheeted Riemann surface defining λ -fold covering of M^4 locally. At space-time level the transition to quantum criticality would thus correspond to a single step in the transition to chaos, not by period doubling but by λ -pling (and more generally, period -pling by a harmonic or subharmonic of λ).

An important application is the quantum model for high T_c super-conductivity [J1, J2, J3]. This model predicts the basic length scales of cell (cell membrane thickness of $L(151) = 10$ nm, the thickness $L(149) = 5$ nm of single lipid layer of the cell membrane, and the over all size of cell like structure involved as $L \leq L(173) = 20 \mu$). The emerging model of bio-system as high T_c superconductor is discussed in [J1, J2, J3]. The basic prediction is that fractally scaled up variants of the cell nucleus with size scales λ^{k_d} should be fundamental for understanding of not only living matter but perhaps also the em and Z^0 interactions at the level of magnetosphere.

The energy of the cyclotron states behaves as λ^{k_d} for given B . Bose-Einstein condensates associated with cyclotron states in Earth's magnetic field $B_E = .5$ Gauss would be fundamental for bio-control and for $k_d = 4$ all ions satisfying $A \leq 223Z$ have cyclotron energy scale above the thermal threshold 86 meV at room temperature. Cyclotron frequencies are in EEG range and most bosonic ions have cyclotron frequencies in alpha band around 10 Hz. Electron cyclotron states satisfy the thermal stability criterion at room temperature even for $k_d = 3$ for B_E . For $k_d = 4$ the size of magnetic flux quanta is about 10 Earth radii so that dark matter hierarchy provides a justification for the notion of magnetic body.

3.7.2 Magnetic walls as reservoirs of dark energy and angular momentum?

This general picture suggests that the magnetic walls associated with the rotating magnetic system contain dark matter Bose-Einstein condensates in cyclotron states having angular momentum and that the spontaneous acceleration of the system is forced by angular momentum conservation as this Bose-Einstein condensate is formed. Since the maximal value of magnetic field is $2^{10}B_E = .05$ Tesla, cyclotron states of electron Cooper pairs are thermally stable at room temperature even for $k_d = 2$. Magnetic walls would be the counterparts of cell membranes and $k_d = 2$ for $\lambda = 2^{11}$ predicts them to

have thickness of $\lambda^2 L(151) = 4$ cm whereas the experimental value is ~ 5 cm. The upper bound for the size of system consisting of magnetic walls, analogous to endoplasma membranes inside cell, would be $\lambda^2 L(173) = 80$ m.

Magnetic walls could serve as angular momentum and energy storages if the Bose-Einstein condensation occurs to a cyclotron state carrying angular momentum. The accelerating rotating system could suck energy and angular momentum from this reservoir by time mirror mechanism which means sending of negative energy phase conjugate photons absorbed by the Bose-Einstein condensate. Note however that the accelerated rotation can be explained in terms of Lorentz torque suffered by the radial ohmic currents.

In the model of living matter $k_d = 4$ bosonic ions at magnetic flux tubes are in a key role and the cyclotron frequencies of most bosonic ions belong to alpha band around 10 Hz. It becomes possible to explain the not only the band structure of EEG but also the narrow sub-bands correctly [J3, M3]. 10 Hz frequency is the rotation frequency of rotating magnetic system and this suggests that also $k_d = 4$ for which cell membrane thickness is scaled up to about 160 km and cell size to about 10 Earth radii is involved.

3.7.3 Also Z^0 magnetic walls could be involved

The large parity breaking observed in rotating magnetic systems suggests that also long ranged weak fields are involved with the dynamics of Searl device. Hence one can ask whether also weakly charged dark matter could be involved. Exotic ions having both weak and em charges result when some nuclear color bonds having quark q and antiquark \bar{q} at their ends become charged $u\bar{d}$ or $d\bar{u}$ type color bonds, are possible and might be of relevance for living matter [F8, F9]. These exotic ions couple to $k_d = 1$ dark variants of $k = 113$ exotic weak bosons. These couplings would be essential for the understanding the chiral selection in living matter.

By the general considerations of [F9, J3] weak dark length scales and em dark scales correspond to each other via $k_d^W = k_d^{em} + 2$ implying $k_d^W = 4$ for rotating magnetic systems. Hence Z^0 cyclotron energies which are apart from numerical factor identical with corresponding em energies would be thermally stable at room temperature for $g_Z B Z = e B_E$. The weak length scale deduced by scaling the Compton length of ordinary intermediate boson with $k = 89$ to $k = 113$ gives $L_W(113, k_d = 2) = .2 \mu\text{m}$. For $k_d = 4$ one has $L_W(113, 4) = .8$ meters, not too far from the distance .5 m between magnetic walls.

These observations suggest that the decomposition $2+2 = 4$ cm defining

the analog of decomposition of cell membrane to lipid layers corresponds to decomposition to two 2 cm thick walls containing neutrino Cooper pair condensates with opposite angular momenta and generating Z^0 magnetic field $g_Z B_Z = e B_E$ inside the .5 meter thick wall. These walls could contain Bose-Einstein condensates of exotic O_2 and N_2 ions thermally stable at room temperature. Interestingly, for exotic O_2^+ ions the Z^0 cyclotron frequency would be in a good approximation equal to 10 Hz.

3.7.4 Is dark matter formed in the air between stator-roller interface?

If stator magnetic field rotates, the situation becomes especially interesting in the small air gap between roller and stator since the electron currents coming from the stator could be transferred to the roller and since very high positive surface charge densities could result in the air gap.

Dark matter identified as a phase with a large value of Planck constant [A9] is in a fundamental role in the TGD based model of living matter [J6, F9, M3]. The formation of large magnetic flux quanta suggests quantum criticality implying a large value of Planck constant so that one can wonder whether some form of dark matter could be formed in this region.

An especially interesting candidate for dark matter corresponds to a phase with a large value of $\hbar = N\hbar_0$ and dark space-time sheets define N -fold coverings of Minkowski space factor of the imbedding space $H = M^4 \times CP_2$ [A9]. The so called N-atoms, in particular N-hydrogen atoms, discussed in [J6, F9] correspond to N-fold coverings and can contain up to N electrons in same state since each sheet of the covering can contain electron with same quantum numbers. It is possible that only valence electrons end up to this state. TGD based model for hydrogen bond and bio-catalysis is as a dark N-atom with maximum number $n = N = 2^{11} = 2048$ of electrons in identical state. Active sites where hydrogen bonds can be formed in turn correspond to $n < N$ and the formation of the bond means a fusion of "half hydrogen bonds" with k and $N - k$ dark electrons.

The formation of N-atoms requires a high density of electrons. The air in the rotor-stator interface where electron currents running in opposite directions meet could indeed lead to high enough densities of electrons which could form dark N-atoms with the atoms of the ionized air.

3.8 Discussion

Searl machine seems to be unique in the sense that physical constraints pose strong limitations on the possible scaling of the system. The effects exhibited by Searl machine might be important for the functioning of the living matter and even in systems like tornadoes.

3.8.1 About the basic construction and its modifications

The basic construction deserves some comments.

1. Optimization

According to the proposed dynamical model of the Searl machine, the optimal situation corresponds to a rotation starting spontaneously at rest or almost at rest. This requires that the purely electromagnetic Lorentz torque wins the friction torque. The minimization of friction torque and the maximization of magnetic field strength could help here. Electromagnets might allow to achieve field strengths considerably above 1 Tesla.

Since Lorentz torque is proportional to conductivity, the maximization of conductivity provides a promising approach to the optimization of the effect. The Lorentz torque is generated by Hall effect. Quantum Hall effect (QHE) is studied in temperatures for which thermal energy is of order of electron's Larmor energy $E_e = eB/2m_e \simeq 1$ K for $B = 1$ Tesla. QHE involves an enormous increase of the conductivity (up to 13 orders of magnitude!) at certain critical value ranges of the magnetic field in the range of field strengths varying from 1 Tesla to 30 Tesla (see the figure 1.2 of [25]).

This raises the hope that QHE might allow to build small spontaneously accelerating magnetic systems with enormous Lorentz torque as compared to that observed at high temperatures. The dynamics of topologically rotating magnetic field of rotor would play a key role since the increases of the conductivity would in TGD Universe relate to the formation of magnetic walls [E9]. By the quantization of the magnetic flux the increase of the magnetic field strength means on one hand the reduction of the flux tube radius and the increase of the number of flux tubes on the other hand, and can lead to a partial fusion of the flux tubes at certain critical field strengths giving rise to highly conducting magnetic walls. If these walls are formed in the radial direction, large radial electron current becomes possible.

Quantum criticality is a prerequisite for the existence of the effects and hence also crucial for the optimization. In particular, the size scales of the system are important since the dark microwave photons from the magnetic flux walls must have wavelength of order system size in order to achieve a

resonant absorption. This wavelength corresponds also to the separation between magnetic walls. The energy of dark microwave photons must correspond to the increment of the zero point kinetic energy of dropped electron, and the fact that only certain values of quantized Planck constant seem to be favored, poses additional constraints. Furthermore, the ionization energy of valence electron of the atom in the uppermost layer must correspond to the increment of the zero point kinetic energy of electron poses conditions on the selection of the material.

2. Testing

For testing purposes modular structure of rollers and stator allowing to vary the geometric parameters would be highly desirable. The use of electromagnets would allow to test the effect of field strength. In particular, one could see whether the thickness of magnetic walls corresponds to twice the wavelength defined by the Larmor frequency of electron. The use of vertical electric field would allow to test whether it is indeed electric field of Earth which is responsible for the dominant part of the effective weight change.

The rotation of rollers should generate also Z^0 magnetic field. Radio active decay rates are reported to change near the Searl effect generator. Long range classical Z^0 field affects weak interactions and thus also the radio active decay rates. Effects are similar to the effects caused by a classical background em field and give rise to corrections, which are of order $\alpha_Z Z^2/m_\nu^4$, where Z is essentially Z^0 field strength at the position of the decaying nucleus. If classical Z^0 field has strength at least of order $1/L(169)^2$, $L(169) \simeq 5$ micrometers, the effect is significant. What happens that in a Feynman diagram describing the decay of d quark to u quark by the emission of virtual W boson decaying to electron and neutrino, the neutrino interacts with the classical Z^0 field in the final state. Recall that classical Z^0 field explains also the dependence of the effect on the direction of rotation although also the spontaneous parity breaking caused by the generation of the radial electric field could also explain this effect. The systematic study of the radio active decay rates obviously provides a clear-cut test for whether classical Z^0 fields and even W fields are present.

3. Is it possible to scale down the magnetic system?

The construction used in the experiments of Godin and Roschin is rather massive and one might ask whether it is possible to use constructions having a smaller size.

The scaling should respect both length scale ratios and frequency ra-

tios. Furthermore the length scale associated with the Larmor frequency of electron should be scaled also. This means that the scaling of dimension down by a factor x requires a scaling of a magnetic field by a factor $1/x$. Already Russians use rare Earth magnet Neodymium [17] with a magnetic field of 1 Tesla which seems to be maximal field allowed by condensed matter properties. This seems to exclude the scaling downwards.

The critical frequency for the clockwise (counter clockwise) rotation is 9 (10) Hz. The no-new-physics explanation is as the frequency above which magnetic torque becomes larger than the friction torque and spontaneous acceleration becomes possible. In TGD based model for brain ELF frequencies in EEG range play a fundamental role and one cannot exclude that also now phase conjugate ELF waves are involved and the criticality also in this sense holds true. An imaginative explanation for the known experimenter dependence of the Searl effect and over unity phenomena in general would be that part of the energy is sucked from the brain or body of the experimenter having strong desire that the device works!

Be it as it may, 10 Hz is a fundamental p-adic frequency serving as clock in living matter as well as a resonance frequency for oscillations inside the cavity defined by the ionosphere (not the same as Schumann frequency). Furthermore, Z^0 cyclotron frequencies vary in the range 9–10 Hz in Earth's Z^0 magnetic field estimated to be 16 times weaker than the ordinary magnetic field of Earth. One cannot exclude the possibility that the phenomenon involves ELF fields in an essential manner and therefore length scales of order Earth size defined by the corresponding wave lengths. This would also fix the frequency scale to that used in the experiments of Russians and only fine tuning could be considered.

Rollers have radius of about 3.7 cm and one could of course imagine of modifying the stator by replacing it by a smaller structure. Russians do not give justification for why the ratio R/r of the radii of the stator and rollers should be integer not smaller than 12 by the requirement of a magnetostatic resonance. Already for $R = r$ 6 rollers are possible and for $R = 2r$ 9 rollers are possible. This might provide a possibility of downwards scaling.

4. Could one simplify the basic system?

The natural question is whether one could simplify Searl device. There are indeed several variants of rotating magnetic systems claimed to be over unity systems (Jean- Louis Naudin's homepage [26] contains a lot of material about these devices). The simplest possible device of this kind would involve only rotor and stator disks which lay in parallel over each other and have same symmetry axis. Magnetization would be orthogonal to the disks and

the use of several stator disks would help to achieve more intense magnetic field inside rotor disk. Rotor disk could also reside between stator disks. In this case only purely electromagnetic Lorentz force would be present and if Lorentz torque is large enough to win the friction torque the system should start to rotate spontaneously. No directional asymmetry would be present since the Z^0 magnetic field created by the rotor disk is not rotating Z^0 . A working device of this kind is indeed claimed to exist and the rotation is indeed reported to start spontaneously [27]. The company Perendev Power Developments Inc. of the inventor Michael J. Brady is reported to have started manufacturing of a unit producing a power of 20 kW.

3.8.2 Searl effect and bio-control

The model of Searl effect is based on essentially the same mechanisms as applied in the quantum models for homeostasis and remote mental interactions [K5, K6].

Strong parity breaking implied by the Z^0 magnetization and the crucial role of neutrinos is the first common aspect. In living matter the key mechanism is the remote quantum entanglement having as a space-time correlate low frequency MEs, and self-organization induced by the high frequency MEs by inducing bridges between, say, magnetic flux tubes and atomic space-time sheets. In particular, the notion of magnetic body is of absolute essential for the model and has astrophysical size. In the case of Searl machine magnetic walls play the role of the magnetic body. This inspires the questions whether living matter utilize Searl effect routinely so that the model for the generation of magnetic walls might be applied also to model the generation of the magnetic body in living matter.

I have proposed in [H9] that time reversal is the basic mechanism of healing. The biological programs simply run backwards to the point, where the error occurred, and a new trial is made. De-differentiation is the counterpart of this mechanism at the cellular level. Stem cells are indeed increasingly used for healing purposes, leukemia being one example of this. The model of Priore's machine [13, 14] is based on this idea and involves phase conjugates of microwaves perhaps inducing time reversal mode of molecular machines at DNA level and thus leading to the correction of the genetic error responsible for the cancer. Irradiation by phase conjugate microwaves at critical frequencies might induce the time reversed mode and thus provide a possible general healing mechanism affecting directly the DNA level.

These observations suggest that various molecular machines such as $F_0 - F_1$ machine responsible for the metabolism (and its variants suggests

by the many-sheeted space-time concept) might at least in their time reversed mode induce time reversals of biological programs and thus healing. The generation of negative energy MEs would induce bound state entanglement and the liberated binding energy would compensate the lack of the metabolic energy feed during the time reversed mode. They could also induce anti-gravitational effects, which together with the macroscopic quantum coherence induced by negative energy MEs, could be an essential aspect of the locomotion of the living organism. Molecules, which have temporarily got partially rid of effective weight would be ideal for the catalysis in the many-sheeted space-time..

One can thus ask whether some molecular machines are actually Searl machines, at least in their time reversed mode. For instance, the $F_0 - F_1$ machine driving protons to atomic space-time sheet from (presumably) magnetic flux tubes of Earth, is much like a power plant containing a rotating shaft. In time reversed mode, in which it acts like a motor, the shaft might have reduced weight. The parity breaking effect induced by the classical Z^0 force would also favor second direction for rotation, this is obviously essential in order to achieve a synchronous action.

A further interesting aspect is that the presence of ELF waves at 10 Hz defining a fundamental bio-rhythm implied by rotation means that the interaction with the body and brain of the experimenter might interfere with the experiment. The importance of the experimenter's intention would conform with the finding that free energy effects are not fully re-producible. This only adds to the fascination of these effects if one is ready to give up the reductionist and materialistic dogmas and accept the possibility of remote mental interactions. Of course, the possibility of this remote mental interaction in bodily length scales would be absolutely essential for the possibility to realize intention by using molecular machines.

3.8.3 Could tornadoes involve Searl effect?

For a rotating vortex in water or air an analogous mechanism might work and so that the rotating vortex would begin to accelerate. Elastic force is essential in the previous example and in case of water or air pressure should provide its counterpart. One might think that the water or air in the vortex expands upwards since the gravitational force pressing the liquid downwards is reduced and pressure remains the same unless temperature is changed. Tornadoes might involve this mechanism. Usually the reduction of the pressure in the core of the tornado is believed to cause its destructive effects but the reduction of the effective gravitational force due to the Z^0

and em charging might be also involved. The observed light phenomena associated with tornadoes support the presence of plasma phase due to the Faraday effect forcing the flow of electrons from the interior of vortex.

Hydrodynamical vortices contain typically smaller vortices and one might consider the possibility that the tornado contains at its outer boundary smaller mini tornadoes playing the role of rollers whereas the central vortex would give rise to a non-rotating Z^0 magnetic field and would act as a stator. Z^0 magneto-static waves in air would replace magneto-static waves as a mechanism of remote metabolism. Larmor frequency would be now the Larmor frequency of neutrinos in the Z^0 magnetic field generated by the tornado. Since neutrino mass is about 5×10^6 times smaller than electron charge, quite high frequencies are possible. The generation of vacuum extremals would guarantee the coupling of Z^0 fields to em fields and therefore the generation of negative energy photons crucial for the remote metabolism. As noticed, the tornadoes can be accompanied also by emission of visible light. Perhaps this is both due to the remote metabolism and the presence of plasma resulting in the rotation of a magnetized structure. The temperatures of air can be as low as -80 C in the space above tornadoes [29], which also suggests the presence of time mirror mechanism of energy metabolism and reversal of geometric arrow of time.

It should be noticed (thanks for Juha Hartikka for proposing this), that one could understand Podkletnov effect if a part of the volume above the rotating super-conductor belongs to the space-time sheet of the rotating super-conductor. Matter at this space-time sheet would lose part of its gravitational mass. The resulting incomplete cancellation of the pressure gradient and gravitational force would also explain why the air above the system started to flow upwards.

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an improved understanding of the role of concrete material composition of the Searl effect and his observation that nylon layers might serve as charge reservoirs has been very valuable.

4 Appendix

4.1 Miscellaneous considerations

4.1.1 Are the magnetostatic waves generated by the stator involved with remote metabolism?

The classical model for accelerating formation is based on the spontaneous acceleration occurring when Lorentz torque exceeds critical frictional torque. One can however consider also non-classical models as independent models or possible underlying microscopic mechanisms of the classical mechanism.

Since the air in the vicinity of the rotor is cooled the remote metabolism a based on generalized four-wave action with standing wave replaced by magneto-static wave rotating around the stator ring suggests itself as one possible mechanism making it possible to suck the rotational energy from environment. Magneto-static waves [15] have been indeed assigned with over-unity effects. Magneto-static waves correspond to spin precession and involve the interaction with magnetic field and classical magnetic interaction whereas magnons are waves which involve purely quantum mechanical exchange interaction between neighboring spins.

If magnetic walls have large value of \hbar the cyclotron energy scale is much larger than the Larmor energy. This would require that the negative energy dark photons from magnetic walls decohere into a bundle of microwave photons in reversed time direction. In ordinary description this would be interpreted as a self assembly of ordinary phase conjugate microwave photons to dark microwave photons with much higher energy.

1. Magnetostatic waves and remote metabolism

From the point of view of four-wave interaction magneto-static waves would serve as an analog of standing waves generating "reference beam" and its phase conjugate. According to [15], magneto-static waves are generated surprisingly easily and the generation requires much less energy than the generation of ordinary electromagnetic waves: this might relate to the ability of these waves to "take care of itself" by sucking energy from the environment.

The existence of phase conjugate magnetostatic waves is an experimental

fact and shown to lead to about 10^4 -fold amplification of the signal wave [24]. The experiment involves a pumping microwave, the signal wave, and a phase conjugate wave, and the frequencies satisfy $\omega_p = \omega_s + \omega_{pc}$, where p refers to pumping microwave, s to magnetostatic wave representing signal, and pc to the phase conjugate magnetostatic wave. In the recent case a variant of this process in which magnetostatic wave itself acts as a pumping wave generating an amplified magnetostatic wave at a slightly higher frequency and a phase conjugate microwave at the Larmor frequency associated with $B = .05$ Tesla. The discrete change of the Larmor frequency for stator could correspond to a change of the quantized magnetic flux by one unit: this makes sense if the transversal area of the flux quantum is about 200 nm. In the case of rollers spin flip transitions would generate microwaves at frequency of about $f_L = .6$ GHz if the net magnetic field inside the roller is 0.5 Tesla and would correlate strongly with the formation of magnetic walls. Four wave mechanism suggests that a standing microwave is generated and magnetic walls are created at its nodes. In the case that only the spins of the electrons of $J = 2$ Cooper pairs are flipped, the spin flip frequency equals to the Larmor frequency of electron.

Bifilar coils in which currents running in opposite directions produces nearly vanishing magnetic field, are known to have biological effects [19] in particular, they are known to stimulate cell growth. A possible explanation is that the currents running in opposite directions induce magnetostatic wave inside the coil making possible remote metabolism by the generalized four-wave mechanism. Cells would suck energy from the bifilar in turn sucking energy from environment. One could say that bifilar coil would represent a lower level in the nutrition chain.

Searl has reported that the effect disappears, when the system is irradiated with radio waves of same wavelength as used in the fabrication of magnets, which must be of the order of the radius of the rotor. If the frequency of microwaves corresponds to magnetostatic frequency for electrons, their effect could be due the destruction of the coherence of the magnetostatic wave patterns so that they cannot suck the rotational kinetic energy from the environment.

2. Magnetostatic waves generated by stator

Magnetostatic waves do not actually propagate since in a good approximation the frequency does not depend on wave vector in the approximation that exchange interaction can be neglected: this is the case at the limit of long wave lengths. Hence complex time-periodic spatial patterns oscillatory mathematically completely analogous to plasma wave patterns are

created. This of utmost importance since repeatedly recurring patterns are ideal for sustained representation of (conscious) information. Thus magnetostatic waves could be seen as magnetic analogs of plasmoids, which in TGD inspired theory of living matter are regarded as primitive life forms. Magnetostatic waves could be important also in living matter. The basic metabolic machinery is indeed analogous to electric power plant involving a rotating shaft and this machinery could be seen as a nano-scale Searl machine.

The allowed frequencies of magneto-static waves depend on boundary conditions (dispersion relations are derived by considering suitable continuity conditions at boundaries [15]). The frequencies depend only on the external field H and on magnetization M besides geometric parameters. The dispersion relation for plane waves depends on the direction of the propagation relative to the direction of the magnetic field [15]:

$$\omega = \sqrt{\omega_H(\omega_H + \omega_M \sin^2(\theta))} . \quad (84)$$

Here θ is the angle between the magnetic field and direction of propagation. Using the units $\mu_0 = \epsilon_0 = 1, c = 1, \omega_0$ resp. ω_M are obtained from Larmor frequency by replacing B with the magnetizing (external) field H resp. induced magnetization M . Hence one has $\omega_0 + \omega_M = \omega_L$. In the general case the frequency is in the range $\omega_H \leq \omega \leq \sqrt{\omega_H(\omega_H + \omega_M)}$. $\omega_H = geH/2m$ is Larmor (spin flip) frequency of electron in the case that unpaired electrons are responsible for the magnetism. $\omega_M = geM/2m$ is the Larmor frequency in the induced magnetization field. For Earth's magnetic field of nominal value $.5 \times 10^{-4}$ Tesla one would have $\omega_B \simeq .6$ MHz.

In the recent case M corresponds to the background magnetization of the stator magnet and H to the sum of rotating approximately dipolar magnetic fields generated by rollers inside the stator ring: can express H as ϵM_0 , where ϵ depends on the position around roller ring and M_0 corresponds to the magnetization of roller (1 Tesla) in absence of H : note that H induces changes of M_0 in ferromagnets. The geometry is cylindrical but since $\theta = \pi/2$ holds true for the waves moving around the stator ring, a good guess is that $\omega = \omega_L$ holds true. A band of frequencies results since H varies in some range determined by the distance of the roller rings. This deviation is also due to the fabrication. Unfortunately, it is not quite clear from the article of Godin and Roschin whether stator magnetization is parallel or antiparallel to the rotor magnetization. If they are parallel then the frequencies are below $\omega_L = 12$ GHz. Otherwise above it.

The frequency of the magneto-static wave in stator would be determined by the magnetic field strength and due the variation in the direction and magnitude of the magnetic field would be in a band below or above 12 GHz. The rate for the change of the external magnetic field strength H created by the rotating rollers should be lower than that defined by Larmor frequency for this picture to make sense. This is obviously the case since electronic Larmor frequency is for a field strength of Tesla around 12 GHz whereas rotation frequency is around 10 Hz. This would correspond to wavelength of 3.5 cm. This is of the same order of magnitude as the width 5-6 cm of the observed magnetic walls so that there is a satisfactory consistency taking into account that the frequency of magneto-static waves varies.

The magnetic field generated by the stator inside rollers is time independent apart from the effect created by the magnetic inserts, and it is not clear whether magnetostatic waves are appreciably generated in this case.

4.1.2 Could one understand the critical rotation frequency from the scaling law of homeopathy?

According to TGD inspired theory of consciousness, living systems possess besides the material body also a magnetic body having astrophysical size scale, and sensory representations are realized at the magnetic body using essentially remote mental interactions based on quantum entanglement and self-organization induces by microwaves [M1, N1]. The mechanism involves bound state entanglement having as a space-time correlate MEs at EEG frequencies. Of special importance are the frequencies in alpha band, in particular Schumann frequency of about 7.8 Hz associated with the lowest cavity resonance of Earth's magnetic field, are especially interesting. 10 Hz frequency is also fundamental one since it corresponds to the p-adic time scale $T_2(127)$ defining the fundamental time scale in living matter: the average alpha frequency is 10 Hz. It also corresponds to the resonance frequency for the oscillations in ionospheric cavity with the property that the fields are almost constant in radial direction.

What makes the situation so interesting is that the critical rotation frequency has also an interpretation in terms of rotation frequency above which the torque produced by the ball bearing motor effect is larger than the torque of friction. Searl device might fail to function only because the friction torque has too large value!

In TGD inspired theory of living matter the basic mechanisms of homeostasis and remote mental interactions involve low frequency MEs (short hand for "massless extremals", topological light rays) serving as space-time

correlates for bound quantum entanglement even in astrophysical length scales, and high frequency MEs propagating inside low frequency MEs like massless particles. High frequency MEs induce bridges between superconducting magnetic flux tubes (or some other space-time sheets) and atomic space-time sheets (or some other space-time sheets), which in turn make possible the leakage of supra currents and their dissipation at the atomic space-time sheets giving rise to self organization.

The scaling law of homeopathy discussed in [K5] states that high frequency MEs and low frequency MEs accompany each other, and that their frequencies are in certain preferred ratios $f_{low}/f_{high} = v/c$, whose values can be understood in TGD framework. These ratios also correspond to some characteristic velocities v of the system, say EEG wave phase velocities. Low frequency is cyclotron transition frequency $f_c = ZeB/2\pi m$ of ion at a magnetic flux tubes of (say) Earth's magnetic field and high frequency corresponds to the zero point kinetic energy $E_0(k) \simeq \pi^2/2mL(k)^2$ of ion liberated, when the ion drops from some space-time sheet to a much larger space-time sheet such as the magnetic flux tube of Earth. Both cyclotron energy and the zero point kinetic energy scale as $1/L^2(k) \propto 2^{-k}$ as a function of p-adic length scale and are inversely proportional to the mass of ion so that the ratio f_{low}/f_{high} does not depend on the mass of the charged particle.

For the proton the zero point kinetic energy .5 eV for the atomic space-time sheet $k = 137$ and corresponds to the basic energy quantum of metabolism in living matter.

- a) For $k = 137$ one has $f_{high}/f_{low} = 2 \times 10^{11}$ for $B = .5$ Gauss.
- b) For $k = 149$, which corresponds to the p-adic length scale of 5 nm, one half of the cell membrane thickness, one has $f_{high}/f_{low} = 10^8/2$ and the corresponding velocity is about $v = 6$ m/s which is quite near to the velocity of alpha waves in brain. Note that the velocity depends on the local value of the Earth's magnetic field.
- c) For $k = 151$, which corresponds to the p-adic length scale of 10 nm, the cell membrane thickness, one has $f_{high}/f_{low} = 10^8/8$ and the corresponding velocity is about $v = 24$ m/s.

The frequencies f_l of the low frequency MEs naturally correspond to the frequencies associated with the rotating magnetic system. The first frequency is the frequency f_{rot} of rotation for the ring of magnets and 10 Hz typically. The second frequency is the frequency of the oscillating magnetic and electric fields equal to $f_{field} = N \times f_{rot}$, where N is the number of rolling magnets, $N = 23$ in the experiments considered so that one has $f_{field} = 230$ Hz. Scaling law predicts that these frequencies give rise to microwave fre-

quencies, which ought to manifest themselves in the field patterns associated with the system.

It is an interesting exercise to look whether the scaling law of homeopathy is consistent with various frequencies, scales, and velocities appearing in the system.

For the rotation velocity of 600 rpm, the rotation frequency of the ring system is about 10 Hz. The rotation velocity of the ring of magnets is 5.74 m/s at outer radius quite near to the 6 m/s of alpha waves and the velocity predicted by the scaling law for $k = 149$ in Earth's magnetic field. From $f_{high}(k = 149)/f_{low} = 10^8/2$ the wavelength of high frequency waves predicted by the scaling law is .6 m and defines the outer radius 57.4 cm of the ring magnet system in a good approximation. The value of f_{high} is .5 GHz and corresponds to microwave range.

The field pattern generated by the 23 rolling magnets oscillates with the frequency of $23 \times 10 = 230$ Hz in this case. For $f_{low} = 230$ Hz one has $f_{high} = 23/2$ GHz which is rather near to the upper bound of 12 GHz for the magnetostatic resonance frequency and corresponds to the wavelength $\lambda_{high} = 2.6$ cm, somewhat smaller than the diameter $d = 3.7$ cm of the rolling magnets and the rough estimate 4 cm for the periodicity of the wavy magnetic field lines.

The problem with this estimate is that the local value of the Earth's magnetic field affects the estimate for f_{high} . One can however estimate f_{high} also directly from the zero point kinetic energy at $k = 149$ space-time sheet by using .5 eV for proton at $k = 137$ space-time sheet and scaling by 2^{137-k} . For a protonic Cooper pair dropping from $k = 149$ to $k = 151$ space-time sheet one has $\Delta E_0 = (1 - 1/4) \times 2^{137-149} \times .5$ eV and $\lambda = 2.67$ cm, which is quite near to the estimate obtained using the scaling law.

4.1.3 Other mechanisms of remote metabolism?

The fact that critical frequency is in 9-10 Hz range forces however to consider the possibility that topological light rays at these frequencies fundamental for the functioning of living matter are involved and spontaneous acceleration is accompanied by the emergence of a new source of energy. The energy quantum of metabolism in living matter is in the range .4-.5 eV and corresponds to the zero point kinetic energy when proton drops from atomic space-time sheet ($k = 137$) to a larger space-time sheet. This energy corresponds also to the Z^0 plasma frequency of water. Since 10 Hz frequency defines a fundamental bio rhythm, the question whether this ELF frequency might somehow induce the counterpart of biological metabolism so that the

large value of energy quantum would make possible the spontaneous acceleration. Perhaps the generation of Z^0 plasmoids, which are nearly vacuum extremals coupling the classical Z^0 fields and em fields and generating negative energy photons with energies about .5 eV and absorbed by protons dropping to larger space-time sheets, could provide the new source of energy. These negative energy photons could propagate through the wave guides provided by 10 Hz topological light rays. In this case the remote metabolism could occur in the length scale defined by the wave length of 10 Hz photon, roughly the circumference of Earth. This would make possible spontaneous acceleration.

As already found, the scaling law of homeopathy assigns the Larmor frequency of the magnetic system to the frequency 230 Hz. This would suggests that the new source of metabolic energy is realized as enhanced emission of the phase conjugate microwaves. According to the model for the scaling law of homeopathy the microwave MEs ("massless extremals" or topological light rays) would travel to the source of energy as particle like structures inside ELF MEs corresponding to 230 Hz frequency and serving as wave guides. The energy would be sucked from a considerably larger region since the wavelength of of 230 Hz waves is 1300 km.

The scaling law of homeopathy in its original very restricted form ($f_l/f_h = 2^{10^{11}}$) would assign to $f_L = 207$ Hz the frequency $f_h = .46 \times 10^{14}$ Hz whereas which the frequency associated with the .4 eV energy quantum of metabolism in living matter is about 10^{14} Hz. Unfortunately, there is a discrepancy by a factor of $\sim 1/2$. One could of course consider the possibility that the dropping of electron Cooper pairs from the space-time sheet $k = 149$ corresponding to the length scale of lipid layer of cell membrane (5 nm) provides the energy. In this case one cannot however assign Z^0 plasma frequency with the process. An interesting question is whether the doubling of the rotation velocity (prevented by the loss of mechanical stability in the experiment of Russians) could excite the ordinary metabolism.

4.2 Some general facts about classical solutions of field equations

4.2.1 General considerations

The vanishing of Lorentz 4-force for the induced Kähler field means that the vacuum 4-currents are in a mechanical equilibrium. Lorentz 4-force vanishes for all known solutions of field equations which inspires the hypothesis that all extremals or at least the absolute minima of Kähler action satisfy

the condition. The vanishing of the Lorentz 4-force in turn implies local conservation of the ordinary energy momentum tensor. The corresponding condition is implied by Einstein's equations in General Relativity. The hypothesis would mean that the solutions of field equations are what might be called generalized Beltrami fields. The condition implies that vacuum currents can be non-vanishing only provided the dimension D_{CP_2} of the CP_2 projection of the space-time surface is less than four so that in the regions with $D_{CP_2} = 4$, Maxwell's vacuum equations are satisfied.

The hypothesis that Kähler current is proportional to a product of an arbitrary function ψ of CP_2 coordinates and of the instanton current generalizes Beltrami condition and reduces to it when electric field vanishes. Kähler current has vanishing divergence for $D_{CP_2} < 4$, and Lorentz 4-force indeed vanishes. The remaining task would be the explicit construction of the imbeddings of these fields and the demonstration that field equations can be satisfied.

Under additional conditions magnetic field reduces to what is known as Beltrami field. Beltrami fields are known to be extremely complex but highly organized structures. The natural conjecture is that topologically quantized many-sheeted magnetic and Z^0 magnetic Beltrami fields and their generalizations serve as templates for the helical molecules populating living matter, and explain both chirality selection, the complex linking and knotting of DNA and protein molecules, and even the extremely complex and self-organized dynamics of biological systems at the molecular level.

Field equations can be reduced to algebraic conditions stating that energy momentum tensor and second fundamental form have no common components (this occurs also for minimal surfaces in string models) and only the conditions stating that Kähler current vanishes, is light-like, or proportional to instanton current, remain and define the remaining field equations. The conditions guaranteeing topologization to instanton current can be solved explicitly. Solutions can be found also in the more general case when Kähler current is not proportional to instanton current. On basis of these findings there are strong reasons to believe that classical TGD is exactly solvable.

4.2.2 Absolute minimization of Kähler action and second law of thermodynamics

By quantum classical correspondence the non-deterministic space-time dynamics should mimic the dissipative dynamics of the quantum jump sequence. Beltrami fields appear in physical applications as asymptotic self organization patterns for which Lorentz force and dissipation vanish. This

suggests that absolute minima of Kähler action correspond to space-time sheets which asymptotically satisfy generalized Beltrami conditions so that one can indeed assign to the final (rather than initial!) 3-surface a unique 4-surface apart from effects related to non-determinism. Absolute minimization abstracted to purely algebraic generalized Beltrami conditions would make sense also in the p-adic context. Also the equivalence of absolute minimization with the second law strongly suggests itself. Of course, one must keep mind open for the possibility that it is the second law of thermodynamics which replaces absolute minimization as the fundamental principle.

4.2.3 The dimension of CP_2 projection as classifier for the fundamental phases of matter

The dimension D_{CP_2} of CP_2 projection of the space-time sheet encountered already in p-adic mass calculations classifies the fundamental phases of matter. For $D_{CP_2} = 4$ empty space Maxwell equations hold true. This phase is chaotic and analogous to de-magnetized phase. $D_{CP_2} = 2$ phase is analogous to ferromagnetic phase: highly ordered and relatively simple. $D_{CP_2} = 3$ is the analog of spin glass and liquid crystal phases, extremely complex but highly organized by the properties of the generalized Beltrami fields. This phase is the boundary between chaos and order and corresponds to life emerging in the interaction of magnetic bodies with bio-matter. It is possible only in a finite temperature interval (note however the p-adic hierarchy of critical temperatures) and characterized by chirality just like life.

4.2.4 Could the strange effects in rotating magnetic systems relate to $D_{CP_2} = 2 \rightarrow 3$ phase transition?

The general picture could have non-trivial implications also in the case of rotating magnetic systems.

a) A non-vanishing vacuum Kähler charge density is generated when a constant magnetic field is put into rotation. The non-vanishing charge density is not consistent with the vanishing of the Kähler 4-current and requires a 3-dimensional CP_2 projection and topologization of the Kähler current. Beltrami condition cannot hold true exactly for the rotating system. The conclusion is that rotation induces a phase transition $D_{CP_2} = 2 \rightarrow 3$.

b) This could help to understand various strange effects related to the rotating magnetic systems. For instance, the increase of the dimension of CP_2 projection could generate join along boundaries contacts and wormhole

contacts leading to the transfer of charge between different space-time sheets. The possibly resulting flow of gravitational flux to larger space-time sheets might help to explain the claimed antigravity effects.

c) The phase transition implies a qualitative change in the structure of the magnetic fields and could thus explain the generation of magnetic walls observed in the rotating magnetic system. What is fascinating that $D_{CP_2} = 3$ phase corresponds to the living matter in the proposed classification. This would conform with the idea that the ADP-ATP machinery responsible for the metabolism is a molecular Searl machine. Hence the strange effects observed in rotating magnetic systems might reveal the fundamentals of the dead \rightarrow alive phase transition.

4.3 Could spontaneous acceleration be due to the change of inertial mass?

The first model for the reduction of inertial mass was based on the reduction of inertial mass inducing pirouette effect. This mechanism could explain the spontaneous acceleration if one accepts the new view about the relationship between gravitational and inertial energy (the earlier model was based on strict form of Equivalence Principle). The reduction of the inertial mass alone cannot explain the strong parity breaking effects, and the observed fast increase of the weight change with the rotation velocity and classical Z^0 and em forces are needed. Applying Occam's razor one could conclude that classical em and Z^0 forces are all that is needed and the possible gravitational and inertial effects are quite too weak to explain the effects. It is however possible that the generation of gravitational and inertial energy from vacuum occurs in much smaller quantities and the resulting model could serve as a general model for these effects in different contexts.

4.3.1 The reduction of inertial mass and pirouette effect

If the angular momentum of the rotor can be assumed to be conserved, one can understand the rapid angular acceleration as a pirouette effect caused by the reduced inertial mass causing the reduction of moment of inertia. For the clockwise rotation direction the net change of the weight is about 1 per cent in the range 550 – 600 rpm and starts from mass reduction of 30 per cent, which would mean 3.5 kg change of inertial mass, which would be a rather dramatic effect.

This crazy sounding prediction might be killed by simple experimental tests (note however that inertial mass could be invisible in the case that

it resides at non-standard space-time sheets). One cannot deny that the hypothesis about the reduction of the inertial mass is on somewhat shaky grounds since it relies basically on the pirouette mechanism and has so dramatic implications. The simplest assumption is that similar process occurs also for the counter clockwise rotation.

The conservation of angular momentum gives

$$L = I\omega = \text{constant} . \quad (85)$$

Here I denotes the moment of inertia. I is proportional to mass and thus decreases. Denoting by $m = xm_0$ the reduced mass one has $I = xI_0$. Therefore the rotation frequency f must be inversely proportional to the mass:

$$\frac{f}{f_0} = \frac{m_0}{m} . \quad (86)$$

where m refers to inertial mass. Now the moment of inertia decreases because the mass is reduced: usually the system gets thinner in the direction defined by the axis of rotation.

In the absence of other effects the predicted dependence of $\Delta m/m_0$ on f above critical rotation frequency $f_{cr}(\pm)$ in the region of rapid acceleration would be

$$\frac{|\Delta m|}{m_0} = 1 - \frac{f_{cr}(\pm)}{f} . \quad (87)$$

Below f_{cr} there would be no effect. The reduction of effective weight however begins already at $f_0 \sim 200$ rpm so that other effects must be involved. Classical Z^0 force is the most natural candidate responsible for these effects.

4.3.2 A parametrization for the changes of inertial mass and redistribution of gravitational flux

Assume that there is change of inertial mass and redistribution of gravitational flux above the critical frequency. The dependence of the inertial mass on frequency can be parameterized in the linear approximation as

$$m(f) = m_0 \frac{f_{cr}(\pm)}{f} \text{ for } f \geq f_{cr}(\pm) . \quad (88)$$

The general formula 13 gives for the fractional change of the effective weight

$$\begin{aligned} \frac{\Delta[m_{eff}(f, \pm)]}{m_0} &= \theta(f - f_{cr}(\pm)) \left[\epsilon(f) \frac{f_{cr}(\pm)}{f} - 1 \right] \\ &\mp \frac{Q_Z(f, \pm)g_Z E_Z + Q_{em}(f, \pm)eE_{em}}{m_0 g} \end{aligned} \quad (89)$$

in the proposed parametrization.

a) The possibly occurring reduction of the inertial mass occurs freely at least during the step, which corresponds to $\Delta G/G \simeq .01$ per $\Delta f = 50$ rpm giving slope $d(\Delta G/G)/df \sim .1/f_{cr}$. For $\epsilon(f) = 1$ the slope would be $1/f_{cr}$ and 10 times larger so that also the redistribution of gravitational flux should also be present and its change must together with the inertial mass must almost compensate for the growth of weight caused by the increase of Z^0 charge. This would require that $d\epsilon/df \sim 1.3$ at $f = f_{cr}$. This would mean that the fraction of the gravitational flux feeded to the space-time sheet carrying the Earth's gravitational field must increase.

b) The gravitational mass of the system must increase at least by the same amount as the inertial mass is reduced in the process. Since positive and negative inertial energy matter can be generated, the change of gravitational mass can be larger than the change of the inertial mass. If the resulting new gravitational flux is feeded to the space-time sheet carrying the gravitational field of Earth the standard distribution of gravitational flux changes in the desired manner. One expects that the distribution of the gravitational flux returns to the normal later.

Remark: In [16] it is stated that in the area 550 rpm a force against the direction of the gravitational vector is created. Figure 3.1.2 however implies just the opposite of this interpretation since the reduction of the weight slows down. Also the statement that the weight of the device quickly changes at 550 rpm is in conflict with figure 3.1.2.

c) The simplest parametrization for the redistribution of the gravitational flux for clockwise rotation is

$$\epsilon(f) = 1 + k \times \frac{f - f_{cr}(+)}{f_{cr}(+)} , \quad k \simeq 1.3 . \quad (90)$$

in the range $\Delta G/G \in [30 - 31]$ per cent. Of course, the effects should be present also above this range if the reduction of inertial mass is the explanation of the spontaneous acceleration. The process might be regarded

as a phase transition and the conjecture of the authors of [16] is that this is the case and that similar phase transitions could occur also at higher rotation velocities.

The phase transition would create a vacuum extremal having a gravitational mass and would be followed by a continuous flow of positive inertial mass from the magnetic system. The slow down of the rapid spontaneous acceleration would be due to the coupling of the load so that angular momentum conservation would not hold true anymore. Thus the reduction of the inertial mass would not be anymore visible as an acceleration.

A similar parametrization works also in the counter clockwise situation and the simplest assumption is the same phase transition occurs and the parametrization is identical. The reduction of inertial mass causes acceleration but the growth of gravitational mass compensates this effect to the weight and only steepens increase the rate of mass change due to the Z^0 force. Indeed, in [16] it is stated that in area 600 rpm a force in the direction of the gravitational force of Earth is created.

4.3.3 Could the generation of self-organizing vacuum extremals induce a reduction of inertial mass and increase of the gravitational mass?

Vacuum extremals correspond to regions of space-time where induce Kähler field vanish, are vacua with respect to the density of inertial energy. In vacuum regions em and Z^0 fields are non-vanishing in general and Z^0/γ ratio satisfies $Z^0/\gamma = 4/\sin^2(\theta_W) \simeq 8$. Thus there is a coupling between classical Z^0 em fields which might be of importance. The presence of classical Z^0 magnetic and electric fields inducing strong parity breaking effects would conform with the observed dependence of the effect on the direction of rotation serving as a direct signature of parity breaking effect.

Vacuum regions are not gravitational vacua and the generation of these kind of regions could give rise to a creation of matter and antimatter whose inertial energies would have opposite sign and cancel each other. Einstein's equations tell the density of gravitational four momentum generated in the process and if highly curved space-time sheets are created, creation of considerable amounts matter is unavoidable. This kind of regions could contain quite considerable density of positive and negative energy matter, say as photons and their phase conjugates and perhaps even positive energy electrons and negative energy positrons.

Vacuum regions are non-deterministic and un-stable against phase transitions changing the topology of the space-time sheet as well as generation of

inertial energy. The inherent instability of vacuum means that they would gradually self-organize to non-vacua by emitting negative energy matter, in particular phase conjugate photons, and thus develop a net positive inertial energy. The behavior of these systems would have a definite evolutionary aspect, which suggests that the creation of vacuum regions is the quintessence of life. System is living as long as it can create these regions and utilize the energy sucked by these regions as they self-organize to positive energy states by sending negative energy into the environment. Plasmoids are excellent candidates for regions evolving from inertial vacuum. Plasmoids indeed seem to be primitive life forms.

The changes the gravitational and inertial masses of the system would be a signature of this process. Gravitational/inertial anomalies have been repeatedly reported to accompany over unity effects. The vacuum extremal is unstable and stabilizes by generating negative net inertial mass. This is achieved by a flow of a fraction of positive energy matter out of the system. A plausible looking idea is that gravitational energy might be created from vacuum in the energy scale which corresponds to the magnetic energy density associated with the magnetic walls: this would make roughly 10^{-4} eV per atomic volume which corresponds to the frequency of 10 GHz microwaves associated with magneto-static waves. In this case the effects on inertial and gravitational masses are of course completely negligible and visible only as remote metabolism.

The assumption that the changes of inertial mass and redistribution of gravitational mass are responsible for the effective weight change requires that matter is created from vacuum in macroscopic amounts. If 1 kg of both positive energy electrons and negative energy positrons are created in a volume of 1 cubic meter, roughly 1 electron per atomic volume would be created and it seems that Coulomb repulsion does not allow so dense a plasma. Needless to say, the laboratory scale big bang creating kilograms of matter from vacuum would mean a technological revolution. Of course, so high a density of matter created from vacuum looks highly implausible. The hypothesis can be killed by comparing this density to the density of plasma phase just outside the system. Of course, positive energy matter could also flow also to larger space-time sheets and remain invisible.

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