Emerging Physics for Novel Field Propulsion

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In this talk we present and discuss novel physical concepts that might lead to advanced space propulsion technology based on novel gravitational-like force fields. Such a propulsion technology would be working without propellant. This technology is based on the existence of two additional gravity-like fields, which are gravitational fields that are not described by conventional gravitation. The paper begins with an introduction of the present theoretical and experimental concepts pertaining to the novel physics of these gravity-like fields. In the following section, the latest gravitomagnetic experiments performed at ARC Seibersdorf (2008) are analyzed, and a qualitative explanation for the highly varying measured results is given. In section three, the physical basis (termed Extended Heim Theory, *EHT*) employed in the explanation of the ARC experiments is presented. *EHT*, based on the construction of a poly-metric (geometric approach), which is obtained by providing each point of external spacetime with an internal 8D space (Heim space), requires the existence of six fundamental interactions, three gravitational fields, which are both attractive and repulsive as well as the known electromagnetic, weak, and strong forces. Moreover, from the interpretation of the poly-metric, the existence of ordinary matter (fermions and bosons) as well as non-ordinary matter (virtual imaginary particles as well as stable neutral (heavy) lepton particles with rest mass) is postulated. It is shown that conservation principles need to be applied to the complete physical system containing both types of matter. Furthermore, it is argued that the re-interpretation of the general symmetry breaking mechanism leads to virtual particles of imaginary mass, which in turn, should be responsible for the conversion of electromagnetic into gravitational energy (ARC experiments). In section four, based on this conversion, the physical mechanism underlying the ARC experiments is discussed and comparison of *EHT* predictions and measured results are given. Arguments will be provided to ensure the consistency of the ARC measurements. The last section, based on the results of *EHT*, is dedicated to describe a novel experiment for the generation of a gravity-like field (acceleration field) that could serve directly as a propulsion principle, since the direction of the force should be along the axis of rotation of the disk (ring in ARC experiments) and not in the circumferential direction as is the case in the ARC experiments. Furthermore, the scaling of this experiment will be discussed and calculations will be given that show that a substantial force should be producible with current technology. In the *Conclusions* the validity and consistency of gravitomagnetic experiments performed is argued and their relation to the existence of six fundamental forces is debated. The widespread scientific and technological consequences of gravity-like fields in the general area of transportation (earthbound, air and space), physics as well as cosmology are also outlined. Finally, recommendations are made how the state of gravity-field like research could be advanced both theoretically and experimentally.

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I. Experimental and Theoretical Concepts of Novel Field Propulsion

THE current status of space propulsion is characterized by two contradicting scenarios. The first one, chemical propulsion delivers high thrust but for several minutes only at relatively low specific impulse, and is used today to lift heavy payloads from the surface of the Earth into nearby space (for instance LEO). The second one, electric and plasmadynamic propulsion, provides low thrust over longer periods of time (up to several months) at high specific impulse, and is employed in scientific interplanetary missions of long duration. Propulsion systems can be classified according to their physical principles as thermal propulsion systems or electromagnetic propulsion systems. Advanced versions of these systems are described in the recent book by Bruno et al.,[12] which means a linear extrapolation of present technology, envisaged to be realizable in 2020. Another class of advanced concepts using photonic propulsion, solar sails or laser propulsion, has been suggested. Comparing these advanced concepts with the space propulsion concepts discussed in the books by Seifert et al. (1959)[1] and Corliss (1960)[2] it becomes obvious that the physical principles of all of these concepts have been around for several decades, but with regard to performance no significant progress has been achieved. For instance, electric propulsion systems were already tested in the 1960s and so was nuclear propulsion. Chemical propulsion systems were never more powerful than in the 1960s.

The reason for this lack in progress is that physical laws pose strict limits on the practicality and the performance of even the most advanced propulsion systems. First, all systems considered so far operate on the basis of expulsion of mass and energy, i.e., have to obey classical momentum conservation. Hence, propellant needs to be provided. Second, the speed of light in vacuum is limited by special relativity, so interstellar travel in general will not be feasible. This, however, is not of concern at present, since our propulsion systems are delivering velocities of about 10 km/s.

A different type of advanced space propulsion concepts, based on more sophisticated physics, like space drives, warp drives, or gravity control are described in Davis and Millis (eds.)[3] . Nevertheless, these concepts are all utilizing one of the known four fundamental physical interactions, but, for instance, are making use of special properties of the spacetime metric of general relativity (*GR*), or try to exploit quantum entanglement for faster than light travel. Although these concepts have been known, too, in physics since the late 1930s, their engineering realization seems to be as unlikely today as it was at the time of their discovery.

On the other hand, current physics has no explanation for the existence of exactly four fundamental forces, that is, there is a belief only on the existence of four fundamental interactions[4] . The question therefore arises, are there any additional fundamental physical interactions? This question was already discussed in more detail in several papers, for instance,[5–9] . The novel physical ideas presented in these papers, termed Extended Heim Theory (*EHT*) [a] proposed by the authors since 2002, postulate the existence of **six fundamental forces**, *three gravitational forces* along with the known electromagnetic, weak, and strong forces. Beside Newtonian gravitation (graviton, attractive), *EHT* requires the existence of two additional gravitational fields, termed *gravitophoton interaction* (both attractive and repulsive), which results from the conversion of electromagnetic energy into gravitational energy, and *quintessence* (repulsive)[5–7] . The geometric approach and underlying physical concepts of *EHT* are briefly presented in Sec. **??**.

The question naturally arises about the physical relevance of theses ideas. Are there any, hitherto unknown, physical phenomena that might justify the existence of additional physical interactions? The answer seems to be affirmative. In March 2006, the European Space Agency (ESA), on their webpage, announced credible experimental results, reporting on the generation of both gravitomagnetic (termed frame dragging in *GR*, which, however, is too small to be measured in a laboratory on Earth) and gravity-like fields (acceleration field) performed at ARC Seibersdorf, Austria. Since then further experimental results have been published by Tajmar et al. from ARC[23–25] and, in July 2007, Graham et al. published a paper on the generation of a gravitomagnetic field produced by a cryogenic lead disk, but using a completely different measurement technique[26] . However, their results are not conclusive, see Table **??**, since the sensitivity of their ring laser gyro was about two orders of magnitude lower than for the gyro employed at ARC. Moreover, in 2008 Tajmar et al.[27] published a more comprehensive set of gravitomagnetic experiments. In Sec. **??**, *EHT* will be used to present a qualitative explanation for these results. Furthermore, in 2007 results of the NASA Stanford Gravity-Probe B (GP-B) experiment[10] became available, and *EHT* was used to model the gyro anomaly seen in this experiment as well as the acceleration and deceleration of the two gyro pairs[6] .

GR predicts that any rotating massive body (Earth) drags its local spacetime around, called the frame dragging effect, generating the so-called gravitomagnetic field. This effect, predicted by Lense and Thirring in 1918, however, is far too small to be seen in a laboratory on Earth. For this reason the Gravity-Probe B (GP-B) experiment was launched in 2004. On the other hand, the values measured by Tajmar et al. were about 18 orders of magnitude higher than predicted by *GR*, and therefore are outside *GR*. They cannot be explained by the classical frame-dragging effect

[a] *EHT* does not have (yet) reached the status of physical theory. It is a classification scheme to construct a poly-metric tensor that possibly encompasses all physical interactions.[6–8] At present, it is an approach to geometrize physics as envisaged by Einstein[11] and somewhat later by Heim[13] in 1952 as well as Finzi[21] in 1955 .

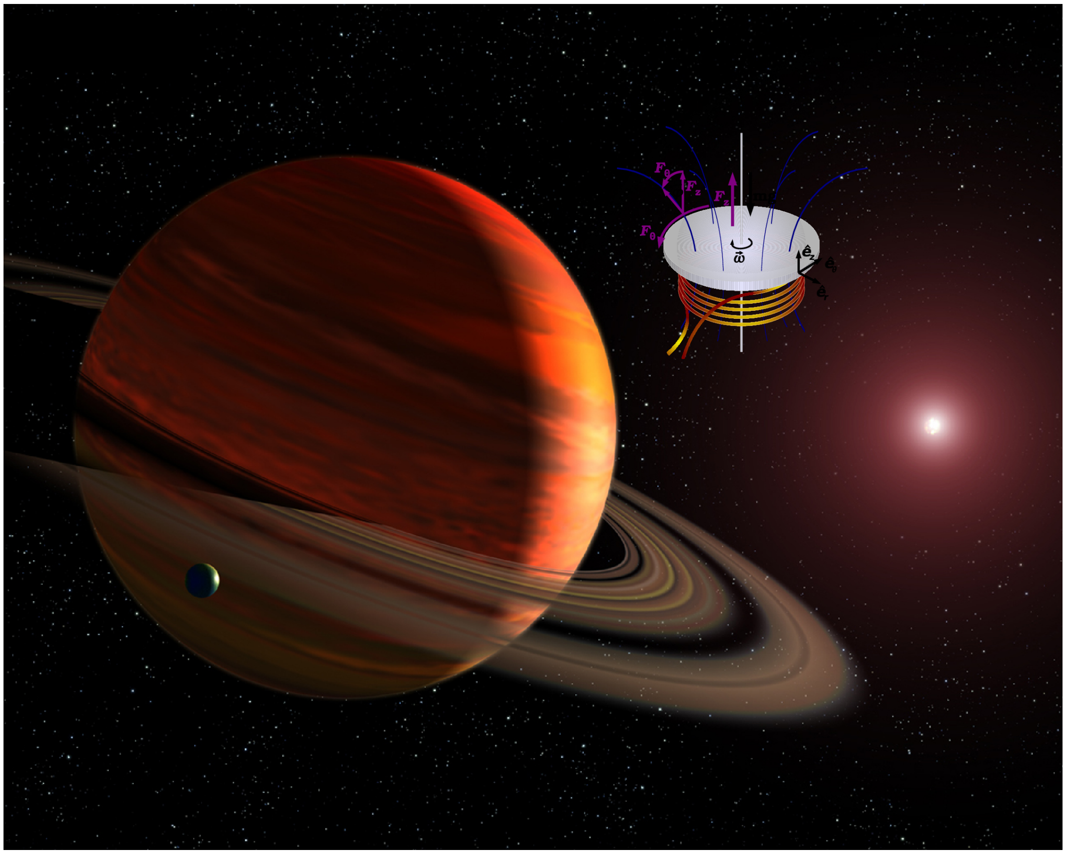

Figure 1. The picture shows one of the recently detected exoplanets (artist's impression) with a blueprint of the gravitational propulsion system (upper right) based on physical concepts of Extended Heim Theory.

of *GR* and represent a new kind of physical phenomenon. In other words, the *superconducting Nb ring, with a mass of about 100 grams, caused approximately the same gravitomagnetic effect as a white dwarf*[6] .

When analyzing the experiments by Tajmar et al. using *EHT*, it became clear that though the gravitomagnetic and gravity-like fields generated are large compared to the effects predicted by *GR*, they are quite small when compared to the forces needed for a space propulsion system. Also, since the gravity-like acceleration produced by the accelerated rotating ring lies in the plane of the ring in circumferential direction, it cannot be directly used to accelerate a space vehicle. To this end, a force along the axis of rotation is needed. Therefore, though the ARC experiments seem to predict *novel physics*, and thus are of *prime importance*, their relevance for a gravity-engineered technology may be less pronounced. For a space propulsion system, a novel experiment is mandatory, producing a *force in axial direction without requiring the ring to be accelerated*.

Since this novel effect only occurs at very low temperatures, it is surmised that a phase change takes place. In *EHT* it is postulated that this phase change is leading to a novel kind of (imaginary) virtual two-positron interaction (Boson coupling, Bose-Einstein Condensate). The physical mechanism of the experiments at ARC is presented in Sec. **??**.

Regarding the construction of an advanced propulsion device, an additional base experiment, according to *EHT*, might indeed be feasible, in which the gravity-like field is directed along the axis of rotation, and thus could provide a direct mechanism for a field propulsion principle working without propellant. In addition, it is argued that the experiment can be scaled such that a device can be constructed to lift a sizable mass from the surface of the Earth. In Sec. *EHT* will be employed to providing guidelines for the setup of this experiment. Based on considerations of *EHT*, the technical requirements like magnetic induction field strength, current density, and supply power are calculated. They should be feasible with present technology.

Naturally, such a propellantless propulsion system would be far superior over any existing propulsion technology, while its technology might be substantially simpler than the chemical, fission, or fusion rockets. There is, of course, insufficient knowledge at present to guarantee the realization of such a device.

II. Conclusions and Future Activities

Since 2002 ideas for a geometric approach of describing physical interactions, termed Extended Heim Theory (*EHT*), were published. This approach predicts six fundamental physical interactions, three gravitational fields, electromagnetism, and the weak and strong interactions[5,6,8,9] . Gravitation can be both attractive and repulsive. *EHT* also predicts the existence of virtual particles of imaginary mass, responsible for the conversion of electromagnetic energy into gravitational energy. In addition to the existence of ordinary matter (fermions and bosons), non-ordinary matter in the form of virtual particles of imaginary mass and stable neutral leptons should exist, which might be accountable for dark matter.

Numerous experiments by *Tajmar et al. at ARC Seibersdorf* carried out since 2003, and first published in 2006, report on the generation of gravitomagnetic and gravity-like fields in the laboratory. The *gravitomagnetic effects measured were about 18 orders of magnitude larger than predicted by the so called Lense-Thirring effect of GR*. In other words, the rotating niobium ring, having a mass of some 100 grams utilized by Tajmar, produces a frame dragging effect similar to the mass of a white dwarf[6] . These experiments were repeated by Graham et al.[26] in 2007, and more recently Tajmar et al.[25] provided a comparison between the two experiments. Provided that the experiments of Tajmar and Graham are correct, a similar effect should have been observed in the NASA-Stanford Gravity-Probe B experiment as was calculated in[5,6] . Indeed, a large gyro anomaly was observed.

On the theoretical side, *EHT*, was used to analyze these experiments and to also approximately predict the magnitude of the gyro misalignment by spin-spin interaction, caused by the generation of gravity-like fields acting between the gyros in each of the two gyro pairs. The GB-P experiment utilized two counterrotating pairs that exhibited an asymmetric misalignment depending on the direction of rotation. Theoretical predictions and measured misalignment were compared and gave reasonable agreement. It remains to be seen whether the electrostatic patch effect used to predict gyro misalignment by the Stanford team is capable to completely account for both the magnitude and the anomalies observed in the post-flight analysis. This anomaly should not be totally explainable by classical effects, i.e., electrostatic forces , etc. The Lense-Thirring (frame-dragging) effect exists exactly as predicted by *GR*. Hence, there is no room using a modification of the Lense-Thirring effect as an explanation for the observed gravitomagnetic fields. *The explanation must be sought outside GR and requires novel physics.*

In summary, the present situation is characterized by the fact that numerous experiments were performed over a period of four years, employing different measurement techniques, showing similar, but unexpected results. Measurement techniques in all experiments are clearly state of the art, in particular for the GP-B experiment. *This leads to the conclusion that there is experimental evidence for gravitomagnetic and gravity-like fields.*

In all experiments a phase transition seems to have occurred at low temperatures (not necessarily at T_C, the critical temperature for superconducting, but possibly boson interaction took place (virtual imaginary particles). *GR* cannot be used to explain these phenomena, even if the full nonlinear Einstein field equations were used. The Lageos and GP-B experiments have clearly demonstrated that the inertial frame dragging effect, even from celestial bodies, is extremely small and within *GR*. These facts provide evidence for *novel physics in the form of additional fundamental forces*.

How to proceed? The experiments performed so far serve as demonstrators for the existence of a novel physical effect. However, in order to produce a space propulsion system, the experiment of Sec. **??** needs to be carried out. Since the effect should be large enough to be detectable by relatively simple measuring equipment, in contrast to the experiments performed so far, which need extremely sensitive equipment to measure a small effect, and thus are susceptible to background noise. Moreover, an axial field might directly lead to some kind of gravity control.

Moreover, gravity-like fields most likely would lead to novel technologies in the general field of transportation, and thus should be of major interest to the public and, in particular, to industry. In addition, these fields might also be usable in energy generation.

The next step should therefore be to conduct the modified experiments as outlined in Sec.**??** in order to test whether the material (steel, MLI) shielding effect actually takes place as predicted by *EHT* for experiments B and C, see Figs.**??**. Most important, the axial gravity-like field experiment should be carried. Since, according to *EHT*, the effect should be easily measurable, much less sophisticated equipment than in current gravitomagnetic experiments could be employed, reducing both experimental difficulty and cost. The theoretical work should focus on a comprehensive and detailed study for determining the technical experimental details in order to realize the proposed axial field. Many theoretical questions remain, ranging from the formulation of a gauge theory, i.e., the state vectors representing the particles undergoing the six fundamental interactions. Such a gauge theory must originate from the symmetry of the state vectors in internal Heim space H^8 . Of even more practical importance would be the aspect of energy conversion from direct interaction between electromagnetism and gravitation or from employing gravity-like fields in nuclear fusion, for instance, in magnetic mirrors.

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