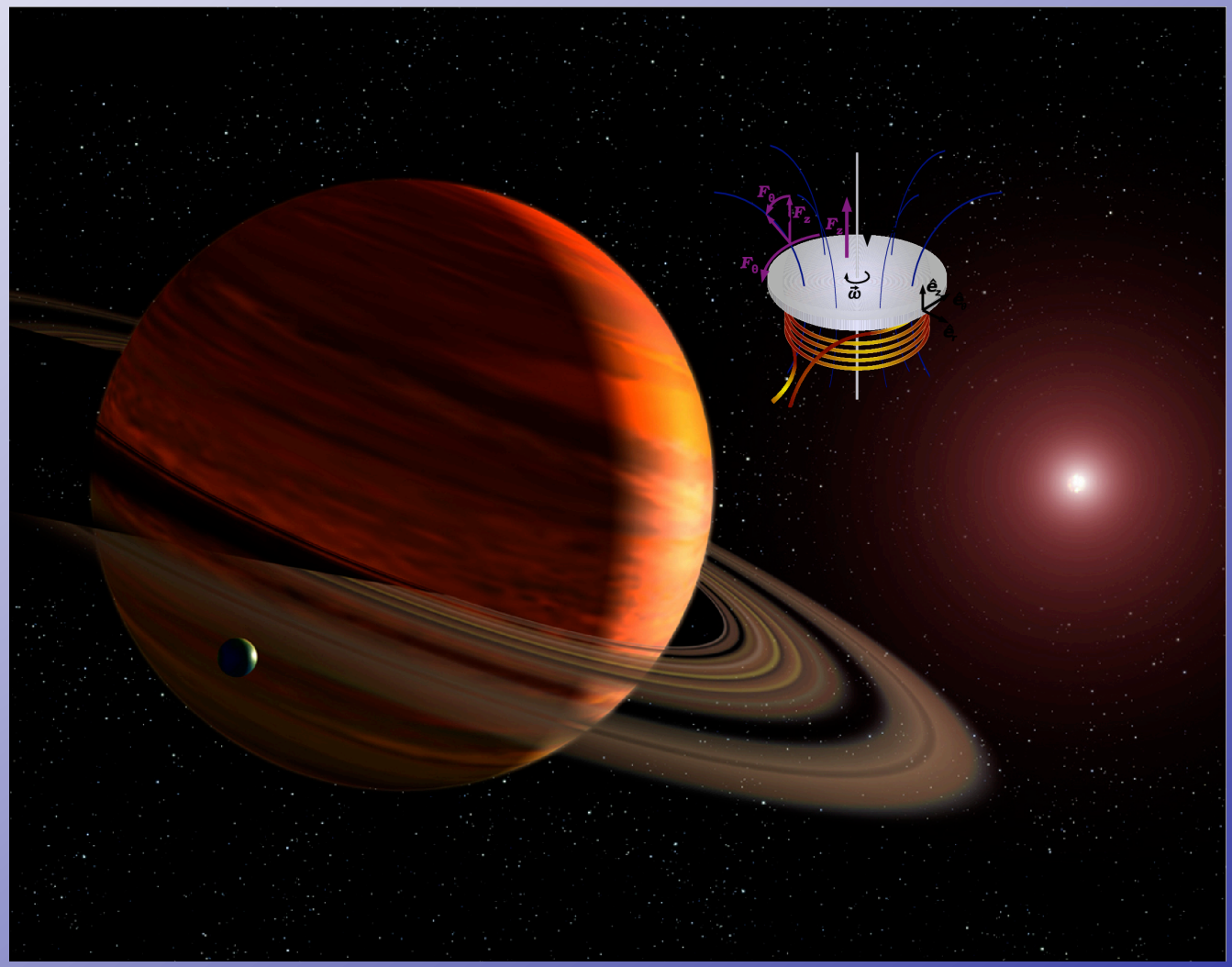
Physics of Propulsion from Gravity-Like Fields

New Paradigm for Air & Space Propulsion and Direct Energy Generation



Jochem Hauser, Walter Dröscher

ILT, DLR Hamburg-Harburg, 15 December 2011

HPCC-Space GmbH, Hamburg, Germany

Institut für Grenzgebiete der Wissenschaft , Innsbruck, Austria

Aerospace America
NFF Dec 2007
NFF Dec 2008

AIAA Papers
2002-2094
2003-4990
2004-3700
2005-4621
2006-4608
2007-5321
2008-5124
2009-5069
2010-3097
2011-6042

American
Institute of Physics
Feb 2005
Feb 2010

ESA-Launcher
2007 O-42

Intl Rev Aero Eng
April 2011
Jan/Feb 2012

Downloadable at
www.hpcc-space.com

Theory Experiment Technology

Propulsion by Novel Force Fields Needed

Recently found planet in habitable zone mass 2.4 x Earth

Kepler22b

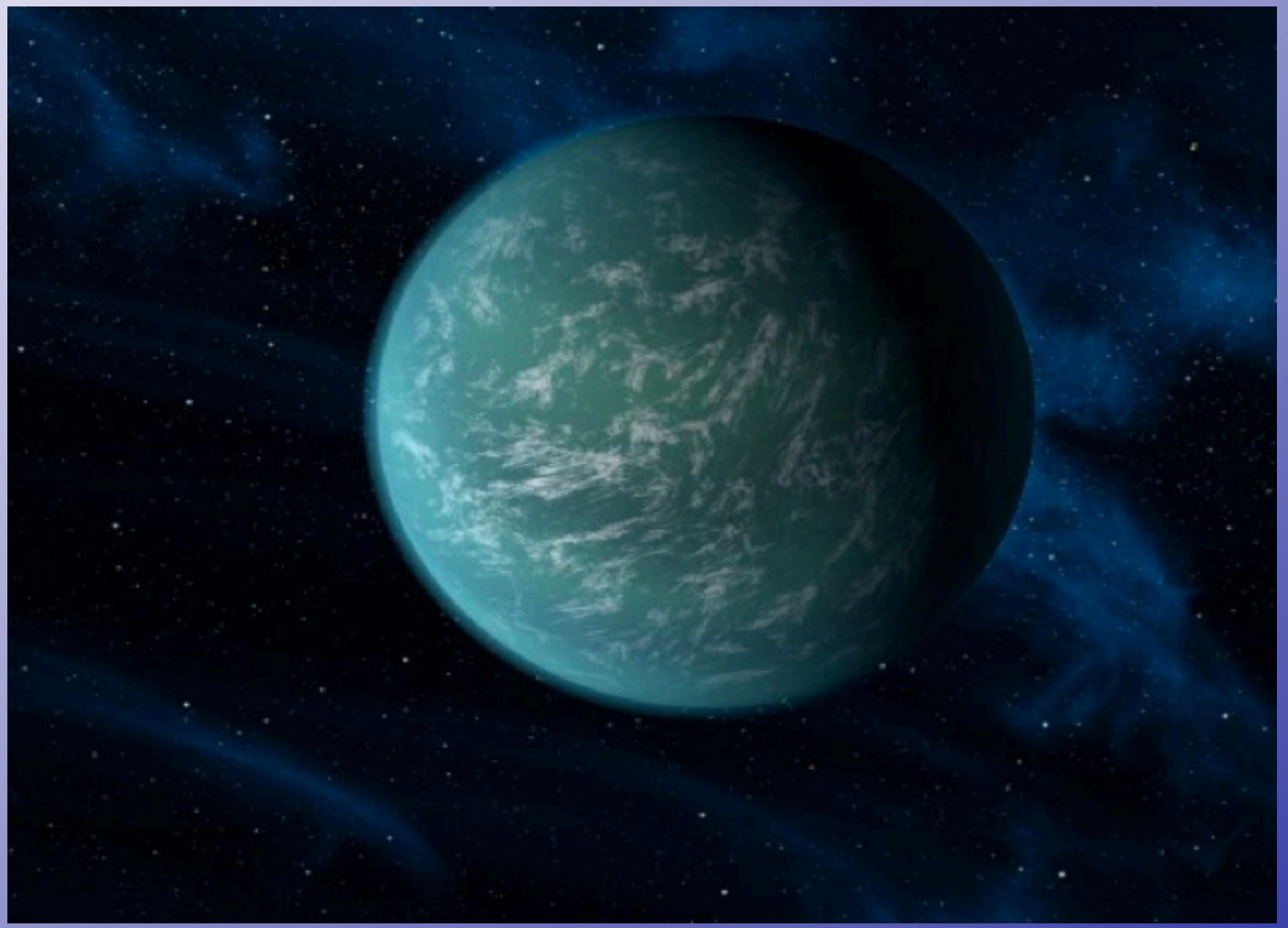
600 Ly from Earth

How could one fly to this planet if it were Earth-like?

Corliss 1960, McGraw Hill Propulsion Sytems for Space Flight: Chapter 9

Proppulsion systems using

novel long range force fields



Theory of Novel Force Fields → *Experiment* → *Technology*

Wanted: Proplellantless Propulsion

Recent Propulsion Buzzwords

Game Changing

Breakthrough in Propulsion

Visionary Aerospace Architecture

Advanced and Innovative Aerospace Technologies

Revolution in Physics not in Engineering needed

Novel physical forces of long range

must exist in Nature

Novel Physical Interactions Needed

Current Status of Space 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*.

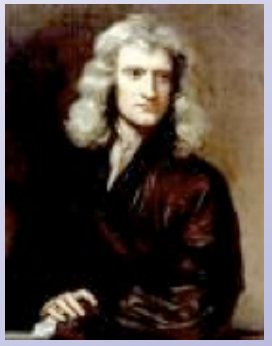
Another class of advanced concepts using photonic propulsion, solar sails, or laser propulsion has been suggested.

Comparing these advanced concepts with the space propulsion concepts discussed in the books by* Seifert et al. 1958 Space Technology *and* Corliss 1960 Space Propulsion *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.

Seifert, H. (ed.).: *Space Technology*, Wiley 1959, Corliss, W.R. : *Propulsion Systems for Space Flight*, Chaps. McGrawHill, 1960

Current Status of Space Propulsion

Limits imposed by Classical Physics

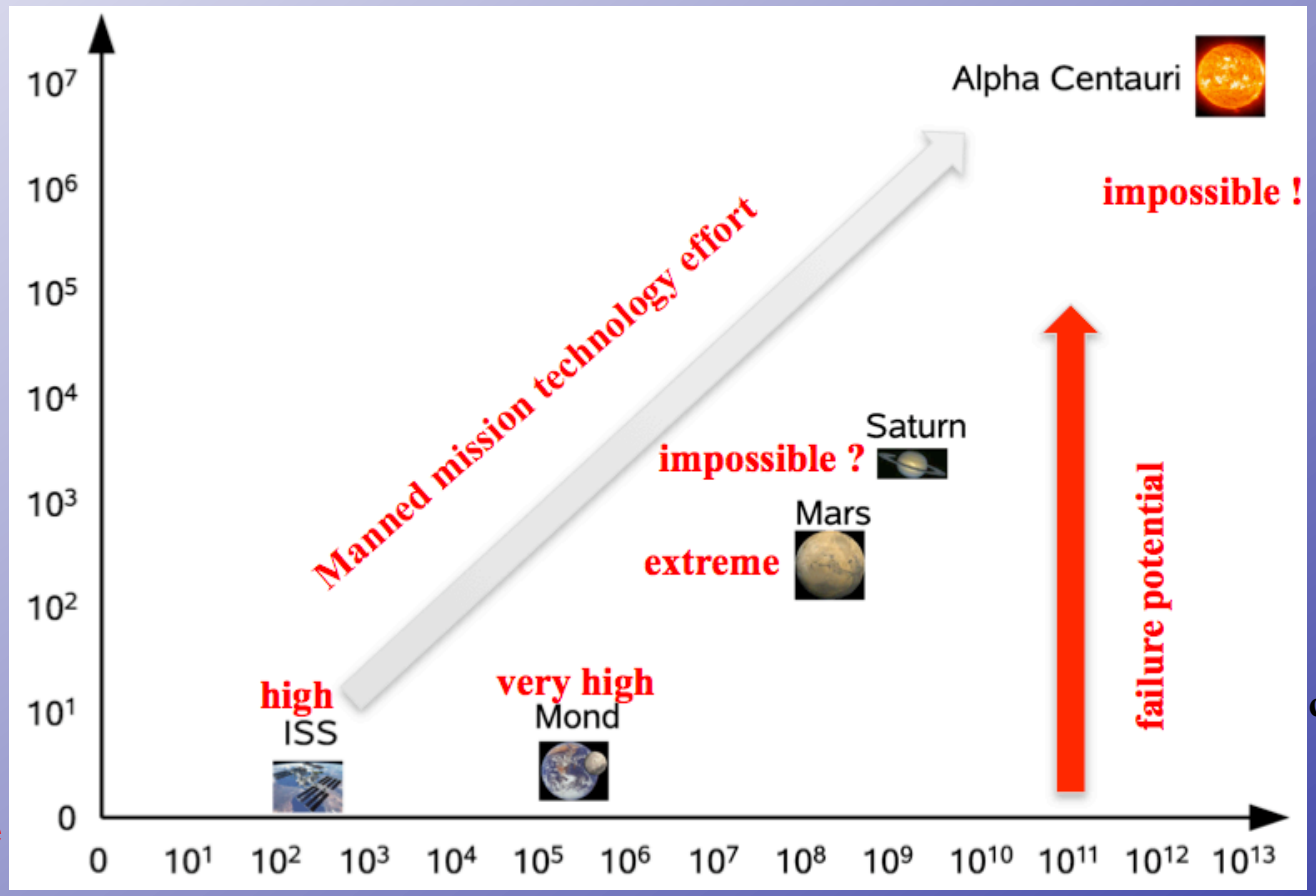


Isaac Newton

Newton‘s laws

fuel

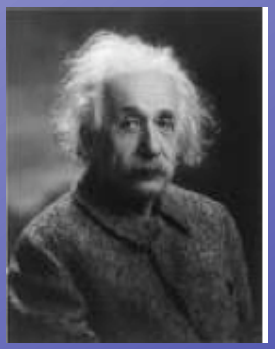
All current space propulsion systems are based on the *conservation of momentum according to Newton‘s law* (1687). Hence all propulsion systems need fuel. Rockets can reach velocities of up to 10 km/s.



New

Physics

Limits imposed by Special Relativity



Albert Einstein

c = 300,000 km/s

According to Einstein‘s SR (1905) the vacuum speed of light, 300,000 km/s, is the maximum propagation speed in the Universe. Hence, space travel to other stars is impossible according to current physics.

Summary and Conclusions for Current Status of Space Propulsion

1. Current space propulsion technology costly, unsafe, severely limited

2. Advanced concepts physically not impossible, but technically *totally unfeasible*, but wormholes etc. ruled out by recent CDT

3. Going back to the Moon under the foreseen budget with current technology seems to be *highly unfeasible* (Augustine Report 2009)

The reason for this stalling is

RISK AVERSION OF LARGE SPACE AGENCIES AND INDUSTRY

The four fundamental forces of current physics do not allow for an efficient propulsion system

No propulsion breakthrough achievable with current physical laws

Spaceflight will remain severely limited unless

novel physical laws need to be found

this might have been the case ?!

Introduction to the Physics of Extreme Gravitomagnetic Fields

Gravity in the form of Newtonian gravity is the weakest of the four known fundamental forces, though there is no proof for the existence of exactly four fundamental interactions. In 2006 Tajmar et al. reported on the measurements of extreme gravitomagnetic fields from small Nb rings at cryogenic temperatures that are about 18 orders of magnitude larger than gravitomagnetic fields obtained from GR (general relativity). Cifuolini in 2006 and the NASA-Stanford Gravity Probe-B experiment in Dec 2008 confirmed the Lense-Thirring effect as predicted by GR (gravitomagnetic fields generated by a rotating massive body, i.e. Earth) within some 10%-15%. In 2007 gravitomagnetic fields generated by a rotating cryogenic lead disk were measured by Graham et al. 2007. Though these measurements were not conclusive (the accuracy of the laser gyroscope was not sufficient to produce a standard deviation small enough) their experiment seems to have seen the same phenomenon reported earlier by Tajmar et al., termed parity violation. This means that gravitomagnetic fields produced by the cryogenic rotating ring or disk vary substantially and change sign for clockwise and counter-clockwise directions of rotation. The experimental situation therefore occurs to be contradictory. On the one hand GR has been confirmed while at the same time, there seems to be experimental evidence for the existence of extreme gravitomagnetic fields that cannot be generated by the movement of large masses. Moreover McGaugh Feb 2011 has experiments that clearly contradict GR. If these experiments can be confirmed, they give a clear indication for the existence of additional gravitational fields of non-Newtonian nature. As was shown by the GP-B experiment, measuring gravitomagnetic fields from GR poses extreme difficulties. In GP-B overall measuring time was about 10 months and the mass of the Earth acted as a test body. In contrast, Tajmar et al. measure for a few seconds only and the mass of the ring is some 400 g. Their gravitomagnetic field generated is equivalent to that of a white dwarf. Therefore a novel physical mechanism should exist for the generation of gravity-like fields, which might also provide the key to gravitational engineering similar to electromagnetic technology. Furthermore, gravity-like fields may be the long sought enabling technology for space propulsion without fuel. In addition, a combination of axial gravity-like fields and magnetic induction field might stabilize the plasma of a magnetic mirror.

Experiments with Gravity-Like Fields

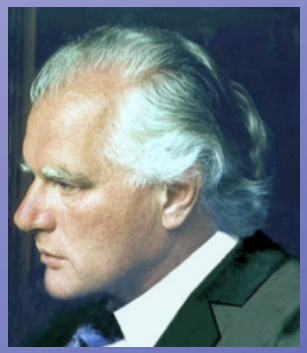
Martin Tajmar, AIT, Austria

GF experiments 2006-2011

Graham et. al. New Zealand, 2007

NASA-Stanford, Gravity-Probe B, 2008

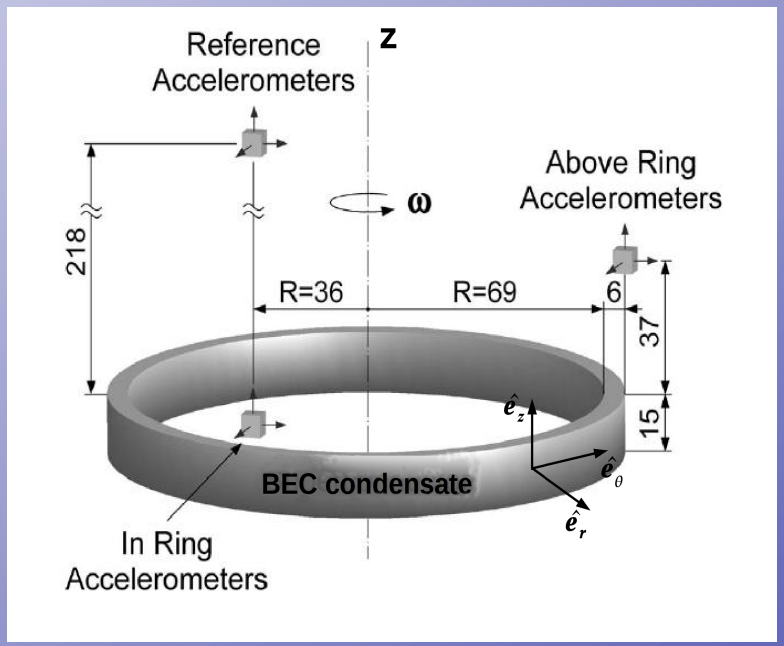
Theory of Gravity-Like Fields

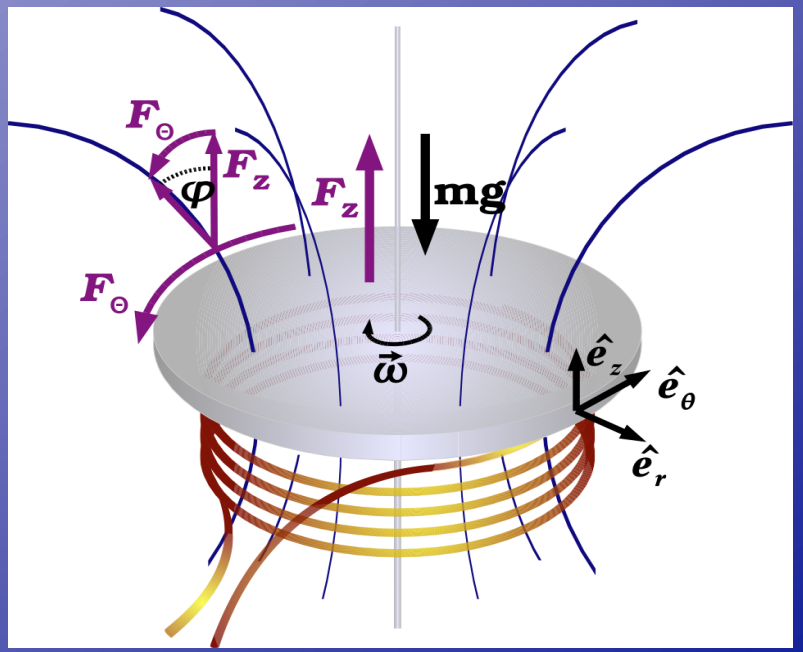


Burkhard Heim, geometrization of physics, 1952

B. Finzi, Italian mathematician, 1955

Walter Dröscher, Jochem Hauser, EHT, since 2002





Novel Physical Interactions Required

1. Gravitomagnetic phenomena cannot be explained by any of the four known physical interactions. **Therefore, the existence of at least one additional long range physical interaction is required.**

2. Moreover, in all experiments that produced a gravitomagnetic field, a strong asymmetry concerning the direction of rotation of the ring or disk (that is, clockwise or counter-clockwise) has been observed.

3. From the experiments it is clear, that these fields are gravity-like. This means that gravitational effects can be produced other than by the accumulation of large masses.

4. The existence of one or two additional physical interactions also demands the existence of one or two messenger particles (like the photon for electrodynamics), which must be bosons. These messenger particles are the carriers of the interactions. Since the fields observed are long range, the rest mass of these particles should be zero.

Physical Model (EHT) of
Extreme Gravitomagnetic and Gravity-Like Fields

A. Einstein 1915

Gravity is Geometry in Continuous Spacetime

The Mono-Metric Tensor of GR

H. Weyl 1918*: gauge space, connections in an internal space*

Weyl, H.: *Space, Time, and Matter*, Dover, 1950

8D Internal Symmetry (Heim) Space H^8

The Poly-Metric Tensor of EHT
15 + 1 Hermetry Forms
6 Fundamental Forces

Two Decay Channels for Gravitophotons

Symmetrybreaking or Not ?

Types of matter: which particles do exist in the Universe: OM and NOM

The 4D Hypercube of all Existing Matter: Particles and Field Quanta

Einstein 1915
Gravity is Geometry in Continuous Spacetime
Einstein's Quest

Einstein, A.: *On the Generalized Theory of Gravitation*, Scientific American, April 1950, Vol 182, NO.4

All Physical Interactions are of Geometrical Origin

EHT (Extended Heim Theory, 2002)

(EHT renamed PMT actually a collection of physical concepts)

Six Fundamental Interactions:
Three gravitational fields (attractive and repulsive)
EM, weak and strong

Experiments by Tajmar et al. at AIT since 2006
Experimental Generation of
Extreme Gravitomagnetic and Gravity-Like Fields !?

Physical Coordinates and Potentials in 8D Internal Symmetry (Heim) Space H^8

To each point in spacetime (*external*), there exists an *internal* symmetry space H^8 comprising subspaces R^3 T^1 S^2 I^2 of coordinates (potentials φ_α), corresponds to the nonlinear-σ model, originally from Gell-Mann,

Jost. J: *Geometry and Physics*, Springer 2009

This concept is similar to gauge theory, but the internal degrees of freedom are not given to particles but to spacetime fields, represented by *Hermetry* forms constructed from the poly-metric tensor (PMT) g_{ik}. There is the O(8,q) group describing all families of bosons and fermions.

1. R^3, **mass (spatial) coordinates O(3,q), 15 generators or families of particles, q= Quaternions, for all fermions and bosons, which in turn, each are described by their proper O(8,q) groups.**

2. T^1, **charges (time) coordinate, O(1,q), 1 generator, inertia field**

3. S^2, **organization (entelechial and aeonic), 6 generators coordinates (order) O(2,q), 6 Higgs fields (matter), EM, and weak**

4. I^2, **information coordinates O(2,q), 6 generators (charge fields)**

Six Fundamntal Forces : Three Gravitatioanl Forces

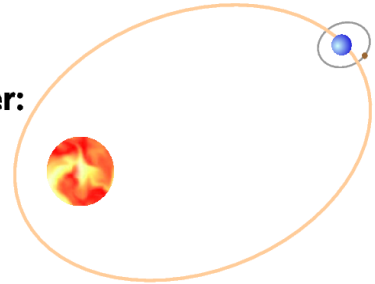
Gravitation

Graviton $H_1(S^2)$: ν_g
attractive +

$G_g = 6.671 \times 10^{-11}\ Nm^2/kg^2$

Ordinary matter:

Solar System
Galaxies
Black holes



Gravitation

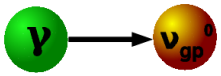
Gravitophoton $H_9(S^2 \times I^2)$: $\nu_{gp}{}^0$
attractive +, repulsive -

$G_{gp} = 1/67^2\ G_g$

Coupling of
Electromagnetism - Gravitation

Non-Ordinary Matter

Dark Matter

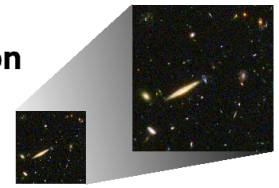


Gravitation

Quintessence $H_{10}(I^2)$: ν_q
repulsive -

$G_q = 4.3565 \times 10^{-18}\ G_g$

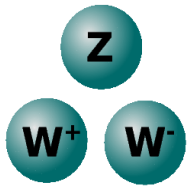
Dark energy
Cosmic acceleration



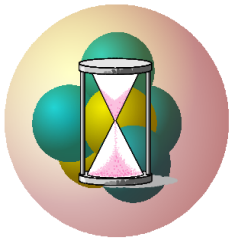
Weak

Bosons
$H_3(R^3 \times S^2 \times I^2)$:

$H_4(R^3 \times T^1 \times S^2 \times I^2)$:

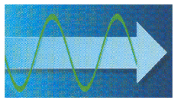


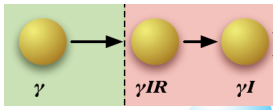
Neutron decay
Beta decay
Neutrino interaction
Stellar fusion

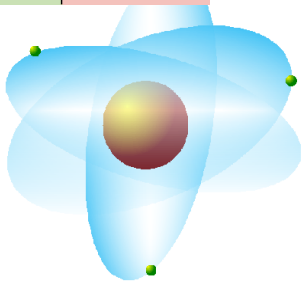


Electromagnetic

Photon $H_2(T^1 \times S^2 \times I^2)$: γ



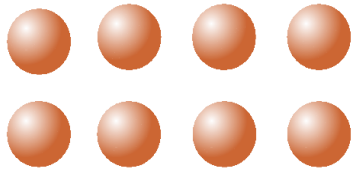




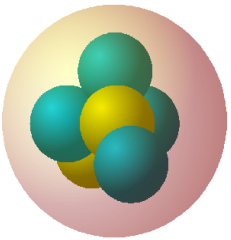
Atoms
Light
Chemistry
Electronics

Strong

Gluons $H_5(R^3 \times I^2)$: g



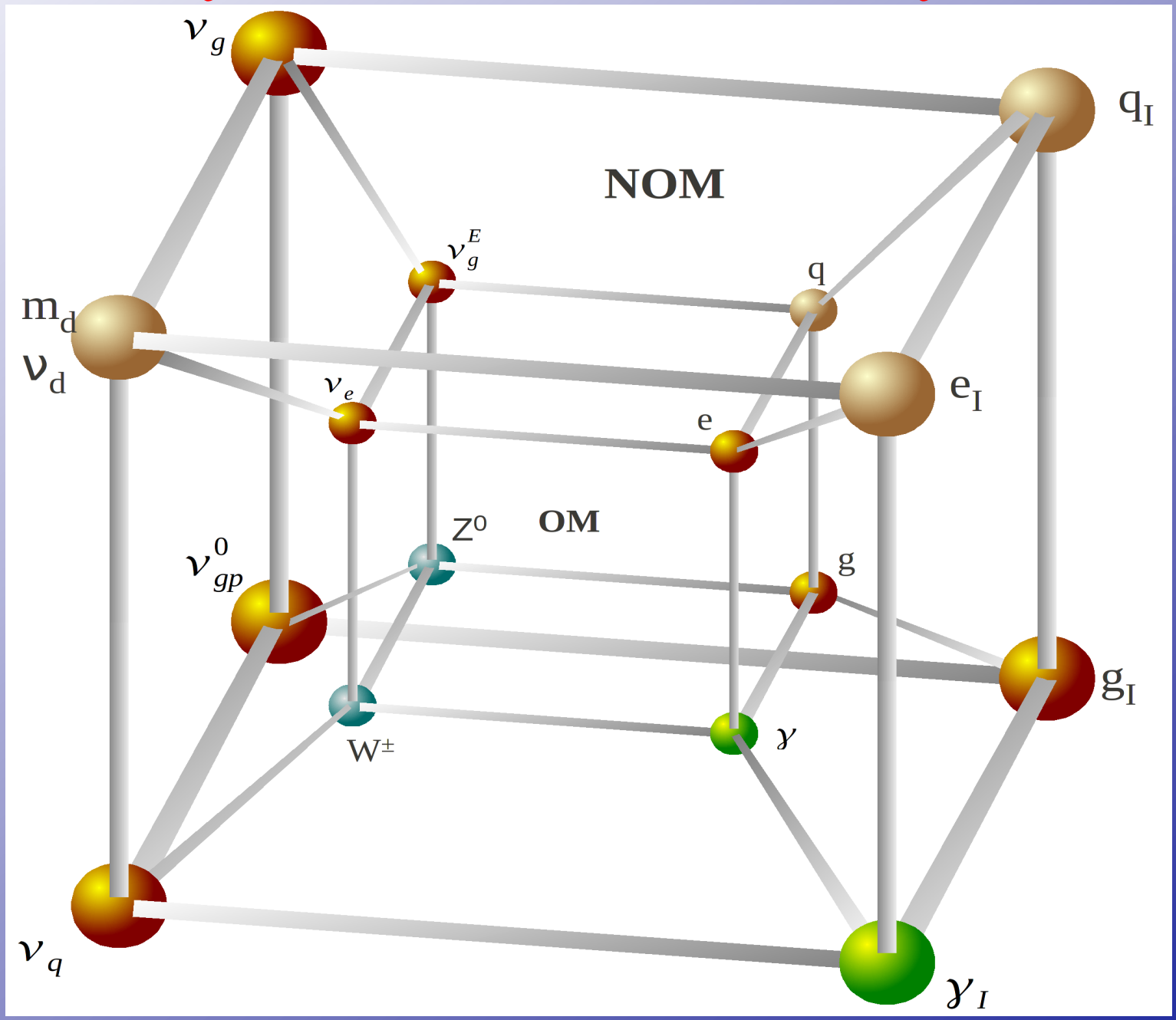
Quarks
Baryons
Mesons
Nuclei



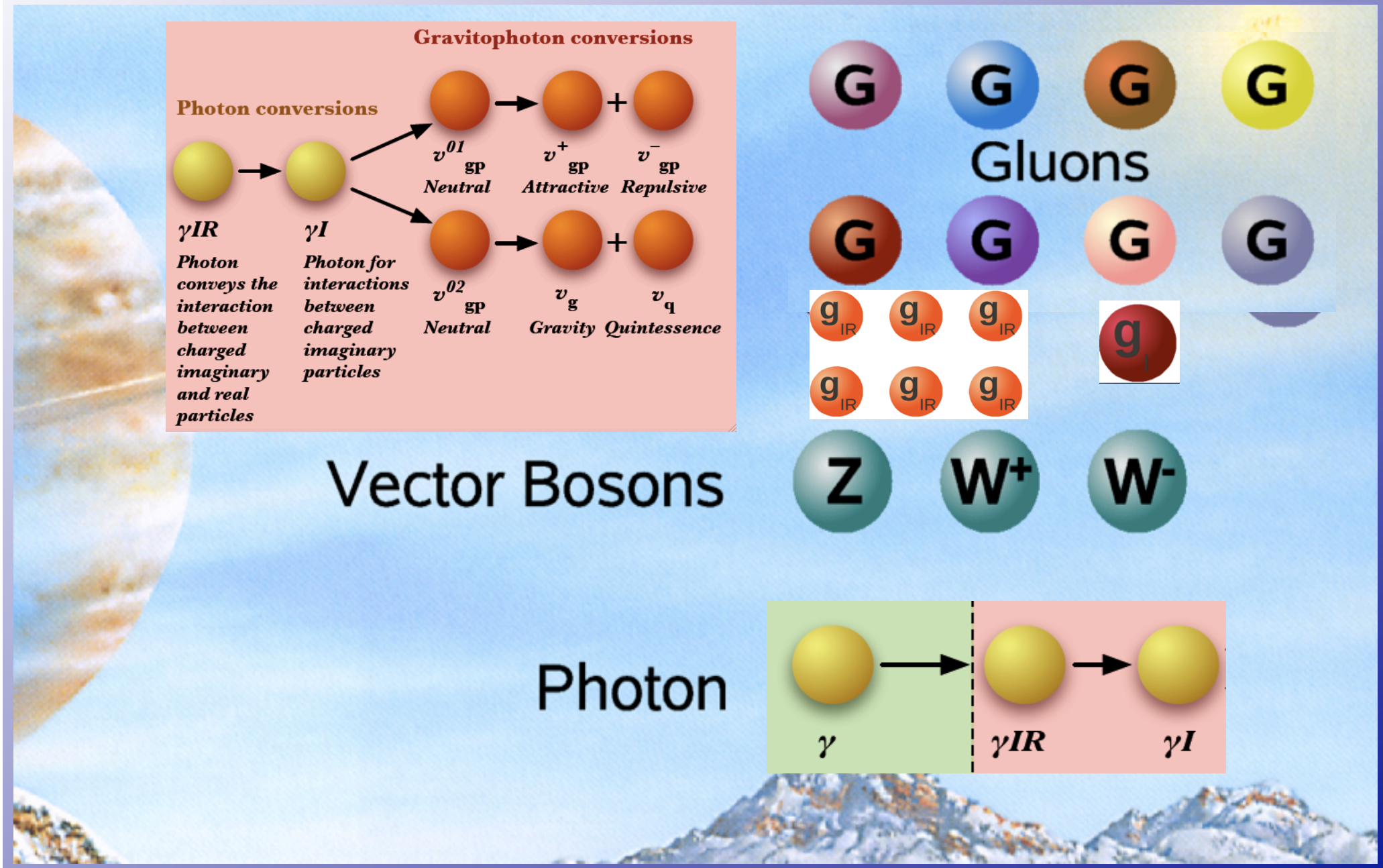
Ordinary and Non-Ordinary Matter

Particle

Families



Gauge Particles in EHT



Conservation Principles Revisited

All Conservation Principles Apply To a Closed Physical System

What is the concept of physical system for gravity-like field interaction ?

Suppose a boat is in the middle of a large lake or ocean. In order to set the boat in motion, a force must be mediated to the boat. The classical momentum principle requires that a person in the boat is throwing, for instance, bricks in the opposite direction to push the boat forward. However, everybody is well aware of the fact that there is a much better propulsion mechanism available. Instead of loading the boat with bricks, it is supplied with sculls, and by rowing strongly the boat can be kept moving as long as rowing continues. The important point is that the **medium itself is being utilized**, *i.e.*, the water of the lake or ocean, which amounts to a completely **different physical mechanism**. The rower transfers a tiny amount of momentum to the medium, but the boat experiences a substantial amount of momentum to make it move. For space propulsion **the medium is spacetime** itself. Thus, if momentum can be transferred to spacetime by field propulsion, a repulsive or recoil force would be acting on the space vehicle moving it through the medium, like a rowing boat. The medium, spacetime, is a physical quantity, namely a field, and if properly quantized, the respective particles mediating forces should also be present. Thus, in principle, spacetime should have the capability to interact with a space vehicle. If this effect somehow can be experimentally established, the principles of momentum and energy conservation require that the combined system, *i.e.*, both spacetime and space vehicle, are considered. According to *EHT*, this actually is the physical mechanism occurring in the experiments by Tajmar *et al.* (2006, 2008) and Graham *et al.* (2007) Important to note, this mechanism does not extract momentum from the spacetime field and transfers it to the space vehicle. Instead, an active process has to be triggered for the creation of gravito-photons, i.e., first generating a strong gravitomagnetic field, $\mathbf{B}_{gp}$. Second, in order to produce the gravity-like field seen in the experiments at AIT, experimental conditions have to be such that the $\mathbf{B}_{gp}$ field can decay, producing gravitons and quintessence particles.

See ***Corliss, 1960, McGrawHill: Chapter 9*** ***Propulsion Systems Using Natural Force Fields*****: need to exchange momentum with the primary reference frame through the use or alteration of these naturally occurring forces.**

Conservation principles need to be applied to both OM and NOM

The important point is that in this scheme not only gravitons exist, but also gravito-photons as well as quintessence particles. The important fact is that in the generation of the gravitomagnetic force via the decay of the gravito-photon, *as is assumed to be the case in the gravity-like experiments by Tajmar et al.* (2006, 2008), both the *OM* (**graviton**, negative gravitational energy density) and *NOM* (**quintessence particle** positive gravitational energy density) are generated, see Figure 3. The total energy in the generation of these two particles is therefore zero. *Gravitons interact with the space vehicle*, i.e. they are absorbed by the space vehicle, while the *quintessence particles are reabsorbed by spacetime itself.* This effect causes an acceleration of the space vehicle, while the momentum of the quintessence particle is not felt by the space vehicle, but by the surrounding **spacetime and leads to its expansion**, because of the repulsive force, and thus total momentum is being conserved. This effect is most likely too small to be observed, but this kind of space propulsion should contribute to the expansion of the *Universe*. In the same way the momentum change of the ocean would not be discernible from the presence of a rowing boat. Perhaps a local disturbance of spacetime might be measurable in the experiments by Tajmar *et al*. (2008)?

Gravitomagnetic and Gravity-Like Field Experiments

In some articles published in the popular press it has been suggested that the research published by Li and Torr may explain the results reported by Podkletnov and Nieminen. It is in these experiments that the weight of a body suspended above a rotating superconductor was reduced by about 1%. It is clear from the calculations of Harris that B_G *and* E_G *are too small by some* 20 orders of magnitude to account for such a reduction.

All earlier experimental work on a novel fifth force (Fischbach 1986) or gravity shielding turned out to be incorrect or non-reproducible (Podkletnov, 1996)

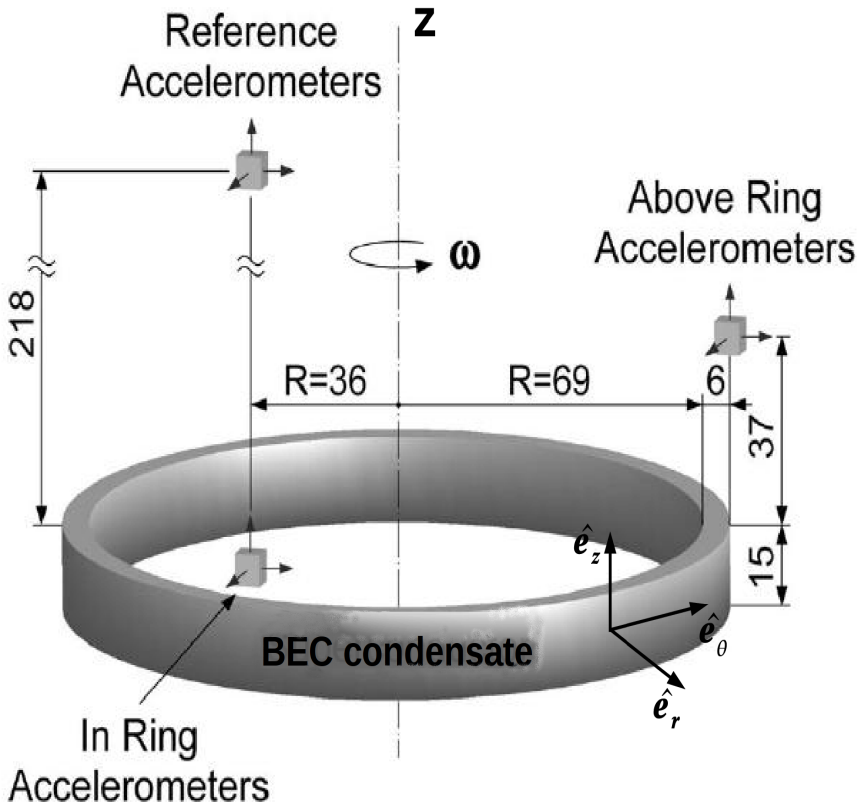
The Power of the Ring

Gravitomagnetic Field Generated 18 Orders of Magnitude Larger than Predicted by GR

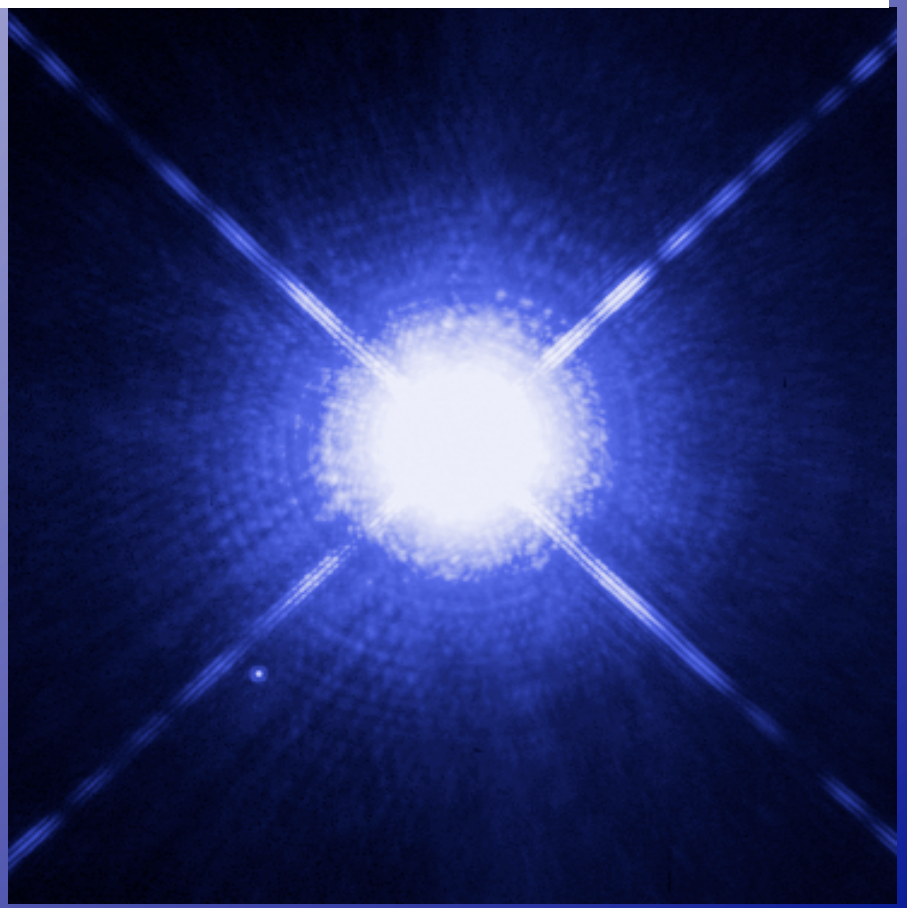
Nb ring, cryogenic, rotating:1.5 x 10^{-1} m , 10^{-1} kg, 450 rad/s (EHT + Tajmar experiments)

White dwarf: 6 x 10^{6} m, 10^{30} kg, 1 solar mass, 200 km/s (GR, Lense-Thirring)

$$\mathbf{B}_g^{Nb} = \frac{3}{5}\,20\pi\,\frac{1}{\sqrt{\alpha_{gp}}}\,\frac{G}{c^2}\,\frac{m_e}{m_p}\,(\rho_{Nb}A_{Nb}+\rho_{Al}A_{Al})\omega = 1.18\times10^{-5}\text{rad s}^{-1}$$



$$\mathbf{B}_g^{WD} = \frac{2}{5}m_{WD}R_{WD}^2\,\frac{2G}{c^2}\,\frac{1}{R_{WD}^3}\,\omega_{WD} = 6.63\times10^{-6}\text{rad s}^{-1}$$



Comparison Theory (EHT) with Gravitomagnetic Experiments

Gravity-Like Experiment	*Theoretical Value*	*Experimental Values*
1. Tajmar et al. B_{gp}/ω	$4.1 \times 10{-}8$	$3 \times 10{-}8$ **and** $5.7 \times 10{-}8$
2. Graham et al. B_{gp}/ω	$35.0 \times 10{-}8$	$37.7 \times 10{-}8$
3. Anomalous Spindrift (GP-B) Ω_{max} Ω_{min}	$3.5 arc\ sec/day/deg$ $0.7 arc\ sec/day/deg$	$3.7 arc\ sec/day/deg$ $0.2 arc\ sec/day/deg$
4. Tangential Acceleration (Tajmar) g_{gp}/ω	$-8.0 \times 10^{-9} \mathbf{grad}^{-1}\mathbf{s}^2$	$-7.2 \times 10^{-9} grad^{-1} s^2$
5. Tangential Acceleration (GP-B) B_{gp}/ω	$\pm 0.8 m/s$	$\pm 1.0 m/s$

Conclusions from Recent Experiments (December2011): Physical Theories that most likely are ruled out

Quantum Theory

1. **LHC has not found any particles up to 700 GeV***: no string theory, no super symmetry, no M theory: no 10 or 11 dimensions, no multiverse, etc.*
2. **ESA Integral satellite:** *no polarization dependence of gamma ray bursts on frequency no quantum gravity*
3. **LHC and ESA Integral:** *no multiple universes: 10^{500} universes do not exist*
4. **LHC and ESA Integral:** *no 9 or 10 spatial dimensions*
5. **CDT computer simulation by Loll&Ambjorn***: only 4D spacetime, spherical topology of spacetime, no wormholes, no warped space*

There is the possibility that all major concepts of the so called leading particle theories have been mathematical exercises only and may be relegated to history.

General Relativity

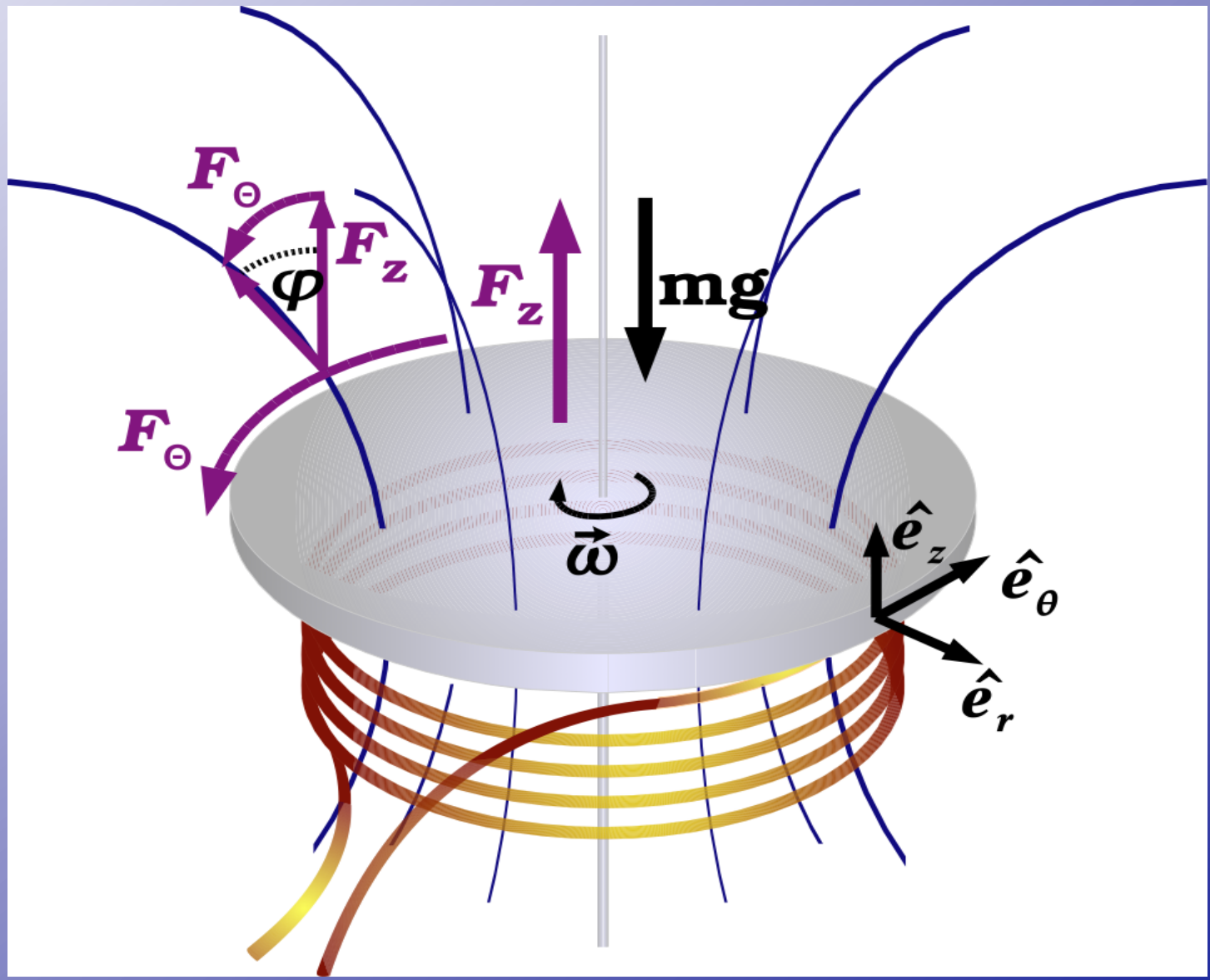
1. **Tajmar et al:** *extreme gravitomagnetic fields may be producible in the laboratory*
2. **Ciufolini, Reyes:** *GR is confirmed experimentally on cosmological scale*
3. **McGaugh:** *GR does not explain orbiting velocities of stars around center of galaxies*

Fundamental contradiction between gravitational experiments.

Current Research Status of Gravity-Like Fields?

- **Currently favored string theory only knows four fundamental interactions:** *No additional gravitational interactions, no gravity-like fields*
- **Alternative theory (EHT) and Tajmar effect:** *Gravity may be more complex, requiring six fundamental interactions*
- *Proof by E.G. Harris: General relativity cannot provide the extreme gravoitomagnetic fields observed by Tajmar (Graham) and perhaps in GP-B.*
- **There should be three gravitational fields both attractive and repulsive.**
- **A conversion from electromagnetic into gravitomagnetic fields may be possible at a phase (Cooper pairs not responsible for the Tajmar effect).**
- **Gravitational interaction between a material body and spacetime, i.e. interchange of momentum and energy takes place, which is the basic principle of** ***propellantless propulsion.***
- *More experimental evidence needed to overrule the established picture of four fundamental interactions*
- *There are several theoretical predictions coming from the postulated six fundamental forces that can be tested with current technology that have substantial technological consequences*
- *Potential for major novel technical applications with regard to transportation and energy generation by new theoretical concepts*

Novel Experiment to Generate Vertical Gravity-Like Force Field



Vertical Gravity-like (Acceleration) Field

$$\mathbf{g}_g = \frac{0.328}{1.18}\alpha_g^2 \mathbf{v} \times \mathbf{B}_{gp}^{+} = \frac{0.328}{1.18}\alpha\alpha_{gp}\alpha_g^3 \frac{4\pi^2 m_e}{3m_p}\frac{\rho_D}{\rho_{0D}}\frac{h_D}{h_{0D}} N \frac{A_C}{A_{0C}}\frac{v^2}{c}\omega_I \tag{22}$$

where the factor α_g^2 comes from the two conversions, namely $\mathbf{B}_{gp}^{+} \rightarrow \mathbf{B}_g$ and $\mathbf{B}_g \rightarrow \mathbf{g}_g$. Since $\alpha\alpha_{gp}\alpha_g^3 \sim \frac{\alpha^2}{\alpha^3}$ a multiplication with the form factors of the α terms of Eq. 10 takes place. Quantities h_D and h_{0D} denote the respective penetration depths of the $\mathbf{B}_{gp}$ field with respect to the disk or ring. The ratio $\frac{h_D}{h_{0D}} \sim 1$ and $h_{0D} = \frac{\hbar}{m_e c_I} \approx 9 \times 10^{-3}$ m and c_I is the propagation speed of the electrons of imaginary mass in the disk. This would mean that gravitophotons in analogy to photons of a superconductor would gain mass.

As an example for a laboratory experiment to producing a sizable axial field a disk of $d = 0.2m$ diameter together with the following parameters is used: $\frac{m_e}{m_p} = \frac{1}{1836}$, $\frac{\rho_D}{\rho_{0D}} = 0.19$, $\frac{h_D}{h_{0D}} = 1$, where ρ_{0D} and h_{0D} are reference density and reference penetration depth for the disk or ring, and $N = 50$ is the number of turns of the coil. A value of $A_C/A_{0C} = 5$ is chosen, where A_C and A_{0C} are the cross section and the so called reference cross section of the coil, respectively. The circumferential speed of the disk is $v = 50$ m s^{-1} and $\omega_I = 7.5 \times 10^5 \text{s}^{-1}$. Inserting these values results in

$$g_g = \frac{0.328}{1.18}\frac{1}{137} \times \frac{1}{212} \times 67^3 \times \frac{13.16}{1836} \times 0.19 \times 50 \times 5 \times \frac{2.5 \times 10^3}{3 \times 10^8} \times 7.5 \times 10^5 \times \frac{1}{9.81} g = \mathbf{0.62}g \tag{23}$$

where g denotes the acceleration of the *Earth*. This value denotes a fairly strong acceleration given the modest technical requirements for the experiment. For the limit of the real current I_L one finds

$$I < I_L = \frac{2\pi R}{\mu_0}\left(\frac{A_C}{A_{0C}}\right)\frac{4\pi^2 m_e}{e}\omega_I \approx 416\, A. \tag{24}$$

Moyer, M: *Fusion's False Dawn*, Scientific American, March 2010

Direct Energy Generation

Fusion of hydrogen isotopes :
Deuterium -Tritium: started out in the 1950s, T = 150 million degrees
1 gallon of deuterium infused water = 1 supertanker of oil
He is the end product

However, a reactor needed, *NOT* an ignition facility

Engineering problems: Plasma instability, materials need to withstand high T, high-energy particles, breeding of tritium fuel neeeded, constant operation (years)

Most likely these problems cannot be solved with magnetic fields only

NIF: National Ignition Facility is an enormous laser, $ 4-billion (U.S.)

ITER: fusion from magnetic fields : Tokamak (donut shaped geometry), $ 14-billion (under construction, Cadarache, France)

misleading figure: 500 MW does not mean anything: for how long? this is power, not energy

Magnetic Mirror with Gravity-like Fields ?

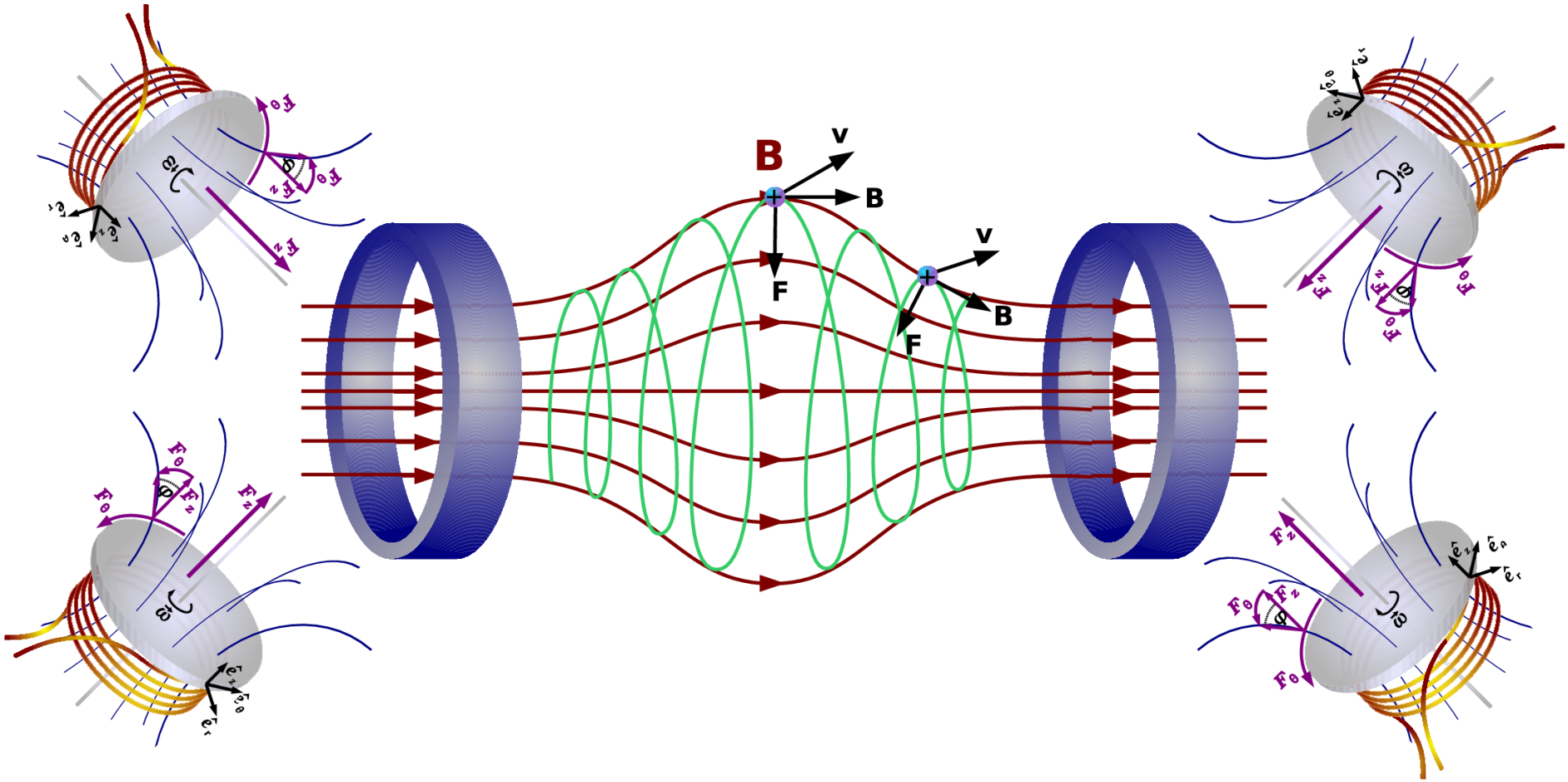
Novel Fusion Device

Linear geometry, *much simpler* than Tokamak

Disadvantage: Plasma is leaking at the ends, cannot be closed by magnetic fields

But a combination of magnetic and gravity-like fields may be able to do the job

Comprehensive computer simulations needed



Consequences for Physics and Technology

- **Recent experiments by Tajmar et al. *dramatic change*: perhaps for the first time *artificial gravitational fields* were generated in the laboratory.**
  However, there is a caveat: G-L Field is in plane of ring only.
  Vertical gravity-like field is needed (Heim experiment).

- **Novel physical theory predicts *six fundamental interactions*, gravitation can be both attractive and repulsive. *EHT was used to anlayze the Tajmar, Graham and Gravity-Probe B experiments and seems to confirm the experimental results.***

- ***Physics: The group of the standard model* SU(3) x SU(2) x SU(1) *may have to be replaced by* O(8,q) = O(3,q) x O(2,q) x O(2,q) x O(1,q) *with q denoting the field of quaternions and 15, 6, 6, 1 generators. Internal Heim space* $H^8 = R^3 \times T^1 \times S^2 \times I^2$ *subspace structure. Interaction between electromagnetism and gravitation.***

- **Technology: gravitational engineering, see the recent book by**
  G. Daigle*: Gravity 2.0 Designing with Gravity-like Fields*, 2011, 226 pp.

- ***EHT proposes an experiment to generate an G-L Field for propellantless propulsion.* It should be possible to lift a spacecraft for the surface of the earth with gravito-magnetic propulsion. This experiment is not more difficult than Tajmar's experiments.**

- **Can we break the *Light Barrier*? Not in our spacetime, but possibly in hyperspace.**

Future Research and Technology Activities

1. *GM and G-L Fs (Gravity-Like Fields) seem to have been generated in the lab with relatively low technical effort (2006, 2007, 2008, 2009 Tajmar et al.)*
   - **Independent confirmation (?) of Tajmar's experiments (Graham, July 2007)**
   - **Comprehensive program of G-L F experimental work on larger scales, improved accuracy etc., Gravity-Probe B might have been impacted by large gravitomagnetic fields**
2. *Theoretical analysis (EHT) seems to qualitatively confirm Tajmar's and Graham's experimental findings on GM and G-L Fs*
   - **Research program on the *Physics of Extreme Gravity-Like Fields***
   - **Feasibility study for vertical gravity-like field demonstrator experiment**
   - **Research program for gravity-like field technology (propulsion, transportation)**
   - **Research Program for green energy generation by gravity-like fields**
   - **Materials science research for gravity-like fields**
   - **Many open questions remain: scalability, materials, spacetime fields, origin of matter, existence of hyperspace ?**
3. *Theoretical-Experimental Program*
   - **Joint research program to devise experiment for vertical force**
   - **Joint research feasibility study how to construct and build propellantless propulsion device**
   - **Investigate gravity-like force for energy production purposes (generators, fusion)**

References

1. NFFTC: *Nuclear and Future Flight Propulsion, Year in Review* , Aerospace America, December 2008.
2. NFFTC: *Nuclear and Future Flight Propulsion, Year in Review*, Aerospace America, December 2007.
3. Hauser,J., W. Dröscher: *Emerging Physics for Novel Field Propulsion Science,* to be published by American Institute of Physics, 2010, 18 pp.
4. Dröscher, W., J. Hauser*: Gravity-Like Fields and Space Propulsion Concepts*, AIAA 2008-5124, 44th AIAA/ASME/SAE/ASE, Joint Propulsion Conference & Exhibit, Hartford, CT, 20-23 July 2008, 19 pp. 7
5. Dröscher,W., J. Hauser: *Current Research in Gravito-Magnetic Space Propulsion*, Paper O-42, 7th International Symposium on Launcher Technologies, 2-5 April 2007, Barcelona, Spain, 16 pp. 8
6. Dröscher,W., J. Hauser: *Advanced Propulsion Systems from Artificial Gravitational Fields*, AIAA 2007-5595, 43th AIAA/ASME/SAE/ASE, Joint Propulsion Conference & Exhibit, Cincinnati, OH, 8-11 July 2007, 15 pp.
7. Dröscher,W., J. Hauser: *Spacetime Physics and Advanced Propulsion Concepts*, AIAA 2006-4608, 42nd AIAA/ASME/SAE/ASE, Joint Propulsion Conference & Exhibit, Sacramento, CA, 9-12 July 2006, 20 pp., (available as revised extended version 20 August 2006 at www.hpcc-space.de).
8. Heim, B.: *Vorschlag eines Weges einer einheitlichen Beschreibung der Elementarteilchen*, Zeitschrift für Naturforschung, 32a, 1977, pp. 233-243.
9. Woods C. et al.: *Gravity Modification by High Temperature Superconductors*, AIAA 2001-3363, 37 th AIAA/ASME /SAE/ASE, Joint Propulsion Conference & Exhibit, Salt Lake City, Utah, 8-11 July 2001.
10. M. Tajmar et al.: *Experimental Detection of the Gravitomagnetic London Moment*, http://arxiv.org/abs/gr-qc/0603033, 2006.
11. M. Tajmar et al.: *Measurement of Gravitomagnetic and Acceleration Fields Around Rotating Superconductors*, STAIF AIP, February 2007.
12. M. Tajmar et al.: *Search for Frame Dragging in the Vicinity of Spinning Superconductors*, http://arxiv.org/abs/0707.3806v5, 14 September 2007, 14 pp. Note: This paper contains a comparison with the measurements by R.D. Graham et al. and also with the Stanford-NASA Gravity Probe B experiment. 27 R.
13. D. Graham et al.: *Experiment to Detect Frame Dragging in a Lead Superconductor*, www2.phys.canterbury.ac.nz/ phys- rin/papers/SuperFrameDragging2007.pdf), 6 July 2007, 11 pp.
14. M. Tajmar et al.: *Anomalous Fiber Optic Gyroscope Signals Observed Above Spinning Rings at Low Temperature*, http://arxiv.org/abs/gr-qc/0603033, June 2008.
15. Kahn, R. (prepared by): *Gravity Probe B Final Report*, Stanford University, http://einstein.staanford.edu/content/final_report/GPB_Final_NASAReport-020509-web.pdf, 31 Dec. 2008.
16. M. Tajmar.: *Homopolar artificial gravity generator based on frame dargging*, Acta Astonautica (2009) doi: 10.1016/j.actaastro.2009.10.22, 5 pp.
17. M. Tajmar. F. Plecescu: *Fiber Optic Gyroscope Measurements Close to Rotating Liquid Helium,* to be published by American Institute of Physics, 2010, 6 pp.

References

18. Tajmar, M. et al.: *Evaluation of enhanced frame-dragging in the vicinity of a rotating niobium superconductor, liquid helium and a helium superfluid*, Supercond. IOP Publsihing, Sci. Tech- nol. 24 (2011) 125011 (9 pp).
19. Millis, M.G., E. W. Davis (eds): *Frontiers in Propulsion Science*, AIAA, 2009.
20. Van Flanderen, T.: *The Speed of Gravity: What the Experiments Say*, Physics Letters A 250:1-11, 1998.
21. Adam K. et al.: *Measurement of the neutrino velocity with the OPERA detector in the CNGS beam*, arXiv: 1109.4897[hep-ex] 20 September and 17 November 2011.
22. Cohen, A.G., S.L. Glashow: *New Constraints on Neutrino Velocities*, arXiv:1109.4897[hep-ex] 29 Septem- ber 2011.
23. McGaugh, S.S.: *A Novel Test of the Modified Newtonian Dynamics with Gas Rich Galaxies*, arXiv 1102.3913v1 [astro-ph.CO] 18 Feb 2011.