Future Space Propulsion Based on Heim's Field Theory

AIAA 2003-4990

AIAA Paper
2002-2094
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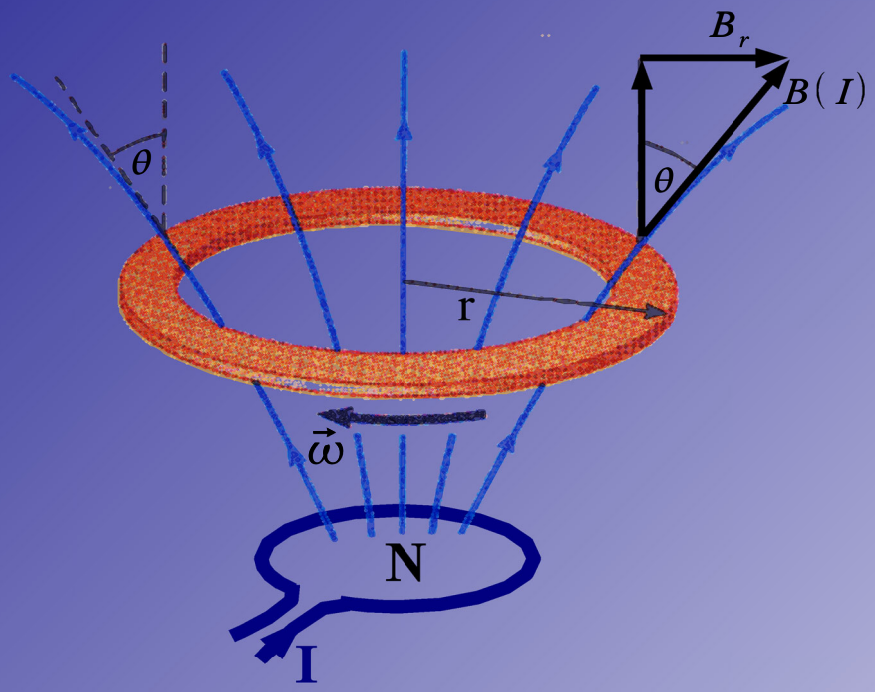

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presented at the 39th AIAA Propulsion Conference,

von Braun Center, Huntsville, Alabama

20-23 July 2003

Acknowledgments

The authors are grateful to Prof. Dr. Dr. A. Resch, Director of the Institute of Grenzgebiete der Wissenschaften, Leopold-Franzens Univ. Innsbruck, Austria for providing access to Heim's legacy and his hospitality.

The authors are grateful to Prof. Dr. T. Waldeer for numerous discussions, and T. Gollnick and O. Rybatzki, Univ. of Applied Sciences, Salzgitter, Germany for producing some of the figures.

This research was partly funded by the ministry of Science and Culture of the State of Lower Saxony, Germany.

Now is the time to take longer strides
time for a great new American enterprise
time for this nation to take a clearly leading role in space achievement,
which in many ways may hold the key to our future on earth[1]

President Kennedy's message to the congress on May 25, 1961

[1]**It does not seem that the old Europe currently has any vision of space**

Presentation Overview

Space Visionaries and Space Transportation
Physical Ideas of Heim's Unified Field Theory
Cosmogony of Space and Matter
Gravitophoton Force for Space Propulsion
Experimental Setup for Gravitophoton Force
Interplanetary and Interstellar Missions
Conclusions and Future Work

NASA's Breakthrough Physics Propulsion Program Goals

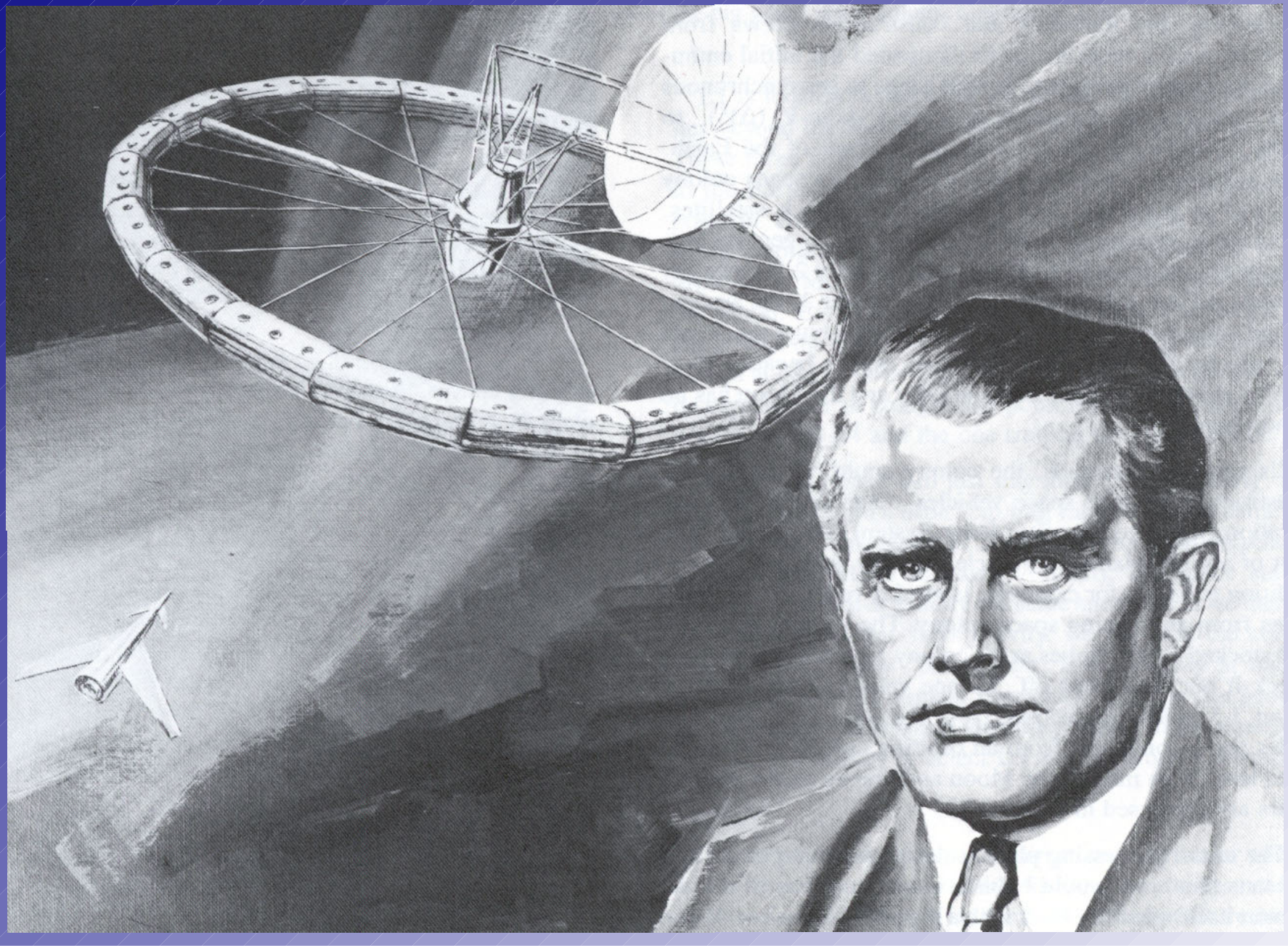
by Marc G. Millis et al., NASA Glenn Research Center

- no fuel,
- superluminal speed, **and**
- no excessive amounts of energy

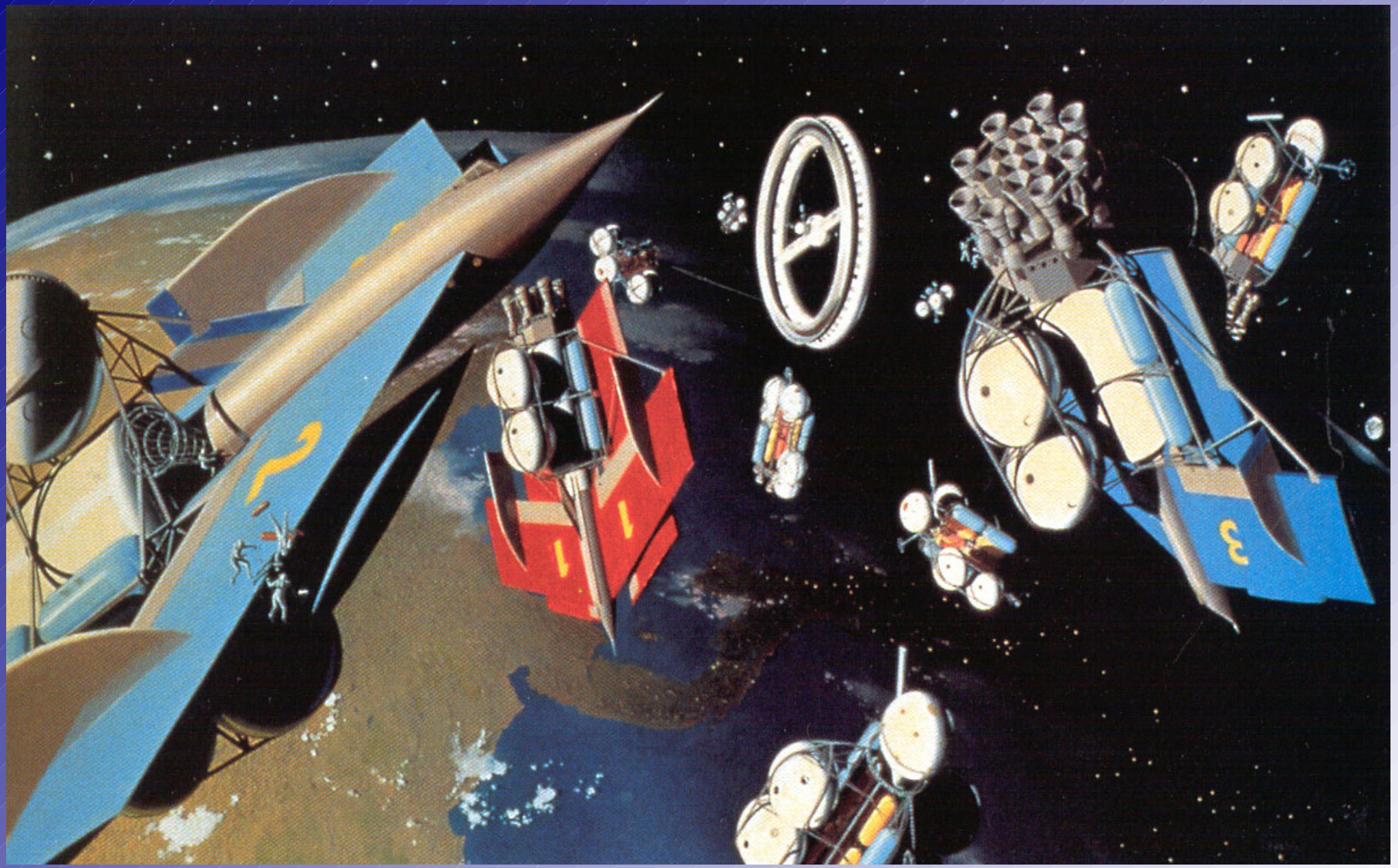
needed for a revolutionary space propulsion system
might be met by
Heim's Unified Field Theory

Space Visionaries and Space Transportation

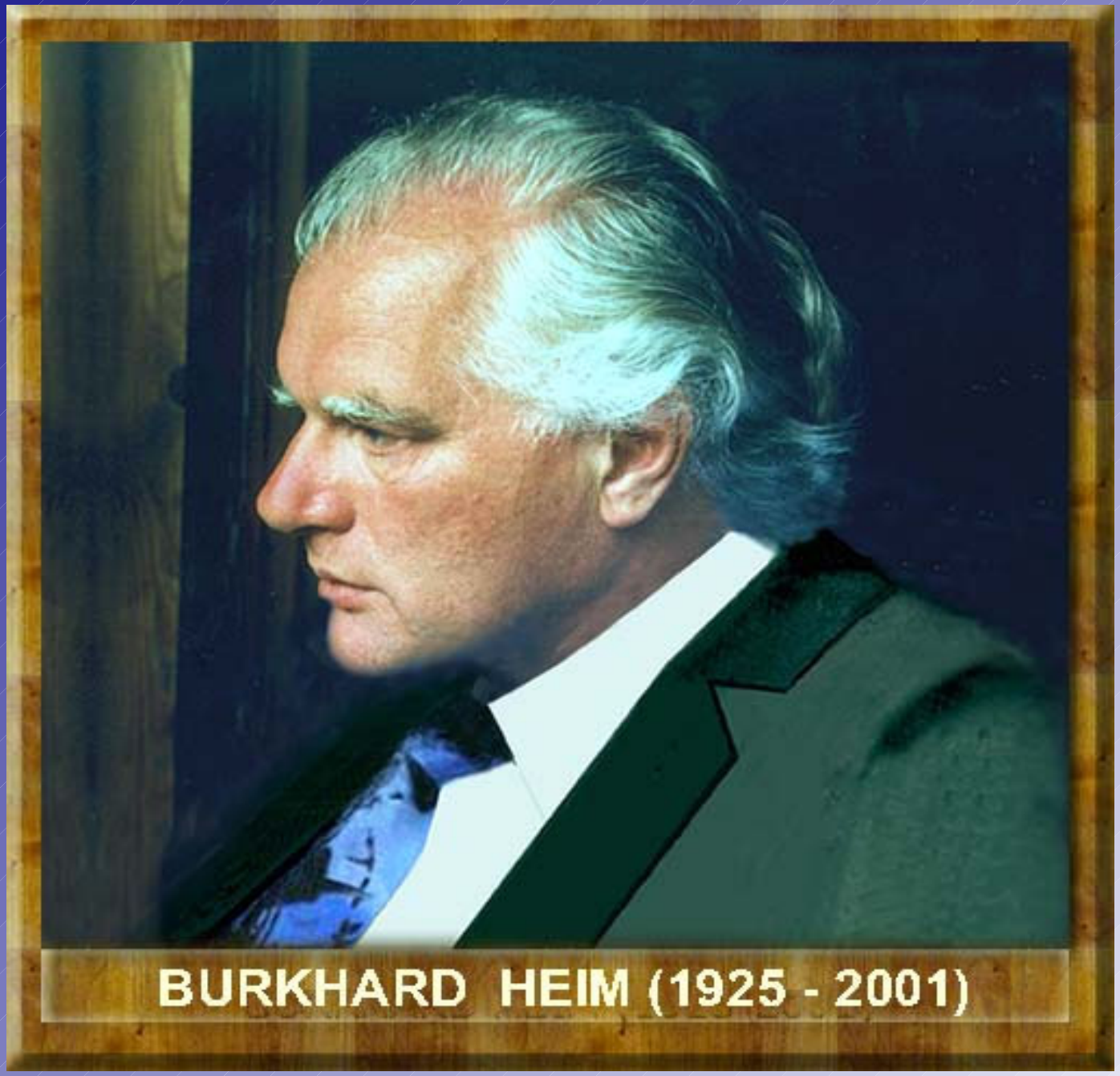
Space Transportation Originator



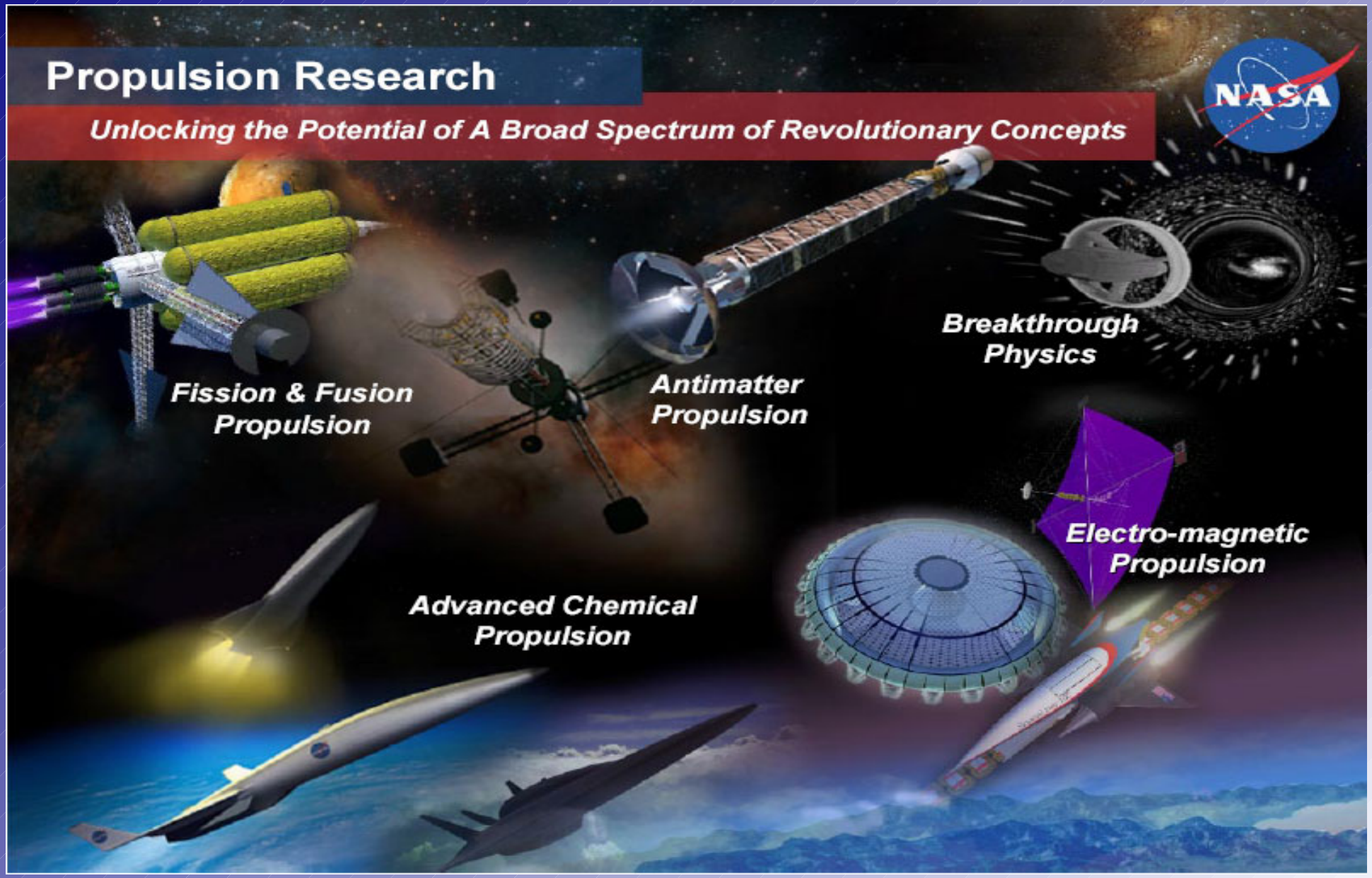
von Braun's Vision of Space Flight



Space Transportation Revolutionary?

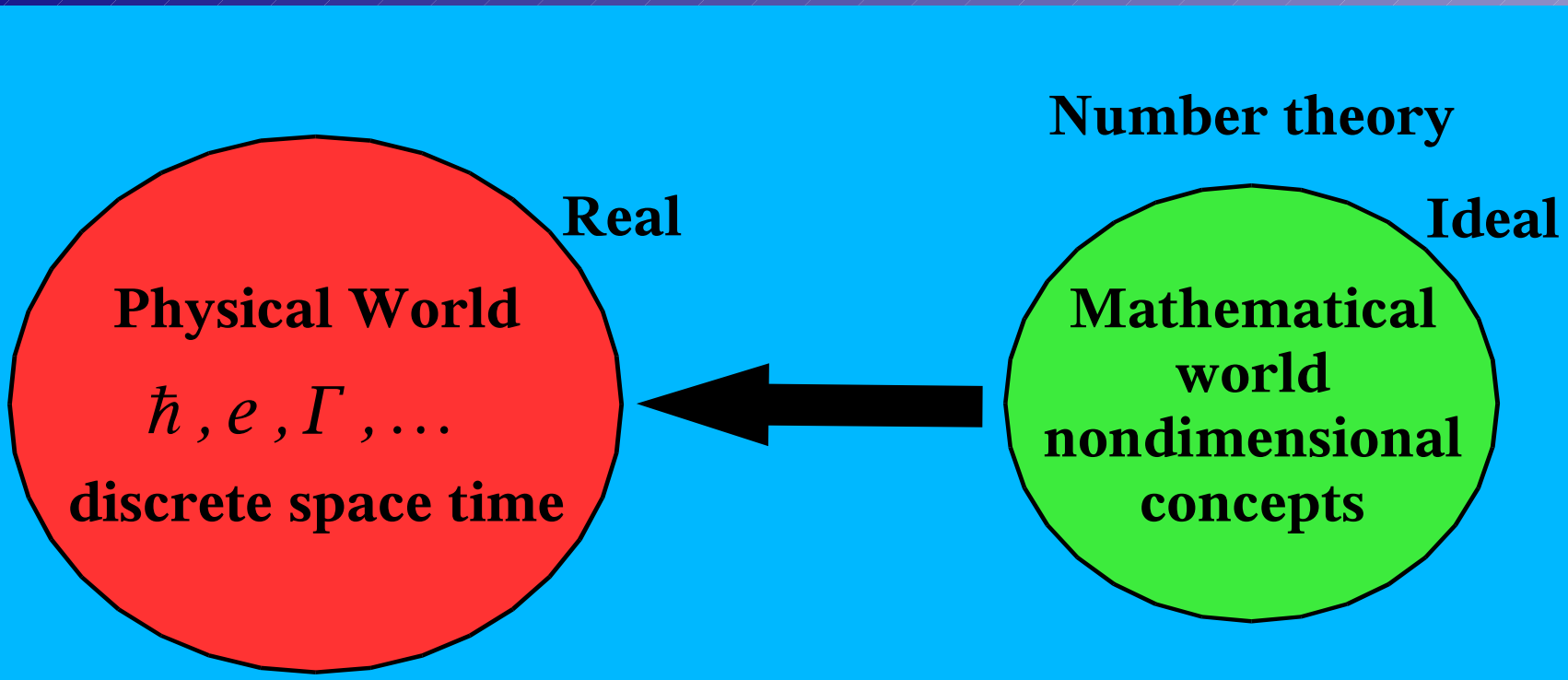


Space Transportation Breakthrough



Physical Ideas of Heim's Unified Field Theory

From the Mathematical to the Physical World



Heim:

1. From dimensionless constants of the mathematical world to the physical world.

2. From the diameter of the primeval universe, all physical constants can be derived.

Heim's Discrete 8-Dimensional Space

Continuous Space Time
4D (Einstein)

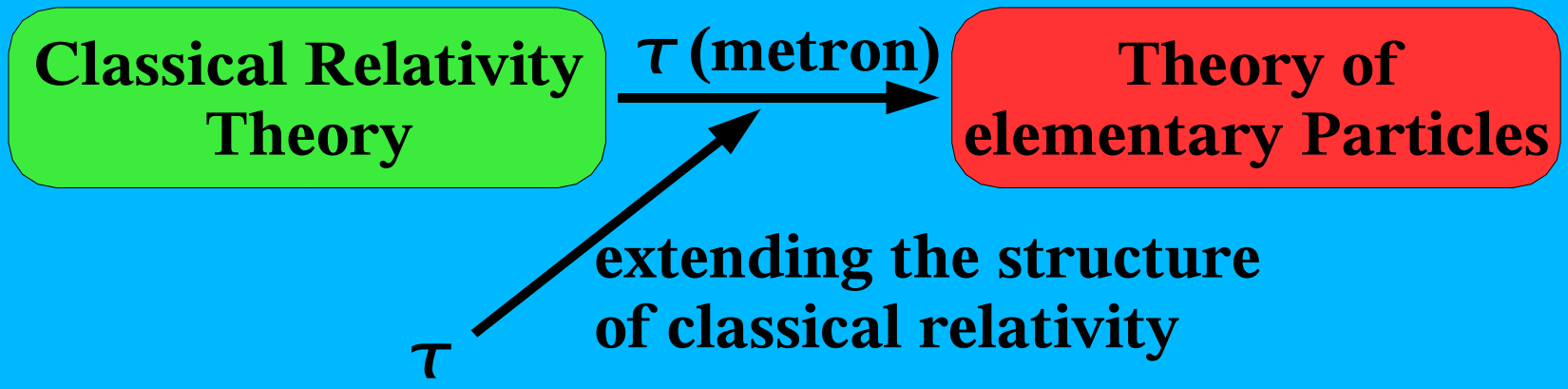
- real numbers
  3.14159
- calculus and limits
- complex numbers
  real and imaginary parts
  described by real numbers

Discrete Space Time
8D (Heim)

- natural numbers
  1,2,3,...
- quantization principles
- complex numbers
  real and imaginary parts
  described by natural numbers

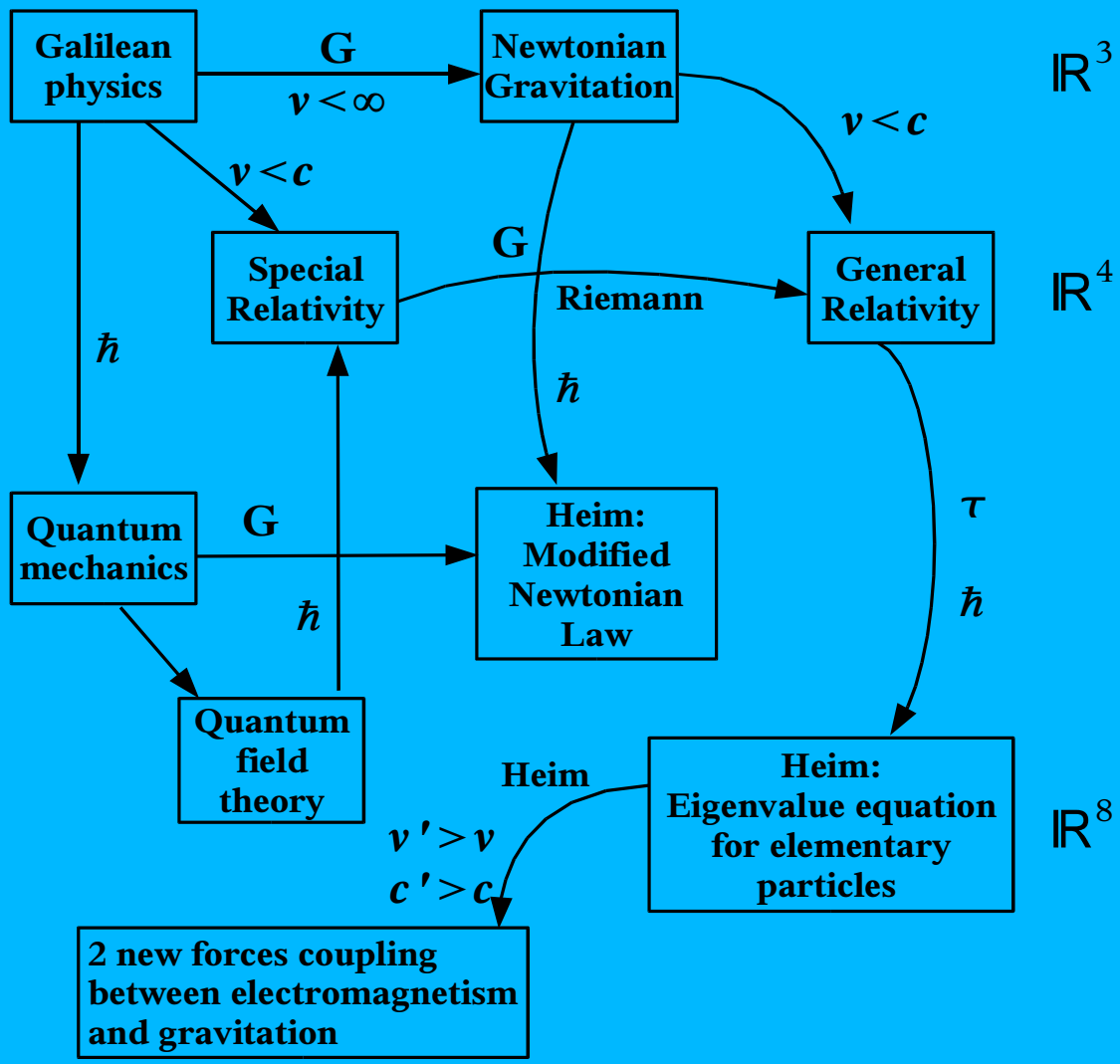
continuous $\mathbb{R}^4$ space time

$\mathbb{R}^8$ discrete space time



Elementary particles are elementary in the sense that they cannot be decomposed into subcomponents. However, simple elementary particles are comprised of volumes in $\mathbb{R}^8$, built from a set of 2D metrons. These particles, however, possess structure visible as different zones from scattering experiments.

Heim Space 8-Dimensions
Discrete spacetime, Metron τ



Inertial Transformation
$m' < m$
$c' > c$
$v' > v$

c = vacuum speed of light
v = velocity of ponderable mass (rest mass $\neq 0$)
τ = metron
m', c', v': quantities after inertial transformation
Heim space : $\mathbb{R}^8$ discrete, τ metrons
Riemann space: $\mathbb{R}^4$ continuous

Physical Coordinates in 8D Heim Space

The metric tensor in 8-space comprises several subtensors, such that each subtensor is responsible for a different physical interaction. In the same way the metric tensor of Einstein's GRT acts as a tensor potential for gravitation, the additional subtensors constructed from the quantized Heim space, $\mathbb{R}^8$, are responsible for all physical interactions in our universe. In other words, the subspaces in $\mathbb{R}^8$ in which the individual metric tensors are specified, are the cause of physical forces. In that respect, we can speak of a completely geometrized theory. In Heim space $\mathbb{R}^8$ four groups of coordinates are discerned:

1. $\mathbb{R}^3$, spatial coordinates (real) (ξ_1, ξ_2, ξ_3),
2. T^1, time coordinate (imaginary) (ξ_4),
3. S^2, entelechial and aeonic coordinates (imaginary) (ξ_5, ξ_6),
4. I^2, information coordinates (imaginary) (ξ_7, ξ_8).

Physical Coordinates in 8D Heim Space

For a metric subtensor to represent a physical interaction, it must contain coordinates of subspaces S^2 or I^2, the so called trans-coordinates.

$$x_m(\xi_\alpha(\eta_i)),$$

$$g_{ik} = \frac{\partial x_m}{\partial \xi_\alpha} \frac{\partial \xi_\alpha}{\partial \eta_i} \frac{\partial x_m}{\partial \xi_\beta} \frac{\partial \xi_\beta}{\partial \eta_k}$$

where indices $\alpha, \beta = 1,...,8$ and $i, m, k = 1,...,4$.

Inertial Transformation in Heim's Theory

$$\boldsymbol{P} = m_0 (1 - v^2/c^2)^{-1/2} (\boldsymbol{v}, ic)$$
$$= (m\boldsymbol{v}, imc) = (\boldsymbol{p}, imc) \quad \text{with} \quad \boldsymbol{p} = m\boldsymbol{v}$$

Since the magnitude of $\boldsymbol{P}$ is an invariant, both momentum and energy conservation hold:

$$m v = m' v' \quad \text{and} \quad m c = m' c'$$

Since $m > m'$, it follows that $c' > c$ and $v' > v$ and therefore $v'/c' = v/c$.

Inertial Transformation in Heim's Theory

Owing to the invariance of the Lorentz matrix with respect to an inertial transformation, which is rooted in the fact that $v'/c' = v/c$, ***superluminal velocities*** should be possible. There is *no contradiction* to special relativity, since an inertial transformation is not considered in SRT. The argument in SRT is, that if $v > c$, then $\beta = v/c$ becomes imaginary. Thus, it is concluded that no observer can possess a velocity greater than that of light relative to any other observer. In an ***inertial transformation***, however, β remains *positive*.

Such a transformation is not possible in SRT or GRT, since it is a consequence of the unification of physical interactions and the poly-metric in Heim space $\mathbb{R}^8$.

Cosmogony of Space and Matter

The Quantized Bang

- The primeval universe came into existence when the size of a single Metron covered the surface of the universe
- The primeval universe expanded and the Metron size was reduced, while the number of Metrons increased
- Most of the time the primeval universe was without matter

Cosmic Numbers

in Heim's universe, all physical constants depend on a single length scale

$D = 10^{125}$ m current diameter of primeval

$\tau = 10^{-70}$ m^2 current Metron size,i.e., quantized elemental surface area

$$\tau \sim D^{-6/11}$$

$$\hbar \sim D^{-8/11} \quad \text{and} \quad G \sim D^{-13/11}$$

$$\epsilon_0 \sim D^{13/11} \quad \text{and} \quad \mu_0 \sim D^{-3/11}$$

alternatively, all constants may be expressed through τ instead of D

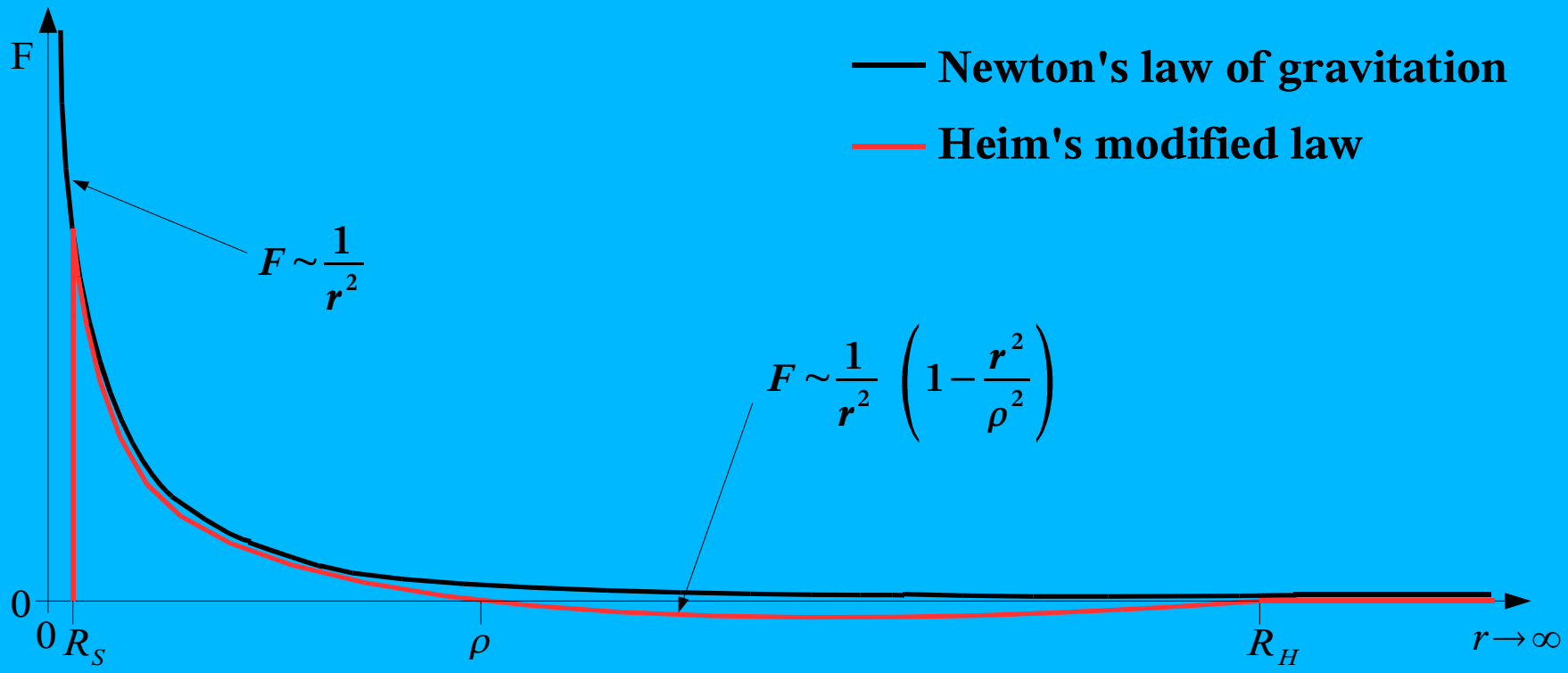
Heim's Modified Newtonian Law of Gravitation

- gravitational attraction is 0 at distances smaller than the Schwarzschild radius,
- graviatational attraction goes to 0 at distances of some 46 Mpc,
- gravitational attraction becomes repulsive at distances larger than 46 Mpc and goes again to 0 at the Hubble radius,

According to Heim (the derivation of the formula below was not calculated independently by the authors), Newton's law needs to be modified for large distances by a negative term and thus becomes repulsive:

$$a = G\frac{m(r)}{r^2}\left(1-\frac{r^2}{\rho^2}\right)\ ,\ \rho = \frac{h^2}{G\,m_0^3}$$

m_0 being the mass of a single nucleon comprising the mass of the field source. Mass m(r) is the total mass and comprises the ponderable and the field mass. The formula above is an approximation only.

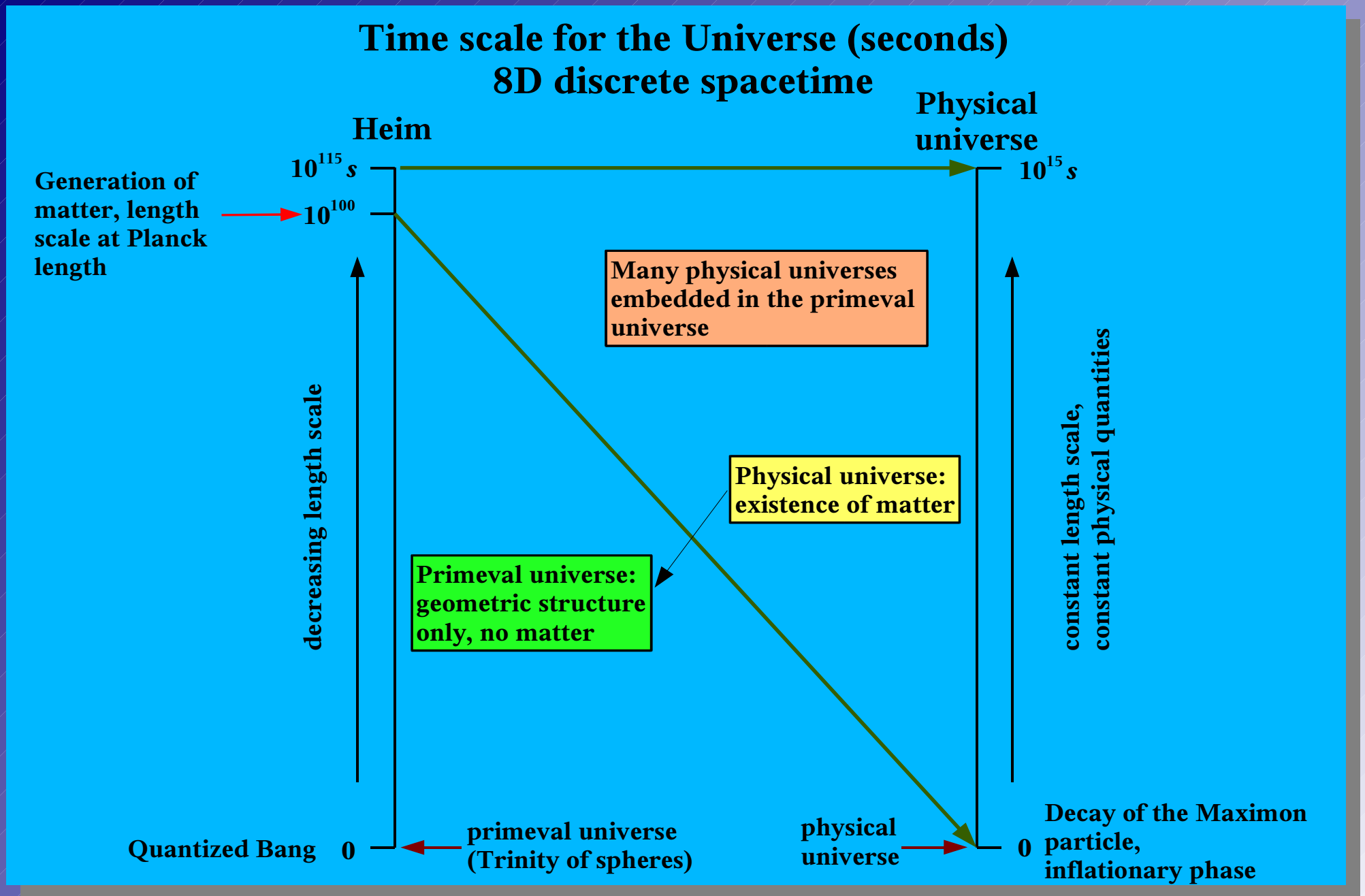


Gravitation goes to 0 at approximately 46 MParsec

R_S **(Schwarzschild radius)**

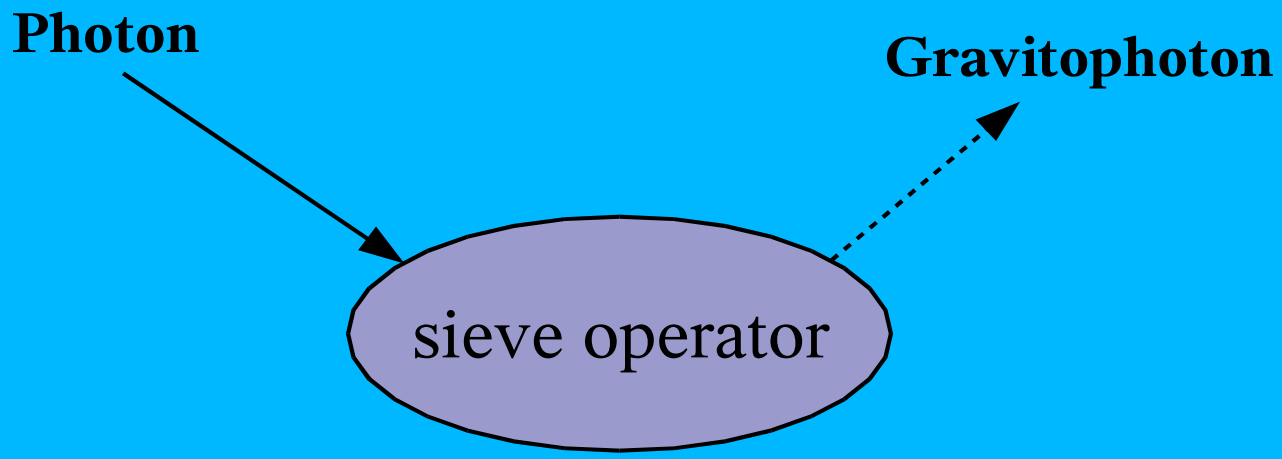
ρ ~ ***46MPc***

R_H ~ **Hubble radius**


Time scale for the Universe (seconds)
8D discrete spacetime
Heim
Physical universe
10^{115} s
10^{15} s
Generation of matter, length scale at Planck length
10^{100}
Many physical universes embedded in the primeval universe
Physical universe: existence of matter
Primeval universe: geometric structure only, no matter
decreasing length scale
constant length scale, constant physical quantities
Quantized Bang
0
primeval universe (Trinity of spheres)
physical universe
0
Decay of the Maximon particle, inflationary phase

Gravitophoton Force for Space Propulsion

Inertial Transformation to reduce the inertial Mass of a Body



Since $m' < m$ conservation of energy and momentum requires that

$$c' > c \,,\; v' > v$$

This implies that Lorentz matrix remains unchanged

$$\sqrt{1-\frac{v^2}{c^2}} = \sqrt{1-\frac{v'^2}{c'^2}}$$

Heim-Lorentz Equation

The gravitophoton force is surprisingly similar to the electromagnetic Lorentz force.
It was termed the Heim-Lorentz force by these authors.
This equation is the basis for the following gedanken-experiment.

$$F_{gp} = \Lambda_p e \mu_0 v^T \times H$$

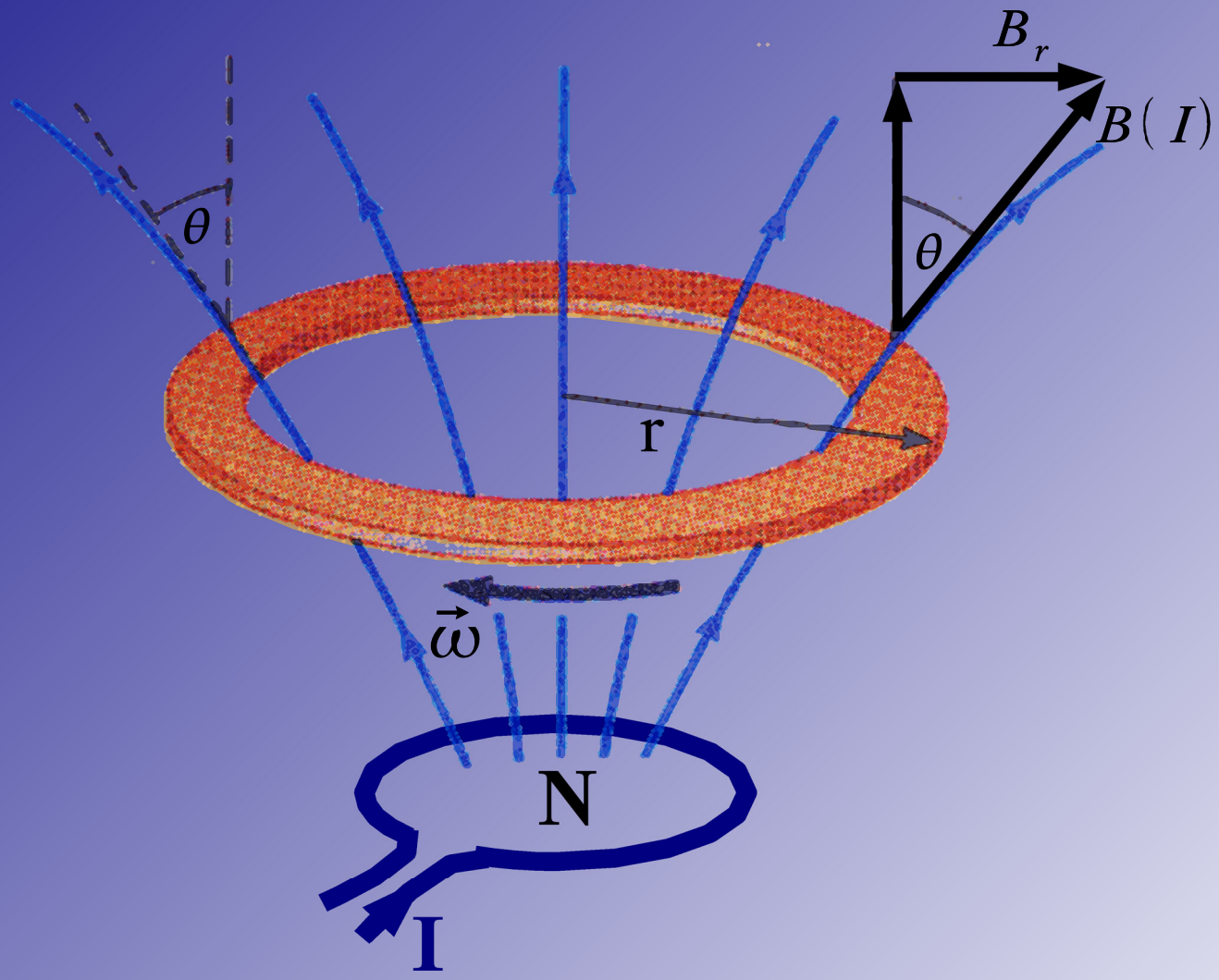
$$\Lambda_p = \frac{32}{3}\left(\frac{Nw_{gpe}}{w_{ph}}\right)^2 (Nw_{gpa})^4 \left(\frac{\hbar}{m_p c}\right)^2 \frac{d}{d_0^3} Z$$

m is the mass of the rotating ring, v^T its velocity, and **H** is the magnetic field generated by the current loop. It should be noted that the sign of depends on the direction of the velocity of the rotating body. As a rule, the velocity of the charges in the current loop and the circumferential velocity of the rotating ring must be in opposite directions.

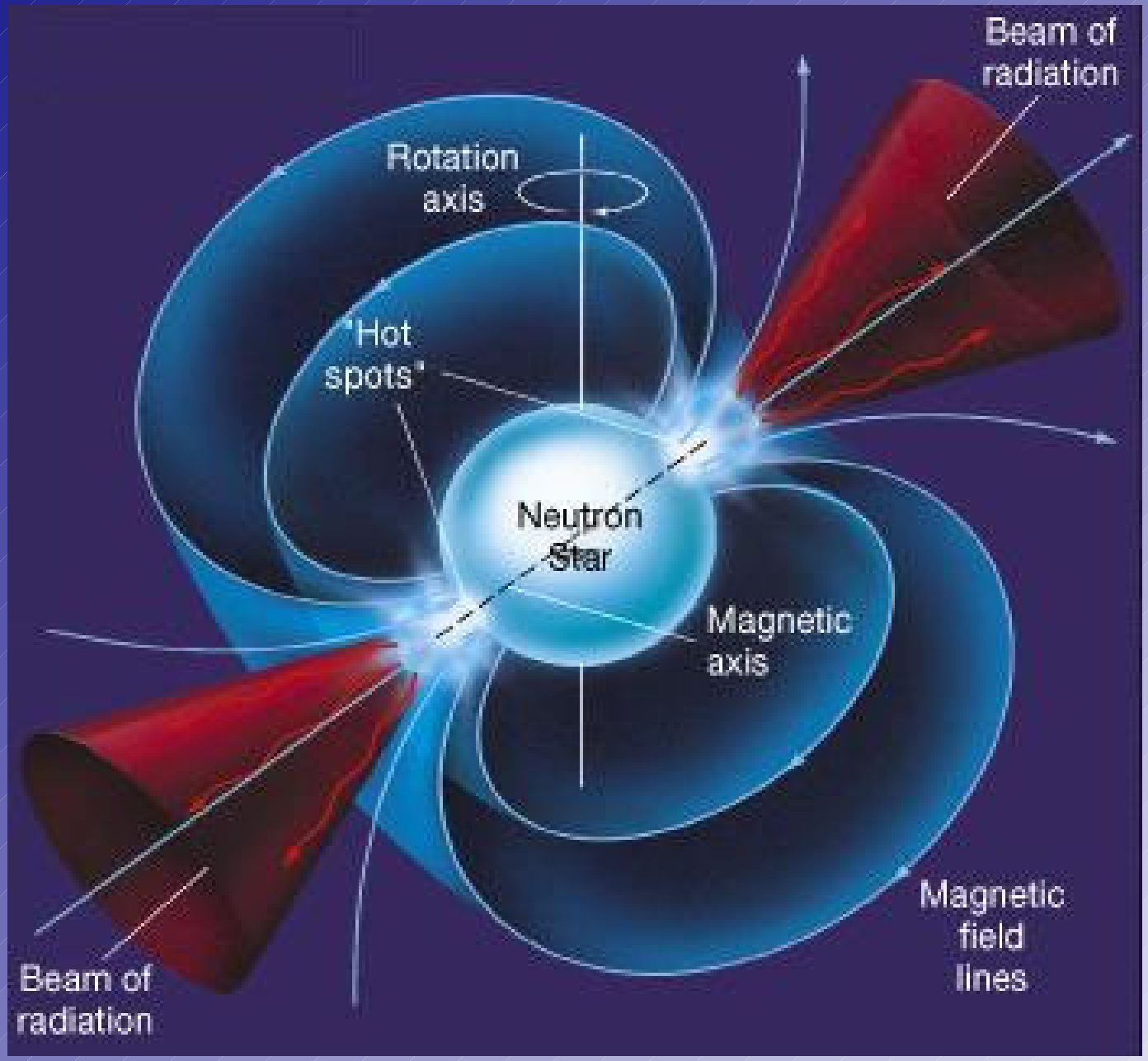
Gravitophoton Force

Experimental Setup for Gravitophoton Force

Experimental Setup for Measuring the Gravitophoton Force



Gravitophoton Force in Neutron Stars (Pulsars)



Interplanetary and Interstellar Missions

Mission to Mars

- **Speed** $1.5\times10^{6}\,m/s$
- **Travel time ~ 4 days**

Mission to a Planet 100 Ly from Earth

The interstellar mission to a planet some 100 ly away from earth would take place in two stages.

- In stage one, lasting 30 days, the spacecraft reaches a speed of some 0.1c, using gravitophoton acceleration.
- In stage two, the inertial mass of the spacecraft is reduced by a factor of 10^{-4}.
- Because the ratio of the initial and the reduced inertial masses is proportional to the ratio of the final and initial velocities of the spacecraft, which follows directly from the conservation of momentum and energy), the final speed of the spacecraft is **10^{3} c**.
- The spacecraft would travel in some kind of hyperspace in which the speed of light $c' = 10^{4}$ c.
- The total travel time would be 0.1 y + 2×30 d, which is approximately 3 months. A return trip would be feasible in 6 months time. A major advantage would be that during 4 months, the astronauts are subjected to an acceleration of 1 g.

Conclusions

- Heim's theory is an extension of Einstein's theory in that each physical interaction and its associated interaction particle is described in a quantized higher dimensional space. In other words, all forces and all material particles are of geometric origin.
- Elementary particles possess a complex dynamic structure that also exhibits zones within such a structure. In the 8-dimensional space, termed Heim space by the authors, several metric subtensors can be formed. Each of these subtensors, called a Hermetry form, is responsible of a physical interaction or interaction particle.
- When these metric subtensors are formed, two new additional interactions along with their interacting particles occur. One of these particles, termed the gravitophoton, is responsible for the reduction of the inertial mass of a material body (spacecraft).
- This physical effect would lead to an inertial transformation in the Lorentz matrix, that, in principle, allows for superluminal travel, because of the conservation of momentum and energy. The kinetic energy of the spacecraft, flying at a velocity greater than the vacuum speed of light, has not increased, since its inertial mass decreased. Otherwise, any spacecraft, flying at velocities close to c, would need an amount of kinetic energy that is impossible to supply and to pay for.
- In that respect, the goals of NASA's Breakthrough Physics Propulsion Program, namely, no fuel, superluminal speed, and no excessive amounts of energy needed for a revolutionary space propulsion system can be met, provided, of course, that Heim's theory represents physical reality.

Future Work

Future work will focus on a more precise prediction of the gravitophoton field with emphasis on the experiment suggested in order to measure the reduction of inertial mass. Computations will be refined to give a better prediction of the performance of the proposed propulsion device. Furthermore, the physical model underlying this propulsion system will be given a more extensive description.