The GEMS (Gravity Electro-Magnetism Super) Unification Theory

and

The NASA JSC EM Thruster

J.E. Brandenburg

**Morningstar Applied Physics LLC**

Presented at Aerospace Corporation

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Agenda

- **Introduction :Pure EM Propulsion**
- **Spacetime transfers of momentum**
- **The GEMS (Gravity Electro-Magnetism) Unification Theory**
- **Transfer of momentum between EM Fields and Spacetime**
- **GEM interpretation of Eagleworks Q-V thruster**
- **Summary**

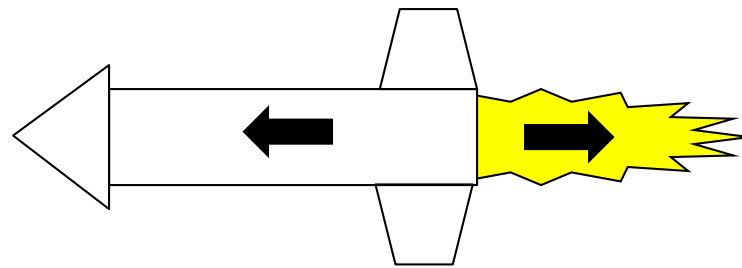# Underlying Goal : Enabling a Lower Cost Human Mars Mission
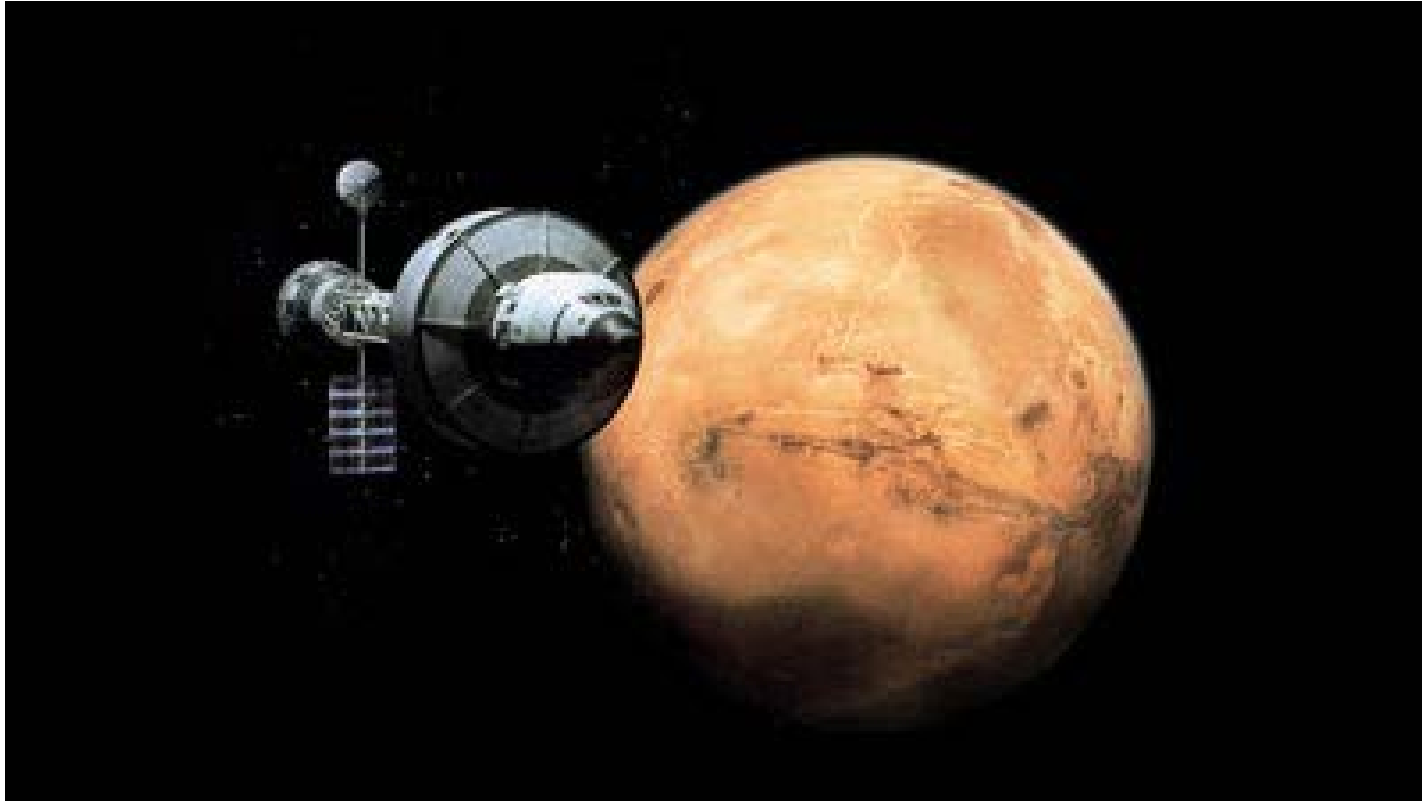
To achieve this , *we must go to the frontiers of Physics*

Propulsion

All propulsion involves momentum exchange with a reaction mass
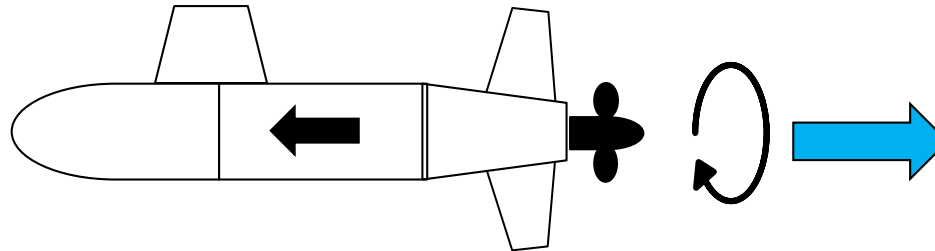
Rocket : reaction mass is propellant
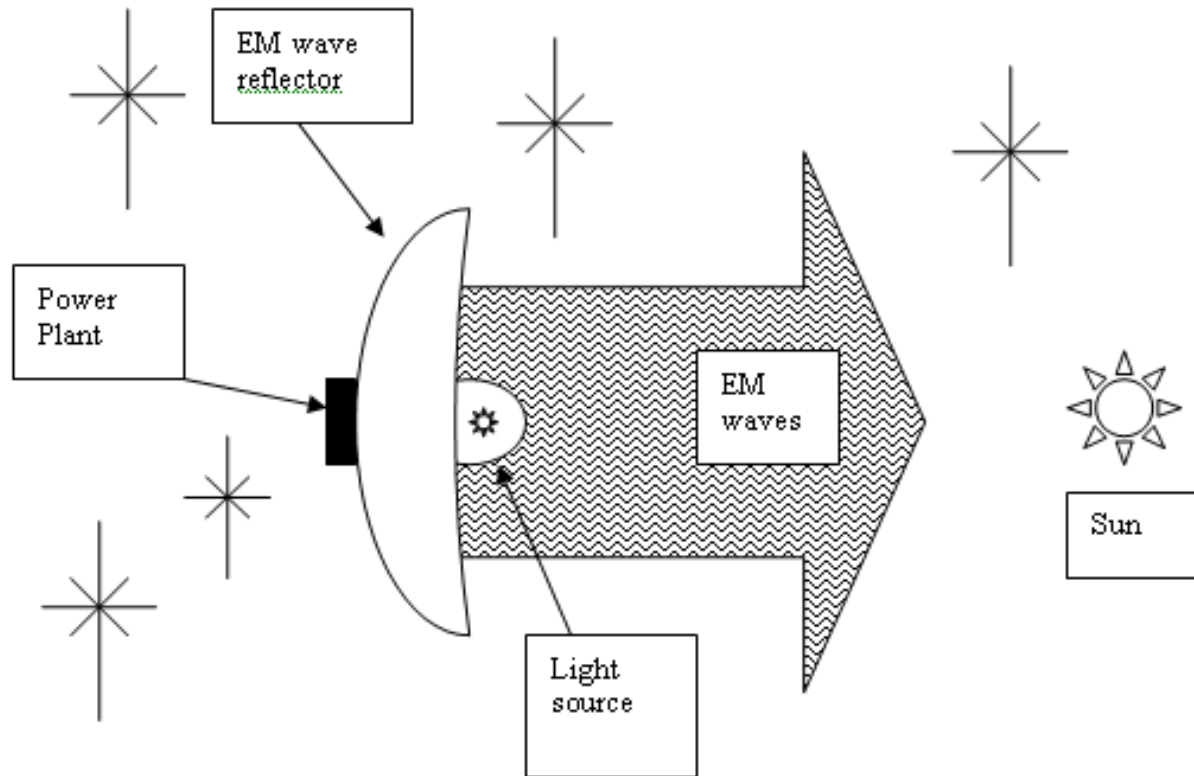
Reaction   Action

Submarine: Reaction mass is the medium

Pure Electro-Magnetic Rocket

- **Pure Electro-Magnetic drive emits EM radiation but has poor thrust per unit power ~2/c = 6.7µN/kW**

Eagle Works Thruster

Eagle works thruster emits no EM radiation
suggests exchange of momentum with the vacuum itself
– *how is this possible?*

Quantum Vacuum

- **Quantum mechanics suggests vacuum can be treated as a medium capable of momentum exchange**

- **Quantum Vacuum is full of EM waves called ZPF (Zero Point Fluctuations) and Virtual particle-antiparticle pairs**

- **Conceptually this means vacuum is a "substance" that can exchange momentum with a spacecraft**
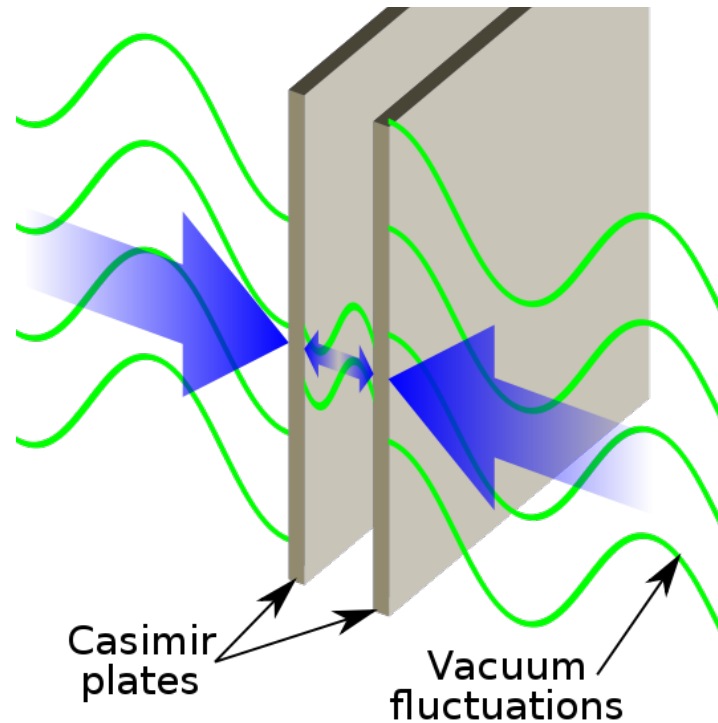
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DISTRIBUTION STATEMENT C

Quantum ZPF
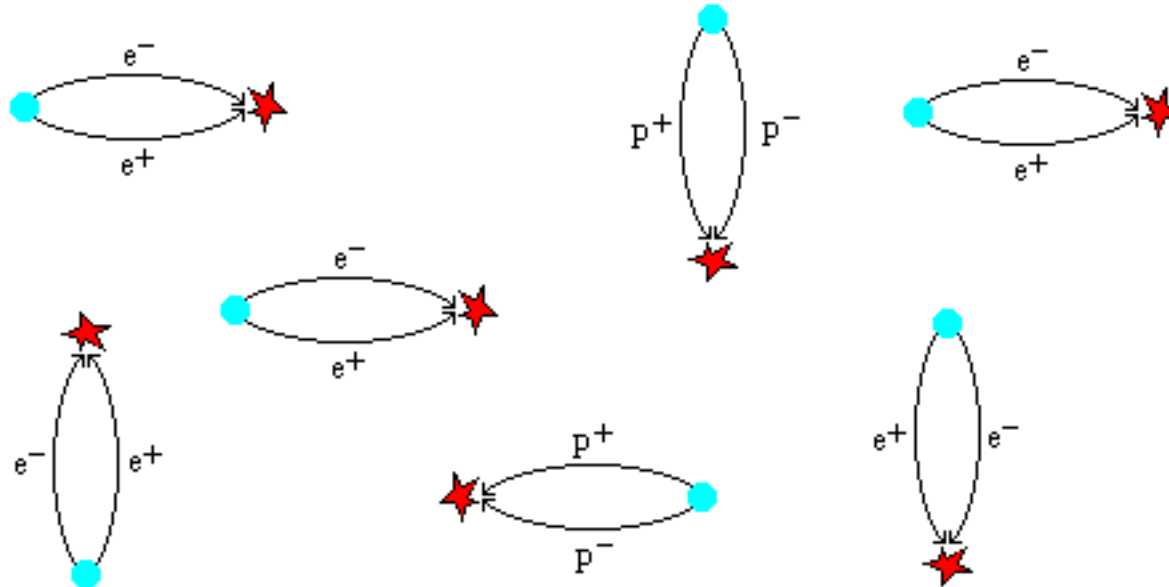
- **Quantum Heisenberg Uncertainty predicts that the Vacuum is filled with a "Virtual Plasma" of virtual particle anti-particle pairs and ZPF field oscillations down to the Planck scale in wavelength (highest energy)**

8

Reality of the ZPF

Casimir Force

Casimir plates

Vacuum fluctuations

The existence of the ZPF is seen directly in the Casimir Force of attraction between parallel metal plates

BUT… this Violates Present Quantum theory

- **Virtual Plasma and ZPF exist ,however…**

- **Present Quantum Mechanics is consistent with Special Relativity :QED (Quantum Electro-Dynamics)**

- **Special Relativistic Invariance of quantum vacuum says it cannot exchange momentum with matter.**

- **Therefore "pushing on the vacuum" is impossible in QED : *Vacuum not connected to mass***

- ***However, accelerated vacuums can have physical effects: Hawking Evaporation ect…***

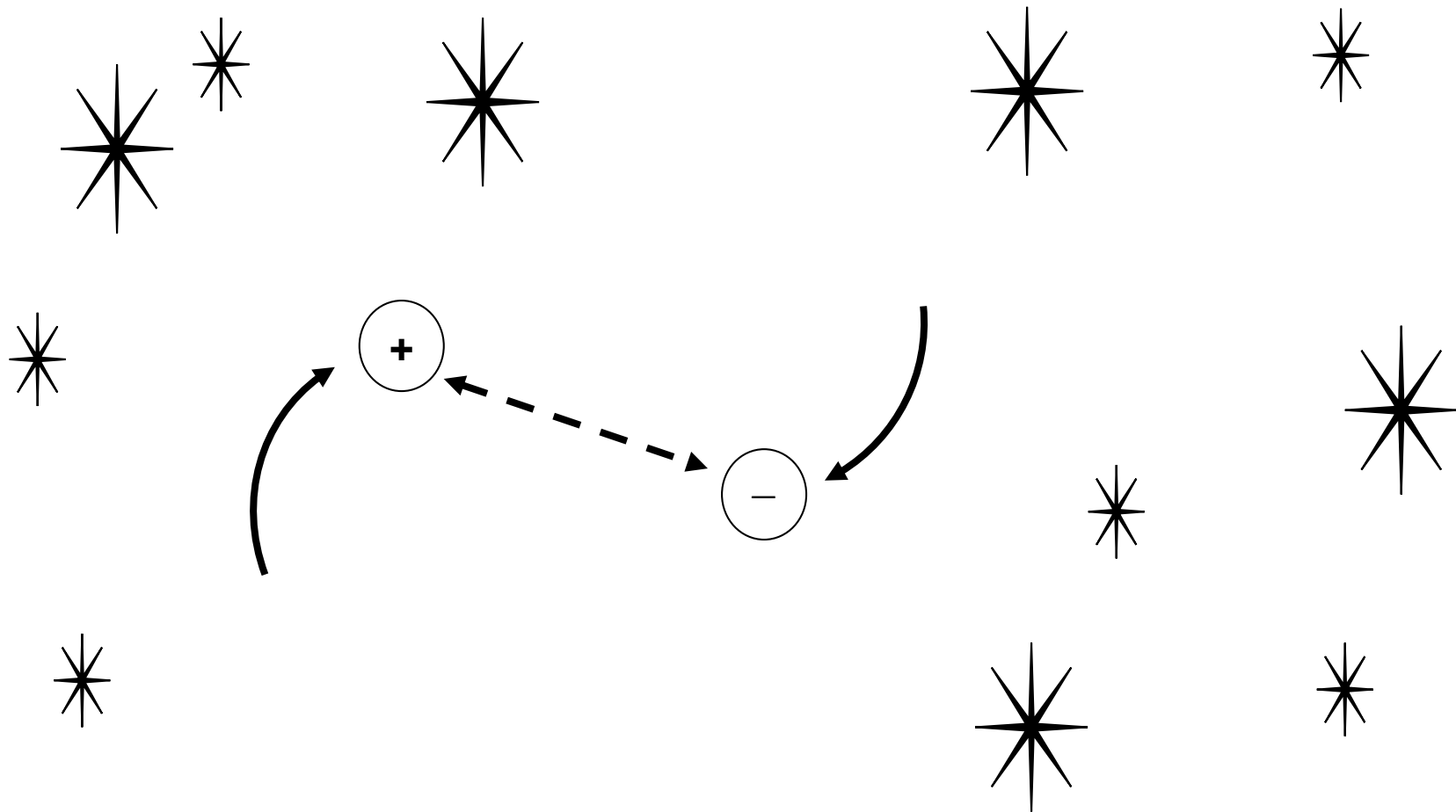- ***What is required for "pushing on the vacuum" to be possible?***

General Relativity

Spacetime is "massless" but its geometry is anchored in General Relativity to nearby masses : Mach's Principle
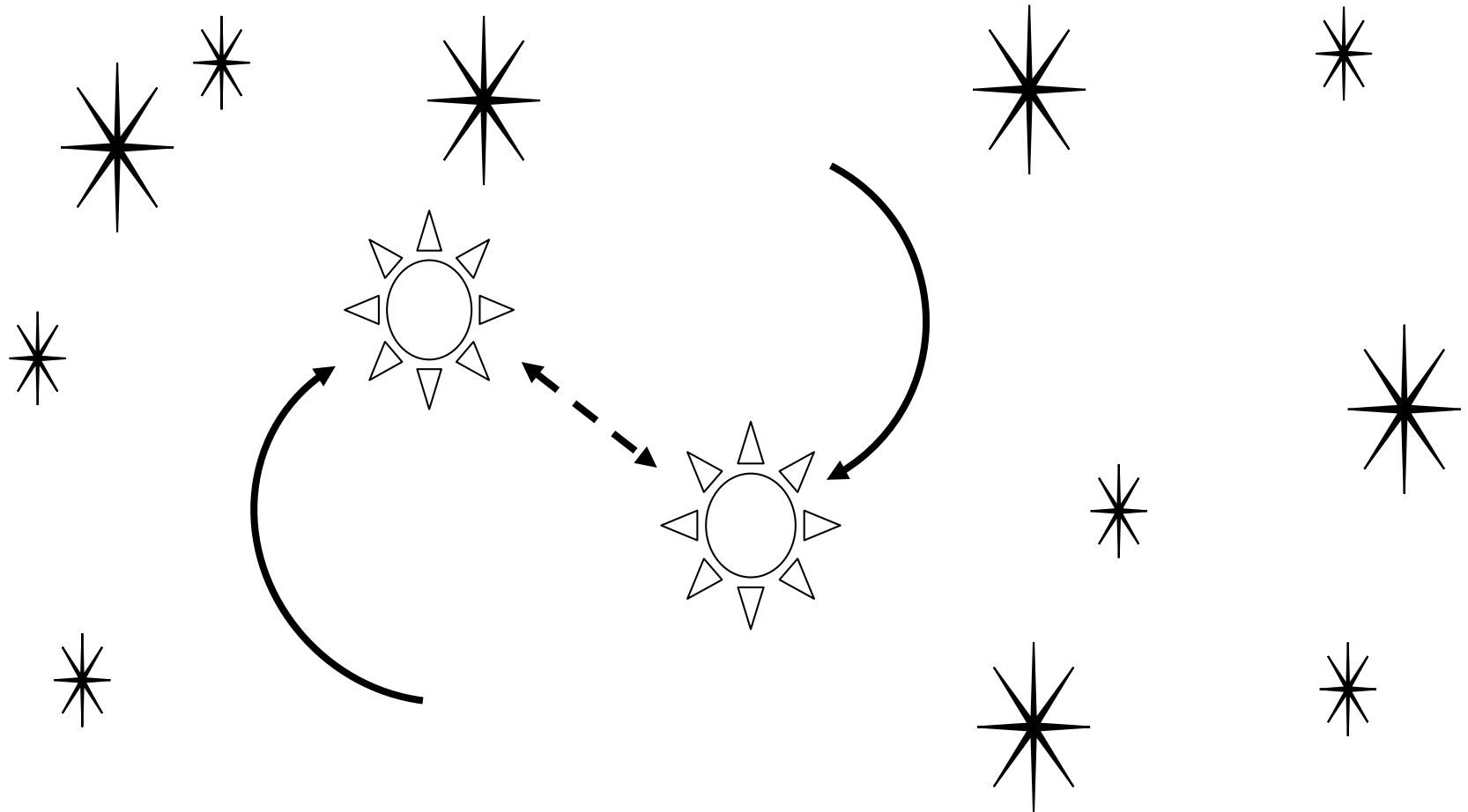

A Reaction mass can be connected to the medium of space : Spacetime in General Relativity

Electromagnetic Fields Transport Momentum

Example : Electrons and Positrons orbit a common center of mass

Spacetime Transports Momentum

Example : Double Stars orbit a common center of Mass

Electromagnetic Spacetime

To make Eagleworks thruster work spacetime must be electromagnetic

and we must be able to modify spacetime with electromagnetism to exchange momentum with masses that anchor its structure

General Relativistic Momentum flow in spacetime

$$R^{\nu}_{\mu} - \frac{1}{2}\delta^{\nu}_{\mu}R = \frac{8\pi G}{c^4}T^{\nu\ Matter}_{\mu}$$

$$T^{\nu\ Matter}_{\mu} = \rho V_{\mu}V^{\nu} \qquad V^{\nu} = \frac{dx^{\nu}}{d\tau}$$

$$m\frac{d^2x_{\alpha}}{d\tau^2} = mV^{\nu}V_{\mu}\Gamma^{\mu}_{\alpha\,\nu} \Rightarrow \frac{d^2x_{\alpha}}{d\tau^2} = V^{\nu}V_{\mu}\Gamma^{\mu}_{\alpha\,\nu}$$

Particles follow geodesics in spacetime – *where is momentum flow?*

Gravity – EM   Momentum flow

$$R_\mu^{\ v} - \frac{1}{2}\delta_\mu^{\ v} R = \frac{8\pi G}{c^4}\left[T_\mu^{\ v\ Matter} + T_\mu^{\ v\ EM} \right]$$

$$T_\mu^{\ v\ Matter} + T_\mu^{\ v\ EM} = \rho V_\mu V^v + F_{\mu\kappa}F^{\kappa v} - \frac{1}{4}\delta_\mu^{\ v} F_{\sigma\kappa}F^{\kappa\sigma}$$

$$m\frac{d^2 x_\alpha}{d\tau^2} = m V^v V_\mu \Gamma_{\alpha\ v}^{\ \mu} + q V^v F_{v\alpha}$$

Gravity Force   **Lorentz Force**

Gravity-EM Momentum flow

$$R_\mu^\nu - \frac{1}{2}\delta_\mu^\nu R = \frac{8\pi G}{c^4}\left[T_\mu^{\nu\ Matter} + T_\mu^{\nu\ EM}\right]$$

$$T_\mu^{\nu\ Matter} + T_\mu^{\nu\ EM} = \rho V_\mu V^\nu + F_{\mu\kappa}F^{\kappa\nu} - \frac{1}{4}\delta_\mu^\nu F_{\sigma\kappa}F^{\kappa\sigma}$$

$$m\frac{d^2 x_\alpha}{d\tau^2} = mV^\nu V_\mu \Gamma_{\alpha\ \nu}^{\mu} + qV^\nu F_{\nu\alpha}$$

Mass affects geometry and charge affects field
leading to momentum flow between particles

Non-Relativistic limit

$$\frac{dp}{dt} = Q_1 \ E_1 \ + Q_2 \ E_2$$

$$\frac{dp}{dt} = Q_1 \ \frac{Q_2}{R^2} \ - Q_2 \ \frac{Q_1}{R^2} = 0$$

$$\frac{dp}{dt} = M_1 \ g_1 \ + M_2 \ g_2$$

$$\frac{dp}{dt} = M_1 \ \frac{GM_2}{R^2} \ - M_2 \ \frac{GM_1}{R^2} = 0$$

Gravity and Electromagnetically bound Systems Conserve system momentum similarly

Planck Scale

- **At the ZPF Planck Scale particle-antiparticle pairs that are quantum Black Holes of the Planck Mass m_P form and annihilate at the Planck Length r_P**

$$r_P = \sqrt{\frac{G\hbar}{c^3}} = 1.61 x 10^{-35} m \qquad M_P = \sqrt{\frac{\hbar c}{G}} = 2.17 x 10^{-8} kg$$

- **This action makes Space-Time a foam at the Planck Scale of plus and minus charges**

Einstein's Unified Field Theory

- Einstein's last theory

- Tried to relate EM Tensor to spacetime metric tensor $F_{\mu\nu}$ → $g_{\mu\nu}$ of gravity

- Two particle paradigm : **Hydrogen**

Proton mass m_p and electron mass m_e are the fundamental masses and $\mp e$ the electron-proton charge are fundamental

- Einstein rejects quantum mechanics

- **Einstein's Unification effort is unsuccessful**

- *However:* Einstein discovers quantum ZPF and helps Kaluza-Klein Theory get published
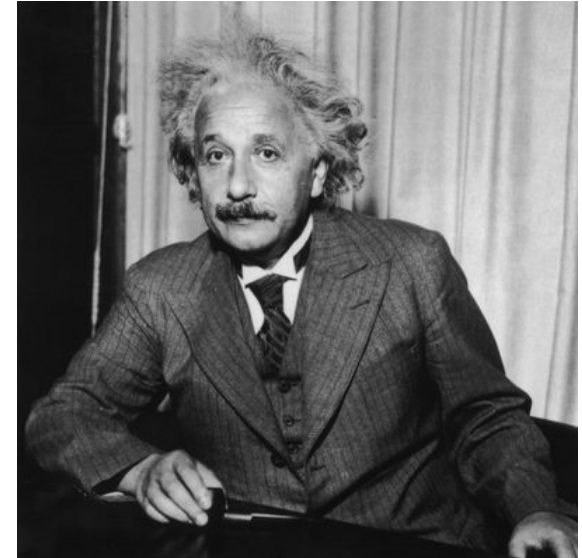
$$g_{\alpha\beta} \propto F_{\alpha\beta}$$

$$m_o \Rightarrow \begin{array}{l} +e, m_p \\ -e, m_e \end{array}$$

GEM Theory: In Brief

- **The GEM (Gravity Electro-Magnetism) Unification Theory Brandenburg (2007, 1995, 1992) uses two postulates:**

  - **Gravity is equivalent to an array of ExB drifts created by the Quantum ZPF (Zero Point Fluctuation)**

$$g_{\alpha\beta} = \frac{4 F_\alpha^\gamma F_{\gamma\beta}}{F_{\mu\gamma} F^{\mu\gamma}}$$

  - **Gravity and EM forces and protons and electrons separate from the Planck scale vacuum with the appearance of a 5th dimension of size r_o**

$$m_P, r_P \Rightarrow r_o \quad \begin{array}{c} +e, m_p \\ -e, m_e \end{array}$$

GEM Theory: In Brief

- **The GEM (Gravity Electro-Magnetism) Unification Theory Brandenburg (2007, 1995, 1992) uses two postulates:**

  - Gravity is equivalent to an array of ExB drifts created by the Quantum ZPF (Zero Point Fluctuation)

  - Gravity and EM forces and protons and electrons separate from the Planck scale vacuum with the appearance of a 5th dimension

- **The Theory is a formal combination of the ZPF gravity concept of Sakharov (1968) and the 5th dimensional concept of Kaluza-Klein (1926)**

- **Theory results in a "Vacuum Bernoulli Equation" modifying gravity by EM and an accurate formula for Newton's Constant G =6.674 x10^{-11} N-m^2 kg^{-2}**

John Brandenburg

The GEM Unification Theory
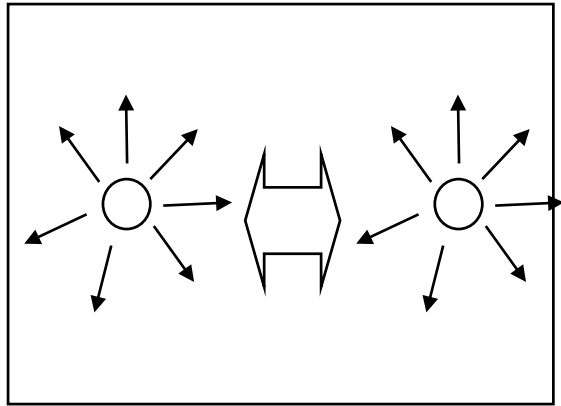
Extending the Standard Model to Include Gravitation

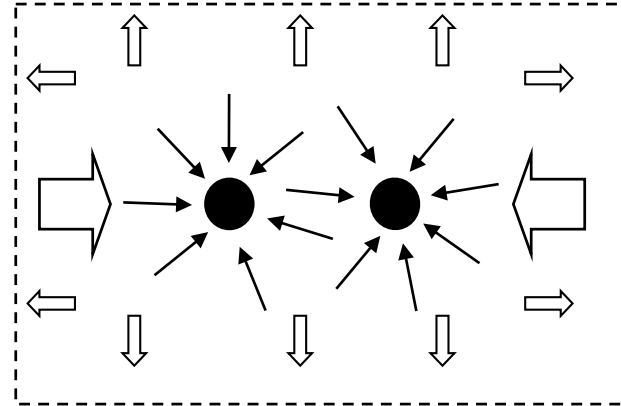**LAP** **LAMBERT**
Academic Publishing

GEM Unification Theory Cont.

- **Sakharov (1968) proposed gravity as a radiation pressure produced by variations in the quantum ZPF**

Bright objects in dark box repel each other

Dark objects in bright box attract each other

- **Poynting vector S=ExBc (ESU units) defines the direction of radiation pressure**

Sahkarov (1967)

"Zero Point" Theory of Gravity

$$W \; = \; (16\pi G)^{-1} \int R\sqrt{-g}\,dx^4$$

Hilbert Action Principle → Einstein Equations

$$W = G^{-1} \cong \frac{\hbar}{2c^5} \int_{o}^{\omega^*} \omega\,d\omega = \frac{\hbar\omega_P^2}{c^5}$$

$$G \cong \frac{c^3 r_P^2}{\hbar} = \frac{c^4}{r_P^2 T_o}$$

Kaluza-Klein (1929)

"Hidden" 5th dimensional Theory of Gravity-EM

$$W \;=\; \int \left(\frac{Rc^4}{16\pi G} + \frac{F_{\mu\nu}F^{\mu\nu}}{4} \right)\sqrt{-g}\,dx^4\, r_o$$

Extended Hilbert Action Principle
r_o =   hidden dimension size

**Results in Einstein Equations
and Maxwell's Equation s of
EM**

$$R_\mu^\nu - \frac{1}{2}\delta_\mu^\nu R = \frac{8\pi G}{c^4} T_\mu^{\nu EM}$$

$$F_{\nu;\mu}^\mu = J_\nu$$

$$F_{\mu\nu;\gamma} + F_{\mu\gamma;\nu} + F_{\nu\gamma;\mu} = 0$$

GEM theory

- **Postulate 1: New 5th Dimension splits ZPF Vacuum**

Gravity Fields –

Planck length: r_P

proton mass: m_p

ZPF

EM Fields –

New Hidden dimension size:

electron mass: m_e

$$r_o = \frac{e^2}{(m_p m_e)^{1/2} c^2}$$
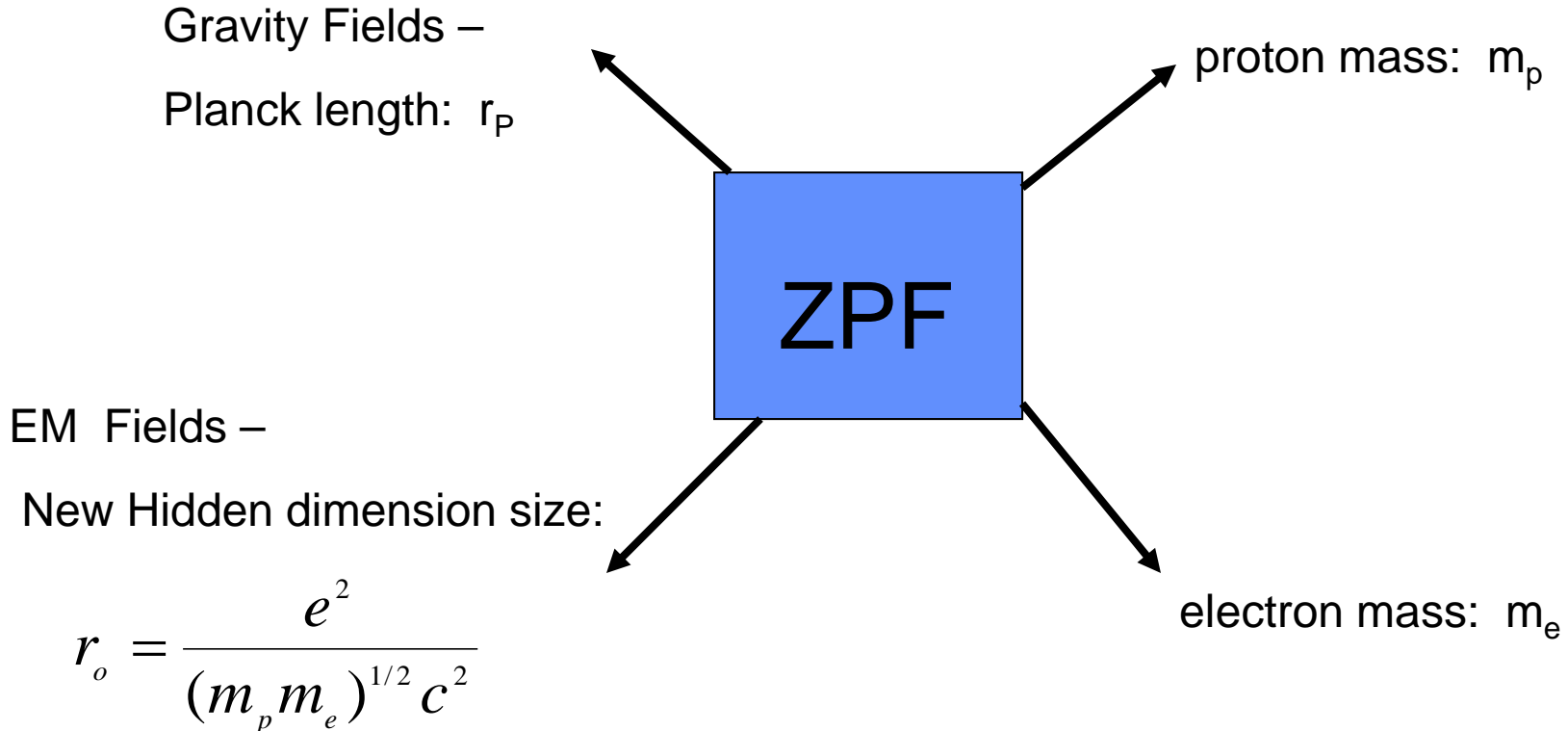
New 5th dimension allows "deployment" of field-particle system from primordial ZPF plasma

27

A Gedanken Experiment
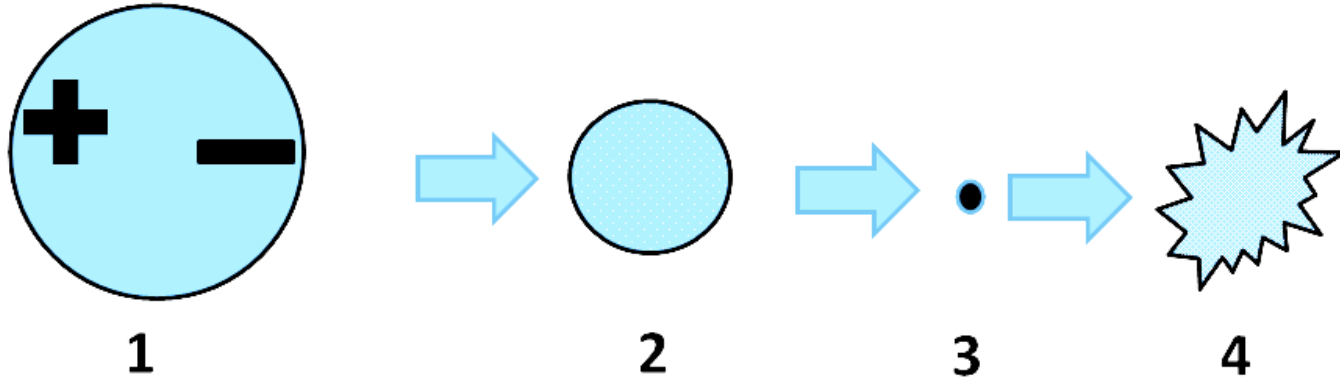
1. A single atom of hydrogen, a proton and an electron, is shrunk

2. And ionizes. Finally it reaches the Planck size

3. And becomes a Black Hole, whereupon,

4. , it undergoes Hawking Evaporation and becomes a cloud of gamma rays, matter and antimatter

so that original hydrogen is lost.

Mass Model

$$m = m_o \cos(\phi) + i m_o \sin(\phi)$$

Make angle imaginary

$$m = m_o \exp(\pm \phi_o)$$

$$\sqrt{\frac{m_p}{m_e}} = \exp(\phi_o) = \sigma$$

First GEM Postulate Cont.

$$\ln\left(r_o \Big/ r_P\right) = \left(\frac{m_p}{m_e}\right)^{1/2} = \sigma = 42.8503...$$

- **Size ratio of 5th dimension to Planck length must be related to proton electron mass ratio**

Geometric parameter is a ratio of Gravity to EM Forces

$$r_o \Big/ r_P = \sqrt{\frac{e^2 \alpha}{G m_o^2}}$$

Inversion of previous formulas

$$G = \frac{e^2}{4\pi\varepsilon_o m_p m_e} \alpha \exp(-2\left[\frac{m_p}{m_e}\right]^{1/2}) = 6.668 x 10^{-11} N - m^2 / kg^2$$
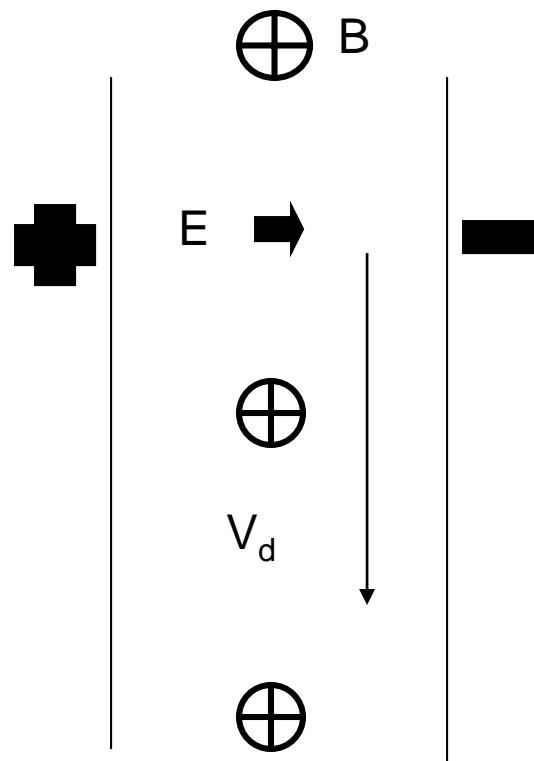
$$G = 6.673 x 10^{-11} m^3 kg^{-1} \sec^{-2} \quad \text{Accepted value}$$

$$m_p = M_P \exp(-(\alpha^{-1/2} + \alpha)\ln\sigma) = 1.6665 x 10^{-24} g$$

$$m_p = 1.67 x 10^{-24} \quad \text{Accepted value}$$

Second GEM Postulate

$$V_D = \frac{(ExB)c}{B^2}$$

$$g = \frac{\dot{E}\,xB_o c}{B_o{}^2}$$

B

E

V_d
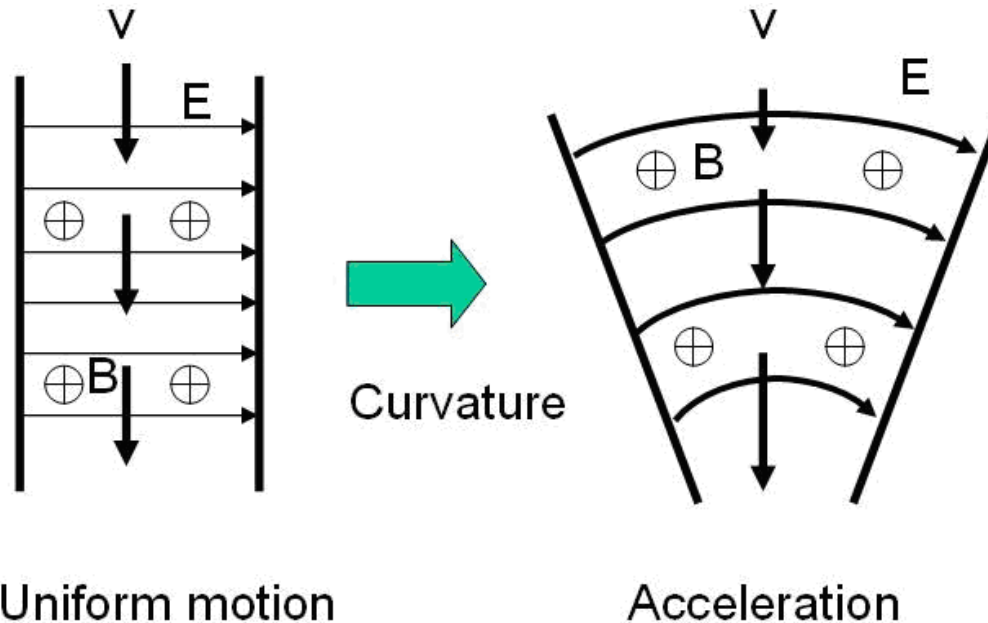
ExB drift effects all particles regardless of mass or charge, satisfies equivalence principle

Gravity fields are equivalent to E x B field arrays

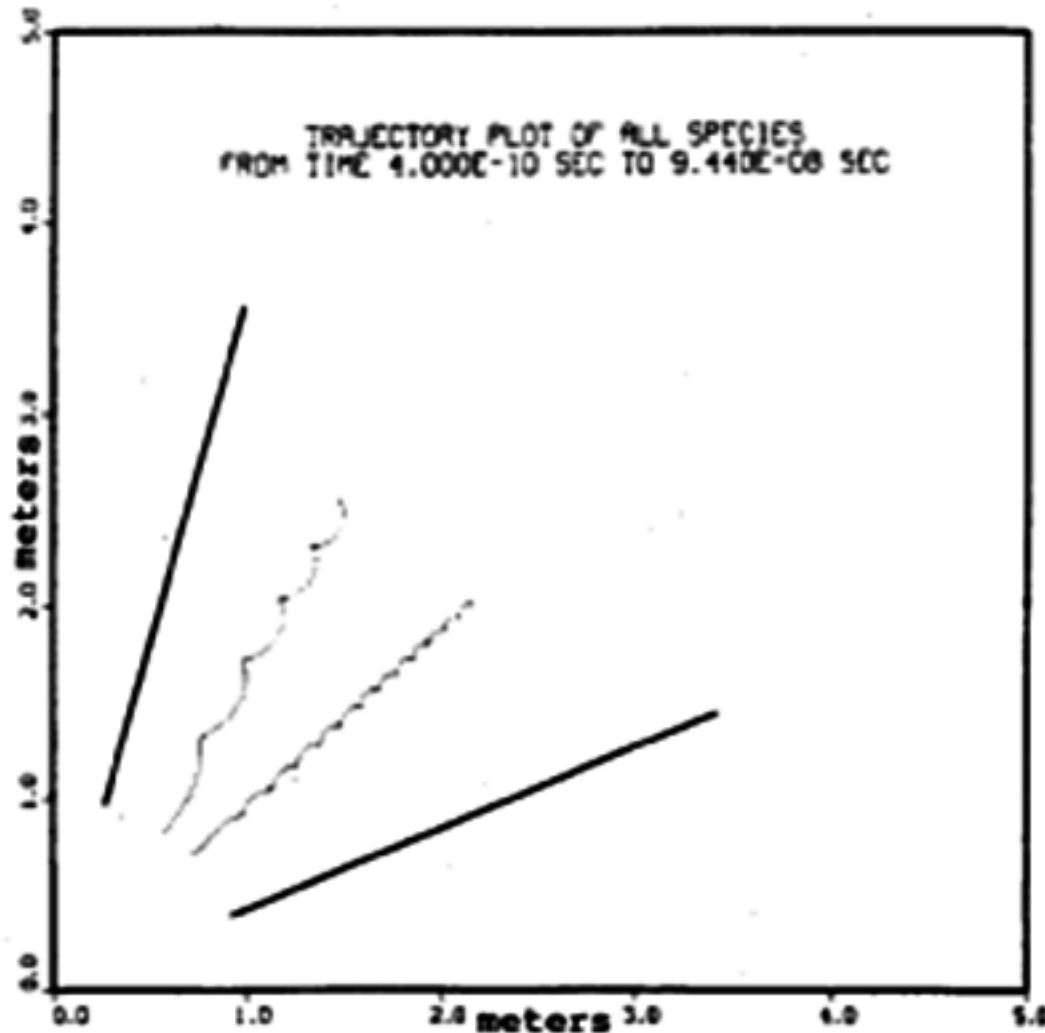**(Standard Model of Physics –all particles are charged)**

Second GEM Postulate Cont.

Uniform motion   Curvature   Acceleration

- **Curved ExB drift fields accelerate all charged particles**

Simulation of Second Postulate

TRAJECTORY PLOT OF ALL SPECIES
FROM TIME 4.000E-10 SEC TO 9.440E-08 SEC

Computer Simulation of ExB acceleration for simulated electron and proton

(proton is 10xm_e in the simulation)

GEMS gravity

$$\phi = \frac{1}{2}\frac{E_x^{\;2}}{B_z^{\;2}}c^2$$

$$g_{\alpha\beta} = \frac{4F_\alpha^{\;\gamma}F_{\gamma\beta}}{F_{\mu\gamma}F^{\mu\gamma}}$$

$$g_{\alpha\beta} = 2[B^2 - E^2]^{-1}\begin{vmatrix} -E^2 & 0 & 0 & 0 \\ 0 & E_x^2 - B_y^2 - B_z^2 & 0 & 0 \\ 0 & 0 & E_y^2 - B_x^2 - B_z^2 & 0 \\ 0 & 0 & 0 & E_z^2 - B_y^2 - B_x^2 \end{vmatrix}$$

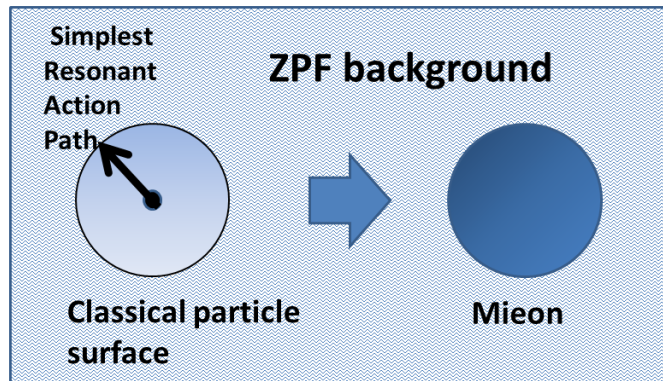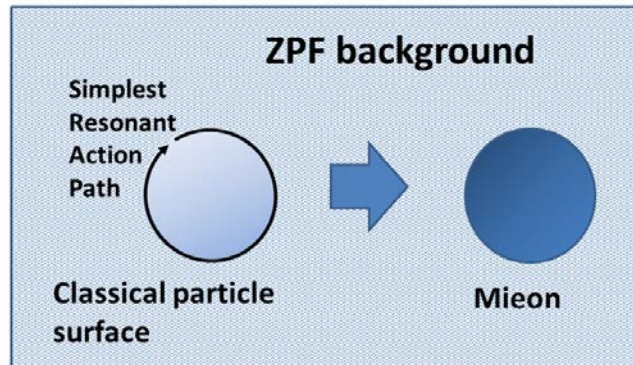$$T_{\alpha\beta} = F_\alpha^{\;\gamma}F_{\gamma\beta} - g_{\alpha\beta}\frac{F_{\mu\gamma}F^{\mu\gamma}}{4} = 0$$

Vacuum ZPF energy vanishes!

Scholarly Digression

- **GEM Theory can *, unexpectedly,* be extended to short range Strong and Weak Forces**

- **This may allow new compact and clean forms of nuclear power**

Exchange bosons

*A quantum Mie scattering caused by a
fundamental resonant excitation vector on a classical particle surface*

GEMS Unification

GEM theory now gives masses, spins, and charges of exchange bosons for Strong and Weak Forces

TABLE 1. Particle Masses Predicted by the GEM theory

Particles	Particle Properties		
	Predicted Mass	Measured Mass	% error
$\pi\pm$	140.05MeV	139.6MeV	0.3%
W$\pm$	80.409GeV	80.398GeV	0.01%
η_c	3000.6MeV	2985MeV	0.7%

$$\frac{M_W}{m_{\pi\pm}} = \sigma^3 \alpha = 574.3$$

Actual value 574.2

GEM Basic results

- **First Postulate: separation from Planck Scale of EM and gravity with appearance of 5th dimension leads to accurate formula for G**

$$G = \frac{e^2}{4\pi\varepsilon_o m_p m_e}\,\alpha\exp(-2\left[\frac{m_p}{m_e}\right]^{1/2}) = 6.668 x10^{-11} N - m^2 / kg^2$$

Accepted value: $G = 6.673 x10^{-11} m^3 kg^{-1} \sec^{-2}$
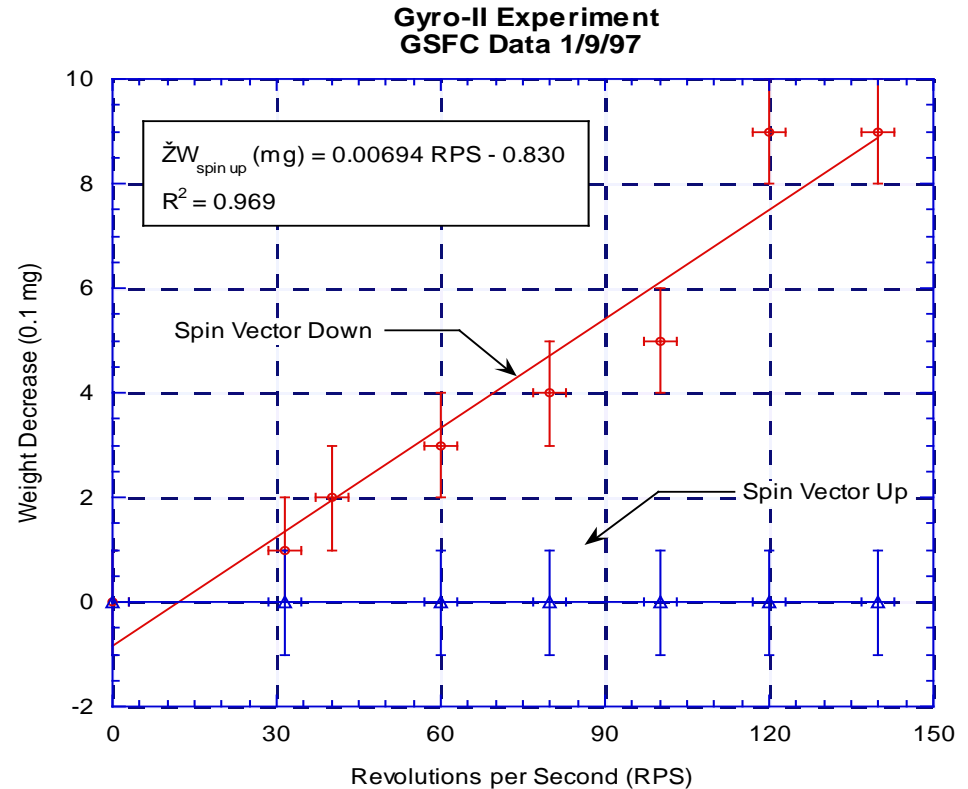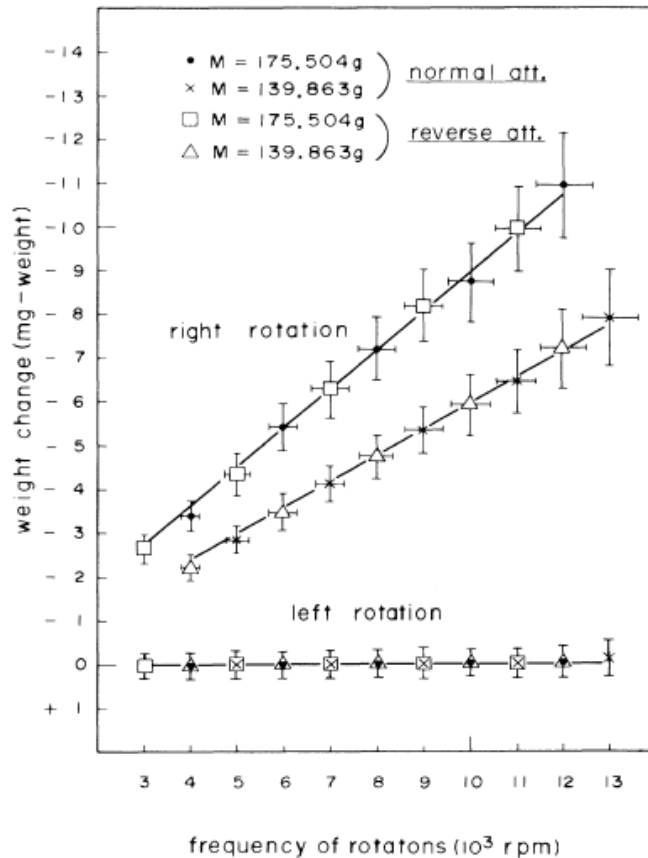
- **Second Postulate: Gravity as EM ZPF radiation pressure leads to "<u>Vacuum Bernoulli Equation</u>"**

$$\frac{Rc^4}{8\pi G} - \frac{1}{4} F_{\nu\mu} F^{\nu\mu} = 0 \quad \Rightarrow \quad \frac{g^2}{2\pi G} - \frac{\varepsilon_o (ExB)^2}{B^2} = Const.$$

## *Electromagnetic Gravity Modification is Possible*

Brandenburg J.E. and Kline J. (1998) , Joint Propulsion Conf. AAIA-98-3137

Weight Loss In Gyroscopes

Gyro-II Experiment
GSFC Data 1/9/97

$\check{Z}W_{\text{spin up}}$ (mg) = 0.00694 RPS - 0.830

R^2 = 0.969

Spin Vector Down

Spin Vector Up

Weight Decrease (0.1 mg)

Revolutions per Second (RPS)

- **Investigation began by reproducing the weight loss found by Hayasaka and Takeuchi (1989) for metal rotors spun by 3-Phase EM fields (Brandenburg and Kline 1998)**

Brandenburg-Kline Effect

Sartorius 11/7/96 A set
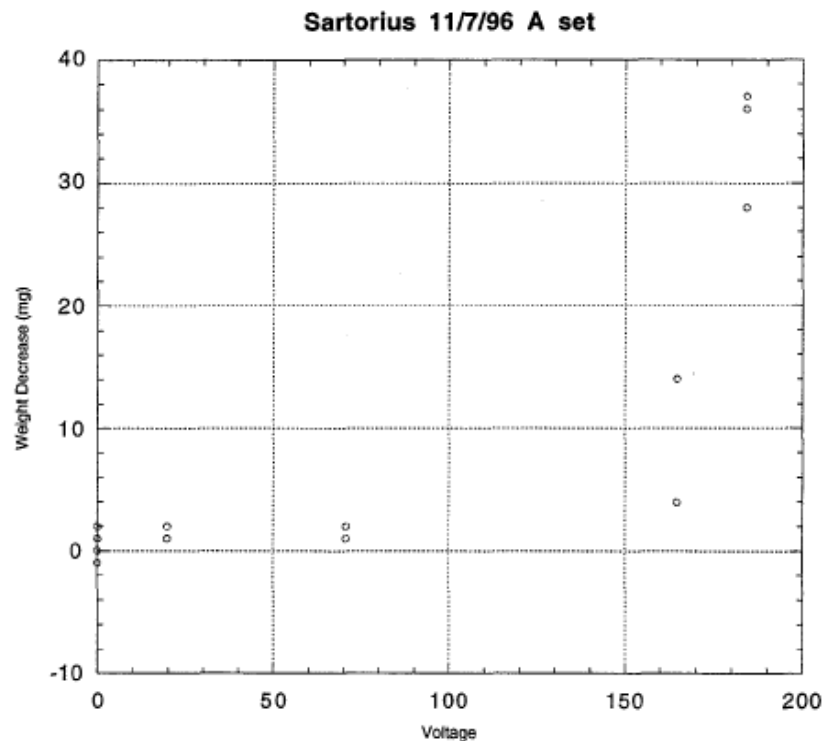
- **Weight loss increased when metal rotors of 3-phase gyroscope removed, and went as voltage to fourth power (Brandenburg and Kline 1998)**

Recent GEM experiment
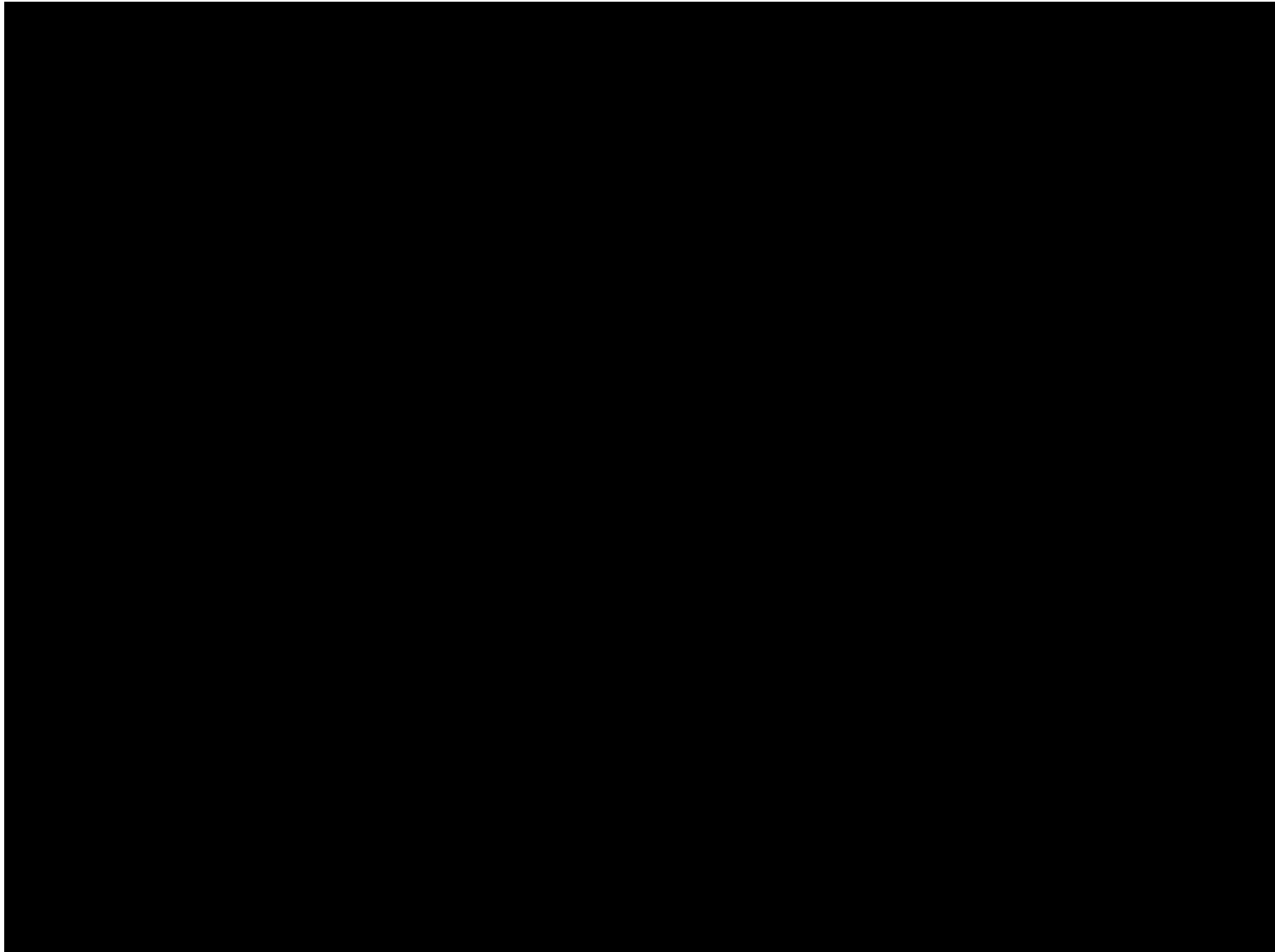
GEM Working Hypothesis

- **Working Hypothesis for Brandenburg-Kline effect is that is due to GEM "Vacuum Bernoulli Effect" : local Poynting vector caused by applied power causes destructive interference with ZPF causing gravity and locally weakens it (Brandenburg and Kline 1998)**
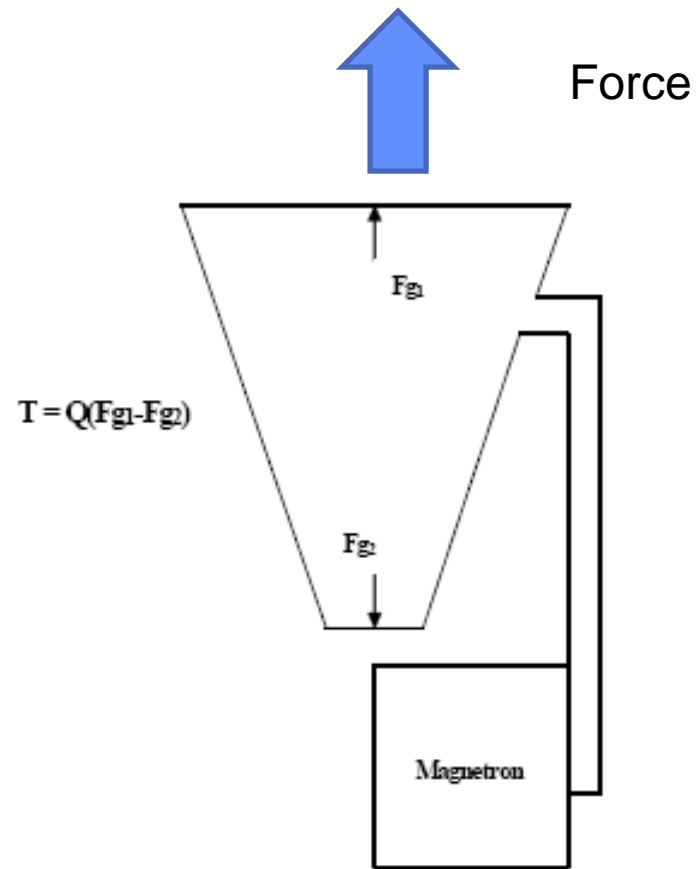
GEM Interpretation of QV Thruster Results
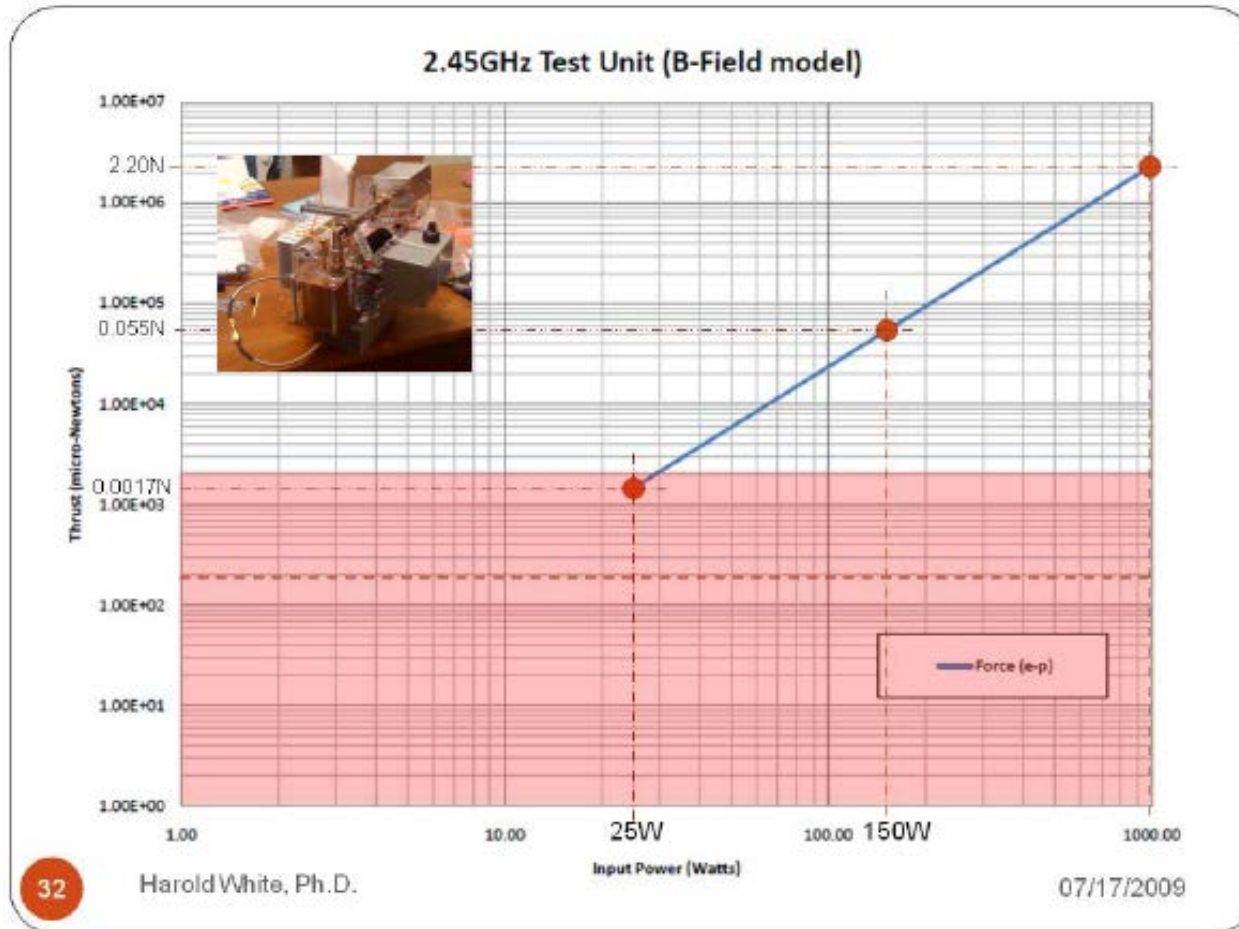
Shawyer's Microwave Device
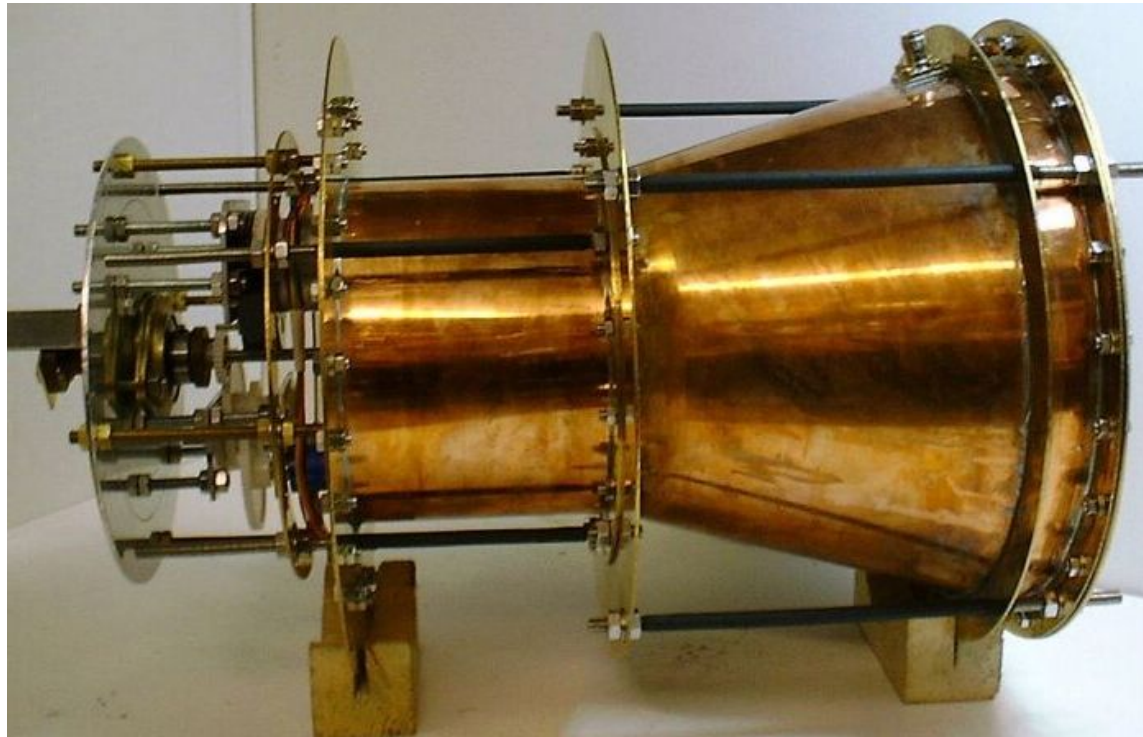
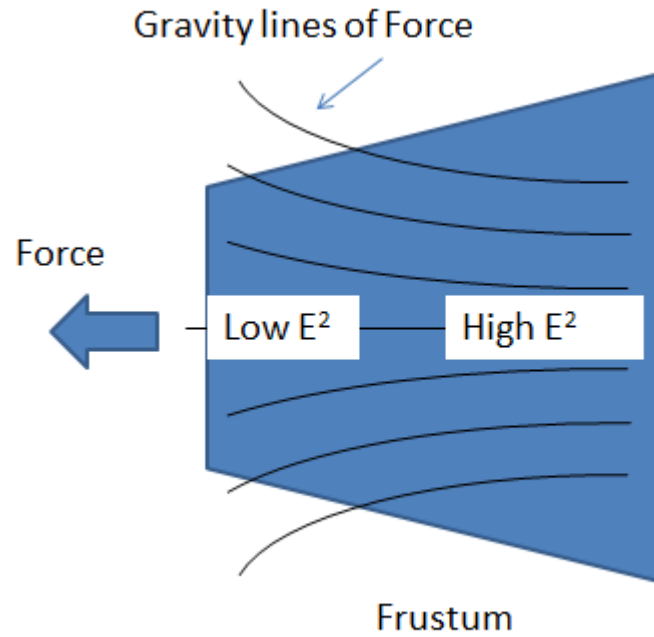**Taken from Shawyer (2009)**

Shawyer's Device Cont.

Force

Fg_1

$T = Q(Fg_1 - Fg_2)$

Fg_2

Magnetron

QVPT Test

From White (2009)

QV Thruster

Power-Thrust Relation (low power)

"linear" limit   Thrust $\propto$ Power

$$S = P_{EM} V_{esc} \cong 6 \times 10^7 W / m^2$$

$$F_{QV} \cong m_{QV} g \frac{dS}{S} \cong 1 \times 10^{-5} N = 10 \mu N$$

$$\frac{F_{QV}}{W} \cong \frac{m_{QV} g}{AS} \cong 2 \times 10^{-7} N = 0.2 \frac{\mu N}{W}$$

$F_{QV}/W = 0.7 \mu N/W$ observed

Power-Thrust Relation (high-power)

"non-linear" limit   Thrust ∝ (Power)²

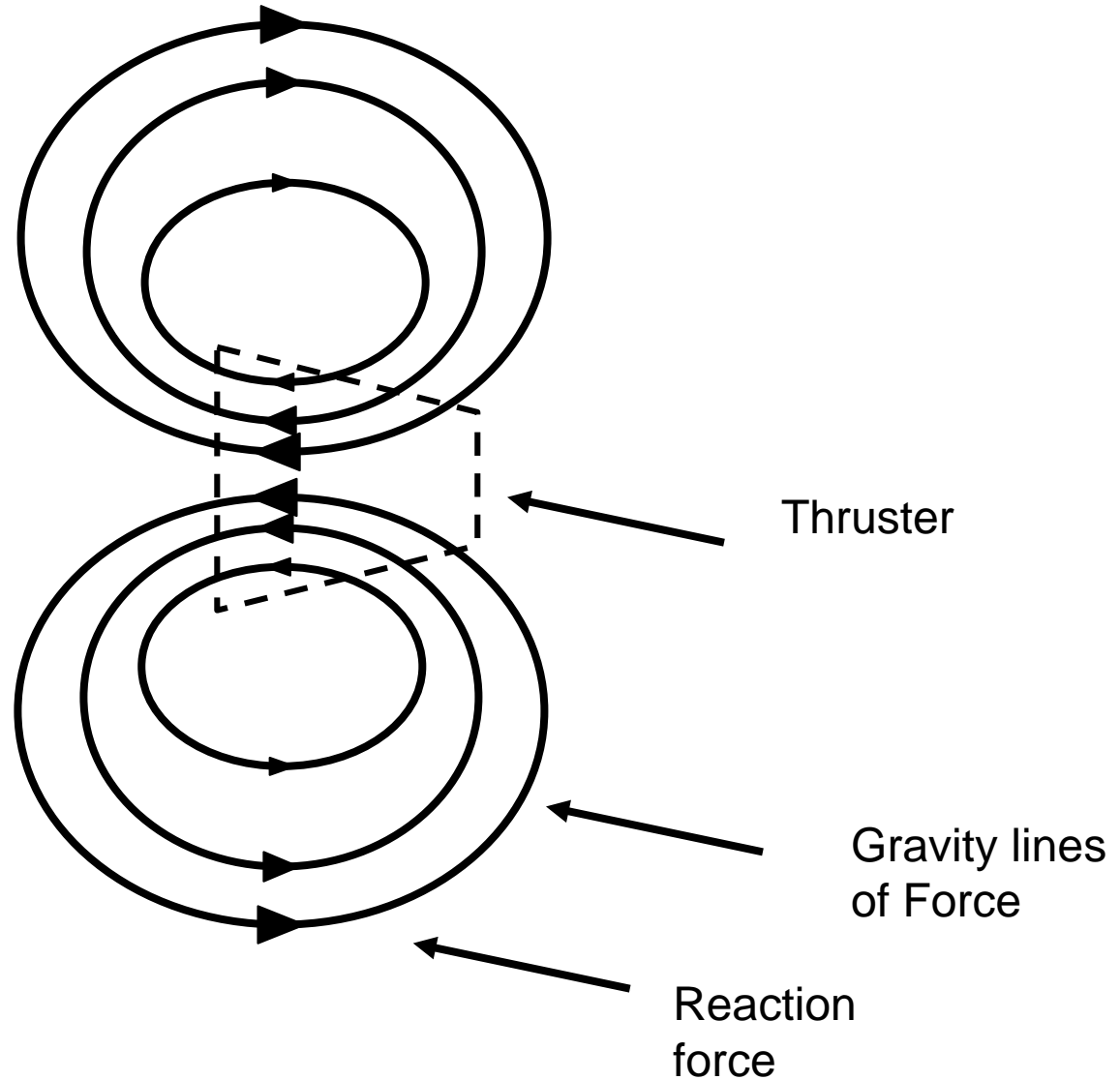$$\frac{dg \bullet g}{2\pi G} = \frac{S'^2}{u_o c^2}$$

$$\frac{|dg|}{|g|} \frac{g^2}{2\pi G} = \frac{S'^2}{|S^2|} \frac{S^2}{u_o c^2} = \frac{S'^2}{|S^2|} \frac{S^2}{u_o c^2}$$

$$\frac{|dg|}{|g|} \cong \frac{S'^2}{|S^2|}$$

$$F_{QV} \cong m_{QV} g \frac{S'^2}{|S^2|} \cong 0.1N \left[\frac{100MW}{60MW} \right]^2 = .27 N / kW$$

$F_{QV}/W = 0.2\text{N/kW}$ reported

Extended Gravity field according to GEM

Thruster

Gravity lines
of Force

Reaction
force

Working Hypothesis and Predictions

- **Working Hypothesis:**

Eagle-Works thruster is modifying spacetime with EM fields and transfering momentum to nearby masses according to GEM Theory

Predictions:

1. Thrust will be proportional to (Power)^2 at kW powers

2. Opposing forces will be found near Eagle Works Thruster during its operation indicating transfer of momentum to other masses

Summary

- **Modern Theory of the Vacuum does not preclude "Q thrusters" or EM modification of Spacetime**

- **Small anomalous forces seen in experiments may be signs of "Q-V thruster" or GEM forces**

- **GEM Unification theory can explain forces, magnitudes and phenomenology seen in experiments**

- **GEM predicts non linear limit and reaction forces**

- ***Opinion: Breakthroughs, Experimental and Theoretical have occurred***

The Future

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- **White H. "Revolutionary Propulsion and Power for the Next Century of Space of Space Flight" Von Braun Symposium Oct 2009**

Supplemental Viewgraphs
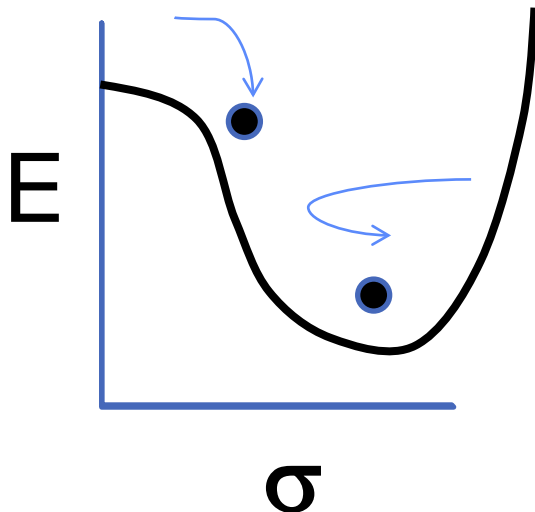
GEM Correspondence with Electroweak theory

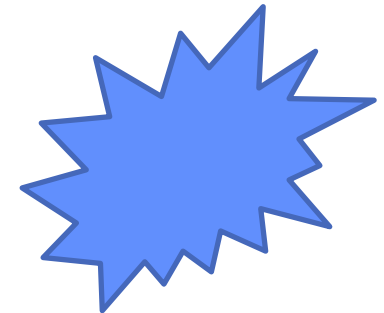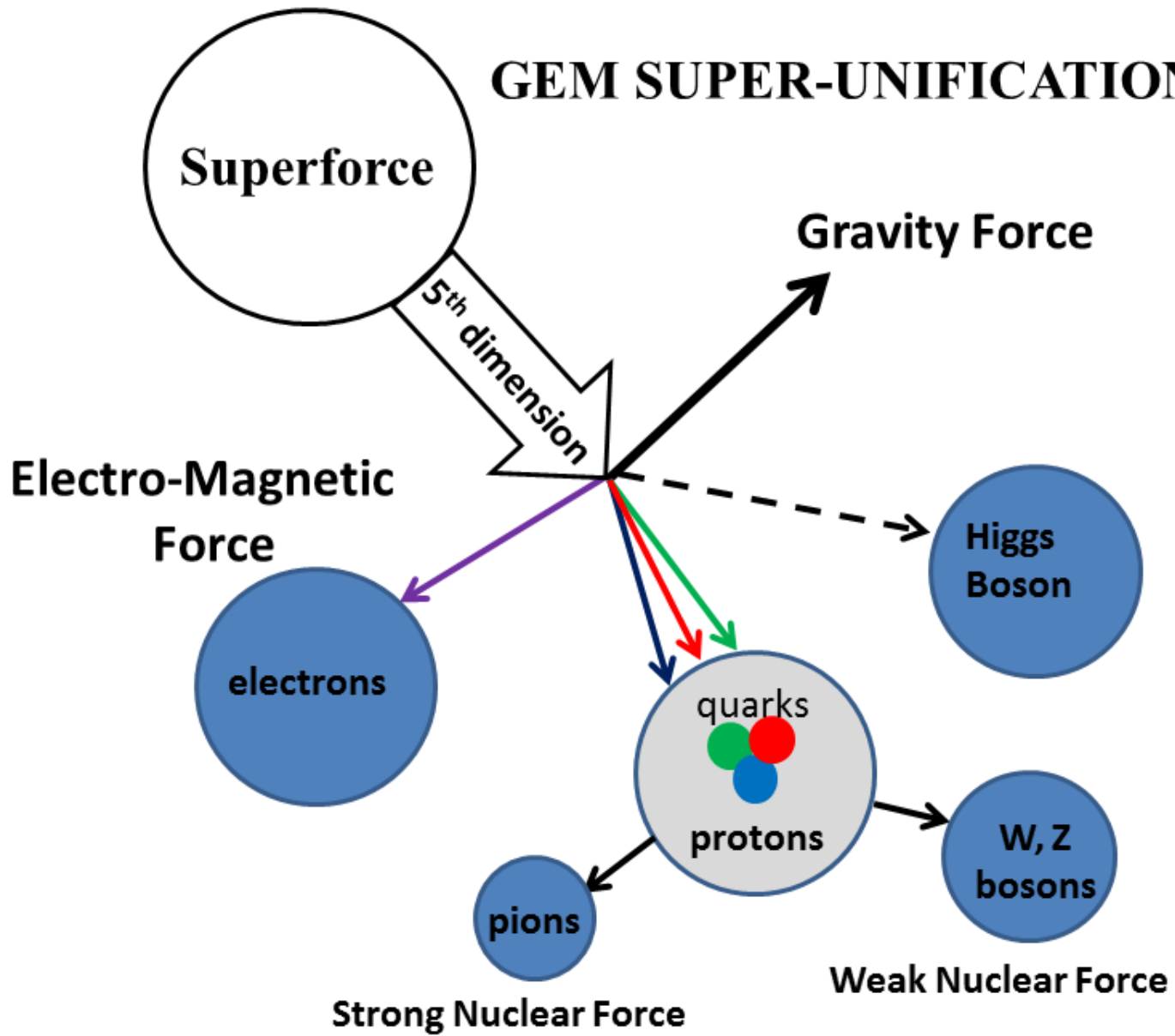**Spontaneous Symmetry Breaking**
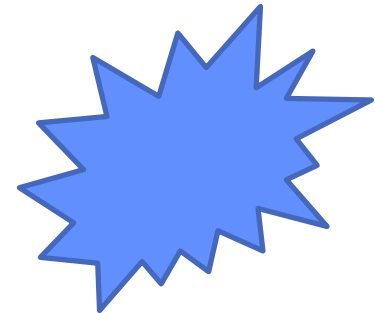
Empty Space → **Big Bang**

Vacuum Energy

E

σ

Compactification of a 5th Dimension

Empty Space → **Big Bang**

DISTRIBUTIO

Correspondence with Electroweak theory

$$\frac{m_W}{m_Z} = Cos(\theta_W) = \frac{1}{1 + 5/\sigma} = .8813 \qquad \sigma = 42.85035$$

$$\sigma = \frac{5}{1 - \left(\dfrac{m_W}{m_Z}\right)_{Obs.}} = 42.3$$

Particles	Particle Properties		
	Predicted Mass	Measured Mass	% error
π_o	135.12MeV	134.98MeV	0.1%
Z	91.03GeV	91.19GeV	0.2%
Higgs	124.1GeV	125.1GeV	0.8%
M*	21.98MeV	****	***