Advanced Propulsion Workshop -2017

Entanglement Drive Analysis of the Mach Effect Thruster

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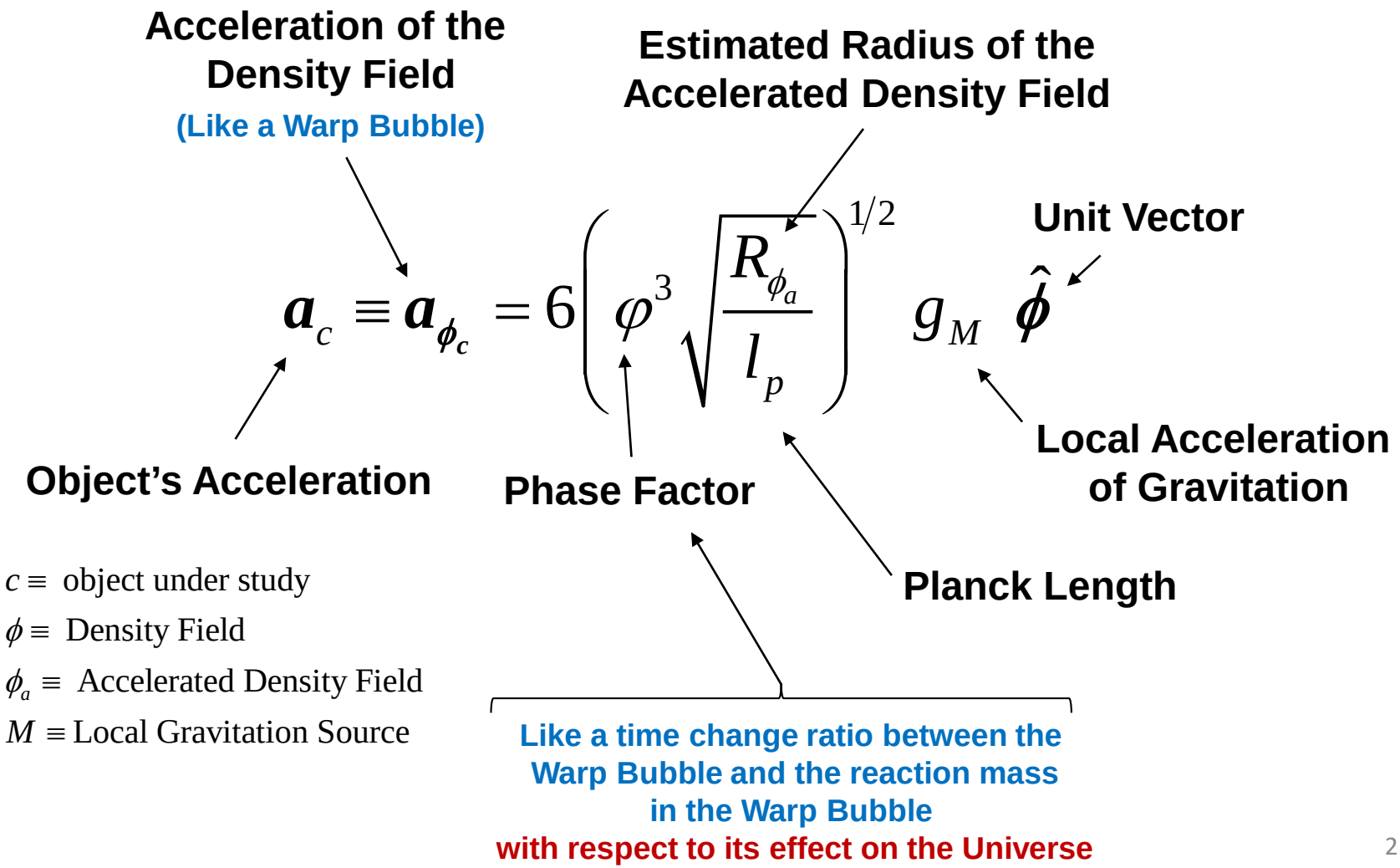
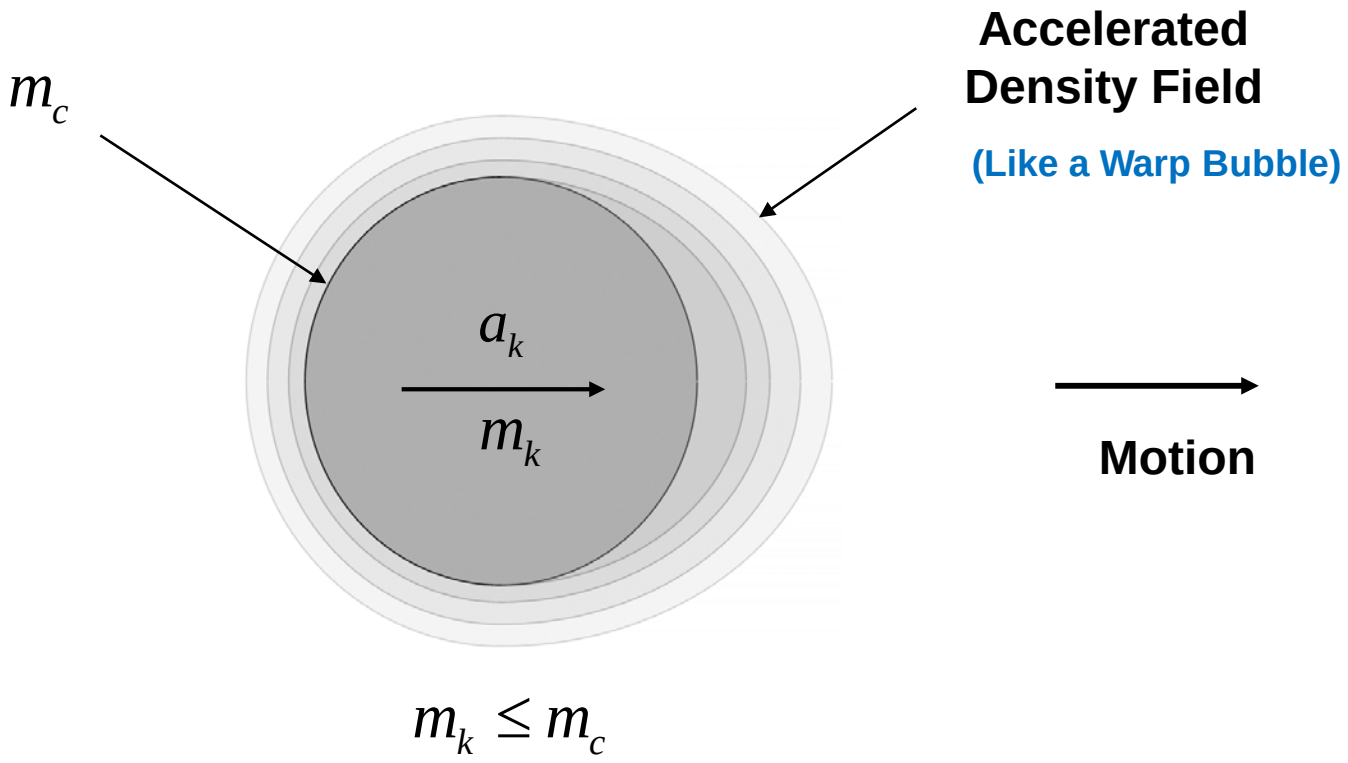
Part 2

Generalized Form of a New Non-Gravitational Acceleration Equation

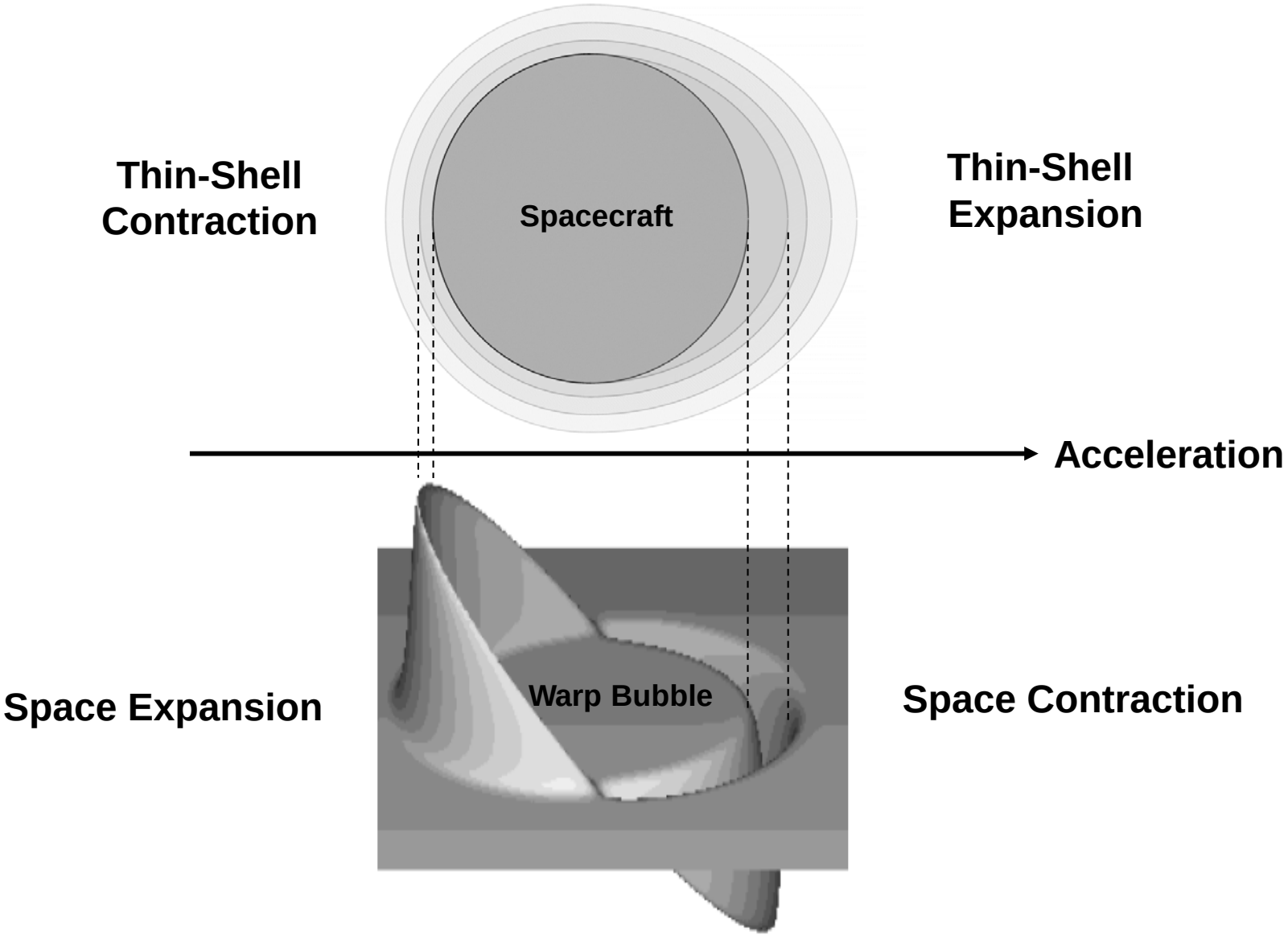


ACCELERATION MECHANISM



$c \equiv$ object under study

$k \equiv$ accelerated mass in the object under study


Thin-Shell
Contraction
Spacecraft
Thin-Shell
Expansion
Acceleration
Space Expansion
Warp Bubble
Space Contraction

Warp Drive

Phase Factor

$$\varphi \equiv \frac{time\ rate\ of\ \ change\ of\ \ the\ \text{Warp Bubble}}{time\ rate\ of\ \ change\ of\ \ the\ accelerated\ \ m_k} \qquad \alpha_U \approx \left(\frac{dt_\phi}{dt_k}\right)\alpha_U$$

$$\alpha_U \equiv \frac{Universe\ normalization\ of\ \ dt_k}{Universe\ normalization\ of\ \ dt_\phi} = \frac{dt_{k_U}}{dt_{\phi_U}}$$

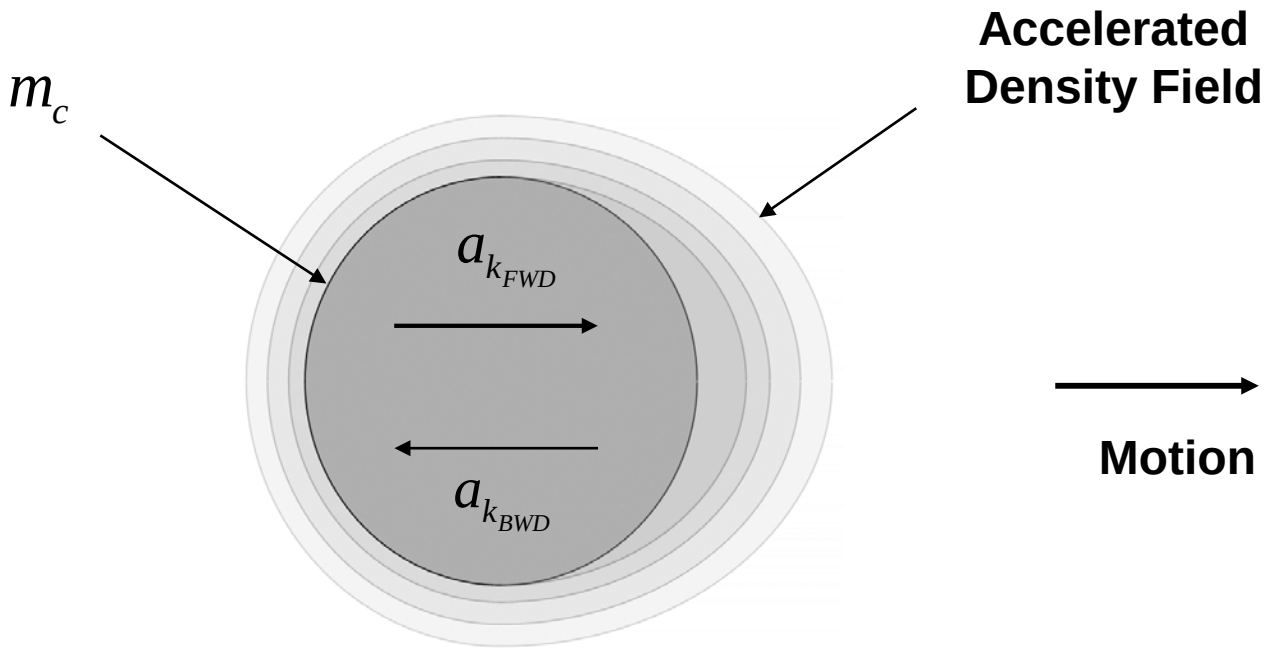
$$dt_\phi \approx dt_{\phi_U}$$ **Implies a Mach Effect System**

Estimated Radius of the Accelerated Density Field

$$R_\phi = \frac{R_c}{\left(1+\left(\frac{a_k}{g_M}\right)\left(\frac{m_k}{m_c}\right)\right)^{1/3}}$$

ACCELERATION MECHANISM

Entanglement Drive



$$a_{k_{FWD}} > a_{k_{BWD}}$$

$$m_k \leq m_c$$

ACCELERATION MECHANICS
FOR
ENTANGLEMENT DRIVE

$$\boldsymbol{a}_{\boldsymbol{\phi}_c} \equiv \boldsymbol{a}_{\boldsymbol{\phi}_{ED}} \approx f_{A_{FWD}}\, dt_{\phi_{FWD}}\, \boldsymbol{a}_{\boldsymbol{\phi}_{FWD}} - f_{A_{BWD}}\, dt_{\phi_{BWD}}\, \boldsymbol{a}_{\boldsymbol{\phi}_{BWD}}$$

$f_A \equiv$ Frequency of the accelerated mass

$dt_\phi \equiv$ Time rate of change of the density field

ACCELERATION MECHANICS
FOR
ENTANGLEMENT DRIVE

$$\varphi_{FWD} \approx \left(\frac{1}{\eta_{\phi_{FWD}}\eta_{k_{FWD}}}\right)\left(\frac{1}{M_E^2\left(d_{k_{FWD}}R_c\right)}\right) \qquad \varphi_{BWD} \approx \left(\frac{1}{\eta_{\phi_{BWD}}\eta_{k_{BWD}}}\right)\left(\frac{1}{M_E^2\left(d_{k_{BWD}}R_c\right)}\right)$$

(Type I)

$$R_{\phi_{FWD}} = \frac{R_c}{\left(1+\left(\frac{a_{k_{FWD}}}{g_M}\right)\left(\frac{m_{k_{FWD}}}{m_c}\right)\right)^{1/3}} \qquad R_{\phi_{BWD}} = \frac{R_c}{\left(1+\left(\frac{a_{k_{BWD}}}{g_M}\right)\left(\frac{m_{k_{BWD}}}{m_c}\right)\right)^{1/3}}$$

(Type II)

m_k and a_k are unknown

d_k is estimated from test object

R_ϕ is estimated from test data

Cosmological Energy Scale Factor.

$$M_E \approx \left(\frac{\Lambda}{8\pi l_p^2} \right)^{1/4} \approx 11378\ m^{-1}$$

Λ **- Cosmological Constant**

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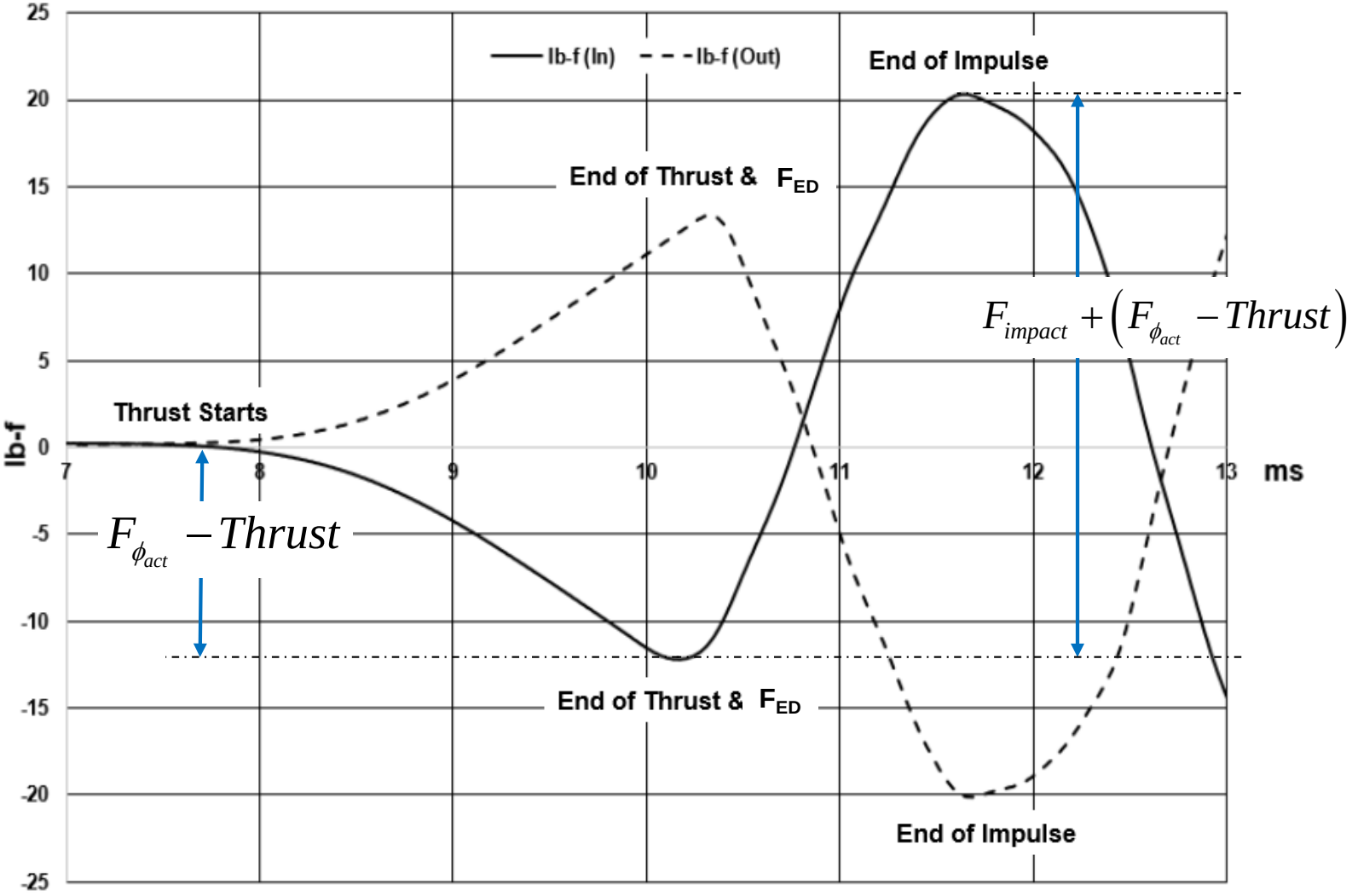
Dual Position Latching Actuator Test

Single Impulse



Entanglement Drive

Dual Position Latching Actuator

$$F_{\phi_{act}} \approx m_{act} a_{\phi_{act}} \approx 91.38 \text{ N } (\square\ 20.54 \text{ lbs})$$

$$a_{\phi_{act}} \approx 6\left(\varphi_{act}^{3}\sqrt{\frac{R_{\phi_{act}}}{l_p}}\right)^{1/2} \quad g_N \approx 404.34 \ m/s^2$$

Single Impulse

$$R_{\phi_{act}} \approx \left(1+\left(\frac{a_{arm}}{g_{\oplus}}\right)\left(\frac{m_{arm}}{m_{act}}\right)\right)^{-1/3} \quad R_{act} \approx 0.0085 \ m$$

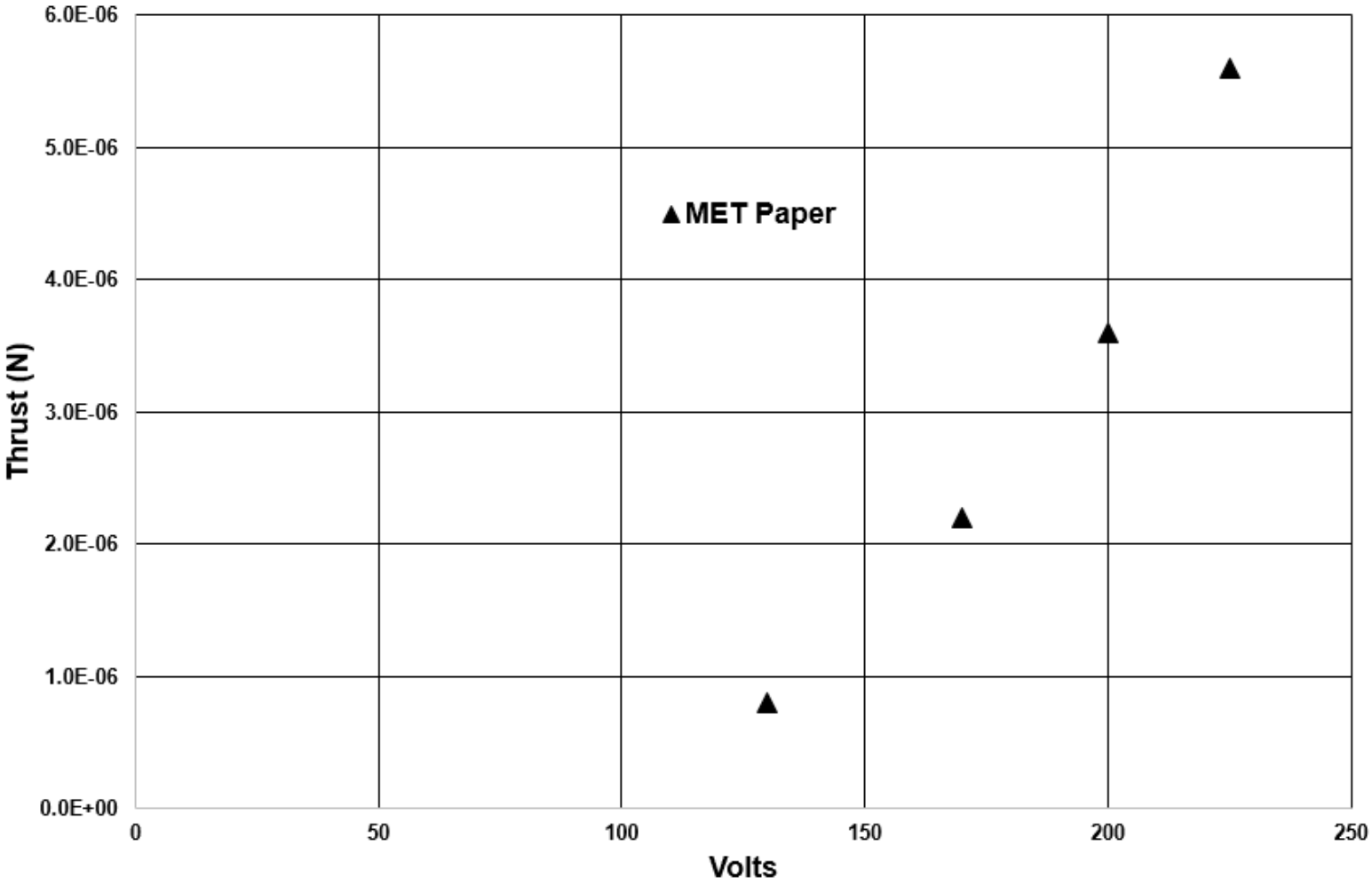
$$\varphi_{act} \approx \eta\left(\frac{1}{8\pi M_E^2 d_{arm} R_{act}}\right) \approx \eta\left(1.24\times10^{-5}\right)$$

Type I

$$\eta_\phi \eta_k = 8\pi/\eta \qquad \eta = 1.0256$$

PZT - Mach Effect Thruster

Frequency Modulated



Entanglement Drive

PZT - Mach Effect Thruster

Frequency Modulated

Voltage

$$\boldsymbol{F}_{\phi_V} = m_{MET}\left(f_A dt_{\phi_V} \boldsymbol{a}_{\phi_V} \right) \approx \frac{9}{2} f_A \left(\frac{R_{\phi_V}}{c} \right) \left(\varphi_V^3 \sqrt{\frac{R_{\phi_V}}{l_p}} \right)^{1/2} W_c \, \hat{\boldsymbol{\phi}}$$

$$dt_{\phi_V} = \frac{3}{4}\left(\frac{R_{\phi_V}}{c} \right) \qquad W_c = m_{MET} g_{\oplus}$$

$$\boldsymbol{a}_{\phi_V} \approx 6 \left(\varphi_V^3 \sqrt{\frac{R_{\phi_V}}{l_p}} \right)^{1/2} g_M \, \hat{\boldsymbol{\phi}}$$

Entanglement Drive

PZT - Mach Effect Thruster

Frequency Modulated

$$M_E \approx \left(\frac{\Lambda}{8\pi l_p^2} \right)^{1/4}$$

$$\varphi_V \approx \frac{3}{4\pi} \left(\frac{1}{M_E R_c} \right)$$

$$dt_\phi \approx dt_{\phi_U} \longrightarrow R_{\phi_V} \approx \left(M_E d_{k_V} \right) R_c$$

A Mach Effect System

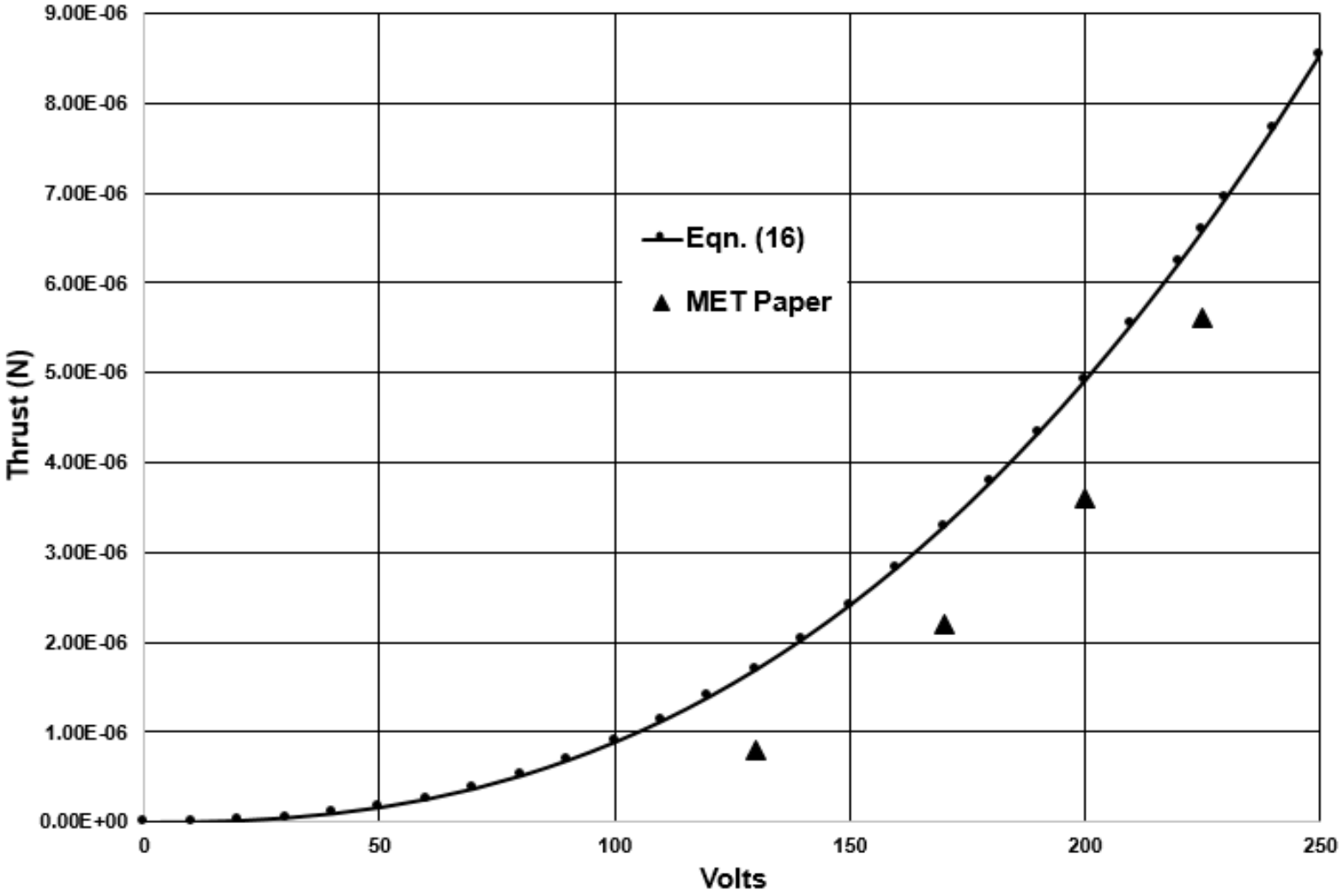
$$d_{k_V} = \left(K_p V + K_e V^2 \right) x_0$$

Type II

$$\varphi_V \approx \left(\frac{1}{\eta_{\phi_V} \eta_{k_V}} \right) \left(\frac{1}{M_E^2 \left(d_{k_V} R_c \right)} \right) \approx \frac{dt_\phi}{dt_k} \frac{dt_{k_U}}{dt_{\phi_U}}$$

PZT - Mach Effect Thruster

Frequency Modulated



Entanglement Drive

PZT - Mach Effect Thruster

Frequency Modulated

$$\underbrace{F_{\phi_M}} \approx f_A dt_{\phi_M} \boldsymbol{a}_{\boldsymbol{\phi}_M} \approx \frac{9}{2} f_A \left(dt_{\phi_M} \left(\varphi_M^3 \sqrt{\frac{R_{\phi_M}}{l_p}} \right)^{1/2} \right) W_c \approx 10^{-6}\, N$$

Mechanical

Entanglement Drive

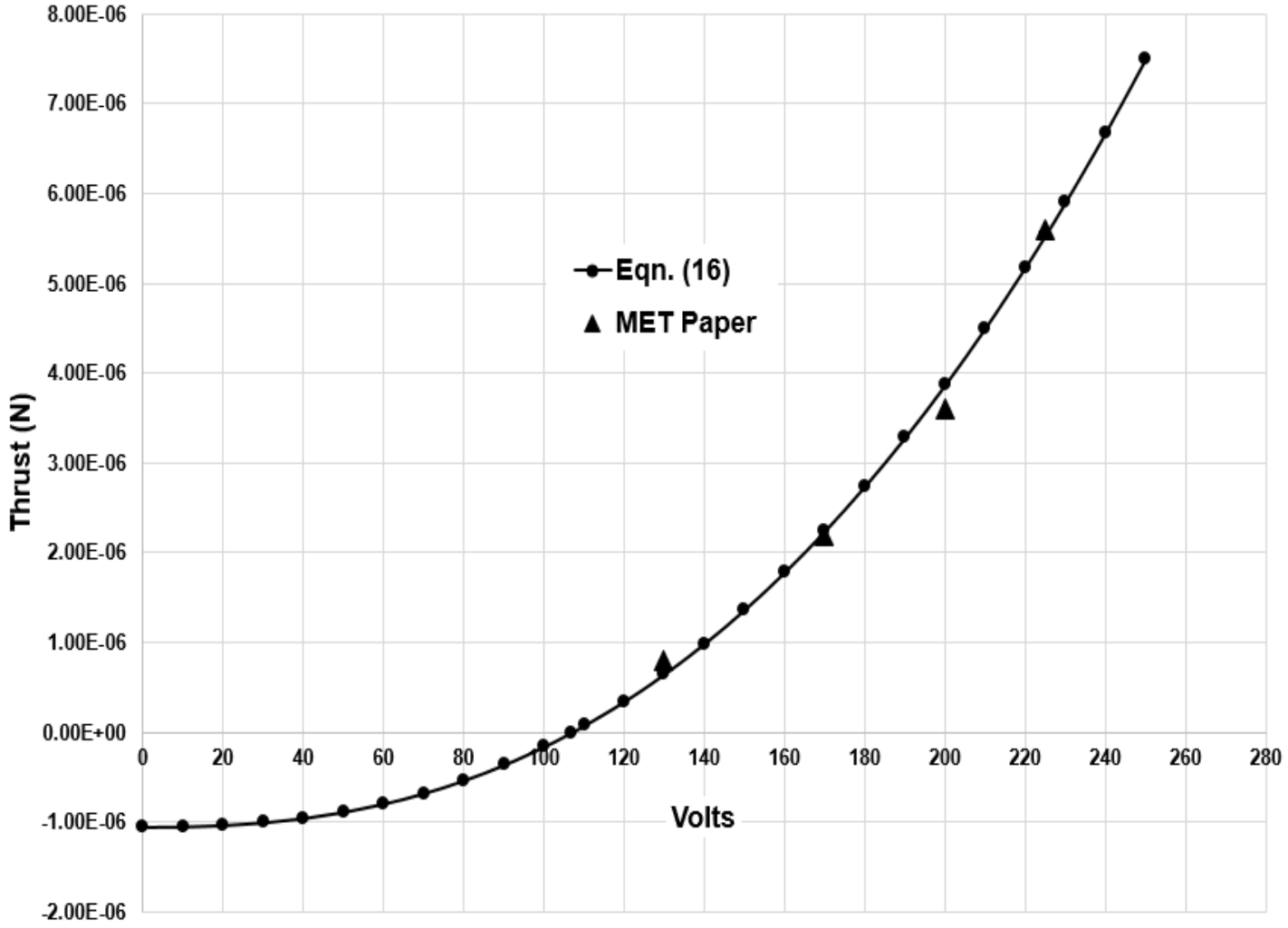
PZT - Mach Effect Thruster

Frequency Modulated

$$T = \underbrace{F_{\phi_V}}_{\text{Voltage}} - \underbrace{F_{\phi_M}}_{\text{Mechanical}} \approx \frac{9}{2} f_A \left(\left(\frac{R_{\phi_V}}{c} \right) \left(\varphi_V^3 \sqrt{\frac{R_{\phi_V}}{l_p}} \right)^{1/2} \right) W_c - 10^{-6} N$$

PZT - Mach Effect Thruster

Frequency Modulated



THE ACCELERATION EQUATION FOR:

MACH EFFECT THRUSTERS
OR
NEW PROPELLANT-LESS SPACE DRIVES
OR
WARP DRIVES

$$\boldsymbol{a} \approx f_{A_{FWD}}\, dt_{\phi_{FWD}}\, \boldsymbol{a}_{\phi_{FWD}} - f_{A_{BWD}}\, dt_{\phi_{BWD}}\, \boldsymbol{a}_{\phi_{BWD}}$$

Where all you need to know is the internal reaction mass and its

- **Forward and backward accelerations, and**
- **Frequency of the internal mass acceleration.**

Forward Work

$$\boldsymbol{a}_{\phi_c} = 6\left(\varphi^3\sqrt{\frac{R_{\phi_a}}{l_p}}\right)^{1/2} g_M\ \hat{\boldsymbol{\phi}}$$

$$\ln\left(\frac{a_k}{g_M}\right)\sqrt{1-\left(a_k dt\right)^2/c^2} \approx 6$$

For current test data

Lorentz Factor

- To drive the field acceleration to zero at the acceleration of gravity, and
- Prevent a violation of the conservation of energy at the speed of light