DEVELOPMENT OF m THEORY PART ONE: RELATIVISTIC KINETIC ENERGY, EINSTEIN ENERGY EQUATION, AND POTENTIAL ENERGY DUE TO m (r).

by

M. W. Evans and H. Eckardt,

Civil List and AIAS / UPITEC

(www.aias.us, www.upitec.org, www.et3m.net, www.archive.org, , www.webarchive.org.uk)

ABSTRACT

The systematic development is initiated of classical dynamics in the most general spherically symmetric spacetime (m space). The Einstein energy equation, the rest energy, the relativistic kinetic energy and the potential energy due to m (r) (the energy due to spacetime, vacuum or aether) are derived systematically. Rigorous self consistency of concepts and methods is demonstrated.

Keywords: Development of m theory, relativistic kinetic energy, Einstein energy equation, rest energy, potential energy from m (r).

4FT 418

1. INTRODUCTION

In the immediately preceding paper (UFT417) of this series {1 - 41}, the natural philosophy (m theory) was initiated of the most general spherically symmetric spacetime (m space). It was shown that in that type of naturally philosophy or physics, superluminal signalling, infinite energy from m space, and counter gravitation are rigorously possible. In Section 2 of this paper the m theory is developed systematically in classical dynamics to derive the relativistic kinetic energy the Einstein energy equation, the rest energy, and potential energy from m (r). The latter is defined by the infinitesimal line element of m space. The rigorous self consistency of concepts and methods is demonstrated in several complementary ways.

This paper is a brief synopsis of extensive calculations found in the notes accompanying UFT418 on www.aias.us . Note 418(1) defines the classical limit of the hamiltonian and lagrangian of m theory, which is part of the ECE and ECE2 generally covariant unified field theory. Note 418(2) is a demonstration of the rigorous self consistency of the Hamiltonian and Lagrangian methods used in m theory. Note 418(3) the flat spacetime limit, the work integral and begins the derivation of the relativistic kinetic energy in m space. Note 418(4) derives the relativistic kinetic energy of m space from the work integral over the relativistic momentum of m space. Note 418(5) is a convenient summary of m space classical dynamics, a demonstration of the rigorous self consistency of the Lagrangian method used in m space, a derivation of the ECE2 spin connection from m theory and initial development of a concept unique to m theory: the potential energy of m space. This is the rigorous definition of "energy from spacetime", "vacuum energy", or "aether energy". Note 418(6) derives the Einstein energy equation of m space from its relativistic linear momentum. This method also derives the rest energy of m space. Notes 418(7) and 418(8) give a rigorously self consiste derivation of the important potential energy due to m space ("the energy of the vacuum").

In Section 3, the calculations and concepts of Section 2 are analysed numerically and graphically, so that the meaning of the complicated mathematics becomes clear.

2. FUNDAMENTAL CONCEPTS

The frame of reference used in m theory is ($\underline{r}_1$, ϕ), which is a self consistent development of the plane polar coordinates ($\underline{r}$, ϕ). Here:

$$\underline{r}_1 = \frac{\underline{r}}{m(r)^{1/2}} \quad -(1)$$

where the m (r_1) function is defined by the infinitesimal line element of the most general spherically symmetric spacetime:

$$ds^2 = c^2 d\tau^2 = m(r)\, c^2 dt^2 - \frac{dr^2}{m(r)} - r^2 d\phi^2 \quad -(2)$$

Here τ is the proper time and c the speed of light in vacuo, taken to be a universal constant. The hamiltonian of m theory is:

$$H = \gamma\, m(r_1)\, mc^2 - \frac{mMG}{r_1} \quad -(3)$$

where the potential energy of interaction of a mass m orbiting a mass M is:

$$U = -\frac{mMG}{r_1}. \quad -(4)$$

Here

$$\gamma = \left(m(r_1) - \frac{\underline{r}_1 \cdot \underline{r}_1}{c^2} \right)^{-1/2} \quad -(5)$$

is the Lorentz factor in m space {1 - 41}. The lagrangian of m space is:

$$\mathcal{L} = -mc^2 \left(m(r_1) - \frac{1}{c^2}\, \dot{\underline{r}}_1 \cdot \dot{\underline{r}}_1 \right)^{1/2} + \frac{mMG}{r_1} \quad -(6)$$

It is shown in Note 418(2) and 418(5) that the vector Euler Lagrange equation:

$$\frac{d}{dt}\frac{\partial \mathcal{L}}{\partial \dot{\underline{r}}_1} = \frac{\partial \mathcal{L}}{\partial \underline{r}_1} = \underline{\nabla} \mathcal{L} = \frac{\partial \mathcal{L}}{\partial r_1}\underline{e}_r \quad -(7)$$

is rigorously equivalent to the scalar Euler Lagrange equations:

$$\frac{d}{dt}\frac{\partial \mathcal{L}}{\partial \dot{r}_1} = \frac{\partial \mathcal{L}}{\partial r_1} \quad -(8)$$

and

$$\frac{d}{dt}\frac{\partial \mathcal{L}}{\partial \dot{\phi}} = \frac{\partial \mathcal{L}}{\partial \phi} \quad -(9)$$

where:

$$\dot{\underline{r}}_1 \cdot \dot{\underline{r}}_1 = \dot{r}_1^2 + r_1^2\dot{\phi}^2. \quad -(10)$$

Eq. (9) gives the conserved angular momentum of m theory:

$$L = \frac{\partial \mathcal{L}}{\partial \dot{\phi}} = \gamma m r_1^2 \dot{\phi} \quad -(11)$$

so that:

$$\frac{dL}{dt} = 0. \quad -(12)$$

The hamiltonian of m theory is conserved, so:

$$\frac{dH}{dt} = 0 \quad -(13)$$

The equations of motion of m theory are therefore:

$$\frac{dH}{dt} = 0 \quad -(14)$$

and

$$\frac{dL}{dt} = 0. \quad -(15)$$

These are rigorously consistent with the equations of motion from the lagrangian of m theory. In the preceding paper (UFT417) it was shown that the hamiltonian, lagrangian and equations of motion give forward and retrograde precession of orbits, shrinking orbits, the possibility of expanding orbits and counter gravitation, superluminal signalling and infinite potential energy from m (r). These are major advances in classical dynamics.

The relativistic kinetic energy of m theory is evaluated from the work integral:

$$W_{12} = T_2 - T_1 = \int_1^2 \underline{F}_1 \cdot d\underline{r} \quad -(16)$$

from state 1 to state 2. The force in m theory is:

$$\underline{F}_1 = \frac{d\underline{p}_1}{dt} = \frac{d}{dt}\left(\gamma m \dot{\underline{r}}_1\right) \quad -(17)$$

where γ is the Lorentz factor of m theory, first derived in immediately preceding papers. If the initial state is for a particle at rest, and the final state for a particle with velocity v_1, the relativistic kinetic energy of m theory is:

$$W = T = \int \frac{d}{dt}\left(\gamma m \dot{\underline{r}}_1\right) \cdot \dot{\underline{r}}_1 \, dt = m \int_0^{v_1} v_1 \, d(\gamma v_1) \quad -(18)$$

Integrating by parts:

$$\int_0^{v_1} v_1 \, d(\gamma v_1) = \gamma v_1^2 - \int_0^{v_1} \gamma v_1 \, dv_1 \quad -(19)$$

where

$$\gamma = \left(m(r_1) - \frac{v_1^2}{c^2}\right)^{-1/2} \quad -(20)$$

It follows that:

$$m\int_0^{v_1}\gamma v_1\,dv_1 = -mc^2\left(m(r_1)-\frac{v_1^2}{c^2}\right)^{1/2}\Bigg|_0^{v_1} \quad -(21)$$

because:

$$\frac{d}{dv_1}\left(m(r_1)-\frac{v_1^2}{c^2}\right)^{1/2} = -\frac{v_1}{c^2}\left(m(r_1)-\frac{v_1^2}{c^2}\right)^{-1/2} \quad -(22)$$

It has been assumed that:

$$\frac{dm(r_1)}{dv_1} = 0 \quad -(23)$$

The reason for this is that the general spherically symmetric spacetime is:

$$ds^2 = g_{aa}(a,b)\,da^2 + g_{ab}(a,b)(da\,db+db\,da) + g_{bb}(a,b)\,db^2 + r^2(a,b)\,d\Omega^2 \quad -(24)$$

in spherical polar coordinates. Here a and b are coordinates and $r^2(a,b)$ is an undetermined function. The coordinate function $m(r_1)$ therefore does not depend on the velocity v_1 of a particle, and Eq. (22) follows.

From Eq. (21):

$$m\int_0^{v_1} v_1\,d(\gamma v_1) = m\gamma v_1^2 + mc^2\left(m(r_1)-\frac{v_1^2}{c^2}\right)^{1/2}\Bigg|_0^{v_1} \quad -(25)$$

Therefore the relativistic kinetic energy of m space is:

$$T = \gamma m v_1^2 + \frac{mc^2}{\gamma} - m(r_1)^{1/2}mc^2 \quad -(26)$$

From the generalized Lorentz factor (20):

$$v_1^2 = c^2\left(m(r_1)-\frac{1}{\gamma^2}\right) \quad -(27)$$

so:

$$T = \gamma mc^2 \left(m(r_1) - \frac{1}{\gamma^2} \right) + \frac{mc^2}{\gamma} - m(r)^{1/2} mc^2$$

$$= m(r_1)\gamma mc^2 - m(r_1)^{1/2} mc^2 \quad -(28)$$

From the infinitesimal line element (2) the total relativistic energy in m space is:

$$E = m(r_1)\gamma mc^2 \quad -(29)$$

Therefore the relativistic kinetic energy in m space is:

$$T = E - m(r_1)^{1/2} mc^2 \quad -(30)$$

The Einstein energy equation in m space is found from the relativistic linear momentum in m space:

$$\underline{p_1} = \gamma m \underline{v_1} = \gamma m \underline{\dot{r}_1} \quad -(31)$$

From Eq. (31):

$$p_1^2 c^2 = \gamma^2 m^2 v_1^2 c^2 = \gamma^2 m^2 c^4 \frac{v_1^2}{c^2} \quad -(32)$$

where

$$\frac{v_1^2}{c^2} = m(r_1)^2 - \frac{1}{\gamma^2} \quad -(33)$$

from the Lorentz factor of m space, Eq. (20). It follows that:

$$p_1^2 c^2 = \gamma^2 m^2 c^4 \left(m(r)^2 - \frac{1}{\gamma^2} \right) \quad -(34)$$

and:

$$E^2 = p_1^2 c^2 + E_0^2 \quad -(35)$$

which is the Einstein energy equation in m space, Q. E. D. Here

$$E_0 = mc^2 \quad -(36)$$

is the rest energy in m space. Defining the four momentum:

$$p_1^\mu = \left(\frac{E}{c}, \underline{p_1} \right) \quad -(37)$$

the Einstein energy equation in m space becomes:

$$p_1^\mu p_{1\mu} = m^2 c^4 \quad -(38)$$

This is an equation of ECE and ECE2 generally covariant unified field theory and can be quantized to a wave equation and related to the tetrad postulate of Cartan geometry.

The classical dynamics of m space can be developed using the force equation:

$$\underline{F}_1 = \frac{d\underline{p_1}}{dt} = -\left(\frac{mc^2}{2} \gamma \frac{dm(r_1)}{dr_1} - \frac{mMG}{r_1^2} \right) \underline{e}_r \quad -(39)$$

which is the direct result of the Euler Lagrange equation (7) with the m space lagrangian (6). This contains the new force term:

$$\underline{F} = -\frac{mc^2}{2} \gamma \frac{dm(r_1)}{dr_1} \underline{e}_r \quad -(40)$$

which in UFT417 was defined as the vacuum force. In the (r , ϕ) coordinate system:

$$\underline{F} = mc^2 \left(\frac{\gamma m(r)^{3/2}}{r \frac{dm(r)}{dr} - 2m(r)} \right) \frac{dm(r)}{dr} \underline{e}_r \quad -(41)$$

and the vacuum force goes to infinity when:

$$r\frac{dm(r)}{dr} = 2m(r). \quad -(42)$$

Using the work theorem:

$$T_2 - T_1 = U_1 - U_2 = -\frac{mc^2}{2}\int_1^2 \gamma \frac{dm(r_1)}{dr_1}\, dr_1 \quad -(43)$$

as usual in classical dynamics. Here:

$$\Delta U = U_1 - U_2 \quad -(44)$$

is the change in potential energy. In flat spacetime:

$$\frac{dm(r_1)}{dr_1} = 0 \quad -(45)$$

so:

$$\Delta U = 0 \quad -(46)$$

From Eq. (43), total energy is conserved:

$$T_1 + U_1 = T_2 + U_2. \quad -(47)$$

The change in potential energy due to the vacuum force is therefore:

$$\Delta U = -\frac{mc^2}{2}\int_1^2 \gamma\, dm(r_1) = -\frac{mc^2}{\gamma}\Big|_1^2 \quad -(48)$$

If it is assumed that the initial state is that of a particle at rest:

$$v_1 = 0 \quad -(49)$$

then:

$$\Delta U = -mc^2 \left(\left(m(r_1) - \frac{v_1^2}{c^2} \right)^{1/2} - m(r_1)^{1/2} \right) \quad -(50)$$

Note carefully that this is non-zero if and only if:

$$\frac{dm(r_1)}{dr_1} \neq 0. \quad -(51)$$

In the classical limit:

$$v_1 << c \quad -(52)$$

the change in potential energy due to m (r_1) is:

$$\Delta U = -mc^2 m(r_1)^{1/2} \left(\left(1 - \frac{v_1^2}{m(r_1)c^2} \right)^{1/2} - 1 \right) \rightarrow \frac{1}{2} \frac{mv_1^2}{m(r_1)^{1/2}} \quad -(53)$$

and in the limit of flat spacetime:

$$T = \Delta U \rightarrow \frac{1}{2} mv^2 \quad -(54)$$

in the usual (r, ϕ) coordinate system.

The velocity v can be thought of as that of a vacuum particle, and is imparted to the material particle of mass m by the fact that:

$$dm(r_1) / dr_1 \neq 0 \quad -(55)$$

Integrating by parts as in Note 418(8):

$$\int \gamma \frac{dm(r_1)}{dr_1} dr_1 = \gamma m(r_1) - \int m(r_1) d\gamma. \quad -(56)$$

The function $dm(r_1)/dr_1$ becomes infinite at:

$$r \frac{dm(r)}{dr} = 2m(r). \quad -(57)$$

Self consistently from Eq. (56), in the flat spacetime limit of:

$$\frac{dm(r_1)}{dr_1} = 0 \quad -(58)$$

it follows that:

$$\gamma \to \infty. \quad -(59)$$

From Eq. (56), the condition (59) can be satisfied by:

$$m(r_1) = v_1^2 / c^2 \quad -(60)$$

i. e.

$$m(r) = \frac{v^2}{c^2} \cdot \frac{1}{m(r)} \quad -(61)$$

In the (r, ϕ) coordinate system this means:

$$m(r) = \frac{v}{c}. \quad -(62)$$

3. NUMERICAL ANALYSIS AND GRAPHICS

ACKNOWLEDGMENTS

The British Government is thanked for a Civil List Pension and the staff of AIAS and others for many interesting discussions. Dave Burleigh, CEO of Annexa Inc., is thanked for voluntary posting, site maintenance and feedback maintenance. Alex Hill is thanked for many translations, and Robert Cheshire and Michael Jackson for broadcasting and video preparation.

REFERENCES

{1} M. W. Evans, H. Eckardt, D. W. Lindstrom, D. J. Crothers and U. E. Bruchholtz. "Principles of ECE Theory, Volume Two" (ePubli, Berlin 2017).

{2} M. W. Evans, H. Eckardt, D. W. Lindstrom and S. J. Crothers, "Principles of ECE Theory, Volume One" (New Generation, London 2016, ePubli Berlin 2017).

{3} M. W. Evans, S. J. Crothers, H. Eckardt and K. Pendergast, "Criticisms of the Einstein Field Equation" (UFT301 on www.aias.us and Cambridge International 2010).

{4} M. W. Evans, H. Eckardt and D. W. Lindstrom "Generally Covariant Unified Field Theory" (Abramis 2005 - 2011, in seven volumes softback, open access in various UFT papers, combined sites www.aias.us and www.upitec.org).

{5} L. Felker, "The Evans Equations of Unified Field Theory" (Abramis 2007, open access as UFT302, Spanish translation by Alex Hill).

{6} H. Eckardt, "The ECE Engineering Model" (Open access as UFT203, collected equations).

{7} M. W. Evans, "Collected Scientometrics" (open access as UFT307, New Generation, London, 2015).

{8} M .W. Evans and L. B. Crowell, "Classical and Quantum Electrodynamics and the B(3) Field" (World Scientific 2001, open access in the Omnia Opera section of www.aias.us).

{9} M . W. Evans and S. Kielich, Eds., "Modern Nonlinear Optics" (Wiley Interscience, New York, 1992, 1993, 1997 and 2001) in two editions and six volumes, hardback, softback and e book.

{10} M. W. Evans and J. - P. Vigier, "The Enigmatic Photon" (Kluwer, Dordrecht, 1994 to 1999) in five volumes hardback and five volumes softback, open source in the Omnia Opera Section of www.aias.us).

{11} M. W. Evans, Ed. "Definitive Refutations of the Einsteinian General Relativity" (Cambridge International Science Publishing, 2012, open access on combined sites).

{12} M. W. Evans, Ed., J. Foundations of Physics and Chemistry (Cambridge International Science Publishing).

{13} M. W. Evans and A. A. Hasanein, "The Photomagneton in Quantum Field Theory (World Scientific 1974).

{14} G. W. Robinson, S. Singh, S. B. Zhu and M. W. Evans, "Water in Biology, Chemistry and Physics" (World Scientific 1996).

{15} W. T. Coffey, M. W. Evans, and P. Grigolini, "Molecular Diffusion and Spectra" (Wiley Interscience 1984).

{16} M. W. Evans, G. J. Evans, W. T. Coffey and P. Grigolini", "Molecular Dynamics and the Theory of Broad Band Spectroscopy (Wiley Interscience 1982).

{17} M. W. Evans, "The Elementary Static Magnetic Field of the Photon", Physica B, 182(3), 227-236 (1992).

{18} M. W. Evans, "The Photon's Magnetic Field: Optical NMR Spectroscopy" (World Scientific 1993).

{19} M. W. Evans, "On the Experimental Measurement of the Photon's Fundamental Static Magnetic Field Operator, B(3): the Optical Zeeman Effect in Atoms", Physica B, 182(3), 237 - 143 (1982).

{20} M. W. Evans, "Molecular Dynamics Simulation of Induced Anisotropy: I Equilibrium Properties" , J. Chem. Phys., 76, 5473 - 5479 (1982).

{21} M. W. Evans, "A Generally Covariant Wave Equation for Grand Unified Theory" Found. Phys. Lett., 16, 513 - 547 (2003).

{22} M. W. Evans, P. Grigolini and P. Pastori-Parravicini, Eds., "Memory Function Approaches to Stochastic Problems in Condensed Matter" (Wiley Interscience, reprinted 2009).

{23} M. W. Evans, "New Phenomenon of the Molecular Liquid State: Interaction of Rotation and Translation", Phys. Rev. Lett., 50, 371, (1983).

{24} M .W. Evans, "Optical Phase Conjugation in Nuclear Magnetic Resonance: Laser NMR Spectroscopy", J. Phys. Chem., 95, 2256-2260 (1991).

{25} M. W. Evans, "New Field induced Axial and Circular Birefringence Effects" Phys. Rev. Lett., 64, 2909 (1990).

{26} M. W. Evans, J. - P. Vigier, S. Roy and S. Jeffers, "Non Abelian Electrodynamics", "Enigmatic Photon V olume 5" (Kluwer, 1999)

{27} M. W. Evans, reply to L. D. Barron "Charge Conjugation and the Non Existence of the Photon's Static Magnetic Field" , Physica B, 190, 310-313 (1993).

{28} M. W. Evans, "A Generally Covariant Field Equation for Gravitation and Electromagnetism" Found. Phys. Lett., 16, 369 - 378 (2003).

{29} M. W. Evans and D. M. Heyes, "Combined Shear and Elongational Flow by Non Equilibrium Electrodynamics", Mol. Phys., 69, 241 - 263 (1988).

{30} Ref. (22), 1985 printing.

{31} M. W. Evans and D. M. Heyes, "Correlation Functions in Couette Flow from Group Theory and Molecular Dynamics", Mol. Phys., 65, 1441 - 1453 (1988).

{32} M. W. Evans, M. Davies and I. Larkin, Molecular Motion and Molecular Interaction in the Nematic and Isotropic Phases of a Liquid Crystal Compound", J. Chem. Soc. Faraday II, 69, 1011-1022 (1973).

{33} M. W. Evans and H. Eckardt, "Spin Connection Resonance in Magnetic Motors", Physica B., 400, 175 - 179 (2007).

{34} M. W. Evans, "Three Principles of Group Theoretical Statistical Mechanics", Phys. Lett. A, 134, 409 - 412 (1989).

{35} M. W. Evans, "On the Symmetry and Molecular Dynamical Origin of Magneto Chiral Dichroism: "Spin Chiral Dichroism in Absolute Asymmetric Synthesis" Chem. Phys. Lett., 152, 33 - 38 (1988).

{36} M. W. Evans, "Spin Connection Resonance in Gravitational General Relativity", Acta Physica Polonica, 38, 2211 (2007).

{37} M. W. Evans, "Computer Simulation of Liquid Anisotropy, III. Dispersion of the Induced Birefringence with a Strong Alternating Field", J. Chem. Phys., 77, 4632-4635 (1982).

{38} M. W. Evans, "The Objective Laws of Classical Electrodynamics, the Effect of Gravitation on Electromagnetism" J. New Energy Special Issue (2006).

{39} M. W. Evans, G. C. Lie and E. Clementi, "Molecular Dynamics Simulation of Water from 10 K to 1273 K", J. Chem. Phys., 88, 5157 (1988).

{40} M. W. Evans, "The Interaction of Three Fields in ECE Theory: the Inverse Faraday Effect" Physica B, 403, 517 (2008).

{41} M. W. Evans, "Principles of Group Theoretical Statistical Mechanics", Phys. Rev., 39, 6041 (1989).