HAMILTON JACOBI FORMALISM

by

M. W. Evans and H Eckardt,

Civil List and AIAS / UPITEC

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ABSTRACT

The Hamilton Jacobi (HJ) formulation of ECE2 theory is developed in preparation for a HJ development of m theory. The action is found by integration of the HJ equation. An extensive computer analysis is given of the Hamilton equations in special relativity.

Keywords: ECE2 theory, Hamilton Jacobi equations and Hamilton equations.

UFT 426

1. INTRODUCTION

In recent papers of this series {1 - 41} The Euler Lagrange and Hamilton dynamics have been applied to m theory, thus giving information that is not available when considering the Euler Lagrange equations alone. A fourth complete system of dynamics has been developed recently, the Evans Eckardt dynamics, based simply on the fact that the hamiltonian and angular momentum are constants of motion on any level, classical, special relativistic, m theory and in quantized dynamics. The three complete systems of dynamics were hitherto thought to be the Euler Lagrange, Hamilton and Hamilton Jacobi equations.

This paper is a short synopsis of detailed calculations found in the notes that accompany UFT426 on www.aias.us and www.upitec.org. These notes are an intrinsic part of the paper and should be read with the paper itself. Note 426(1) gives the fundamental equations of the Euler Lagrange Hamilton dynamics and derives a new equation of motion of the Hamilton dynamics. Note 426(2) uses the new equation to show that the m (r1) function of m theory has no dependence on the Newtonian velocity v_N. Notes 426(3) and 426(4) review the Hamilton Jacobi system of dynamics. Note 426(5) gives a new formulation of the Hamilton Jacobi equation and Note 426(6) computes the action of the Hamilton Jacobi equation applied to ECE2 theory, which develops the equations of special relativity in a space with finite curvature and torsion. These results are a preparation for the application of the Hamilton Jacobi system of dynamics to m theory in future work.

Section 2 computes the action of the Hamilton Jacobi formulation of ECE2 and Section 3 gives an extensive computer analysis of the Hamilton equations.

2. HAMILTON AND HAMILTON JACOBI DEVELOPMENT OF ECE2 THEORY

Define the ECE hamiltonian as:

$$H = (p^2c^2 + m^2c^4)^{1/2} - \frac{mMG}{r} \quad -(1)$$

where p is the relativistic linear momentum:

$$p = \gamma m v_N \quad -(2)$$

and m is the mass of an object that orbits M. The Newton constant is G and r is the distance between m and M. The canonically conjugate generalized coordinates p and q of the Hamilton dynamics are chosen to be:

$$p_r = \gamma m v_N, \quad q_r = r \quad -(3)$$

and

$$p_\phi = L, \quad q_\phi = \phi \quad -(4)$$

where L is the angular momentum, a constant of motion and where ϕ is defined by the plane polar coordinates (r , ϕ). The Evans Eckardt equations of the system are:

$$\frac{dH}{dt} = 0 \quad -(5)$$

and

$$\frac{dL}{dt} = 0. \quad -(6)$$

The first Hamilton equation gives:

$$\dot{p} = -\frac{\partial H}{\partial r} = -\frac{mMG}{r^2} \quad -(7)$$

i.e. :

$$\frac{d}{dt}\left(\gamma m v_N\right) = -\frac{mMG}{r^2} \quad -(8)$$

The same result is given by the Euler Lagrange system of dynamics as shown in previous papers of the UFT series. This is a successful demonstration of the rigorous self consistency of the UFT series. The second Hamilton equation is:

$$\dot{r} = \frac{\partial H}{\partial p} = \frac{pc^2}{(p^2c^2+m^2c^4)^{1/2}} = \frac{pc^2}{\gamma mc^2} = \frac{p}{\gamma m} \quad -(9)$$

where use has been made of:

$$E = \gamma mc^2 = (p^2c^2+m^2c^4)^{1/2} \quad -(10)$$

where the Lorentz factor is:

$$\gamma = \left(1 - \frac{v_N^2}{c^2}\right)^{-1/2}. \quad -(11)$$

It follows that the second Hamilton equation gives:

$$\dot{r} = \frac{p}{\gamma m} \quad -(12)$$

i. e.

$$p = \gamma m\dot{r}. \quad -(13)$$

This is the relativistic momentum:

$$p = \gamma m v_N \quad -(14)$$

provided that:

$$v_N = \dot{r} \quad -(15)$$

Q. E. D.

To extend to plane polar coordinates use:

$$\underline{p} = \gamma m \dot{\underline{r}} = \gamma m \left(\dot{r}\, \underline{e}_r + r\dot{\phi}\, \underline{e}_\phi \right) \quad -(16)$$

It follows that:

$$p^2 = p_r^2 + \frac{p_\phi^2}{r^2} . \quad -(17)$$

The angular generalized coordinates are:

$$p_\phi = L, \quad q_\phi = \phi \quad -(18)$$

where the angular momentum is:

$$L = \gamma m r^2 \dot{\phi} . \quad -(19)$$

The first Hamilton equation gives:

$$\dot{L} = -\frac{\partial H}{\partial \phi} = 0 \quad -(20)$$

so L is a constant of motion:

$$\frac{dL}{dt} = 0 . \quad -(21)$$

This is the second Evans Eckardt equation.

The second Hamilton equation gives:

$$\dot{\phi} = \dot{q}_\phi = \frac{\partial H}{\partial L} \quad -(22)$$

where:

$$H = \left(p_r^2 c^2 + \frac{L^2}{r^2} c^2 \right)^{1/2} - \frac{mMG}{r}. \quad -(23)$$

It follows that:

$$\dot{\phi} = \frac{Lc^2}{\gamma m c^2 r^2} = \frac{L}{m\gamma r^2} \quad -(24)$$

or:

$$L = \gamma m r^2 \dot{\phi} \quad -(25)$$

which is the constant angular momentum, Q. E. D. Again, the same result is given by the Euler Lagrange analysis of ECE2 theory {1 - 41}, another successful check of the rigorous self consistency of ECE2 theory.

With reference to the background notes accompanying UFT426 on www.aias.us and www.upitec.org the Hamilton Jacobi system of dynamics defines:

$$p_r = \frac{\partial S}{\partial r}, \quad p_\phi = \frac{\partial S}{\partial \phi} \quad -(26)$$

where S is the total action:

$$S = S_r + S_\phi. \quad -(27)$$

The quantum of action is $\hbar$, the reduced Planck constant. Therefore Eq. (23) gives the two Hamilton Jacobi equations:

$$E = \left(c^2 \left(\left(\frac{\partial S_r}{\partial r} \right)^2 + \frac{L^2}{r^2} \right) + m^2 c^4 \right)^{1/2} - \frac{mMG}{r} \quad -(28)$$

and

$$L = \frac{\partial S_\phi}{\partial \phi} \quad -(29)$$

where E is the total energy:

$$H = E. \quad -(30)$$

This equation quantizes to the Schroedinger equation:

$$H\phi = E\phi \quad -(31)$$

where ϕ is the wave function.

These equations pave the way for the application of the Hamilton Jacobi formalism to m theory and its eventual quantization. This will be the subject of future work.

The Hamilton Jacobi equation (28) is integrated using Maxima in Section 3, by co author Horst Eckardt, giving interestingly original results described in Section 3. The latter also gives an extensive numerical analysis of the Hamilton equations applied to ECE2 theory and special relativity.

The two Evans Eckardt equations:

$$\frac{dH}{dt} = 0, \quad \frac{dL}{dt} = 0, \quad -(32)$$

can be used with the Hamilton Jacobi equations, and the Euler Lagrange system of dynamics can be combined with the Hamilton Jacobi system of dynamics . The essence of the HJ system is to find constants of motion and to find the action. The lagrangian is the integral of the action and the Hamilton Principle of Least Action minimizes the action to find essentially all of classical physics.

3. NUMERICAL RESULTS AND GRAPHICS.

Section by Dr. Horst Eckardt

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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).