THE SAGNAC EFFECT IN m THEORY

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

It is shown that the Sagnac effect is a method of experimental measurement of the m (r) function of m theory, and an experimental method of investigating the gravitational dependence of m (r).

Keywords: ECE Unified field theory, m theory, Sagnac effect.

UFT 422

1. INTRODUCTION

In immediately preceding papers of this series {1 - 41} the m theory of natural philosophy has been developed from the infinitesimal line element of the most general spherically symmetric spacetime. In section 2 this line element is applied to the well known Sagnac interferometer, and it is shown that m (r) can be measured experimentally. Section 3 presents graphics for various m (r) functions. This short paper is based on Note 420(4) on www.aias.us.

2. DERIVATION OF THE SAGNAC EFFECT

Consider the infinitesimal line element of m theory in the plane polar coordinates (r, ϕ):

$$ds^2 = c^2 d\tau^2 = m(r) c^2 dt^2 - \frac{dr^2}{m(r)} - r^2 d\phi^2 \quad -(1)$$

where τ is the proper time and m (r) is any function of r. In the Einsteinian general relativity (EGR):

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

where M is the attracting mass, G is the gravitational constant, and c is the speed of light in vacuo. From Einstein's equivalence principle an object such as a photon travelling at the speed of light is described by a null geodesic:

$$ds^2 = 0. \quad -(3)$$

The distance r in the Sagnac effect is the radius of the rotating platform of the interferometer, so it does not change:

$$dr = 0. \quad -(4)$$

It follows that:

$$m(r)c^2 dt^2 = r^2 d\phi^2. \quad -(5)$$

The Sagnac effect is consequently:

$$d\phi \rightarrow d\phi + \Omega dt \quad -(6)$$

where Ω is the angular frequency of rotation of the platform. Eq. (6) is an example of the frame rotation theory developed in immediately preceding UFT papers. This concept is used for example in de Sitter precession and Thomas precession. It follows that:

$$m(r)^{1/2} dt = \frac{r}{c}(d\phi + \Omega dt). \quad -(7)$$

Define the angular frequency of light traversing the Sagnac interferometer as:

$$\omega = \frac{c}{r} \quad -(8)$$

and define the angular frequency of platform rotation by:

$$\Omega = \frac{v}{r}. \quad -(9)$$

It follows that:

$$dt = \frac{\frac{1}{\omega} d\phi}{m(r)^{1/2} - \frac{\Omega}{\omega}} \quad -(10)$$

So:

$$dt = \frac{d\phi}{m(r)^{1/2}\omega - \Omega}. \quad -(11)$$

Integrating over the 2π orbit of light traversing the perimeter of the platform:

$$t_1 = \frac{2\pi}{m(r)^{1/2}\omega - \Omega} \quad - (12)$$

For light propagating in the opposite sense:

$$t_2 = \frac{2\pi}{m(r)^{1/2}\omega + \Omega} \quad - (13)$$

It follows that:

$$\Delta t = t_1 - t_2 = \frac{4\pi\Omega}{m(r)\omega^2 - \Omega^2} \quad - (14)$$

Now use:

$$\omega \gg \Omega \quad - (15)$$

to find that:

$$\Delta t = \frac{4 A_r \Omega}{m(r) c^2} \quad - (16)$$

where the area of the platform is:

$$A_r = \pi r^2 \quad - (17)$$

Therefore m (r) can be measured experimentally in a high sensitivity Sagnac interferometer. The time difference is measured by interferometry, and the area of the platform is maximized by using many turns of a thin optical fibre.

This type of interferometer is compact and the time difference can be measured in the earth's gravitational field in a laboratory at sea level, and in a spacecraft under zero gravity conditions. This would measure the dependence of m (r) on gravity. Measurements of the Sagnac time difference at different altitudes would reveal the dependence of m (r) on r. EGR predicts that:

$$m(r) = 1 - \frac{2MG}{c^2 r} \quad -(18)$$

where r is the radial coordinate. For a Sagnac interferometer on the earth's surface, r would be the radius of the earth according to EGR. The Schwarzschild radius of the earth is 0.09 metres so if r is interpreted as the radius of the platform:

$$m(r)\,(EGR) = 1 - 0.09 / r \quad -(19)$$

and m (r) would depend on the radius r of a Sagnac platform. This can be easily investigated experimentally and is a test of EGR. The above derivation is also an experimental test of the Einstein equivalence principle in m space.

3. GRAPHICS OF THE SAGNAC EFFECT FOR VARIOUS M FUNCTIONS

Section by Dr. Horst Eckardt

The Sagnac effect in m theory

M. W. Evans*, H. Eckardt†
Civil List, A.I.A.S. and UPITEC

(www.webarchive.org.uk, www.aias.us,
www.atomicprecision.com, www.upitec.org)

December 30, 2018

3 Graphics of the Sagnac effect for various m functions

According to Eq. (14) the time difference measured by a Sagnac interferometer rotated in two directions is

$$\Delta t = \frac{4\pi\Omega}{\omega^2 \ \mathrm{m}(r) - \Omega^2} \tag{20}$$

where ω is the angular frequency of the light and Ω is that of mechanical rotation. The time difference will depend on the distance r from the gravitational centre if $\mathrm{m}(r)$ sufficiently differs from unity in the radial range investigated. Eq. (20) has been evaluated graphically for a demo system in Fig. 1. The model m function is that derived from Einsteinian theory:

$$\mathrm{m}(r) = 1 - \frac{r_S}{r} \tag{21}$$

with so-called Schwarzschild radius

$$r_S = \frac{2MG}{c^2} \tag{22}$$

where M is the gravitating mass. From Fig. 1 it can be seen that Δt has a pole at $r = r_S$, however r_S normally lies inside the gravitating body so that we always have $r \gg r_S$ where $\mathrm{m}(r)$ is nearly unity. Correspondingly, the time differences to be expected are small and are determined by the right hand side asymptotic value which is

$$\Delta t \to \frac{4\pi\Omega}{\omega^2 - \Omega^2}. \tag{23}$$

Values of Δt for some celestial bodies are listed in Table 1. We assumed $\Omega = 10^4$/min and $\omega = 10^{15}$/s, i.e. for a Sagnac interferometer with optical fibres.

*email: emyrone@aol.com
†email: mail@horst-eckardt.de

body	m [kg]	r_S [m]	r [m]	Δt [s]
earth	5.97219e24	0.00887	6.371009e6	1.32e-26
sun	1.98855e30	2953	6.95508e8	1.32e-26
galactic centre	8.36e36	1.24e10	1.24e11	1.46e-26

Table 1: Parameters of Sagnac effect for $\omega = 10^15/\text{s}$, $\Omega = 10^4/\text{min}$.

When measured at the surface of the earth and (hypothetically) at the surface of the sun, it is seen that the result is $\Delta t = 1.32 \cdot 10^{-26}$ s in both cases. This means that the time difference is determined by the interferometric limit (23) and no dependence on r is detectable any more. Even when inspecting the case of the galactic centre, which is an extremely heavy star with a Schwarzschild radius of 10^{10}m, the time difference would already be in saturation at the ten-fold distance of this radius.

In order to obtain well measurable time differences one would have to reduce the frequency of electromagnetic radiation in the interferometer drastically. The time difference depends on the inverse square of ω. We have graphed the dependence of Δt from ω for a fixed earth radius in Fig. 2. The curves are presented on logarithmic scales. Obviously the radiation frequency has to be lowered to the MHz range to obtain time differences in the range of 10^{-8}s. For comparison we have added a curve for a different m function (exponential function) we used in preceding UFT papers:

$$\mathrm{m}(r) = 2 - \exp\left(\log(2)\exp(-\frac{r}{R})\right). \tag{24}$$

We had to increase the parameter R to 10^7m to obtain a visible difference in the diagram. Practical measurements of $\mathrm{m}(r)$ seem to be a hard challenge for an experiment.

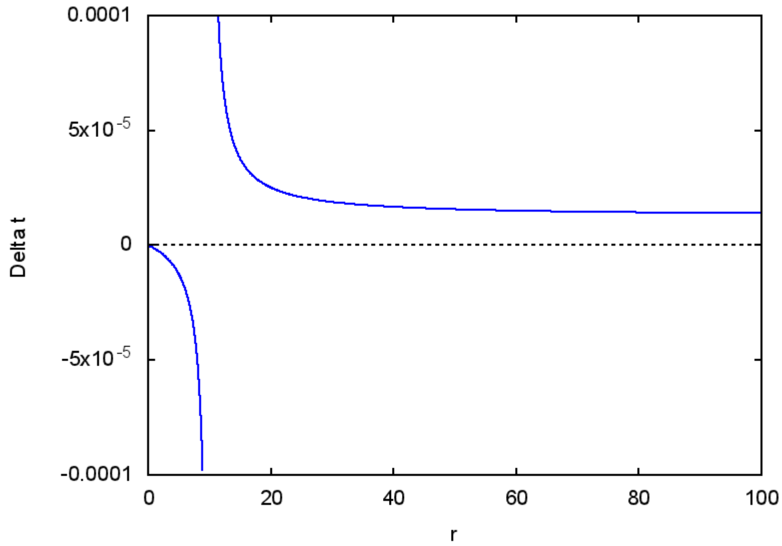

Figure 1: Principal dependence of Sagnac effect on r.

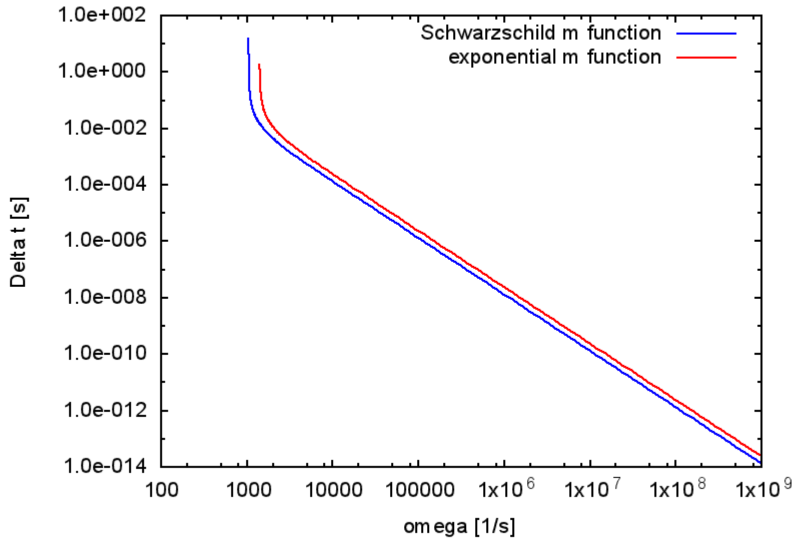

Figure 2: Dependence of Sagnac effect on ω at earth surface.

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 nd 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).