Paper 46 Notes 1

THE EFFECT OF GRAVITATION ON THE SAGNAC EFFECT

The procedure in the Evans unified field theory (i.e. Cartan / Einstein field theory) is to examine the homogeneous field equation:

$$d \wedge F^a = \mu_0 j^a \quad — (1)$$

$$F^a = d \wedge A^a + \omega^a{}_b \wedge A^b, \quad — (2)$$

$$A^a = A^{(0)} q^a. \quad — (3)$$

The Sagnac effect is due to a rotating tetrad q^a, so gravitation affects q^a when:

$$j^a \neq 0. \quad — (4)$$

This means that when eq. (4) is true, gravitation affects the Sagnac effect.

$$\boxed{\text{This has been observed experimentally by: J. Shelburne (personal communication 2005).}}$$

This seems to be a highly accurate method of testing eq. (4), first qualitatively, then quantitatively, using numerical solutions.

The homogeneous current is defined by:

$$j^a = \frac{A^{(0)}}{\mu} \left(R^a{}_b \wedge q^b - \omega^a{}_b \wedge T^b \right)$$

2) For pure electromagnetism or for pure gravitation:

$$j^a = 0 . \quad -(6)$$

In order that eq. (4) be true, an asymmetric connection is needed. In this case gravitation and electromagnetism influence each other. Note that this is not just the well known bending of light by gravity in the Eddington effect, it is an entirely new and original inference.

Tensor Notation

In tensor notation, eq. (1) is:

$$\partial_\mu F^a_{\nu\rho} + \partial_\nu F^a_{\rho\mu} + \partial_\rho F^a_{\mu\nu}$$

$$= A^{(0)}\left(R^a_{\mu\nu\rho} + R^a_{\nu\rho\mu} + R^a_{\rho\mu\nu} - \omega^a_{\mu b}T^b_{\nu\rho} - \omega^a_{\mu b}T^b_{\nu\rho} - \omega^a_{\rho b}T^b_{\mu\nu}\right)$$

$$= \mu_0\left(j^a_{\mu\nu\rho} + j^a_{\rho\mu\nu} + j^a_{\nu\rho\mu}\right) \quad -(7)$$

the Hodge dual of which is:

$$\partial_\mu \tilde{F}^{a\mu\nu} = \mu_0 \tilde{j}^{a\nu} \quad -(8)$$

$$\tilde{j}^{a\nu} = \frac{A^{(0)}}{\mu_0}\left(\tilde{R}_\mu{}^{a\mu\nu} - \omega^a_{\mu b}\tilde{T}^{b\mu\nu}\right). \quad -(9)$$

3) For Einsteinian gravitation:

$$\tilde{R}_{\mu}{}^{a\mu\nu} = 0 \qquad -(10)$$

$$\tilde{T}^{b\mu\nu} = 0. \qquad -(11)$$

For pure electromagnetism:

$$\tilde{R}_{\mu}{}^{a\mu\nu} = \omega^{a}{}_{\mu b}\tilde{T}^{b\mu\nu}. \qquad -(12)$$

So in both cases eqn. (6) is true. When electromagnetism is uninfluenced by gravitation:

$$\partial_{\mu}\tilde{F}^{a\mu\nu} = 0. \qquad -(13)$$

In vector notation, eqn. (13) is:

$$\underline{\nabla}\cdot\underline{B}^{a} = 0 \qquad -(14)$$

$$\underline{\nabla}\times\underline{E}^{a} + \frac{\partial\underline{B}^{a}}{\partial t} = \underline{0}. \qquad -(15)$$

Eqn. (14) for each index a is the Gauss law applied to magnetism, and eqn. (15) for each index a is the Faraday law of induction.

Eqns (14) and (15) are true when the ring laser gyro is not influenced by gravitation.

4)

When gravitation influences electromagnetism eqns (14) and (15) become:

$$\underline{\nabla} \cdot \underline{B}^{a} = \mu_0 \tilde{j}^{a} \quad -(16)$$

$$\underline{\nabla} \times \underline{E}^{a} + \frac{\partial \underline{B}^{a}}{\partial t} = \mu_0 \underline{\tilde{j}}^{a} \quad -(17)$$

where:

$$\tilde{j}^{a\nu} = (\tilde{j}^{a}, \underline{\tilde{j}}^{a}) \quad -(18)$$

This means that the frequencies of $\underline{B}^{a}$ and $\underline{E}^{a}$ are changed, and so gravitation causes a shift in the laser gyro.

This is the qualitative effect of gravitation on the Sagnac effect in the Evans field theory.

Quantitative Calculation

This requires a definition of the scalar current $\tilde{j}^{a}$ and the vector current $\underline{\tilde{j}}^{a}$.

Scalar Current $\tilde{j}^{a}$.

This is derived using:

$$\nu = 0, \mu = 1, 2, 3 \quad -(19)$$

so:

$$\boxed{\tilde{j}^{a} = \frac{A^{(0)}}{\mu_0} \left(\tilde{R}_i^{\ a i 0} - \omega^{a}_{\ ib} \tilde{T}^{b i 0} \right) \qquad i = 1, 2, 3} \quad -(20)$$

5) In eq. (20) summation is implied over repeated i, as usual. The scalar current is non-zero if and only if the connection $\omega^a{}_{ib}$ is not dual to the tetrad. This means that there must be an influence of spin on curvature and vice-versa for mutual influence to occur.

If the ring laser gyro can detect this influence it may lead to major new technologies, because $\tilde{j}^a$ does not exist in Maxwell Heaviside field theory. So major new sources of energy could be found.

Vector Current $\underline{\tilde{j}}^a$

This is given by:

$$\underline{\tilde{j}}^a = \tilde{j}^a_x \underline{i} + \tilde{j}^a_y \underline{j} + \tilde{j}^a_z \underline{k} \quad -(21)$$

$$\tilde{j}^a_x = \frac{A^{(0)}}{\mu_0}\left(\tilde{R}_0{}^{a10} + \tilde{R}_2{}^{a12} + \tilde{R}_3{}^{a13} - \omega^a{}_{0b}\tilde{T}^{b10} - \omega^a{}_{2b}\tilde{T}^{b12} - \omega^a{}_{3b}\tilde{T}^{b13}\right)$$

$$\tilde{j}^a_y = \frac{A^{(0)}}{\mu_0}\left(\tilde{R}_0{}^{a20} + \tilde{R}_1{}^{a21} + \tilde{R}_3{}^{a23} - \omega^a{}_{0b}\tilde{T}^{b20} - \omega^a{}_{1b}\tilde{T}^{b21} - \omega^a{}_{3b}\tilde{T}^{b23}\right)$$

$$\tilde{j}^a_z = \frac{A^{(0)}}{\mu_0}\left(\tilde{R}_0{}^{a30} + \tilde{R}_1{}^{a31} + \tilde{R}_2{}^{a32} - \omega^a{}_{0b}\tilde{T}^{b30} - \omega^a{}_{1b}\tilde{T}^{b31} - \omega^a{}_{2b}\tilde{T}^{b32}\right)$$

6)

Therefore a quantitative calculation would require knowledge of the scalar elements in eq (21). In general it can be seen that the vector current depends on spin connection, curvature and torsion. These are not independent because they are inter-related by Cartan geometry:

$$T^a = d \wedge q^a + \omega^a{}_b \wedge q^b \quad -(22)$$

$$R^a{}_b = d \wedge \omega^a{}_b + \omega^a{}_c \wedge \omega^c{}_b \quad -(23)$$

$$D \wedge T^a = R^a{}_b \wedge q^b \quad -(24)$$

$$D \wedge R^a{}_b = 0. \quad -(25)$$

Eqs (22) and (23) are the Cartan structure equations, and eqs (24) and (25) are the Bianchi identities in most general form. Finally the tetrad obeys the Evans Lemma

$$\Box q^a = R q^a; \quad -(26)$$

where:

$$R = -kT. \quad -(27)$$

So this is a numerical problem in general.