1) 113(9): The ECE Dynamical Equation

The basic structure of the equations is given by the Bianchi identity:

$$D \wedge T := R \wedge q \quad -(1)$$

and the Hodge dual identity:

$$D \wedge \tilde{T} := \tilde{R} \wedge q. \quad -(2)$$

A particular case of eq. (1) in tensor notation is:

$$D_\mu \tilde{T}^{\kappa\mu\nu} = \tilde{R}^{\kappa}{}_{\mu}{}^{\mu\nu} \quad -(3)$$

and a particular case of eq. (2) is:

$$D_\mu T^{\kappa\mu\nu} = R^{\kappa}{}_{\mu}{}^{\mu\nu}. \quad -(4)$$

Eq. (3) splits into vector laws of the homogeneous field equation, and eq. (4) into two vector laws of the inhomogeneous field equation. Eq. (3) can be written as:

$$\partial_\mu \tilde{T}^{\kappa\mu\nu} = \tilde{J}^{\kappa\nu} \quad -(5)$$

and eq. (4) as:

$$\partial_\mu T^{\kappa\mu\nu} = J^{\kappa\nu} \quad -(6)$$

It can be seen that these are similar to the well known Maxwell Heaviside field equations:

$$\partial_\mu \tilde{F}^{\mu\nu} = 0 \quad -(7)$$

$$\partial_\mu F^{\mu\nu} = J^{\nu}/\epsilon_0 \quad -(8)$$

2)

The $\kappa = 0$ Laws

These are:

$$\partial_\mu \tilde{T}^{0\mu\nu} = \tilde{J}^{0\nu} \quad -(9)$$

and

$$\partial_\mu T^{0\mu\nu} = J^{0\nu} \quad -(10)$$

In vector notation eq. (9) is:

$$\underline{\nabla} \cdot \tilde{\underline{T}} = \tilde{J}^0 \quad -(11)$$

and eq. (10) is:

$$\underline{\nabla} \cdot \underset{\sim}{T} = J^0 \quad -(12)$$

These are respectively the dynamical analogies of the Gauss law:

$$\underline{\nabla} \cdot \underline{B} = 0 \quad -(13)$$

and the Coulomb law:

$$\underline{\nabla} \cdot \underline{E} = \rho / \epsilon_0 \quad -(14)$$

In eq. (12), if the Cartesian system is chosen:

$$\underset{\sim}{T} = T^{010}\, \underline{i} + T^{020}\, \underline{j} + T^{030}\, \underline{k} \quad -(15)$$

and

$$\tilde{\underline{T}} = \tilde{T}^{010}\, \underline{i} + \tilde{T}^{020}\, \underline{j} + \tilde{T}^{030}\, \underline{k} \quad -(16)$$

From the well known experimental similarity between the Newton and Coulomb inverse square laws, eq. (12) may be identified as giving the Newton inverse square law in the ~~lim~~ non-relativistic limit. From consideration of units:

$$\underline{g} = c^2 \underset{\sim}{T} \qquad - (17)$$

is identified as the acceleration due to gravity.

Therefore:

$$\boxed{\underline{\nabla} \cdot \underline{g} = c^2 J^0} \qquad - (18)$$

and

$$\boxed{\underline{\nabla} \cdot \underline{\tilde{g}} = 0} \qquad - (19)$$

Eq. (18) is the dynamical equivalent of the Coulomb law, and eq. (19) that of the Gauss law. These are relativistic laws and generally applicable.

In the non-relativistic limit the spin connection becomes very small, and:

$$J^0 \rightarrow R^0{}_1{}^{10} + R^0{}_2{}^{20} + R^0{}_3{}^{30} \qquad - (20)$$

The mass density is identified from eqs. (18) and (20) as:

$$\rho_m = \frac{1}{k}\left(R^0{}_1{}^{10} + R^0{}_2{}^{20} + R^0{}_3{}^{30}\right) \quad -(21)$$

where k is the Einstein constant in metres per kilogram. Therefore in the non-relativistic limit:

$$\boxed{\underline{\nabla} \cdot \underline{g} = c^2 k \rho_m} \quad -(22)$$

which is the direct analogy of the Coulomb law (14). More generally:

$$\boxed{\rho_m = J^0 / k} \quad -(23)$$

In the non-relativistic limit, the Newtonian force is:

$$\underline{F} = m\underline{g} \quad -(24)$$

where m is the mass of an object in a gravitational acceleration $\underline{g}$. Therefore:

$$\boxed{\underline{F} = mc^2 \underline{T} = E_0 \underline{T}} \quad -(25)$$

where the rest energy is:

$$E_0 = mc^2. \quad -(26)$$

5)

Therefore the Newtonian force is defined by the orbital torsion:

$$\boxed{\underline{F} = E_0 \left(T^{010} \underline{i} + T^{020} \underline{j} + T^{030} \underline{k} \right)} \quad -(27)$$

and:

$$\boxed{\underline{\nabla} \cdot \underline{F} = mc^2 k \rho_m = E_0 k \rho_m} \quad -(28)$$

Also:

$$\boxed{\underline{\nabla} \cdot \underline{\tilde{F}} = 0} \quad -(29)$$

where:

$$\boxed{\underline{\tilde{F}} = E_0 \left(\tilde{T}^{010} \underline{i} + \tilde{T}^{020} \underline{j} + \tilde{T}^{030} \underline{k} \right)} \quad -(30)$$

Eqs. (29) and (27) are the orbital force laws arising from well defined components (27) and (30) of the orbital torsion.

In orbital dynamics the theorem of orbits is:

$$nr = \frac{r}{n} = \int dr = r + \mu \quad -(31)$$

and from the spherical symmetry of space-time define

6) the line - element of all orbits :

$$ds^2 = -\left(1+\frac{\mu}{r}\right)c^2dt^2 + \left(1+\frac{\mu}{r}\right)^{-1}dr^2 + r^2d\Omega^2 \quad -(32)$$

in spherical polar coordinates. If an attempt is made to use the Christoffel symbol :

$$\Gamma^{\kappa}_{\mu\nu} = \Gamma^{\kappa}_{\nu\mu} \quad -(33)$$

to compute Riemann tensor elements from eq. (32), the result is :

$$R^{0}{}_{1}{}^{10} + R^{0}{}_{2}{}^{20} + R^{0}{}_{3}{}^{30} = 0 \quad -(34)$$

$$\tilde{R}^{0}{}_{1}{}^{10} + \tilde{R}^{0}{}_{2}{}^{20} + \tilde{R}^{0}{}_{3}{}^{30} = 0. \quad -(35)$$

By definition, eq. (33) produces :

$$T^{010} + T^{020} + T^{030} = 0 \quad -(36)$$

$$\tilde{T}^{010} + \tilde{T}^{020} + \tilde{T}^{030} = 0. \quad -(37)$$

Therefore the Christoffel connection cannot be used to describe orbits or dynamics in general, because this connection produces zero force and zero mass density, i.e. a universe without matter.

This finding makes the Einstein field equation obsolete. It is replaced by the ECE field equations with an asymmetric connection.

7) <u>The $\kappa = 1, 2, 3$ Laws.</u>

These laws are the dynamical analogues of the Faraday law of induction:

$$\underline{\nabla} \times \underline{E} + \frac{\partial \underline{B}}{\partial t} = \underline{0} \quad -(38)$$

and the Ampère Maxwell law:

$$\underline{\nabla} \times \underline{B} - \frac{1}{c^2}\frac{\partial \underline{E}}{\partial t} = \mu_0 \underline{J} \quad -(39)$$

in S.I. units. In ECE theory the components appearing in these laws are as in Table 1.

Law	Electric Field	Magnetic Field	Type
Gauss		$B^{001}, B^{002}, B^{003}$	Orbital
Coulomb	$E^{010}, E^{020}, E^{030}$		Orbital
Faraday	$E^{332}, E^{113}, E^{221}$	$B^{101}, B^{202}, B^{303}$	Spin
A/M	$E^{110}, E^{220}, E^{330}$	$B^{332}, B^{113}, B^{221}$	Spin

So by analogy there are <u>two</u> dynamical orbital laws, one being <u>the Hodge dual of the other</u>, and <u>two spin laws</u>. The orbital laws are $\kappa = 0$, the spin laws are $\kappa =$ 1, 2, 3.

The dynamical spin law corresponding to

8) The Faraday law of induction is:

$$\boxed{\underline{\nabla} \times \underline{\tilde{T}}_1 + \frac{\partial \underline{\tilde{T}}_2}{\partial t} = \underline{0}} \quad - (40)$$

where

$$\underline{\tilde{T}}_1 = \tilde{T}^{332} \underline{i} + \tilde{T}^{113} \underline{j} + \tilde{T}^{221} \underline{k} \quad - (41)$$

and

$$\underline{\tilde{T}}_2 = \tilde{T}^{101} \underline{i} + \tilde{T}^{202} \underline{j} + \tilde{T}^{303} \underline{k} \quad - (42)$$

are Hodge duals of spin torsion vectors.

The dynamical spin law corresponding to the Ampère Maxwell law is:

$$\boxed{\underline{\nabla} \times \underline{T}_1 - \frac{\partial \underline{T}_2}{\partial t} = \underline{J}} \quad - (43)$$

$$- (44)$$

where

$$\underline{T}_1 = T^{332} \underline{i} + T^{113} \underline{j} + T^{221} \underline{k},$$

and

$$\underline{T}_2 = T^{101} \underline{i} + T^{202} \underline{j} + T^{303} \underline{k} \quad - (45)$$

Eq. (40) is the Hodge dual of eq. (43).

Eq (40) is the gravitational equivalent of the

Faraday law of induction and has been observed recently in the ESA / Austrian experiment of de Matos and Tajmar and colleagues. These spin equations are again relativistic. The current $\underline{J}$ is the mass current density, a current density of mass analogous to the current density of charge in electrodynamics. In the non-relativistic limit:

$$\underline{J} = J_x \, \underline{i} + J_y \, \underline{j} + J_z \, \underline{k} \quad -(46)$$

where:

$$\left.\begin{aligned} J_x &= R^1{}_0{}^{01} + R^1{}_2{}^{21} + R^1{}_3{}^{31} \\ J_y &= R^2{}_0{}^{02} + R^2{}_1{}^{12} + R^2{}_3{}^{32} \\ J_z &= R^3{}_0{}^{03} + R^3{}_1{}^{13} + R^3{}_2{}^{23} \end{aligned}\right\} \quad -(47)$$

The Euler Equation of Motion

This is the classical equation of rotational motion, and governs the well known gyroscope. It is:

$$\underline{Tq}\,(\text{moving}) = \underline{Tq}\,(\text{fixed}) - \underline{\Omega} \times \underline{L} \quad -(48)$$

where $\underline{Tq}$ denotes torque, $\underline{\Omega}$ angular velocity and $\underline{L}$ angular momentum.

The Newtonian torque is :

$$\underline{Tq}\,(\text{fixed}) = \frac{d\underline{L}}{dt} \quad -(49)$$

and the precessional term $\underline{\Omega} \times \underline{L}$ is not present in Newtonian dynamics.

In order to derive the Euler equation from ECE theory it is inferred that torque is due to spin torsion, force is due to orbital torsion. In analogy with the force, the torque is defined as:

$$\underline{Tq} = mc^2 \int \underset{\sim}{T}\,(\text{spin})\, dr \quad -(50)$$

i.e.

$$\boxed{\underline{Tq} = E_0 \int \underset{\sim}{T}\,(\text{spin})\, dr} \quad -(51)$$

in analogy with:

$$\boxed{\underline{F} = E_0\, \underline{T}\,(\text{orbital})} \quad -(52)$$

Therefore it is seen that force is an orbital torsion defined by the $\kappa = 0$ equations and torque is a spin torsion defined by the $\kappa = 1, 2, 3$ equation. The Euler equation is derived from the Cartan

1) structure equation:

$$T^a = d \wedge q^a + \omega^a_{\ b} \wedge q^b \quad -(52)$$

and the precessional term is due to the spin connection term in eq. (52). In tensor notation eq. (52) is:

$$T^a_{\mu\nu} = \partial_\mu q^a_\nu - \partial_\nu q^a_\mu + \omega^a_{\mu b} q^b_\nu - \omega^a_{\nu b} q^b_\mu \quad -(53)$$

If the torsion $\underline{T}_1$ of eq. (44) is considered it is defined by:

$$\underline{T}_1 = \underline{\nabla} \times \underline{q} - \underline{\omega} \times \underline{q} \quad -(54)$$

in analogy with the magnetic field of ECE theory

$$\underline{B} = \underline{\nabla} \times \underline{A} - \underline{\omega} \times \underline{A} \quad -(55)$$

where $\underline{\omega}$ is the spin connection vector.

Finally infer that eq. (54) is the Euler equation, with:

$$\underline{Tq}\,(\text{moving}) = E_0 \int \underline{T_1}\, dr \quad -(56)$$

$$\underline{Tq}\,(\text{fixed}) = E_0 \int \underline{\nabla} \times \underline{q}\, dr \quad -(57)$$

and:

$$\underline{\Omega} \times \underline{L} = E_0 \int \underline{\omega} \times \underline{q}\, dr \quad -(58)$$

Precession is due to spinning spacetime.