379(5): New Method of Calculating Field Potential Relations and Antisymmetry Conditions

Consider the first Cartan Maurer structure equation:

$$T^a_{\mu\nu} = D_\mu q^a_\nu - D_\nu q^a_\mu \quad -(1)$$

where $T^a_{\mu\nu}$ is the torsion two-form, D_μ the covariant derivative, and q^a_ν the tetrad one-form. The antisymmetry condition is:

$$D_\mu q^a_\nu = -D_\nu q^a_\mu \quad -(2)$$

because a two-form is antisymmetric by definition:

$$T^a_{\mu\nu} = -T^a_{\nu\mu} \quad -(3)$$

By definition:

$$D_\mu q^a_\nu = \partial_\mu q^a_\nu + \omega^a_{\mu b} q^b_\nu \quad -(4)$$

$$D_\nu q^a_\mu = \partial_\nu q^a_\mu + \omega^a_{\nu b} q^b_\mu \quad -(5)$$

where $\omega^a_{\mu b}$ is the Cartan spin connection.

Also by definition:

$$\omega^a_{\mu b} q^b_\nu = \omega^a_\mu q_\nu \quad -(6)$$

and

$$\omega^a_{\nu b} q^b_\mu = \omega^a_\nu q_\mu . \quad -(7)$$

(S. M. Carroll, "Spacetime and Geometry: an Introduction to General Relativity", open source on the internet, chapter 3.) As described by Carroll on page 89, there are relations such as:

$$q^\mu_a q^a_\nu = \delta^\mu_\nu \quad -(8)$$

) and:
$$\bar{V}^a = q^a_\mu \bar{V}^\mu \quad (9)$$
Also:
$$\bar{V}^a{}_b = q^a_\mu \bar{V}^\mu{}_b \quad (10)$$
It follows that:
$$V^\mu = q^\mu{}_a V^a \quad (11)$$
and
$$V_\mu = q^a{}_\mu V^\mu \quad (12)$$
and so on.

So the first structure equation can be reduced to:
$$T^a{}_{\mu\nu} = \partial_\mu q^a{}_\nu - \partial_\nu q^a{}_\mu + \omega^a{}_\mu q_\nu - \omega^a{}_\nu q_\mu \quad (13)$$
Multiply both sides of eq. (13) by e_a, as in UFT 316, where e_a is a unit vector, and it follows that:
$$\boxed{T_{\mu\nu} = \partial_\mu q_\nu - \partial_\nu q_\mu + \omega_\mu q_\nu - \omega_\nu q_\mu} \quad (14)$$

Q.E.D.

The internal indices have been removed.

The antisymmetry law for Eq. (14) is:
$$\partial_\mu q_\nu + \omega_\mu q_\nu = -(\partial_\nu q_\mu + \omega_\nu q_\mu) \quad (15)$$
e
$$(\partial_\mu + \omega_\mu) q_\nu = -(\partial_\nu + \omega_\nu) q_\mu \quad (16)$$
The covariant derivatives have been reduced

) to:

$$D_\mu = \partial_\mu + \omega_\mu \quad -(17)$$

and

$$D_\nu = \partial_\nu + \omega_\nu \quad -(18)$$

Electromagnetism

The electromagnetic field is:

$$F_{\mu\nu} = A^{(0)} T_{\mu\nu} \quad -(19)$$

and the electromagnetic potential is:

$$A_\mu = A^{(0)} q_\mu \quad -(20)$$

So:

$$F_{\mu\nu} = D_\mu A_\nu - D_\nu A_\mu \quad -(21)$$

$$= (\partial_\mu + \omega_\mu) A_\nu - (\partial_\nu + \omega_\nu) A_\mu$$

with antisymmetry law:

$$(\partial_\mu + \omega_\mu) A_\nu = -(\partial_\nu + \omega_\nu) A_\mu \quad -(22)$$

For the electric field:

$$F_{0\nu} = (\partial_0 + \omega_0) A_\nu - (\partial_\nu + \omega_\nu) A_0 \quad -(23)$$

Now translate into vector notation using:

$$\partial_\mu = \left(\frac{1}{c}\frac{\partial}{\partial t}, \underline{\nabla} \right) \quad -(24)$$

$$A_\mu = \left(\frac{\phi}{c}, -\underline{A} \right) \quad -(25)$$

$$\omega_\mu = \left(\frac{\omega_0}{c}, -\underline{\omega} \right) \quad -(26)$$

4) By definition of the electromagnetic field tensor:

$$E_X/c = -E_1/c = F_{01} \quad -(28)$$

$$E_Y/c = -E_2/c = F_{02} \quad -(29)$$

$$E_Z/c = -E_3/c = F_{03} \quad -(30)$$

It follows that

$$T_{0n} = \partial_0 q_n + \omega_0 q_n - (\partial_n q_0 + \omega_n q_0) \quad -(31)$$

$$\underline{E} = -\frac{\partial \underline{A}}{\partial t} - \omega_0 \underline{A} - (\underline{\nabla} \phi - \phi \underline{\omega})$$

The electric field strength in volts per metre is therefore:

$$\boxed{\underline{E} = -\frac{\partial \underline{A}}{\partial t} - \omega_0 \underline{A} - \underline{\nabla} \phi + \phi \underline{\omega}} \quad -(32)$$

Note that:

$$D_0 A_n \rightarrow -\frac{\partial \underline{A}}{\partial t} - \omega_0 \underline{A} \quad -(33)$$

$$D_n A_0 \rightarrow \underline{\nabla} \phi - \phi \underline{\omega} \quad -(34)$$

The antisymmetry law is therefore:

$$\boxed{D_0 A_n = -D_n A_0} \longrightarrow \boxed{-\frac{\partial \underline{A}}{\partial t} - \omega_0 \underline{A} = -\underline{\nabla} \phi + \phi \underline{\omega}}$$

$$-(35)$$

) Gravitation

The gravitational field is:

$$G_{\mu\nu} = Q^{(0)} T_{\mu\nu} \quad -(36)$$

and the gravitational potential is:

$$Q_\mu = Q^{(0)} q_\mu \quad -(37)$$

where

$$Q_\mu = \left(\frac{\Phi}{c}, \underline{Q} \right). \quad -(38)$$

By definition:

$$G_{0i} = -g_i / c, \quad i = 1, 2, 3 \quad -(39)$$

and

$$\begin{aligned} g_X &= -g_1 \\ g_Y &= -g_2 \\ g_Z &= -g_3 \end{aligned} \quad -(40)$$

It follows that:

$$\boxed{\underline{g} = -\frac{\partial \underline{Q}}{\partial t} - \omega_0 \underline{Q} - \underline{\nabla} \Phi + \Phi \underline{\omega}} \quad -(41)$$

with antisymmetry condition:

$$\boxed{-\frac{\partial \underline{Q}}{\partial t} - \omega_0 \underline{Q} = -\underline{\nabla} \Phi + \Phi \underline{\omega}} \quad -(42)$$

There are various solutions possible of eqs. (41) and (42). Each one can be investigated systematically

6)

Solution 1

In this case:

$$\underline{g} = 2\left(-\underline{\nabla}\,\Phi + \Phi\,\underline{\omega}\right) \quad -(43)$$

Solution 2

$$\underline{g} = 2\left(-\frac{\partial \underline{Q}}{\partial t} - \omega_0\,\underline{Q}\right) \quad -(44)$$

In the standard model of physics, in the non relativistic limit:

$$\underline{g} = -\underline{\nabla}\,\Phi_N \quad -(45)$$

where

$$\Phi_N = -\frac{MG}{r} \quad -(46)$$

is the Newtonian potential. The Newtonian limit is recovered when:

$$\Phi \rightarrow \Phi_N / 2 \quad -(47)$$

and

$$\underline{\omega} \rightarrow \underline{0} \quad -(48)$$

$$\underline{Q} \rightarrow \underline{0} \quad -(49)$$

Counter Gravitation

This occurs when $\underline{g}$ is positive. The earth's gravitation produces:

$$\underline{g} = -MG\,\frac{\underline{r}}{r^3} \quad -(50)$$

Therefore for counter gravitation:

$$\Phi\,\underline{\omega} - \underline{\nabla}\,\Phi > \underline{0} \quad -(51)$$

7) If the potential is approximately Newtonian:

$$-\frac{MG}{r}\underline{\omega} - \frac{MG\underline{r}}{r^3} > 0 \quad -(52)$$

i.e.

$$\boxed{-\underline{\omega} - \frac{\underline{r}}{r^2} > \underline{0}} \quad -(53)$$

If

$$\underline{\omega} = -\frac{\underline{r}}{r^2} \quad -(54)$$

there is zero gravitation. Experiments producing zero gravitation can be explained in this way. Therefore counter gravitation occurs under the condition:

$$\boxed{-\underline{\omega} > \frac{\underline{r}}{r^2}} \quad -(55)$$

In terms of the $\underline{Q}$ vector, counter gravitation occurs under the condition:

$$-\frac{\partial \underline{Q}}{\partial t} - \omega_0 \underline{Q} > \underline{0} \quad -(56)$$

i.e.

$$\boxed{-\frac{\partial \underline{Q}}{\partial t} > \omega_0 \underline{Q}} \quad -(57)$$

The extra force defined by $\underline{Q}$ is:

$$\underline{F} = -m\frac{d\underline{Q}}{dt} \quad -(58)$$

Zero gravitation occurs when:

$$-\frac{\partial \underline{Q}}{\partial t} = \omega_0 \underline{Q} \quad -(59)$$