1) 121(6): Derivation of Conservation Theorems of Physics

In ECE theory the conservation theorems of physics are based on the tetrad postulate of geometry:

$$D_\mu q^a_{\ \nu} = 0 \qquad -(1)$$

which is true in any frame of reference. Now use the definition

$$q^\mu_{\ a} q^a_{\ \nu} = \delta^\mu_\nu \qquad -(2)$$

where:

$$\left.\begin{array}{l} \delta^\mu_\nu = 1 \text{ if } \mu = \nu \\ \delta^\mu_\nu = 0 \text{ if } \mu \neq \nu \end{array}\right\} \qquad -(3)$$

to find that:

$$q^{\mu\nu} = g^{\mu\sigma} \delta^\nu_\sigma = g^{\mu\nu} \qquad -(4)$$

so:

$$\boxed{\begin{array}{l} q^{\mu\nu} = g^{\mu\nu} \qquad -(5) \\ q_{\mu\nu} = g_{\mu\nu} \qquad -(6) \end{array}}$$

These are useful relations which show that the tetrad in the base manifold is the metric, and the inverse tetrad $q^{\mu\nu}$ is the inverse metric. Therefore:

$$q^{\mu\nu} q_{\mu\nu} = 4 \qquad -(7)$$

$$g^{\mu\nu} g_{\mu\nu} = 4. \qquad -(8)$$

Now use the metric compatibility condition:

$$D_\rho g_{\mu\nu} = D_\rho g^{\mu\nu} = 0 \quad -(9)$$

or

$$D^\rho g_{\mu\nu} = D^\rho g^{\mu\nu} = 0 \quad -(10)$$

to find that

$$\boxed{D^\mu g_{\mu\nu} = 0} \quad -(11)$$

when:

$$\rho = \mu \quad -(12)$$

Summation over repeated indices occurs in eq. (11). However, by convention:

$$q^\mu_a q^a_\mu = 1 \quad -(13)$$

by definition. Eq. (13) must be true in order for eq. (1) to be true. (see note 121(5)).

The fundamental ECE hypothesis is:

$$A^a_\mu = A^{(0)} q^a_\mu \quad -(14)$$

so:

$$\boxed{A_{\mu\nu} = A^{(0)} g_{\mu\nu}} \quad -(15)$$

and

$$\boxed{D^\mu A_{\mu\nu} = 0} \quad -(16)$$

3)

Eq. (16) is one of the fundamental conservation theorems of ECE theory. It can be seen that it follows from metric compatibility, a geometrical property. The conservation theorems of physics follow from geometry. In Cartan geometry, the conservation theorem is:

$$D_\mu \underset{\sim}{A}^a = 0 \quad -(17)$$

which may be developed as:

$$\boxed{\Box \underset{\sim}{A}^a = R \underset{\sim}{A}^a} \quad -(18)$$

and

$$(\Box + kT) \underset{\sim}{A}^a = 0 \quad -(19)$$

The wave equations of physics are conservation theorems of physics.

The conservation of canonical energy - momentum density follows from:

$$T^a_\mu = T^{(0)} q^a_\mu \quad -(20)$$

so:

$$\boxed{D^\mu T_{\mu\nu} = 0} \quad -(21)$$

which is the covariant Noether Theorem.

+) Therefore:

$$\boxed{\square\, T^{a}_{\sim} = R\, T^{a}_{\sim}} \quad - (22)$$

i.e. canonical energy momentum density is quantized and also stochastic.

The conservation of charge-current density follows from:

$$J^{a}_{\mu} = J^{(0)}\, q^{a}_{\mu} \quad - (23)$$

so

$$\boxed{D^{\mu} J_{\mu\nu} = 0} \quad - (24).$$

or

$$\boxed{\square\, J^{a}_{\mu} = R\, J^{a}_{\mu}} \quad - (25)$$

i.e. charge-current density is quantized and stochastic.

The dual identity of gravity is:

$$D_{\mu} T^{\kappa\mu\nu} = R^{\kappa}{}_{\mu}{}^{\mu\nu} \quad - (26)$$

and it is possible to define a curvature:

$$R^{\kappa\nu} = R^{\kappa}{}_{\mu}{}^{\mu\nu} \quad - (27)$$

by summation over internal indices (i.e. by

5) index contraction. By hypothesis similar to that of Einstein:

$$R^{\kappa\nu} = k\, T^{\kappa\nu} \quad -(28)$$

$$= D_\mu T^{\kappa\mu\nu}$$

Here:

$$T^{\kappa\mu\nu} = k\, J^{\kappa\mu\nu} \quad -(29)$$

where:

$$J^{\kappa\mu\nu} = -\frac{1}{2}\left(T^{\kappa\mu} x^\nu - T^{\kappa\nu} x^\mu\right) \quad -(30)$$

is the canonical angular energy-momentum density tensor.

So:

$$\boxed{D_\mu J^{\kappa\mu\nu} = T^{\kappa\nu}} \quad -(30)$$

or:

$$D^\kappa J_{\mu\kappa\nu} = T_{\mu\nu} \quad -(31)$$

and the conservation of canonical angular energy-momentum density is:

$$\boxed{D^\mu\left(D^\kappa J_{\mu\kappa\nu}\right) = D^\mu T_{\mu\nu} = 0} \quad -(32)$$