155(4): Basic Symmetry Considerations

The first Cartan structure equation is:

$$T^a_{\mu\nu} = \partial_\mu q^a_\nu - \partial_\nu q^a_\mu + \omega^a_{\mu b} q^b_\nu - \omega^a_{\nu b} q^b_\mu \quad -(1)$$

$$= \partial_\mu q^a_\nu - \partial_\nu q^a_\mu + \omega^a_{\mu\nu} - \omega^a_{\nu\mu}$$

and the tetrad postulate is:

$$D_\mu q^a_\nu = \partial_\mu q^a_\nu + \omega^a_{\mu b} q^b_\nu - \Gamma^\lambda_{\mu\nu} q^a_\lambda = 0$$

$$= \partial_\mu q^a_\nu + \omega^a_{\mu\nu} - \Gamma^a_{\mu\nu} = 0 \quad -(2)$$

The basic commutator equation is:

$$[D_\mu, D_\nu] V^\sigma = R^\sigma_{\ \rho\mu\nu} V^\rho - T^\lambda_{\mu\nu} D_\lambda V^\rho \quad -(3)$$

where the Riemann torsion is:

$$T^\sigma_{\mu\nu} = q^\sigma_a T^a_{\mu\nu} = \Gamma^\sigma_{\mu\nu} - \Gamma^\sigma_{\nu\mu}. \quad -(4)$$

Therefore:

$$\boxed{[D_\mu, D_\nu] V^\sigma = -\Gamma^\lambda_{\mu\nu} D_\lambda V^\rho + \ldots} \quad -(5)$$

By definition: $[D_\mu, D_\nu] = 0 \quad -(6)$

if: $\mu = \nu \quad -(7)$

so: $\Gamma^\sigma_{00} = \Gamma^\sigma_{11} = \Gamma^\sigma_{22} = \Gamma^\sigma_{33} = 0 \quad -(8)$

because.

2) $[D_0, D_0] = [D_1, D_1] = [D_2, D_2] = [D_3, D_3] = 0$ — (9)

Also:

$$[D_\mu, D_\nu] V^\sigma = -(\Gamma^\sigma_{\mu\nu} - \Gamma^\sigma_{\nu\mu}) D_\sigma V^\rho + \dots \quad -(10)$$

If, in eq. (10)

$$\Gamma^\sigma_{\mu\nu} \overset{?}{\neq} 0, \ \mu = \nu \quad -(11)$$

then, in eq. (5):

$$[D_\mu, D_\nu] \overset{?}{\neq} 0, \ \mu = \nu \quad -(12)$$

whereas by definition:

$$[D_\mu, D_\nu] = -[D_\nu, D_\mu] \quad -(13)$$

so

$$\boxed{\Gamma^\sigma_{\mu\nu} = -\Gamma^\sigma_{\nu\mu}} \quad -(14)$$

To see this in another way, write:

$$[D_\mu, D_\nu] V^\sigma = \Gamma^\sigma_{\nu\mu} D_\sigma V^\rho + \dots \quad -(15)$$

or

$$[D_\nu, D_\mu] V^\sigma = -\Gamma^\sigma_{\nu\mu} D_\sigma V^\rho + \dots \quad -(16)$$

Add eqns. (5) and (16):

$$([D_\mu, D_\nu] - [D_\nu, D_\mu]) V^\sigma$$

$$= -(\Gamma^\sigma_{\mu\nu} - \Gamma^\sigma_{\nu\mu}) D_\sigma V^\rho + \dots$$

$-(17)$

3) If it is argued that, for example:

$$\Gamma^{\sigma}_{11} - \Gamma^{\sigma}_{11} = 0 \quad -(18)$$

but Γ^{σ}_{11} may not be zero, it would mean that

$$[D_1, D_1] - [D_1, D_1] = 0 \quad -(19)$$

but $[D_1, D_1]$ may not be zero. However by definition $[D_1, D_1]$ is zero. Therefore:

$$\Gamma^{\sigma}_{11} - \Gamma^{\sigma}_{11} = 0 \quad -(20)$$

and

$$\Gamma^{\sigma}_{11} = 0. \quad -(21)$$

because

$$[D_1, D_1] - [D_1, D_1] = 0 \quad -(22)$$

$$[D_1, D_1] = 0. \quad -(23)$$

The catastrophic error in the standard model was to assert arbitrarily that for $\mu = \nu$:

$$\Gamma^{\sigma}_{\mu\nu} \stackrel{?}{=} \Gamma^{\sigma}_{\nu\mu} \quad -(24)$$

$$\neq 0$$

so by eq. (5):

$$[D_\mu, D_\nu] = ? \, [D_\mu, D_\nu] \neq 0 \quad -(25)$$

Key Point. There is a one to one relation between the commutator $[D_\mu, D_\nu]$ and the connection $\Gamma^{\sigma}_{\mu\nu}$.

This argument has major consequences for physics, as is being realized by now.

4) Another fundamental point is that the symmetries of the gamma connection and spin connection are fundamentally different. The gamma connection is antisymmetric, but the spin connection is asymmetric.

This is seen from:

$$\Gamma^a_{\mu\nu} = \partial_\mu q^a_\nu + \omega^a_{\mu\nu} = -\Gamma^a_{\nu\mu} \quad -(26)$$

Therefore:

$$\partial_0 q^a_0 + \omega^a_{00} = 0 \quad -(27)$$

$$\partial_1 q^a_1 + \omega^a_{11} = 0 \quad -(28)$$

$$\partial_2 q^a_2 + \omega^a_{22} = 0 \quad -(29)$$

$$\partial_3 q^a_3 + \omega^a_{33} = 0 \quad -(30)$$

$$\partial_0 q^a_1 = -\partial_1 q^a_0 - \left(\omega^a_{01} + \omega^a_{10}\right) \quad -(31)$$

and so on.

From eqns (27) to (30):

$$\partial_0 q^a_0 - \left(\partial_1 q^a_1 + \partial_2 q^a_2 + \partial_3 q^a_3\right) = -\omega^a_{00} + \left(\omega^a_{11} + \omega^a_{22} + \omega^a_{33}\right) \quad -(32)$$

i.e.

$$\boxed{\partial_\mu q^{a\mu} = -\omega^a_{00} + \omega^a_{11} + \omega^a_{22} + \omega^a_{33}} \quad -(33)$$

Sum up over a indices:

5)

$$\partial_\mu q^\mu = -\omega_{00} + \omega_{11} + \omega_{22} + \omega_{33} \quad -(34)$$

The ECE hypothesis is:

$$A^\mu = A q^\mu \quad -(35)$$

so

$$\boxed{\partial_\mu A^\mu = A\left(-\omega_{00} + \omega_{11} + \omega_{22} + \omega_{33}\right)} \quad -(36)$$

In the standard model "the Lorenz gauge" is:

$$\partial_\mu A^\mu = ?\, 0 \quad -(37)$$

As can be seen from eq. (36), this is not true.

By definition:

$$A^\mu = \left(A^0, \underline{A}\right) = \left(\frac{\phi}{c}, \underline{A}\right) \quad -(38)$$

so the Lorenz gauge is

$$\frac{1}{c^2}\frac{\partial \phi}{\partial t} + \underline{\nabla} \cdot \underline{A} = 0 \quad -(39)$$

In ECE theory:

$$\boxed{\frac{1}{c^2}\frac{\partial \phi}{\partial t} + \underline{\nabla} \cdot \underline{A} = A\left(-\omega_{00} + \omega_{11} + \omega_{22} + \omega_{33}\right)} \quad -(40)$$

Eq. (40) has many implication for physics,

6) for example there is photon mass, radiation in the vacuum is not transverse, gauge theory has to be abandoned, and a U(1) sector symmetry cannot be used in a unified field theory.

In general

$$\omega^a_{\mu\nu} = \frac{1}{2}\left(\omega^a_{\mu\nu} + \omega^a_{\nu\mu}\right) + \frac{1}{2}\left(\omega^a_{\mu\nu} - \omega^a_{\nu\mu}\right) \quad -(41)$$

From eq. (31):

$$\boxed{\partial_0 A^a_1 = -\partial_1 A^a_0 - A\left(\omega^a_{01} + \omega^a_{10}\right) \quad \text{etc.}} \quad -(42)$$

If the spin connection is very small (limit of flat spacetime)

$$\partial_0 A^a_1 \doteq -\partial_1 A^a_0 \quad -(43)$$

In this limit eq. (43) leads to:

$$F = mg = -\frac{mMG}{r^2} \quad -(44)$$

$$F = e_1 E = -\frac{e_1 e_2}{4\pi\epsilon_0 r^2} \quad -(45)$$

which are the equivalence principles of classical (Newtonian) dynamics and electrostatics.