55(5): Some Arbitrary Assumptions of the Standard Model

In basic mathematics, and for a mathematical space of any dimension,

$$[D_\mu, D_\nu] V^\rho = -(\Gamma^\lambda_{\mu\nu} - \Gamma^\lambda_{\nu\mu}) D_\lambda V^\rho + (\partial_\mu \Gamma^\rho_{\nu\sigma} - \partial_\nu \Gamma^\rho_{\mu\sigma} + \Gamma^\rho_{\mu\lambda}\Gamma^\lambda_{\nu\sigma} - \Gamma^\rho_{\nu\lambda}\Gamma^\lambda_{\mu\sigma}) V^\sigma \quad -(1)$$

It is seen that the right hand side consists of expressions in the connection $\Gamma^\lambda_{\mu\nu}$. Both torsion and curvature are defined by the connection. The most fundamental symmetry is therefore that of the connection.

By definition the commutator is antisymmetric:

$$[D_\mu, D_\nu] V^\rho = -[D_\nu, D_\mu] V^\rho \quad -(2)$$

This means that the sign of the commutator is changed if $\mu \to \nu$, $\nu \to \mu$. The indices of the commutator are μ and ν. Therefore in eq. (1):

$$[D_\nu, D_\mu] V^\rho = (\Gamma^\lambda_{\nu\mu} - \Gamma^\lambda_{\mu\nu}) D_\lambda V^\rho - (\partial_\nu \Gamma^\rho_{\mu\sigma} - \partial_\mu \Gamma^\rho_{\nu\sigma} + \Gamma^\rho_{\nu\lambda}\Gamma^\lambda_{\mu\sigma} - \Gamma^\rho_{\mu\lambda}\Gamma^\lambda_{\nu\sigma}) V^\sigma \quad -(3)$$

From comparison of eqns. (1) and (3) the following results emerge mathematically if $\mu \to \nu$; $\nu \to \mu$:

2)

$$\boxed{\begin{aligned} \Gamma_{\mu\nu}^{\lambda} &\rightarrow -\Gamma_{\nu\mu}^{\lambda} &-(4)\\ \partial_\mu \Gamma^{\rho}_{\nu\sigma} &\rightarrow -\partial_\nu \Gamma^{\rho}_{\mu\sigma} &-(5)\\ \Gamma^{\rho}_{\mu\lambda}\Gamma^{\lambda}_{\nu\sigma} &\rightarrow -\Gamma^{\rho}_{\nu\lambda}\Gamma^{\lambda}_{\mu\sigma} &-(6) \end{aligned}}$$

In each case the relevant subscripts are μ and ν, the subscripts of the commutator of covariant derivatives.

It is seen that eqs (4) to (6) are symmetries involving the connection. Eq. (4) is the symmetry of the connection itself, eq. (5) is the symmetry of the four-derivative of the connection, eq. (6) is the symmetry of the product of connections. The symmetry is always determined by μ and ν, because σ and λ are summation indices. Finally, ρ is the index of the vector V^{ρ}.

Eqs. (4) to (6) are direct consequences of the definition of the commutator of covariant derivatives in eq. (2). The covariant derivative is defined by the connection:

$$D_\mu V^\nu = \partial_\mu V^\nu + \Gamma^{\nu}_{\mu\lambda} V^{\lambda}. \quad -(7)$$

In the Minkowski spacetime:

3)

$$\Gamma^{\nu}_{\mu\lambda} = 0. \quad -(8)$$

By definition the Riemannian torsion is:

$$T^{\lambda}_{\mu\nu} := \Gamma^{\lambda}_{\mu\nu} - \Gamma^{\lambda}_{\nu\mu} \quad -(9)$$

and the Riemannian curvature is:

$$R^{\rho}_{\sigma\mu\nu} := \partial_{\mu} \Gamma^{\rho}_{\nu\sigma} - \partial_{\nu} \Gamma^{\rho}_{\mu\sigma} + \Gamma^{\rho}_{\mu\lambda} \Gamma^{\lambda}_{\nu\sigma} - \Gamma^{\rho}_{\nu\lambda} \Gamma^{\lambda}_{\mu\sigma} \quad -(10)$$

The erroneous assumption of the standard model of gravitation is:

$$\Gamma^{\lambda}_{\mu\nu} =? \Gamma^{\lambda}_{\nu\mu} \quad -(11)$$

so:

$$T^{\lambda}_{\mu\nu} =? 0 \quad -(12)$$

Eq. (11) would mean:

$$[D_{\mu}, D_{\nu}] =? [D_{\nu}, D_{\mu}] \neq 0, \quad -(13)$$

which is incorrect. The commutator always has the properties:

$$[D_{\mu}, D_{\nu}] = -[D_{\nu}, D_{\mu}] \quad -(14)$$

and if

$$\mu = \nu \quad -(15)$$

then

$$[D_{\mu}, D_{\mu}] = [D_{\nu}, D_{\nu}] = 0. \quad -(16)$$

In the standard model, it is always accepted that

$$R^{\rho}_{\sigma\mu\nu} = -R^{\rho}_{\sigma\nu\mu} \quad -(17)$$

4) but it is assumed erroneously that the connection can have any symmetry. This erroneous assumption comes from:

$$[D_\mu, D_\nu] V^\rho := ? \; R^\rho{}_{\sigma\mu\nu} V^\sigma \quad -(18)$$

In the standard model this is erroneously elevated to the level of an axiom, with catastrophic consequences to physics. In the standard model it is assumed arbitrarily that the fundamental quantities are $T^\lambda{}_{\mu\nu}$ and $R^\rho{}_{\sigma\mu\nu}$, whereas the fundamental quantity is the connection $\Gamma^\lambda{}_{\mu\nu}$. It is seen from eqs. (1) and (3) that all quantities or terms in μ and ν change sign under $\mu \rightarrow \nu$, $\nu \rightarrow \mu$. The correct mathematical evaluation of the left hand side of eq. (1) always produces the right hand side of eq. (1). It is therefore incorrect to use eq. (18). The entire subject area of twentieth century gravitational physics collapses. It has been replaced by ECE theory, based on the Cartan torsion and Cartan curvature.

5) The tetrad postulate of Cartan geometry can be written as:

$$\boxed{\Gamma^a_{\mu\nu} = \partial_\mu q^a_\nu + \omega^a_{\mu\nu},} \quad -(19)$$

where $\omega^a_{\mu\nu}$ is a format of the spin connection defined by:

$$\omega^a_{\mu\nu} = \omega^a_{\mu b}\, q^b_\nu \quad -(20)$$

Here q^a_ν is the Cartan tetrad. The connection $\Gamma^a_{\mu\nu}$ is defined by

$$\Gamma^a_{\mu\nu} = \Gamma^\lambda_{\mu\nu}\, q^a_\lambda, \quad -(21)$$

so:

$$\boxed{\Gamma^a_{\mu\nu} = -\Gamma^a_{\nu\mu}} \quad -(22)$$

The base manifold of Cartan geometry is the one defined by the connection $\Gamma^\lambda_{\mu\nu}$. The spin connection is defined by $\omega^a_{\mu b}$, where a and b are indices of a tangent spacetime at point P. <u>The fundamental symmetry</u> <u>is</u> <u>always</u>:

$$\Gamma^\lambda_{\mu\nu} = -\Gamma^\lambda_{\nu\mu} \quad -(23)$$

so

$$\boxed{\left(\partial_\mu q^a_\nu + \omega^a_{\mu b}\, q^b_\nu\right) = -\left(\partial_\nu q^a_\mu + \omega^a_{\nu b}\, q^b_\mu\right)} \quad -(24)$$

6)

From eq. (1):

$$[D_\mu, D_\nu](V^\rho) = -\Gamma^\lambda_{\mu\nu}(D_\lambda V^\rho) \quad -(25)$$

$$+ \cdot \cdot \cdot$$

and

$$[D_\mu, D_\nu](V^\rho) = \Gamma^\lambda_{\nu\mu}(D_\lambda V^\rho) \cdot \cdot \cdot \quad -(26)$$

so if $\mu = \nu$ $\quad -(27)$

$$\boxed{\Gamma^\lambda_{\mu\mu} = \Gamma^\lambda_{\nu\nu} = 0.} \quad -(28)$$

The antisymmetry of the connection becomes clear if and only if the commutator is used to define a round trip in the general mathematical space. If this calculation is done correctly, there is a one to one relation between the commutator and connection.

In the original definition (1), there is no means of determining the symmetry of the connection.

Riemann does not appear to have defined the Riemann tensor, and the idea of connection was apparently introduced by Christoffel. The idea of torsion was apparently due to Cartan, after the Einstein equation of 1915.

7) By definition:

$$[D_\mu, D_\nu] V^\rho = - T^\lambda_{\mu\nu} D_\lambda V^\rho + R^\rho{}_{\sigma\mu\nu} V^\sigma \quad -(29)$$

so when $\mu = \nu$:

$$T^\lambda_{\mu\mu} D_\lambda V^\rho = R^\rho{}_{\sigma\mu\mu} V^\sigma \quad -(30)$$

$$= 0$$

So when $\mu = \nu$ there is no torsion and no curvature.

In this case the space is the Minkowski spacetime, in which

$$D_\mu V^\sigma = \partial_\mu V^\sigma \quad -(31)$$

i.e.

$$\boxed{\Gamma^\sigma_{\mu\mu} = 0} \quad -(32)$$

Q.E.D.

Conversely, a space with torsion and curvature must be defined by:

$$\mu \neq \nu. \quad -(33)$$

The reason for this is that torsion and curvature are defined by parallel transport of a vector V^ρ around a closed loop defined by two vectors A^μ and B^ν. If δa and δb are the infinitesimal lengths of the sides of the loop, then the change δV^ρ in V^ρ on going around the loop

8)

is defined by eq. (29). In a Minkowski spacetime:

$$[D_\mu, D_\nu] V^\rho = [\partial_\mu, \partial_\nu] V^\rho = 0 \quad -(34)$$

and there is no torsion and no curvature. In this case:

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

i.e. eq. (33), there is no loop.

Therefore the symmetries defined by eqs. (2), and (4) - (6) are the symmetries associated with going around a loop clockwise and anti-clockwise. They are related to the symmetries of handedness or chirality. In order for a sense of clockwise or anticlockwise to be defined:

$$\mu \neq \nu \quad -(36)$$

Only in this case is the space different from the Minkowski space(time). If

$$\mu = \nu \quad -(37)$$

there is no connection because the space is a Minkowski spacetime, i.e.

$$\Gamma^\lambda_{\mu\mu} = 0 \quad -(38)$$

and

$$\Gamma^\lambda_{\mu\nu} = -\Gamma^\lambda_{\nu\mu} \quad -(39)$$