12(6): Proofs of the Wave and Field Equations of ECE Theory

Wave Equation

The wave equation is one of spacetime itself, thus spacetime is already quantized. Consider the tetrad postulate:

$$D_\mu q^a_\sigma = 0, \quad -(1)$$

it follows that:

$$D^\mu (D_\mu q^a_\sigma) := 0. \quad -(2)$$

By definition:

$$D^\mu \phi = \partial^\mu \phi \quad -(3)$$

if ϕ is scalar valued. Therefore:

$$D^\mu 0 = \partial^\mu 0. \quad -(4)$$

All elements of $D_\mu q^a_\sigma$ are zero, and each element is scalar valued. Therefore eq. (4) is true for all elements and

$$\partial^\mu (D_\mu q^a_\sigma) = 0. \quad -(5)$$

Therefore:

$$\partial^\mu \left(\partial_\mu q^a_\sigma + \omega^a_{\mu b} q^b_\sigma - \Gamma^\lambda_{\mu\sigma} q^a_\lambda \right) = 0 \quad -(6)$$

i.e.:

$$\Box q^a_\sigma = \partial^\mu \left(\Gamma^\lambda_{\mu\sigma} q^a_\lambda - \omega^a_{\mu b} q^b_\sigma \right) \quad -(7)$$

where

$$\Box := \partial^\mu \partial_\mu \quad -(8)$$

2)

Define the scalar curvature R by:

$$R q^a_{\ \sigma} := \partial^\mu \left(\Gamma^\lambda_{\mu\sigma} q^a_{\ \lambda} - \omega^a_{\ \mu b} q^b_{\ \sigma} \right) \quad - (9)$$

Multiply both sides of eq. (9) by $q^\sigma_{\ a}$ and use:

$$q^a_{\ \sigma} q^\sigma_{\ a} = 4. \quad - (10)$$

Thus

$$\boxed{\square q^a_{\ \sigma} = R q^a_{\ \sigma}} \quad - (11)$$

where:

$$R := \frac{1}{4} q^\sigma_{\ a} \partial^\mu \left(\Gamma^\lambda_{\mu\sigma} q^a_{\ \lambda} - \omega^a_{\ \mu b} q^b_{\ \sigma} \right) \quad - (12)$$

Various examples of eq. (11) have been worked out in the ECE papers. Eq. (11) is the ECE Lemma. It is a subsidiary proposition to the wave equation. The latter is found by the hypothesis:

$$R = -kT \quad - (13)$$

where k is a constant of proportionality. The Lemma is purely geometrical but the wave equation:

$$\boxed{(\square + kT) q^a_{\ \mu} = 0} \quad - (14)$$

is physics. It is assumed that k is the Einstein constant.

Cross Check

Regard $D_\mu q^a_\sigma$ as a rank three mixed index tensor. Its covariant derivative is defined as:

$$D^\mu\left(D_\mu q^a_\sigma\right) = \partial^\mu\left(D_\mu q^a_\sigma\right) + \omega^{a\mu}_{\ \ b} D_\mu q^b_\sigma - \Gamma^{\lambda\mu}_{\ \ \mu} D_\lambda q^a_\sigma - \Gamma^{\lambda\mu}_{\ \ \sigma} D_\lambda q^a_\mu$$
$$= 0 \quad - (15)$$

Now use the tetrad postulate:

$$D_\mu q^b_\sigma = D_\lambda q^a_\sigma = D_\lambda q^a_\mu = 0 \quad - (16)$$

to find that:

$$\boxed{\partial^\mu\left(D_\mu q^a_\sigma\right) = 0} \quad - (17)$$

QED.

Some Limits of the Wave Equation

The Lemma and Wave equation show that spacetime itself is quantized. Eq. (11) shows that geometry itself is quantized. This finding unifies relativity and wave mechanics. In the limit:

$$kT \rightarrow \left(\frac{mc}{\hbar}\right)^2 \quad - (18)$$

some well known equations of physics are found, as in the ECE papers. In general, gravitation is quantized by eq. (14). Eq. (18) reduces the non-linear structure of eq. (14) to a linear

4)

structure:

$$\left(\Box + \left(\frac{mc}{\hbar}\right)^2 \right) q^a_\mu = 0 \quad -(19)$$

where

$$\lambda_c = \frac{\hbar}{mc} \quad -(20)$$

is the Compton wavelength. Therefore eq. (19) is an expression of wave-particle dualism.

Gravitation

Eq. (19) is the linearized equation ~~of~~ quantized gravitation.

Electron

Eq. (19) is the Dirac equation. In SU(2) representation space, q^a_μ is the Dirac spinor.

Photon

Using:

$$A^a_\mu = A^{(0)} q^a_\mu \quad -(21)$$

eq. (19) is the Proca equation, where m is the photon mass:

$$\left(\Box + \left(\frac{mc}{\hbar}\right)^2 \right) A^a_\mu = 0 \quad -(22)$$

where a is the polarization index.

If one regards $m \to 0$, then for each a:

$$\Box A_\mu = 0 \quad -(23)$$

which is the d'Alembert equation.

The equations of the weak and strong fields, and of unified fields, are built up as in the ECE papers using representation spaces. They all have the same structure (14). Each field sector makes a contribution to kT, and in general the field is a unified field. The latter is generally covariant because of the general covariance of the tetrad postulate. The latter is true in any frame of reference. This can be regarded as a principle replacing the gauge principle.

Stochastic Processes

The Smoluchowski, Fokker-Planck, Kramers and other diffusion equations can be regarded as limits of eq. (14).