Rotation Perpendicular to X and φ by Imaginary Angle α

Now it starts to become clear that the motion of the particle is actually in a five dimensional space (four physical dimensions and a time) and at the speed of light, being the three dimension motion just a drift.

The trigonometric functions associated with a relativistic Lorentz transformation are given in terms of velocity by:

$$\cosh(\alpha) == \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} \tag{A.3}$$

$$\sinh(\alpha) == \frac{\frac{v}{c}}{\sqrt{1-\frac{v^2}{c^2}}} \tag{A.4}$$

$$\tanh(\alpha) = \beta = \frac{v}{c} \tag{A.5}$$

Manipulating equation (A.2) and using $m = m_0 \cosh(\alpha)$ one obtains:

$$(mc)^2 = (mv)^2 + m_0{}^2 c^2 \tag{A.6}$$

$$(m_0 \cosh(\alpha) c)^2 = (m_0 v \cosh(\alpha))^2 + m_0{}^2 c^2 \tag{A.7}$$

$$(m_0 \cosh(\alpha) c)^2 = (m_0 \sinh(\alpha) c)^2 + m_0{}^2 c^2 \tag{A.8}$$

$$\left(\frac{1}{\lambda_\tau}\right)^2 = \left(\frac{1}{\lambda_{x\,\mathrm{Prime}}}\right)^2 - \left(\frac{1}{\lambda_{\tau\,\mathrm{Prime}}}\right)^2 \tag{A.9}$$

With

$\frac{1}{\lambda_\tau} = \frac{m_0 c}{h}$ de Broglie wavelength for the particle on its own reference frame, traveling at the speed of light in the dimensional time τ direction.

$\frac{1}{\lambda_{\tau\,\mathrm{Prime}}} = \frac{1}{\lambda_\tau}\cosh(\alpha)$ Projection on the τPrime direction.

$\frac{1}{\lambda_{x\,\mathrm{Prime}}} = \frac{1}{\lambda_\tau}\sinh(\alpha)$ Projection on the xPrime direction.

Equation (A.9) is the basic equation for the Quantization of Relativity.
It describes the motion of a particle as the interaction of two waves along dimensional time and three-dimensional space.

The $\lambda_{\tau \Pr ime}$, that is, the projection on the τ' axis of the wave propagating along the τ axis (resting reference frame) is given by:

$$\frac{\lambda_\tau}{\lambda_{\tau \Pr ime}} = \cosh(\alpha) \tag{A.10}$$

$$\frac{\lambda_\tau}{\lambda_{x \Pr ime}} = \sinh(\alpha) \tag{A.11}$$

This means that the projected de Broglie Time-Traveling wavelength is zero when the relative velocity reaches the speed of light. Zero wavelength means infinite energy is required to twist spacetime further. The rate of spacetime twisting with respect to proper time relates to the power needed to accelerate the particle to a given speed.

From equation (A.5), acceleration in the moving reference frame can be calculated to be:

$$Acceleration_{\Pr ime} = c^2 \frac{d \tanh(\alpha)}{d\tau_{\Pr ime}} \tag{A.12}$$

In the particle reference frame the acceleration has to be given by Newton's Second Law

$$Force = M_0 Acceleration_{\Pr ime} = M_0 c^2 \frac{d \tanh(\alpha)}{d\tau_{\Pr ime}} \tag{A.13}$$

This means that any force locally twists spacetime, and not only Gravitation as it is considered in General Relativity. It also shows the as the relative speed between the two reference frames increases towards the speed of light, the required force to accelerate the particle approaches infinite.

The Meaning of Inertia

From equation (A.12) it is clear that inertia is a measure of the spring constant of spacetime, that is, how difficult it is to twist spacetime. In the Standard Model paper of this series, it will become clear that Gravitational Mass is incidentally related to Inertial Mass.

Energy Conservation of de Broglie Waves:

The total kinetic energy, calculated in terms of de Broglie momenta, is equal to the Relativistic Total Energy value of a free particle.

The total energy is M_0c^2 in the proper reference frame and equal to:

$$E = \frac{1}{M_0}\left[\left(\frac{h}{\lambda_{x \Pr ime}}\right)^2 - \left(\frac{h}{\lambda_{t \Pr ime}}\right)^2\right] = \frac{h^2}{M_0}\left[\left(\frac{\cosh(\alpha)}{\lambda_t}\right)^2 - \left(\frac{\sinh(\alpha)}{\lambda_t}\right)^2\right] = \frac{h^2}{M_0 \lambda^2 \tau} = M_0 c^2 \tag{A.14}$$

in the moving referential frame.

Phase Matched de Broglie Wave Interpretation of a Particle

Let consider a particle as a free de Broglie wave. In its own referential, it just propagates in the direction of dimensional time τ. On a moving reference frame, the de Broglie wave is decomposed in two:

- One with wavelength $\frac{1}{\lambda_{x\,\mathrm{Prime}}} = \frac{\cosh(\alpha)}{\lambda_\tau}$ propagating along x
- A second with wavelength $\frac{1}{\lambda_{\tau\,\mathrm{Prime}}} = \frac{\sinh(\alpha)}{\lambda_\tau}$ propagating along τ.

Their nonlinear interactions results in:

$$\psi_1(x,\tau) = \cos(\frac{2\pi}{\lambda_e} x\cosh(\alpha))\cosh(\frac{2\pi}{\lambda_e}\tau\sinh(\alpha)) \tag{A.15}$$

$$\psi_1(x,\tau) = \frac{1}{2}\cosh(\frac{2\pi}{\lambda_e}(x\cosh(\alpha) - \tau\sinh(\alpha))) + \frac{1}{2}\cos(\frac{2\pi}{\lambda_e}(x\cosh(\alpha) + \tau\sinh(\alpha))) \tag{A.16}$$

or two waves propagating in the direction of α and –α with wavelength equal to $\frac{\lambda_e}{\cosh(\alpha)}$

Thus a particle can be described as a phase matched wave propagating along its dimensional time direction as the Hyperspherical Universe expands as a function of Cosmological Time.

Next one uses the interference of spacetime waves to derive Quantum Gravity and unify it to Electrostatic interaction.