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A CONCEPT OF MASS AS A STATISTICAL INTENSIVE PARAMETER

Geoffrey Holstrom
Physics Department, Victor Valley College,
Victorville, California 92395-5850/ USA

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The electron mass is an intensive parameter on the distribution of formation intervals. The distribution is determined via a bridge connection defined by vectors existing across both parts of a direct product of such intervals. Particle mass and creation neutrinos form together. When mass exits coordinates are defined: mass and coordinates appear together. Bridge operators are determined for Maxwell, Einstein, and scale fields. Heavy particles are formed in an analogous way by putting them in groups.

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1. Basic Method

Start with a collection of formation intervals for a single particle, grouped on a sheet. There is no geometry. Two sheets are linked in a direct product. Connections exist, in formation interval space, bridging this direct product. One sheet separates, leaving the connections behind on the other sheet and triggering the development of formation distributions. The intensive parameters of these distributions are the particle properties of mass and specific density. Associated fields follow from these, as does geometry and the description in coordinates.

2. Discussion of Approach

X and V are formation intervals on a flat sheet. Define internal vectors on two sheets: $\gamma^i e_i$ and $\beta^a E_a$. e and E are basis vectors on each sheet. γ and β sort each basis. Define a direct product of two formation interval sheets: $\gamma \times \beta$. For this the bridge vector is $\nabla \gamma^i e_i \beta^a E_a$, the bridge connection is $\mathbf{\Gamma}^a_{bi} + \frac{1}{2}\mathbf{T}^a_{bi}$. Indices are flat. One index is on the base sheet, and two on the attached sheet. Bridge connections exist with flat indices. Develop the bridge metric: $G_{ab} = \beta_a \tilde{S} \beta_b$, where $S = \Box^2$ and $\tilde{S}$ is its inverse. Take the norm, and obtain the Particle-Field equation ($\mathcal{X}$ stands for X, V):

$$\gamma^i \Big\{ \frac{\partial}{\partial \mathcal{X}^i} - \frac{1}{8}\mathbf{\Gamma}^a_{bi}(\beta_a \beta^b - \beta^b \beta_a) + \frac{1}{8}\mathbf{T}^a_{ai} \Big\} U(\mathcal{X}) \times \overline{U}(\mathcal{X}) = \beta^a \frac{\partial}{\partial \mathcal{X}^a} U(\mathcal{X}) \times \overline{U}(\mathcal{X}) \quad (1)$$

This is an equation for a general union of sheets. To start the formation process, allow $\overline{U}$ to separate. The union is now a determined one. The Particle-Field equation splits into two parts. One part results in a massless creation neutrino. The other part forms a particle. Upon separation, the β indices on $\underset{\sim}{\mathrm{T}}$ are summed, turning it into a single index operator φ. The sign depends on whether a bridge vector or one form is inserted. This leads to leptons. The departure of the creation neutrino turns $\mathbf{\Gamma}$ into a single index operator ε. Its sign depends on neutrino propagation up or down. Three possible directions imply a one-third factor, and results in quarks. The Particle equation for leptons is:

$$\gamma^i \frac{\partial}{\partial \mathcal{X}^i} \mathbf{\Psi}(\mathcal{X}) = k \cdot O_p^m \Psi(\mathcal{X}) \tag{2}$$

where $O_p^m = \pm(\frac{\partial}{\partial \mathcal{X}} - \phi(\mathcal{X}))$ and k is the $\overline{U}$ wave number. From the commutator of the connection operator for determined unions, we obtain the equation for field operators: $Div\ \mathbf{K} = 0$. In formation interval space, these have the form: $Max\ \varphi = J(\varphi)$.

$$Max\ \phi_n = \Box^2\phi_n - \partial_n\partial\cdot\phi + S\Big(\Box^2\phi_n - \partial_n\partial\cdot\phi\Big)\tilde{S} + \eta^{jm}\Big\{-\Big(\phi_n - SS\phi_n\tilde{S}\tilde{S}\Big)_j \frac{\partial}{\partial \mathcal{X}^m} + \Big(\phi_m - SS\phi_m\tilde{S}\tilde{S}\Big)_j \frac{\partial}{\partial \mathcal{X}^n}\Big\} \tag{3}$$

(S is a mass shell operator on the wave function of a created particle). J is a bridge operator for specific density. A typical term, of four, in the J operator is $J_n = \eta^{jm}\frac{1}{2}\Big(SS\phi_n\tilde{S}\tilde{S}\phi_m - SS\phi_m\tilde{S}\tilde{S}\phi_n\Big)_j$.

It will generate Maxwell's equations without introducing any external current density. In the event a creation neutrino does not separate, we are left with the unmarked connections $\mathbf{\Gamma}$ and $\mathbf{T}$. Properties do not form. For field operators the connections of the Particle-Field equations are used. This is a sheet of undetermined unions of formation intervals.

3. Properties

On a determined union sheet, we find that $\Psi^\dagger\Psi$ is the distributionof X and V. A random process establishes Ψ and φ. The intensive parameters are: $\frac{\partial S}{\partial \overline{X}} = m$ for any X and $\frac{\partial S}{\partial \overline{V}} = \frac{1}{\Delta}$ for any V. $\overline{X}$, $\overline{V}$ are average values. S is the entropy. By performing a four-integration over formation intervals, we find:

$$\langle \Psi \mid \gamma^i \frac{\partial}{\partial \mathcal{X}^i} \mid \Psi \rangle_{X,V} = \int dX \Big(\frac{\langle \Psi \mid O_p^m \mid \Psi \rangle_V}{\langle \Psi \mid \Psi \rangle_V}\Big) \langle \Psi \mid \Psi \rangle_V = \int dX\ m \langle \Psi \mid \Psi \rangle_V \tag{4}$$

for the intensive parameter m associated with the extensive variable X. Similarly

$$\langle \Psi \mid Max\ \phi \mid \Psi \rangle_{X,V} = \int dV \Big(\frac{\langle \Psi \mid J \mid \Psi \rangle_X}{\langle \Psi \mid \Psi \rangle_X}\Big) \langle \Psi \mid \Psi \rangle_X = \int dV \frac{1}{\Delta} \langle \Psi \mid \Psi \rangle_X \tag{5}$$

for the intensive parameter $\frac{1}{\Delta}$ associated with the extensive variable V. m is independent of X and $\frac{1}{\Delta}$ is independent of V. The equation of state among the intensive variables is:

$$\frac{1}{{\lambda_c}^3} = m^3 = \frac{\hbar c}{e^2} \sqrt{\Big(\frac{1}{\Delta}\Big)^i \Big(\frac{1}{\Delta}\Big)_i} \tag{6}$$

The entropy is a concave increasing function of an extensive variable and we find that m and particle energy are always positive. Also, the electron mass is associated with a creation neutrino and the positron mass with a creation anti-neutrino.

4. Space, Time, and the Dirac Equation

The Dirac equation unfolds from the development of the intensive parameter of mass, expressed in units of one over length. It establishes a flat geometry, puts in coordinates, and connects the intensive properties to them. Whatever the size of X, m is always the same. Similar ideas apply to the specific density $\frac{1}{\Delta}$. Thus X is interpreted as ct and $V^{\frac{1}{3}}$ as x. We have coordinates as well as mass. The coordinate space is flat. The reason is that the particle can have no interaction until it appears, and formation intervals are flat. With mass available, we have $\langle\psi \mid \gamma^i \frac{\partial}{\partial x^i} \mid \psi\rangle_3 = m$, the Dirac equation in an average form. Note that this is mechanical in nature. It is time reversible because m is the same for any X. Mass and energy must be positive because they are associated with increasing entropy. The Dirac equation is an envelope carrying mass. The concept of mass having a location of its on its own is meaningless. Location is supplied by the Dirac envelope.

5. Field Operators on Determined Sheets - Maxwell's Equations

The field operator yields Maxwell's equations: $\langle\psi \mid Max\ \phi \mid \psi\rangle_3 = \frac{1}{\Delta}$. $\frac{1}{\Delta}$ is a formed property. Its value has nothing to do with ψ. If ψ is from the sheet where properties were formed, $\frac{1}{\Delta}$ appears. If it is from another sheet, the field is free. Notice that the field operator equation must be averaged under a concentrated Dirac wavefunction. Doing this with a mass shell by moving the averaging particle around results in a push map: $\Box^2_{\overline{x}} A(\overline{x}, t) = \frac{1}{\Delta}$. We have used the definition $e\langle\mid \phi \mid\rangle_3 = \frac{e^2}{\hbar c} A$. If we do not use a mass shell test, the other terms in $Max\ \phi$ contribute. The result is radiation due to particle acceleration, deceleration, or orbital change.

6. Field Operators on Undetermined Sheets: Einstein's Equations

On undetermined sheets no neutrino has separated and nothing has been created. We then use the connections from the Particle-Field equation. Curvature, $\mathbf{K} = [\nabla, \nabla]$ involves $\mathbf{R}$. $Div\ \mathbf{R} = 0$. (∇ is the covariant derivative with Γ. $\mathbf{R}$ is the bridge operator for full Reimann curvature). In contrast to Maxwell, there is no source and no created property. A mass shell test yields $Div\ R = 0$. $R(X)$ is the mass shell average of the bridge curvature. It depends on the average particle position. We attempt to match to some property (a three-index object A^*) already created by other means. Perform a four-integration on the contraction, apply the Bianchi identity, A^* falls out, and we obtain the Einstein equations, where the divergence free objects $T^{\alpha\beta}$ and $\Lambda g^{\alpha\beta}$ are put in by hand. The average particle position is the spatial variable in Einstein's equation. It is possible to reintroduce A^* into the problem and use it to construct a divergence-free object, and we can match to the divergence of the full Riemann curvature $Div\ \mathbf{R} \to A^*$. This makes an energy-momentum tensor related to quarks using the full Riemann curvature.

7. Relating Undetermined Sheets: The Scale Field

The geometric scale on determined sheets is fixed by the formed mass. The scale resulting from undetermined sheets is not so fixed. This results in a scale field bridge operator. This field changes the geodesic equation but, under certain restrictions, leaves Einstein's equations alone. The scale field bridge operator is an addition to $\Gamma + \frac{1}{2}T$. It is $S = \frac{1}{\Omega}\frac{\partial \Omega}{\partial x^i}$. Covariant derivatives are taken using it and the connection $\nabla(\Gamma, S)$. The geodesic equation is

$$\frac{du^\sigma(\overline{x})}{d\lambda} + \Gamma^\sigma_{\mu\nu}(\overline{x})u^\mu(\overline{x})u^\nu(\overline{x}) + S_\nu(\overline{x})u^\nu(\overline{x})u^\sigma(\overline{x}) = 0 \tag{7}$$

$\overline{x}$ is the average position. The equation for the scale field in the gravitational field of a single large mass is

$$S = \frac{1}{\Omega}\frac{\partial \Omega}{\partial r} = \frac{bC}{r^4}\frac{1}{D}e^{-\frac{2m}{r}} \tag{8}$$

where

$$D = \frac{C}{2m}\Big(\frac{1}{r^2} + \frac{1}{mr} + \frac{1}{2mr^2}\Big)e^{-\frac{2m}{r}} + B \tag{9}$$

C, B are constants. b is a parameter depending on matter compared to antimatter formation. It can be positive or negative, and is local. By adjusting these, the scale field can support or detract from standard gravity.

8. Heavy Particles

Arrange a stack of direct product formation interval functions. The bridge connection is diagonal: the same for each function. Transform to mix the functions. This is invariant and gauge fields appear in the standard way. (This is in contrast to trying to stack quarks, where the masses are different). Let a creation neutrino separate out of the direct product. Bridge connections are then marked and the invariance is broken. There are only three connection possibilities: a positron connection, an electron connection, and a quark connection of one sign only. A single neutrino can handle only that. A different neutrino is required if the quark connection is to change sign. Signs of the electron connections are unaffected. All carry gauge fields. The equation for the stack of three $U \times \overline{U}$ contains $\mathbf{T}$ and $\mathbf{\Gamma}$, plus eight gauge fields. This is invariant to a mix. If $\overline{U}$ leaves, invariance is destroyed. We are left with marked bridge fields $^T(a\phi^+ \quad b\epsilon \quad c\phi^-)$, where a, b, and c are integers. The result is a bridge operator working on three Ψ functions. Mass depends on the numbers of positron, quark, and electron connections, as well as the gauge fields. Marked bridge fields for some particles are:

$$
\begin{array}{llllll}
\text{electron: } \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}_l & & & & \text{positron: } \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}_l & U(1) \\
\text{u: } \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}_l & \text{d: } \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}_l & \text{lh}\nu\text{: } \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}_r & \text{rh}\overline{\nu}\text{: } \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}_l & \text{proton: } \begin{pmatrix} 2 \\ 3 \\ 0 \end{pmatrix}_l & SU(2) \\
\text{neutron: } \begin{pmatrix} 3 \\ 3 \\ 2 \end{pmatrix}_l & & & & & SU(3)
\end{array}
$$

The proton is *uud*, but the neutron is not *udd*. Two anti-neutrinos, with a left mark, have to be added. These bootstraps get the right mass and the right decay scheme. All bootstraps are unstable. Fractional charges violate the equation of state.

9. Conclusion

Particle masses are statistical intensive parameters. Coordinates exist because mass does. Both come into being together. Leptons, hadrons, and neutrinos can be created, and all are associated with creation neutrinos. EM fields exist because of $\frac{1}{\Delta}$. Mass and $\frac{1}{\Delta}$ are intensive parameters in formation interval and volume distributions. EM fields have sources and leave space alone. Gravity has no source and controls space. Both have their origin in the same connection. A scale field can exist where mass does not set the scale. Geometry comes after creation. It is established by the Dirac equation and Maxwell forces, and shaped by the Einstein equations and the scale field. It is physical, and not the product of imagination