Tempus Edax Rerum

Jonathan Tooker[1]

[1]*Georgia Institute of Technology, Atlanta, Georgia, USA, 30308*

(Dated: September 4, 2012)

Einstein's equations and the fine structure constant are derived. The problem of precession in classical mechanics gives an example.

PACS numbers: 04.60.-m, 04.20.-q

Quantum mechanical state vectors evolve in time according the Schrödinger equation. Here we propose a non-unitary process by which quantum state tensors evolve in time. For clarity in this article, the canonical theory of vector states $|\psi\rangle$ is called chronos and the theory of tensor states $|\psi\rangle\hat{\pi}$ is called chiros. By combining these ideas, we will show something that is beautiful about Nature.

To observe the effects of chiros two measurements must be made: A and B corresponding to events a and b. The boundary condition set by A will be used to predict the state at b. The observer applies physical theory to trace a trajectory into the future and predict what the state will be at that time. Before the observer can verify the theory, sufficient time must pass that the future event b occurs. Once this happens a signal from b reaches the observer in the present and a second measurement B becomes possible. If the observer's proper time is t_0 we may begin to quantify the process with a Gel'fand triple $\{\aleph, \mathcal{H}, \Omega\}$ wherein each set holds a Minkowski picture S.

$$Present \to Future \to Past \to Present \tag{1}$$

$$\begin{aligned} Past &\propto [t_{min}, t_0) \\ Present &\propto [t_0] \\ Future &\propto (t_0, t_{max}] \end{aligned} \tag{2}$$

$$\begin{aligned} \aleph &= \{x_\mu^- \in S | t_{min} \le t < t_0\} \\ \mathcal{H} &= \{x_\mu \in S | t = t_0\} \\ \Omega &= \{x_\mu^+ \in S | t_0 < t \le t_{max}\} \end{aligned} \tag{3}$$

The past and future light cones define the half spaces $\aleph$ and Ω and the hypersurface of the present is a 3D delta function $\delta(t - t_0)$ in a 12D bulk. The present is defined according to the observer so it is an axiom of this interpretation that the observer is isomorphic to the δ.

Unification of the theories requires that quantum mechanics in $\mathcal{H}$ be connected with general relativistic dynamics in $\aleph$ and Ω. To this end, define a tensor evolution operator $\hat{M}^3$ that is non-unitary and complimentary to the (vector) unitary evolution operator $\hat{U}$.

$$\begin{aligned} Chronos \Rightarrow \;\; \hat{U} \;&: \mathcal{H} \to \mathcal{H} \\ \hat{U} \;&= \partial_x \end{aligned} \tag{4}$$

$$\begin{aligned} Chiros \Rightarrow \;\; \hat{M}^3 \;&: \mathcal{H}_1 \to \Omega \to \aleph \to \mathcal{H}_2 \\ \hat{M}^3 \;&= i\pi\varphi\, \partial_t^3 \end{aligned} \tag{5}$$

A quantum mechanical particle in an infinite square well of length L is represented by a well-known state vector. A particle confined to a temporal square well of duration D should be represented by a similar vector. The quatum state vector confined in space and time follows from the example of the 2D box.

$$|\psi; x, t\rangle := \psi\left(\frac{n\pi x}{L}, \frac{m\pi t}{D}\right) \tag{6}$$

The values L and D should not affect the theory so let us fix the golden ratio $D = 2\varphi L$ in the spirit of $C = 2\pi R$. Thus, we define one quantum of spacetime. Setting $D = \varphi$ and using the identity $\Phi = \varphi^{-1}$ we simplify the state vector.

$$|\psi\rangle = \psi(2n\pi x, \Phi m\pi t) \tag{7}$$

From this function it is possible to derive the fine structure constant and Einstein's equations. Assume an evolution operator that is the sum of a vector part and a tensor part so that $\hat{\Upsilon} \equiv \hat{U} + \hat{M}^3$. The operator ∂ is a unit vector and $\hat{M}^3$ takes on unitary properties in chronos.

$$\hat{\Upsilon}|\psi\rangle = \partial_x|\psi\rangle + \partial_t^3\,|\psi\rangle \tag{8}$$

$$\hat{\Upsilon}|\psi\rangle\hat{\pi} = \partial_x|\psi\rangle\hat{\pi} + (i\pi\varphi)\partial_t^3\,|\psi\rangle\hat{\pi} \tag{9}$$

$$\langle\psi|\hat{\Upsilon}|\psi\rangle = \langle\psi|\hat{U}|\psi\rangle + \langle\psi|\hat{M}^3|\psi\rangle \tag{10}$$

$$\langle\psi|\hat{M}^3|\psi\rangle := \int \psi^*(x_\mu)\,\delta(t)\,\partial_t^3\,\psi(x_\mu)dx_\mu \tag{11}$$

Methods for computing $\langle\psi|\hat{U}|\psi\rangle$ are well established. The spatial part x_i of equation (11) can be integrated directly but the temporal part t contains new complexity. The observer is fixed in the present (at the origin) with the inclusion of $\delta(t)$. When the observer is included in this way, any extraneous constants due to the non-unitary rescaling $\{\mathcal{H}_i \to \Omega \to \aleph \to \mathcal{H}_{i+1}\}$ can be absorbed into the δ since the two values in its range, 0 and

∞, are invariant under multiplication by a constant. This may explain renormalization.

To use an integrand of the form $f(t)\delta(t)$ we must employ the method from complex analysis $f(t)\delta(t) \mapsto g(r,\theta)$. The integral over all times will trace a path through $\aleph$, $\mathcal{H}$ and Ω.

$$\begin{aligned} \int f(t)\,\delta(t)\,dt &= \int_0^\infty g(r,0)\,dr + \\ &+ \int_0^{\alpha^{-1}} g(\infty,\theta)\,d\theta + \int_{-\infty}^0 g(r,\alpha^{-1})\,dr \end{aligned} \tag{12}$$

$$\begin{aligned} \hat{\Upsilon}|\psi\rangle &= \partial_x|\psi\rangle + \partial_t^3\,|\psi\rangle \\ \Upsilon_{nm} &= 2n\pi + (\Phi m\pi)^3 \\ \Upsilon_{11} &= 137.6 \approx \alpha^{-1} \end{aligned} \tag{13}$$

The small deviation in the predicted value and the currently accepted value of α can be attributed to many causes. Ralston has notably treated this subject in [1]. We will return to the fine structure constant after Einstein's equations are derived. The inner product $\langle\psi|\psi\rangle$ takes place in the complex plane so the rotation in equation (11) must be through an unidentified hypercomplex plane. For this reason, the canonical rotation through π radians is replaced with a new path through α^{-1} hyperadians. Let this structure be represented by a non-unitary set of basis vectors $\{\hat{\imath},\hat{\pi},\hat{\varphi}\}$ in $\mathbb{C}^3$ which will identify Dirac vectors with the state spaces $\{\aleph,\mathcal{H},\Omega\}$.

$$|\hat{\imath}| = i \qquad |\hat{\pi}| = \pi \qquad |\hat{\varphi}| = \varphi \tag{14}$$

$$\begin{aligned} |\psi\rangle\hat{\imath} &= \psi(x_\mu^-) \\ |\psi\rangle\hat{\pi} &= \psi(x_\mu) \\ |\psi\rangle\hat{\varphi} &= \psi(x_\mu^+) \end{aligned} \tag{15}$$

The vector $\hat{\pi}$ is associated with $\mathcal{H}$, the domain of chronos. To explore chiros let us suppress one power of π so that $\hat{M}|\psi\rangle := \Phi m|\psi\rangle$. Setting $m = 1$ we develop the tensor component of $\hat{M}^3$.

$$\begin{aligned} \hat{M}^1|\psi\rangle\hat{\pi} &= \Phi \quad |\psi\rangle\pi\,\hat{\varphi} \\ \hat{M}^2|\psi\rangle\hat{\pi} &= \Phi^2 \quad |\psi\rangle\pi\,\varphi\,\hat{\imath} \\ \hat{M}^3|\psi\rangle\hat{\pi} &= \Phi^3 \quad |\psi\rangle\pi\,\varphi\,i\,\hat{\pi} \end{aligned} \tag{16}$$

Chiros brings a fractal structure to the algebra. The identities $\hat{\pi} = \pi\Phi\hat{\varphi}$, $\hat{\pi} = -i\pi\hat{\imath}$ and $\Phi^2 = \Phi + 1$ are demonstrative.

$$\begin{aligned} \hat{M}^3|\psi\rangle\hat{\pi} &= i\pi\Phi^2|\psi\rangle\hat{\pi} \\ &= i\pi\Phi\,|\psi\rangle\hat{\pi} + i\pi\,|\psi\rangle\hat{\pi} \\ &= i\pi^2\Phi^2|\psi\rangle\hat{\varphi} + \pi^2|\psi\rangle\hat{\imath} \end{aligned} \tag{17}$$

Laithwaite's fantastic work *The Multiplication of Umbrellas by Bananas*[2] examines the problem of precession in classical mechanics. He asks if the rate of change of the acceration might be responsible for the anomalous motion. For the case of a spinning wheel we have the following simple relationships for the velocity and centripetal force on a small element near the rim.

$$\frac{dv}{dt} = v\frac{d\theta}{dt} = v\omega = r\omega^2 \tag{18}$$

$$\frac{dF}{dt} = F\frac{d\theta}{dt} = F\omega = mr\omega^3 \tag{19}$$

If the state of a spinning element is r we arrive at a representation $\hat{M}^3|\psi\rangle = r\omega^3$. Using $\omega = 2\pi f$ and equation (17) we recover Einstein's equations.

$$\begin{aligned} 8\pi^3 f^3|\psi\rangle\hat{\pi} &= i\pi^2\Phi^2|\psi\rangle\hat{\varphi} + \pi^2|\psi\rangle\hat{\imath} \\ 8\pi f^3|\psi\rangle\hat{\pi} &= i\Phi^2|\psi\rangle\hat{\varphi} + |\psi\rangle\hat{\imath} \\ 8\pi f^3\psi(x_\mu) &= i\Phi^2\psi(x_\mu^+) + \psi(x_\mu^-) \end{aligned} \tag{20}$$

$$\begin{aligned} f^3\psi(x_\mu) &\mapsto T_{\mu\nu} \\ i\Phi^2\psi(x_\mu^+) &\mapsto G_{\mu\nu} \\ \psi(x_\mu^-) &\mapsto g_{\mu\nu}\Lambda \end{aligned} \tag{21}$$

$$8\pi T_{\mu\nu} = G_{\mu\nu} + g_{\mu\nu}\Lambda \tag{22}$$

In other work we show that the metric in the past is different than in the future [3]. This indicates that the size of the wheel changes as chiros flows. While this idea is foreign to the realm of everyday physics, the discovery of time reversal symmetry violation by the BaBar collaboration shows that this is possible [4]. The apparent anti-gravity effects witnessed in Laithwaite's gyro demonstration at the Royal Society can be explained if there is a net force on $\mathcal{H}_i$ due to contributions from $\mathcal{H}_{i\pm n}$.

$$\begin{aligned} F_{net}\,\hat{\pi}_i &:= \sum_n \alpha^n \left(\dot{F}\hat{\pi}_{i+n} - \dot{F}\hat{\pi}_{i-n}\right) \\ &:= m\omega^3 \sum_n \alpha^n \Delta r_n \end{aligned} \tag{23}$$

A 20 kilogram wheel was spun at 2500 revolutions per minute. Precession lifted the wheel 1.5 meters in 3 seconds. This created a constant linear $\hat{z}$-momentum. Divding the impulse by the time we see the force of precession was about 3 Newtons stronger than the gravitational force. Keeping terms to first order in α we derive a characteristic length scale for chiros.

$$\begin{aligned} \vec{F}_p &= m\omega^3\alpha\Delta r\hat{z} \\ 200 &= (20)(1.8\times 10^7)\alpha\Delta r \\ \Delta r &\approx 10^{-4}\ meters \end{aligned} \tag{24}$$

And that looks about right! Far from the nano-scale of quantum mechanics and far from the macro-scale of ordinary perception. We find an intermediate regime near the scale of the through-provoking Casimir effect.

Beyond this example from classical mechanics, many modern results support the ideas presented here. The physics of cellular spacetimes have been developed extensively by 't Hooft [5]. We show an isomorphism to string theory noting that our cosmic structure $\{\aleph, \mathcal{H}, \Omega\}$ contains a 9+1D subspace $\{x_i^-, x_i, x_i^+, t\}$. Rubino *et al.* have discovered a third mode in quantum optical experiments which is consistent with our three-fold interpetation of time [6]. Palev and Van der Jeugt have developed quantum statistics associated with a three mode quantum structure and they present a resolution to the mystery of quark color confinement [7].

To illustrate the method we employ the Reimann sphere. Such a sphere is formed from $\mathcal{H}$ by mapping infinity to a single null point. In this way the domain of canonical quantum mechanics is mapped to a sphere missing one pole. The null point defines a dual point: the origin, where we have placed the observer by using $\delta(t)$. The position of the origin and the null point may be permuted without affecting physics on the sphere. The flow of time proceeds as a quantum clockwork. At first the observer connects $\mathcal{H}$ and Ω. The value zero is in the present and the value infinity is in the future. With the application of the evolution operator the connection to $\mathcal{H}$ is released and then connected to $\aleph$. Next, the end that is connected to Ω is released and that is reconnected to $\mathcal{H}$. So time flows.

[1] J.P. Ralston, arXiv:1203.5557, [hep-ph] (2012)
[2] E.R. Laithwaite, Electrical Review, 20/27, December (1974)
[3] J.W. Tooker, viXra:1208:0077 (2011)
[4] J.P. Lees *et al.* (BaBar Collaboration), arXiv:1207.5832 [hep-ex] (2012)
[5] G. t Hooft, arXiv:1205.4107 [quant-ph] (2012)
[6] E. Rubino *et al.*, Phys Rev Lett, 108, 253901 (2012)
[7] T.D. Palev and J. Van der Jeugt, Journal Math Phys, 46, 3850 (2002)