Letter: Spatial space as a time-averaged quantum clock caused by an orthogonal state-system – an alternative explanation to LQG and CDT

Abstract:
A model is proposed in which space itself is not a fixed background object, but arises from ultrafast rotating of orthonormal quantum states. The fundamental frequency is $\left(\omega \sim t_{PL}^{-1}\right)$ (Planck time). Observable spatial and temporal quantities emerge as averages over many Planck cycles. The model provides natural explanations for: Lorentz invariance as effective symmetry, gravitation as a statistical mean of rotational dynamics and cosmic fluctuations as frozen rotational phases. Furthermore, experimentally accessible signatures are predicted, including transverse correlations in the holometer, time noise in atomic clocks, and quadratic Planck corrections for the speed of light.

Key-words:

Spacetime-dimensions; orthogonal quantum-states; space-rotation; Planck-frequency; ermergent gravity; average Lorentz-invariance; falsifable theory; exact measurements; time-trigger; alternative to LQG and CDT.

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1. Introduction:

Traditionally, space is viewed as a static background. Taken is a radical step further: Spatial directions $\left(\left\langle e_i(t)\right\rangle\right)$ are dynamic quantum states [1.],[2.] that rotate with a Hamilton operator of:

$$H=\hbar\omega\begin{pmatrix}0 & -i & i\\ i & 0 & -i\\ -i & i & 0\end{pmatrix} \qquad (1.)$$

The fundamental timescale is $t_{PL}\sim 5.39\cdot 10^{-}44\,s$. Measurements can only resolve time-averaged quantities $\Delta t \gg t_{PL}$.

2. Effective Lagrange-density:

2.1. The dynamical basis is described by the velocity of rotation:

$$\Omega^{ab}=\left(e^{-1}\right)^{a}{}_{c}\left(\dot{e}\right)^{cb};\Omega^{ab}=-\Omega^{ba};\Omega^{ab}\in\left(so\left(3\right)\right). \tag{2.}$$

with the elements of:

$e\left(t\right)$ --- timedependent tripod- or rotation-matrix, typical is, that $e\in\left(SO\left(3\right)\right)$,

$\dot{e}$--- time-derivation of e,

$e^{-1}\dot{e}$--- measures the self rotation of the referencesystem/frame,

Ω^{ab}--- the components of this system,

$\Omega^{ab}\in\left(so\left(3\right)\right)$ means that the size is in the Lie-algebra of $\left(SO\left(3\right)\right)$, ergo antisymmetric.

2.2. Physical meaning is:

Ω^{ab} is the angle velocity of the rotating frame and for 3D this corresponds to a vector of:

$\vec{\omega}$ and $\Omega^{ab}=\epsilon^{ab}{}_{c}\omega^{c}$.

The microscopic effect of action then is:

$$S_{micro}=\frac{I}{2}\int dt\,Tr\left(\Omega^{2}\right);I\sim\hbar\,t_{PL} \tag{3a.}$$

The coupling to matter is:

$$S_{\int}=\int dt\,\psi^{\dagger}\left(i\,\partial_{t}-\Omega^{ab}J_{ab}\right)\psi \tag{3b.}$$

Time-averaged, effective spacetime metrics then yields:

$$S_{eff}=\frac{1}{16\,\pi\,G}\int d^{4}x\sqrt{-det\left(g_{\mu\nu}\left(x\right)\right)}R\left(g_{\mu\nu}\left(x\right)\right)+S_{mat}\left[g_{\mu\nu},\psi\right]+S_{corr}\left[g_{\mu\nu}\right] \tag{4.}$$

Terms of correcture S_{corr} are strongly depressed by t_{PL}.

3. Experimentally measurable predictions:

3.1 Holometer-signature:

$$\left\langle\delta x_{orth}^{2}\right\rangle=\kappa\,L\,c\,t_{PL} \tag{5.}$$

where κ a dimensionless constant.

This measurement is valid for two near interferometers with arm L. Transversal cross-correlations are the key.

3.2. Time-noise:

$$\left\langle\Delta t^{2}\right\rangle\sim t_{PL}\,\Delta t \tag{6.}$$

Testable by high precise atomic clocks.

3.3. Energy-dependent lightspeed-velocity:

$$\frac{\Delta c}{c} \sim \left(\frac{E}{E_{PL}} \right)^2 \qquad (7.)$$

Measurable by gamma-ray bursts or high energetic neutrinos.

3.4. Cosmological signatures:

Primordial fluctuations correspond to frozen rotation phases → nearly scaleinvariant.

Tensor to scalar ratio:

$r \ll 10^{-3}$.

Correlated to direction, minimal deviations from Gauss-profile, not a Gaussian distribution.

More detailed explanations can be found in [3.]. This paper will be published shortly.

4. Comparison to established QG-models [4.],[5.]:

Type of Model	Space-structure	Time-structure	Measurable signatures
LQG	Discrete spin-networks	Problematic	No time-noise, local
CDT	Simple building blocks	Preferred time	Noise by ensemble
Superstrings	Backgroundspace	Continous	Hardly at low energies (energy-densities)
This model	Dynamical quantum-rhythm	Time-averaged	Holometer-correlations, time-noise, quadratic $(c(E))$-corrections

Table 1: Comparison between experimental possibilities to falsify the respective quantum-spacetime model [6.].

5. This model is falsifable by :

1. No measuring of transversal cross-correlations,

2. Only measuring of linear deviation in $\frac{E}{E_{PL}}$.

3. Atomic clocks without a noise of $\sqrt{(\Delta t \cdot t_{PL})}$.

6. Roadmap for experiments:

6.1. Holometer/Interferometer:

Aim: transversal cross-correlations:

$(\Delta x_{orth}) \sim (10^{-19} - 10^{-20} m)$.

Time: Actual generation of measurement instruments or a little more developed/upgraded measure – devices.

6.2. Atomic clocks:

Time:$10^4\,s$ measurement; future clock generation, example: optical lattices.

6.3. Astrophysics:

Aim: Quadratic Plamck-correlations for light velocity.

Gamma-ray bursts, high-energetic neutrino beams.

6.4. Cosmology:

CMB and primordial fluctuations, testing: direction correlated weak Non-Gaussian measurement: $r \ll 10^{-3}$.

6.5. Long-term measuring:

Combination of signals; consistent tests, model can be falsified or confirmed between 10-20 years.

7. Summary:

Space is a dynamic process whose statistical averages generate classical geometry. Measurable signatures are clearly defined, falsifiable, and distinguish the model from LQG, CDT, and super-string theory. Cosmology also provides testable differences in primordial fluctuations. A more detailed paper will follow.

8. References:

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9. Verification:

This paper definitely is written without support from an AI, LLM or chatbot like
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