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Quantized Conductivity as a Neutral Quadrupolar Generator

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Abstract **Review Article**

In a model with bifurcated spacetime a microstructure layer with meV voltages and quantized conductivity of is capable to emit a cosmic ray spectrum by neutral quadrupolar waves with low count rate. Enhanced air ionization, air composition change, layer damage and nuclear disintegration stars as well a second sound with independent waves of temperature and entropy is predicted. The cosmological constant problem is quantitatively explained that quantum statistical vacuum energy density in the layer already contains on average a broadband emission up to cosmic rays. For bifurcated ripped spacetime quantum statistics treats k-components of the tree as particles. Particles as monopole-like fractal strings arise near zeros of zeta functions.

Keywords: Quantized Conductivity, Cosmological Constant Problem, Quantum Statistics, Charge Quantization, Monopole Problem, Bifurcation, One-Dimensional Chaotic Map, Cosmological Model.

INTRODUCTION

Experimental values of the vacuum energy density ρ_{exp} are 50 to 200 orders of magnitude smaller than the theoretical value ρ_{QS} of zero-point energy suggested by quantum statistics (QS). This disagreement constitutes the substantial problem of the cosmological constant (CCP) [1, 2]. However, high-precision nanostructure measurements are in good agreement with QS. Theoretically charge quantization requires **B**-field lines in the complex electromagnetic field **E**+i**B** drawing a pole which is realizable e.g. by large ball of strings as a large monopole mass [3]. The aim of the present note is to describe meV semiconductor experiments to clarify both fundamental problems. Charge quanta are experimentally detected for a mass ratio 10^{20} between oil drop and electron [4]. Within a fractal zeta universe (FZU) [5], of ripped bifurcating spacetime the Millikan experiment (ME), the quantum Hall (QH) effect, atmospheric clouds and universe clouds are shown to be self-similar tight-binding models each of mass ratio $\simeq 10^{20}$ extending Dirac's large number hypothesis [6]. Orbits of period-doubling k-components of a quadratic map alternate with a lap number l_ω of equivalent periods ω. Simplest cycles ν_q of iterated quadruples $k+3\in\{k,k+1,k+2\}$ yield a bicubic bispinor norm solving CCP. Nanostructure experiments allow even conclusions to cosmological and global parameter [5].

Experimental Predictions

The QH current is a neutral oscillating complex quadrupole (inertial) moment I_{xy}. Experimental support for FZU is global temperature gradient oscillation over 10^6 years and microwave emission at QH [7, 8]. Despite a large scaling factor of 10^{20} detector dimensions for ME, QH and cosmic ray (CR) detector (Wulf's bifilar electrometer, Wilson chamber) are comparable. FZU has invariant dimensionless vacuum energy densities $\rho_{FZU} \simeq \lambda_k g_k^2 \simeq \rho_{exp}$ with modular units g_k and predicts very low CR count rates as a bifurcating spacetime tree of k-components for a conductivity plateau σ_H. CR emission should depend on σ_H measurement accuracy κ which is the Born-Oppenheimer parameter in a tight-binding model. A first prediction of high-energy emission at QH not yet observed is extended to a model of a universal CR-atmospheric charge cloud superfluid [9, 10]. [5]. Iterated Weber invariants $f(\omega)$ by map (4) is regarded as a complex curvature. Doubly-periodic cycles shape Feigenbaum constants α_F, δ_F and periods ν_{Sh} due to Sharkovsky's theorem. Whereas laps l are particle orbits k-components is ripped or bifurcating spacetime. Particles at first periods ν_{Sh} at $k\leq 3$ are not observable. Periods ν_{Sh} near k=3 is spacetime oscillation felt as cosmic microwave background (CMB). k-components changes into a fluid of elastic spacetime at step $k\simeq G_5^{-1}$ with dark exchange scattering coupling constant $G_5\simeq 10^{-167}$. Then a general Riemann surface $\binom{w+1}{2}<3w+3$ for $w\leq 5$ is self-similar congruent $k \simeq 2^{2^9} \to 1$ At conductivity plateau magnetic field **B** ≃ $\delta_k h_t(g_k)$ is topological entropy $h_t(g_k)$ whereas electric field **E**≃∇T is temperature. Charges as Coulomb singularities or self-dual **E**+i**B** require dominant laps. Large fields **B** or large convection $\delta_k h_t$ in thin layers induces chaotic k trees. FZU-emission rates of CMB at QH behave as κ^{-2}. Regarding k-components as identical charges quantum statistics overestimates ρ_{exp} by factor $2^{2^9} \simeq G_5^{-1}$ as a F_9-congruences with Fermat number F_t in $\rho_{QS} \gg \rho_{exp}$ [11]. Rare CR predicted with probability 2^{-2^k} cause enhanced anomalous atmospheric ionization in the laboratory measurable by air composition or air ionization as well as by nuclear disintegration stars in surrounded layers [12]. Large scale CR detector arrays indicate CR emissions at QH correlated over macroscopic dimensions with a very low count rate up to 10^{-2} year. The real counterpart to I_{xy} are gravitational waves. A second sound for the incompressible QH superfluid state is predicted as an independent heat transfer by wave-like motion. Coupled to $\alpha_F,\delta_F,\nu_{Sh}$ a second sound describes independent wave motion of entropy and temperature like propagation of pressure waves in air (sound) in addition to predicted CMB emission at QH. The velocity of the second sound is proportional to the entropy $\delta_k h_t$≃**B** and depends e.g. on magnetic field.

Quantum theory as k-incongruent laps

QS normalizes each lap state ψ to 1 in a 2^{2^k}component CR bifurcation tree as an air shower giving in total an 2^{2^k} fold of energy as CCP. FZU consists of cryptographic-like pseudo-random integer addition steps k on elliptic curves. But Legendre modular function $\lambda_k \to 0$ and large $g_k \to \infty$ for $k \to \infty$ stand for QS. FZU implies cubic f(ω) and finite λ_k and g_k. The cubic behavior of λ transmits to the coupling constant G_w for w≤5 independent general complex Riemann surfaces for w-interactions w=(strong,weak,em,grav,dark). Topological entropy $\lambda_k \simeq h_t(g_k)$ depends on λ causing a convection process. An invariant energy density

$\rho \simeq \frac{1}{2} \sum_{(w,\mathbf{k})} G_w(E)E(\mathbf{k}) \simeq \rho_{FZU} \simeq \rho_{exp} \simeq 10^0 \ldots 10^{-1}\mathrm{eVcm}^{-3} \simeq \rho_{CR} \simeq \rho_{CMB}$ (1)

results from a bicubic bispinor norm $Nm(\psi)=E_i\psi'\psi''=1$ of conjugated units. Energy E(**k**) is defined as a change of units E_i or a change of λ_k giving directly the Dirac equation [5], where **k** is explained by periods ν_{Sh} capturing Bloch states by $\gamma(\phi_3)$- fixed points. CCP implies E(**k**→∞)→∞. QS implies ν_{Sh} congruent and k-incongruent laps. FZU implies finite E(**k**→∞)→E_∞ and congruent steps $2^{2^k} \to 1$. The coupling constant

$lnG_w(0) = -w!\, 2^w \ln_3^w 2$ (2)

optimizes the circulant regulator index $R_{\Delta ij}=\{\log E\}_{ij}$ in eq. (6) with ω_i-congruences as number fields. This circulant behavior is missing in QS. For simplest cycles ν_q the Euclidean norm $N(E)=E_q^{-2}$ in eq. (6) recovers the until now accepted bispinor norm. The cutoff in eq. (1) is due to eq. (2) and $G_w(E)$, The unified bispinor norm depends on $E(G_W)$ as a tidal-like four curvature state. CCP is a time averaging problem for rare but ultra-large mass $M_k \simeq g_k$ on bifurcating clouds.

$\rho_{QS} \simeq \Delta t M_k c^2 R_{net} + \rho_{exp}$ (3)

with $M_k \to \infty$ and $R_{net} \to 0$ depending on $d\sigma_5$ and time interval $\Delta t \to \infty$. Number theoretic congruences $1 = 2^{2^k} \simeq G_5^{-1}$ leading to ρ_{exp} resolve CCP reducing ρ_{QS} to ρ_{exp}. As a result, CR and CMP is inherent in any spacetime also at low altitudes. Map (4) iterates near quadrupolar nontrivial zeros of the Riemann zeta function ζ(z) as universal clock frequency j(z). For k→∞ $\zeta(z_n \simeq \lambda)=0$ imply quanta of charge [13, 5]. The 2^{2^k}- pole cloud of iterated complex f(ω)- strings gets a mass like a magnetic monopole. In FZU the order parameter ψ≃K+iK' is linear expanded into f(ω) which is viewed as complex curvature R_u of a self-similar universe where quarter periods K, K' are exact theta constants [5]. Complex R_u describe large tensile forces as CR in balanced ionized clouds with CMB. FZU regards the complex coordinate z itself as iterated theta constants equivalent to a correlated path-ordered complex temperature potential V_T+iT. Friedmann equations of open, closed or flat spacetime confirm FZU by elliptic integrals for complex time t+iβ ≃ V_T+iT ≃ω [14]. In FZU periods ν_{Sh} mutually depend on congruent half-periods ω_i containing fluctuating discriminants Δ_k. Periods ν_{Sh} induce congruent integer indices ω_i [5]. Addition on iterated elliptic curves is a cryptographic, regular, pseudo-random chaotic bifurcation process of period-doubled Riemann surfaces. Fixpoints of the period-doubling map are iterated cubic roots f(ω) of $\phi_3(f(\omega))$

$$\gamma(\phi_3(f)) = \begin{vmatrix} \frac{1}{3}\phi_3'(f) & \phi_3(t) - \frac{t}{3}\phi_3'(f) \\ -1 & f \end{vmatrix} \quad (4)$$

The orbit subgroup detγ=1 of equivalent lattices is called lap. This neutral background cloud is an excitation on the minimum of a thermal potential V_T of resting non-turbulent Carnot cycles ν_{Sh} with large scale floating non-radiative bifurcations. The holomorphic function ξ≃E is field-like $\xi(z) = \binom{z}{2}\pi^{-\frac{z}{2}}\Gamma(\frac{z}{2})\zeta(z) = \frac{1}{2}\prod_n(1-\frac{z}{z_n}) = -\frac{\partial j(z)}{\partial z}$ where a current-like $j(z) = -4\int_1^\infty \frac{dt}{\log t} t^{-1/4}\partial_t(t^{3/2}\partial_t(\vartheta_3(0,e^{-\pi t}) - 1))\sinh(\frac{1}{2}(z-\frac{1}{2}))\log t$ depends on the Jacobi theta function ϑ_3. From γz, γξ - invariances Coulomb singularities are expected for cycles ν_q or ξ''≃ξ' [15].

Neutral superfluid potential flow

A relation of charge and flux to thermal convection has already been proven. The flux-quantized superconducting order parameter is calculated as a theta function satisfying a heat conduction equation [16], which is in accord with FZU. For nonequilibrium semiconducting electron states a Benard convection lattice state is predicted [17]. In FZU dynamics of Kirchhoff equations $X_{k+2}=\hat{a}[\gamma]X_{k+1}$ and $X_{k+1}=\hat{a}[\gamma]X_k$ is governed by discrete steps with substitution [4], and orthogonal $\hat{a}[\gamma]$. The iterated X_k-flow is floating, homogeneous, non-turbulent. A quadratic map of eq [4], as a fractional substitution relates period-doubling to cubic roots. At step k=0 a pole $f^{24}(\omega)|_{k=0}=2^4/\lambda(\lambda-1)$ exists on λ-plane of $\zeta(z=\lambda)$. Eq [4], creates an entire, holomorphic polynomial $f_k(f_{k=0})$. Subsequent steps yield Feigenbaum renormalized invariants.

$$\gamma^{(ren)}=\gamma+\gamma\circ\gamma^{(ren)} \quad (5)$$

which acquire a pole in crossing points of periods ν_{Sh}. Time-thermal cycles of braid groups encircle k- components $\gamma_0\circ\ldots\circ\gamma$ near the pole. Eq. (5) changes into a Bethe-Salpeter-like equation for a Greens function $G_{ss'}[\psi]$ defined in terms of a quartic roots shifted to $s=\pm\infty,\pm i\infty$ where $\gamma \simeq G^{-1}[\psi]G^{-1}[\psi]$ [11]. Eq. (5) expands into Feynman diagrams for $G_{ss'}[\psi_q]$ for ν_q where $q\simeq s$. Optimal units $E(\omega_k)$ and $f_k=f(\omega_k)$ with Euclidean norm $\sum_q f_q^{-2} = \sum_q f_q' f_q''$ reproduce a bicubic spinor norm $Nm(f(\omega))=f(\omega)f'(\omega)f''(\omega)=2$ with complex conjugates invariants f' and f''. Optimal entropy is given by minimizing $R_{\Delta ij}^2$ of a circulant regulator for finite geometric zeta function $\zeta(l_s,m_s,z)$ of string length l_s and multiplicity m_s and Euclidean norm N(E) as.

$$2 R_{\Delta ij} +\mu_1+2\mu_2\zeta(l_s,m_s, R_{\Delta ij})e^{2R\Delta ij} +\mu_3N(e^{R\Delta ij})\zeta'(l_s,m_s, R_{\Delta ij}) =0 \quad (6)$$

For an entropy-based universe [18]. A Mandelbrot zoom sequence is first unrelated to quantum statistical electron clouds. However, optimal real algebraic $E^{(opt)}$ units are μ_1,μ_2,μ_3-parametric superpositions of cardioids and zoomed bulbs which explain the Lorentz Huygens- Fresnel principle by a maximum information current by subsequent spheres within spheres [5]. The real eq [6], is easily solved by four-component complex rotations of units E_i or $e^{2E}{}_i$. The optimal regulator $R_{\Delta ij}$ has plateaus of susceptibility $\chi\simeq G_w$ as elastic Lagrangian oscillations. Then $\chi\simeq\sigma_H[\delta_F]$ is a universal constant for $k\rightarrow\infty$. At finite k χ exhibits a minimum e.g. $\chi \simeq 1/128$ at 10^9eV [19]. Similarly, a QH plateau describes a universal (all interaction containing) neutral quadrupolar current.

Fractional charges are quadrupolar elliptic oscillations

Laughlin- wave functions $\exp(|z|^2)\Pi(z_i-z_j)^q\simeq \exp(|z|^2)\Delta^q$ are similar to q^{th} order Vandermonde discriminants Δ or q^{th} order Weierstrass sigma functions $\sigma^{(q)}(z,\omega)$ [20, 21]. FZU relates iterated zeta functions to hyperelliptic sigma functions linear expanded into period-doubled $f(\surd\Delta_k)$ of chaotic one-dimensional substitutions in a cubic invariant $\phi_3(f(\omega))=0$ [5]. Braid groups and periods ν_{Sh} are related. Complex z-values are half-periods in modular units $g(a\omega,\omega)\simeq\sigma^{(q)}(z=a\omega,\omega)$. During iteration points $X(f(\surd\Delta_k))$ of an incompressible fluid get synchronized with lattices $\omega[f(\omega_k)]$ as a doubly-periodic charge-heat or time-temperature potential $V_T^{(k)}$. A 3K minimum of global temperature V_T is explainable as period 3 of a bifurcating spacetime string. Neutral quadrupolar-like correlations $[\zeta(\lambda_k), \zeta(\lambda_k)]\simeq[f(\omega_k), f(\omega_{k'})]$ induce a two-sound massive superfluid [5]. Standard units of time and energy count the number of precessions n and the number of Carnot cycles m independent on fluctuating two-periods. Accordingly, a floating tidal-like phase-correlated bifurcating fluid cloud persists with balanced collision-less ionization in a stable universe. The minimum $z_k\simeq V_T(f_k)$ allows rare ultra-high energy CR and persistent CMB of the iterated 2^{2^N}- polar holomorphic fluid $z_{k+N}[\ldots z_k]$ that forms a ball of strings. Charges are poles of the Feigenbaum renormalized $f(\omega(\lambda_k))$ centered at the center of the ball.

Longitudinal and quadratic thermopower

Measurements of longitudinal thermopower at QH yield only small corrections to σ_H [22, 24]. FZU determines σ_H itself as iterated quadratic thermopower and universal coupling constant [25]. A zero $\zeta(z_n)=0$ is a dissipation less superfluid with singular 2.2 susceptibility matrix χ for charge and heat components.

$$\xi\simeq E(z)=\chi^{-1}(\nabla V,\nabla T)= \chi^{-1}\nabla V_T\longrightarrow 0 \quad (7)$$

of equivalent periods ω as an ordered state. Inequivalent periods ω near simple zeros $\zeta(\lambda_n)\simeq\chi_{nn'}(\lambda_{n'}-z_{n'})$ cause off-diagonal doubly-periodic complex susceptibilities $\chi_{nn'}$. In Corbino geometric $\sigma_H = \chi_{12}/\chi_{11}$ singular $\det\chi=0$ are regular chaotic inflection points on elliptic curves [24]. A parameter-free zeta function $\zeta(z)$ or one parametric Mandelbrot zoom is subjected to four-parametric substitutions (4) as a two- bit input flux in analogy to a complex local Ricci scalar [5]. The sum $j(z)+j^*(z)$ satisfies the hyperbolic Laplace eq. which holds also for the entire polynomial $f_k(f_{k=0})$ as a neutral one-dimensional complex holomorphic electrostatic problem. For zero longitudinal resistance the charge-heat susceptibility χ describes the Seebeck coefficient $Q_S=\chi_{12}/\chi_{11}$ as the entropy h_t per charge carrier $Q_S= h_t/eN_e$. Cycles ν_{Sh} and ν_q and poles of $\zeta(z)$ and $f(\omega)|_{k=0}$ and δ_F yield a density of residue $\frac{m}{2\pi i\delta_F^2(2n+1)}$ where n and m result from the exact elliptic equation $\frac{d^2K}{d\lambda^2}-\lambda\frac{dK}{d\lambda}+nK=0$ for quarter periods $K(\lambda),K'(\lambda)$. Accordingly, a quadratic transverse Seebeck coefficient $Q_S \simeq\chi\chi^{-1}\simeq\sigma_H$ as voltage gradient $\nabla V= Q_S\nabla T$ vs. temperature gradient ∇T measures time-thermal Carnot cycles. A tight-binding approach of liquid sites is proven for QH [26].

Second sound

The atmospheric equivalent of second sound is e.g. flash bang and thunder as independent thermal and entropy cycles. Simplest cycles ν_q describe an incompressible non-dissipative superfluid. The discrete velocity has longitudinal, transverse and rotatory components $\mathbf{k}_i\mathbf{k}_j$, δ_{ij}- $\mathbf{k}_i\mathbf{k}_j/k^2$, $\varepsilon_{ijkl}\mathbf{k}_k\mathbf{k}_l$. The cubic invariant couples longitudinal and rotatory components in roton-like upper energy valleys [27, 28]. A Feigenbaum diagram hysteresis displays a Carnot energy gain. In the layer a second sound of neutral quadrupolar waves maintains cloud stability by independent temperature T and entropy $\mathbf{B}\simeq\delta_k h_t$ cycles. Emission of transverse waves has been already detected at microwave frequencies at QH where exp $B/m_e(t+i\hbar/k_BT)$) [8].

CONCLUSIONS

Within FZU second sound, CR, CMB is predicted at quantized susceptibility which solves CCP $\rho_{exp} \neq \rho_{QS}$ by relating QS to a lap number of k-components. Iterated invariants $f_k(\omega)$ and periods $\omega=\omega_k$ predict a one-dimensional complex bifurcation tree of bifurcating complex curvature R. Tensile forces of bifurcated, ripped spacetime are felt as CR and CMB [5]. Iteration by (4) around invariant zeros $z_n=\xi^{-1}=E^{-1}$ of the Riemann zeta function can be visualized by strings of j(z) at cycles v_q of a bifurcation tree of quadrupolar points 1,2→1',2'. tending to two-valleys of a two-body tight binding model with inertial tensor $I_{ij}= \delta f\wedge\delta f$. Like a Mandelbrot zoom the γ-map $z_k\rightarrow z_{k+1}$, $j_k\rightarrow j_{k+1}$, $E_k\rightarrow E_{k+1}$ on complex plane with its normal can be embedded into space where $j(z) \rightarrow \mathbf{j}(z)$, $E \rightarrow \mathbf{E}+i\mathbf{B}$. The chain of strings $[\delta\mathbf{j}_{k+N+1}/\delta\mathbf{E}^{-1}{}_{k+N} \ldots[\delta\mathbf{j}_{k+1}/\delta\mathbf{E}^{-1}{}_{k}]$ draws a doubly-periodic 2^{2^N}-polar ball as a singularity in two-dimensional Laplace equation [29], felt as a charge quantum. This is the fractal analog of the magnetic Dirac monopole problem for large (monopole) masses [3]. Subsequent quadrupolar waves yield a background permeability $\varepsilon_0(\mathbf{k})=1/I_{ij}\mathbf{k}_i\mathbf{k}_j$ of potential $1/\varepsilon(\mathbf{k})\mathbf{k}^2$ in $\mathbf{k}$-space which is the exchange scattering term. Then $\varepsilon_0(R_u)\simeq R_u^2$ with cloud (universe) radius R_u explain cosmological redshift and CMB both caused by simplest cycles of clock frequency j(z). Predicted emissions relate nanostructures to possible future energy technology as well as to consequences for the model of universe and climate.

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