Complex-Dynamical Approach to Cosmological Problem Solution

Creative Cosmology Paradigm

THE CONSTRUCTIVE POWER OF INTERACTION-DRIVEN CHAOS IN COSMIC STRUCTURE CREATION AND DYNAMICS

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Universe structure emerges in the unreduced, complex-dynamic interaction process with the simplest initial configuration (two attracting homogeneous fields). The unreduced interaction analysis, avoiding any perturbative model, gives intrinsically creative cosmology, describing the real, explicitly emerging world structure with dynamic randomness on each scale [1-7].

Without imposing any postulates or additional entities, we obtain physically real, three-dimensional space, irreversibly flowing time, elementary particles with their detailed structure and intrinsic properties, causally complete and unified version of quantum and relativistic behaviour, the origin and number of naturally unified fundamental forces, classical behaviour emergence in a closed system, and true quantum chaos. Major problems of standard cosmology and astrophysics are consistently solved in this unified picture, including those of quantum cosmology and gravity, entropy growth and time, "hierarchy" of elementary particles (Planckian unit values), "anthropic" difficulties, space-time flatness, Big Bang inconsistency, and "missing" ("dark") mass and energy [2].

The unified origin of usual theory difficulties is rigorously specified as reductive, dynamically single-valued projection of multivalued reality, devoid of genuine structure-creation ability in principle.

[1] A.P. Kirilyuk, *Universal Concept of Complexity by the Dynamic Redundance Paradigm: Causal Randomness, Complete Wave Mechanics, and the Ultimate Unification of Knowledge* (Kyiv, Naukova Dumka, 1997). For a non-technical review see also: E-print physics/9806002 at http://arXiv.org.

[2] A.P. Kirilyuk, "Complex-Dynamic Cosmology and Emergent World Structure", Report presented at the International Workshop on Frontiers of Particle Astrophysics (Kiev, June 21-24, 2004). E-print physics/0408027 at http://arXiv.org.

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SCHEME OF COMPLEX-DYNAMICAL UNIVERSE STRUCTURE:

two attracting, omnipresent protofields give rise to all particles and fields, their intrinsic properties, unified quantum and relativistic behaviour

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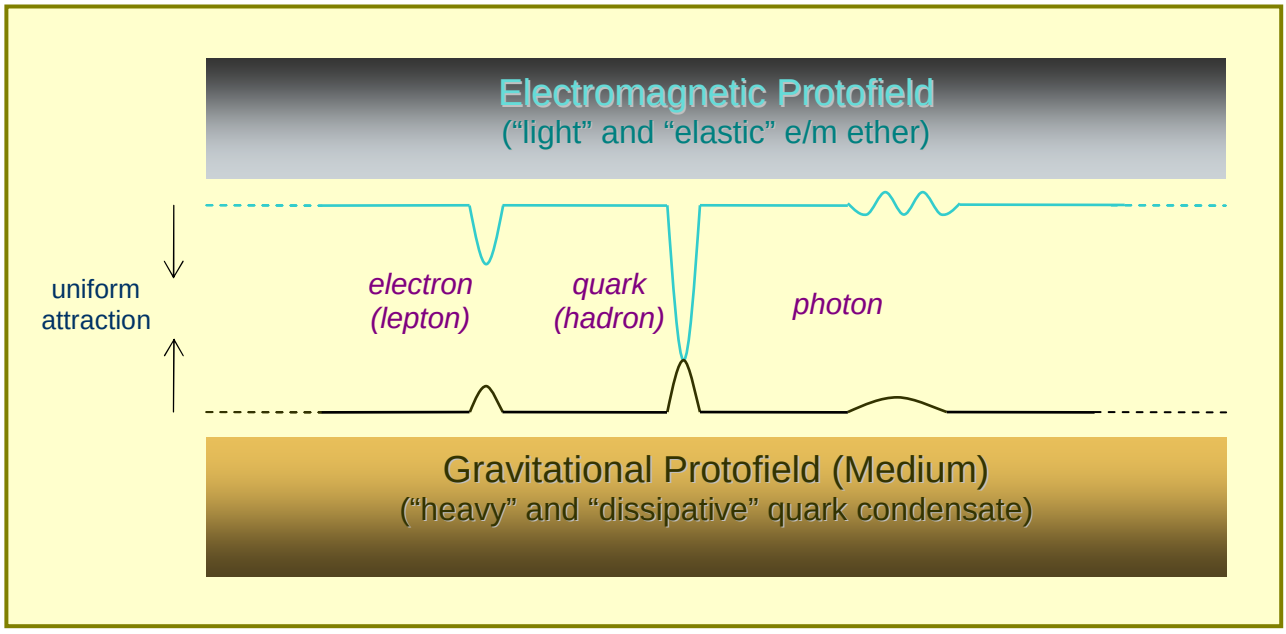
QUANTUM FIELD MECHANICS



Unreduced interaction analysis gives inhomogeneous, changing and chaotic structure emergence (elementary particles) in the initially homogeneous (simplest) system configuration [1-5]:

$$\left[h_{\mathrm{g}}(\xi)+V(\xi,q)+h_{\mathrm{e}}(q)\right]\Psi(\xi,q)=E\Psi(\xi,q) \qquad (1)$$

In terms of internal degrees of freedom of e/m protofield:

$$\Psi(\xi,q)=\sum_{n}\psi_{n}(\xi)\varphi_{n}(q)\ ,\quad h_{\mathrm{e}}(q)\varphi_{n}(q)=\varepsilon_{n}\varphi_{n}(q) \qquad (2a)$$

$$\left[h_{\mathrm{g}}(\xi)+V_{nn}(\xi)\right]\psi_{n}(\xi)+\sum_{n'\neq n}V_{nn'}(\xi)\psi_{n'}(\xi)=\eta_{n}\psi_{n}(\xi) \qquad (2b)$$

$$V_{nn'}(\xi)=\int_{\Omega_q}dq\phi_{n}^{*}(q)V_{\mathrm{eg}}(q,\xi)\phi_{n'}(q)\ ,\quad \eta_{n}=E-\varepsilon_{n} \qquad (2c)$$

Instead of usual perturbative approximation,

$$\left[h_{\mathrm{g}}(\xi)+V_{nn}(\xi)+\tilde{V}_{n}(\xi)\right]\psi_{n}(\xi)=\eta_{n}\psi_{n}(\xi)\ ,\quad \left|V_{0}(\xi)\right|\leq\left|\tilde{V}_{n}(\xi)\right|\leq\left|\sum_{n'}V_{nn'}(\xi)\right| \qquad (3)$$

we get the dynamically probabilistic sum of redundant system realisations:

$$\rho(\xi,q)\equiv\left|\Psi(\xi,q)\right|^{2}=\sum_{r=1}^{N_{\Re}}{}^{\oplus}\rho_{r}(\xi,q)\ ,\quad \alpha_{r}=\mathrm{prob}\left[\rho_{r}(\xi,q)\right]=\frac{1}{N_{\Re}}\ ,\quad \rho_{r}(\xi,q)=\left|\Psi_{r}(\xi,q)\right|^{2} \qquad (4)$$

$$\Psi_r(\xi,q)=\sum_i c_i^r\left[\varphi_0(q)\psi_{0i}^r(\xi)+\sum_{n,i'}\frac{\varphi_n(q)\psi_{ni'}^0(\xi)\int_{\Omega_\xi}d\xi'\psi_{ni'}^{0*}(\xi')V_{n0}(\xi')\psi_{0i}^r(\xi')}{\eta_i^r-\eta_{ni'}^0-\varepsilon_{n0}}\right] \quad (5)$$

where $\{\psi_{0i}^r(\xi),\eta_i^r\}$ are eigen-solutions of the effective potential (EP) equation:

$$h_g(\xi)\psi_0(\xi)+V_{\text{eff}}(\xi;\eta)\psi_0(\xi)=\eta\psi_0(\xi) \quad (6)$$

$$V_{\text{eff}}\left(\xi;\eta_i^r\right)\psi_{0i}^r(\xi)=V_{00}(\xi)\psi_{0i}^r(\xi)+\sum_{n,i'}\frac{V_{0n}(\xi)\psi_{ni'}^0(\xi)\int_{\Omega_\xi}d\xi'\psi_{ni'}^{0*}(\xi')V_{n0}(\xi')\psi_{0i}^r(\xi')}{\eta_i^r-\eta_{ni'}^0-\varepsilon_{n0}} \quad (7)$$

and $\{\psi_{ni}^0(\xi),\eta_{ni}^0\}$ are eigen-solutions of a truncated system of equations:

$$\left[h_g(\xi)+V_{nn}(\xi)\right]\psi_n(\xi)+\sum_{n'\neq n}V_{nn'}(\xi)\psi_{n'}(\xi)=\eta_n\psi_n(\xi)\ ,\quad n\neq 0 \quad (8)$$

Emerging elements of space $\Delta x=\lambda_C=\Delta_r\eta_i^r$, time $\Delta t=\Delta x/c$, and action $\mathcal{A}_0=h=|V_{\text{eff}}|\Delta t$ (9)

Dynamic complexity C is universally defined as a growing function of realisation number $N_{\Re}$, or rate of their change, equal to zero for $N_{\Re}=1$: $C=C(N_{\Re})$, $dC/dN_{\Re}>0$, $C(1)=0$

COMPLEX-DYNAMICAL FRACTAL AS THE GENERAL SOLUTION OF A PROBLEM

System of auxiliary (truncated) equations (8) is replaced by its effective version:

$$\left[h_0(\xi)+V_{\text{eff}}^n(\xi;\eta_n)\right]\psi_n(\xi)=\eta_n\psi_n(\xi) \quad (10)$$

$$V_{\text{eff}}^n(\xi;\eta_n)\psi_n(\xi)=V_{nn}(\xi)\psi_n(\xi)+\sum_{n'\neq n,\,i}\frac{V_{nn'}(\xi)\psi_{n'i}^{0n}(\xi)\int_{\Omega_\xi}d\xi'\psi_{n'i}^{0n*}(\xi')V_{n'n}(\xi')\psi_n(\xi')}{\eta_n-\eta_{n'i}^{0n}+\varepsilon_{n0}-\varepsilon_{n'0}} \quad (11)$$

where $\left\{\psi_{n'i}^{0n}(\xi),\eta_{n'i}^{0n}\right\}$ are eigen-solutions of a further truncated system of equations:

$$h_0(\xi)\psi_{n'}(\xi)+\sum_{n''\neq n'}V_{n'n''}(\xi)\psi_{n''}(\xi)=\eta_{n'}\psi_{n'}(\xi)\ ,\quad n'\neq n\ ,\quad n,n'\neq 0 \quad (12)$$

Dynamic multivaluedness of solutions of eqs. (10)-(11):

$$\left\{\psi_{ni}^0(\xi),\eta_{ni}^0\right\}\rightarrow\left\{\psi_{ni}^{0r'}(\xi),\eta_{ni}^{0r'}\right\} \quad (13)$$

$$\Downarrow$$

Dynamical, probabilistic fractal as the truly <u>complete general solution</u> [1,2]:

$$\rho(\xi,Q)=\sum_{r,r',\ldots}^{N_{\Re}}{}^{\oplus}\rho_{rr'\ldots}(\xi,Q),\quad \rho_{\exp}(\xi,Q)=\sum_{r,r',\ldots}^{N_{\Re}}\alpha_{rr'\ldots}\rho_{rr'\ldots}(\xi,Q),\quad \alpha_{rr'\ldots}=\text{prob}[\rho_{rr'\ldots}]=\frac{N_{rr'\ldots}}{N_{\Re}} \quad (14)$$

ELEMENTARY PARTICLE AS A SPATIALLY CHAOTIC QUANTUM BEAT PROCESS

Unreduced protofield interaction gives rise to spatially chaotic (dynamically multivalued), time-periodic local pulsation, or quantum beat = elementary (massive) field-particle as such

Action as a universal (integral) complexity measure (of emerging structure) [1-6]:

$$\Delta\mathcal{A} = -E\Delta t + p\Delta x \tag{15}$$

Elementary field-particle at rest (= minimum complexity-energy):

$$E_0 = -\frac{\Delta\mathcal{A}}{\Delta t} = \frac{h}{\tau_0} = h\nu_0 \tag{16}$$

where $\Delta\mathcal{A} = -h$ for one quantum jump and $\nu_0 \equiv 1/\tau_0$ is the quantum beat frequency ($\nu_0 \sim 10^{20}$ Hz for the electron) → complex-dynamic origin of irreversible time flow

Universal inertia and inertial mass result from derived spatial chaoticity of quantum beat:

$$m_0c^2 = h\nu_0 \tag{17}$$

→ no need for additional entities (Higgs, zero-point fields, etc.) "providing" mass

Global field-particle motion rigorously defined as increased complexity-energy [1-5]:

$$\frac{\Delta\mathcal{A}}{\Delta t} = \frac{\Delta\mathcal{A}}{\Delta t}\Big|_{x=\text{const}} + \frac{\Delta\mathcal{A}}{\Delta x}\Big|_{t=\text{const}}\frac{\Delta x}{\Delta t}\ , \quad E = -\frac{\Delta\mathcal{A}}{\Delta t} + \frac{\Delta\mathcal{A}}{\lambda}\frac{\Delta x}{\Delta t} = \frac{h}{T} + \frac{h}{\lambda}v = hN + pv \tag{18}$$

Universally defined total energy-complexity: $E = -\frac{\Delta\mathcal{A}}{\Delta t}\Big|_{x=\text{const}} = \frac{h}{\tau} = h\nu$ (19)

Universally defined momentum-complexity: $p = \frac{\Delta\mathcal{A}}{\Delta x}\Big|_{t=\text{const}} = \frac{\Delta\mathcal{A}}{\lambda} = \frac{h}{\lambda}$ (20)

Dynamic "quantum of space" or de Broglie wavelength (now causally derived):

$$\lambda \equiv \lambda_B \equiv (\Delta x)|_{t=\text{const}} = \frac{h}{p} \tag{21}$$

INTRINSIC UNIFICATION OF CAUSALLY DERIVED QUANTUM AND RELATIVISTIC DYNAMICS

"Relativistic" dispersion relation expresses chaotic wandering within field-particle [3-5]:

$$p = E\frac{v}{c^2} = mv \tag{22}$$

where $m \equiv E/c^2$, now by rigorously substantiated definition

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Special relativity, Newton's laws are causally derived as unreduced complexity manifestations

Using relations (22) and (19) in eq. (18), we get dynamically derived time relativity:

$$\tau = T\left(1 - \frac{v^2}{c^2}\right)\ , \quad T\tau = (\tau_0)^2\ , \quad T = \frac{\tau_0}{\sqrt{1 - \frac{v^2}{c^2}}} \quad \text{or} \quad N = \nu_0\sqrt{1 - \frac{v^2}{c^2}} \tag{23}$$

Relativistic/quantum effects are due to the complex (multivalued) dynamics within each field-particle

COMPLEX-DYNAMIC ORIGIN OF QUANTIZED GRAVITY AND GENERAL RELATIVITY

Quantum beat dynamics as causal origin of quantized gravity and general relativity [1,3-5]:

$$h\nu_0(x) = m_0c^2\sqrt{g_{00}(x)}\ , \quad g_{00}(x) = 1 + 2\phi_g(x)/c^2 \tag{24}$$

where $g_{00}(x)$ is the (relative) tension/density of gravitational medium (protofield) and $\phi_g(x)$ is the classical gravitational field potential

Since $\phi_g(x) < 0$ (attraction), $\nu_0(x) < \nu_0 = m_0c^2/h$ → causal time retardation in gravitational field

DYNAMIC QUANTIZATION AND CAUSALLY DERIVED WAVE EQUATIONS

Natural quantization of quantum beat (realisation change) by conservation of complexity [1-6]:

$$\Delta(\mathcal{A}\Psi) = \mathcal{A}\Delta\Psi + \Psi\Delta\mathcal{A} = 0\ , \quad \Delta\mathcal{A} = -\mathcal{A}_0\frac{\Delta\Psi}{\Psi} = -i\hbar\frac{\Delta\Psi}{\Psi} \tag{25}$$

Causal, realistic meaning of the wavefunction Ψ as quasi-free protofield state during chaotic transitions between dynamically squeezed, "corpuscular" states

Inserting (25) into universal definitions of energy (19) and momentum (20) one obtains causally derived version of Dirac quantization:

$$E = -\frac{\Delta\mathcal{A}}{\Delta t}\Big|_{x=\text{const}} = \frac{1}{\Psi}\,i\hbar\frac{\partial\Psi}{\partial t}\ , \quad p = \frac{\Delta\mathcal{A}}{\Delta x}\Big|_{t=\text{const}} = -\frac{1}{\Psi}\,i\hbar\frac{\partial\Psi}{\partial x}\ , \quad p^2 = -\frac{1}{\Psi}\hbar^2\frac{\partial^2\Psi}{\partial x^2}\ , \quad E^2 = -\frac{1}{\Psi}\hbar^2\frac{\partial^2\Psi}{\partial t^2} \tag{26}$$

Causal quantization relations are inserted into eq. (18) using eq. (23),

$$E = m_0c^2\sqrt{1-\frac{v^2}{c^2}} + \frac{p^2}{m} \quad \text{or} \quad mE = m_0c^2 + p^2 \tag{18'}$$

which gives relativistic wave equations (Klein-Gordon, Dirac):

$$i\hbar m\frac{\partial\Psi}{\partial t} + \hbar^2\frac{\partial^2\Psi}{\partial x^2} - m_0^2c^2\Psi = 0\ , \quad \frac{\partial^2\Psi}{\partial t^2} - c^2\frac{\partial^2\Psi}{\partial x^2} + \omega_0^2\Psi = 0\ , \quad \omega_0 \equiv m_0c^2/\hbar = 2\pi\nu_0 \tag{27}$$

Causally derived Schrödinger equation (using eq. (26)):

$$E = \frac{p^2}{2m_0} + V(x,t) \quad \Rightarrow \quad i\hbar\frac{\partial\Psi}{\partial t} = -\frac{\hbar^2}{2m_0}\frac{\partial^2\Psi}{\partial x^2} + V(x,t)\Psi(x,t) \tag{28}$$

$$\Downarrow$$

Complex-dynamic origin of "energy level discreteness"

DYNAMICALLY EXPLAINED (EMERGING) PROPERTIES OF THE UNIVERSE STRUCTURE [1-10]

- Dynamic, physically real origin of material, quantized space and irreversibly flowing time
  origin and number (3) of space dimensions, universality (synchronisation) of time flow
- Physically real, "minimal", universal origin of particles/fields and all their intrinsic properties
  Unified causal (dynamic) explanation of relativistic and quantum properties, mass, charge, spin
- Combination of global universality and local independence (time, space, wavefunction, etc.)
  Origin of universal constants (below), interactions, time flow, individual particle properties
- Causal origin and number (4) of intrinsically unified particle interactions
- Dynamic origin of classicality (in a closed system) and other higher-complexity cases
  Causal quantum measurement, wave reduction, true quantum chaos, many-body problems, etc.

UNIVERSALITY AND MEANING OF PLANCK'S AND FINE STRUCTURE CONSTANTS

$$\alpha\hbar = \frac{e^2}{c} \quad \Rightarrow \quad m_0 c^2 = \frac{2\pi}{\alpha}\frac{e^2}{\lambda_C} = N^e_{\Re}\frac{e^2}{\lambda_C} \tag{29}$$

$\lambda_C = \dfrac{h}{m_0 c^2}$, $N^e_{\Re} = 2\pi/\alpha \approx 861$ is the number of electron (quantum beat) realisations

$$\lambda_C = \frac{h}{m_0 c^2} = N^e_{\Re} r_e, \text{ where } r_e = \frac{e^2}{m_0 c^2} \text{ is the "classical electron radius"} \tag{30}$$

$\Downarrow$

Size of the dynamically squeezed electron state ("virtual soliton") $D_e \simeq 2\pi r_e = \pi d_e$ (31)

Universal meaning of Planck's constant h and fine structure constant α:

$$h = \lambda_C p_e = N^e_{\Re}\frac{e^2}{c}, \quad p_e = m_0 c = E_0/c \tag{32a}$$

$\lambda_C = N^e_{\Re} r_e$, $N^e_{\Re} = 2\pi/\alpha$ is the width of EP well for a field-particle (e.g. electron) (32b)

$p_e = m_0 c$, $e^2/c = \alpha\hbar$ is the depth of EP well for a field-particle (e.g. electron) (32c)

$h = \lambda_C p_e = N^e_{\Re}\dfrac{e^2}{c}$ is the universal "volume" of EP well for any field-particle (32d)

Additional confirmation: largest nuclear mass ≈ largest particle mass (≈ 100 GeV)

DYNAMIC ORIGIN OF THE GRAVITATIONAL CONSTANT AND MODIFIED PLANCKIAN UNITS

Usual gravitational constant γ: indirect, long-range attraction through gravitational medium

"Unified gravity" constant γ_0 in real Planckian units: direct, local protofield attraction:

$$L_P = \left(\frac{\gamma_0\hbar}{c^3}\right)^{\frac{1}{2}} \approx 10^{-17} - 10^{-16}\,\text{cm} \approx l_{\exp} \tag{33a}$$

$$T_P = \left(\frac{\gamma_0\hbar}{c^5}\right)^{\frac{1}{2}} \approx 10^{-27} - 10^{-26}\,\text{s} \approx t_{\exp} \tag{33b}$$

$$M_P = \left(\frac{\hbar c}{\gamma_0}\right)^{\frac{1}{2}} \approx 10^{-22} - 10^{-21}\,g \;\; (10^2 - 10^3 \;\; \text{GeV}) \approx m_{\exp} \tag{33c}$$

$\gamma_0 = \left(\dfrac{l_{\exp}}{l_P}\right)^2 \gamma \approx (10^{33} - 10^{34})\gamma$, $l_P \approx 10^{-33}\,\text{cm} \ll l_{\exp}$ is the ordinary Planckian length (34)

Important consequences and related results [1-5]:

causal mass spectrum (no redundant, mathematically "guessed" particle species);
no "hierarchy problem" or postulated "hidden dimensions" (around abstract "manifolds");
dynamic origin and intrinsic unification of "fundamental interactions";
consistent, reality-based explanation of the relative weakness of gravity;
causal theory of "black hole" and other (dense) "quantum condensates";
no "inflation"; no usual "quantum gravity"; etc.

SELF-TUNING UNIVERSE EMERGENCE IN THE UNREDUCED INTERACTION PROCESS

Dynamically emerging universe always has dynamically consistent, adaptable structure [1,2]:

dynamic origin of "universal" constants and intrinsic field-particle properties (above)

→ no "miraculous", "anthropic" coincidence in matter structure at any level

Viable universe with adaptable structure emerges for generic protofield interaction parameters:

$$V_{\text{proto}} = M_{\text{univ}}c^2 \quad \Rightarrow \quad M_{\text{univ}} \to \sum_{\text{part}} N_{\text{part}} m_{\text{part}} + V_{\text{int}} \to \sum_{\text{atom}} N_{\text{atom}} m_{\text{atom}} + V_{\text{chem}} \to \dots \qquad (35)$$

Variable universe mass M_{univ} is further split into probabilistic, adaptable fractal hierarchy (14)

Non-generic, now consistently understood cases of "black holes" and "primordial chaos" [1]

Complex-dynamic universe structure emergence is a self-tuning process as such:

universal dynamic adaptability of unreduced (multivalued) interaction dynamics

→ probabilistic dynamic fractality → symmetry (development) of complexity

Usual, dynamically single-valued (unitary) cosmology "models" are intrinsically "anthropic":
the ultimate, unified origin of old and new difficulties of any unitary, "postulated" cosmology

POSITIVE TOTAL ENERGY/MASS OF THE UNIVERSE AND REAL TIME ARROW

Universal symmetry of complexity [1-6]: total dynamic complexity, $C = I + S$, is conserved by transformation of decreasing dynamic information I into increasing dynamic entropy S

Dynamic information I is universally measured by complexity-action $\mathcal{A}$: $\Delta\mathcal{A} = \Delta I = -\Delta S < 0$

Total time derivative of action, or (generalised) Lagrangian, is negative
(eventually because of dynamically random realisation change):

$$L = \frac{\Delta\mathcal{A}}{\Delta t} = pv - H < 0\,, \text{ with Hamiltonian } H = E = -\frac{\Delta\mathcal{A}}{\Delta t}\Big|_{x=\text{const}} \qquad (36a)$$

→ Rigorously derived arrow (flow) of time oriented to growing complexity-entropy [2,6]:

$$L < 0 \quad \Rightarrow \quad E, H(x,p,t) > pv \geq 0\,, \quad \Delta t = \frac{\Delta\mathcal{A}}{L} > 0 \qquad (36b)$$

Time can go ($\Delta t > 0$) only in a universe with positive (conserved) total energy
i.e. any really existing universe ($\Delta t > 0$) has strictly positive total energy balance

Conventional cosmology ("Hamiltonian constraint", Wheeler-deWitt equation, etc.)
strongly prefers zero total energy balance (universe "tunneling from nothing")
accompanied by arbitrarily postulated, mechanistic time flow
→ origin of dark matter, time and entropy problems of usual cosmology:

- the true origin of mass/energy is inevitably lost in the single-valued theory projection
- real time cannot exist (flow) in a unitary universe model with zero energy/mass balance
- any real (multivalued) structure emergence corresponds to entropy growth, not decrease
  → solution to all entropy/information problems by the unified symmetry of complexity
  as the unique Order of the World giving all particular laws and real structures [1-6]

DARK MASS: DYNAMICALLY SINGLE-VALUED (REGULAR) MODEL DEFICIENCY [2]

Usual virial theorem for the time-averaged kinetic $\bar{T}$ and potential $\bar{U}$ system energy:

$$2\bar{T} = -\bar{U} \tag{37}$$

whereas in reality this regular kinetic energy $\bar{T} = \bar{T}_{\rm reg}$ is a smaller part of its total, chaotic content:

$$\bar{T}_{\rm real} = N_{\Re}\bar{T}_{\rm reg} \tag{38}$$

where $N_{\Re}$ is the effective (average) realisation number ($N_{\Re} = 1$ for usual, unitary models)

The observed potential energy (visible mass), $\bar{U}_{\rm obs}$, correlates with the real kinetic energy

$$2\bar{T}_{\rm real} = -\bar{U}_{\rm obs} \tag{39}$$

But observations are interpreted within the regular, deficient version of dynamics, eq. (37):

$$2\bar{T}_{\rm reg} = -\bar{U}_{\rm obs} \tag{40}$$

and therefore one obtains a discrepancy, δ, given by division of eq. (39) by eq. (40):

$$\delta = \frac{\bar{T}_{\rm real}}{\bar{T}_{\rm reg}} = N_{\Re} \tag{41}$$

which is explained in terms of invisible, "dark" mass, $M_{\rm dark} = M_{\rm real} - M_{\rm reg}$, contributing to $\bar{U}_{\rm obs}$:

$$\frac{M_{\rm real}}{M_{\rm reg}} = \frac{\bar{T}_{\rm real}}{\bar{T}_{\rm reg}} = \delta = N_{\Re}\ , \quad \frac{M_{\rm dark}}{M_{\rm reg}} = \delta - 1 = N_{\Re} - 1 \tag{42}$$

The observed discrepancy, or "dark mass", is a measure of (average) complexity/chaoticity C:

$$C = N_{\Re} - 1 = \frac{M_{\rm dark}}{M_{\rm reg}} = \delta - 1 \tag{43}$$

Since $\bar{T} \propto \overline{Mv^2}$, in reality there is additional motion (velocity), rather than mass, in the system:

"dark motion" effect: $(\overline{v^2})_{\rm real} = N_{\Re}(\overline{v^2})_{\rm reg}$ (44)

Distance-dependent case: $v(r)$ is proportional not to $\sqrt{M_{\rm reg}(r) + M_{\rm dark}(r)}$, but to $\sqrt{N_{\Re}(r)}$:

$$v(r) = \sqrt{\frac{\gamma N_{\Re}(r) M_{\rm obs}(r)}{r}} \quad \text{or} \quad N_{\Re}(r) = \frac{rv^2(r)}{\gamma M_{\rm obs}(r)} \tag{45}$$

where $M_{\rm obs}(r) = M_{\rm real}(r)$ is the ordinary, "visible" mass within radius r

One can derive the features of chaotic dynamics, $N_{\Re}(r)$, from the observed $v(r)$ and $M_{\rm obs}(r)$

Chaoticity $N_{\Re}(r)$ will typically have a wide, irregular peak in galactic halo or cluster centre as should be expected

Essential correlations:

- Chaoticity provides unique explanation of the huge diversity of "dark mass" effects
  There is a general correlation between expected object chaoticity and its dark mass content/location
  Usual, dynamically single-valued, false chaos ($N_{\Re} = 1,\ C = 0$) cannot explain dark mass effects
- A highly variable property is rather due to a dynamic feature than escaping, fixed entity
  Structural chaos correlates with dynamical chaos and can contribute to the dark mass effects
- Chaoticity is due to effective interaction change, which explains MOND-like features
- Unified solution of problems of mass origin, universe energy/entropy/time, and dark mass
  Corresponding unified reason for the absence of the same problems solution in usual theory

DARK ENERGY AND BIG BANG CONTRADICTIONS: DEFICIENT UNITARITY [2]

Fundamentally deficient logic (vicious circle) of usual regular, clock-work cosmology:

postulated nothingness of universe content ("tunneling from nothing", "inflation", etc.) →
→ unstable static universe → mechanical expansion (*forced interpretation* of the red shift) → (46)
→ uneven expansion = problems with mass/energy content → return to the starting mistake ↑

The whole dynamically single-valued, zero-complexity model is ***fundamentally unstable***, irrespective of the details → the ***inherent*** problem of "fine-tuned", "anthropic" structure of the ***clock-work, unitary*** universe
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Mechanistic universe construction ***falls inevitably*** as a house of cards
(= "dark matter" + "old" problems)

↑↓

Alternative of unreduced, ***complex-dynamic (multivalued) interaction process***:
It's a distributed "big bang" of ***fractal structure creation***, extended ***im***plosion, rather than mechanistic ***ex***plosion and artificial "inflation" of nothingness
creative, structure-forming instability → ***dynamic***, autonomous "fine-tuning"
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Unified solution to ***all*** particular problems of the unitary "model"

The "dark energy" problem does not even appear in the complex-dynamic cosmology:

positive mass/energy of the universe appears *dynamically* from the *unreduced protofield interaction* →
→ *creative instability* of the initially *extended*, but *structureless* universe → no mechanical expansion,
red shift explanation by *physically real* photon interaction with the gravitational protofield→ (47)
→ nonlinear red shift dependence on distance is *natural* for a generic *unreduced* interaction →
→ *no need* for any "dark" quantities, no *model-destructive* instability

Additional features: no angular blur in soliton-like photon interaction with the gravitational medium; red shift data scatter growing with distance; CMBR is a general, quasi-equilibrium e/m protofield excitation (photons) due to all particle quantum beat processes and their changes (cf. [11]): its "cosmological" origin is but a special assumption of the incorrect mechanistic approach (46)

OTHER EVIDENCE IN FAVOUR OF COMPLEX-DYNAMICAL, CREATIVE UNIVERSE

- Interaction complexity development and conservation provides unique combination of internal change and global stability (no mechanistic universe expansion or shrinking)
  Explicit structure emergence [2,7] vs contradictions of standard expansion (Solar system, etc.)
- All problems of universe age and (long-distance) "peculiarities" find new and unified solution in complex-dynamic cosmology (causally explained structure and evolution)
- Natural and unified solution of "old" cosmological problems and all other "mysteries"
  (fractality, flatness, time, entropy, quantum origin, "beginning mysteries", quantum puzzles, etc.)
- Unification with causally complete versions of quantum mechanics, relativity, gravity, field/particle theory, all higher complexity levels → the whole world structure emergence
  All the involved properties are first explicitly derived/explained (contrary to other theories): space, time, mass/energy, charge, spin, quantum/classical, intrinsically unified interactions, etc.
- Universal Symmetry of Complexity as the unique, unbroken (exact) Order of the World
  Dynamically multivalued fractal as the unified diversity of resulting structure at all scales
  Explicitly obtained (emergent) and intrinsically unified diversity of real universe structure and laws

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