

# TOWARDS SUSTAINABLE FUTURE

## BY TRANSITION TO THE NEXT LEVEL CIVILIZATION

how many  
moments  
left ?

*COUNTDOWN'S ON*

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# Countdown agenda

## 1. Universal science of complexity

*Unreduced solution to any real interaction problem*

## 2. Life as unfolding interaction complexity

System evolution as step-wise complexity development

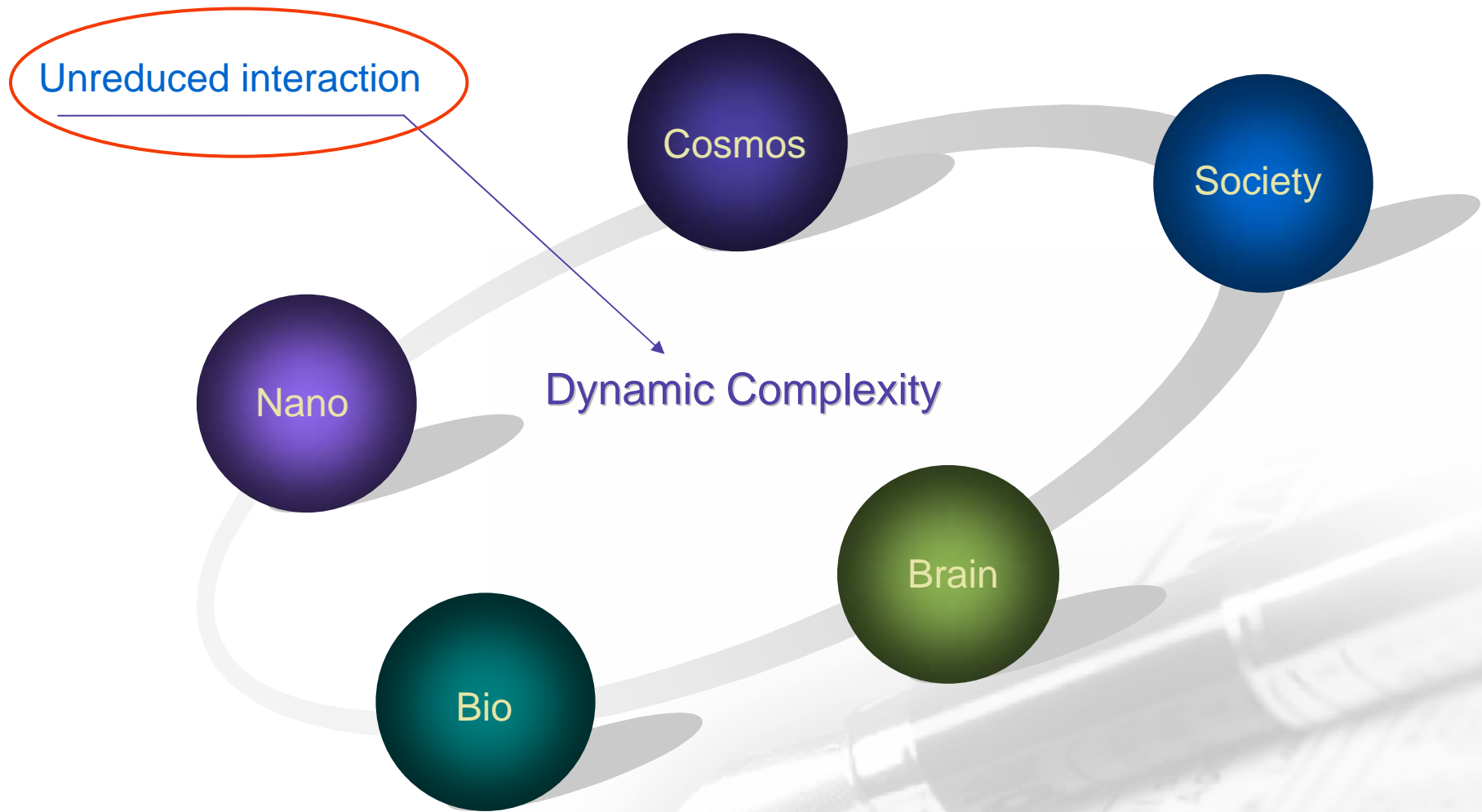
## 3. Transition to superior level of life *now*

*We are at the point of inevitable complexity revolution*

## 4. Particular transition aspects

New knowledge, social structure, production, settlement

# Universal Science of Complexity



# Unreduced dynamic complexity

- Life/planet dynamics and evolution = unreduced interaction process
- Unreduced interaction analysis: permanent chaotic, fractally structured realisation change → universal dynamic complexity  
>> usual “science of complexity” (1 realisation, 0 complexity, no complexity definition)
- Classification of all dynamic regimes (more regular or chaotic) and transitions between them → what can ever happen/emerge
- Intrinsic chaos is inevitable in any real interaction (multivaluedness): unreduced dynamic complexity of life, brain, civilisation, etc.  
FRACTAL ↓ FRACTAL  
Exponentially high efficiency → “magic” properties of all “living” systems
- Universal evolution/dynamics law: universal symmetry of complexity, total complexity conservation by its internal form transformation  
dynamic information → dynamic entropy
- Applications: <http://arxiv.org/find/quant-ph,gr-qc,physics/1/au:+Kirilyuk/0/1/0/all/0/1>

# Science Progress Diagram

## NEW MATHEMATICS OF COMPLEXITY

Unitary science: only one from many real system realisations  
Universal Science of Complexity (USciCom): all system realisations

Unitary 1

Unitary 2

USciCom

Mechanistic  
discreteness:  
Numbers  
Classical figures  
No interaction  
No change  
No quality

Mechanistic  
continuity:  
Calculus  
Deformable shapes  
Trivial interaction  
Formal change  
No quality

Dynamic  
discreteness:  
Multivaluedness  
Dynamical fractal  
Full interaction  
Intrinsic change  
Full quality

# Unreduced Interaction Dynamics

Arbitrary many-body interaction process:

$$\left\{ \sum_{k=0}^N \left[ h_k(q_k) + \sum_{l>k}^N V_{kl}(q_k, q_l) \right] \right\} \Psi(Q) = E \Psi(Q), \quad Q = (q_1, q_2, \dots, q_N)$$

or

$$\left\{ h_0(\xi) + \sum_{k=1}^N \left[ h_k(q_k) + V_{0k}(\xi, q_k) \right] + \sum_{l>k}^N V_{kl}(q_k, q_l) \right\} \Psi(\xi, Q) = E \Psi(\xi, Q), \quad \xi \equiv q_0$$

The unreduced (nonperturbative) general solution is always *probabilistic* (phenomenon of *dynamic multivaluedness* = *intrinsic chaoticity*):

$$\rho(\xi, Q) = \sum_{r=1}^{N_{\mathfrak{R}}} \oplus \rho_r(\xi, Q)$$

Dynamically determined probability

$$\alpha_r = \frac{N_r}{N_{\mathfrak{R}}}, \quad \sum_r \alpha_r = 1$$

# Unreduced Interaction Dynamics

Arbitrary interaction process in terms of (free) component eigenvalues:

$$h_0(\xi)\psi_n(\xi) + \sum_{n'} V_{nn'}(\xi)\psi_{n'}(\xi) = \eta_n\psi_n(\xi)$$

where the total system state-function is obtained as

$$\Psi(\xi, Q) = \sum_{n \equiv (n_1, n_2, \dots, n_N)} \psi_n(q_0)\varphi_{1n_1}(q_1)\varphi_{2n_2}(q_2)\dots\varphi_{Nn_N}(q_N) \equiv \sum_n \psi_n(\xi)\Phi_n(Q)$$

Usual perturbative approximations:

$$\left[ h_0(\xi) + V_{nn}(\xi) + \tilde{V}_n(\xi) \right] \psi_n(\xi) = \eta_n \psi_n(\xi), \quad V_0(\xi) < \tilde{V}_n(\xi) < \sum_{n'} V_{nn'}(\xi)$$

Unreduced general solution of the same problem:

$$\rho(\xi, Q) \equiv |\Psi(\xi, Q)|^2 = \sum_{r=1}^{N_{\mathfrak{R}}} \oplus \rho_r(\xi, Q), \quad \rho_r(\xi, Q) = |\Psi_r(\xi, Q)|^2$$

$$\Psi_r(\xi, Q) = \sum_i c_i^r \left[ \Phi_0(Q) \psi_{0i}^r(\xi) + \sum_{n, i'} \frac{\Phi_n(Q) \psi_{ni'}^0(\xi) \int_{\Omega_\xi} d\xi' \psi_{ni'}^{0*}(\xi') V_{n0}(\xi') \psi_{0i}^r(\xi')}{\eta_i^r - \eta_{ni'}^0 - \varepsilon_{n0}} \right]$$

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

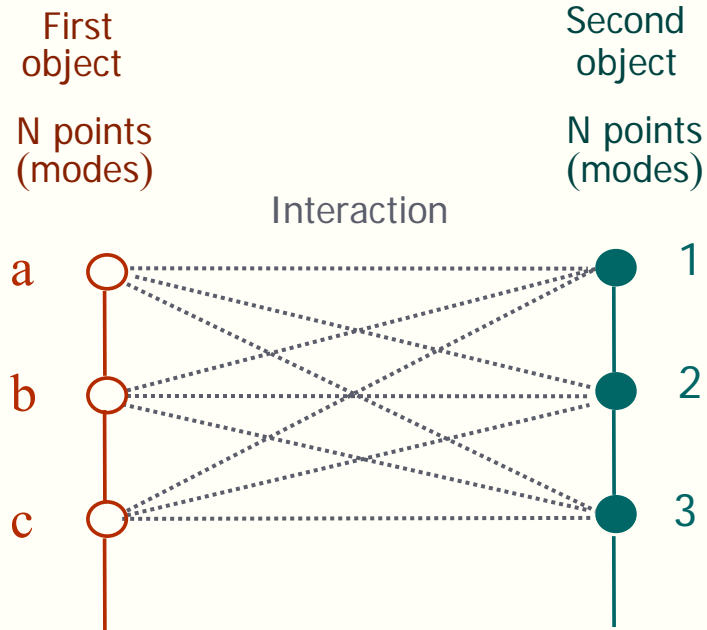
$$h_0(\xi) \psi_0(\xi) + V_{\text{eff}}(\xi; \eta) \psi_0(\xi) = \eta \psi_0(\xi)$$

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

Elementary length  $\Delta x = \lambda = \Delta \eta_i^r$ , time  $\Delta t = \Delta x / v_0$ , action  $\Delta \mathcal{A} = V_{\text{eff}} \Delta t$



# Unreduced Interaction: Dynamic Multivaluedness (Chaos)

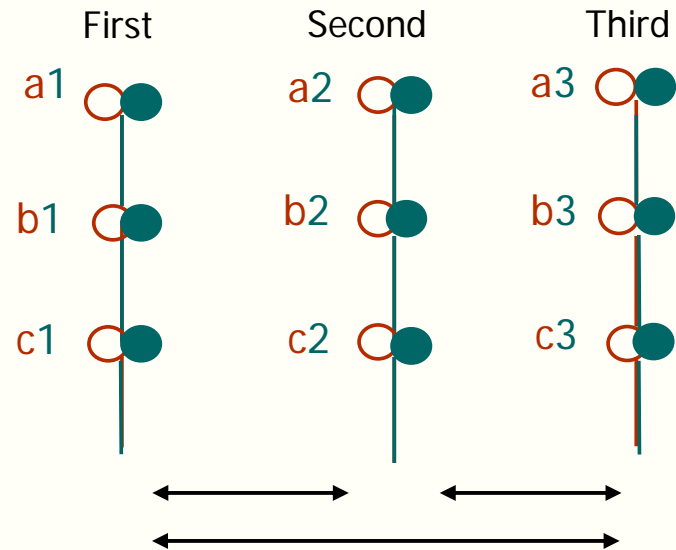


( $N \times N$ ) combinations  
of mode entanglement  
(a1,a2,a3,b1,b2,etc.)



N-fold redundance

Dynamically redundant  
interaction result:  
incompatible  
system *realisations*



Permanent realisation change  
in *causally (dynamically) random* order

# Universal Regimes of Complex Dynamics

Two limiting regimes of complex dynamics:  
*multivalued self-organisation/SOC and uniform (global) chaos*

Universal criterion of global (strong) chaos:

$$\kappa \equiv \frac{\Delta \eta_i}{\Delta \eta_n} = \frac{\omega_\xi}{\omega_Q} \approx 1$$

or *resonance* of the main system motions

Criterion of quasi-regularity (self-organisation):  $\kappa \ll 1$  (or  $\kappa \gg 1$ )

As network intensity grows one *cannot avoid resonance* ("jam"):  $\kappa \sim 1$   
and therefore *essential dynamic randomness becomes inevitable*

**Highly complicated interaction networks cannot be close to regularity**  
Ordinary, unitary dynamic models and approaches are inapplicable

Let's transform the unitary approach *defect* ("insolubility")  
into the unreduced, complex-dynamic operation *advantage* :  
superior power and qualities

# Large Interaction Network Properties

Huge efficiency growth of dynamically chaotic (*multivalued*) interaction:

Chaotic network efficiency is determined by the number of *all combinations of links*

$$N! \approx \sqrt{2\pi N} (N/e)^N \sim N^N \propto C \text{ (unreduced dynamic complexity)}$$

where the number of links  $N$  is very large itself

Unitary (regular) dynamic efficiency grows only as  $N^\beta$  ( $\beta \sim 1$ ).

The huge advantage in efficiency expresses *intrinsic creativity/adaptability* of the unreduced complex dynamics obtained at the expense of its *chaoticity*



**LIFE, INTELLIGENCE, CONSCIOUSNESS, SUSTAINABILITY, ETC.**

## Particular aspects and applications

- (1) Knowledge-based structure of advanced (intelligent) civilisation dynamics
- (2) Holistic dynamics of intelligent communication network ("superbrain")  
Complex-dynamic meaning of *true* intelligence/consciousness (physics/0409140)
- (3) Intelligent network participants *automatically* become more intelligent  
Ability to solve unreduced, complex-dynamic problems → *revolution of complexity*
- (4) Universal symmetry/development of complexity: unified guiding principle  
Transformation of *dynamic information* ("interaction potential") into *dynamic entropy*

# Evolution as complexity development

- System evolution as a result of the symmetry of complexity: qualitative, irreversible, dynamically discrete (quantized) change (event): transformation of dynamic information,  $I$ , into dynamic entropy,  $S$ , while the sum, total complexity,  $C = I + S$ , remains unchanged:

$$\Delta C = 0, \Delta S = -\Delta I = -\Delta \mathcal{A} > 0,$$

where the extended, nonlinear action  $\mathcal{A} = I$  is a unified measure of complexity-information,  $|\Delta \mathcal{A}| \sim |V_{\text{eff}}| \Delta t$

- Generalised Hamilton-Jacobi and Schrödinger equations:

$$\frac{\Delta \mathcal{A}}{\Delta t} \Big|_{x=\text{const}} + H \left( x, \frac{\Delta \mathcal{A}}{\Delta x} \Big|_{t=\text{const}}, t \right) = 0, \quad \hat{H} \left( x, \frac{\Delta}{\Delta x} \Big|_{t=\text{const}} \right) \Psi(x) = E \Psi(x)$$

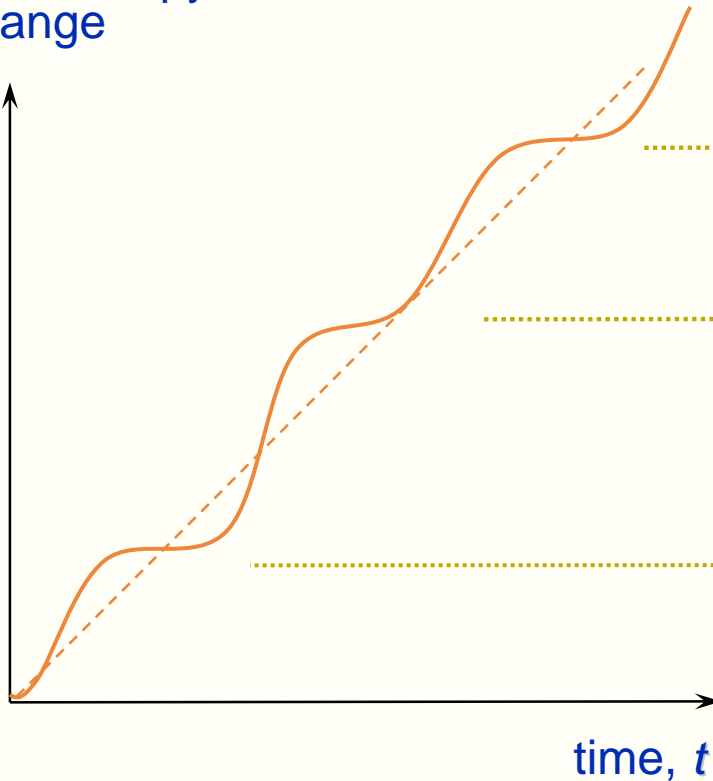
- The universal meaning and dynamics of any system evolution, progress, and existence: complexity development as a result of the symmetry of complexity → sense of history, life, etc.

# Progress by complexity steps

## DYNAMICALLY DISCRETE COMPLEXITY DEVELOPMENT

dynamic entropy  
change

$-\Delta I, \Delta S$



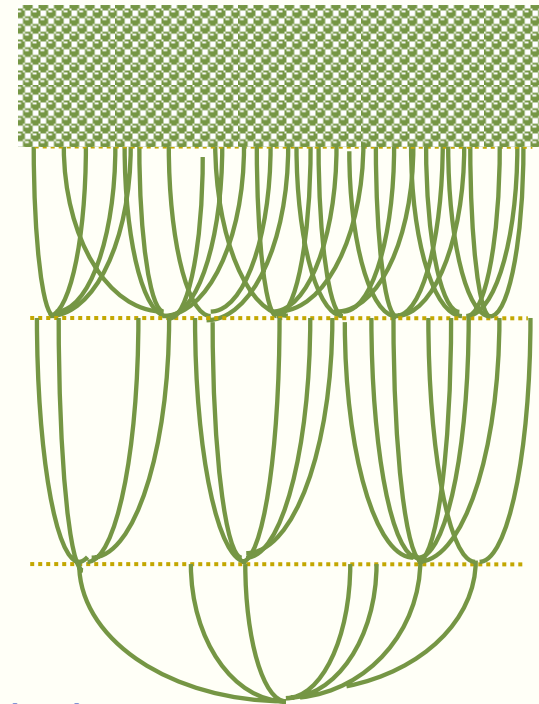
Fractal hierarchy of complexity

$n = 3$

$n = 2$

$n = 1$

Complexity  
levels,  $n$



Any structure creation is a *growth* of complexity-entropy

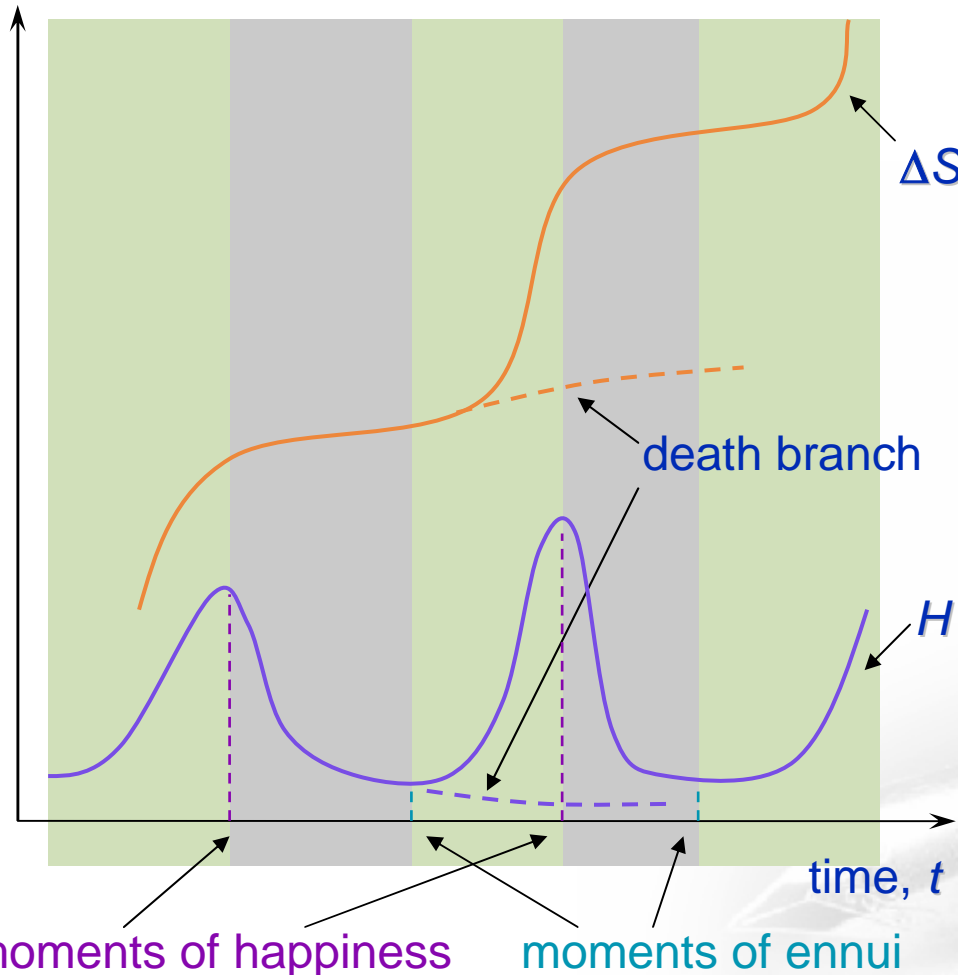
# “progress” vs “decline”

dynamic entropy change,  $\Delta S$ ,  
Hamiltonian (energy),  $\Delta S/\Delta t = H, E$

period of  
progress



period of  
decline



For both “progress” and “decline”:

$$H = \partial S / \partial t > 0$$

Progressive development (creation):

$$W = \partial H / \partial t = \partial^2 S / \partial t^2 > 0$$

Decline (decay, degradation):

$$W = \partial H / \partial t = \partial^2 S / \partial t^2 < 0$$

Max progress results (“happiness”):

$$\partial H / \partial t = \partial^2 S / \partial t^2 = 0, \quad \partial^3 H / \partial t^3 < 0$$

Max decay results (“ennui”):

$$\partial H / \partial t = \partial^2 S / \partial t^2 = 0, \quad \partial^3 H / \partial t^3 > 0$$

Transition *max* (“moment of truth”):

$$\partial^2 H / \partial t^2 = 0, \quad \partial^3 H / \partial t^3 < 0$$

Decline crisis (“moment of sin”):

$$\partial^2 H / \partial t^2 = 0, \quad \partial^3 H / \partial t^3 > 0$$

# Sustainability Transition

CREATIVE APOCALYPSE NOW

## GREAT SUSTAINABILITY TRANSITION BEGINS TODAY

- The “End” of History, Science, Art, Religion, etc.: exhaustion
- Maximum “ennui” point is just behind us: beginning “agitation”
- Transition maximum is still (qualitatively) far ahead of us

## OPPOSITION TO TRANSITION CHANGES: LOSSES

- Discreteness: Transition *is* a result of *all* system interactions
- One cannot overcome the (dynamic) entropy growth
- Unsuccessful transition is replaced by a *death branch*

## UNDERSTANDING OF TRANSITION DETAILS: GAINS

- Universal science of complexity → *rigorous*, reliable futurology

<http://arxiv.org/abs/physics/9806002>

# New kind of knowledge

## SCIENCE REVOLUTION: UNREDUCED COMPLEXITY

### BLIND (EMPIRICALLY BASED), BUT OMNIPOTENT R&D: REAL DANGER

- ✓ Today's empirical technology modifies the *whole depth* of complexity: high energies, genomics, biochemistry, ecosystem, society, psyche  
Without equally complete knowledge *only destruction can result*

### CAUSALLY COMPLETE UNDERSTANDING OF REALITY: NO "MODELS"

- ✓ Scholar science is an ultimately rough, *dynamically single-valued* "model" of the *dynamically multivalued reality*: *anti-completeness*, including single-valued imitations of empirically defined "complexity"  
Transition to the unreduced, complex dynamics is *vitaly* important:  
One cannot fool Nature (contrary to funding bodies and taxpayers)

### ONLY UNREDUCED KNOWLEDGE FOR SUSTAINABILITY TRANSITION

- ✓ Universal science of complexity for the "*knowledge-based society*"  
Only unreduced science can guide the transition to sustainable life



# Complexity-increasing production

## GROWTH WITHOUT DESTRUCTION

### FROM DESTRUCTION TO CREATION BY COMPLEXITY BOOST

- From declining to progressive phase: transition to superior complexity
- Complexity-driven technologies: “bio-inspired” complexity growth  
*Creative, not restrictive ecology concept* → real sustainability

### UNIVERSAL CRITERION OF PROGRESS: $\partial H/\partial t = \partial^2 S/\partial t^2 \gg W_{\text{death}}$

- Self-accelerated complexity development: *sustainability by creation*
- Against “sustainability” by restriction: entropy growth is invincible  
*Unreduced science of complexity: unique basis for new production*

### HUMAN ASPECTS OF NEW PRODUCTION: CREATIVE PERSONALITY

- From massive and reductive to *individual* and *creative* technology
- From centralised and rigid to *distributed* and *evolving* structure  
*Complexity-driven production involves essential personal progress*

# Non-unitary social structure

## ORDER WITHOUT GOVERNMENT: POWER OF IDEAS

### FROM UNITARY TO HARMONICAL SYSTEM: THE LAST BASTILLE

- Versions of Unitary System: totalitarian, democratic, meritocratic
- Harmonical System: *emerging* social order (cf. “market economy”)  
**Sustainability Transition: from Unitary to Harmonical *complexity***

### HARMONICAL SYSTEM: UNREDUCED INTERACTION COMPLEXITY

- Autonomous evolution of interacting (small) “management” units  
≠ “NGO” or “free-market” structures *within* the Unitary System
- *Superior democracy*: real, inevitable extension of unitary “freedom”  
**Harmonical System is the *unique way of any further progress***

### THE PRICE TO PAY FOR HAPPINESS: DISTRIBUTED REVOLUTION

- High-order “phase transition”: growing “seeds of freedom” network  
**Complexity-based origin of Harmonical Future → new science bliss**

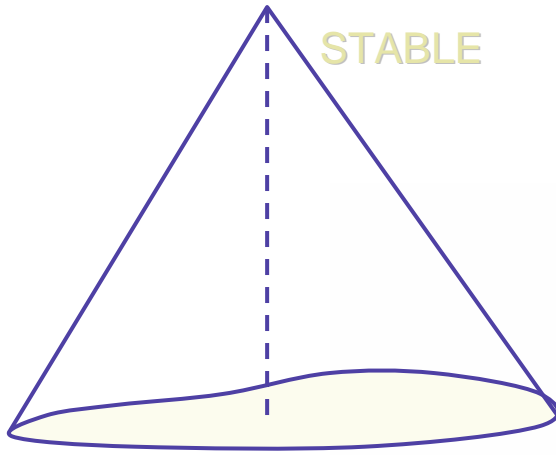
NEW SCIENCE STRUCTURE → <http://arxiv.org/abs/physics/0403084>

# Replete Industry: Critical Instability

UNITARY SYSTEM: DEATH BY SUCCESS

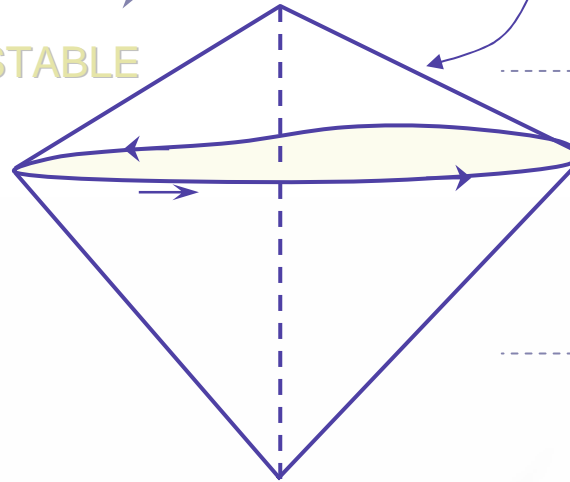
industrial revolution

“gravitational” attraction  
to the material basis



pre-industrial unitary society

UNSTABLE

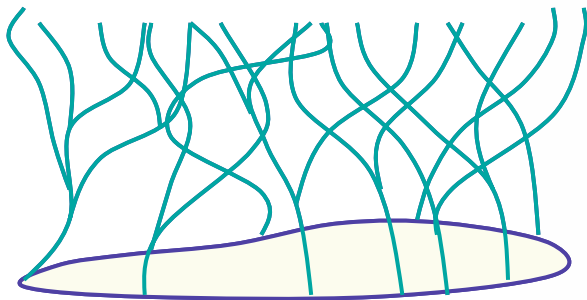


post-industrial unitary society

social  
position

labour  
middle class elite

sustainability transition



unlimited  
complexity growth

**AFTER SUSTAINABILITY TRANSITION  
GROWTH CAN ONLY INCREASE STABILITY:  
“LIVING ARBORESCENCE” DYNAMICS**

# New kind of settlement

## MAN-MADE NATURE

### BIO-INSPIRED AND BIO-DOMINATED, DISTRIBUTED INFRASTRUCTURE

- Unitary infrastructure: centralised (urban), rigid, reductive, decadent
- Harmonical infrastructure: man-made “forest”, omnipresent, evolving  
*Creation, not “protection” of “natural” (= complex) environment*

### SETTLEMENTS SUBMERGED INTO CREATED “NATURAL” COMPLEXITY

- Harmonical interaction with nature → *growth* of natural complexity
- Complex-dynamic environment influence on man: complexity boost  
*The unreduced nature complexity should become again our home*

### NATURAL COMPLEXITY EVOLUTION: SUPERNATURE, NOOSPHERE

- From “biosphere” to *Supernature*: *greater* than “natural” complexity
- *Noosphere*: entangled intelligence and Supernature development  
*Harmonical evolution: nondestructive, unlimited growth & diversity*

# SUSTAINABILITY COMPONENTS

## UNREDUCED COMPLEXITY APPLICATIONS

- Unified, causally complete fundamental physics (quantum mechanics, relativity, particles, fields, forces, cosmology): no “mysteries”, transparent, realistic knowledge and world view, the unique way to unlimited clean energy
- Real, complex-dynamic nanodevices (quantum & classical), huge efficiency
- Causally complete, reliable genomics (unreduced interaction dynamics)
- Complex-dynamic biology: causal evolution theory, integral medicine
- Creative ecology/development: realistic, unreduced sustainability concept
- Emerging genuine intelligence and consciousness (natural and artificial)
- Complex-dynamic, intelligent communication networks and software systems

## UNREDUCED SUSTAINABILITY CASES

- “Poor” countries rise by local, permanent, constructive, massive interaction: creating a new, quality life for oneself, not extended misery for others
- Practical responsibility of scientists for creation of “knowledge-based society” and “understanding-based (complete) knowledge”: no deficient “models”
- Constructive use of diversity instead of destructive mechanistic unification

<http://arxiv.org/find/quant-ph,gr-qc,physics/1/au:+Kirilyuk/0/1/0/all/0/1>

# Cosmic Life, Future, and Complexity: Concluding Remarks

- Intrinsic unification of *causally specified* meaning and purpose of life, future, progress, nature, cosmos, and our destiny:  
**universal symmetry and development of complexity**
  - *practical guiding principle* for civilisation development
- Life *realisations* are *multiple* and *different*: unique life is improbable  
You'll meet new intelligence when you become more intelligent:  
**complexity correspondence principle**
  - unified intelligence: find an alien within yourself
  - Life exams are fair: you progress or disappear  
Complexity challenge is about one's mind-set:  
**apocalyptic time needs individual Revelation**
    - real Future comes as a higher consciousness level
  - Every future is uncertain at the transition point  
**one should understand now all futures**
  - Universal Science of Complexity is *the true futurology*

## References

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