Toward a unified vision of natural phenomena

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Quantum field theory

- Spontaneous breakdown of symmetry
- coherence
- dissipation (non-equilibrium thermodynamics)
- phase transitions
- scale laws - self-similarity

Spontaneous breakdown of symmetry $\Rightarrow$

long range correlations $\Rightarrow$

ordered patterns

order = lack of symmetry

In QFT long range correlations are indeed dynamically generated through the mechanism of SBS.

These correlations manifest themselves as the Nambu-Goldstone (NG) boson particles or modes,

which have zero mass and therefore are able to span the whole system.

The NG bosons are coherently condensed in the system lowest energy state, the vacuum or ground state (Bose-Einstein condensation).

Due to such correlations in this way established, the system appears in an ordered state.

The vacuum density of the NG bosons provides a measure of the degree of ordering or coherence: the order parameter, a classical field specifying (labeling) the observed ordered pattern.

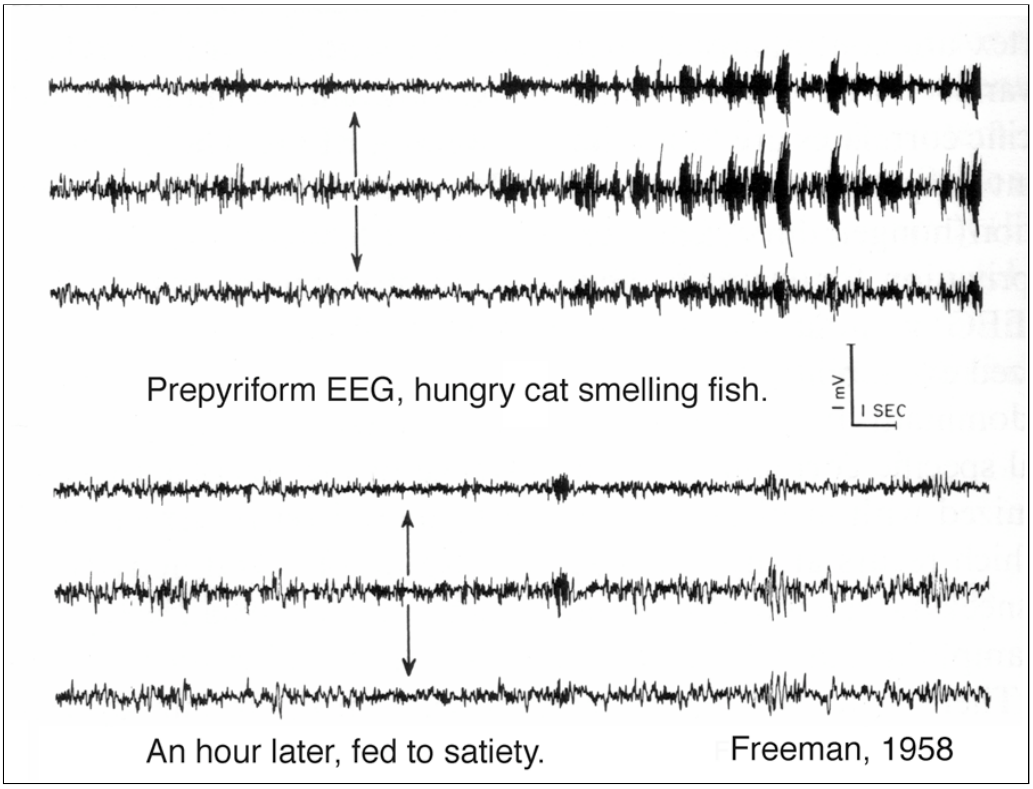
Stability of order parameter against quantum fluctuations is a manifestation of the coherence of boson condensation.

“change of scale” (from microscopic to macroscopic scale) dynamically achieved through the coherent boson condensation mechanism.

The order parameter is not affected by quantum fluctuations. In this sense, it is a macroscopic observable. It is a “macroscopic quantum state”.

"...we must not only give a correct account of celestial matter, explaining in what way the wandering of the sun and moon occur and by what power things happen on earth. We must also take special care and employ keen reasoning to see where the soul and the nature of the mind come from,..."

(Titus Lucretius Carus, 99 - 55 B.C. *De rerum natura*)



My cat with bipolar electrodes fixed across the prepyriform dipole field was deprived of food for two days and was waiting patiently in a box; There was a constant flow of air into the box, into which I introduced an odor of fish (at the arrows), after the cat had settled into an alert but relaxed state. Within seconds of onset of the odor at the arrows the cat was prowling and miauing in search of the food.

After feeding to satiety, the same odor elicited no comparable gamma oscillations with inhalation.

My interest came to focus on the background activity, which was robust, formless, and pervasive.

This broad-band "1/f" 'spontaneous' oscillation looks like chaos, but it is not, at least, not deterministic chaos, which is noise-free, stationary, time invariant, and autonomous. Brains and their parts and networks are noisy, nonstationary, time-varying, and engaged with the environment.

The activity proves to be self-organized, controlled, bandpass filtered noise maintained by a non-zero point attractor, which is stabilized by the thresholds and refractory periods of neurons everywhere.

A week olfactory stimulus activates about 10^3 neurons in the olfactory bulb. These stimulate the excitation of 10^6 neurons and the inhibitory activity of 10^7 neurons, which propagates in $5...10$ ms over a distance of about 10 mm, even if the average lengths of the axons are of about 1 mm and the synaptic propagation time is about 10 times longer.

- **stimulus** $= \epsilon\, s\, e^{i\phi} \to 0$ **for** $\epsilon \to 0$,

$\epsilon\, s =$ **modulus,** $\phi =$ **phase**

$$M = \lim_{\epsilon\to 0} M_\epsilon = \lim_{\epsilon\to 0} \epsilon\, s\, e^{i\phi}\, \frac{m}{\epsilon\, s} = e^{i\phi}\, m$$

The "order parameter" M **does not depend on the intensity (modulus) of the stimulus, but depends on its phase***

*H. Umezawa, Advanced field theory: micro, macro and thermal concepts. AIP, N.Y. 1993
G. Vitiello, My Double Unveiled. John Benjamins Publ. Co., Amsterdam 2001
M. Blasone, P. Jizba and G. Vitiello, Quantum field theory and its macroscopic manifestations. Imperial College Press 2011

Dissipation $\Rightarrow$ time-evolution of $|0(t)\rangle_{\mathcal{N}}$ at finite volume V controlled by the entropy variations $\Rightarrow$ irreversibility of time evolution (breakdown of time-reversal symmetry) $\Rightarrow$ arrow of time (a privileged direction in time evolution)

- order $\Leftrightarrow$ phase correlation ("tissue")
- coherence
- fractal self-similarity

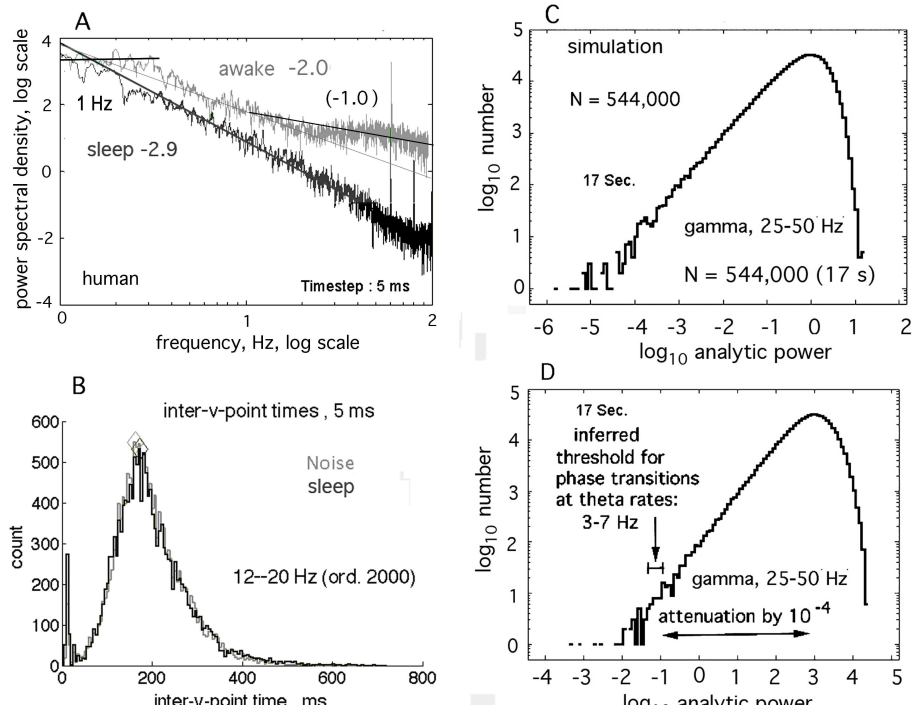
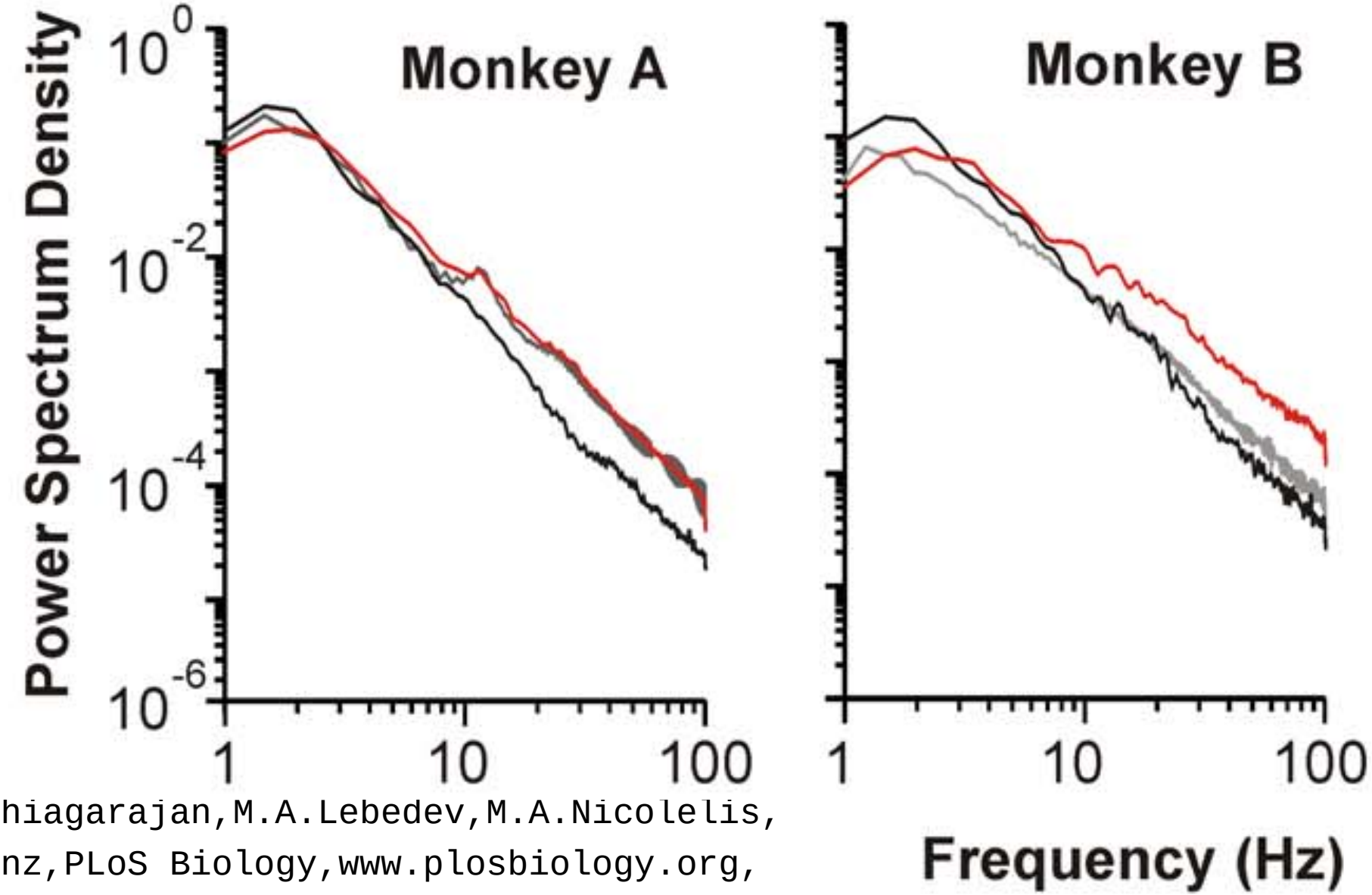
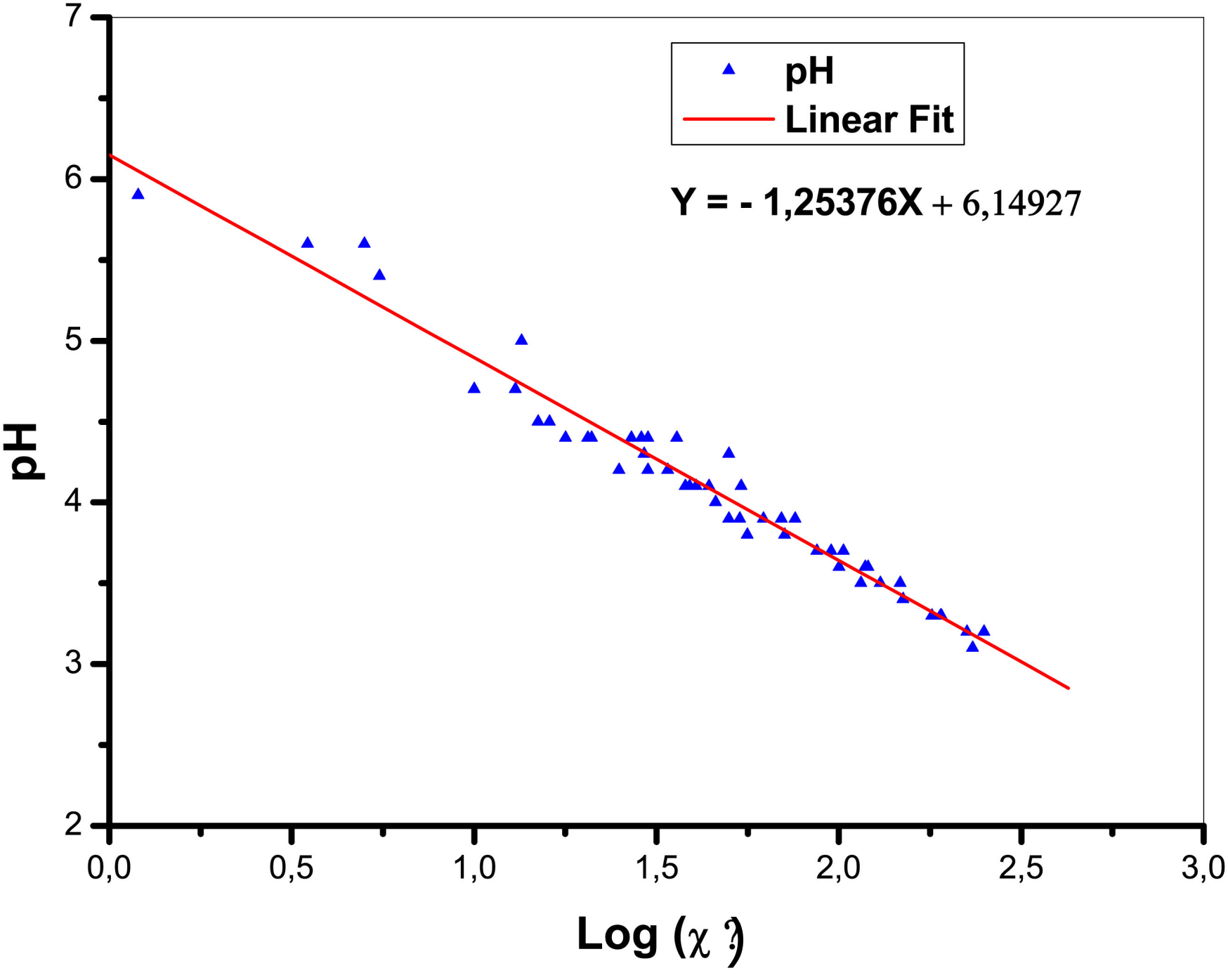


Figure 11. Evidence is summarized showing that the mesoscopic background activity conforms to scale-free, low-dimensional noise [Freeman et al., 2008]. Engagement of the brain in perception and other goal-directed behaviors is accompanied by departures from randomness upon the emergence of order (A), as shown by comparing PSD in sleep, which conforms to black noise, vs. PSD in an aroused state showing excess power in the theta (3 7 Hz) and gamma (25 100 Hz) ranges. B. The distributions of time intervals between null spikes of brown noise and sleep ECoG are superimposed. C,D. The distributions are compared of $\log_{10}$ analytic power from noise and ECoG. Hypothetically the threshold for triggering a phase transition is 10^{-4} down from modal analytic power. From [Freeman, O'Nuillain and Rodriguez, 2008 and Freeman and Zhai, 2009]



T.C.Thiagarajan,M.A.Lebedev,M.A.Nicolelis,
D.Plenz,PLoS Biology,www.plosbiology.org,
Jan.2010 V.8 e1000278

Nafionaized water - V.Elia et al. Experiments



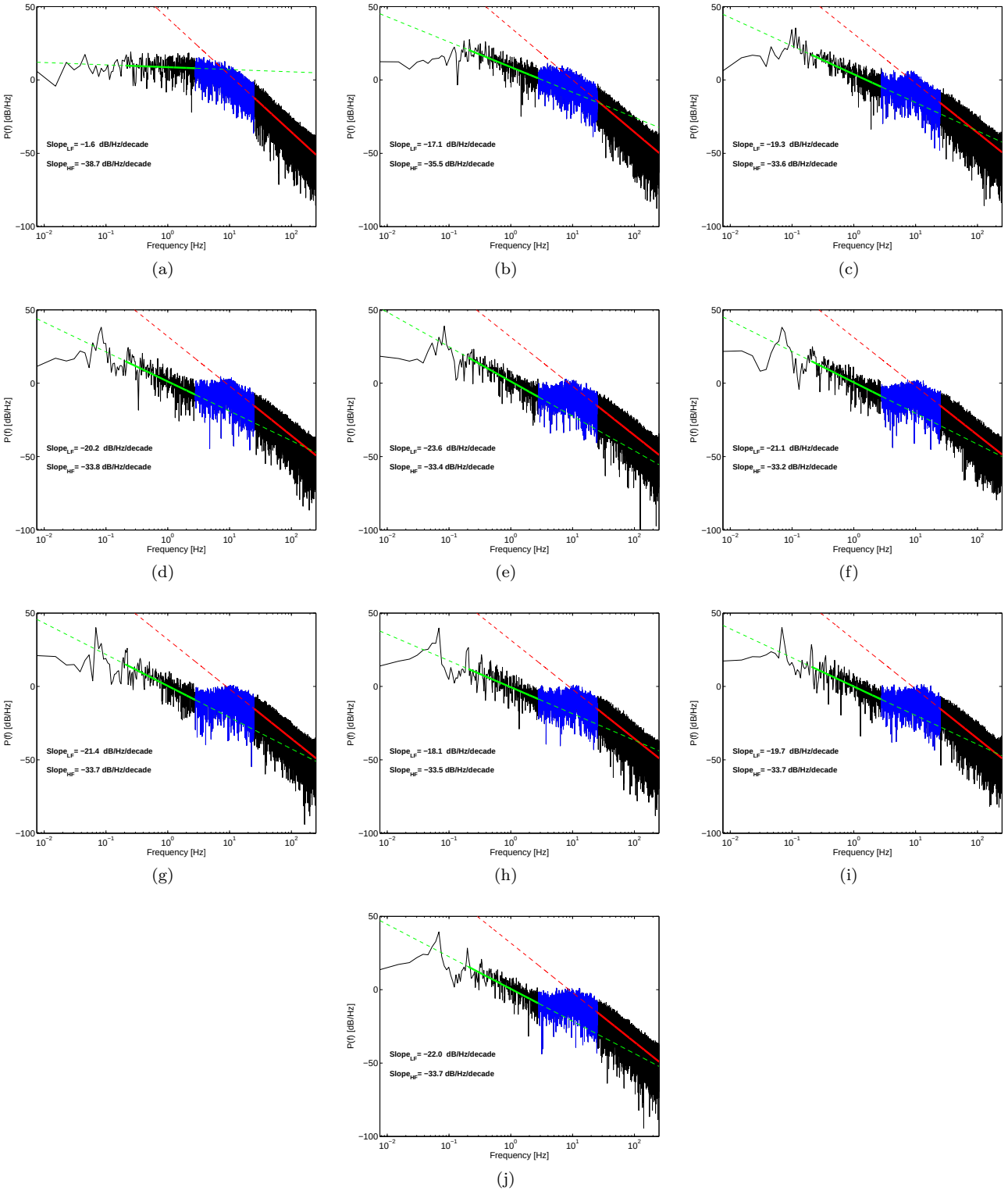


Figure 6: Log-log power density spectra of membrane potential signals of a representative cell in clusters of increasing size, stimulated by a postprandial glucose concentration ($[G] = 9.5\,mM$): a) single cell; j) $10 \times 10 \times 10$ cluster; b)-i) intermediate cases $n \times n \times n$ (with n integer and $1 < n < 10$). The slope at low frequencies (S_{LF}) is highlighted in green, the slope at high frequencies (S_{HF}) in red. As in fig.3 Continuous lines segments highlight the PDS points used for the linear fitting; dotted lines segments are the prosecution of the linear estimation. Transition region between the two linear zones is highlighted in blue.

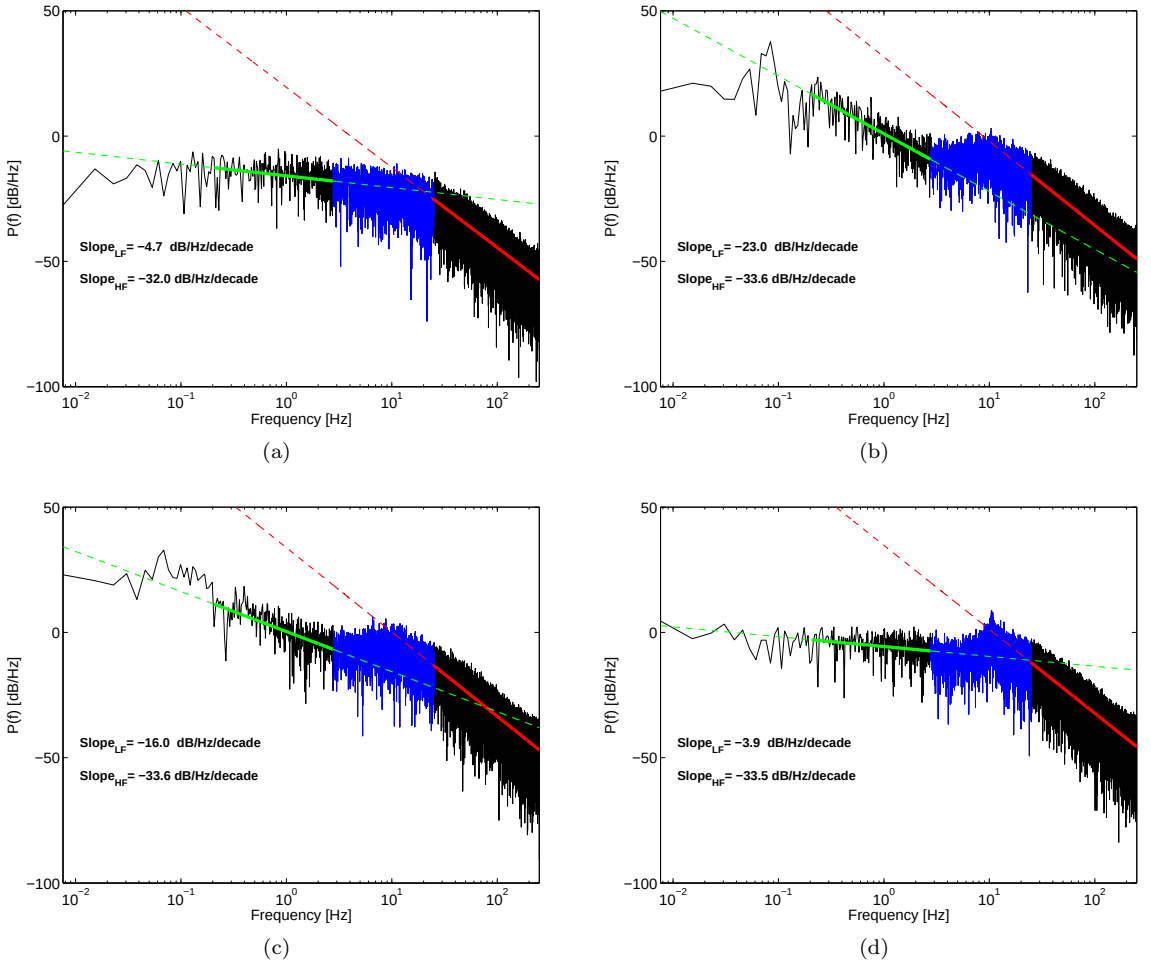
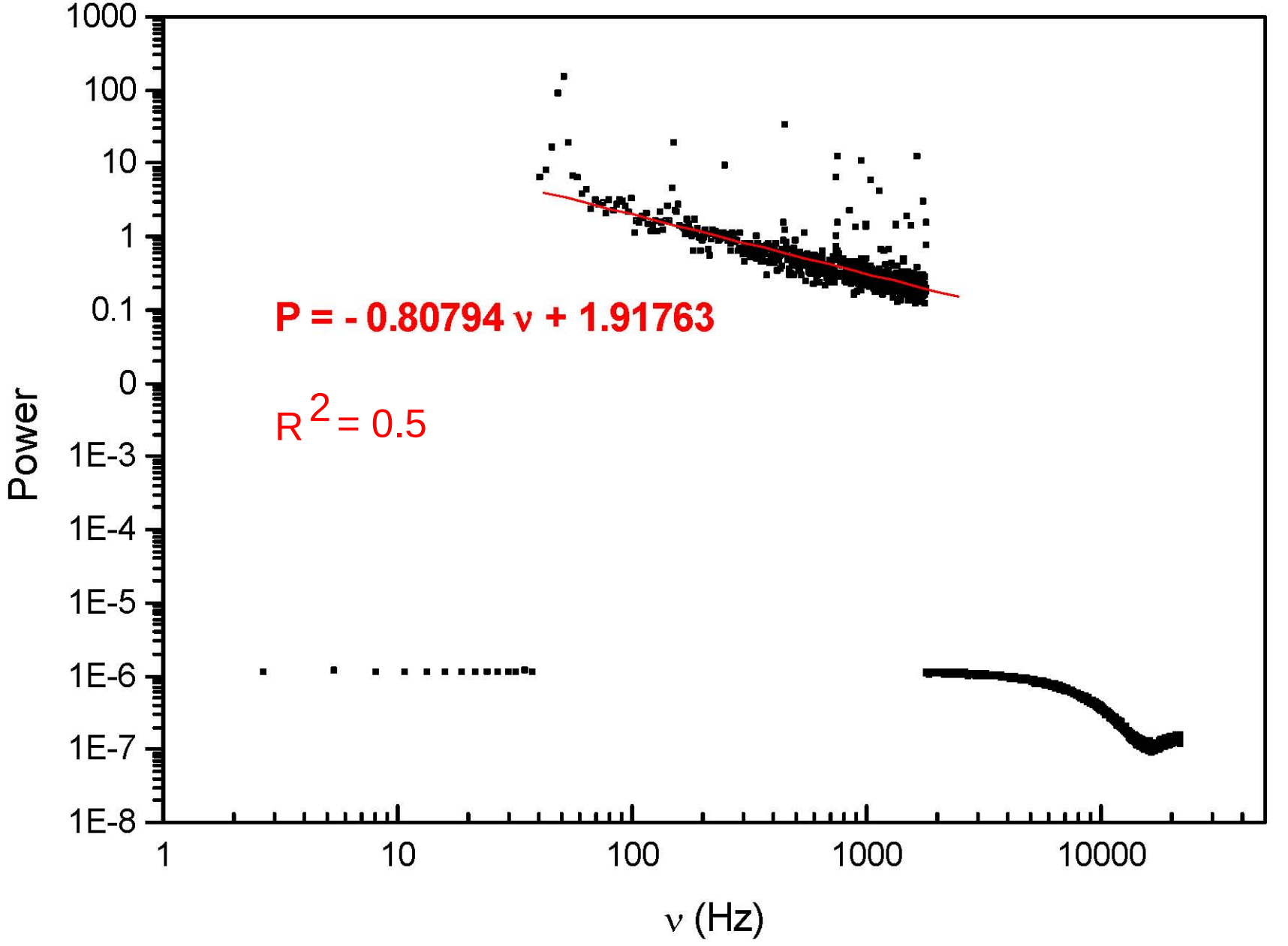
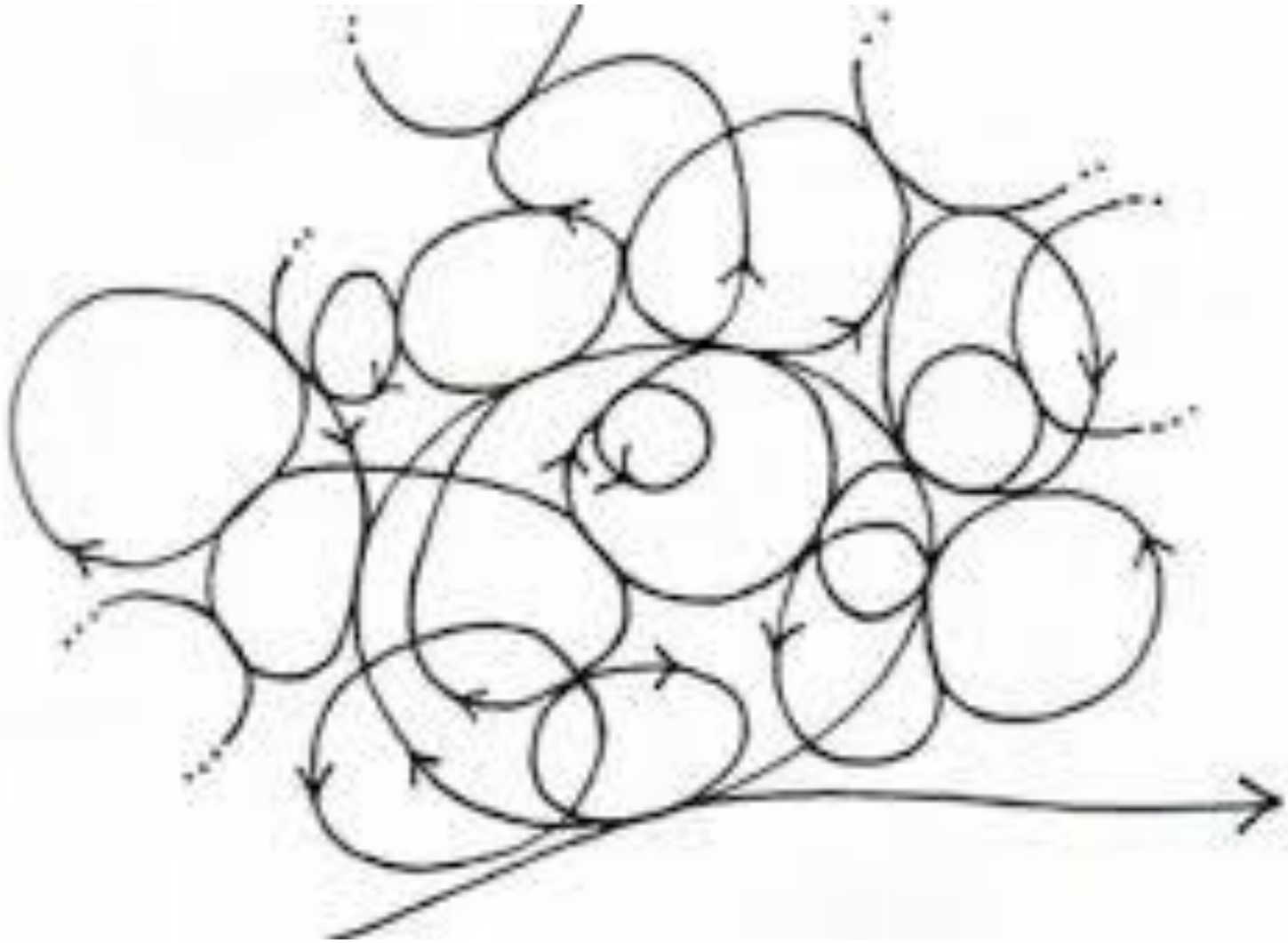


Figure 3: Log-log power density spectra of membrane potential signals of a representative cell in a $5 \times 5 \times 5$ cluster, stimulated by different glucose concentrations: a) $[G] = 4.7\,mM$; b) $[G] = 9.5\,mM$; c) $[G] = 12.6\,mM$; d) $[G] = 16.6\,mM$. The slope at low frequencies (S_{LF}) is highlighted in green, the slope at high frequencies (S_{HF}) in red. Continuous lines segments highlight the PDS points used for the linear fitting; dotted lines segments are the prosecution of the linear estimation. Transition region between the two linear zones is highlighted in blue.


1000
100
10
1
0.1
0
1E-3
1E-4
1E-5
1E-6
1E-7
1E-8
Power
P = - 0.80794 ν + 1.91763
R 2 = 0.5
1
10
100
1000
10000
ν (Hz)



log-log straight line plot

$\Rightarrow$ dynamical formation of self-similar fractal structures in water

self-similarity/coherent-state theorem[‡]

$\Rightarrow$ dynamical formation of coherent structures in water

[‡]G.Vitiello, New Mathematics and Natural Computation 5, 245 (2009)
Phys. Lett. A 376, 2527 (2012)

Theorem:

The global nature of fractals emerges from coherent local deformation processes.

$\Rightarrow$

the dynamical formation of fractals

Outlook: A unified vision of Nature

The result relating the coherent dynamics to the fractal formation accounts for the universality of the recurrence in space and in time of self-similar patterns, including the so widely observed logarithmic spiral and Fibonacci progression.

Coherence appears as the universal morphogenetic paradigm.

An integrated ecological vision thus emerges, where the appearance of forms through coherence becomes the formation of meanings.

** G. Vitiello, New Mathematics and Natural Computation 5, 245 (2009); Phys. Lett. A 376, 2527 (2012)

Perhaps, one might conclude with Darwin that

"[. . .] in this view of life, with its several powers, having been originally breathed into a few form or into one; [. . .] from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved."

C. Darwin, *On the Origin of Species*, John Murray, London, 1860, 490

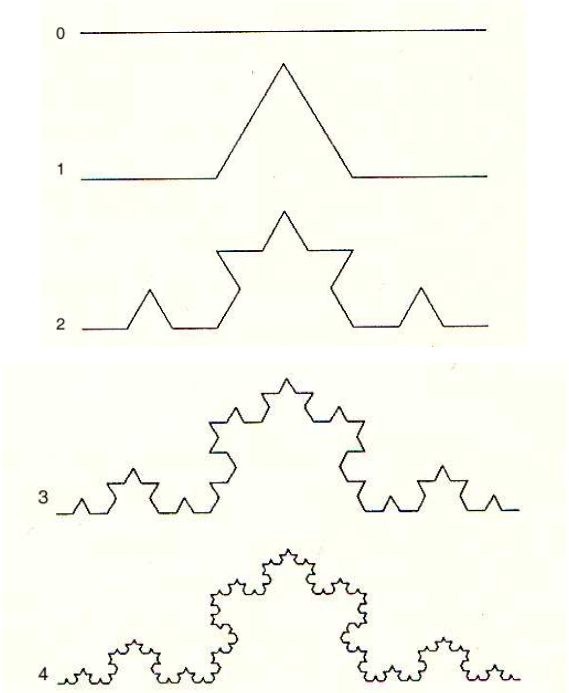


Fig. 1. The ¯rst ¯ve stages of Koch curve.

RJ Glauber
2005 Nobel Laureate

Factorizatilibity Criterion of Quantum Coherence

$$G_{(1)}(X_1, X_1)\, G_{(1)}(X_2, X_2) = |G_{(1)}(X_1, X_2)|^2$$

Translation by MW Ho:

"A system is quantum coherent if its parts are so perfectly correlated that their cross-correlations are exactly the product of the individual self-correlations, so that each appears paradoxically totally uncorrelated with the rest.
"It is a state of maximum local freedom and global cohesion"

Credits Mae Wan Ho

Is Spacetime Fractal and Quantum Coherent in the Golden Mean?

By Mae-Wan Ho, Mohamed el Naschie & Giuseppe Vitiello

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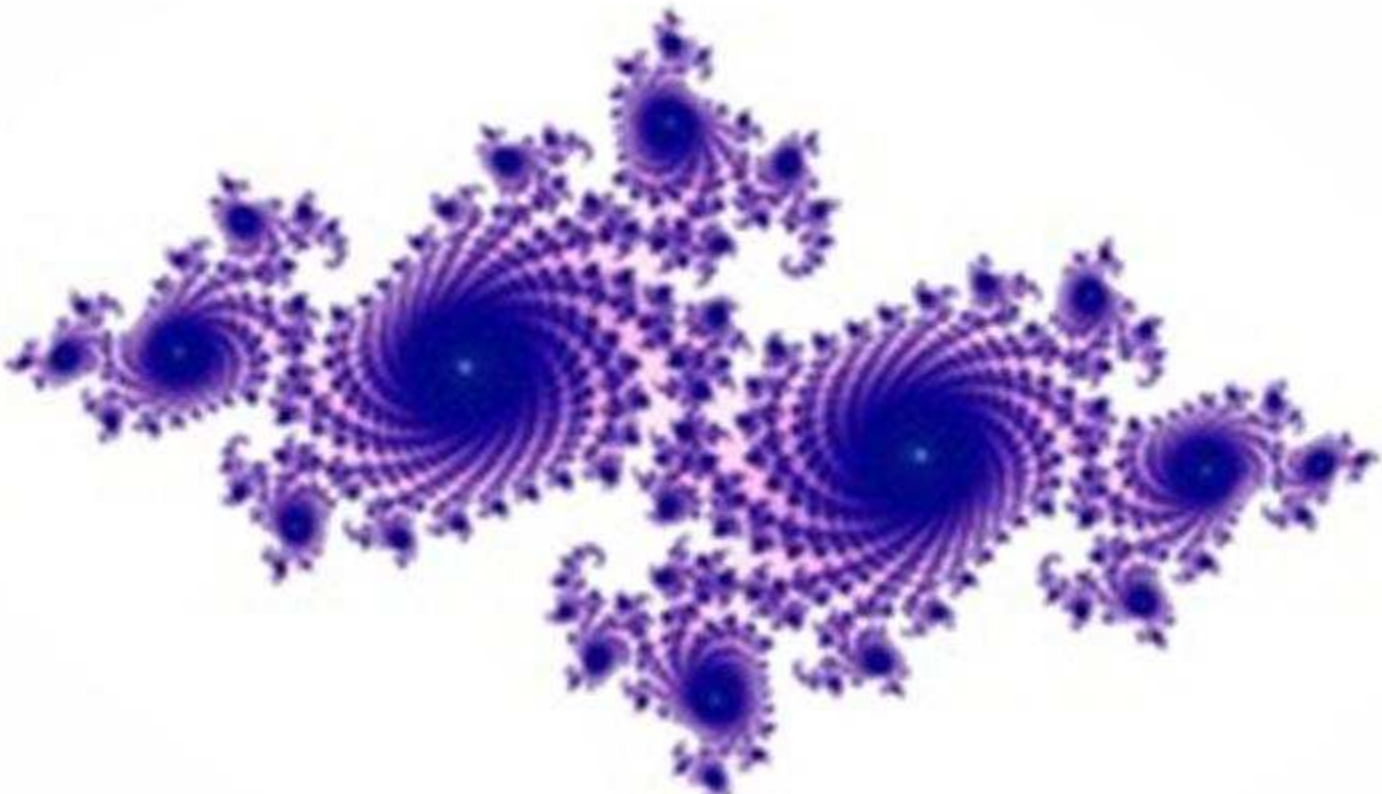
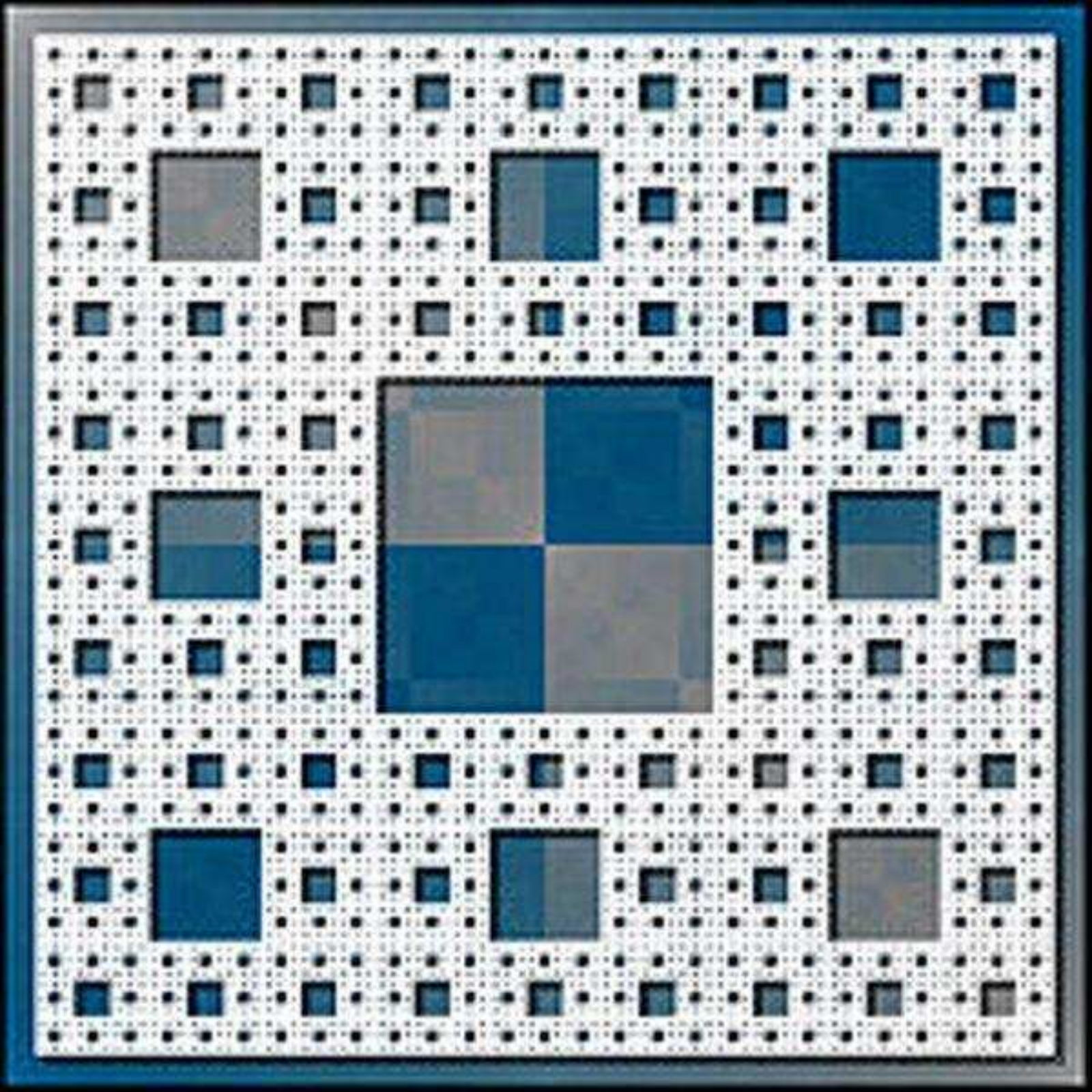
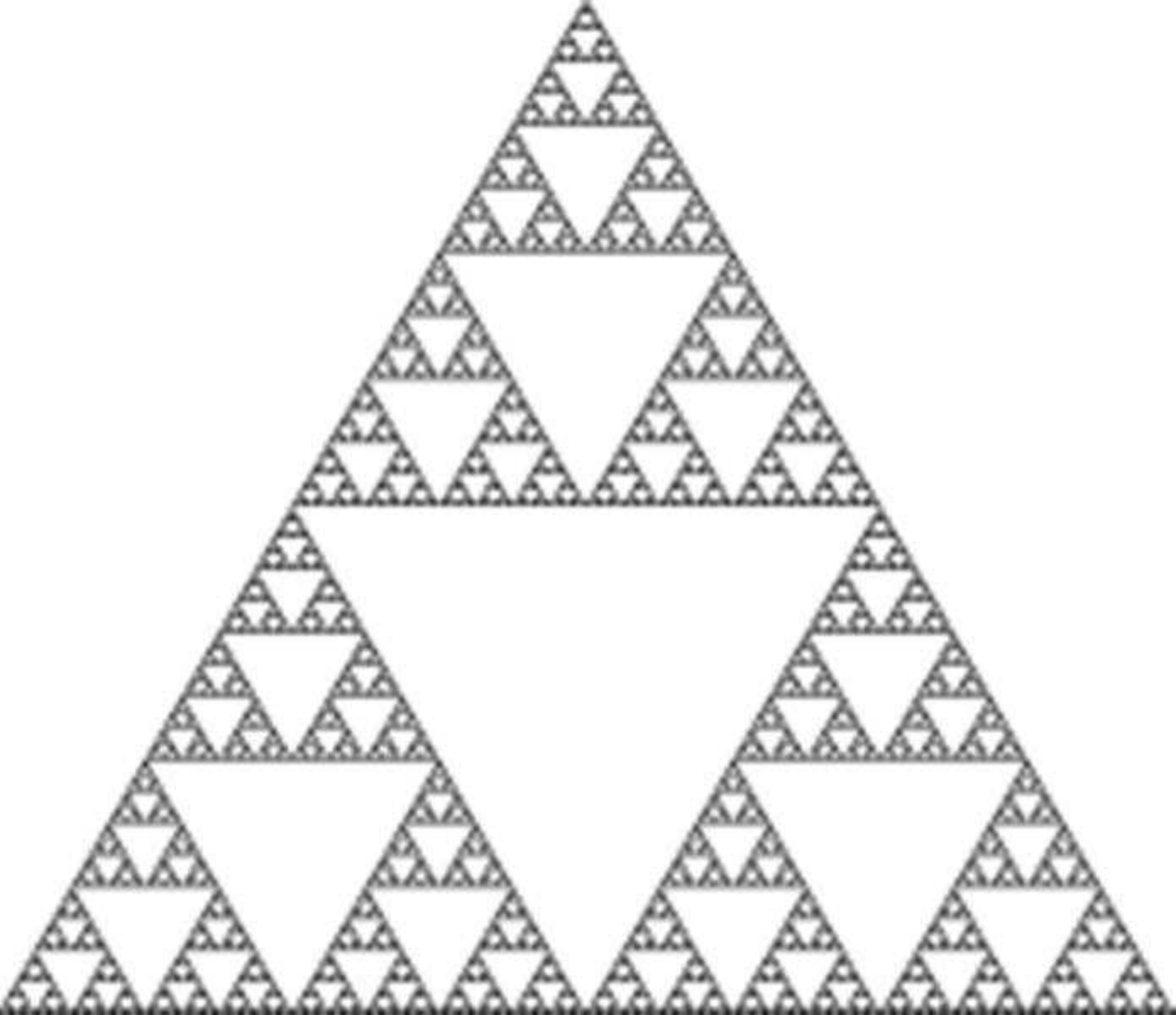
Abstract- We consider the fabric of spacetime from a wide perspective: from mathematics, quantum physics, far from equilibrium thermodynamics, biology and neurobiology. It appears likely that spacetime is fractal and quantum coherent in the golden mean. Mathematically, our fractal universe is non-differentiable and discontinuous, yet dense in the infinite dimensional spacetime. Physically, it appears to be a quantum coherent universe consisting of an infinite diversity of autonomous agents all participating in co-creating organic, fractal spacetime by their multitudinous coupled cycles of activities. Biologically, this fractal coherent spacetime is also the fabric of conscious awareness mirrored in the quantum coherent golden mean brain states.

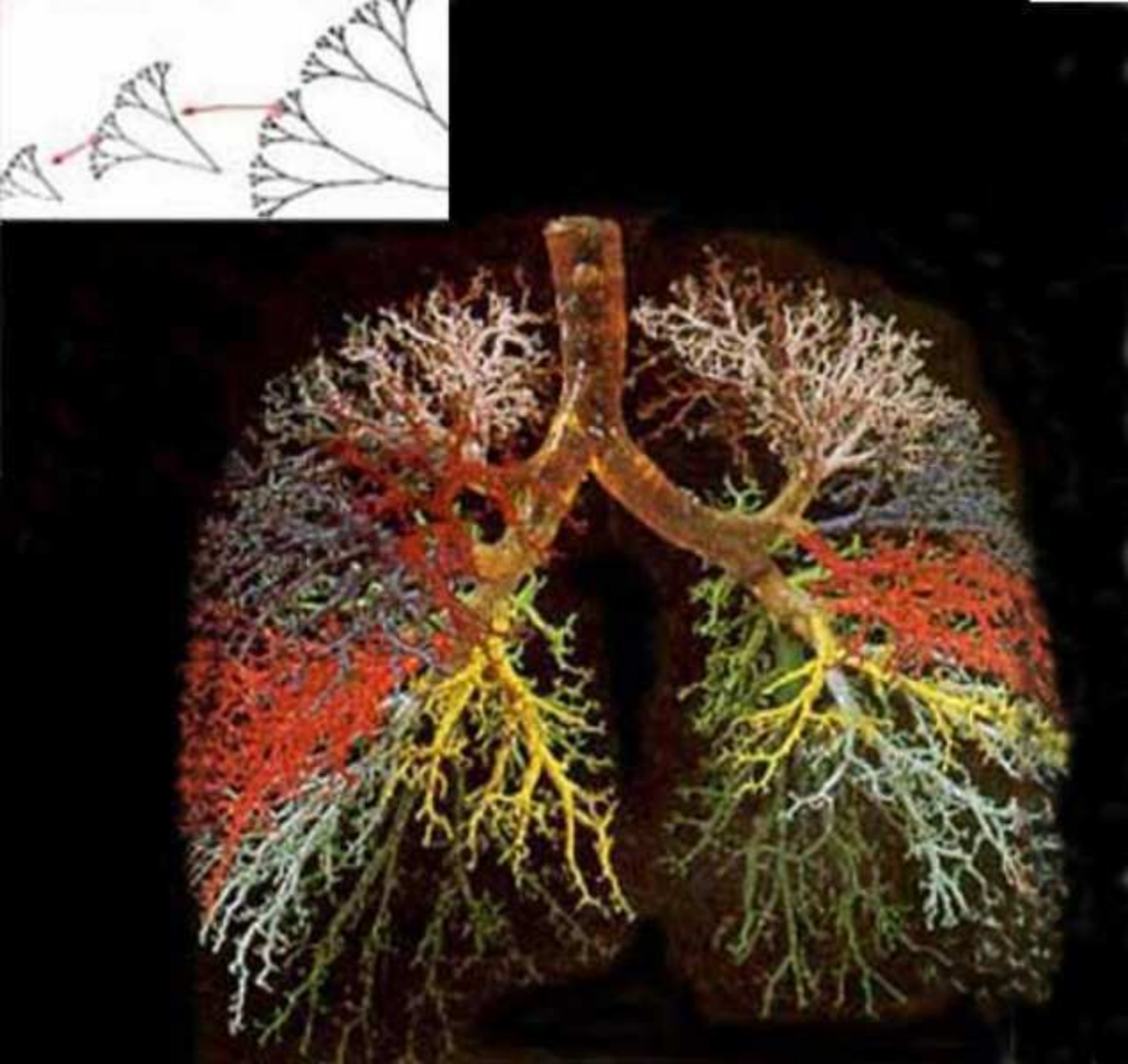
Keywords: whitehead's philosophy, discontinuous nondifferentiable spacetime, fractals, coupled activity cycles, deterministic chaos, quantum coherence and fractals, golden mean.

GJSFR-A Classification : FOR Code: 020699, 020109









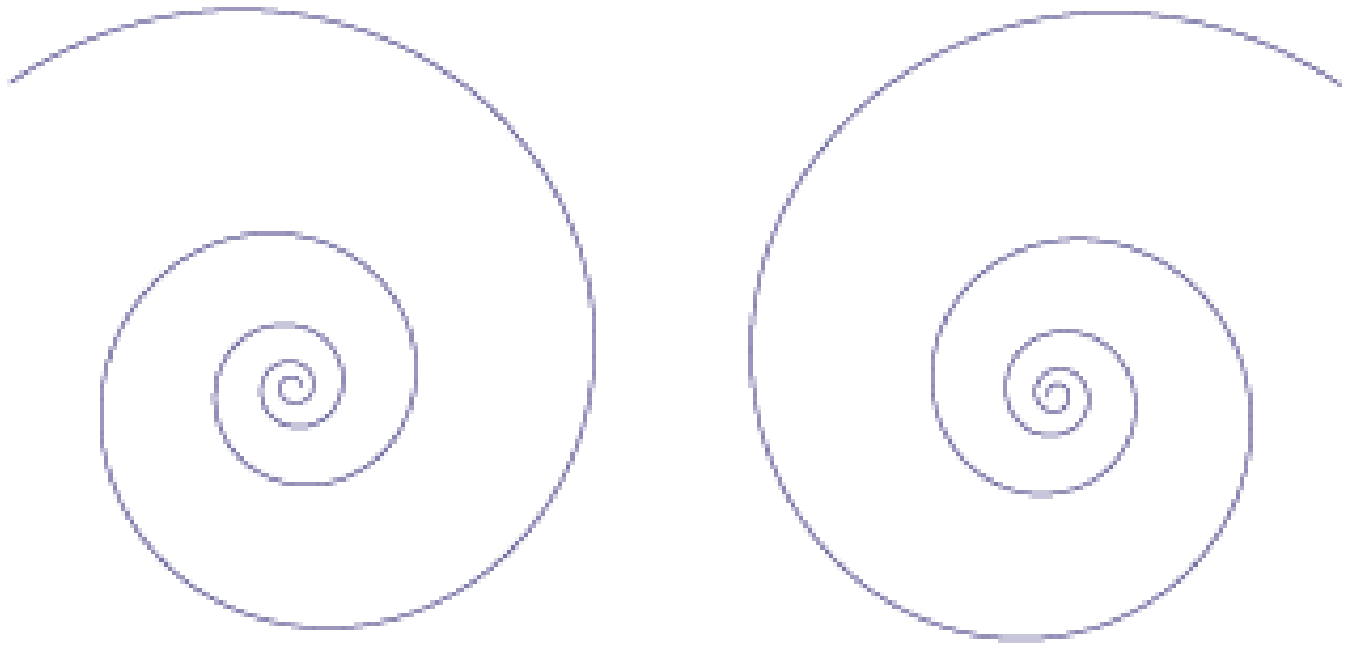


FIG. 2: The anti-clockwise and the clockwise logarithmic spiral.

A FLUVIAL NET

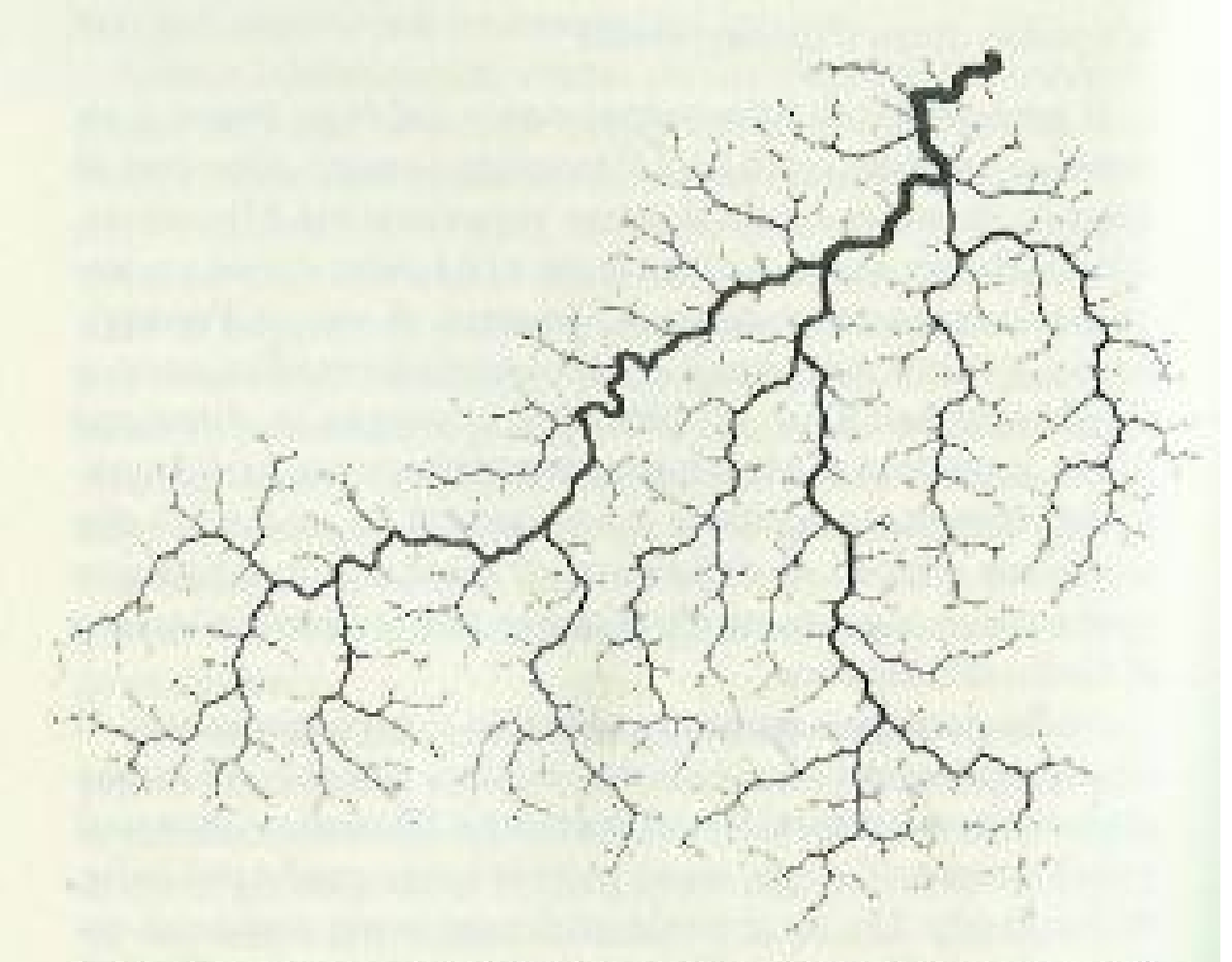
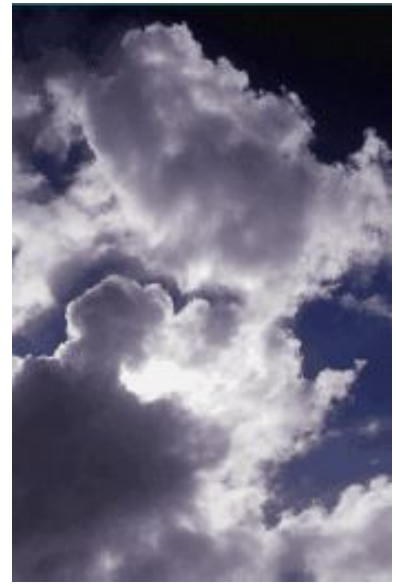


Figura 13. La struttura della rete fluviale del Fella, in Friuli. (L'immagine, riprodotta con il permesso di Ignacio Rodriguez-Iturbe e Andrea Rinaldo, è tratta da *Fractal River Basins*, Cambridge, Cambridge University Press, 1997.)



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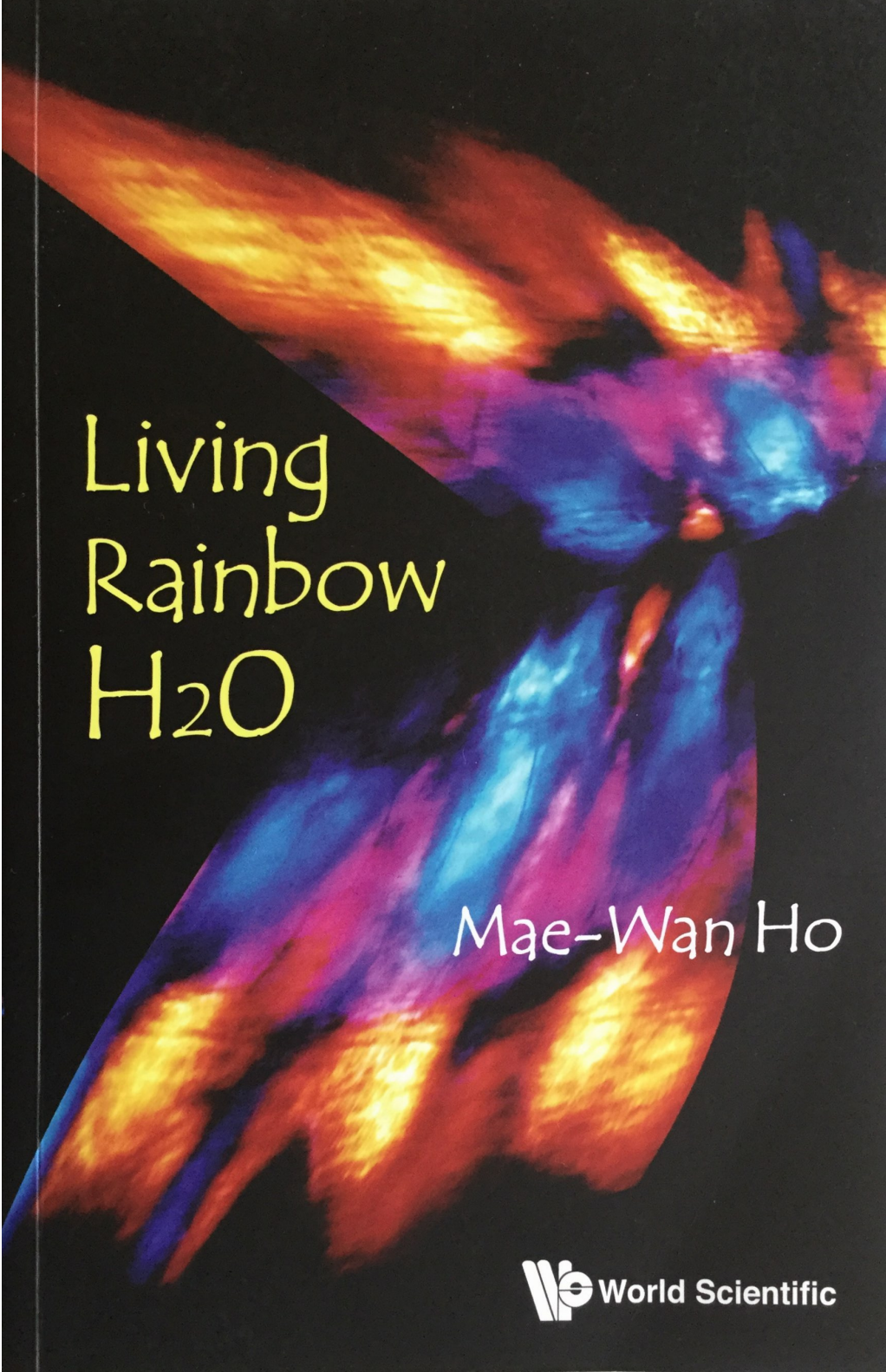
Living
Rainbow
H2O
Mae-Wan Ho
World Scientific