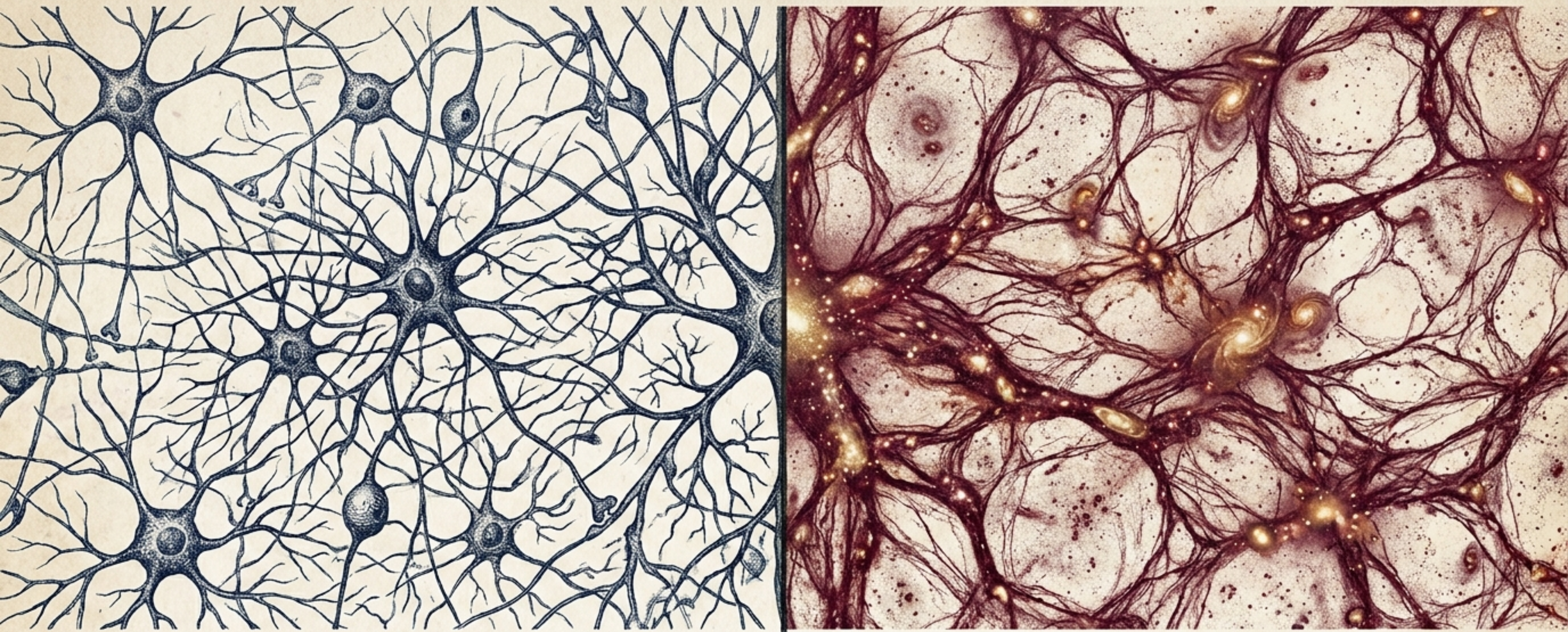
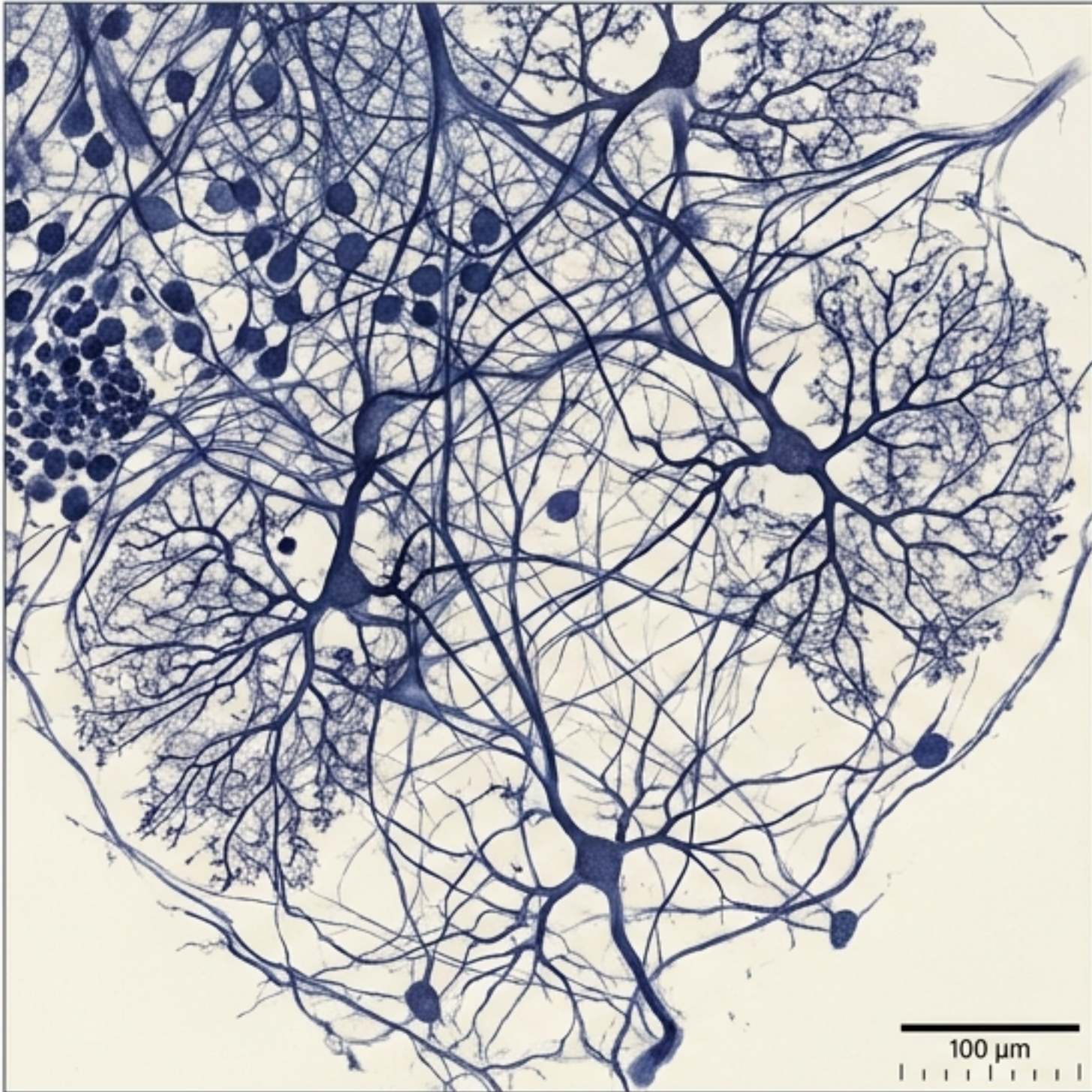




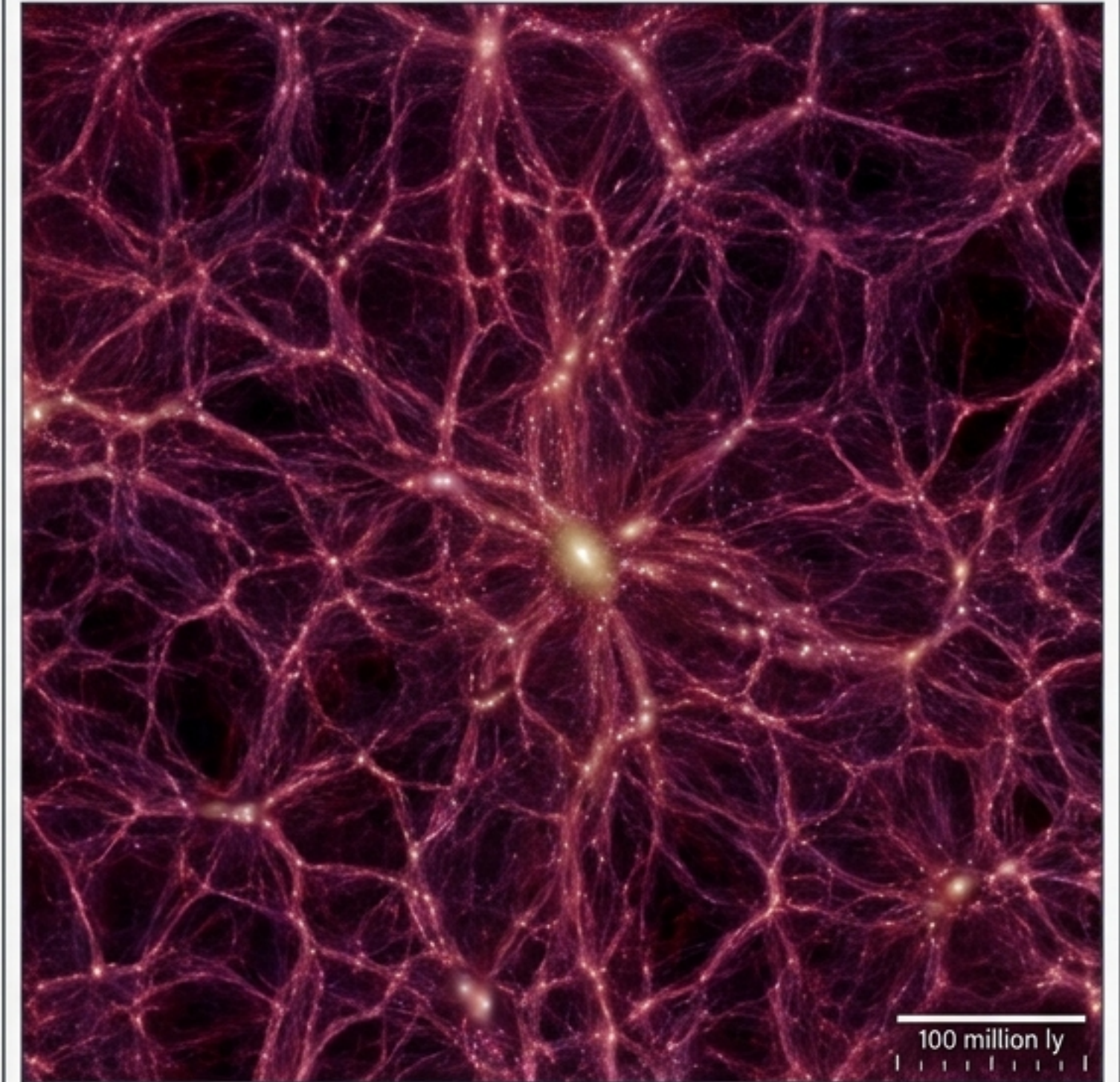
THE COSMIC MIRROR

The Scale-Invariant Symmetry of the Brain and the Universe

An Unlikely Reflection



Cerebellum Tissue Slice (40x Magnification)



Cosmic Web Simulation (ENZO Code)

Astrophysicist Dr. Franco Vazza and Neurosurgeon Dr. Alberto Feletti observed an uncanny morphological similarity between two of the most complex systems in nature. Their question: Is this merely a visual trick of the human eye, or mathematically verifiable structural symmetry?

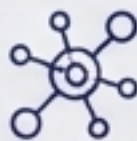
Bridging 27 Orders of Magnitude



The Human Brain



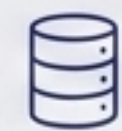
Scale: 1.6 Millimeters
(Tissue Sample)



Total Nodes:
~86 Billion Neurons

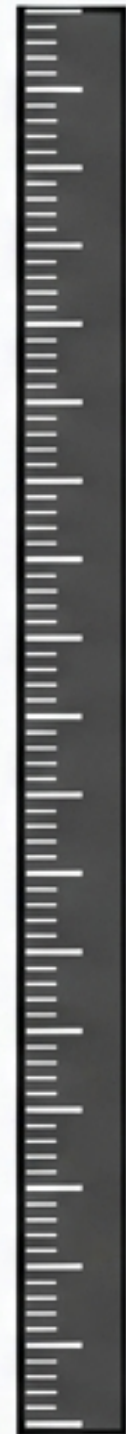


Node Type:
Biological Cells



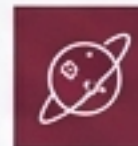
Memory Capacity:
~2.5 Petabytes

10^{27}

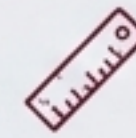


10^0

A spatial ratio of
 1.875×10^{27}



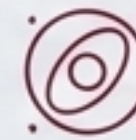
The Observable Universe



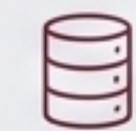
Scale: 100 Megaparsecs
(Cosmic Volume)



Total Nodes:
~100 Billion Galaxies



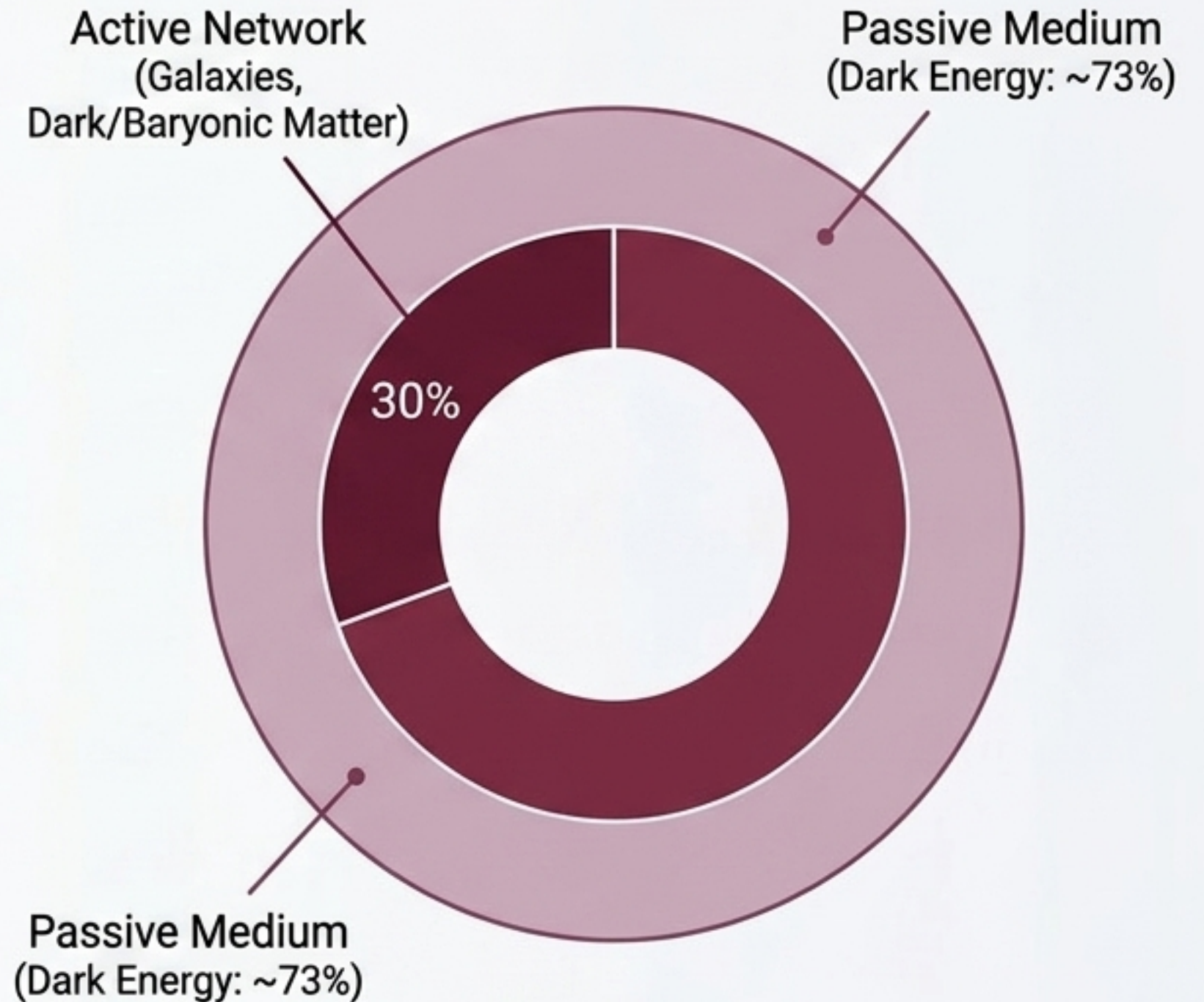
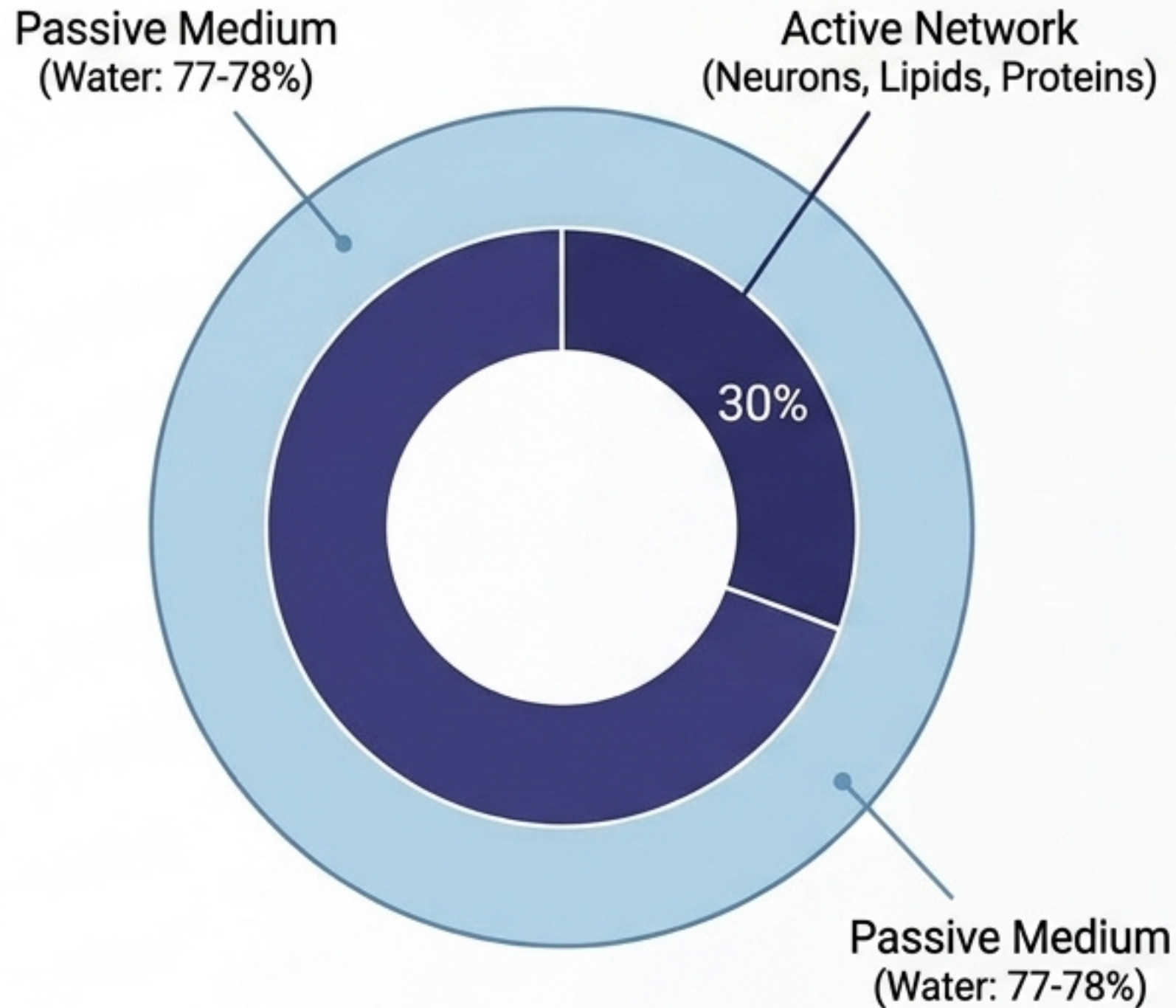
Node Type:
Gravitational Halos



Memory Capacity:
~4.5 Petabytes

The 30/70 Composition Rule

Despite entirely different physical substrates, both systems allocate mass and energy in near-identical ratios.

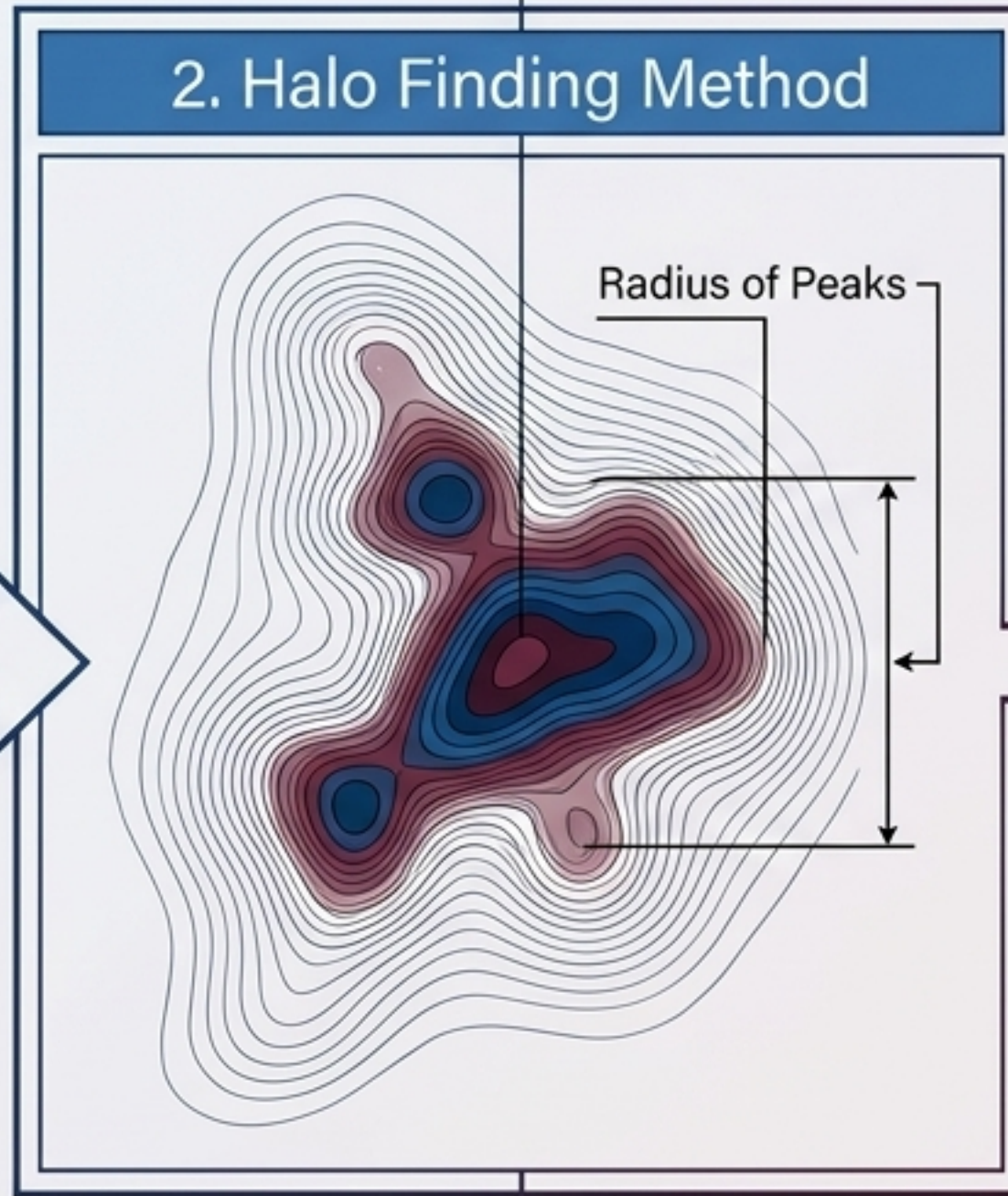


The physical structures doing the active processing account for only about 30% of the total distribution.
The remaining 70% acts as a passive, supportive medium.

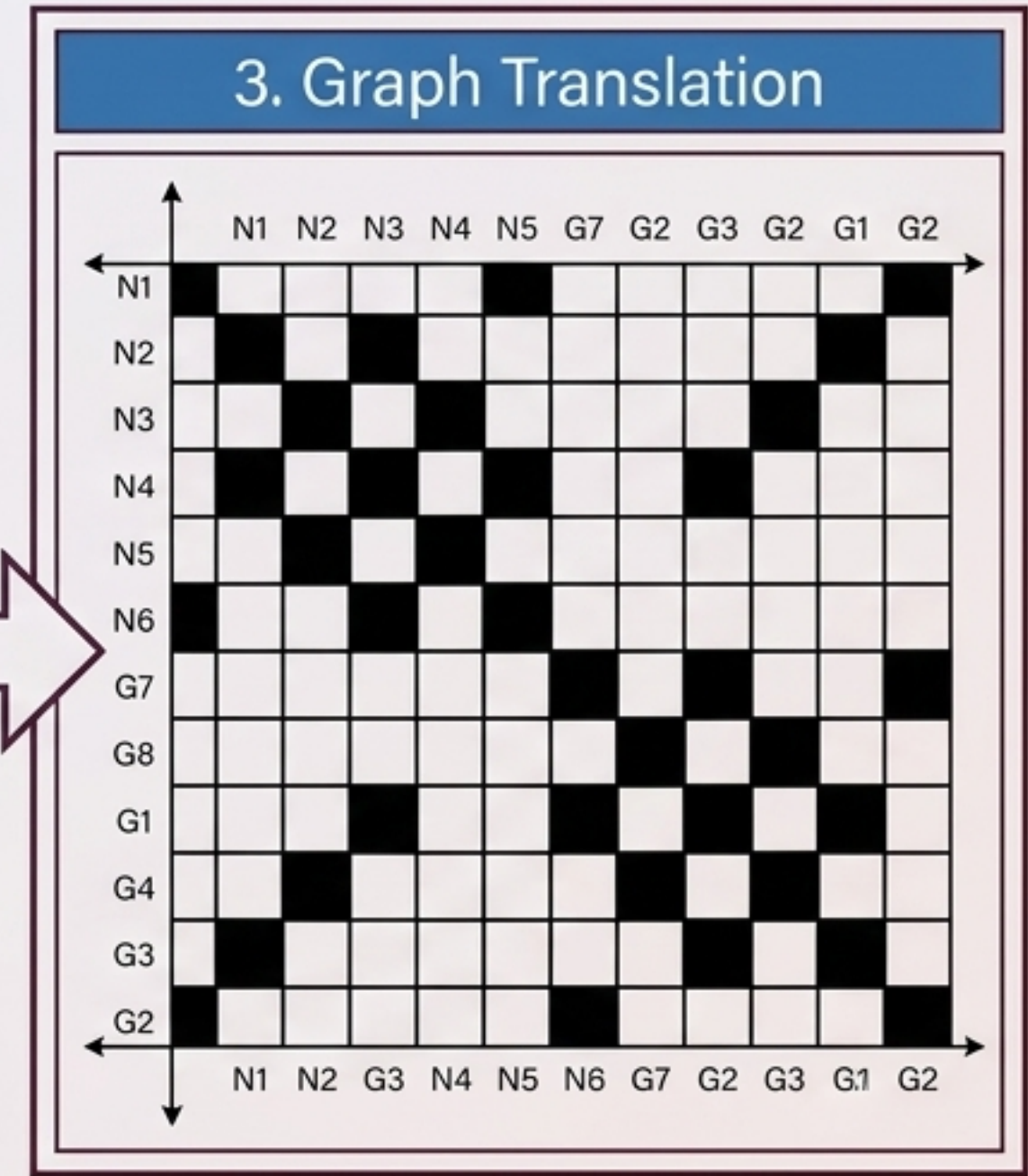
Translating Matter into Mathematics



Sourcing biological tissue slices and supercomputer cosmological simulations.

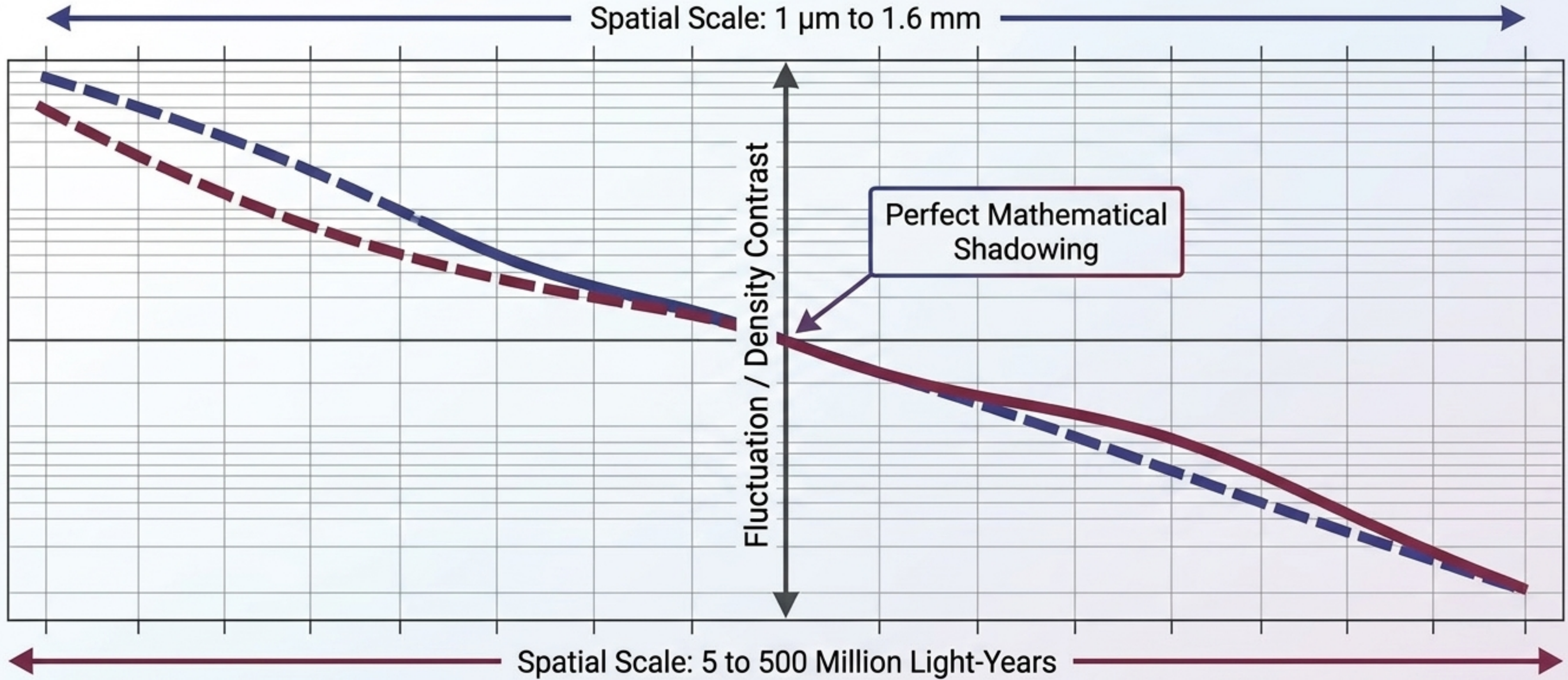


Applying intensity thresholding to identify the top 10% brightness peaks, stripping away the physical material.



Converting physical proximity into an abstract adjacency matrix, treating both neurons and galaxies universally as mathematical nodes.

The Fluctuation Alignment



Spectral density measures the spatial distribution of matter fluctuations. The mathematical progression of matter fluctuations within the cerebellum at microscopic scales perfectly shadows the progression of cosmic matter at mega-scales.

Network Topology: Non-Random Neighborhoods

The Brain



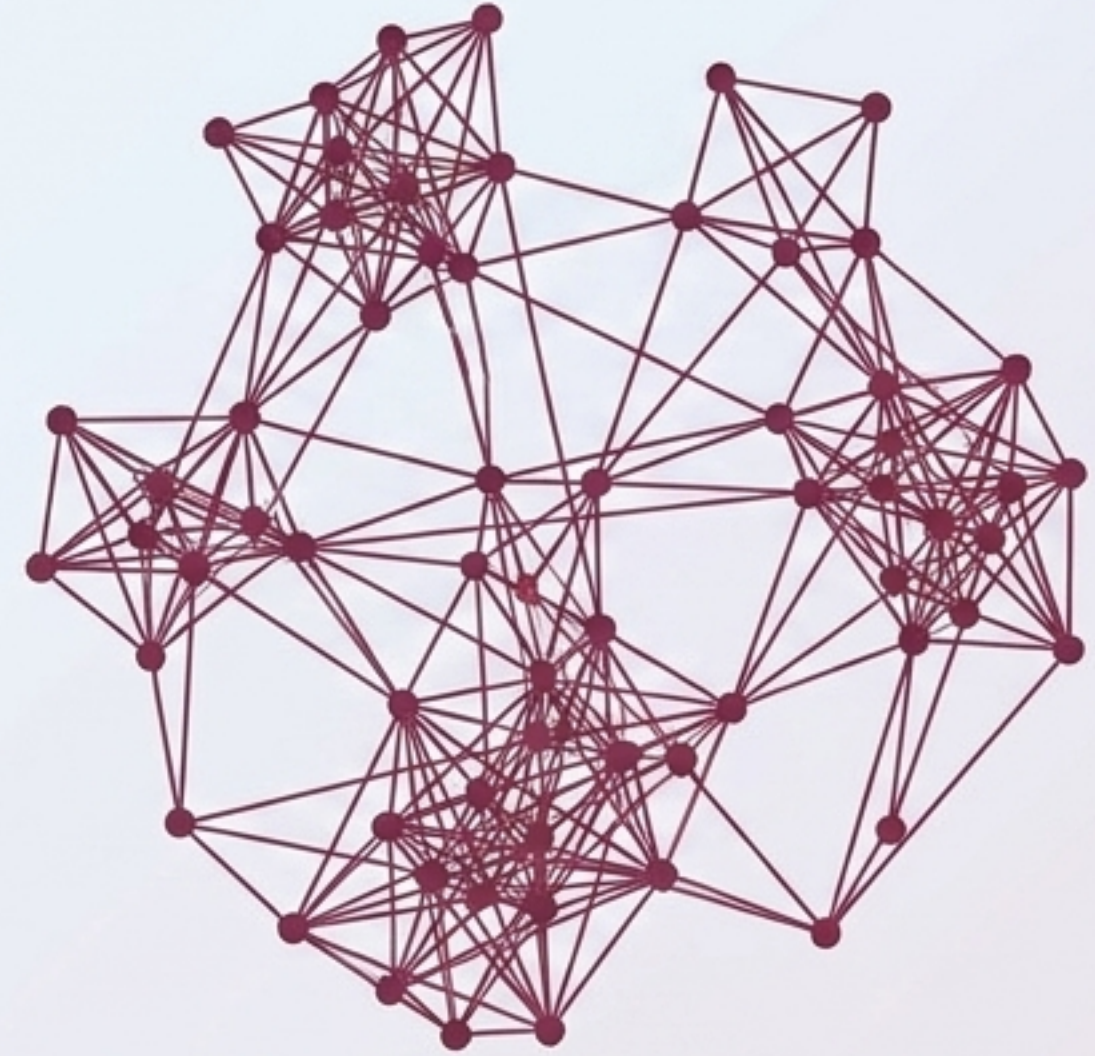
Clustering Coefficient: $C \approx 0.1 - 0.4$



Random Probability

Clustering Coefficient: $C \leq 0.002$

The Cosmic Web



Clustering Coefficient: $C \approx 0.1 - 0.4$

Neither the brain nor the universe is randomly scattered. Both systems exhibit **high clustering coefficients**—a mathematical tendency to form highly organized, closely connected local neighborhoods.

Network Topology: Degree Centrality

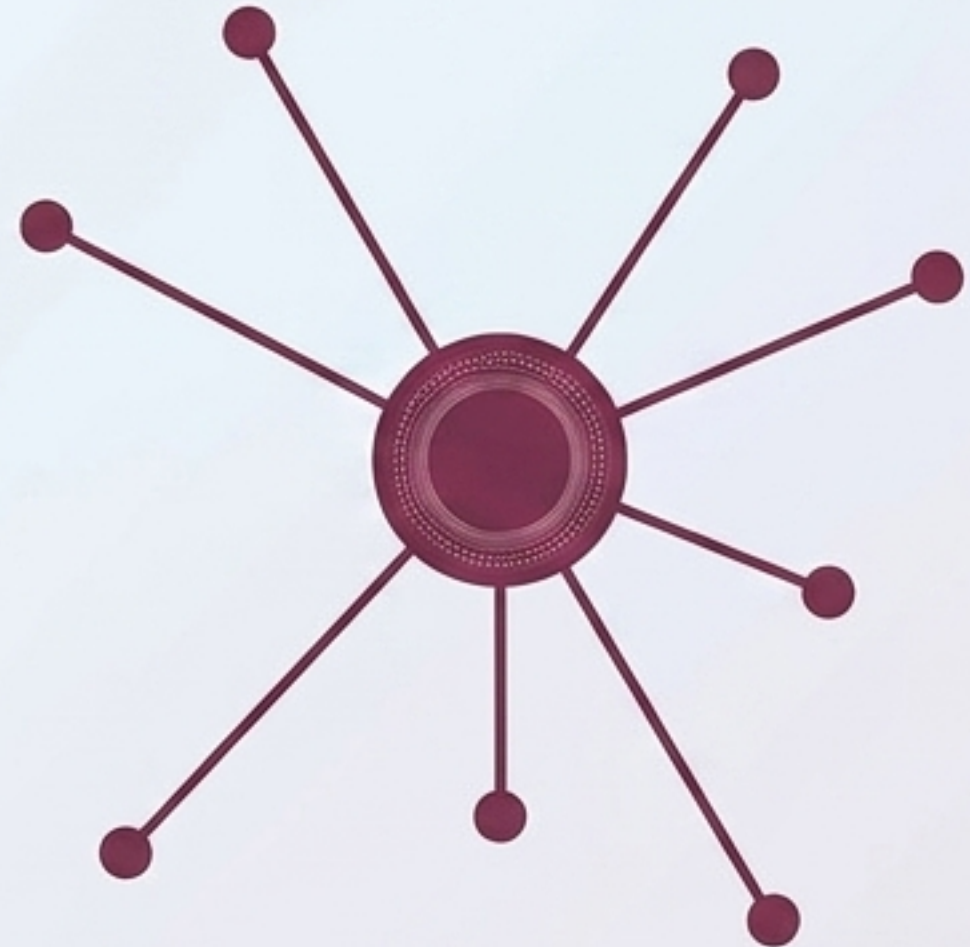
Neuron Node

1.9 to 5.4 Average Connections



Gravitational Halo

3.8 to 4.1 Average Connections



$$C_d(j) = \frac{k_j}{n - 1}$$

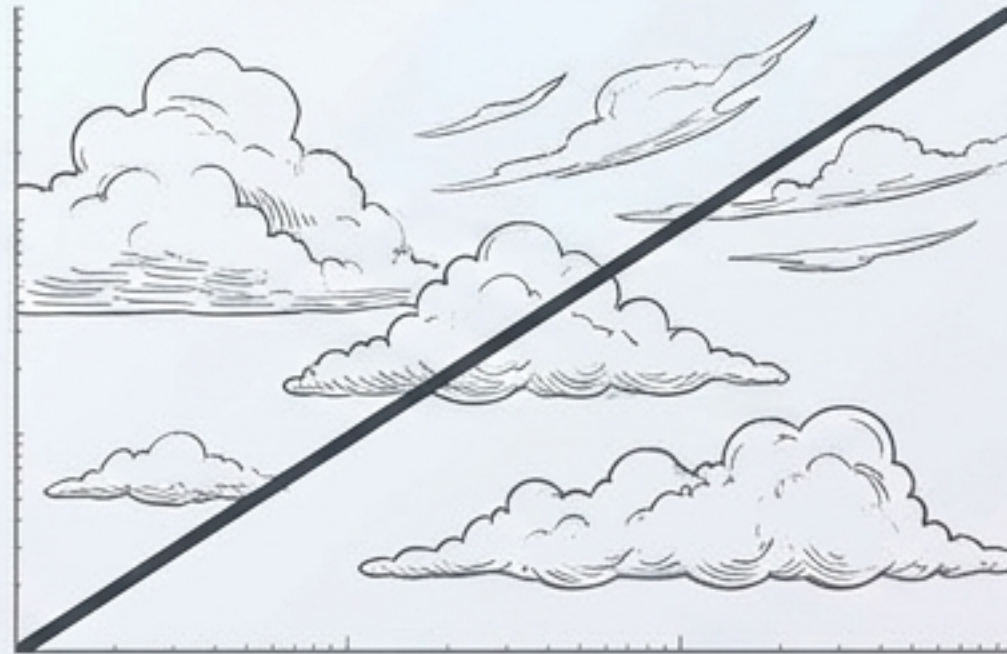
When analyzed purely as mathematical graphs, the average number of connections stemming from a single node is strikingly similar, placing both systems within the exact same highly correlated network class.

The Fractal Falsification

Scale-Dependent Self-Organization (Brain & Cosmic Web)

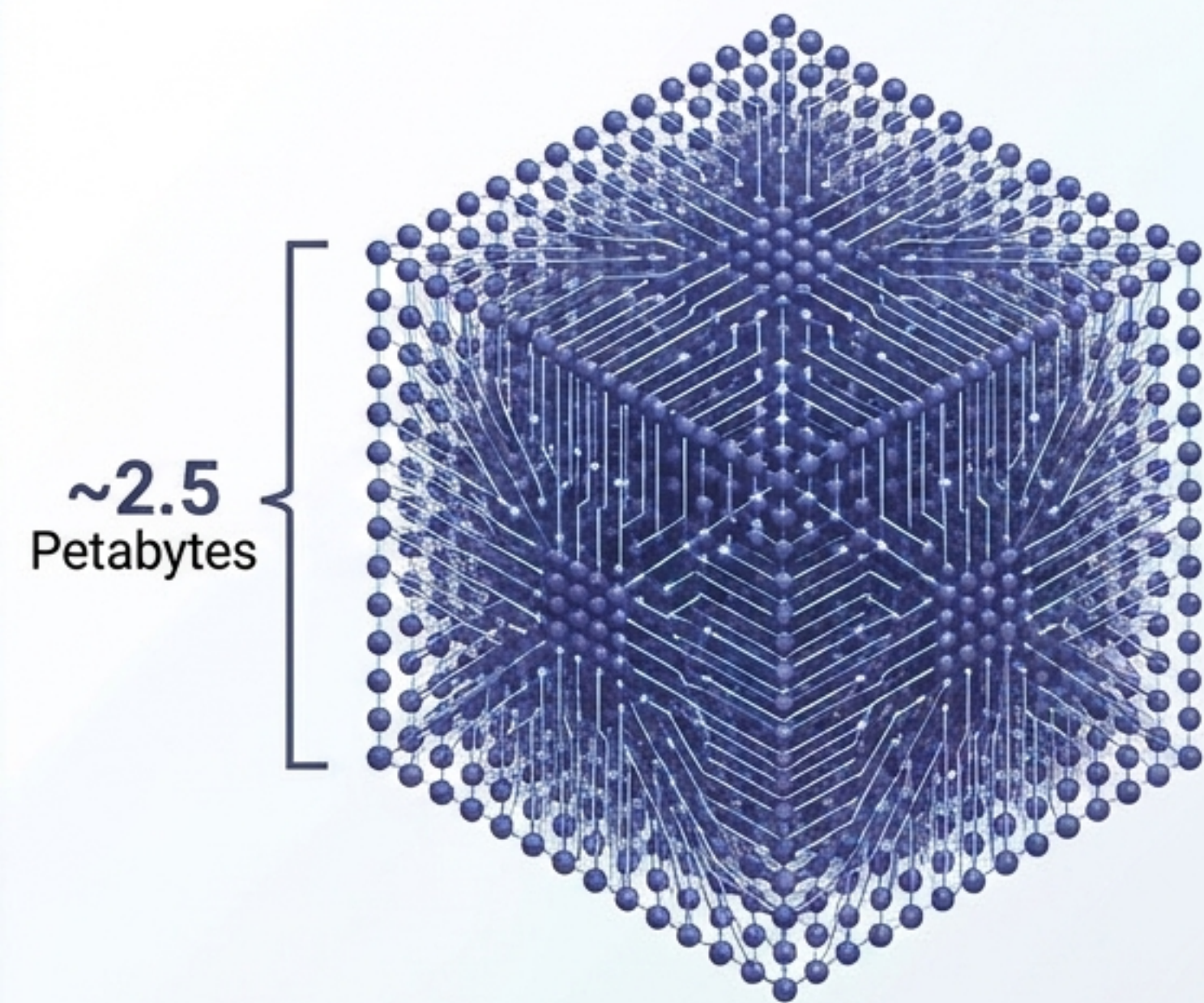


Simple Fractal Geometries (Trees, Clouds, Water)

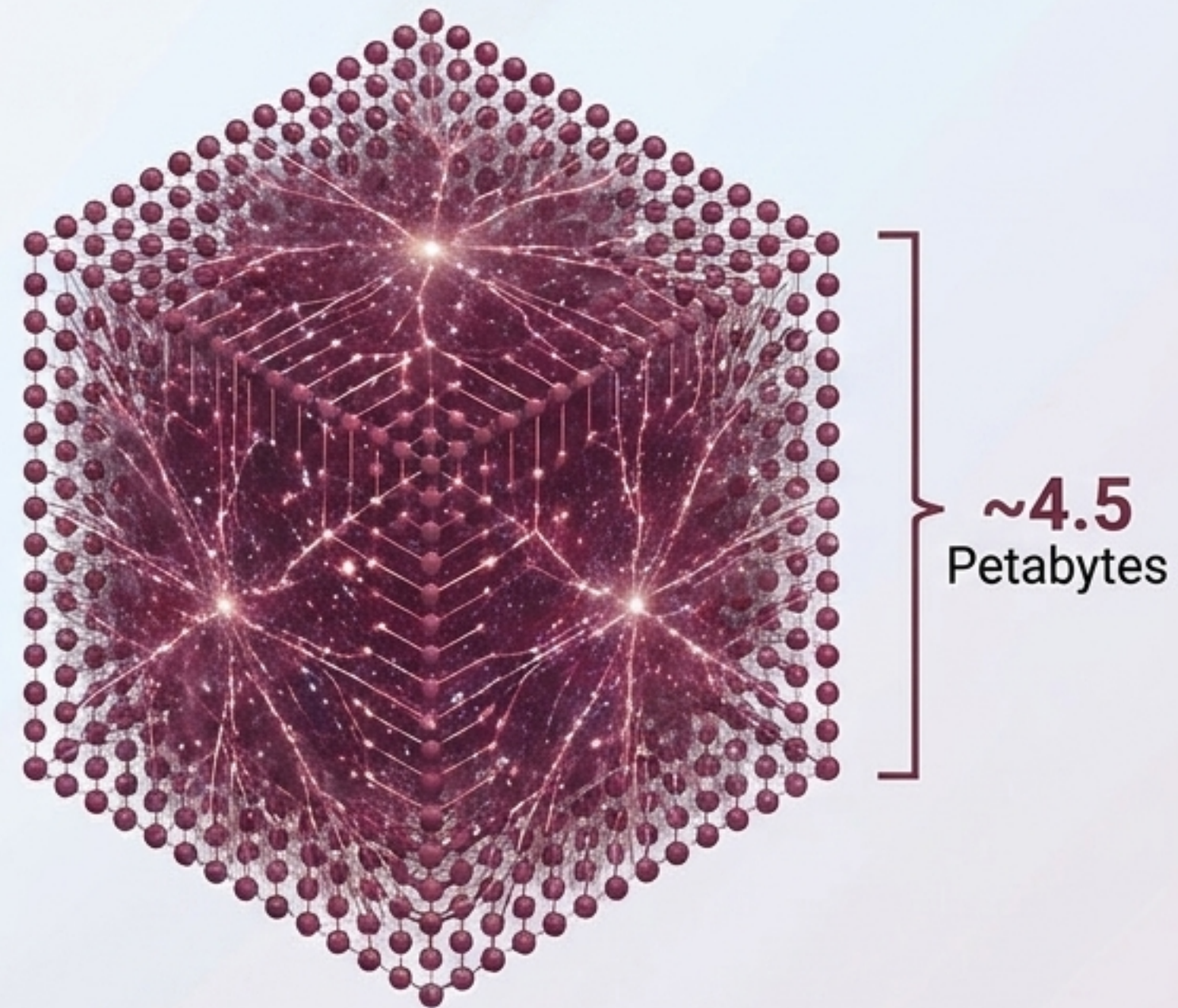


Is everything connected this way? No. Control tests on other complex natural systems reveal simple, steep fractal geometries. The brain and the cosmic web share a uniquely non-fractal architecture.

The Bounds of Memory



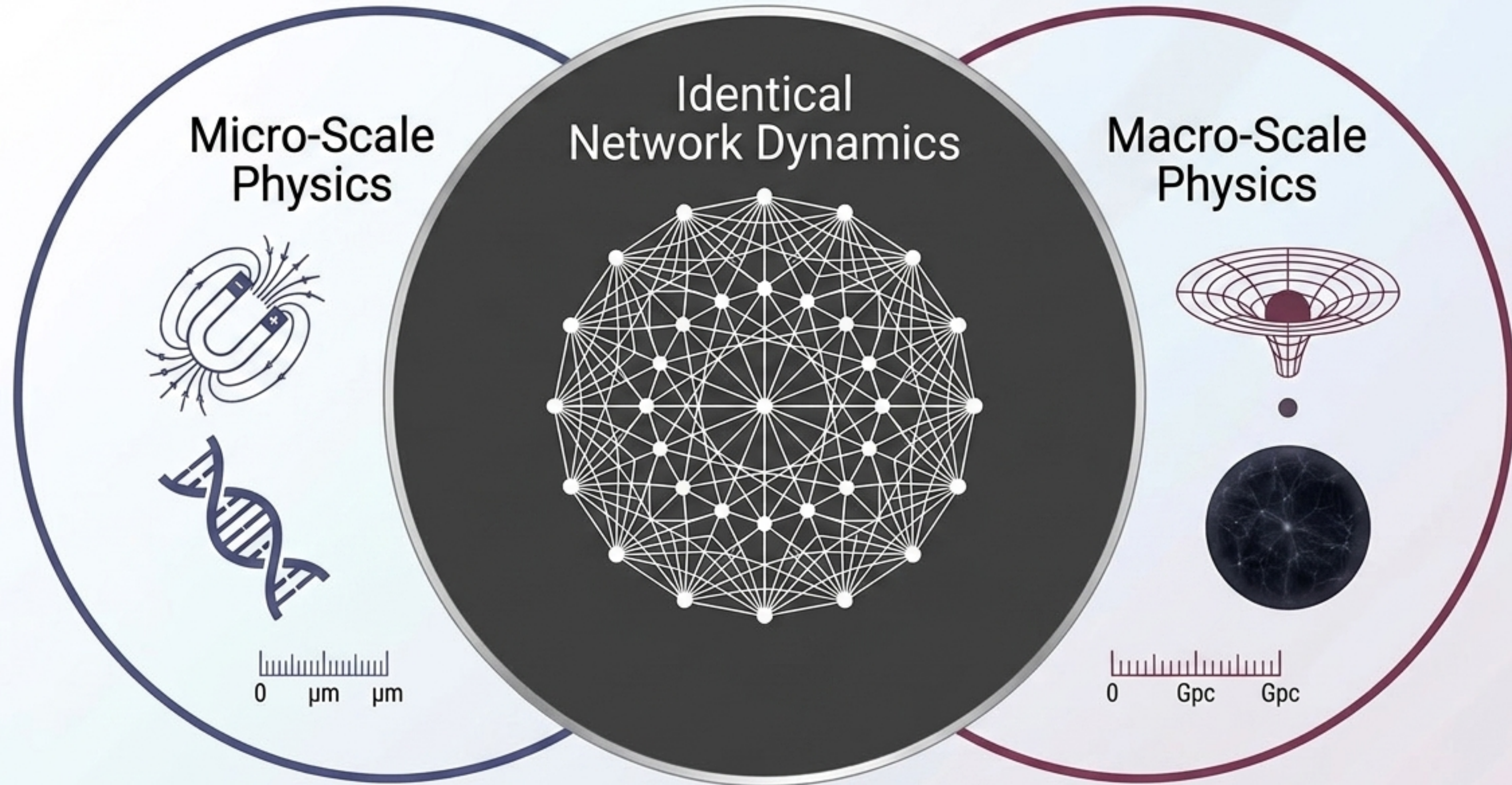
The total memory capacity of an adult human brain
(Derived from 4.7 bits per cell across 26 synaptic strengths).



The statistical complexity required to model
cosmic evolution over 13.8 Gigaparsecs.

The sum of an entire human life experience is mathematically scaled to roughly the exact same data volume required to store the evolutionary complexity of the observable universe.

Emergence



How can systems separated by 27 orders of magnitude be twins? The rules of complexity dictate structure regardless of the underlying physical substrate. Entirely different physical forces yield the exact same self-organizing architecture.

The Architecture of Reality



From the microscopic firing of a synapse to the macroscopic collision of galaxies, nature relies on a singular, optimal blueprint for processing information. We do not just live in the universe; the structure of the universe lives within us.