Solving the black hole information paradox

The black hole information paradox poses a dilemma for physicists. When a black hole evaporates, it destroys the information that’s fallen into it. Yet quantum theory says information cannot be destroyed. In his pursuit of innovative connotations of existing physical theories, independent researcher Dr Szymon Łukaszyk offers a solution to the black hole information paradox. His study reveals the concept of black hole binary potential and finds that dissipative structures, including living organisms, can be considered as spheres in nonequilibrium thermodynamic conditions.

Dr Szymon Łukaszyk, an independent researcher in Poland, offers a solution to the black hole information paradox. Instead of suggesting novel physical theories, he pursues innovative connotations of existing physics, specifically the theory of relativity.

BIG BANG THEORY

John Archibald Wheeler’s “bit from bit” argues that spacetime continuum doesn’t exist. Without this four-dimensional space, Łukaszyk advocates that nature should therefore be researched using a vertex-labelled graph of nature (a network of interrelated points with labels) with specific properties relating to the second laws of thermo- and info-dynamics. He describes how space and time did not exist before the primordial Big Bang singularity, when the first point emerged. This event generated a countably infinite number of other points and sparked the evolution of the graph of nature in various dimensionalities. These include real, negative, fractional, and imaginary dimensions, but four dimensions are distinct due to the Exotic ℜ⁴ property that is absent from other dimensionalities.

THE EXOTIC ℜ⁴ PROPERTY

The Exotic ℜ⁴ property of four-dimensional Euclidean space ensures the continuum of differentiable manifolds (topological spaces that are locally similar to Euclidean space near each point) that are shape preserving, or homeomorphic, but non-smooth, ie, not diffeomorphic, to the Euclidean space ℜ⁴. The lack of diffeomorphism lets biological evolution exploit the Exotic ℜ⁴ property with the perception of reality in four dimensions in the perceived world. These four dimensions, three real spatial and one imaginary time dimension, create models of perceived reality in observing individuals’ memories, and the material world emerges through a process of perception of living organisms. These models cannot be diffeomorphic as smooth memorised models would be the same for everyone and evolution would be impossible. The memorised models of reality are therefore distinct, so every human being is unique.

Different genetically determined characteristics, or traits, present different rates of reproduction and survival. It’s necessary for these traits to vary among individuals as they are passed from one generation to the next. Information is communicated as binary messages with time perceived only in the present. Moreover, both communication and perception need classical information (ie, bits not quibits). Therefore, the perceived space requires an integer dimensionality, leading Łukaszyk to believe that ‘life explains the measurement problem of quantum theory’.

BLACK HOLES

While a black hole can be depicted as a sphere, nothing can be said about its interior, which equates to it not having one. It follows that a black hole can only be defined by diameter and not radius, as shown in Figure 4. Hawking blackbody radiation is emitted from a black hole. This is only dependent on the black hole’s diameter (or its mass or temperature) and carries no other information. The holographic principle postulates that one bit of the information separating two regions on a holographic screen corresponds to a Planck area, whereas the black hole horizon forms a limiting one-sided holographic sphere. Jacob Bekenstein discovered that the black hole entropy is precisely one-quarter of the information capacity of a black hole.

Simplices generalise the notion of a triangle or tetrahedron to arbitrary dimensions. Considering the Euclidian space ℜⁿ in terms of a simplical n-manifold (when n = 2 it is triangulated) brings a natural topology from ℜⁿ. This approach unavails the metric-independent topological content from the metric-dependent geometric content of the modelled quantities. Planck areas on both holographic spheres and black hole horizons must therefore be triangular. All basic geometrical structures present in all complex dimensions, n-simplices, n-orthoplices, n-cubes, and n-balls, have bivalued volumes and surfaces that are additive inverses of each other, as shown in Figure 2.

ENTROPIC GRAVITY

Entropic gravity describes gravity as an entropic force. Erik Verlinde derived his entropic gravity formula using the variational potential, when a unit information on a black hole event horizon to be equal to the black hole gravitational potential of –c²/2. The number of active Planck triangles on a black hole horizon therefore equates to half of all the black hole triangles. Uncovering this concept of binary potential revealed that black hole horizons are patternless binary

Quantum theory says information cannot be destroyed or disappear, but black holes breach the time symmetry of physics.
messages that maximise Shannon entropy, as shown in Figure 3. This concurs with the experimentally verified no-hiding theorem and demonstrates that information is never lost.

**PYTHAGOREAN RELATIONSHIPS**

To find the smallest black hole that satisfies this theory, Łukaszyk assumes that the observable acceleration acting perpendicular to the holographic sphere is bounded by an unobservable acceleration, a tangent at a specified Planck area. He applied Pythagoras’ theorem with the hypotenuse corresponding to the Planck acceleration and revealed that the n-bit black hole, shown in Figure 6, with $a_B$ equivalent to the Planck length, is the smallest black hole that complies with this relation. This provides real values for the observable acceleration while the unobservable one vanishes. The energy of this black hole, $E = N \frac{\delta}{2} \sqrt{\frac{a_B}{2}}$, where $E$ and $T$ denote the black hole energy and temperature, $k_B$ is the Boltzmann constant relating temperature to energy, and $E_{\text{Planck}}$ is the Planck energy. An interesting observation is that while the information capacity of $n$ is required for black hole acceleration, precisely 4 bits are required for one unit of black hole entropy. This equation is an improvement on the equi-partition theorem for an atom in a monatomic ideal gas ($E = 3k_BT/2$). Moreover, this formula facilitates the discovery of the exact equations for both Unruh and Hawking temperature. Comparisons of Unruh temperature with Hawking temperature led to the introduction of a complementary time period together with its relationship to the classical time period, as shown in Figure 5. The researcher notes, however, that considering time is only significant for black holes with diameters greater than $\ell_{\text{Pl}}/2$, where $\ell_{\text{Pl}}$ is Planck length. Such a black hole has an information capacity of $2n$ (6 bits).

Perceived space requires an integer dimensionality, leading Łukaszyk to believe that ‘life explains the measurement problem of quantum theory’. Łukaszyk observes a similar Pythagorean relationship where observable velocity acts as a tangent to the holographic sphere and unobservable velocity acts perpendicular to a particular Planck area. Here, the speed of light corresponds to the hypotenuse. This unveils an unusual form of Lorentz contraction (shortening in the direction of motion relative to an observer) that doesn’t depend on time or velocity and implies that the observed reality is nonlocal, a well-known phenomenon of quantum theory.

**RESOLVING THE BLACK HOLE INFORMATION PARADOX**

Łukaszyk’s solution starts with two maximally entangled qubits, A and B. Qubit B is thrown into a black hole so in concurrence with the no-hiding theorem, all of the information contained in particle B is lost. The black hole horizon is a quantum system and the minimum time needed to transfer the black hole from one state to another is determined using the Margolus-Levitin theorem that establishes the fundamental limit of quantum computation. It cannot, however, stand in the role of an observer and its patternless event horizon destroys the entanglement of the qubits A and B. This doesn’t apply to a living organism’s observation of B on its holographic sphere of perception, as shown in Figure 1. This research has shown that an observer can be considered to be a sphere in nonequilibrium thermodynamic condition, so the information contained in qubit B can penetrate to the interior of the observer as one bit of classical information through a Planck area $\ell_{\text{Pl}}^2$ on a holographic sphere. A black hole has no interior, so this transfer of information is impossible. This study explores black hole quantum statistics, with energy level degeneracy, black holes with diameters greater than $\ell_{\text{Pl}}/2$, where $\ell_{\text{Pl}}$ is Planck length. Such a black hole has an information capacity of $2n$ (6 bits).


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**Personal Response**

What has been the most rewarding outcome of your research to date? The discovery of the fractional part of an equipotential sphere information capacity ($\delta^2$), where $\delta$ is the Planck length $\ell_{\text{Pl}}$, multiplier of its diameter $D = \delta^2$, means that there is a part of the equipotential sphere (a black hole horizon in the limiting case) that is smaller than the Planck area $\ell^2$ and thus is unable to carry a bit, the smallest possible amount of information that always contain a natural number of bits. This may allow for the notion of love to enter into the realm of physics. ‘If I have the gift of prophecy and can fathom all mysteries and all knowledge, and if I have a faith that can move mountains, but do not have love, I am nothing.’ [Saul of Tarsus, First Epistle to the Corinthians]