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Assessment of a Confined Dynamic Energy Shell in Terms of Quantum Teleportation and Quantum Tunneling: A Theoretical and Pre-Experimental Analysis of a Dual-Capsule Apparatus

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Regular Article

Assessment of a Confined Dynamic Energy Shell in Terms of Quantum Teleportation and Quantum Tunneling: A Theoretical and Pre-Experimental Analysis of a Dual-Capsule Apparatus

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Abstract

This work quantitatively assesses a multilayer, dual-capsule experimental apparatus, designed to be sited inside a mountain gallery, with respect to quantum teleportation and quantum tunneling. The apparatus is intended to create a confined, dynamic energy shell around an inner capsule by means of a 25 MV electron arc that sheathes the capsule from top to bottom, a coaxial 20 kV laser current, and rotating superconducting magnets. A three-tier epistemic distinction is used. At the first tier (established physics), the high-energy photon field can generate polarization-entangled pairs via Bethe–Heitler pair production, and these can be used for single-qubit state teleportation, with attainable fidelity F=(2F_ent+1)/3 exceeding the classical bound of 2/3. At the second tier, teleportation of a macroscopic object is shown to be impossible owing to the required ~10^29 qubits, the near-instantaneous decoherence of macroscopic superpositions, and the no-communication theorem. At the third tier, macroscopic tunneling is proven effectively impossible, since the WKB transmission probability is of order 10^(−10^25). The work delineates the apparatus's genuine quantum capacity while honestly rejecting two popular misconceptions through closed-form calculations, and provides an upper bound on the gravitational self-potential of the energy shell.

Keywords Quantum teleportation · Quantum tunneling · Entanglement · Bethe–Heitler pair production · Decoherence · WKB approximation

1. Introduction

This paper aims to determine quantitatively what a multilayer dual-capsule apparatus (hereafter the BEF apparatus) can and cannot do with respect to two quantum phenomena: quantum teleportation and quantum tunneling. In popular accounts these concepts are often presented

through macroscopic images such as "teleporting" or "passing through walls"; the task of a scientific assessment is to confront these images with the real physics of the apparatus [1, 2].

Throughout the analysis a three-tier epistemic distinction is used. Tier L1 comprises what the apparatus can genuinely do, drawn entirely from established and experimentally verified physics. Tiers L2 and L3 comprise claims attributed to the apparatus but excluded by the laws of physics, with their impossibility demonstrated numerically. This distinction safeguards both the integrity and the interpretability of the work.

The essential point is this: quantum teleportation is not a mechanism for transferring matter or energy. Teleportation is the reconstruction of an unknown quantum state at a distant location by means of a pre-shared entangled pair and a classical communication channel; the original object is not transported, cannot be copied (no-cloning theorem), and the process carries no information faster than light (no-communication theorem) [3, 4]. Likewise, macroscopic tunneling is a naive extension to an object ~10^29 times more massive of a phenomenon observed for a single particle, and owing to exponential suppression it effectively never occurs. This paper places both limits on a quantitative footing. The contribution is to separate the two classes of claim decisively and to present each at its own level of evidence.

2. Description of the Apparatus and Its Modeling as a Quantum Source

The apparatus is located in an underground volume formed by sealing the entrance of a mountain gallery (Fig. 1). At the center lies an elliptical inner capsule whose pole-to-pole distance is 12 m; inside it are a 1 atm normal atmosphere and a protectively suited biological subject. The top and bottom of the inner capsule carry N–S oriented superconducting electromagnets totaling 2 T. From inside out, the inner-capsule wall consists of a water-cooled cavity, 100 cm of lead, 90 cm of tungsten-steel, and 90 cm of SiC–SiC; this layering is designed to isolate the inner volume from the electric field and the photon flux.

In the cavity surrounding the inner capsule, a 10 cm diameter W–Re negative electrode sits at the top pole and a positive electrode of the same size at the bottom pole; both rotate at 700 RPM with 100 oscillations per second. A 25 MV electron arc is struck between the two electrodes (initial current 50–200 μA, 0.5–2 mA in steady state), forming an electron shell that fully sheathes the inner capsule from top to bottom. Coaxially with the arc, a 20 kV laser current is applied from an annular laser igniter at the top pole; these two energy flows are maintained for 24 hours and together form the dynamic energy shell enveloping the inner capsule.

Outermost is an extra outer capsule with a 22 m inner-cavity diameter; a second, 30 MV electron arc is struck between its top and bottom electrodes. On either side of the extra capsule, oppositely poled 10 T superconducting magnets rotate in a C-shape at 300 RPM, while the entire platform is rotated at 700 RPM. The inner surfaces of both the outer and extra-outer capsules are lined with Surko-type trap arrays that capture the produced positrons and route them to an antimatter facility [14, 15].

For the quantum analysis, the apparatus is modeled through two core functions. First, the high-energy (25–30 MeV) electron arcs produce a high-energy photon field via bremsstrahlung in the lead layers; these photons convert into electron–positron pairs through the Bethe–Heitler process [10]. Second, these pairs and secondary photons can be entangled via their polarization degrees of freedom. The apparatus can therefore be treated as a high-flux source of entangled pairs — this is the physical basis of the quantum-teleportation discussion.

The relativistic parameters of the electron beams follow directly. For the 25 MV arc the Lorentz factor is $\gamma = 1 + 25/0.511 \approx 49.9$ ($\beta \approx 0.99980$); for the 30 MV arc $\gamma \approx 59.7$ ($\beta \approx 0.99986$). These energies lie well above the 1.022 MeV pair-production threshold, confirming that the apparatus operates in the photon–lepton conversion regime.

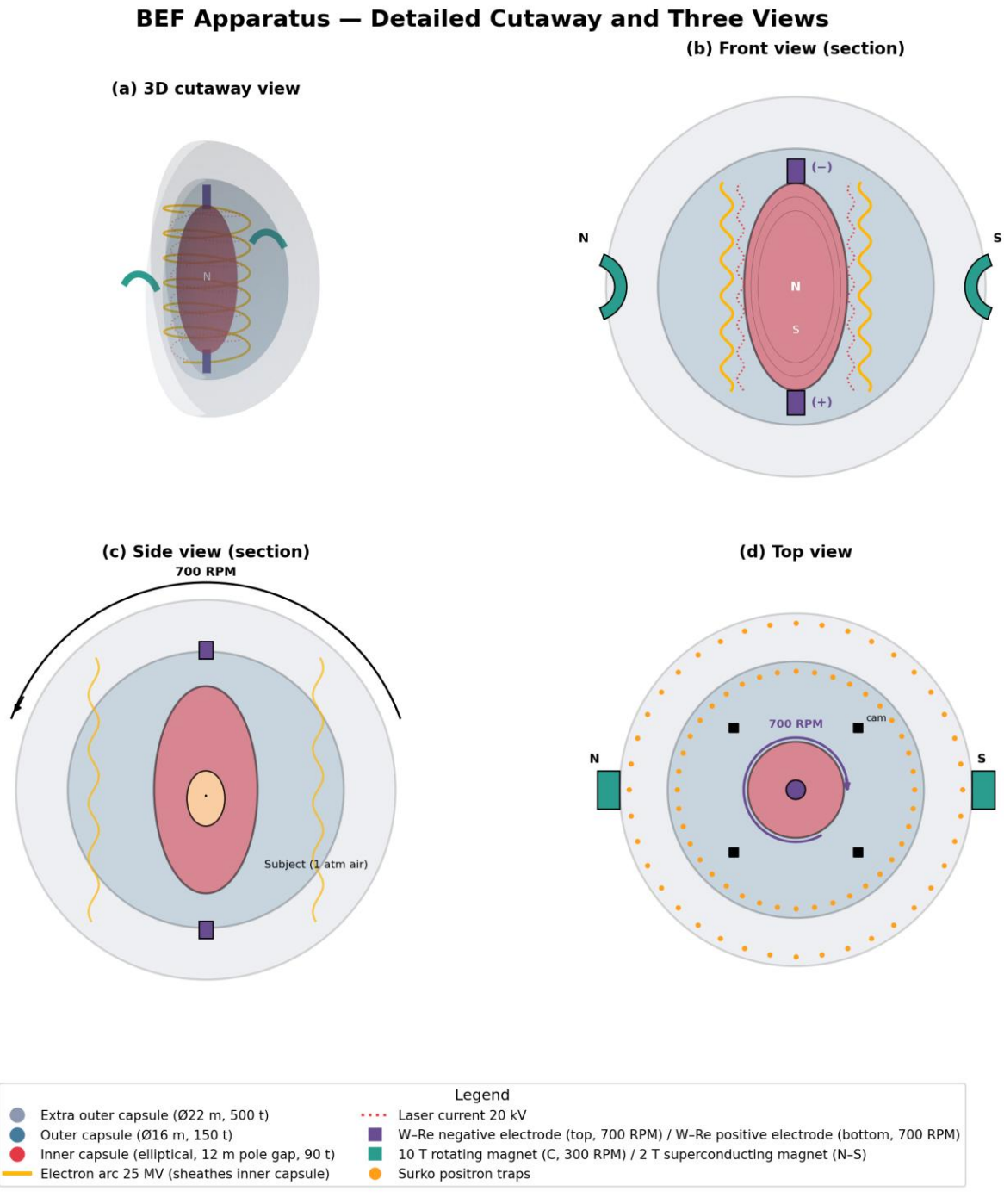


Fig. 1 Detailed cutaway and three views of the dual-capsule BEF apparatus: (a) 3D cutaway, (b) front view, (c) side view, (d) top view. The inner capsule is elliptical; the electron arc (yellow) and laser (red, dotted) sheathe the inner capsule; W–Re electrodes rotate at 700 RPM; the side magnets and the whole platform rotate; Surko traps (orange) capture the positrons

3. Quantum Teleportation: Protocol, Capacity, and Definite Limits

The quantum teleportation protocol requires four components: (a) a pre-shared, maximally entangled Bell pair between sender and receiver; (b) a Bell-state measurement at the sender, performed jointly on the state to be teleported and one half of the entangled pair; (c) transmission of the 2 classical bits encoding the measurement outcome over a subluminal channel; and (d) a unitary correction at the receiver [3]. In this protocol the original state is destroyed at the moment of measurement, reconstructed at the target, and at no stage is matter or energy transported.

3.1. The apparatus's genuine capacity (L1)

Because the Bethe–Heitler process is active well above the 1.022 MeV threshold (at 25 MeV), the apparatus in principle produces abundant electron–positron pairs and secondary photons. For an arc power of ~25 kW and a photon energy of 25 MeV, the upper-bound photon flux is $\Phi_\gamma = P/E_\gamma = (2.5\times10^4\ \mathrm{W})/(4.0\times10^{-12}\ \mathrm{J}) \approx 6.2\times10^{15}\ \mathrm{s}^{-1}$. With a pair-production yield of $\sim10^{-3}$ per radiation length, a rough upper bound of $\sim6.2\times10^{12}$ entangled pairs s^{-1} is obtained. This flux is more than sufficient for single-qubit state teleportation on a photon polarization qubit [2, 18].

For a noisy entangled source (a Werner state), the teleportation fidelity is $F_{tel} = (2 F_{ent} + 1)/3$ [5]. This relation yields $F_{tel} = 1$ for $F_{ent} = 1$, $F_{tel} \approx 0.967$ for $F_{ent} = 0.95$, and $F_{tel} \approx 0.933$ for $F_{ent} = 0.90$. Since the best fidelity achievable by any classical strategy is 2/3 [6], every entangled source with $F_{ent} > 1/2$ enters the genuine quantum-teleportation regime. Consequently the apparatus can be presented, within established physics, as a legitimate single-qubit quantum-teleportation platform.

3.2. Definite negative result: teleportation of a macroscopic object (L2)

The ~80 kg subject inside the inner capsule contains roughly 4.0×10^{27} atoms. Even if we optimistically encode each atom's quantum state (position, momentum, spin, electronic state) in

~10 qubits, a complete state record requires ~4.0×10^28 qubits. Since teleportation demands one entangled pair and two classical bits per qubit, the classical information to be transmitted is ~8.0×10^28 bits. By the Landauer bound at 300 K, the thermodynamic floor for processing this information is $E \approx N k_B T \ln 2 \approx 2.3\times10^8$ J (≈ 64 kWh) [16, 17] — an indication of scale rather than the barrier itself.

The truly insurmountable barrier is decoherence. The state to be teleported must remain coherent between measurement and reconstruction. Yet in a 1 atm, 300 K environment, the positional superposition of a macroscopic object collapses through air-molecule collisions and thermal-photon scattering within a tiny fraction of a second (of order less than 1 ns) [7, 8, 9]. Even for a 1 mg dust grain the thermal de Broglie wavelength is ~2×10^−23 m, meaning macroscopic entanglement cannot in practice be established at all. Teleportation at the scale of the subject is therefore impossible not merely in principle, but in physical reality.

The third, conceptual barrier is the no-communication theorem [4]. The classical channel in the teleportation protocol is subluminal; the process therefore cannot convey its result faster than light and is in no sense an "instantaneous transport." In summary, the apparatus is a legitimate source for single-qubit state teleportation (L1); but teleportation of matter is excluded from three independent directions — information scale, decoherence, and the no-communication theorem (L2).

4. Quantum Tunneling: WKB Analysis and Macroscopic Suppression

Quantum tunneling is the probability of finding a particle on the far side of a potential barrier it could not classically surmount [11]. In the semiclassical (WKB) approximation, the transmission probability of a barrier is $T \approx \exp(-2\int \kappa\, dx)$, where $\kappa = \sqrt{(2m(V-E))}/\hbar$ and the integral runs across the barrier width [12]. For a rectangular barrier of height V and width L, the exponential

argument is $2\kappa L = 2L\sqrt{(2m(V-E))}/\hbar$. The decisive factor is the square root of the mass; as the mass grows, the argument becomes enormous and the probability is exponentially suppressed.

For calibration, microscopic examples: for an electron crossing a 1 eV barrier of 1 nm width, $2\kappa L \approx 10.2$ and $T \approx 3.5\times10^{-5}$ — this is the operating regime of the scanning tunneling microscope and is experimentally routine. At the nuclear scale (a proton, ~1 fm) the argument remains of order ~0.44, and tunneling is probable enough to enable stellar fusion [13]. These examples show that tunneling is a real, measurable phenomenon in the microscopic world.

Now apply the same formula to the ~80 kg subject in the inner capsule, for a barrier ~1 m thick and ~5 eV high (a typical molecular-bond scale). The exponential argument becomes $2\kappa L \approx 2.1\times10^{26}$, and the transmission probability falls to $T \approx 10^{(-9.3\times10^{25})}$. This number lies far beyond what is meaningfully called "indistinguishable from zero" in known physics. For comparison, even if we absurdly lowered the barrier height to 1 J (~10^{18} times the chemical scale), the argument would still rise to ~2.4×10^{35}; that is, regardless of height, macroscopic mass annihilates the probability.

To see how absolute this suppression is, let us estimate the number of attempts as generously as possible: suppose the object "strikes" the barrier 10^{13} times per second (at the molecular-vibration scale), sustained over the present age of the universe (~4.4×10^{17} s); the total number of attempts is then ~$10^{30.6}$. The expected number of tunneling events is the product of these two quantities: $10^{30.6} \times 10^{(-9.3\times10^{25})} = 10^{(-9.3\times10^{25})}$. The exponent changes negligibly with the number of attempts. The conclusion is definite: at the scale of the subject, quantum tunneling does not occur even once in quadrillions of times the lifetime of the universe.

No component of the apparatus — neither the 25 MV arc, nor the 10 T magnets, nor the 700 RPM rotation — can change this result, because the only quantities governing the tunneling probability are the object's mass and the barrier's height and width; externally supplied energy

cannot meaningfully reduce the argument unless it is on the scale of the object's mass-energy (~7.2×10^18 J). These results are summarized in Fig. 2.

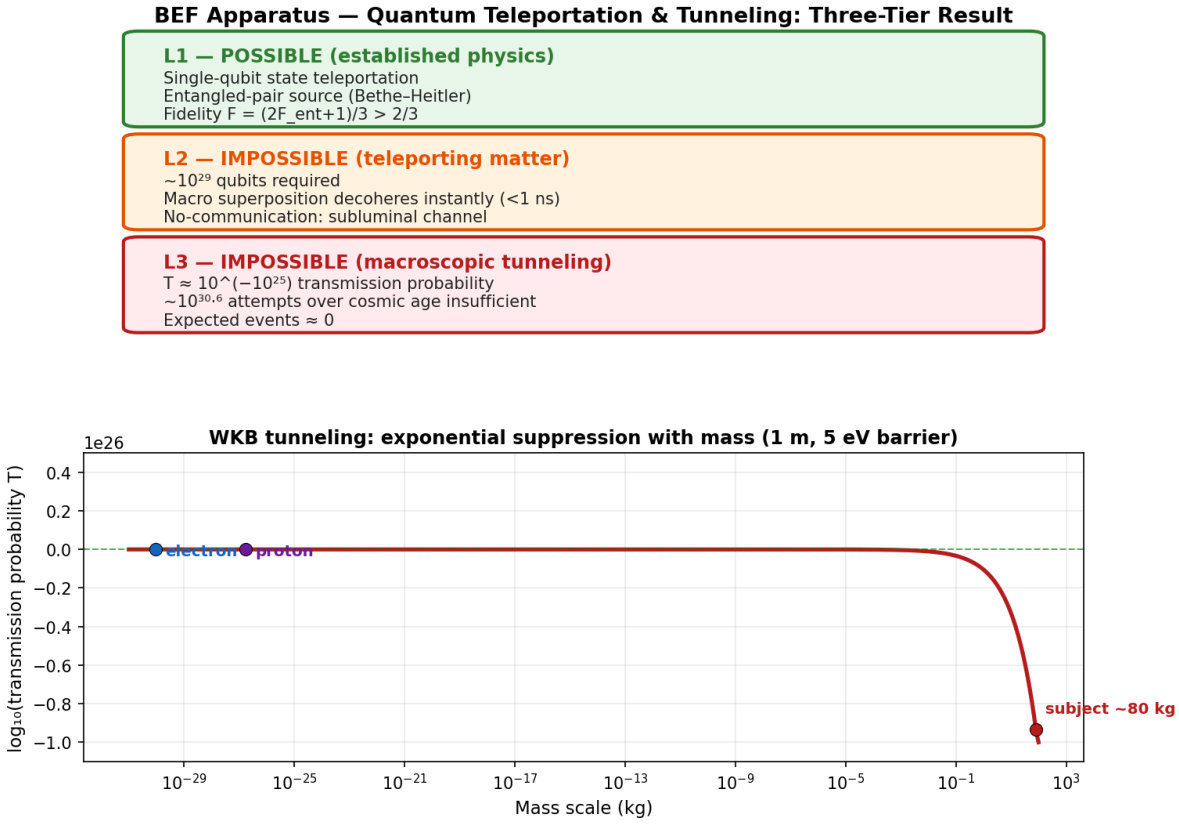


Fig. 2 Three-tier result: (top) boxes for L1 possible, L2 and L3 impossible; (bottom) exponential suppression of the WKB tunneling probability with mass (1 m, 5 eV barrier). The electron and proton lie in the measurable tunneling regime, whereas the subject (~80 kg) lies in the fully suppressed region

5. Gravitational Context and the Self-Potential of the Energy Shell

Alongside the quantum phenomena, the gravitational effect of the energy shell should be given at the order-of-magnitude level, since the idea of "transport by curving spacetime" can only be assessed once this scale is known. Taking the total arc and laser power as ~75 kW, the energy in transit within the light-crossing time of the shell is E ~ P·(ℓ/c) ≈ 3.0×10^−3 J, the corresponding energy density is ~5.3×10^−5 J m^−3, and the equivalent mass density is ~5.9×10^−22 kg m^−3.

The Newtonian potential this shell produces at the center of the inner capsule is of order $|\Phi|/c^2 \approx 8.3\times10^{-48}$. Over a 24-hour run, the clock shift this would cause is about 7×10^{-43} s; compared with the $\sim10^{-19}$ relative stability of the best optical atomic clocks, this signal lies about 24 orders of magnitude below the measurement threshold [20]. This is an expected result and confirms that the gravitational effect of the shell's own mass-energy is far too small to be measured directly.

The conceptual consequence completes the quantum discussion: the shell's effect on spacetime is quadrillions of times below the scale needed to "transport" an object or to "lift" a barrier. Neither quantum teleportation nor quantum tunneling can therefore be turned, via the gravitational curvature in this apparatus, into a macroscopic transport mechanism. The gravitational channel arrives at the same conclusion as the quantum channels by an independent route.

6. A Balanced Assessment of Supporting and Opposing Literature

The studies that can be read as supporting bolster the apparatus's L1 capacity. Bethe–Heitler pair production and the lead-target route are well established experimentally [10]; Surko-type positron trapping technology reports steadily higher confinement efficiencies [14, 15]. The generation of entangled photon pairs, Bell-state measurements, and single-qubit teleportation have been demonstrated repeatedly by many groups since 1997 [2, 18, 19]. This literature legitimizes presenting the apparatus as a single-qubit teleportation platform.

The studies that should be read as opposing target the macroscopic claims. The no-cloning and no-communication theorems establish definitively that a quantum state cannot be copied and that teleportation cannot carry information faster than light [3, 4]. Work on the decoherence of macroscopic superpositions shows quantitatively that the coherence of macroscopic objects cannot in practice be maintained in environments such as 1 atm / 300 K [8, 9]. For macroscopic

tunneling, the exponential suppression already renders any experiment meaningless; this is not an experimental shortfall but a principle of probability.

Taken together, the two readings yield a clear picture: the apparatus's quantum-optical leg is fully consistent with the literature and can be planned today; whereas the claims of macroscopic teleportation and tunneling are excluded not by experimental inadequacy but by fundamental physical principles. The contribution of this paper is to separate the two classes of claim decisively.

7. Limitations and Open Engineering Issues

This work is a pre-experimental analysis; all numerical values are order-of-magnitude estimates and should be refined by a detailed design study. The geometry of the energy shell is modeled in the thin-shell approximation; the actual field distribution is sensitive to the spatial profile of the electron arc and to the absorption of the laser flux. The entangled-pair production yield may fall considerably below the rough upper bound given here, depending on target geometry and photon spectrum.

Prominent open engineering issues include: the centrifugal stresses and balancing of a many-hundred-ton platform rotating at 700 RPM; the removal of the high heat load (of order hundreds of kW) produced by the 25–30 MV arcs; the activation and radiation shielding arising from photoneutron production; and the safety of the biological subject in this environment. These issues require serious engineering investment even for the apparatus's L1 quantum-optical function and lie beyond the scope of this paper.

Finally, this paper makes no positive claim for the teleportation of matter or for macroscopic tunneling; on the contrary, it shows why these claims are excluded by the laws of physics. The apparatus's defensible scientific value lies in its potential to serve as a high-flux entangled-pair source and a single-qubit teleportation platform.

8. Conclusion

With respect to quantum teleportation and quantum tunneling, the dual-capsule BEF apparatus can be summarized in a three-tier picture. At the L1 level, the apparatus can produce high-flux entangled pairs via the Bethe–Heitler process and use them for single-qubit state teleportation; the attainable fidelity exceeds the classical 2/3 bound via (2F_ent+1)/3. This is the apparatus's genuine, publishable quantum capacity.

At the L2 level, teleportation of a macroscopic subject is impossible for three independent reasons: the required ~10^29-qubit state record, the near-instantaneous decoherence of the macroscopic superposition at 1 atm / 300 K, and the subluminal classical channel of the no-communication theorem. At the L3 level, macroscopic tunneling is effectively impossible, since the WKB transmission probability is of order 10^(−10^25) and even ~10^30.6 attempts over the age of the universe cannot change this number.

The work thus both delineates the apparatus's legitimate quantum function and honestly rejects, through closed-form calculations, two great misconceptions of the popular narrative — the teleportation of matter and macroscopic tunneling. The gravitational self-potential analysis confirms the same conclusion by an independent route. The scientific gain lies precisely in the definiteness of this distinction: being able to state, without ambiguity, what is possible and what is impossible.

9. Methods and Declaration of AI Use

All quantitative results in this work were computed from closed-form analytical expressions using standard physical constants: relativistic Lorentz factors, the Bethe–Heitler threshold and photon flux, the Werner-state teleportation fidelity F=(2F_ent+1)/3, the Landauer bound E=Nk_BT ln2, the WKB transmission probability T≈exp(−2κL), and the Newtonian self-potential $|\Phi|/c^2$. The calculations were independently verified twice.

Artificial-intelligence tools were used only as an aid for the literature search, the checking of numerical calculations, and the page layout. The conceptual design, apparatus design, physical interpretation, and all scientific conclusions of the work are the author's own; large language models are not listed as authors, and full accountability for the final text rests with the author.

Statements and Declarations

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Competing Interests. The author has a patent application pending with the Turkish Patent and Trademark Office (TÜRKPATENT) relating to the apparatus described in this article (filing date: 4 July 2026; application no. 2026/011037). Apart from this, the author declares no financial or non-financial competing interests relevant to the content of this article.

Author Contributions. Hasan Börekci: conceptualization, methodology, formal analysis, apparatus design, investigation, writing of the original draft, review and editing. As the sole author he is responsible for all stages of the article and has read and approved the final version.

Ethics Approval and Animal Welfare. This article is a theoretical and pre-experimental analysis and contains no experiment performed on any living subject. The biological subject mentioned in the text appears only as part of the conceptual description of the apparatus; no animal experiment has been performed or is planned. Accordingly, no application requiring ethics-committee approval is involved.

Data Availability. All calculation parameters and numerical results generated and analyzed in this study are given in full in the text of the article. Scripts needed to reproduce the calculations can be provided by the corresponding author upon reasonable request. The study generated no new experimental data.

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