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# Three Novel Approaches to Deep Space: Interstellar Travel that Transcend the Limitations Imposed by the Rocket Equation

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## Abstract

At the time of writing this abstract, we read about Betelgeuse star has exploded in the last few days. While there are various explanations and interpretations on how that event would have impacted this Earth's inhabitants, our interpretation asserts that there are several chains of stars that act to lock this Earth to the 3D realm, and the exploded Betelgeuse star can be considered as a signal from heaven that we, all Earth inhabitants, are allowed to be elevated to 5D consciousness and to explore the Deep Space beyond this solar system. Therefore, in the present paper, it is considered three novel approaches to Deep Space / interstellar travel that transcend the limitations imposed by the Tsiolkovsky rocket equation. Among other things, we explore the possibility of utilizing macro quantum tunneling as an alternative propulsion method. By inducing a state of quantum coherence in a macroscopic object, it is theorized that it could tunnel through barriers, bypassing the need for conventional propulsion systems. Furthermore, we investigate the potential role of spin supercurrents in facilitating this process. The paper delves into the theoretical underpinnings of macroquantum tunneling and spin supercurrents, discussing the challenges and opportunities associated with their application to space travel.

**Keywords:**5D Consciousness; Betelgeuse Star; Macroquantum Tunneling; Alternative Propulsion Methods; Deep Space Travel.

## 1 | Limitations of Tsiolkovsky Equation

In the past decades, there has been growing interest in novel approaches beyond existing technologies, especially to explore the Deep Space and beyond [1-3]. In this regard, the Tsiolkovsky rocket equation, a cornerstone of astronautics, provides a fundamental relationship between a spacecraft's initial mass, final mass, exhaust velocity, and the change in velocity it can achieve. While this equation has been instrumental in numerous space missions, it also presents inherent limitations that hinder our ability to explore the vast expanse of the universe [1].

One significant limitation of the Tsiolkovsky equation is the requirement for carrying propellant. The more propellant a spacecraft carries, the heavier it becomes, necessitating even more propellant to accelerate that increased mass. This creates a feedback loop that limits the maximum achievable velocity. As a result, long-duration missions to distant destinations, such as Mars or beyond, become increasingly challenging and resource-intensive.

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Another constraint imposed by the Tsiolkovsky equation is the need for high exhaust velocities. To achieve significant changes in velocity, a spacecraft must expel propellant at very high speeds. This often necessitates the use of highly energetic propellants, which can be difficult to store, handle, and transport. Furthermore, the high temperatures and pressures associated with these propellants can introduce structural and safety concerns.

In addition to these limitations, the Tsiolkovsky equation does not account for external factors that can influence a spacecraft's trajectory. Gravitational fields from celestial bodies, atmospheric drag, and solar radiation pressure can all affect a spacecraft's velocity and trajectory, making it challenging to accurately predict and control its path.

To overcome these limitations and explore new frontiers of space exploration, it is imperative to develop alternative propulsion methods that transcend the constraints imposed by the Tsiolkovsky equation. This paper will delve into one such promising approach: macroquantum tunneling. By harnessing the principles of quantum mechanics, we may be able to develop propulsion systems that enable spacecraft to travel vast distances without the need for conventional propellants or high exhaust velocities.

# 2 | Results

## 2.1 | An Alternative to Tsiolkovsky Equation: Towards Macroquantum Tunneling/EPR Bridge

The Tsiolkovsky rocket equation, a cornerstone of astronautics, provides a fundamental relationship between a spacecraft's initial mass, final mass, exhaust velocity, and the change in velocity it can achieve. While this equation has been instrumental in numerous space missions, it also presents inherent limitations that hinder our ability to explore the vast expanse of the universe.

One promising avenue for overcoming these limitations lies in the realm of quantum mechanics. Specifically, the concept of **macro quantum tunneling** offers the intriguing possibility of bypassing the constraints imposed by the Tsiolkovsky equation. This phenomenon involves the quantum mechanical tunneling of a macroscopic object through a potential energy barrier.

To better understand the implications of macro quantum tunneling for space travel, it is instructive to recall the profound experiments conducted in laboratories involving **superfluids** and **superconductors**. These materials exhibit remarkable quantum properties at low temperatures, including the ability to flow without resistance and to exhibit macroscopic quantum coherence.

In superfluids, atoms can behave collectively as a single quantum entity, exhibiting phenomena such as quantization of circulation and superfluidity. These properties arise from the Bose-Einstein condensation of the atoms, which leads to a macroscopic wave function. In superconductors, electrons form Cooper pairs, which can also behave as a single quantum entity. This leads to the phenomenon of superconductivity, where electric current can flow without resistance.

The experiments conducted with superfluids and superconductors have demonstrated the possibility of observing macroscopic quantum phenomena in laboratory settings. These experiments have provided valuable insights into the behavior of quantum systems at the macroscopic scale and have laid the groundwork for exploring the potential applications of quantum mechanics in fields such as quantum computing and quantum communication.

One potential application of macroquantum tunneling is in the realm of space travel. By inducing a state of quantum coherence in a macroscopic object, it may be possible to cause it to tunnel through spacetime barriers, bypassing the need for conventional propulsion systems. This could enable spacecraft to travel vast distances without the constraints imposed by the Tsiolkovsky equation.

While the realization of macro quantum tunneling for space travel remains a challenging and speculative endeavor, the experiments conducted with superfluids and superconductors provide a foundation for exploring this possibility. By understanding the principles governing the behavior of quantum systems at the macroscopic scale, we may be able to develop novel propulsion technologies that could revolutionize space exploration.

#### 2.1.1 | Detecting Macroquantum Tunneling: Near-Field Physics and Spin Supercurrents

Following the aforementioned arguments concerning to possibility of macroquantum tunneling to be considered in the lab setting, we already discussed small-scale experiments; while our results are not quite convincing regarding traversability, what we reported concerns plausible quantum tunneling simulation for iced-water with simple measurement devices [4, 5].

More than that, the detection of macro quantum tunneling, the phenomenon where a macroscopic object tunnels through a potential energy barrier, presents a significant challenge due to its inherently quantum nature. However, recent advances in near-field physics and the study of spin supercurrents offer promising avenues for overcoming these obstacles [7].

#### 2.1.2 | Near-Field Physics

Near-field physics, which deals with the interaction of objects separated by distances on the nanometer scale, provides powerful tools for probing quantum phenomena. Techniques such as atomic force microscopy (AFM) and scanning tunneling microscopy (STM) can be used to measure the forces and currents acting between a probe tip and a sample surface with unprecedented sensitivity [6].

By using these techniques, researchers can potentially detect the presence of a macroscopic object that has tunneled through a barrier. For example, if a macroscopic object were to tunnel through a barrier and appear on the other side, it would likely perturb the local environment. This perturbation could be detected using near-field techniques, providing evidence of the tunneling event.

#### 2.1.3 | Spin Supercurrents

Another promising approach to detecting macroquantum tunneling involves the study of spin supercurrents, cf. our article at [6]. These are currents of spin-polarized electrons that can flow without resistance in certain materials, such as topological insulators. Spin supercurrents are highly sensitive to external magnetic fields and can be used to probe the quantum state of a system.

By coupling a macroscopic object to a spin supercurrent, researchers may be able to detect the effects of quantum tunneling. For example, if a macroscopic object were to tunnel through a barrier, it could alter the magnetic environment of the spin supercurrent. This change could be detected by measuring the properties of the spin supercurrent, providing evidence of the tunneling event.

#### 2.1.4 | Hartman Effect / Estimation of Tunneling Time

**Quantum tunneling**, a phenomenon where particles can penetrate through barriers that they classically shouldn't be able to, is a cornerstone of quantum mechanics. A particularly intriguing aspect of this phenomenon is the **Hartman effect**, which suggests that the tunneling time, the time it takes for a particle to traverse a potential barrier, is largely independent of the barrier's width. This seemingly counterintuitive observation has been a subject of much debate and experimentation in the quantum physics community.

#### 2.1.5 | The Experiment

To understand the Hartman effect, consider a simple experiment. A particle, such as an electron, is fired toward a potential barrier. Classically, the particle would need to have sufficient energy to "climb" over the barrier to reach the other side. However, in the quantum world, there's a finite probability that the particle will tunnel through the barrier, even if it doesn't have enough classical energy.

Early experiments found that the tunneling time seemed to be roughly the same, regardless of the barrier's width. This was surprising because one might expect that a wider barrier would require more time for the particle to traverse. The Hartman effect suggested that the particle was somehow "pre-existing" on the other side of the barrier and was simply "appearing" there without spending time within the barrier.

The Hartman effect has sparked considerable debate among physicists. Some argue that the effect is a genuine quantum phenomenon, reflecting the non-classical nature of tunneling. Others suggest that the apparent independence of tunneling time on barrier width is an artifact of the measurement process or a result of how tunneling time is defined.

One of the challenges in studying the Hartman effect is defining tunneling time itself. In classical physics, time is a well-defined quantity. However, in the quantum world, it's not always straightforward to measure the time it takes for a particle to traverse a barrier. Different methods of measuring tunneling time can yield different results, making it difficult to reach a definitive conclusion.

In the context of Josephson junctions, this would imply that the time it takes for Cooper pairs to tunnel across the junction is relatively constant, regardless of the junction's thickness.

### 2.1.6 | Using the OR Theorem

a. The OR theorem, a foundational result in quantum mechanics, can be utilized to provide a framework for analyzing tunneling times. While the exact details of applying the OR theorem to Josephson junctions might be complex, we can outline a general approach using Mathematica.

   Steps Involved:

   1. Define the Potential Barrier: We'll consider a simple rectangular potential barrier:
      - potential[x_] := Piecewise[{{0, x < 0}, {V, 0 <= x <= a}, {0, x > a}}]
   2. Set Up the Time-Dependent Schrödinger Equation: We'll use the time-dependent Schrödinger equation to describe the evolution of the wave function:
      - iℏ D[ψ[x, t], t] == -ℏ^2/(2m) D[ψ[x, t], {x, 2}] + potential[x] ψ[x, t]
   3. Specify Initial Wave Function: We'll use a Gaussian wave packet as the initial wave function
      - ψ[x, 0] := Exp[-(x - x0)^2/(2 σ^2)] Exp[I p0 x/ℏ]
   4. Apply the OR Theorem:
      - Implement the OR theorem to extract the tunneling time. This typically involves analyzing the probability amplitude for the system to be in a particular state after a certain time.
      - To calculate the tunneling time, we can track the center of the wave packet as it moves through the barrier. The time it takes to traverse the barrier can be considered the tunneling time.

Mathematica code (outline only):

```
Mathematica

(* Define parameters *)

ℏ = 1;

m = 1;

V = 10;

a = 5;

x0 = -10;
```

```
σ = 2;
p0 = 1;
(* Define the potential and initial wave function *)
potential[x_] := Piecewise[{{0, x < 0}, {V, 0 <= x <= a}, {0, x > a}}]
ψ[x, 0] := Exp[-(x - x0)^2/(2 σ^2)] Exp[I p0 x/ℏ]
(* Set up the time-dependent Schrödinger equation *)
eq = I ℏ D[ψ[x, t], t] == -ℏ^2/(2 m) D[ψ[x, t], {x, 2}] + potential[x] ψ[x, t];
(* Numerical solution (adjust parameters as needed) *)
sol = NDSolve[{eq, ψ[x, 0] == ψ[x, 0]}, ψ[x, t], {x, -20, 20}, {t, 0, 20},
        Method -> "MethodOfLines",
        "SpatialDiscretization" -> {"TensorProductGrid", "MinPoints" -> 200}]
(* Visualize the wave function evolution *)
Animate[Plot[Abs[ψ[x, t] /. sol]^2, {x, -20, 20}, PlotRange -> All], {t, 0, 20}]
(* Calculate tunneling time (approximate method) *)
(* ... (Track the wave packet's center and measure the time it takes to traverse the barrier) ... *)
```

b. Provided we are allowed to hypothesize that the aether medium is composed of quasicrystalline tessellation [11, 12] or something like the crystalline phase of iced water as we discussed previously, we may consider an alternative way to come up with a Hartman tunneling time estimate.

The concept of an aether medium, once prevalent in physics, has largely been superseded by the theory of relativity. However, for this hypothetical exercise, let's assume that the aether is composed of a quasicrystalline tessellation.

### 2.1.7 | Challenges in Modeling a Quasicrystalline Aether

While Mathematica is a powerful tool for numerical simulations and symbolic calculations, modeling a quasicrystalline aether within the framework of quantum mechanics presents several challenges:

1. Quasicrystalline Structure: Quasicrystals have unique properties, such as aperiodic order and rotational symmetry without translational symmetry. Incorporating these features into a quantum mechanical model requires specialized techniques.
2. Define the Quasicrystalline Potential:

   potential[x_] := V0 (1 + Cos[2 π x/λ1] + Cos[2 π x/λ2]),

   where V0 is the potential amplitude, and λ1 and λ2 are incommensurate periods, creating a quasicrystalline structure.
3. Set Up the Time-Dependent Schrödinger Equation:

   This remains the same as in the previous

   iℏ D[ψ[x, t], t] == -ℏ^2/(2m) D[ψ[x, t], {x, 2}] + potential[x] ψ[x, t]
4. Specify Initial Wave Function:

   ψ[x, 0] := Exp[-(x - x0)^2/(2 σ^2)] Exp[I p0 x/ℏ]

5. Interaction with Matter: Defining how a quasicrystalline aether would interact with matter, particularly in the context of a Josephson junction, is a complex task. The nature of the interaction could significantly influence the tunneling behavior.

6. Quantum Mechanical Formulation: Translating the concept of a quasicrystalline aether into a quantum mechanical formalism might require new theoretical frameworks or modifications to existing ones.

### 2.1.8 | Mathematica Code (outline only)

(* Define parameters *) ℏ = 1; m = 1; V0 = 10; λ1 = √2; λ2 = √3; x0 = -10; σ = 2; p0 = 1; (* Define the quasicrystalline potential *) potential[x_] := V0 (1 + Cos[2 π x/λ1] + Cos[2 π x/λ2]) (* Set up the time-dependent Schrödinger equation *) eq = I ℏ D[ψ[x, t], t] == -ℏ^2/(2m) D[ψ[x, t], {x, 2}] + potential[x] ψ[x, t]; (* Numerical solution (adjust parameters as needed) *) sol = NDSolve[{eq, ψ[x, 0] == ψ[x, 0]}, ψ[x, t], {x, -20, 20}, {t, 0, 20}, Method -> "MethodOfLines", "SpatialDiscretization" -> {"TensorProductGrid", "MinPoints" -> 200}] (* Visualize the wave function evolution *) Animate[Plot[Abs[ψ[x, t] /. sol]^2, {x, -20, 20}, PlotRange -> All], {t, 0, 20}] (* Calculate tunneling time (approximate method) *) (* ... (Track the wave packet's center and measure the time it takes to traverse the barrier) ... *).

### 2.1.9 | Considerations and Further Exploration

- Quasicrystal Structure: The specific choice of incommensurate periods will significantly impact the tunneling behavior. Experiment with different values to observe varying effects.
- Aether Medium: While the concept of an aether medium is a subject of debate, modeling the medium as a quasicrystalline structure can provide insights into potential quantum effects.
- Quantum Field Theory: For a more rigorous treatment, consider using quantum field theory to describe the interaction between particles and the quasicrystalline medium.
- Numerical Techniques: The accuracy of the simulation depends on the numerical method used. Experiment with different methods (e.g., finite difference, finite element, spectral methods) to optimize performance.

By simulating the Hartman effect in a quasicrystalline aether medium, we can gain a deeper understanding of quantum tunneling and explore the potential implications for advanced technologies and fundamental physics.

Note:

While this hypothetical code provides a starting point, it's important to emphasize that modeling the interaction between a quasicrystalline aether and a Josephson junction within a quantum mechanical framework is a complex and challenging problem. Significant theoretical and computational advancements would be required to develop a realistic and accurate model.

## 2.2 | Another Alternative Method to Deep Space Travel with Non-orientable Wormhole / Tunneling

While traditional wormhole theories often involve complex mathematical models and exotic matter, recent research has explored a more tangible approach: the manipulation of physical structures to induce wormhole-like effects.

A Möbius strip, a simple geometric object with only one side and one edge, offers a fascinating analogy for understanding non-orientable spacetime. By twisting a strip of paper and connecting its ends, one creates a surface that defies conventional notions of orientation.

### 2.2.1 | Crystal-Induced Wormholes: A Laboratory Experiment

Researchers Hayashi and Ebisawa have proposed a groundbreaking hypothesis: that certain crystals, under specific conditions, could exhibit properties akin to a Möbius strip at the quantum level. By carefully manipulating the crystal's structure and applying external stimuli, it may be possible to induce a localized curvature of spacetime, creating a microscopic wormhole [4-5, 13, 14].

### 2.2.2 | Superconductors: A Quantum Bridge

Superconductors, materials that exhibit zero electrical resistance at low temperatures, offer another intriguing avenue for wormhole research. These materials can facilitate quantum tunneling, a phenomenon where particles can seemingly pass through barriers. By harnessing the unique properties of superconductors, scientists may be able to manipulate spacetime on a macroscopic scale, potentially opening up wormhole-like passages.

### 2.2.3 | Challenges and Future Directions

While the prospect of wormhole travel is undeniably exciting, significant challenges remain:

- **Energy Requirements:** Generating and maintaining a stable wormhole would require immense amounts of energy, far beyond our current technological capabilities.
- **Exotic Matter:** The existence of exotic matter, a fundamental component of many wormhole theories, is still uncertain.
- **Control and Stability:** Controlling and stabilizing a wormhole would be a complex task, requiring precise manipulation of spacetime.

Despite these hurdles, continued research into crystal-induced and superconductor-mediated wormholes could revolutionize our understanding of the universe and pave the way for interstellar travel. By pushing the boundaries of physics and materials science, we may one day unlock the secrets of the cosmos and embark on journeys to distant star systems.

## 2.3 | Utilizing Similarity between Brain Neurons and Galaxy Clusters

The universe, with its intricate network of galaxies, stars, etc., has long captivated human imagination. As we delve deeper into the cosmos, we encounter questions about its origins, evolution, and potential for future exploration. Recent research has revealed intriguing parallels between the structure of the universe and the human brain, suggesting that these two complex systems may share fundamental principles [16, 17].

Both the cosmic web and the human brain are characterized by complex networks of interconnected nodes. In the brain, neurons form intricate neural networks that enable cognitive functions, while in the cosmos, galaxies cluster together, forming vast cosmic structures.

- **Scale-Invariant Structures:** One striking similarity between these two systems is their scale-invariant nature. From the microscopic level of neurons to the cosmic scale of galaxy clusters, both exhibit fractal patterns, meaning that similar structures can be observed at different scales.
- **Quantum Effects:** Quantum mechanics, the physics of the very small, plays a crucial role in both systems. Quantum entanglement, for instance, allows particles to remain connected across vast distances, potentially influencing the behavior of both neurons and galaxies.

### 2.3.1 | Harnessing the Cosmic Neural Quantum Effect

If we can harness the quantum effects that underlie the cosmic web, we may unlock new possibilities for deep space travel. By studying the way galaxies interact and communicate with each other, we may be able to develop novel propulsion systems or navigation techniques.

One potential application is the development of a "cosmic GPS" that utilizes the quantum entanglement of galaxies to precisely determine spacecraft positions. By measuring the quantum correlations between distant galaxies, we could create a highly accurate navigation system that would allow us to explore the universe with unprecedented precision.

Another intriguing possibility is the development of a "warp drive" that could exploit the curvature of spacetime to travel faster than the speed of light. By studying the way galaxies warp spacetime, we may be able to identify ways to manipulate this curvature to our advantage.

### 2.3.2 | Challenges and Future Directions

While the idea of harnessing the cosmic neural quantum effect is still in its infancy, it represents a fascinating new frontier in scientific exploration. However, several challenges must be overcome before we can realize its full potential.

- **Technological Limitations:** Our current technology is not advanced enough to directly manipulate the quantum properties of the universe.
- **Theoretical Understanding:** We still have much to learn about the fundamental nature of quantum mechanics and its role in cosmic structures.

Despite these challenges, the potential rewards of this research are immense. By understanding the deep connections between the human brain and the cosmos, we may unlock the secrets of the universe and pave the way for a future of interstellar exploration.

### 2.3.3 | Harnessing the Cosmic Neural Quantum Effect

While the prospect of wormhole travel is undeniably exciting, significant challenges remain:

# 3 | Discussion

Despite these promising approaches, detecting macroquantum tunneling remains a formidable challenge. The low probability of tunneling events, combined with the difficulty of controlling macroscopic objects at the quantum level, make direct observation difficult. However, by combining near-field physics, spin supercurrents, and other advanced techniques, researchers may be able to develop new methods for detecting and studying this elusive phenomenon.

Future research in this area will likely focus on developing more sensitive and precise measurement techniques, as well as exploring new materials and systems that may be more conducive to observing macro quantum tunneling. By addressing these challenges, scientists may be able to unlock the potential of this fascinating quantum phenomenon and pave the way for new applications in fields such as quantum computing and materials science.

One quite fascinating thing about the macro quantum tunneling effect is that Hartman tunneling time will not vary much especially for the large thickness of the barrier, and even if we consider macro quantum tunneling in the context of the ER=EPR bridge hypothesis, it probably would not involve too much time to pass the barrier to the edge of the EPR bridge (at least hypothetically). We discuss Hartman tunneling time in the following section.

As with the challenge to scale up from lab experiments on low-temperature wormhole tunneling to prototype scale, allow us to suggest that Salvatore Pais's patent with the title Piezoelectricity-induced high-temperature superconductor, perhaps can be used as a guideline to develop prototype-scale high-temperature superconductor for that purpose [15].

With regards to exploring the possibility of non-orientable wormhole tunneling via crystals or superconductors, we admit there are certain great hurdles. Nonetheless, continued research into crystal-induced and superconductor-mediated wormholes could revolutionize our understanding of the universe and pave the way for interstellar travel. By pushing the boundaries of physics and materials science, we may one day unlock the secrets of the cosmos and embark on journeys to distant star systems.

## 4 | Concluding Remark

We have discussed in the present article, among other things that there is growing interest in novel approaches beyond existing technologies, especially in exploring the Deep Space and beyond [1-3]. In this regard, the Tsiolkovsky rocket equation, a cornerstone of astronautics, provides a fundamental relationship between a spacecraft's initial mass, final mass, exhaust velocity, and the change in velocity it can achieve. While this equation has been instrumental in numerous space missions, it also presents inherent limitations that hinder our ability to explore the vast expanse of the universe [1].

We also discussed the possible advantage of utilizing the macro quantum tunneling effect for instance what is known as the Josephson junction, which can be considered a phenomenon well-observed in lab settings, including in various low-temperature physics of superfluid and superconductor.

One interesting feature is called the Hartman effect, a known fact that Hartman tunneling time will not vary much especially for large thickness of barrier, and even if we consider macroquantum tunneling in the context of the ER=EPR bridge hypothesis, it probably would not involve too much time to pass the barrier to the edge of the EPR bridge (at least hypothetically).

Provided we are allowed to hypothesize that the aether medium is composed of quasicrystalline tessellation [11, 12] or something like the crystalline phase of iced water as we discussed previously, we may consider an alternative way to come up with Hartman tunneling time estimation, as well as in the usual time by defining quantum operator of time. [9, 10].

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## Data Availability

The datasets generated during and/or analyzed during the current study are not publicly available due to the privacy-preserving nature of the data but are available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declare that there is no conflict of interest in the research.

## Ethical Approval

This article does not contain any studies with human participants or animals performed by any of the authors.

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