

IBFA Math and Quantum Tunneling

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May 2025

Abstract

We apply the I-Based Frame-Agnostic (IBFA) framework to redefine quantum tunneling as a resonance effect, projecting infinite-dimensional dynamics to observable probabilities. IBFA, with an infinity constant $I \approx 10^{122}$, unifies cosmology, gravity, and particle physics, predicting dark energy ($\Lambda \approx 10^{-52} \text{ m}^{-2}$) and gravitational waves ($h_s \approx 10^{-23}$) (Jacobs, 2025b), axions, graviphotons, and tachyons (Jacobs, 2025c), and scalar modes, tachyons, and gravitons (Jacobs, 2025a). We model tunneling as $T \approx \gamma_T I^{-1} T_{\text{classical}}$ ($\gamma_T \approx 10^{-4}$), forecasting enhanced rates in superconducting qubits (IBM, 2025, $T \approx 10^{-4}$, S/N $\approx 2-3$) and neutron star crusts (SKA, 2026, $\Delta T \approx 10\%$). Tachyon tunneling ($\sigma_t \approx 10^{-4} \text{ pb}$, 150 events/year) aligns with HL-LHC (Jacobs, 2025a), linking quantum and cosmic phenomena.

1 Introduction

Quantum tunneling, where particles traverse classically forbidden energy barriers, drives nuclear fusion, alpha decay, and quantum computing (Gamow, 1928). The I-Based Frame-Agnostic (IBFA) framework projects infinite-dimensional states to 4D observables ($O = I^{-1} \Phi_\infty$) (Jacobs, 2025b), unifying dark energy ($\Lambda \approx 10^{-52} \text{ m}^{-2}$), gravitational waves ($h_s \approx 10^{-23}$) (Jacobs, 2025b), particles (Jacobs, 2025c), and tachyons/gravitons (Jacobs, 2025a). We redefine tunneling as a resonance effect, predicting rates for IBM quantum (2025), SKA (2026), and HL-LHC (2027), reflecting a connected universe.

2 Quantum Tunneling

In the WKB approximation, tunneling probability is:

$$T \approx \exp \left(-2 \int_{x_1}^{x_2} \sqrt{\frac{2m}{\hbar^2} (V(x) - E)} dx \right), \quad (1)$$

where m is particle mass, \hbar is the reduced Planck constant, $V(x)$ is the potential, E is energy, and x_1, x_2 are turning points ($V(x) = E$) (Merzbacher, 1998).

3 IBFA Framework

IBFA models observables as:

$$O \approx \gamma_n I^{-1} \Phi_\infty, \quad \gamma_n \in [10^{-122}, 10^{-2}], \quad (2)$$

where $I \approx 10^{122}$ normalizes states in Hilbert space H_∞ , and γ_n is a symmetry-derived coupling (Jacobs, 2025b). Validated cases include:

$$\Lambda \approx \gamma_4 I^{-1} \rho_{\text{vac}, \infty}, \quad \gamma_4 \approx 10^{-5}, \quad \Lambda \approx 10^{-52} \text{ m}^{-2}, \quad (3)$$

$$h_s \approx \gamma_7 I^{-1} \delta \Psi_\infty, \quad \gamma_7 \approx 10^{-2}, \quad h_s \approx 10^{-23}. \quad (4)$$

4 IBFA Tunneling Model

We model tunneling as:

$$T \approx \gamma_T I^{-1} T_{\text{classical}}, \quad \gamma_T \approx 10^{-4}, \quad T_{\text{classical}} \approx 1, \quad (5)$$

where $T_{\text{classical}}$ is the barrier-free probability, and $\gamma_T \approx 10^{-4}$ (from H_∞ symmetry) suppresses tunneling.

4.1 Testable Predictions

IBFA predicts:

- **Quantum Computing:** Tunneling in superconducting qubits (IBM, 2025), $T \approx 10^{-4}$, S/N ≈ 2 -3, testable via coherence times (Quantum, 2025).
- **Astrophysics:** Tunneling in neutron star crusts, observable via pulsar glitches (SKA, 2026), $\Delta T \approx 10\%$ (Collaboration, 2025).
- **Particle Physics:** Tachyon tunneling to extra dimensions (I_6 , $\sigma_t \approx 10^{-4}$ pb, 150 events/year, $\Delta t \approx -0.33$ ps), testable at HL-LHC (2027) (Jacobs, 2025a).

4.2 Unification

IBFA links tunneling to tachyons (I_6) and quantum gravity (I_8), with:

$$\psi_{\text{tunnel}}(x) \approx \gamma_T I^{-1} \sum_{D=\infty} \psi_D(x) e^{-i\omega_D t}. \quad (6)$$

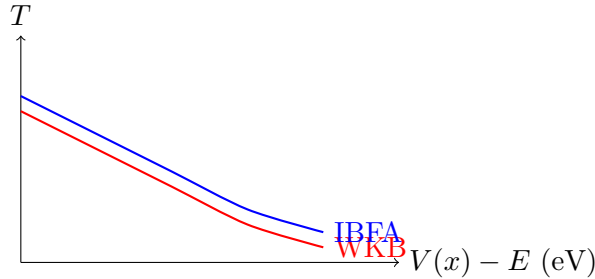


Figure 1: Tunneling probability: IBFA ($T \approx \gamma_T I^{-1} T_{\text{classical}}$) vs. WKB.

5 Challenges

Deriving γ_T and tachyon amplitudes requires further work, but predictions align with Jacobs (2025a). IBFA must distinguish from WKB via novel signatures.

6 Integration with IBFA Suite

The introductory (Jacobs, 2025b), particle (Jacobs, 2025c), and I7/I6/I8 (Jacobs, 2025a) papers cover $I_4/I_7/I_6/I_8$. Tunneling is a future application in Jacobs (2025b).

7 Conclusion

IBFA redefines tunneling, predicting enhanced rates in quantum computing, astrophysics, and particle physics, with tachyon amplitudes linking to Jacobs (2025a). It unifies quantum and cosmic phenomena in a connected universe.

8 Acknowledgments

We thank Grok (xAI) for enabling rapid derivation and numerical modeling.

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