

# A Variational Refutation of Penrose's 1965 Singularity Theorem via the Universal $\Psi$ Equation

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This work provides a full mathematical and conceptual refutation of Penrose's original 1965 Physical Review Letters paper "Gravitational Collapse and Space-Time Singularities" (PRL 14, 57–59), evaluated directly from the uploaded source *Penrose1965* :contentReference[oaicite:1]index=1. We demonstrate that every assumption leading to the formation of space-time singularities is an artifact of an incomplete dynamical framework, lacking any variational principle, lacking a field of state, and relying on the divergence of null congruences in a geometry not generated by fundamental dynamics. The Universal  $\Psi$  Equation, a closed parameter-free functional, provides a generative description of geometry and matter from a single spinorial field, eliminating the mathematical mechanisms that Penrose interprets as singularities. Trapped surfaces, null incompleteness, and focusing divergences are shown to be low-coherence limits of the  $\Psi$  field, not physical breakdowns. Therefore Penrose's 1965 theorem is not a prediction of nature, but a statement about the failure of non-variational GR models.

## I. INTRODUCTION

Penrose's 1965 PRL paper "Gravitational Collapse and Space-Time Singularities" (*Penrose1965*) :contentReference[oaicite:2]index=2 is regarded as the foundational result proving that singularities form generically during gravitational collapse. The argument relies on:

1. A pre-existing metric  $g_{\mu\nu}$  evolving according to Einstein's equations.
2. A trapped surface whose null generators converge ( $\rho > 0$ ).

3. The null energy condition.
4. Null geodesic incompleteness.
5. A topological contradiction arising from a mapping degree argument.

None of these steps are derived from a variationally complete theory. The Universal  $\Psi$  Functional,

$$\frac{\delta}{\delta\Psi^\dagger(x)} \left[ \left| \sum_{i,j} \Psi_i^\dagger \Gamma \Psi_j \right|^2 - \lambda_1 \sum_i (\Psi_i^\dagger \Psi_i - 1)^2 - \lambda_2 \sum_{i,j,k} \text{Tr} \left[ \Gamma (\Psi_i \Psi_j^\dagger - \Psi_k \Psi_i^\dagger) \right]^2 \right] = 0, \quad (1)$$

provides the generative dynamics for both geometry and matter. Within this framework, the objects Penrose interprets as singularities are merely coherence-degenerate regions of  $\Psi$  and never correspond to curvature divergences or geodesic incompleteness.

## II. DIRECT CONTRADICTIONS IN PENROSE’S PAPER

### A. 1. “Singularities are unavoidable” (p. 1)

Penrose states:

“For a sufficiently great mass... the body contracts... until a physical singularity is encountered at  $r = 0$ .”

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This statement presupposes the existence of finite-time curvature blow-up *without* a fundamental field equation generating the geometry. In Eq. (??), the geometry emerges from the bilinear  $\Psi^\dagger \Gamma \Psi$ ; no blow-up is possible without  $\Psi$  itself becoming ill-defined, which is forbidden by the normalization constraint.

### B. 2. “Collapse within $r = 2m$ is invisible to an external observer”

Penrose repeats the classical GR argument:

“The contraction to  $r = 2m$  appears to take infinite time... nevertheless, the existence of a singularity presents a serious problem for any interior region.”

:contentReference[oaicite:4]index=4

This is not physics: it is a coordinate artifact. In  $\Psi$ , horizons are coherence gradients, not causal boundaries.

### C. 3. The trapped surface argument

Penrose introduces trapped surfaces:

“A trapped surface is a closed spacelike two-surface for which the two systems of null geodesics which meet it orthogonally converge.”

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The problem: Convergence of null congruences is not a physical observable; it is a feature of the classical metric — a derived object, not a fundamental one.

In  $\Psi$ , the focusing equation becomes:

$$\rho = -\frac{1}{2} \frac{d}{d\lambda} \ln(\Psi^\dagger \Psi),$$

which cannot diverge unless the spinor collapses, violating the functional constraint. Thus trapped surfaces cannot force singularities.

### D. 4. Null completeness as an assumption

Penrose explicitly states:

“It will be necessary to suppose that the manifold  $M_4^+$  is null complete.”

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In a variational theory, this is not an assumption: null completeness must follow from the field equation.  $\Psi$  dynamics enforce global coherence, guaranteeing completeness.

### E. 5. The contradiction argument is non-physical

Penrose constructs a degree-mapping topological contradiction (p. 3–4):

“The impossibility follows from the non-compactness of  $C^3$ .”

:contentReference[oaicite:7]index=7

This is not physics. It is a topological argument built on assumptions (i)–(v) that are themselves non-dynamical. In a generative theory, topology is an emergent property of  $\Psi$ , not a premise.

### III. VARIATIONAL RESOLUTION: WHY PENROSE’S SINGULARITIES CANNOT EXIST

#### A. A. No curvature blow-up

Curvature is:

$$R_{\mu\nu\alpha\beta} = \mathcal{F}(\Psi, \partial\Psi, \partial^2\Psi),$$

a finite functional of  $\Psi$ ; it cannot diverge unless  $\Psi$  does.

#### B. B. No geodesic incompleteness

Geodesics satisfy:

$$\frac{d^2x^\mu}{d\lambda^2} + \Gamma_{\alpha\beta}^\mu \frac{dx^\alpha}{d\lambda} \frac{dx^\beta}{d\lambda} = 0,$$

where  $\Gamma_{\alpha\beta}^\mu$  are derivatives of  $\Psi^\dagger \Gamma \Psi$ . Smooth  $\Psi$  implies extendable congruences.

#### C. C. Trapped surfaces are coherence features, not singularity predictors

In  $\Psi$ , a trapped surface corresponds to localized compression in the coherence density, not a focusing catastrophe.

#### D. D. Collapse is a smooth path in configuration space

Let:

$$\Psi(t) = \Psi_0 + \delta\Psi(t).$$

The collapse is continuous in  $t$  and cannot terminate in finite-parameter incompleteness.

### **E. E. No singularities appear in any physically realizable solution**

Every solution of Eq. (??) respects the functional constraints; thus the core premise of Penrose’s theorem — singularity formation from trapped surfaces — fails.

## **IV. CONCLUSION**

Penrose’s 1965 theorem is not a prediction of nature but an artifact of assuming:

- a metric not generated by a field,
- trapped surfaces as fundamental objects,
- null focusing as a physical observable,
- null incompleteness as an assumption,
- topological contradictions as physics.

The Universal  $\Psi$  Equation replaces these assumptions with a single generative dynamical law, eliminating curvature blow-up, geodesic incompleteness, and the mechanisms interpreted as singularities.

Therefore the original PRL 1965 result is mathematically invalid.

## **BIBLIOGRAPHY**

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### **Declaration of Authorship and Conceptual Integrity**

This work belongs to the foundational theoretical framework of the Universal  $\Psi$  Lagrangian. Any use or reformulation must explicitly cite its origin.

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