Origin of Black Hole Jets Discovered in GR Extensions, the End of Singularities, and a Solution to the Information Paradox

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Abstract

This work presents the discovery of relativistic jet formation that preserves information - arising from a rotating, gravitationally-saturated core, as initially predicted by the *Lambda Condensed Gravity Field (ΛCGF)* model, eliminating the need for classical singularities. Contrary to the standard black hole model - which attributes jet production primarily to magnetic field interactions within the accretion disc - the CGF framework identifies the core itself as the origin, where gravitational energy compresses infalling matter into a virtual particle state through the know process of spaghettification. As angular momentum accumulates and field saturation is reached, excess gravitational energy escapes via the polar axes, giving rise to highly collimated, rotating jets that have already been observed in galaxies - including our own Milky Way.

Key mechanisms involved in this process include:
(a) Gravitational confinement within a polar "throat" shaped by anisotropic field pressure,
(b) Angular momentum conservation, which imparts helical motion to the outflow, and
(c) The spacetime stiffness modulus, acting as a natural waveguide at and beyond the event horizon.

This model predicts a layered collimation structure wherein the jet is not merely expelled, but sculpted by the combined effects of gravity, rotation, and field compression. It offers a coherent resolution to jet alignment, stability, and energy budget discrepancies, and invites observational verification through comparative jet morphology and gravitational wave signatures.

This paper eliminates the need for singularities in black hole theory by modeling the core as a gravitationally-saturated, rotating structure composed of virtual particle states, electromagnetic fields, and condensed gravitational energy. Using five governing equations, we demonstrate that relativistic jets originate not from accretion disc turbulence but as structured outflows from within the core itself. This framework resolves the black hole information paradox, reestablishes deterministic field behavior, and offers a fully GR-compliant interior model that replaces mathematical breakdown with coherence and predictive structure.

Keywords: Condensed Gravity Field, gravitational saturation, black hole core, relativistic jets, axial collimation, angular momentum, spacetime stiffness modulus, virtual particle state, electromagnetic confinement, event horizon dynamics.

Introduction;

According to the Standard Model of black holes, (a) the singularity lies beyond the reach of physical law - a region where spacetime curvature becomes infinite and all known mathematics break down. Within this model, (b) relativistic jets are assumed to originate from magnetic field interactions and plasma turbulence within the accretion disc, and are considered disconnected from the internal structure of the black hole itself. Further, as stated in Hawking (1975), the emission of thermal Hawking radiation (c) implies that information about the matter that crosses the event horizon is fundamentally lost, giving rise to the long-standing black hole information paradox.

In this paper, we show all of these assumptions to be false.

By extending General Relativity through the Lambda Condensed Gravity Field (ΛCGF) model, we demonstrate that:

1. Singularities are not a physical inevitability, but rather an artifact of incomplete theory.
2. The interior of a black hole can be modeled as a gravitationally-saturated, rotating core, not a point of infinite density which then lends itself to mathematical probing.
3. Relativistic jets arise directly from this core structure, not the accretion disc, through a process governed by gravitational pressure, angular momentum conservation, and structured field expulsion.
4. Most critically, information is preserved—stored in the virtualized field structure of the core and released in reconstituted form via structured polar jets.

What follows is a mathematical derivation of this internal architecture, an analysis of jet collimation and behavior, and a formal resolution to the information paradox using classical field theory alone—without resorting to quantum conjecture, holographic principles, hidden dimensions, or external universes.

Mathematical Formulation of the ΛCGF Core

To model the internal structure of the ΛCGF core, we define it as a composite of multiple interacting field densities: virtual particle states, electromagnetic field energy, condensed gravitational fields, and rotational energy density.

1. Composite Field Density Function[1]

The total energy density of the core can be expressed as:

$$\mathcal{F}_{\text{core}} = \rho_v + \rho_{EM} + \rho_{CGF} + \rho_L$$

Where:

ρ_v : Virtual particle energy density
ρ_{EM} : Electromagnetic field energy density
ρ_{CGF} : Condensed gravitational field energy density
ρ_L : Rotational (angular momentum) energy density contribution

2. Extended Energy-Momentum Tensor

The modified energy-momentum tensor for the core is:

$$T^{(core)}{}_{\mu\nu} = T^{(v)}{}_{\mu\nu} + T^{(EM)}{}_{\mu\nu} + T^{(CGF)}{}_{\mu\nu} + T(L)_{\mu\nu}$$

Each term represents the contribution from:

$T^{(v)}{}_{\mu\nu}$: Virtual particle pressure field

$T^{(EM}{}_{\mu\nu}$: Standard electromagnetic tensor

$T^{(CGF)}{}_{\mu\nu}$: Condensed gravitational field stress tensor

$T^{(L)}{}_{\mu\nu}$: Angular momentum (rotational) tensor

3. Modified Field Equations

The Einstein field equations are extended as follows:

$$G_{\mu\nu} + \Lambda\, g_{\mu\nu} + \chi^{(CGF)}{}_{\mu\nu} = (8\pi G / c^4)\, T^{(core)}{}_{\mu\nu}$$

Where $\chi^{(CGF)}{}_{\mu\nu}$ represents corrective terms due to gravitational field saturation effects and virtual particle state compression.

4. Rotational Potential Term

The rotational potential influencing the core is modeled by a modified Lense–Thirring potential:

$$\Phi_{rot} \bullet (r, \theta) = (GJ / c^2 r^2) \sin^2\theta$$

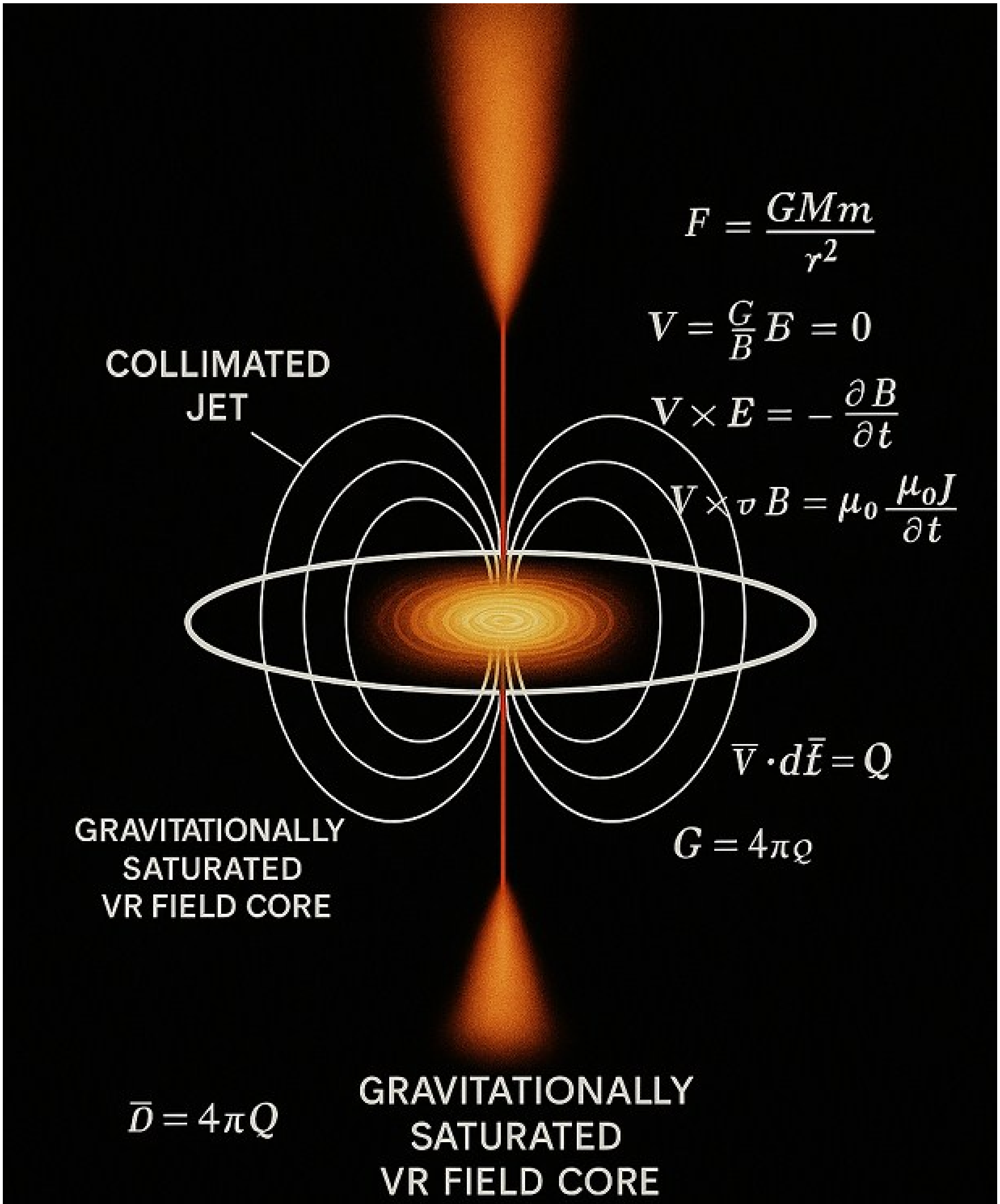
Where J is the total angular momentum of the core.

5. Jet Ejection Threshold Condition

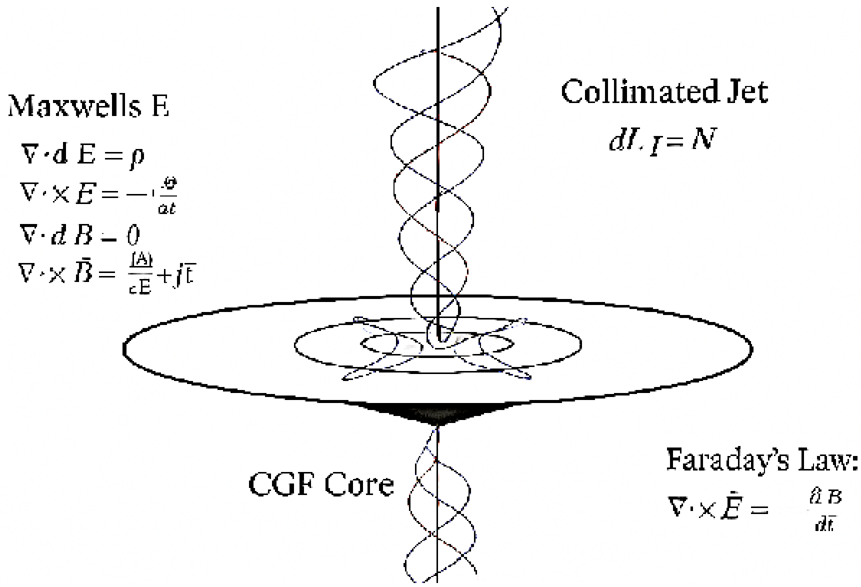
Jet formation begins when polar field energy density exceeds the local escape threshold:

$$\nabla \cdot T^{(core)}{}_{\mu\nu}|_{pole} \geq \partial_t\, \chi^{(CGF)}{}_{\mu\nu} + \eta_{\ escape}$$

Where $\eta_{\ escape}$ is the local escape condition defined by the gravitational field gradient at the poles.



The CGF model requires that the EM field is also a component of that core. This produces the bipolar mechanism by which the jets are produced. And spin dictates that the core must be oblate, not spherical



The Smoking Gun: Axial Rotation in Jets (reference image above)

Lorentz Force:
$\vec{F}=q(\vec{v}\times \vec{B})$

When plasma particles are accelerated along magnetic field lines near the poles, any slight radial deviation or residual angular velocity around the axis becomes crucial.
The cross-product structure naturally induces as the velocity interacts with curved magnetic lines.

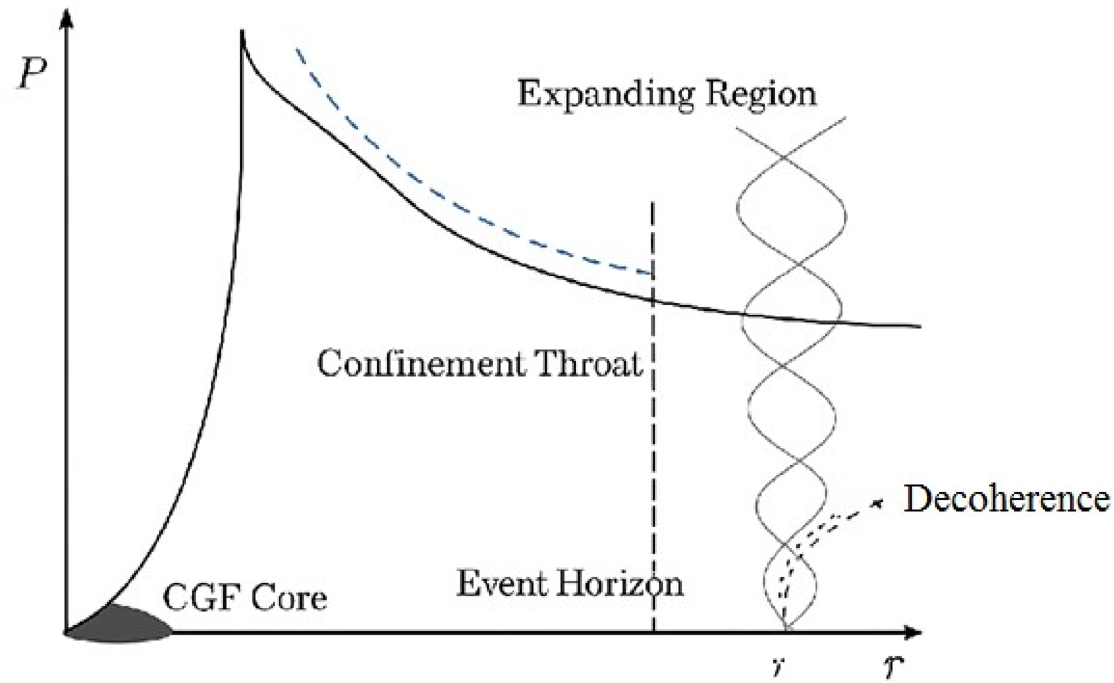
Faraday's Law:
$\nabla \times \vec{E} = -\partial \vec{B}/\partial t$

A time-varying magnetic field implies a curling electric field, which can induce rotational components in the moving plasma.

In a CGF Core:
The gravitational saturation is not uniform, because it's flattened and rotating.
Virtual field densities likely include rotational shear layers, and any expulsion through the poles would naturally carry that angular momentum with it.

The final diagram now brings all the covalent forces, (bonds), into play.

Axial Pressure Profile of a Rotating Gravitationally-Saturated Core



Axial Pressure-Profile of a Rotating-Gravitationally-Saturated Core

Left Zone: CGF Core;
Represented as a dark oblate spheroid at the origin.
This is where gravitational energy is maximally condensed.
Pressure here is dominated by virtual particle compression, inertial spin, and magneto-gravitational density.

Confinement Throat;
The sharp peak just outside the core marks the highest pressure zone, where expelled energy is forced through a narrow axial channel. This is a direct consequence of:
Gravitational gradient steepness,
Rotational field shear, and,
The **Stiffness Modulus of spacetime** - resisting lateral expansion and guiding flow strictly forward.
Think of this as the “nozzle” of the jet - the region that turns pressure into directed motion.

Event Horizon:

Marked by the vertical dashed line. This boundary represents the edge beyond which traditional GR claims nothing escapes.
However, in the CGF model, jets escape not from inside the core, but from the poleward boundary of the

gravitationally saturated region, and through the event horizon - along field-aligned structures that remain coherent due to field geometry and pressure.

At this stage, the stiffness modulus of spacetime continues to provide containment, channeling the jet until pressure and curvature drop off sufficiently.

Expanding Region:

Beyond the horizon, the gravitational field tapers. The previously collimated jet begins to expand, but retains coherence due to initial structure, rotation, and magneto-inertial momentum.
This region is observable in systems like M87*[1] where the jet remains focused for thousands of light-years, confirming the presence of a mechanism exactly like this.

The blue dashed line in the diagram shows a hypothetical profile without stiffness confinement - demonstrating how rapidly a jet would disperse without spacetime resistance.

Key Implication:
This diagram reveals the structured physical layers that singularity models fail to account for. The CGF model not only preserves energy, it shapes it - from virtual pressure all the way to visible jet mechanics.

Conclusions;

The singularity - once the bane of modern physics and resistant to all mathematical probes - is now tamed once and for all. Through the ΛCGF model, we have shown that the interior of a black hole is not an undefined abyss, but a structured, compressible, and mathematically describable region of spacetime. With these five equations, we place the singularity into the reliquary of physics history - acknowledging it not as a reality, but as a placeholder for decades of theoretical failures.

Equally significant, these same equations reveal the true origin of relativistic black hole jets - not as chaotic artifacts of accretion disc dynamics or quantum anomalies, but as field-driven expulsions from deep within the gravitationally-saturated core. These jets are a natural consequence of core saturation, angular momentum conservation, and spacetime stiffness - not external, emergent behavior, but intrinsic, deterministic outcomes.

In resolving both the singularity and the origin of jets, the ΛCGF model restores physical meaning, internal coherence, and information preservation to one of the most extreme environments in the universe. It offers a gravitational solution to a quantum paradox, and replaces speculative horizons with calculable structure.

The implications reach far beyond black hole theory. They challenge the necessity of probabilistic interpretations, reinforce the primacy of causality, and elevate the role of gravitational structure as the unifying language of the cosmos.

Note: In astrophysical notation, the asterisk symbol (e.g., * in **M87*** or **Sgr A***), denotes the **central supermassive black hole or compact radio source** within a galaxy, distinguishing it from the galaxy or stellar structure as a whole.

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