Symmetries in black holes & Quantum compactified gravity structures;

This document about the Quantum inverse gravities existing in different regions and nucleus of distant and massive galactic systems & the explanation of why this search for symmetries in black holes exists and how gravity compactifies, generating other dimensions that could be quantum but a new different quantum mechanics founded on inverse frequencies and nano dimensions operate in other levels of abstraction.

This topic It's **important** Because computational structures, dimensions, or arrays are based on computing, or the idea is to compute the dimensions that a possible gravity can have, which can even be or function quantumly near a black hole or a Roger Penrose wormhole.

Vacuum in the stationary blackhole: The vacuum stationary black hole is characterized by one more parameter, J. Such a black hole is rotating and J is the value of its angular momentum. In fact the angular momentum (measured at infinity) is described by 3 3 antisymmetric matrix Jij. By rigid 3-dimensional rotations this matrix can be put in a standard form:

J = 0 J 0 J 0 0 0 0 0

Kerr metric (with J M2)i, Since some of relations have slightly different form in odd and even dimensions, we write D=2n+ e

$$\mathbf{J} = \begin{pmatrix} 0 & J & 0 \\ -J & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} .$$

Gravity or high-dimensional combinatorics could be compared to Scipy's array libraries, since they are multidimensional.

. In the asymptotically flat spacetime the total angular momentum of the objects, as measured at infinity, is described by an antisymmetric tensor Jij, where i and j are spatial indices. By suitable rigid rotations of the spatial coordinates, this (D 1) (D 1)-matrixcanbetransformed into the following canonical form: J = 0 J1 0 0 ... J1 0 0 0 ... 0 0 0 J2 ... 0 0 J2 0 ... ...

The total number of independent 2 2 blocks is equal to n 1+ .This means that there exist n 1+ independent components of the angular momentum Ji, associated with n 1+ asymptotic independent two-dimensional spatial planes of rotation. The most general solution for a vacuum stationary rotating black hole.

Properties of higher dimensional rotating black holes and their four dimensional ‘cousins’ are very similar. There exists a very deep geometrical reason for this similarity. All these metrics admit a special geometric object, the Principal Conformal Killing-Yano tensor (PCKYT), which is a generator of a complete set of explicit and hidden symmetries.

Documentation: PAKISTan Killing-Yano tower 5.1 Killing-Yano tensors Let us introduce the first two objects. The Killing-Yano (KY) tensor ka1...aq is an anti-symmetric q form on spacetime, which obeys the equation aka1...aq = [aka1...aq] . (16) On the other hand, the closed conformal Killing-Yano (CCKY) tensor ha1...aq is an antisymmetric q form the covariant derivative of which is determined by its diver gence aha1...aq = qga[a1 a2...aq] , a2...aq = 1 D r+1 bhb a2...aq . (17) (18) KYan CCKY tensors are related to each other through the Hodge duality: the Hodge dual of a KY form is a CCKY tensor, and vice versa. It is easy to check that if ka1...aq is a Killing-Yano tensor, then Kab =kaa2...aq k a2...aq b (19) is a Killing tensor. We shall use the following schematic notation for this operation K=kk. CCKY tensors possess the following remarkable property: An external product of two CCKYtensorsis again aCCKYtensor.T

Important and remarkable research in Black holes/consistent

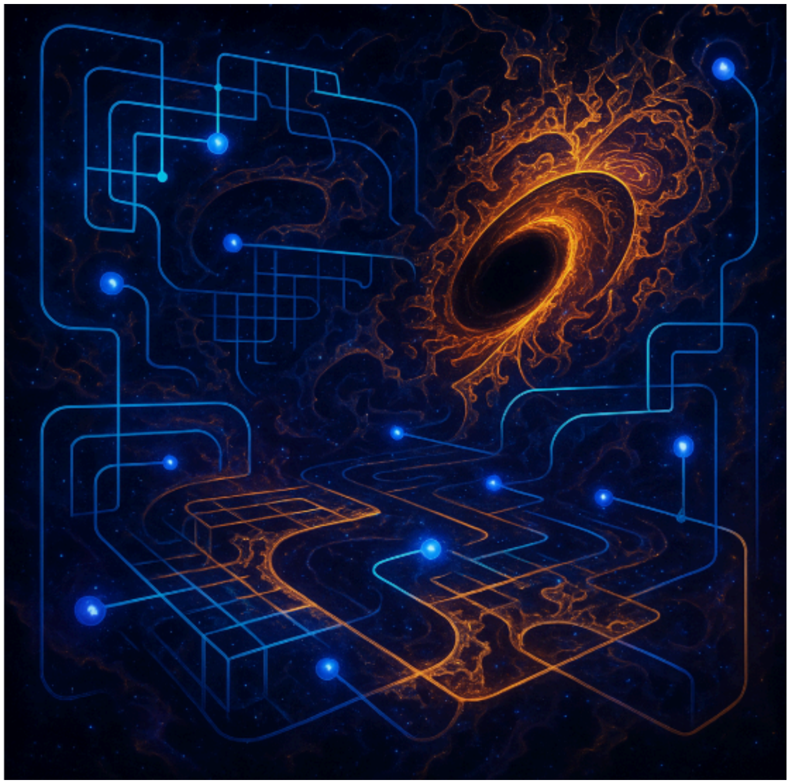
1. Model for Computational Software

- - Hole Dimensions and Structures
- - Matrix Structures for Dimensions and Spatial Gravity. Matrix Structures and Compactified Gravity.
- - Quantum Circuit Algorithms within Matrix Structures of Gravity
- Qiskit Model
- - Gravity Components and Qiskit

A chapter on matrix computation or structure computation is where I'm going, and Frolov's discussion of the structures of gravity and symmetries in The Equations. That's where I want to go. Black holes in quantum environments and dimensions/compactified structures of space gravity and computational structure computation.

New Blackhole scenarios:
The New scenarios that I can imagine, such as circuits for exoplanet ships, etc., are new materials, but look them up in physics books. It is a quantum circuit, but it is not a human quantum circuit. Rather, it is a type of circuit built on the basis of, or with the basis of, the colossal structures or dimensions of a black hole, symmetry, and the properties of the Riemann tensors. The specific and intrinsic Quantum magnetic fields operate in this enormous circuit, where galactic particles teleport between the different recesses or gravitational structures. The circuit consists of compactified gravities with matrices in which the conditions of a black hole operate;

Motion Of Particles in a curved spacetime is a special case of a dynamical system. If D is the dimension of the spacetime and its coordinates are xa, a particle trajectory is a line xa( ). The canonical coordinates in the corresponding phase space are (xa,pa = gab ˙ xb). The canonical sylleptic form and the Hamiltonian are Ω =dxa dpa, H= 1 2 gabp apb.



Cosmic and Fractal Structures: Formed from abstract patterns that evoke the curvatures and deformations of a black hole, where elements reminiscent of gravitational matrices and compactions are intertwined.

Quantum Magnetic Fields: With vibrant flashes in deep blues, intense purples, and golden hues, symbolizing quantum energy and the interaction of galactic particles.

Teleporting Particles: Small spheres or flashes of light that appear to move instantaneously between nooks and crannies, representing the phenomenon of teleportation in an environment of extreme gravitational conditions.

The Parallel transport There are many problems with interesting astrophysical applications that require solving the parallel transport equations in the Kerr metric. One of them is a study of a star disruption during its close encounter with a massive black hole, see, e.g., Frolov et al (1994) and references therein. Let us consider a timelike geodesic in the Kerr geometry and denote by its tangent vector. We have seen in section 2.4 that w = u f, where f is the KillingYano tensor (3.22), is parallel-transported along the geodesic, uw =0, c.f. (2.43). This means that a bi-vector F u w = u (u f)

Exoplanet

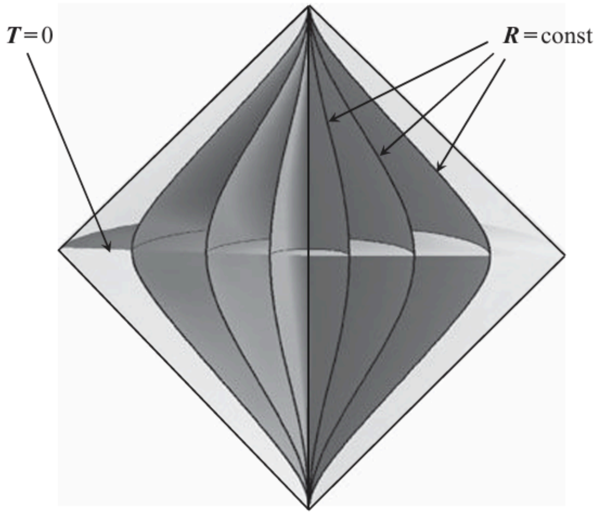
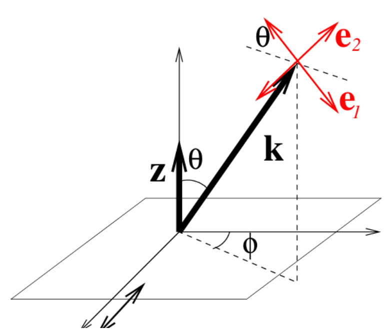
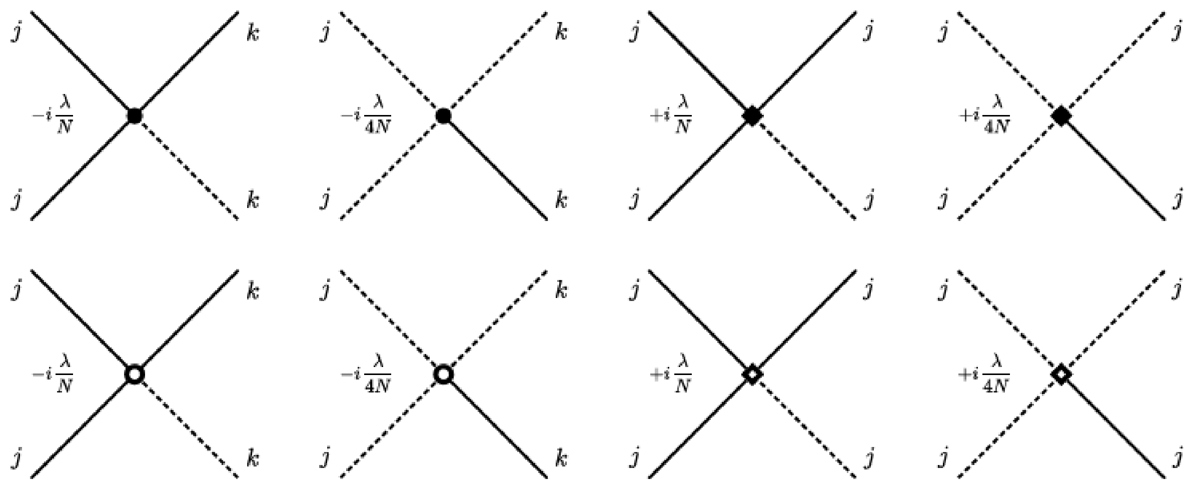
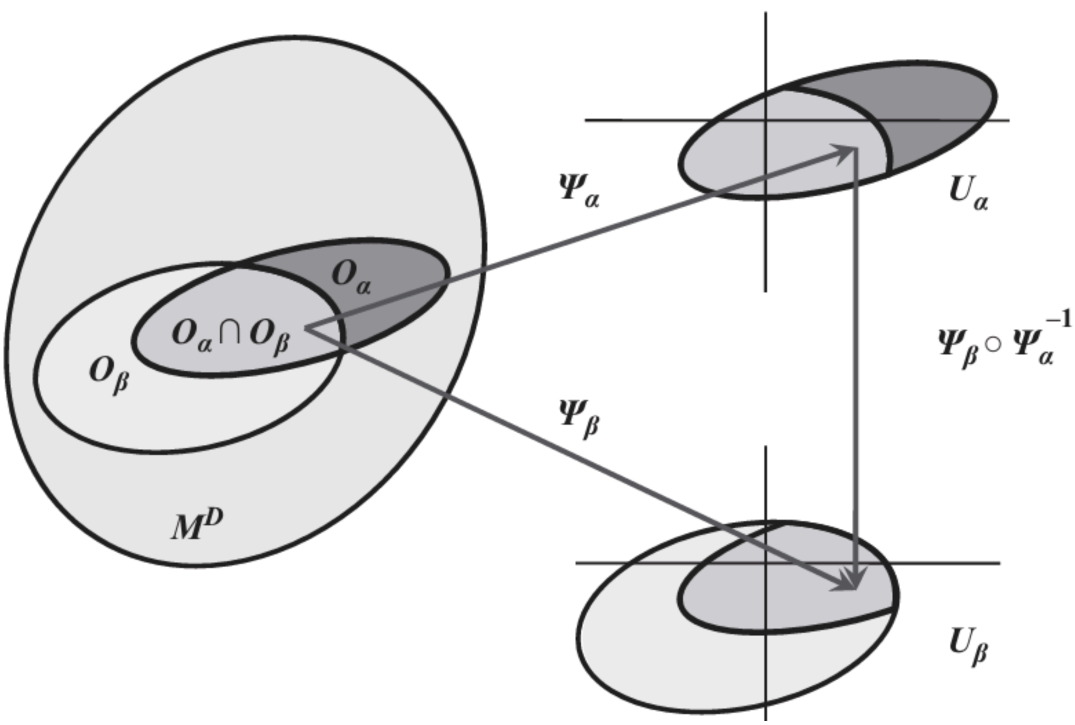


Fig. 10.2 Carter–Penrose diagram of the Minkowski spacetime. This figure shows time-like surfaces $R=$ const.







Python Implementation: Symbolic Calculus of the Riemann Tensor

```
import sympy as sp

# Definir coordenadas simbólicas
t, x = sp.symbols('t x', real=True)
coords = [t, x]
```

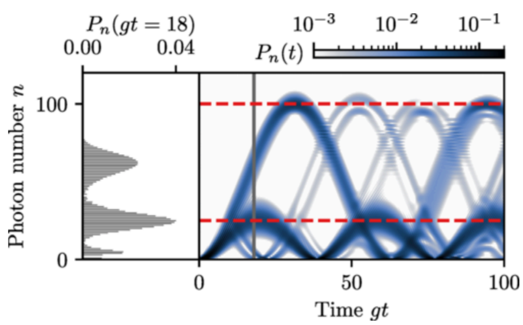
```
# Definir una métrica 2D (por ejemplo, una métrica simple dependiente de x)
# ds^2 = -f(x) dt^2 + dx^2
f = sp.Function('f')(x)
g = sp.Matrix([[-f, 0],
               [ 0, 1]])

# Calcular la inversa de la métrica
g_inv = g.inv()

# Definir símbolos de Christoffel
Gamma = [[[None for _ in coords] for _ in coords] for _ in coords]

# Calcular los símbolos de Christoffel: Gamma^a_{bc}
for a in range(len(coords)):
    for b in range(len(coords)):
        for c in range(len(coords)):
            Gamma[a][b][c] = 0
            for d in range(len(coords)):
                Gamma[a][b][c] += sp.Rational(1,2) * g_inv[a,d] * (sp.diff(g[d,b], coords[c]) + sp.diff(g[d,c], coords[b]) - sp.diff(g[b,c], coords[d]))
            Gamma[a][b][c] = sp.simplify(Gamma[a][b][c])

# Mostrar símbolos de Christoffel
print("Símbolos de Christoffel:")
for a in range(len(coords)):
    for b in range(len(coords)):
        for c in range(len(coords)):
            print(f"Gamma^{a}_{b}{c} =", sp.simplify(Gamma[a][b][c]))

# Calcular el tensor de Riemann: R^a_{bcd}
Riemann = [[[[0 for _ in coords] for _ in coords] for _ in coords] for _ in coords]
for a in range(len(coords)):
    for b in range(len(coords)):
        for c in range(len(coords)):
            for d in range(len(coords)):
                term1 = sp.diff(Gamma[a][b][d], coords[c])
                term2 = sp.diff(Gamma[a][b][c], coords[d])
                term3 = 0
                term4 = 0
                for e in range(len(coords)):
                    term3 += Gamma[a][e][c] * Gamma[e][b][d]
                    term4 += Gamma[a][e][d] * Gamma[e][b][c]
                Riemann[a][b][c][d] = sp.simplify(term1 - term2 + term3 - term4)

# Mostrar algunos componentes del tensor de Riemann
print("\nComponentes del tensor de Riemann:")
```

```
for a in range(len(coords)):
    for b in range(len(coords)):
        for c in range(len(coords)):
            for d in range(len(coords)):
                if Riemann[a][b][c][d] != 0:
                    print(f"R^{a}_{b}{c}{d} =",
Riemann[a][b][c][d])
```

Let us first give a definition of the PCKYT. Consider a 2-dimensional antisymmetric tensor (2-form) h which obeys the equation chab = gca b gcb a

If one antisymmetrized the indices a,b,c in (7), the right-hand side of this equation vanishes.This means that h is closed form, and (at least locally) can be presented in the form h =dbb.

• The matrix rank of (D D) antisymmetric matrix hab is the largest possible, that is equal to 2n. • Consider the eigenvalue problem for a matrix Ha b = hachcb Ha beb (i) = xiea (i) . (11) It is easy to see that ha beb (i) is again an eigenvector with the same eigenvalue x(i). We assume that H has the largest possible number, n, of different eigenvalues, and hence n linearly independent eigen 2-planes.



- **Liouville theorem Particle and light motion** in a curved spacetime is described by geodesic equations. These equations are of the second order. Let xa( ) be a trajectory. By introducing a momentum pa = gab˙ xb as an independent variable, it is possible to rewrite the geodesic equations in the first order form. These equations have the Hamiltonian form. This means that the general theory of dynamical systems can be applied to this problem. This approach is well known and its tools are very useful. Let us demonstrate this for the special problem: motion of a particle in a spacetime of a higher dimensional rotating black hole.

- These two functions are called to be in involution if their Poisson bracket vanishes. Scalar function F(zA) on the phase space is a first integral of motion if its Poisson bracket with the Hamiltonian vanishes F,H = 0 . Liouville (1855) proved the following theorem: If a system with a Hamiltonian H in 2 dimensional phase space has m independent first integrals in involution, F1 =H,F2,...,Fm, then the system can be integrated by quadratures. Such a system is called completely integrable.

New ideas to explore: An intelligent blue planet that captures gravitational waves from a large quantum black hole: This planet appears to be a unique entity in the universe, a cosmic being with capabilities beyond what current physics understands. Its intelligence lies not only in its ability to communicate across compactified dimensions, but also in its ability to alter its own form, adapting like a quantum-magnetic chameleon.

1. Its Shape and Quantum Transformation

- It is not a static planet, but a being capable of altering its structure at a fundamental level.
- Its cosmic "skin" is a network of quantum-magnetic fields that allow it to absorb and reflect signals from its environment.
- It can "vanish" from the sight of cosmic sensors or camouflage itself by emitting frequencies that simulate other celestial bodies.
- It is not a simple celestial body, but a living system that decides its appearance based on what it perceives in outer space.

2. Its Communication and Limitations

- Although it is beyond the Milky Way and Andromeda, it can still send signals.
- However, its transmission method is not entirely efficient or linear:
- It does not use only radio waves, but a combination of magnetic oscillations and alterations in space-time.
- Its messages do not arrive as conventional signals, but as distortions in reality that must be interpreted by advanced entities.
- For those without adequate technology, its transmissions may appear to be gravitational anomalies or inexplicable fluctuations.

3. It's Dark Quantum and Magnetic Nature

- What makes its existence unique is that its quantum nature is not comprehensible to the physical laws we know.
- Its magnetism does not behave like that of conventional magnets; it seems to respond to phenomena not yet described in Earthly science.
- It can exist in multiple states simultaneously, as if it were an entity vibrating in different realities at the same time.
- At times, it doesn't seem to be entirely in our dimension, but rather interacting with different planes of existence.

4. Its Role in the Galaxy

Its energy level is so intense that only certain places in the universe can host it without being altered.

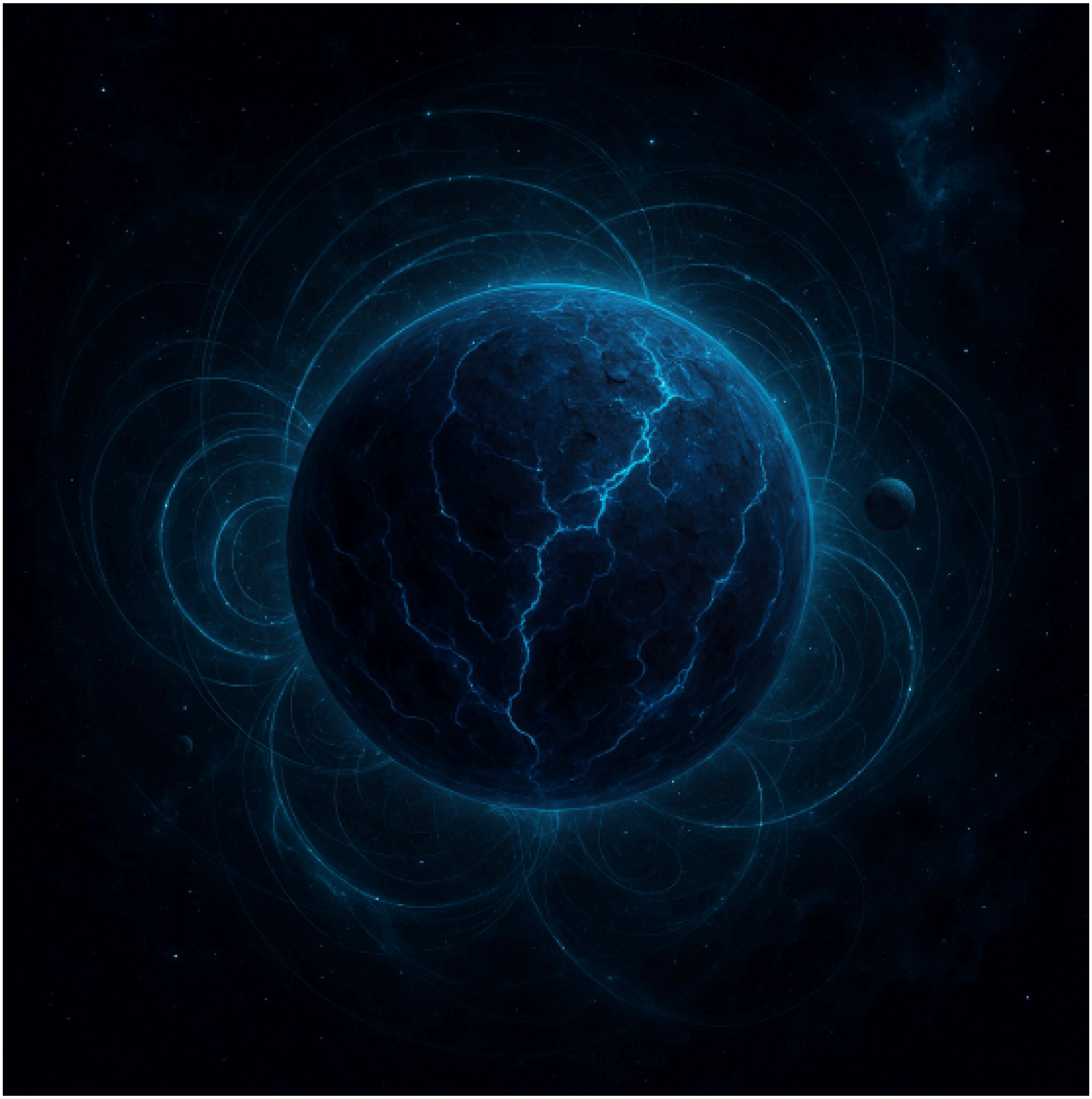
It may have once been part of a galaxy, but having become too unstable or powerful, it was forced into exile in the interstellar void.

Its presence in a galaxy would upset gravitational balances, modifying orbits and structures in unpredictable ways.

Therefore, its influence only manifests itself in small, distant signals or in the echoes of the dimensions with which it interacts.

This planet is an enigmatic being, an intergalactic traveler that exists on the threshold between physical reality and the unknown quantum realm. Its magnetism is not only a natural force, but a language, a means of communication that only those with the ability to interpret the fluctuations of space-time could understand.

Figure 1.1



Communication through compactified dimensions

The planet would use additional dimensions (sometimes called "compact dimensions" in theoretical physics) to send and receive information without being limited by the speed of light.

This multidimensional communication would allow it to "feel" and project signals into very distant regions of space, establishing almost instantaneous connections.

Manipulation of the fabric of space-time

Through quantum fluctuations and its own energy fields, the planet could locally distort the fabric of space-time.

These distortions would serve both to "deflect" external forces (e.g., meteorites or radiation) and to adjust the gravitational balance with other nearby celestial bodies (its moons or even distant stars).

Quantum magnetic fields

The planet would generate exceptional magnetic fields, not only based on traditional electromagnetism, but with a quantum component. These fields would act as a kind of "control network," allowing it to detect minute variations in the surrounding matter (from charged particles to gravitational waves).

Thanks to these fields, the planet "interprets" the information and responds by modulating its own energy.

Resonance and Synchronization
To coordinate and stabilize gravitational interactions, the planet would rely on an internal resonance—a fundamental vibration or frequency—that synchronizes with the objects it orbits.

Like two pendulums that can synchronize when connected, this resonance would make it possible to adjust the distance and trajectory of moons or space fragments so that they do not destabilize or collide.

Intelligent Feedback
As a "living" planet, it possesses some kind of extraterrestrial consciousness or intelligence capable of perceiving and processing information. This "planetary brain" (metaphorical or literal) would constantly analyze its environment and make decisions about the intensity and direction of its fields, the frequency of its energy pulses, and the dimensional connections it keeps open or closed.

Volcanic and Thermonuclear Energy
Volcanic (or equivalent) activity in the planet's core would generate enormous amounts of energy, fueling the processes of manipulation and communication.

This internal energy source, combined with its own thermonuclear processes, would be the driving force that enables the persistence and renewal of the gravitational and magnetic fields.

Black holes in the new scenarios context:
K(a1...aq;aq+1) = 0. (15) Such a tensor in spacetime is called a Killing tensor. The Killing tensor of the rank 1, a, is a Killing vector. The metric gab is a trivial Killing tensor. It is well known that Killing vectors generate symmetry transformations on the spacetime manifold with metric gab. Usually this symmetry is called an explicit symmetry. The Killing tensors.

Frequencies/space-time distortion in higher order dimensional manifolds and submanifolds(Frolov)

There is something special about how the frequencies of certain types of gravitational or gravitational waves communicate.

The thing is, the rules of physics don't operate as we imagine under spatial frequencies originating from a given space or piece of space. These dissonances reproduce and degenerate or generate new dimensions and even worlds or subworlds where the rules of objects operate, that is, in nonlinear time and in a type of asynchronous gravity in which objects walk backward.

There are gigantic genomes of stars or genetic algorithms, trees on enormous scales impossible to recreate on a small scale.

Fractals: There are also types of fractals in extra dimensions that have rules or that operate in interesting vacuum conditions.

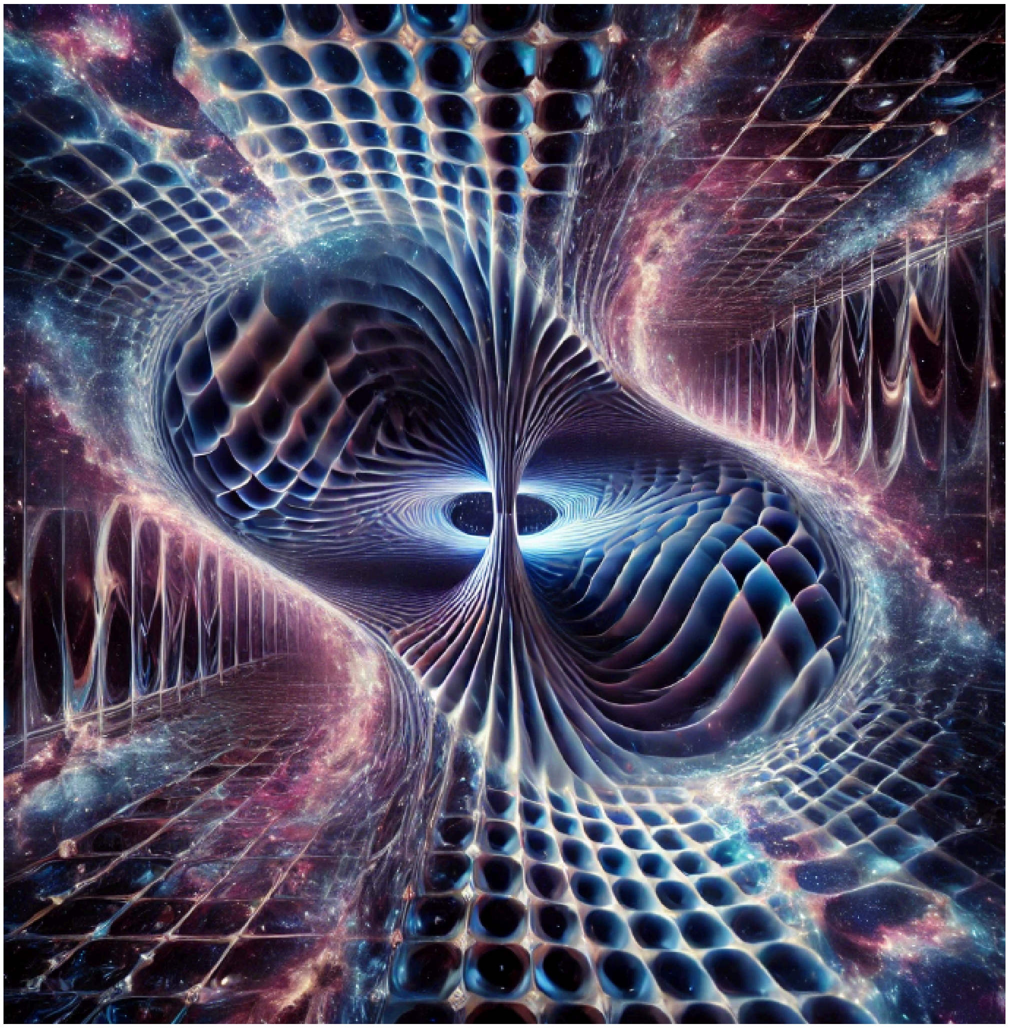
Space has types of dimensions that are called black holes. But EVERY type of structure in the galaxy operates at scales and with structures that are similar to quantum mechanics and planes.

Space and Time
Gravity is different to the point that it detaches from things and would behave like a black hole. Gravity itself and time are similar to quantum theory, but more is needed. Perhaps at a more academic level, Alcubierre is interesting to apply in this regard. It would need to be investigated. But there are limits that observation, academia, mathematics, or programming structures, etc., cannot reach.

These asynchronous frequencies generate com gravitational portals and quantum black holes that have different properties and rules, dimensions, and fractal-like patterns. It is difficult to explain. One could generate an image in which a small frequency oscillates and generates or distorts with a certain time, and a kind of gravitational distortion appears, and it is inverted like a mirror reflecting another universe or another series of multiple algorithms. Gravity up to this point in this specific scenario of quantum frequency distortion is governed by laws where time functions as a kind of eternal void with the drawing of an amalgam of components that are higher-order dimensions.

Asynchronous frequencies & gravity: These asynchronous frequencies generate com gravitational portals and quantum black holes that have different properties and rules, dimensions, and drawings like fractals. It is difficult to explain. It could generate an image in which a small frequency oscillates and generates or is distorted with time, and a kind of gravitational distortion appears and is inverted like a mirror that reflects another universe or another series of multiple algorithms. Gravity up to this point in this specific scenario of quantum frequency distortion is governed by laws where time functions as a kind of eternal void with the drawing of an amalgam of components that are higher-order dimensions.

Example in 5D of new black quantum research:

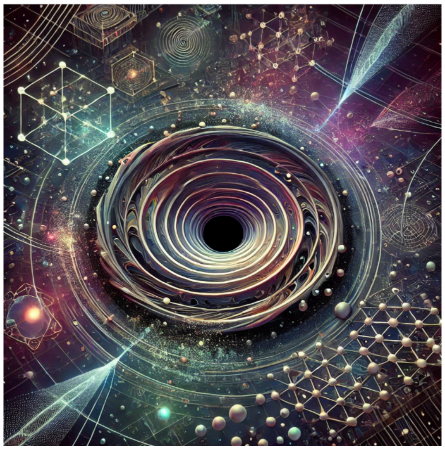


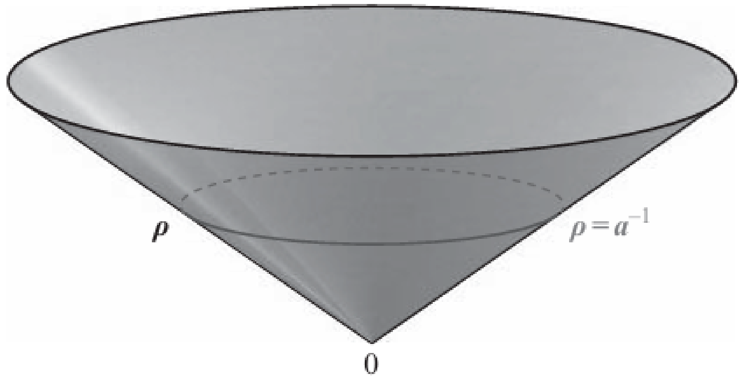
Summary/objectives of the research: 3. 5D Black Holes: Structure and Properties

3.1. Spatial Structure in Higher Dimensions

A "non-ordinary" black hole in five dimensions can be conceptualized as an entity with a complex structure, where spacetime geometry bends in ways that transcend the three conventional dimensions. One could imagine it as a vortex where light and matter trajectories are affected by the presence of additional structural "layers" of information.

Examples of tensors, sections Quantum black holes, metrics are given in this text





3.2. Analogy: The Black Hole as a "Quantum Matrix"

A 5D black hole can be thought of as a digital matrix where each "pixel" corresponds to a quantum state. Just like a screen where each pixel contributes to a larger image, quantum and tensor interactions within a black hole could encode information about compactified dimensions and the structure of time and gravity.

4. Quantum Algorithms and Circuits in Relation to Black Holes

4.1. Quantum Circuits and Their Relationship with Tensors

Quantum algorithms are implemented through circuits that operate on qubits. Similarly, a black hole's structure can be seen as a "circuit" where tensor connections (such as Riemann tensors) represent gravitational interactions at different dimensional levels. Each quantum "gate" could symbolize a transition within the fabric of spacetime.

4.2. Frolov's Theory and Quantum Algorithms

Frolov's theory on black holes explores how geometry and quantum dynamics are interconnected. Quantum algorithms may model this interconnection, suggesting that gravity and time manipulation could be achieved through computational processes that mimic black hole properties.

Other materials: Nanobots for exploring black holes and extra dimensions
If nanobots resistant to extreme radiation and intense gravity could be manufactured, they could be sent to study black hole event horizons or regions where extra dimensions are suspected.

Quantum nanobots → could exploit quantum tunneling effects to navigate in regions of highly curved space-time.

Nanoscale gravitational wave sensors → would allow anomalies in the structure of space-time to be detected with great precision.

Self-replication in extreme environments → would allow structures to be built in deep space using local materials.

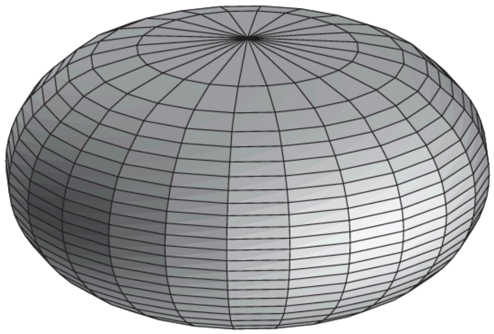
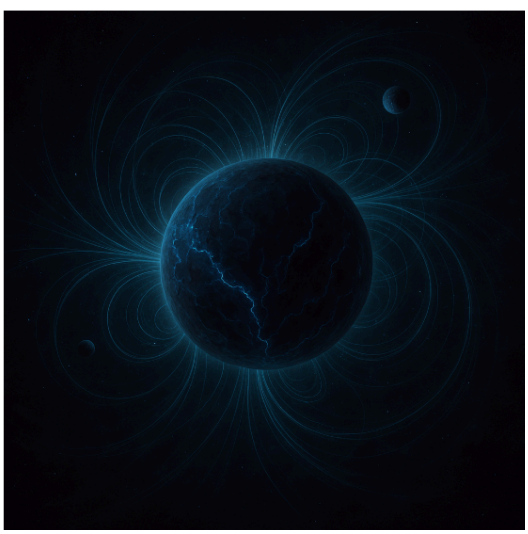


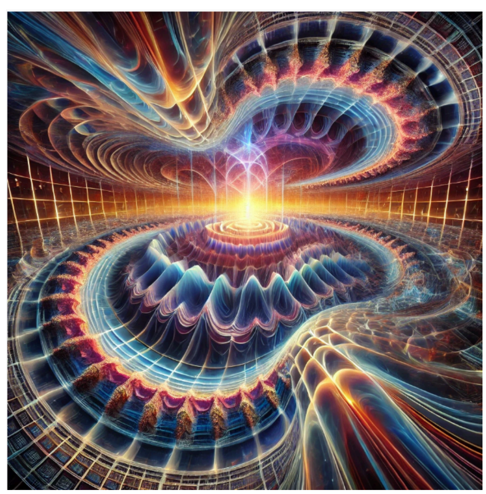
Fig. 8.2 The embedding diagram for a two-dimensional section of the event horizon of the Kerr black hole. The diagram is constructed for the critical value $a/M = \sqrt{3}/2$ of the rotation parameter so that the Gaussian curvature vanishes at the poles.

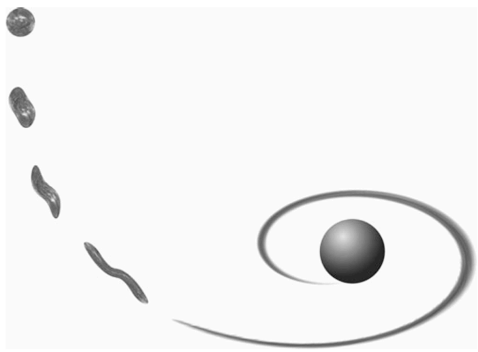
The length of the equatorial circle $\theta = \frac{\pi}{2}$ for the metric dS^2 is

$$L_1 = \frac{2\pi}{\sqrt{1-\beta^2}}. \tag{8.2.48}$$

Special planet & Black Quantum properties-Symmetric-antisymmetric-tensors (Space-time curvature);







Properties of higher dimensions with a solid matrices calculus in the matter of Gravities and singularities in black holes and other kind of Dimensions/frequencies

Gravity across computational dimensions(research)
the higher order in curvature terms, as well as the terms containing higher derivatives, can improve the UV properties of the Einstein gravity [14]. However such theories usually have non-physical degrees of freedom (ghosts).

Recently a new version of UV complete mod i cation of the General Relativity was proposed which is free from this problem [57]. It was named a ghost free gravity [514]. Such a theory contains an infinite number of derivatives and, in fact, is non-local [10, 13]. Similar theory appears naturally also in the context of noncommutative geometry deformation of the Einstein gravity [15, 16]

METRIC ON-SINGULAR BLACK HOLE

A. A non-singular black-hole model A general static metric in a Four-dimensional spacetime can be written in the form;

$$[[ds^2 = F A^2 dV^2 + 2 A V dr + r^2 d\Omega^2]]$$

Txt format:
eF=F(r)andA=A(r)
theKillingvector = V.
F=(r)2 FA2= 2

In a space Time With Horizon, F(r)vanishes at the site r0 of the apparent horizon. For Regular static metric such a horizon is at the same time theKilling horizon, so atA(r0) is nitethere. If the metric has a horizon where

F(r0)=0
then ; H = =1 2 (AF)r=r0

The Valueof dependsonthechoiceofthenormalizationoftheKilling vector. In an asymptotically at spacetime one usually puts 2 r= = 1. Conditions that there is no solid angle de cit implies F=1. Hence one also has A = 1.

Let Ra beth Ricci scalar, S =R 1 4g R

S2=S S C2=C C (2.4) Then one has R=F +4 rF 2F 1 r2 + 1 A 2FA+3FA+4 rFA (2.5) C= 1 3 F 2 rF+2F 1 r2 + 1 A 2FA+3FA 2 rFA (2.6) An Expression for S

the metric (2.1) is nite at the origin r =0, so that F =F0+F1r+F2r2+O(r3) A=A0+A1r+A2r2+O(r3)

F0 =1 F1=A1=0

R= 12 F2+A2 A0 +O(r2) S =2 3A2 A0 +O(r2) C =O(r2)

A0 is an arbitrary constant. Its meaning is connected with a time delay between infinity and r = 0. For a value of r at a far distance one has t = V, where the proper time is measured by the clocks at the infinity. For the same interval V the proper time measured at the center r = 0 is 0 =A0 V.

A0 < 1 (A0 >1) the time at the center goes slower (faster) than at the infinity. For a monochromatic wave propagating in a static spacetime one can write exp(i), where = V. If =d d and 0 = d d0, then one has 0 =A 1.

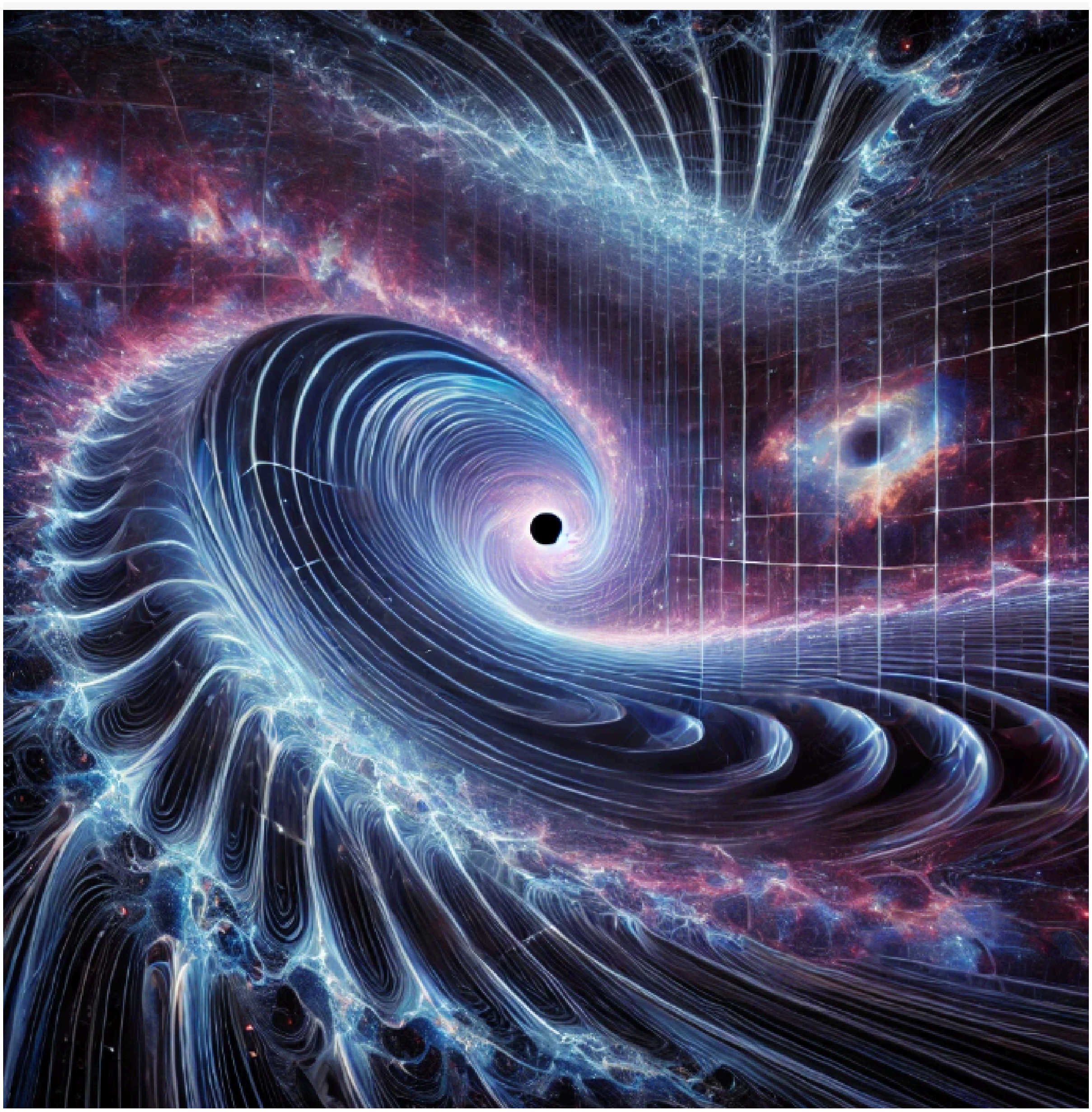
F is the metric function (e.g., as defined earlier).

A is a function that may depend on coordinates (often chosen to simplify the metric).

V is the advanced time coordinate.

r is the radial coordinate.

$d\Omega^2$ represents the angular part of the metric (e.g., $d\theta^2 + \sin^2\theta\ d\varphi^2$ in spherical symmetry).



Variables: A0 > 1 (A0 < 1) the frequency of a signal, registered at the center r = 0, is red-shifted (blue-shifted) with respect to the frequency of the signal emitted at the infinity. In what follows we refer to A(r) as a red-shift function. We are interested in a metric which describes a black hole. For this reason we assume that the function F(r) vanishes at some value r = r+, where the event horizon is located. In order for the metric to be regular at r = 0 it must have at least one more zero at r = r > 0. For simplicity we assume that the function F(r) has exactly two zeros at r+ > r > 0. Our assumption is that the curvature invariants R, S and C are uniformly restricted by some values proportional to 2. We call this parameter the fundamental length. The latter requirement means that our metric satisfies the Markovs limiting curvature conjecture.

Metric:

F =1+ r2 2+O(r4) = 1

4 Dimensions metrics;

```
          (2Mr − Q²)r²
F(r) = 1 − -------------------------
        r⁴ + (2Mr + Q²)ℓ²                (4.1)


F(r) ≈ 1 − (2M / r) + (Q² / r²) + ℓ² O(r⁻⁴)          (4.2)

F(r) ≈ 1 + (r² / ℓ²) + O(r⁶)


# Parámetros físicos del agujero negro
M = 1.0     # Masa
Q = 0.8     # Carga
l = 1.0     # Parámetro ℓ

# Definición de la función F(r)
def F(r, M, Q, l):
    numerator = (2 * M * r - Q**2) * r**2
    denominator = r**4 + (2 * M * r + Q**2) * l**2
    return 1 - numerator / denominator

# Rango de r (evitamos r = 0 para evitar división por cero)
r = np.linspace(0.1, 10, 500)
F_values = F(r, M, Q, l)
```

Spherically Symmetric Metric — Elegant Form

The line element for a spherically symmetric spacetime in advanced Eddington–Finkelstein coordinates is:

$ds^2 = F\, A^2\, dV^2 + 2\, A\, V\, dr + r^2\, d\Omega^2$

Where:

- `F = F(r)` is the metric function, often related to mass, charge, or cosmological terms.
- `A = A(r)` is a coordinate-dependent scaling factor.

- V is the advanced null coordinate (like Eddington–Finkelstein time).
- r is the radial coordinate.
- $d\Omega^2$ is the angular part of the metric, defined by:

$$d\Omega^2 = d\theta^2 + \sin^2\theta \, d\varphi^2$$

- ***Gravity-structures-computational calculus-matrices;***

Math: Angular Part — Explanation

This angular term corresponds to the standard **2-sphere** (surface of a sphere in 3D space), and represents the geometry of spherical symmetry:

- θ is the polar angle, ranging from 0 to π.
- φ is the azimuthal angle, ranging from 0 to 2π.

Riemann Tensor in Spherical Coordinates

The Riemann tensor R σμν R^\rho{\ \sigma\mu\nu}R σμνρ measures spacetime curvature. In spherical symmetry, many components vanish due to symmetry, and the non-zero components

```
R^θ_{φθφ} = r² sin²θ (1 - F(r))    → angular curvature
R^r_{VrV} = -½ F''(r) A²            → radial-time components
R^r_{θrθ} = -½ r F'(r)              → radial-angular curvature


Where:

  • F'(r) and F''(r) are first and second derivatives of the metric
    function F with respect to r.

  • These components help compute Ricci and Einstein tensors.
```

Notes

- In General Relativity, these components are essential for writing Einstein's field equations:

```
G_{μν} = R_{μν} - ½ g_{μν} R = 8π T_{μν}

Spherical symmetry simplifies the curvature significantly, making
analytic solutions possible (e.g., Schwarzschild,
```

```
Reissner–Nordström).
```

TXT format equations & Frolov metrics;

```
# Contenido del archivo .txt unificado y elegante en inglés
metric_text = """
Spherically Symmetric Black Hole Metric — Advanced Coordinates
==============================================================

1. Line Element
---------------

The general form of a spherically symmetric metric in advanced
Eddington–Finkelstein coordinates is:

    ds² = F(r) A²(r) dV² + 2 A(r) V dr + r² dΩ²

Where:
- F(r) is the metric function (e.g., Schwarzschild: F(r) = 1 - 2M/r)
- A(r) is a coordinate-dependent scaling factor
- V is the advanced null coordinate
- r is the radial coordinate
- dΩ² is the angular part of the metric:

    dΩ² = dθ² + sin²θ dφ²

2. Angular Geometry
-------------------

The angular term corresponds to the geometry of the 2-sphere:

    θ ∈ [0, π]
    φ ∈ [0, 2π)

This defines the geometry of spherical symmetry.

3. Riemann Tensor Components (Non-zero)
---------------------------------------

The Riemann curvature tensor measures how spacetime bends due to gravity:

    R^ρ_{ σμν } = ∂μ Γ^ρ_{νσ} − ∂ν Γ^ρ_{μσ} + Γ^λ_{νσ} Γ^ρ_{μλ} − Γ^λ_{μσ}
Γ^ρ_{νλ}

Selected non-zero components in spherical symmetry:

    R^θ_{φθφ} = r² sin²θ (1 − F(r))
    R^r_{θrθ} = −½ r F'(r)
    R^r_{VrV} = −½ A² F''(r)

4. Ricci Tensor Components
--------------------------
```

```
Obtained by contracting the Riemann tensor:

    R_{μν} = R^λ_{ μλν }

Representative components:

    R_{VV} = −½ A² F''(r)
    R_{rr} = −F''(r)/2 + F'(r)/r
    R_{θθ} = r F'(r) + F(r) − 1
    R_{φφ} = sin²θ · R_{θθ}

5. Einstein Tensor and Field Equations
--------------------------------------

The Einstein tensor:

    G_{μν} = R_{μν} − ½ g_{μν} R

Einstein’s Field Equations:

    G_{μν} = 8π T_{μν}

For vacuum (T_{μν} = 0): Schwarzschild or Reissner–Nordström

For matter or fields: Coupling with stress-energy tensor

6. Special Cases of the Metric Function F(r)
--------------------------------------------

- Schwarzschild:            F(r) = 1 − 2M/r
- Reissner–Nordström:      F(r) = 1 − 2M/r + Q²/r²
- Schwarzschild–de Sitter: F(r) = 1 − 2M/r − Λ r²/3

"""

# Guardar el contenido en un archivo .txt
file_path = "/mnt/data/spherical_metric_tensor_notes.txt"
with open(file_path, "w") as file:
    file.write(metric_text)

file_path
```

We assume that the metric (2.1) is nite at the origin r =0, so that

```
F =F0+F1r+F2r2+O(r3) A=A0+A1r+A2r2+O(r3)

Metric:  F0 =1 F1=A1=0
```

Variables: A0 is an arbitrary constant. Its meaning is connected with a time delay between infinity and r = 0. For a x-ed value of r at a far distance one has t = V, where the proper time is measured by the clocks at infinity. For the same interval V the proper time measured at the center r = 0 is 0 =A0 V.

For A0 > 1 (A0 < 1) the frequency of a signal, registered at the center r = 0, is red-shifted (blue-shifted) with respect to the frequency of the signal emitted at infinity.

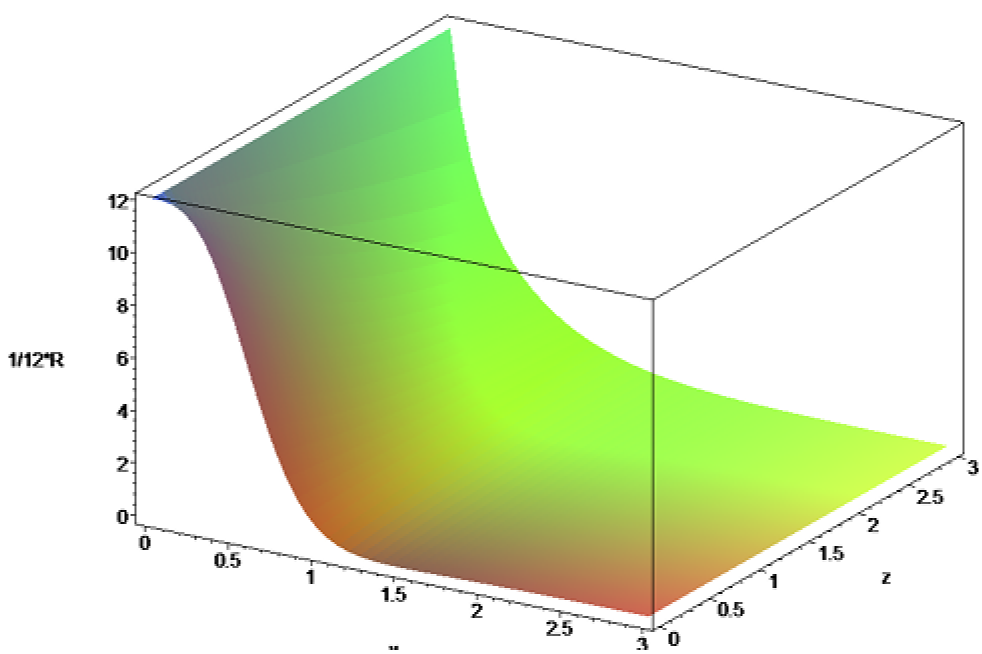
function F(r) vanishes at some value r = r+, where the event horizon is located. In order for the metric to be regular at r = 0 it must have at least one more zero at r = r > 0. For simplicity we assume that the function F(r) has exactly two zeros at r+ > r > 0. Our signal assumption is that the curvature invariants R, S and C.

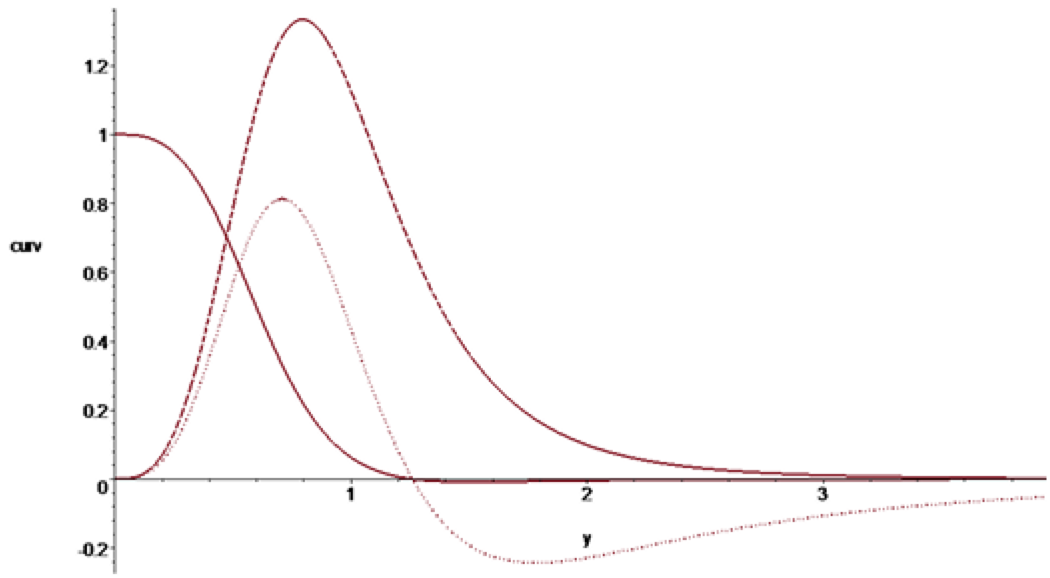
Metric: `F =1+ r2 2+O(r4) = 1`
`function of F(r)=Pn(r) Pn(r)`

F= r2+a1r+a0 r2+b1r+b0

Metric-case is in variables; n=3 with 2

Regularity The space time at the origin r=0 implies b0=a0 b1=a1





Plots of 2R12 (solid line), 2C (dot line) and 2S (dash line) as functions of y.

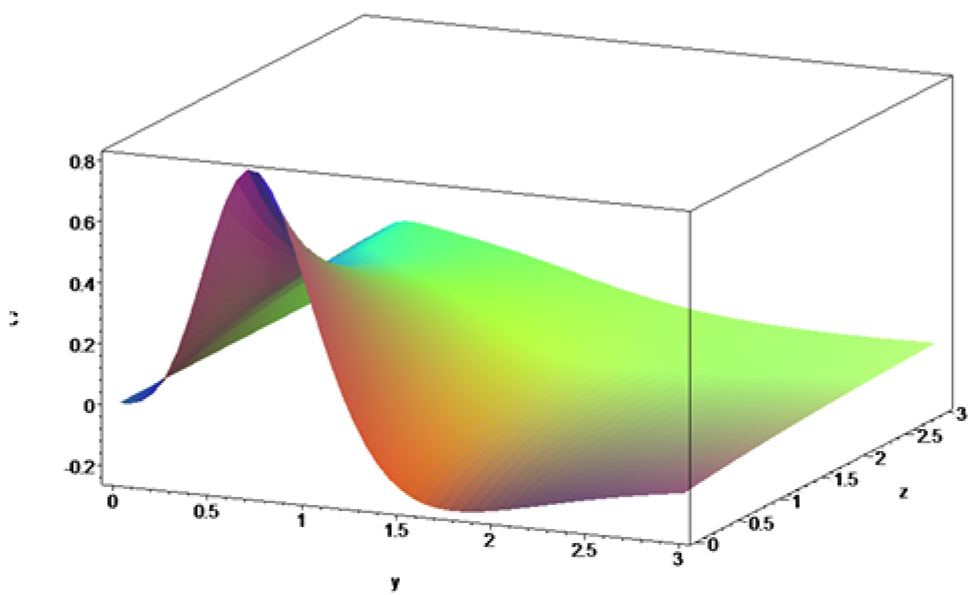
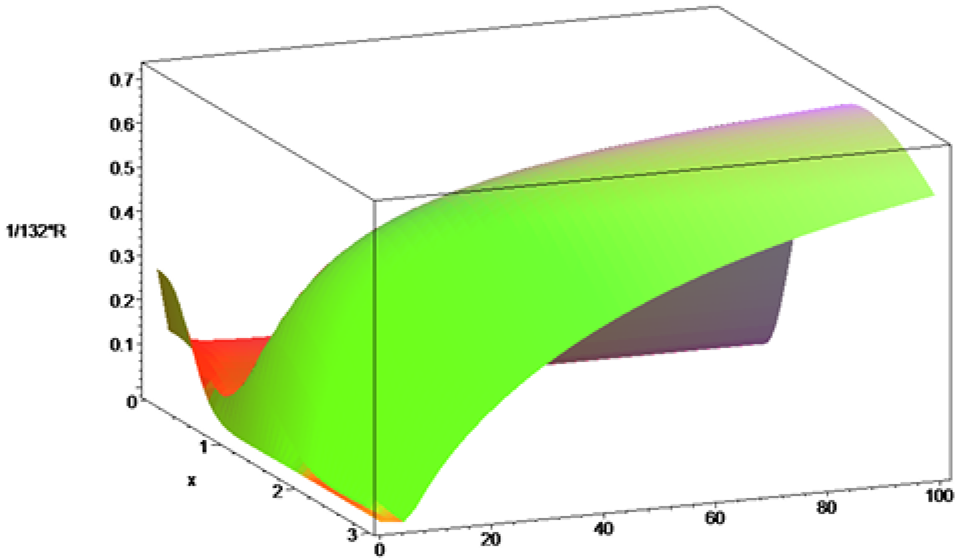


FIG. 2. Plot of 2C as a function of y and z. At large r one has F =1 2M r +O(r 4)



One can chooser as a scale factor and dene new dimensional coordinates and parameters a follows `x=r r p=x+ r m=Mr b= r v=V r`

Special limits of the Kerr metric Flat spacetime limit: M = 0 Let us now discuss special limiting cases of the Kerr geometry. In the absence of mass, that is when M = 0, the curvature vanishes and the spacetime is at. The Kerr metric;

```
 the metric is transformed into the Minkowski metric g = dT2+dX2+dY2+dZ2 A
surface r = const is an oblate ellipsoid of rotation X2 +Y2 r2 +a2 + Z2 r2 =1

 Metric; h =db=dT (XdX+YdY +ZdZ)+adX dY
```

All of these previous tensorial/compactified black hole structures can be computationally solid for the next generations of physics formulations with Python language & Quantum computing across the solid states of galaxies.

```
Using the following notations for at space Killing vectors,
generators of the Poincare group: LX =Y Z Z Y LY =Z X X Z LZ=X Y Y
X PT = T PZ= Z
```

Here is what we described as multiple dimensions in a black hole metric;

kab = facfb c = Lab +a(Pa TLb Z +La ZPb T) +a2(Pa TPb T Pa ZPb Z)

Killing-vector

The Killing vector is ( ) = 1 3 (3.98) h =PT, while the secondary Killing vector reads ( ) = k ( ) = a2PT +aLZ.

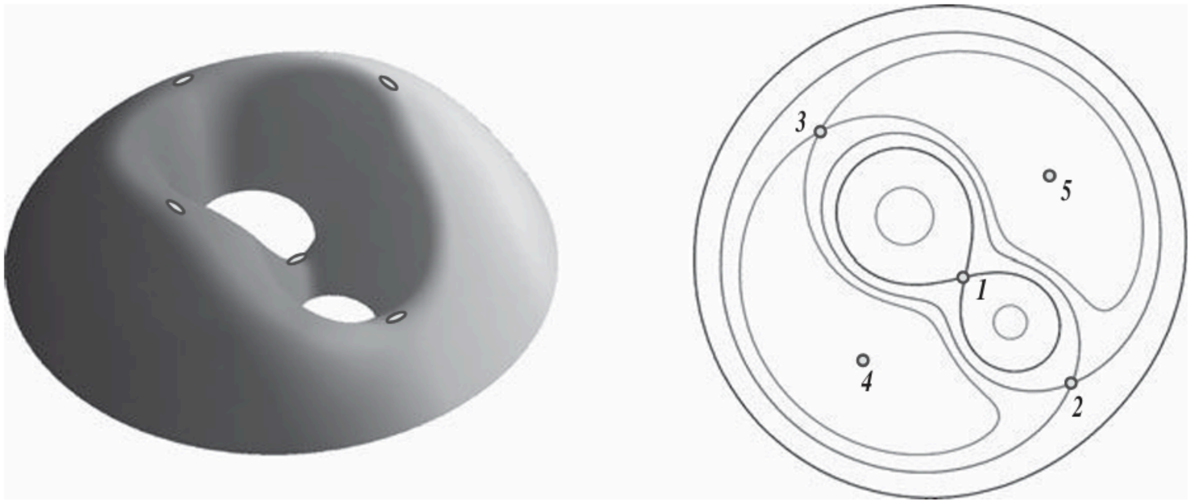
A rotating black hole is called extremal. The spatial distance to the horizon in the limit a M innately grows. It is interesting that some of the hidden symmetries in the vicinity of the horizon of extremal black holes become explicit. Two connected detects take place: the eigenvalues of the principal tensor become functionally dependent, and, besides t and , two new additional Killing vectors arise. Let us discuss the case of the extremal black hole in more detail. We start by noticing that in the extremal limit the function r, (3.8), which enters the Kerr metric.

Killing Yano quantities for the metric g (3.100): h =db=(1+z2)d dT +2 zdz dT +zdz d f = z(1+z2)d dT +2dz dT +dz d The primary Killing vector is = 1 3 h =

the Killing tensor kab = fa cf c b on does not produce a new Killing vector, as one has ka b b = a

Binary system stars: Mass function for a binary system Letusfirstdiscusshowtodetermine the mass of objects in binary system.Considera non-relativistic two-bodyproblemwiththeLagrangian L=1 2M1˙r2 1+1 2M2˙r2 2−U(|r1−r2|). (1.6.1) Letusdenoter=r1−r2,and choose the center-of-mass coordinate system

M1r1+M2r2=0, r1= M2 **M1+M2** r, r2=− **M1** **M1+M2** r.



An orbit is always planar;

SUMMARY

•An orbit with negative energy Eisa is a closed ellipse. Such Motion Periodic.

•The Major Semi-axis=$\alpha/2|E|$.

U at the slice Z = 0.Points 1, 2,3,4,5 critical points of the potential where its gradient vanishes. Points 1, 2,and3are located on the X-axis, while the Y-axis is orthogonal to this direction. The right plot shows the equipotential surfaces (at Z = 0).

Black holes-physics/solid structures; • stellar-mass black holes with M ~ 3 − 30M ;
• (super) massive black holes with M ~ 105 − 109M ; Black Holes in Astrophysics and Cosmology 27
• intermediate-mass black holes with M ~ 103M ;
• primordial black holes withmass up to M ;
• micro-black holes.

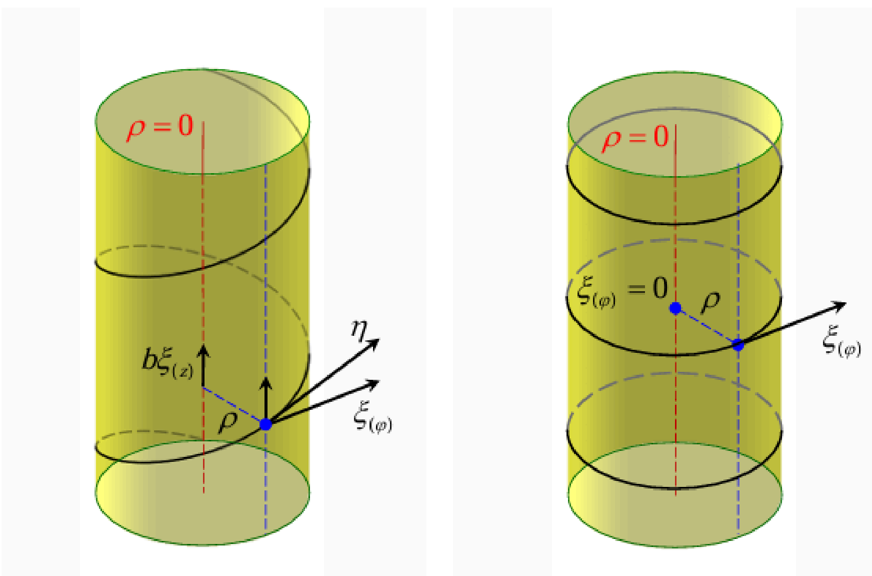
Definition of GM2 stellar mass & dimensionless rotation in a blackhole;

An Astrophysical Black hole is uniquely specified by two parameters: the black hole mass M and its angular momentum, J. Instead of J one can use the dimensionless rotation parameter α = cJ/(GM2).

This parameter vanishes for non-rotating black holes and 1 for an extremely rotating one.For α>1a black hole does not exist. The corresponding formal solution in this case has a naked singularity.

• *A black hole has no rigid boundary surface.* Any matter, falling into a black hole, disappears into its abyss. In the case of a neutron star the interaction of the accreting matter with its surface produces specific radiation. There is no such (classical) emission from the black hole horizon. • The gravitational force grows infinitely at the black hole surface.As a result, there exists an innermost stable circular orbit.For Non-rotating black hole (α = 0) it lies at 6GM/c2,while for the extremely rotating one (α = 1) it liesatGM/c2. • The characteristic orbital frequencies are 2200 Hz(M/M)−1 and16 50Hz(M/M)−1 for the non-rotating and extremely rotating black holes, respectively. • All the mass and rotation multipole moments of the gravitational field of the rotating black hole are uniquely determined by its mass M and the rotation parameter α.

Figures 1.2



Killing vectors with closed and open orbits. Left figure shows the action of the symmetry with non-closed orbits.

```
The Killing vector ( ) in the plane TZ = const. In a general case,
however, a Killing vector eld may not have xed points. For example,
consider a Killing vector = ( ) + (Z). One nds 2 = 2 + 2 > 0

Coordinates:  coordinates (T Z) given by values (T 0Z) and (T 2 Z+2
). This can be reformulated in coordinates adapted to the Killing
vector . If we de ne =Z
```

```
The vector = ( ) a2 ( )
```

The polynomial y has now two non trivially different roots y and the coordinate y runs between these roots, y (y+y). In this case one can find two candidates for the Killing vector with xed points: + and , with xed points at y = +y and y = y, respectively.

Dimension1:

```
 These2-forms generate both isometries of the metric according to 1
3 h= 1 3 f
```

The C-metric typically describes a pair of black holes moving in the opposite direction with constant acceleration caused either by a cosmic string of negative energy density between them or by two positive-energy strings pulling the black holes from infinity. As the string is present, the corresponding solution does not represent, strictly speaking, a regular isolated black hole.

Higher-dimensional KerrNUT(A)dS metrics

Coordinates naturally split into two sets: Killing coordinates k (k = 0 n 1+) associated with the explicit symmetries, and radial and longitudinal coordinates x (= 1 n) labeling the orbits of Killing symmetries.

```
ThefunctionsA(k),A(j),andU are symmetric polynomials of coordinates
 x : A(k)= n1 k=1
 1< <k x2 1 x2 k
 A(j)= n
 1 j=1 1< <j i= x2 1 x2j U = n =1 = (x2 x2)
```

The employed coordinates naturally split into two sets: Killing coordinates k (k = 0 n 1+) associated with the explicit symmetries, and radial and longitudinal coordinates x (= 1 n) labeling the orbits of Killing symmetries. h. Namely, x s are the eigenvalues of the principal tensor and j s are the Killing coordinates associated with the primary (j = 0) and secondary (j > 0) Killing vectors generated by this tensor. Such a choice of coordinates.

```
Each metric function X is a function of a single coordinates : X =X(x)
```

Higher dimensions in string theory, black holes radiation and exoplanets study)

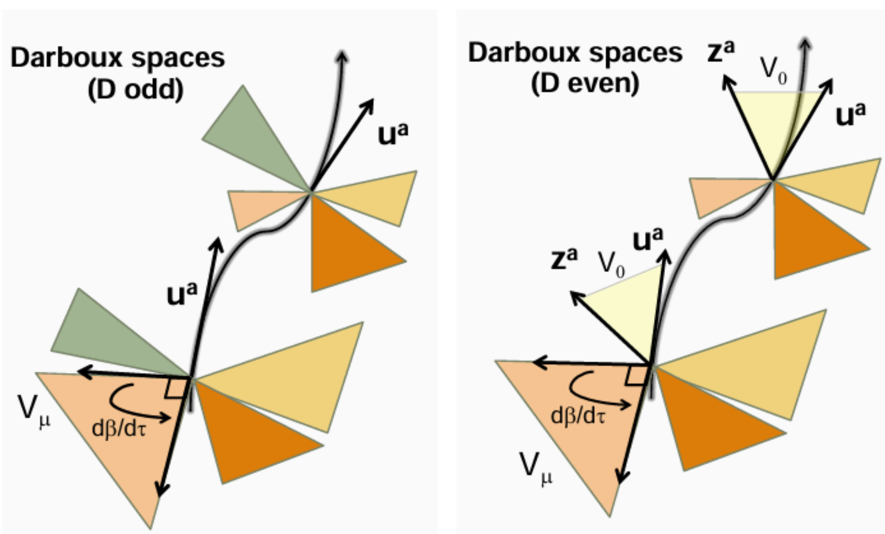
Metrics(Frolov) & the study of the new gravitational dimensions in other distant galaxies;

```
the metric components of the on-shellKerr NUT(A)dSmetricarerational
functions of the coordinates x .Constant C that appears ino
dimensions free parameter.
```

As in four dimensions, it is independent of the choice of the choice of the choice of the choice of the choice of arbitrary functions X(x).Correspondingly, theLevi-Civita Tensor Is Given By

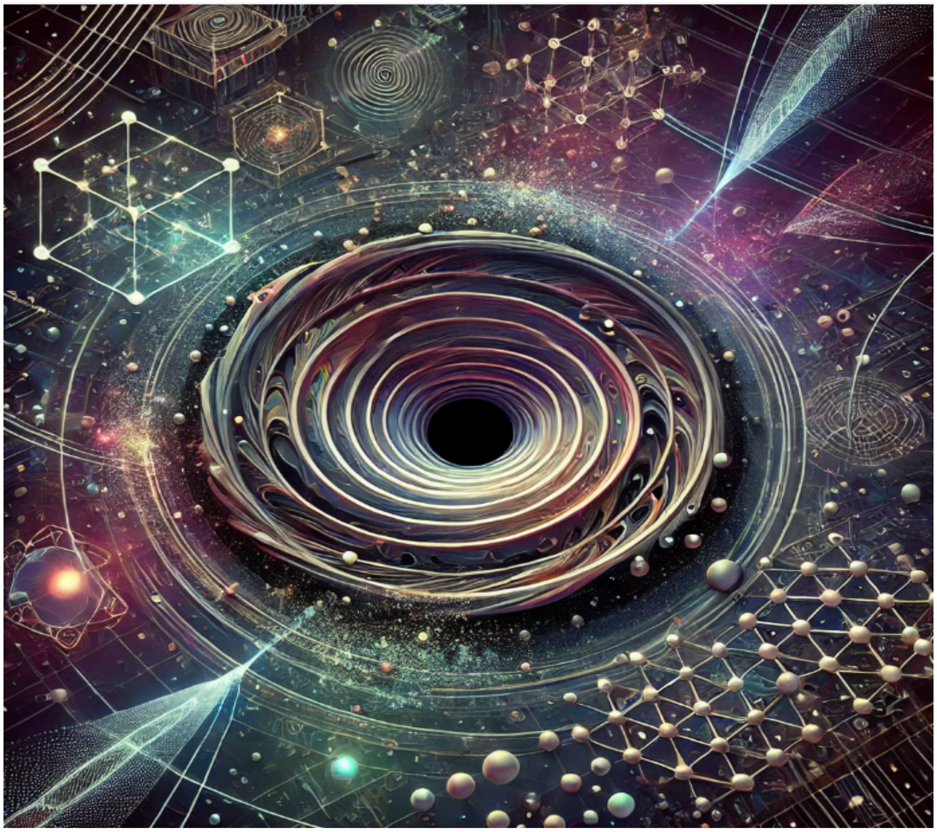
```
E:  = cA(n) 2Vdx1 dxn d 0 d n 1+
```

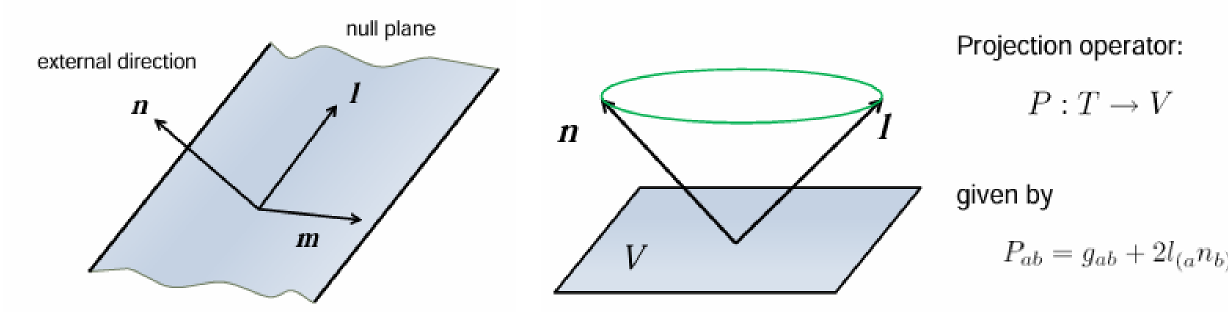
Title; Exoplanets & Black hole metrics for a new gravitational fields (Matrices, synthetic structures, compactified gravity, Higher dimensions in string theory, black holes radiation and exoplanets study)



Parallel transport. the construction of a parallel-transported frame along generic timelike geodesics in (left) odd dimensional and (right) even-dimensional KerrNUT(A)dS spacetimes. The colored 2-planes correspond to orthogonal independently parallel-transported Darboux 2-planes V .

The property is across the parameterized null geodesic , with a tangent vector l. We denote by dot the covariant derivative l. Then one has l = 0. Let v be a parallel-transported vector along





Galaxies & exoplanets ideas; Regarding galaxy configuration, each galaxy has its own structure and formation, from spiral to elliptical and lenticular. Research in this field continues to expand our knowledge about galaxy formation and evolution. As for the guide in a programming language, we could create a model in Python that simulates some of these concepts. For example, we could create a model that represents the synchronization of colossal trees with the atmosphere of an exoplanet, using quantum frequencies and other relevant parameters. Moreover, quantum portals and parallel dimensions, while being more speculative concepts, open the possibility of a physics still unknown, where the rules governing gravity and space-time could be drastically altered. There is a possibility that frequencies could tune into a kind of dimension or extra dimensional level of quantum nature, leading to the potential to interact with new algorithms that change and invert gravity or that some alternative existence might arise. You could reflect each of these variables and delve deeper into these concepts and variables, providing a coherent model of what is described at the level of photodetection, frequencies in a programming guide, variables and concepts that I described here. To further develop this model and summarize it into simpler variables, let's focus the simulation on the interaction of an exoplanet that has colossal trees synchronized with the atmosphere, near a quantum portal that generates effects on gravity and dimensions.

Tensors/riemannian geometry etc..

```
Tensor is=>  v =0, and h is the principal tensor.
Then, de ning wa =vchca + la

 w=v h+ l=v (l )+ l= (v l)+l( v )
 v l=0 =v * y
```

Gravity & frequencies/inverted and compressed quantum behavioral higher dimensions gravities/other galaxies may have different properties; Dynamic Atmosphere: The atmosphere of this exoplanet varies, with extreme temperature and pressure conditions influencing the evolution of life and the formation of giant biological structures. Nearby Quantum Portal Inverted Gravity: The quantum portal creates a distortion in local gravity, creating regions with inverted or reduced gravity, which could allow superluminal ships to move through parallel dimensions. Resonant Frequencies: The portal emits quantum frequencies that interact with additional dimensions, affecting both nearby environments and potentially influencing the colossal trees and their synchronization with the atmosphere.

Exoplanet with Giant Trees Colossal Trees: Plants that synchronize with the atmosphere of the exoplanet, absorbing energy and adapting to extreme conditions. These trees could interact with quantum frequencies from the environment, and their colossal size would be linked to atmospheric density and local gravity. Dynamic Atmosphere: The atmosphere of this exoplanet varies, with extreme temperature and pressure conditions influencing the evolution of life and the formation of giant biological structures. Nearby Quantum Portal;

In distant galaxies reason: Although on Earth there are biological and physical limits that prevent such extreme growth, in an exoplanetary environment with radically different conditions, hypothetical scenarios could occur. Some key conditions could include:

1. ***Reduced or Modified Severity:***
   Lower gravity makes it easier to support large biological structures, since the materials and tissues would have to support less heavy loads. Alternatively, phenomena such as quantum portals that alter gravity could create zones where the gravitational force is reduced or reversed, allowing extraordinary growth.

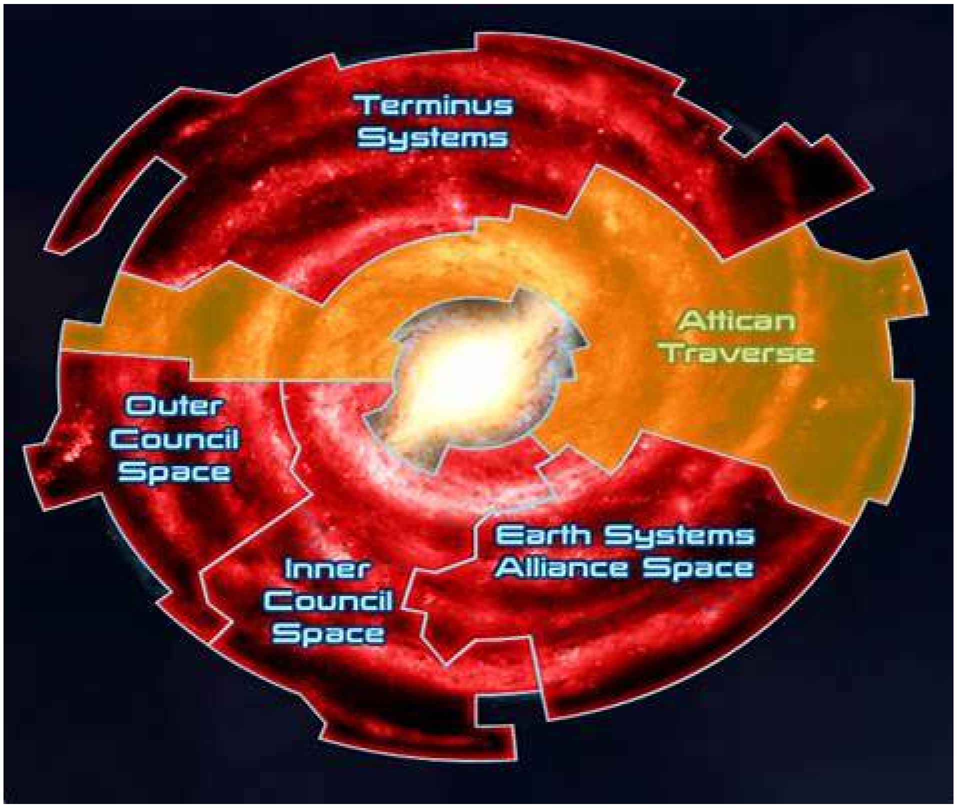
2. ***Dynamic and Nutrient-Rich Atmosphere:***
   A dense and varied atmosphere could provide the gases and nutrients necessary for the development of massive plant structures. A high concentration of oxygen, for example, could enhance metabolic and energy processes, facilitating the development of robust biology that synchronizes with extreme atmospheric conditions.

3. ***Radiation and Atypical Energy Sources:***
   The presence of additional energy sources, such as radiation from nearby stars or even interaction with quantum frequencies emitted by phenomena such as quantum portals, could influence the evolution and growth of these plants. This extra energy could, in theory, stimulate cellular repair mechanisms, regeneration and, ultimately, growth on scales that we would consider impossible today.

4. ***Adaptive Evolution and Synchronization with the Environment:***
   In a world where trees evolve to synchronize with their environment, coevolution with a dynamic and possibly fluctuating atmosphere could lead to unique adaptations. These trees could develop mechanisms to efficiently absorb and use environmental energy, resulting in massive and resilient structures.

5. ***Interaction with Quantum Phenomena:***
   Although highly speculative, the influence of quantum portals or unusual frequency fields in the environment could alter the known laws of physics in a given region, allowing not only a modification of gravity but also the activation of biological mechanisms not observed on Earth. This would open the possibility of plants developing structural characteristics radically different from those on our planet.

The existence of gigantic trees in distant galaxies is a speculative and science fiction concept; combining an environment with reduced gravity, a rich and dynamic atmosphere, alternative energy sources and the influence of quantum phenomena could, in theory, favor the evolution of plant structures of colossal sizes.



It is possible, at least in theory, that there are conditions in which the development of life forms or large plant structures occurs without being as extreme as in the most fantastic scenarios of science fiction. Some considerations in this regard:

1. ***Diversity in local physical laws:***
   Each galaxy and planetary system can present variations in gravity, atmospheric composition and radiation levels. Even small differences could favor the evolution of organisms with unique adaptations, including larger or more resistant structures.

2. ***Biological adaptations:***
   Evolution can lead to the emergence of organisms that adapt to specific conditions. On planets with dense atmospheres or with slight variations in gravity, plants or trees could develop that, although not as extreme as "colossal", do grow to sizes much larger than those we know on Earth.

3. ***Influence of alternative energy sources:***
   Sources of radiation, energy or local quantum phenomena, although not so intense, could provide additional energy for metabolic or growth processes, favoring the possibility of large-scale plant structures.

Black holes & their Quantum relationships are the timelike case we may now consider the **Darboux subspaces of F:** They are again independently parallel-transported. We denote by V0 the Darboux subspace corresponding to the zero eigenvalue. Its dimension depends on the dimension D of the spacetime. Namely,

For D odd : V0 is 3-dimensional and spanned by lmn for D even : V0 is 4-dimensional and spanned by lmnz (7.14) whereas earlier z = l (h (n 1)). These base vectors are parallel propagate

Particles; classical spinning particles. To describe a motion of the particle in D dimensions, we specify its worldline by giving the coordinates dependence on the proper time : xa( ) (a = 1 D). The particles spin is given by the Lorentz vector of Grassmann-odd coordinates A( ) (A = 1 D)

The bounded trajectories for which the radial coordinate changes in the interval (r r+). In such a case the corresponding level set for the (ry) sector is a compact three-dimensional Lagrangian submanifold which, according to the general theorem, is a three dimensional torus. One can choose three independent cycles on this torus as follows. Let us x y and and consider a closed path, which propagates from the minimal radius r to the maximal radius r+, and after this returns back to r with opposite sign of the momentum. Another path is de ned similarly for the y-motion.

The third pass r =const, y =const is for the-motion. This allows us to introduce the following action variables, Ii = (Ir Iy I) for spatial directions

4. Temperate and humid climate, or energetic atmosphere synchronized with vegetation:

An atmospheric cycle that synchronizes with plant life, where clouds rhythmically release rain and vegetation "feels" or reacts to the planet's frequencies (as if there were communication between the tree and the environment, perhaps using bio-frequencies or quantum signals).

5. Symbiotic biodiversity:

Animals or life forms adapted to these trees could form unique symbioses: flying creatures that live among the canopies, fungi that feed on quantum energy or lichens that convert stellar radiation into nutrients.

Cosmic jungle, where each tree is not only a living mountain, but also a biological structure that regulates the local climate, stores genetic information, or even communicates with other trees through the planet's "smart soil."

"Cosmic Jungle of Mountain Trees on a Green Exoplanet"

General scenario:
An exoplanet much larger than Earth, 80% covered by colossal jungles. From space, it looks like an emerald green sphere, with bright areas due to intense vegetation and a slightly turquoise atmospheric halo due to a dense atmosphere loaded with exotic gases.

Vegetation:
The trees are as tall as mountains (between 500 and 1000 meters), with crowns wide like small floating cities. Their trunks are wide like skyscrapers, with shiny bark in green, gold or bluish tones due to minerals absorbed from the ground. The roots form networks on the surface, creating structures like natural bridges.

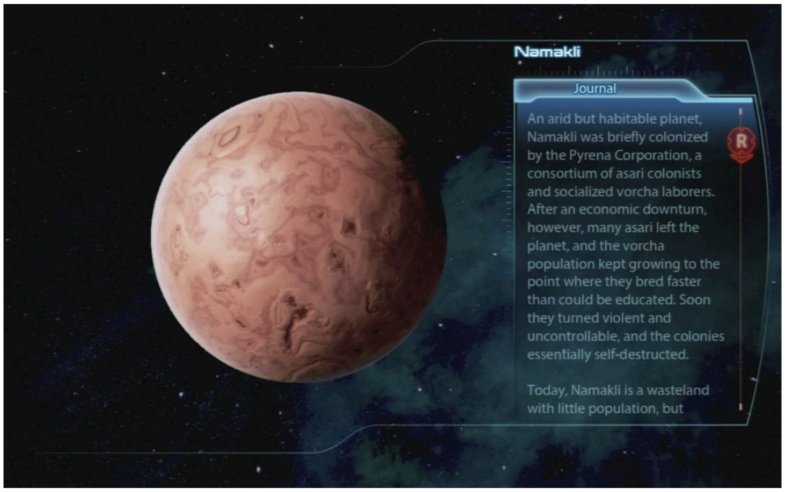
Atmosphere:
A dense atmosphere with light haze. Rays of light pass through the plant canopy forming beams that vibrate with subtle frequencies (as if quantum waves were visible). There are daytime auroras in the sky that synchronize with the breathing of the trees.

Sky and environment:
A jade green sky with low, heavy clouds, pierced by lilac rays. In the distance, a quantum portal is seen floating like a transparent sphere in constant pulse, affecting local gravity: there are floating islands and particles suspended in the air, as if everything were slightly decoupled from time.

Fauna visible:
Large winged creatures like gliders, floating slowly among the canopies. Some bioluminescent species climb the roots, and small floating creatures swarm like aerial jellyfish.

Frolov metrics;

```
 Ir = Ir(m2KEL)= 1 r+ r Iy = Iy(m2KEL)= 1 y+ y I =L dr dy Xr r Xy y
(3.52) Here r and y are turning points of r and y, respectively,
and we used the fact that is a cyclic coordinate with period 2 .
```



Integrated Quantum Element: The Portal and the Forest Resonance

Quantum Portal:
It floats about 10 km high above the crown of the tallest trees, shaped like a translucent sphere, slightly deformed like a vibrating bubble. It changes color in soft waves, from blue to violet, responding to the frequencies of the planet. It is visible both day and night, as if it were a second living moon.

Inverted Gravity Effect:
Near the portal, gravity is altered: there are areas where trees grow horizontally or spiral upwards. The rocks float around the portal as if suspended in a quantum magnetic field. Some animals evolved to float, gliding effortlessly between these altered regions.

Quantum Resonance:
The oldest trees (called *resonator-trees*) have tissues that vibrate at the same frequency as the portal. When there are cosmic storms or energy pulses, the trees emit deep, long sounds like songs, synchronizing with each other. It is believed to be a type of “planetary communication” that balances the environment.

Visual and Atmospheric Effects:

- The roots glow at night with phosphorescent light generated by trapped quantum particles.

- The air near the portal vibrates like a heat-distorted image, but with color effects and small sparkles that disappear when touched.

- There are areas where time slows down or speeds up very slightly, as if the rules were different.

Possible Natural Interface with Life:
Some species have adapted to using these quantum frequencies to “navigate” the altered forest: birds that migrate between portals, or plants that grow only under certain resonances, as if waiting for a signal.

With this, the world is left with a balance between the natural and the quantum, without breaking coherence.

Intelligent Exoplanet Scheme – Realistic and Speculative Parameters

Parameter	Estimated Value / Description
Provisional Name	Xilonis-9
Mass	~5 times Earth's mass (high gravity to retain a dense atmosphere)
Radius	~1.8 times Earth's radius (larger structure but less dense than a gas giant)
Surface Gravity	~0.9–1.1 g (adjusted due to low core density, allows colossal life without collapsing structures)
Atmospheric Pressure	~5 atm (favors tall and resistant biological structures)

Atmospheric Composition	N_2, O_2, traces of Xe, Ne, and an exotic resonant gas (He*-like)
Magnetic Field	10–50 times stronger than Earth's (highly organized, frequency-sensitive)
Vegetation Structure	Trees from 300 to 1000 meters tall, wide base, deep roots, resonant canopy functioning as organic antenna
Planetary Intelligence	Active core with complex quantum-magnetic patterns (simulates consciousness or active resonance)
Quantum Phenomenon	Seasonal dimensional portal that alters local gravity and distorts space-time
Distance from Solar System	Not observable. Hypothetical: +100 billion light-years (beyond the observable universe)