Can special relativity, general relativity, and quantum physics unify into one theory?

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Abstract

Unifying Special Relativity (SR), General Relativity (GR), and Quantum Physics (QP) remains one of the most profound challenges in theoretical physics. While each framework has achieved extraordinary empirical success, they become mutually incompatible under extreme conditions such as the earliest moments of the universe or the interior of black holes. Cosmological observations, including dark matter, dark energy, and the Hubble tension, further expose gaps in our understanding. Existing unification attempts, such as String Theory, Loop Quantum Gravity, and Grand Unified Theories, have not yet produced a complete and experimentally verified solution.

This paper argues that unification becomes possible once the global physical structure of the universe is properly identified. I propose a framework in which quantum physics occupies a central role in cosmology. Within this view, the quantum vacuum is not an empty void but an infinite medium filled with fluctuating fields and transient virtual particles. Quantum Field Theory (QFT) thus provides a natural foundation for both the origin of matter and the large-scale organization of the cosmos. The novelty of this approach lies in linking the quantum vacuum directly to the universal structure, offering a pathway toward reconciling relativistic and quantum descriptions within a single framework.

Fundamental Shortcomings of the ΛCDM Model

The prevailing cosmological framework, **ΛCDM (Lambda–Cold Dark Matter)**, posits that the universe originated from a singularity of infinite density and temperature, expanding for 13.8 billion years. Before the Big Bang, there was no space and no time.
Despite its empirical successes, ΛCDM is not a coherent physical theory but rather a **phenomenological construct**—a model patched with assumptions to fit observations. At its foundation lie several unresolved conundrums:

1. The Singularity Problem
ΛCDM begins with an **undefined singularity**—a "point of infinite density" at $t = 0$, where known physical laws break down. This is not an explanation but a **mathematical placeholder**, leaving the question of the universe's true origin unanswered.

2. Dark Matter

Introduced to reconcile galaxy rotation curves with Newtonian dynamics, **dark matter** has never been directly detected despite decades of experimental effort. Its existence remains **hypothetical**, serving as a theoretical necessity rather than a demonstrated physical entity.

3. Dark Energy

Proposed to account for the observed late-time accelerated expansion, **dark energy** constitutes ~70% of the universe's energy content. Yet its nature remains a **complete mystery**. Far from a derivation from first principles, it is an **ad hoc fix** to preserve the model.

4. Gravity's Origin

ΛCDM does not resolve the fundamental question of **what gravity is**:

- Newtonian mechanics treats it as a force.
- General relativity treats it as curvature of spacetime.
- Quantum physics hypothesizes a graviton mediator.
  No framework reconciles these views, leaving **gravity's origin fundamentally unresolved**.

5. Early Galaxies and JWST Anomalies

Observations from the **James Webb Space Telescope (JWST)** reveal **massive, chemically enriched, and evolved galaxies** at very high redshifts. These galaxies appear **too early, too large, and too developed** to fit ΛCDM's hierarchical structure-formation timeline. This discrepancy challenges the model's predictive power.

6. Spiral Galaxies and Rotation Curves

The persistence of **spiral structures** and the **flattening of galaxy rotation curves** remain unexplained within ΛCDM without invoking dark matter halos. The model lacks an **intrinsic dynamical mechanism** for galaxy morphology and long-term stability.

7. The Hubble Tension

Measurements of the **Hubble constant** differ depending on the method:

- Early-Universe probes (CMB) give one value.

- Late-Universe probes (supernovae, Cepheids) give a higher value.
  This discrepancy, known as the **Hubble tension**, has resisted resolution within ΛCDM and points to a **deeper flaw** in the model.

8. The Universe Flatness Problem

The observable universe is flat to within 0.2%—an astonishing degree of fine-tuning. ΛCDM addresses this by invoking **cosmic inflation**, but inflation itself is **speculative physics** added to rescue the model, without independent experimental verification.

Taken together, these issues reveal ΛCDM not as a **final cosmological theory**, but as a **patchwork model** built around unverified assumptions—dark matter, dark energy, and inflation. Its explanatory gaps in origin, gravity, and structure formation strongly suggest that ΛCDM is **incomplete at a foundational level**.

A genuine cosmological theory must do more than adjust parameters to fit data. It must provide a **coherent physical account** of the universe's origin, structure, and dynamics. The search for such a theory continues, and ΛCDM increasingly appears to be a **transitional framework** rather than the ultimate description of cosmic reality.

An Alternative Structure of the Universe: The Pivot Universe Hypothesis

1. Vacuum Space as the Fundamental Medium

In contrast to ΛCDM, which begins with a singularity and spacetime emerging *ex nihilo*, the proposed alternative model places **vacuum space** at the foundation of reality.

- The **vacuum space is infinite** in all directions, eternal, and independent of the existence of any matter universe.
- Modern **Quantum Field Theory (QFT)** already points in this direction: it treats the vacuum not as empty nothingness, but as a dynamic medium filled with fluctuating fields.
- These fields continuously generate **virtual particle–antiparticle pairs**, which typically annihilate each other almost instantly, maintaining the balance required by conservation laws.

Thus, the vacuum is not void but a **restless sea of potentiality**, capable of giving rise to matter under rare and exceptional conditions.

2. Finite Matter Islands in Infinite Vacuum

Within this infinite vacuum, the **Pivot Universe** is conceptualized as a **finite island of matter** that emerged at a particular place and time.

- It is not unique by necessity; speculative reasoning suggests that **other finite matter islands**—separate universes—could exist elsewhere within the same eternal vacuum.
- This picture places our universe within a broader **multiversal framework**, though grounded not in abstract inflationary landscapes but in the tangible physics of the quantum vacuum.

3. The Origin of Matter in the Pivot Universe

The key problem is to explain how **stable matter** arises from inherently transient vacuum fluctuations.

- In QFT, vacuum fluctuations give rise to particle–antiparticle pairs, but these pairs almost always annihilate back into the vacuum.
- The challenge is to identify a mechanism by which **long-lived, stable matter** emerges.

Proposed Mechanism - I propose that a **special class of vacuum fluctuation** occasionally produces a **neutron and an antineutron** that, rather than annihilating, remain real and stable.

- This stabilization process, though rare, would provide the **seed of matter creation**.
- Over time, gravitational accumulation of neutrons and antineutrons could form a **primeval neutron–antineutron star**, an object of immense density and mass.

See - The origin of matter

4. Catastrophe and the Birth of the Visible Universe

Once this primeval star reached the **limits of stability**, it would undergo a catastrophic explosion.

- This event would liberate its constituent matter, initiating the formation of the **visible Pivot Universe**.

- The explosion thus plays the role that the "Big Bang" does in ΛCDM—but crucially, it does not arise from a singularity, but from the **instability of a finite neutron–antineutron system within the infinite vacuum**.

5. Broader Implications

- This model replaces the singularity and inflation with a **physically coherent mechanism** grounded in QFT and gravitational accumulation.
- It situates our universe not as the totality of existence, but as a **finite structure embedded within an eternal vacuum**.
- It offers a natural resolution to the **problem of matter's origin**, while remaining open to the possibility of **multiple universes** within the vacuum.

The Structure of the Pivot Universe

I propose an alternative cosmological model, which I call the **Pivot Universe**. This framework posits that our matter universe originated from the **catastrophic explosion of a spinning primordial neutron star**—the **Pivot**—formed through quantum processes described earlier. The Pivot Universe is composed of two distinct but interrelated components:

1. **The central spinning neutron star (the Pivot).**
   A compact, massive, and rapidly rotating neutron–antineutron star that survived the primordial explosion.
2. **The visible matter universe.**
   A thin, disk-like structure of matter orbiting the Pivot, distributed according to the gravitational and rotational dynamics imposed by the central star.

1. Gravitational Influence of the Pivot

The Pivot exerts a profound influence on the visible universe through **gravity**. In this model, gravity is identified with the **residual manifestation of the quantum strong interaction**:

- At the **subatomic scale**, the strong force between neutrons and protons is dominant, confining quarks and binding nuclei.

- At the **cosmological scale**, this force is exceedingly weak, but the immense number of nucleons in celestial bodies produces a macroscopic effect recognizable as **gravitational attraction**.

Thus, the Pivot Universe treats gravity not as a separate fundamental interaction but as the **long-range residue of the strong force**. This idea has been elaborated in THE ORIGIN OF GRAVITY

2. Frame Dragging of the Vacuum Space

The second fundamental influence of the Pivot is through **frame dragging**, a general relativistic effect:

- The rapid spin of the Pivot causes the surrounding **vacuum space** to be dragged along with its rotation.
- This dragging determines the **geometry and dynamics** of the matter universe:
  - In the equatorial plane, the dragged space takes on a **flat, disk-like structure**, consistent with the large-scale disk geometry of the visible universe.
  - Along the rotation axis, the dragged space assumes a **spiral structure**, echoing the morphology of spiral galaxies and possibly accounting for large-scale angular momentum distributions.

It is important to note that **vacuum space remains stationary** in regions not subject to dragging. This includes not only the infinite vacuum outside the visible matter universe but also the vacuum permeating the event horizon of the Pivot and even the space at its very center.

3. Implications

This structure provides a unified physical basis for the large-scale organization of the cosmos:

- The **Pivot** acts as both gravitational center and rotational driver of the universe.
- The **visible disk universe** arises naturally from the combined effects of gravity (reinterpreted as the residual strong force) and frame dragging of vacuum space.
- The model introduces no singularity and does not require inflation; instead, it grounds cosmic structure in known physical principles—QFT, nuclear physics, and general relativity—extended into a new cosmological context.

Schematic Representation of the Universe

The structure of the entire universe is illustrated schematically in Fig. **1 to 3**.

Fig. 1 depicts the Entire structure of the universe.

Infinite vacuum space permeates everywhere. It is eternal and unbounded, serving as the background medium.

- Within this vacuum lies a **finite matter universe**—the **Pivot Universe**—located at a specific point in space and time.
- **Vacuum fluctuations** (virtual particles) occur throughout infinite space. However:
    - In regions of undisturbed vacuum, virtual particles appear and disappear without net motion.
    - In contrast, within the **frame-dragged space** surrounding the spinning Pivot, virtual particles acquire motion, reflecting the influence of the dragged geometry.
- The **dragged space around the Pivot** has a distinctive morphology:
    - It is **flattened in the equatorial plane**, forming a disk-like region.
    - Toward the **rotation axis**, the dragged space assumes a **spiral structure**, mirroring the angular momentum distribution imposed by the spinning Pivot.

The schematic shows infinite vacuum space, with the finite Pivot Universe embedded inside it. Virtual particles in undisturbed vacuum remain stationary, whereas those within the dragged space of the Pivot acquire motion. The dragged space is disk-like in the equatorial plane and spiral-shaped along the rotation axis.
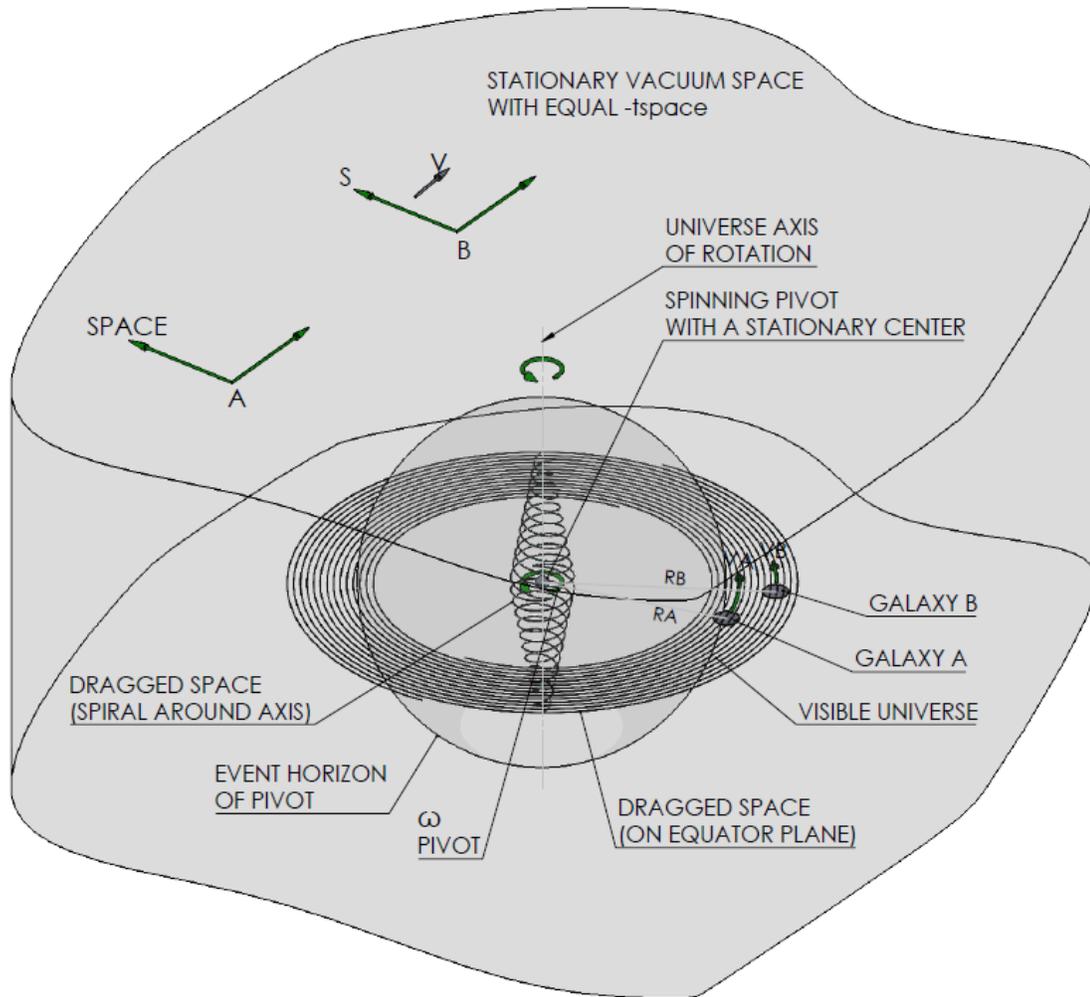
Fig.1- Entire structure of the universe

Fig. 2 — Cross Section of the Pivot Universe

Fig. 2 shows a **cross-sectional view of the Pivot Universe**, centered on the spinning **Pivot.** The figure emphasizes the **peculiar shape of dragged space** generated by the Pivot's rotation.

- The **visible matter universe**—including galaxies, stellar systems, planets, and cosmic dust—exists only within the **frame-dragged space and outside the event horizon** of the Pivot.
- An arbitrary body located **outside the dragged region**, although attracted to the Pivot by gravity, would be moving through **stationary vacuum space**.
  - To maintain an orbit at radius r, the body requires a tangential velocity derived from **Newton's law of gravitation**.

- o However, because the surrounding vacuum is stationary, the body experiences **dragging resistance**, gradually losing orbital velocity.
- o As it spirals inward, the body eventually encounters a region of dragged space where the **space velocity exceeds the speed of light**. At this boundary, the body cannot remain bound and is instead **ejected as radiation along the spiral axes**.
- Conversely, **Galaxy A** and **Galaxy B**, located within the equatorial plane where space is dragged, experience no resistance.
  - o They remain in stable motion indefinitely, co-moving with the dragged vacuum.
  - o Their dynamics must satisfy both the **tangential velocity requirement of Newtonian gravity** and the **dragged-space velocity of general relativity**.
  - o This reconciliation requires replacing the Newtonian orbital distance with the **geodesic distance** dictated by general relativity.
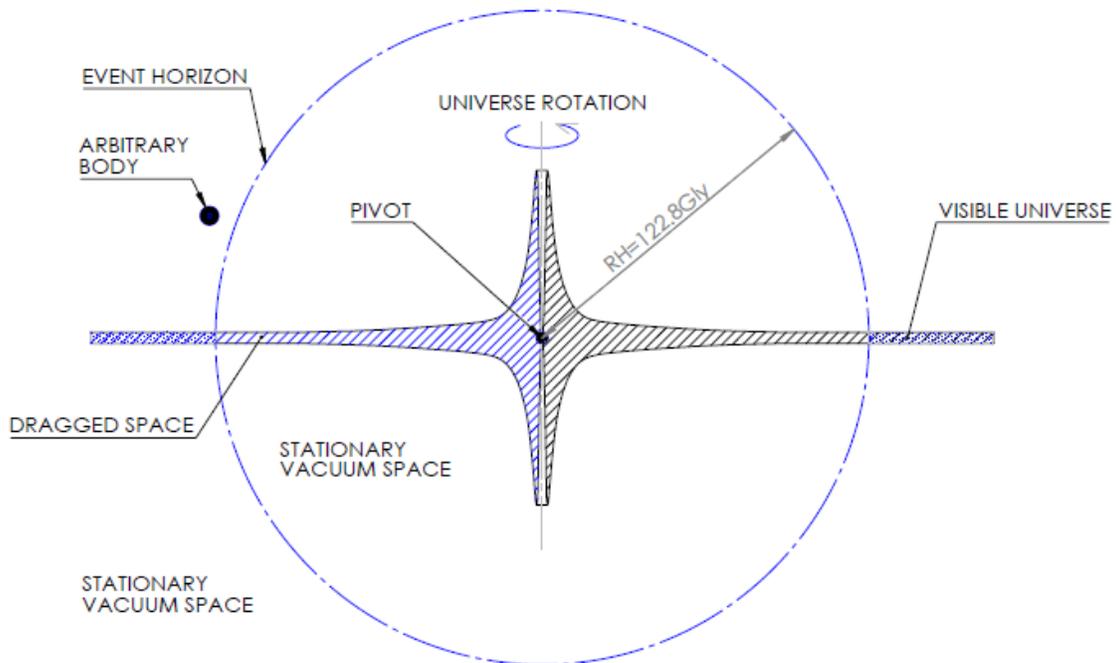

Fig. 2 - Cross section at the rotation axis of the matter universe

Fig. 3 — Velocity Profile of Dragged Space Around the Pivot

Figure 3 presents the **velocity distribution of dragged space** (V_{pivot}) as derived from the **frame-dragging formula** of general relativity. The graph illustrates how the velocity of vacuum space varies with radial distance from the Pivot for two distinct orientations:

1. **Along the axis of rotation** $\theta=0°$ colatitude angle $= 0°$
2. **In the equatorial plane** $\theta=90°$ colatitude angle $= 90°$

Key features:

- **Near the Pivot**:
  - Along the rotation axis, dragged space velocities reach up to ~**32 c**, where matter cannot exist.
  - In the equatorial plane, velocities reach ~**2.5 c**, also prohibiting stable matter.
- **At the event horizon (~123 Gly)**:
  - Dragged-space velocity decreases drastically to ~**2300 km/s**.
  - At this scale, **matter can exist stably**, allowing galaxies, stars, and cosmic structures to form.

Interpretation:
This graph highlights the distinction between the **uninhabitable inner region**, dominated by superluminal frame-dragging, and the **outer finite disk of stable matter**, where the visible universe resides.
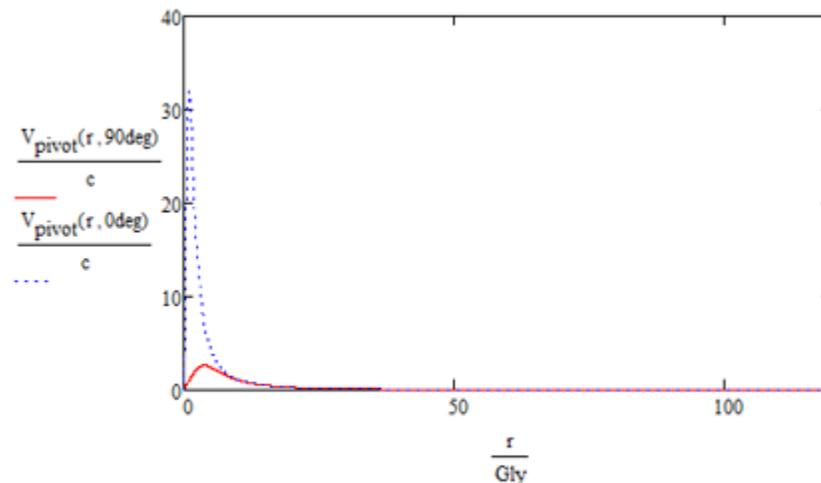

Fig. 3 – Velocity of dragged space around the Pivot

More details in [Spiral galaxies explanation for their shape and the velocity curve flattening](#)

Special Relativity in the Pivot Universe Framework

Special Relativity (SR) is built on two fundamental postulates:

1. **Invariance of physical laws in inertial frames.**
   The laws of physics are identical in all inertial frames of reference—that is, in frames experiencing no acceleration and no gravity.
   - In the Pivot Universe model, this implies that **SR is strictly valid only in regions of vacuum space external to the matter universe**, where gravitational fields are absent.
2. **Constancy of the speed of light.**
   The maximum velocity of light in vacuum is a universal constant, ccc.

In **Fig. 1**, two frames are considered:

- **Frame "SPACE"**: the **stationary vacuum frame**, representing the universal background.
- **Frame S**: a reference frame moving with velocity v relative to "SPACE".

Special relativity predicts a **time dilation** between S and "SPACE," given by:

$$t_s = \frac{t_{space}}{\sqrt{1 - \dfrac{v^2}{c^2}}} \qquad \text{Eq. (1)}$$

From this relation it follows that:

- **Time dilation exists only when there is relative motion** ($v \neq 0$) between S and "SPACE".
- If v=0, then $t_s = t_{space}$; no time dilation occurs.

In the Pivot Universe, **special relativity applies to the stationary vacuum space** rather than to relative motion between arbitrary material bodies.

- Time dilation is interpreted as the effect of motion relative to the universal vacuum background.
- This view restores consistency with the twin paradox by recognizing that elapsed proper time is always measured against the **absolute frame of the vacuum space**, which is stationary and permeates the entire cosmos.

General Relativity in the Pivot Universe Framework

Kinetic Time Dilation Between Galaxies in the Pivot Universe:

In the Pivot Universe, all celestial bodies—including galaxies, stars, and planetary systems—are embedded in the **frame-dragged disk of vacuum space** around the Pivot. As a result, they are in **continuous circular motion** about the central Pivot.

Consider two galaxies, **Galaxy A** and **Galaxy B**, as shown schematically in **Figure 1**:

- Galaxy A orbits at radius R_A from the Pivot with orbital velocity V_A.
- Galaxy B orbits at radius R_B from the Pivot with orbital velocity V_B.

Because their radii differ ($R_A \neq R_B$), their orbital velocities are necessarily different ($V_A \neq V_B$).

$$\Delta t_{s(A-B)} = \frac{t_{space}}{\sqrt{1 - \dfrac{v_A^2}{c^2}}} - \frac{t_{space}}{\sqrt{1 - \dfrac{v_B^2}{c^2}}} \qquad \text{Eq. (2)}$$

• Both galaxies are co-moving with the dragged vacuum space and thus remain in **stable orbital motion** around the Pivot.

• However, because their orbital velocities differ, **their proper times diverge**

Gravitational Time Dilation Between Galaxies in the Pivot Universe

In addition, according to general relativity, there is a gravity time dilation. It is dependent on its orbital radius as shown in Eq. (3)

$$t_{g-A} = \frac{t_{space}}{\sqrt{1 - \dfrac{2 \cdot G \cdot M_{Pivot}}{r \cdot c^2}}} \qquad \text{Eq. (3)}$$

To find the gravitational time dilation between Galaxy A and Galaxy B:

$$\Delta t_{g(A-B)} = \frac{t_{space}}{\sqrt{1 - \dfrac{2 \cdot G \cdot M_{Pivot}}{R_A \cdot c^2}}} - \frac{t_{space}}{\sqrt{1 - \dfrac{2 \cdot G \cdot M_{Pivot}}{R_B \cdot c^2}}} \quad \text{Eq. (4)}$$

The total time dilation between two galaxies A and B located in the Pivot universe is the sum of the kinematic time dilation + the gravitational time dilation, i.e., Eq. (2) + Eq. (4).

Central Principles of the Pivot universe

- **Quantum Field Theory (QFT):** Provides the foundation by explaining both the **existence of matter** (via vacuum fluctuations) and the **large-scale cosmic structure**, making it central to cosmology.
- **Pivot Universe:** Postulates a primeval **neutron–antineutron star (the Pivot)** as the true cosmic origin.
- **Unification:** Within this structure, **Quantum Physics (QP), Special Relativity (SR), and General Relativity (GR)** are reconciled into a single coherent framework.

Pivot Universe Solutions to ΛCDM Conundrums

1. **Singularity Problem**
   - ΛCDM: Begins with a point of infinite density, where physics breaks down.
   - Pivot Universe: No singularity. Matter originates gradually from vacuum energy, forming a primeval neutron star that explodes upon reaching a physical limit.
2. **Dark Matter**
   - ΛCDM: Requires invisible, unknown matter to explain galaxy rotation.
   - Pivot Universe: Dark matter is concentrated in the Pivot itself (a Kerr black hole from an external perspective). Hidden behind the event horizon, it is unobservable to external observers.
3. **Dark Energy**
   - ΛCDM: Introduces dark energy to explain accelerating expansion.
   - Pivot Universe: No dark energy exists; expansion and cosmic dynamics are explained through physical processes of the Pivot and dragged space.
4. **Origin of Gravity**
   - ΛCDM: Treats gravity as spacetime curvature (GR) without microscopic origin.
   - Pivot Universe: Gravity arises from the **residual strong force** acting between matter particles. Although infinitesimal at particle scales, it becomes significant due to the enormous number of nucleons in celestial bodies.
5. **Early Galaxies & JWST Anomalies**
   - ΛCDM: Struggles with massive, chemically enriched galaxies too soon after the Big Bang.

- Pivot Universe: The explosion tore spacetime temporarily, creating voids where matter traveled superluminally. Matter filled space nearly simultaneously, allowing galaxies to form early and uniformly. As vacuum healed, the universal speed limit was reinstated.

6. **Spiral Galaxies & Flat Rotation Curves**
   - ΛCDM: Requires dark matter halos to explain flat velocity profiles.
   - Pivot Universe: Rotation curve flattening is explained by the Pivot's influence and frame-dragging, without invoking exotic dark matter. (Details in your spiral-galaxy explanation section.)

7. **Hubble Tension**
   - ΛCDM: Faces inconsistent values of the Hubble constant depending on measurement method.
   - Pivot Universe: Hubble constant is not universal but **distance-dependent**, tied to a galaxy's location relative to the Pivot.

8. **Flatness Problem**
   - ΛCDM: Requires inflation to flatten the Universe.
   - Pivot Universe: The visible Universe exists within **frame-dragged space outside the Pivot's event horizon**. At these distances, dragged space is naturally flat.

More details are given in:
[The Structure of the Pivot Universe](.).