The Pivot Universe: A Stationary Kerr-Geometry Interpretation of JWST Observations

Arieh Sher
Pivot Universe Theory
pivot.universe.theory@gmail.com

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Abstract

Recent observations from the James Webb Space Telescope (JWST) reveal massive, chemically evolved galaxies and compact massive objects (Little Red Dots) at redshifts $z > 10$. In the standard ΛCDM model, these findings generate severe tensions with hierarchical structure-formation timescales. We propose the **Pivot Universe (PU)**, a stationary Kerr-like gravitational system where redshift is a spatial coordinate $z(r)$ rather than a measure of cosmic time. Utilizing the specific Pivot parameters $M_p = 7.82\times10^{53}$ kg and $J_p = 1.06\times10^{87}$ Js, we derive a relativistic Hill radius (R_H) that accounts for the observed morphological diversity. We demonstrate that the "unpacking" of galaxies and the existence of compact LRDs are natural consequences of the tidal shear and gravitational potential near the Pivot's event horizon ($R_s \approx 122$ Gly).

1 Introduction

The "Early Massive Galaxy" problem suggests galaxies at $z = 14$ are too mature for their supposed age of 300 Myr. The PU model resolves this by asserting that the visible universe is a thin shell where all matter was created quasi-simultaneously during a single global event. Consequently, high-redshift galaxies are coeval with the Milky Way (≈ 13.8 Gyr) but reside deeper in the gravitational potential of a central rotating mass, the Pivot.

2 Spacetime Geometry and Coordinate Redshift

The PU is governed by a central rotating mass M_p. The Boyer-Lindquist metric defines the stationary spacetime:

$$ds^2 = -\left(1 - \frac{2GM_p r}{\rho^2}\right) dt^2 - \frac{4GM_p a r \sin^2\theta}{\rho^2} dt d\phi + \frac{\rho^2}{\Delta} dr^2 + \rho^2 d\theta^2 + \Sigma \sin^2\theta d\phi^2 \qquad (1)$$

where $R_s = 2GM_p/c^2 \approx 1.16 \times 10^{27}$ m. The observed redshift $1 + z$ is determined by the gravitational potential at coordinate r:

$$1 + z = \left(1 - \frac{R_s r}{\rho^2}\right)^{-1/2} \qquad (2)$$

For a Little Red Dot (LRD) at $z = 8.6$, the object is located at $r \approx 1.011 R_s$, placing it within the strong-field regime of the Pivot.

3 Derivation of the Relativistic Hill Radius (R_H)

A primordial black hole seed (M_{BH}) captures matter within a radius where its local gravity exceeds the Pivot's tidal shear. We derive the relativistic Hill radius R_H as:

$$R_H(z, M_{BH}) = r(z) \left(\frac{M_{BH}}{3M_p} \right)^{1/3} \Phi(a, \theta) \tag{3}$$

where the relativistic correction Φ accounts for the Kerr geometry:

$$\Phi(a, \theta) = \left[\frac{\Delta \rho^2}{\Sigma} \cdot \left(1 - \frac{\omega L}{E} \right)^2 \right]^{1/6} \tag{4}$$

At high redshifts, $\Delta \to 0$, causing the physical Hill radius to shrink significantly in coordinate space, leading to the observed compactness of LRDs.

4 Morphological Diversity and Coexistence

The coexistence of compact LRDs and large spirals at high z is explained by the seed mass M_{BH}. For a fixed $z = 7$ ($r \approx 1.015 R_s$), the capture zone scales as $V_H \propto M_{BH}$:

- **LRDs ($M_{BH} \approx 10^7 M_\odot$):** $R_H \approx 32$ kpc. Intense tidal stripping restricts the galaxy to a dense core.
- **Spirals ($M_{BH} \approx 10^{11} M_\odot$):** $R_H \approx 694$ kpc. The massive seed maintains an extended disk.

5 The Unpacking Mechanism and Surface Brightness

As a galaxy's radial coordinate r increases (lower redshift), tidal shear $\Psi \approx 2GM_pD/r^3$ decreases. This results in "unpacking":

1. **Expansion:** The Hill radius expands by $\approx 500\%$ from $z = 10$ to $z = 0.1$.
2. **Density:** Local galaxies are $\approx 200\times$ less dense than LRDs due to this geometric relaxation.
3. **Color:** Redness in LRDs is a product of gravitational redshift (z_g) and high-density dust extinction.

6 Stability Threshold

The threshold for a stable 10 kpc spiral disk at $z = 10$ is calculated as:

$$M_{crit} \approx 3M_p \left(\frac{R_{disk}}{r \cdot \Phi} \right)^3 \approx 2.7 \times 10^4 M_\odot \tag{5}$$

This explains why mature spirals (e.g., ceers-2112) are visible at extreme redshifts; even mid-sized primordial seeds can dominate the Pivot's tidal field at $z = 10$.

7 Conclusion

The Pivot Universe provides a mathematically consistent alternative to ΛCDM. By identifying redshift as a spatial coordinate within a Kerr geometry, it accounts for the maturity and morphology of JWST-observed galaxies without requiring dark energy or accelerated cosmic timelines.

References

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