Section 5. Rotation Curve Reconstruction without Dark Matter

One of the strongest empirical motivations for the dark-matter hypothesis is the observed flatness of galactic rotation curves. In the standard reading, stars at large galactocentric radii move too quickly to be gravitationally bound by the luminous matter alone. The usual conclusion is that an extended halo of unseen matter must be present. CUWF proposes a different interpretation.

In the present framework, the anomalous part of the rotation curve is not attributed to hidden particulate mass. It is attributed to a structural contribution from the entropic field itself. The key idea is that visible baryonic structure does not merely source ordinary Newtonian attraction. It also distorts the entropic manifold in a way that generates a nontrivial entropic tension field extending beyond the luminous core.

The purpose of this section is therefore to show how a flat rotation curve can emerge without adding dark matter as a new substance. The argument is not yet a full numerical fitting program. It is a structural reconstruction demonstrating that the observed large-radius velocity behavior can be understood as the combined effect of baryonic mass and field-level entropic tension.

5.1 Newtonian Baseline

The standard Newtonian prediction begins from the orbital balance condition for a star at radius r around a galaxy with enclosed mass M(r):

$$v^2(r) = G\, M(r) / r$$

Within this framework, if one moves sufficiently far beyond the luminous region so that M(r) approaches an approximately constant asymptotic value, then the predicted velocity must decay as

$$v(r) \propto 1 / \sqrt{r}$$

This is the canonical expectation for a system whose outer dynamics are controlled only by the central baryonic mass distribution. The empirical problem is that observed spiral-galaxy rotation curves often do not show this decline. Instead, the velocity remains approximately constant over large radial ranges.

5.2 CUWF Structural Correction

CUWF reconstructs the missing contribution by introducing entropic tension as a field-level structural term. The modified velocity relation is written schematically as

$$v^2(r) = G\,M(r) / r + \boldsymbol{\kappa}\,\tau^E(r)$$

where

$$\tau^E(r) = -\nabla \cdot \Xi(r)$$

is the entropic tension field and $\boldsymbol{\kappa}$ is the entropic-geometry coupling constant.

The interpretation is direct. Stars do not respond only to enclosed luminous mass. They also respond to the structural resistance of the entropic field. The second term is not a dark-matter halo inserted by hand. It is the effective dynamical contribution of the entropic manifold after it has been non-uniformly distorted by baryonic structure.

5.3 Emergence of Flat Curves from the τ^E Field

The key mechanism becomes visible once the radial behavior of the two terms is compared. Near the galactic core, baryonic matter strongly distorts the entropic field and creates significant curvature in the local manifold. But the structural response does not remain confined to the region occupied by most of the visible mass. The curvature propagates through Ω^E and generates a long-range τ^E field.

As a result, the ordinary Newtonian term

$$G\,M(r) / r$$

decreases with increasing radius in the usual way, while the entropic-tension contribution

$\kappa\,\tau^E(r)$

can remain approximately constant over a broad outer radial regime.

If this occurs, the total $v^2(r)$ approaches a nearly constant value. The flat rotation curve therefore emerges naturally without invoking an unseen mass reservoir. The outer star is not orbiting inside a halo of invisible particles. It is responding to a structural tension topology that extends beyond the luminous matter distribution.

5.4 Spiral Galaxy Archetype

The mechanism may be visualized most clearly in the case of a typical spiral galaxy. The central bulge and inner disk dominate the luminous baryonic mass. These same regions also generate the strongest initial entropic disturbance.

That disturbance does not merely create a local well. It imprints a broader tension structure across the galactic manifold. The outer disk therefore samples not only the declining Newtonian influence of the enclosed luminous mass but also the distributed τ^E field produced by the larger entropic response.

The observed rotation curve then maps the topology of the entropic tension field rather than the distribution of hidden matter. This immediately suggests why galaxies with broadly similar baryonic organization may exhibit similarly flat rotation curves: the relevant large-radius behavior may depend not only on visible mass totals, but on the way baryonic structure induces a comparable entropic tension topology.

5.5 Scope and Meaning of the Reconstruction

The argument of this section should be read at the correct level. It is a structural reconstruction, not yet a complete empirical fitting program across galaxy catalogs. Its purpose is to show that the dark-matter inference is not logically forced by rotation curves alone if the gravitational field is allowed to include a field-reaction term arising from the entropic manifold itself.

The conceptual gain is strong. Instead of adding a non-detected matter halo to repair the discrepancy, CUWF interprets the discrepancy as evidence that the baryon-distorted entropic field carries its own long-range dynamical contribution. Flat rotation curves then become signatures of entropic tension rather than signatures of invisible matter.