Koronda Density-Vortex Mathematical Framework

Core Equations

1. Fine Structure Constant Variation

The fundamental relationship between fine structure constant and gravitational potential:

$$\alpha(r) = \alpha_0 [1 + \kappa \Phi(r)/c^2]$$

Where:

- α_0 = laboratory reference value (~1/137)
- κ = Koronda coupling constant ($0.01 \leq \kappa \leq 0.5$)
- $\Phi(r)$ = gravitational potential (negative near masses)
- c = speed of light

2. Praesto Density Field

The Praesto medium density responds to local energy-momentum:

$$\rho_P(r) = \rho_{P0} [1 + \beta T_{\mu\nu}(r)]$$

Where:

- ρ_{P0} = background Praesto density
- β = energy-momentum coupling constant
- $T_{\mu\nu}$ = stress-energy tensor

3. Electromagnetic Coupling Gradient

The gradient in α creates effective electromagnetic force:

$$F_{EM} = -\nabla[\alpha(r) E^2(r)]$$

This gradient drives matter toward regions of higher α (deeper potential wells).

4. Self-Consistent Field Equations

Modified Poisson Equation

The gravitational potential includes feedback from α-modified energy distribution:

$$\nabla^2\Phi = 4\pi G [\rho_{matter}(r) + \delta\rho_\alpha(r)]$$

Where δρ_α(r) represents energy density redistribution due to α variation:

$$\delta\rho_\alpha(r) = (\partial E_{atomic}/\partial\alpha) \times (\partial\alpha/\partial\Phi) \times \rho_{matter}(r)$$

Matter Flow Equation

Matter density evolves following the α gradient:

$$\partial\rho/\partial t + \nabla\cdot(\rho v) = 0$$

With velocity field:

$$v = -D\,\nabla[\ln \alpha(r)]$$

Where D is a diffusion-like parameter governing response rate.

5. Density-Vortex Formation

Stability Analysis

The system has a critical density ρ_crit where the feedback becomes unstable:

$$\rho_{crit} = c^2/(4\pi G\,\kappa\,\alpha_0\,|\partial E_{atomic}/\partial\alpha|)$$

Above this density, matter accumulation accelerates (vortex formation).

Vortex Structure

In spherical symmetry, the steady-state vortex profile satisfies:

$$d/dr[r^2\,d\Phi/dr] = 4\pi G\,r^2\,\rho_0\,[1 + \kappa\Phi(r)/c^2]^n$$

Where n depends on the atomic energy response to α.

6. Energy Minimization Principle

The system evolves to minimize total electromagnetic energy:

$$E_{total} = \int [\alpha(r)\,E^2(r)/2 + \text{gravitational terms}]\,d^3r$$

The equilibrium configuration balances:

- Electromagnetic energy minimization (drives matter inward)
- Gravitational potential energy (resists further compression)
- Kinetic energy of matter flow

7. Observable Predictions

Spectroscopic Shifts

The fractional wavelength shift for transitions in gravitational field:

$$\Delta\lambda/\lambda = 2\,\Delta\alpha/\alpha = 2\kappa\,\Delta\Phi/c^2$$

Acceleration Profile

The effective gravitational acceleration includes α-gradient contribution:

$$g_{eff} = g_{Newton}\left[1 + \kappa\,\Phi(r)/c^2 + \kappa\, r\, d\Phi/dr / c^2\right]$$

This naturally explains MOND-like behavior at low accelerations where the κ terms become significant.

8. Boundary Conditions

For an isolated mass M:

- At $r \to \infty$: $\Phi \to 0$, $\alpha \to \alpha_0$, $\rho \to \rho_{background}$
- At $r \to 0$: $\Phi \sim -GM/r$, $\alpha \sim \alpha_0[1 - \kappa GM/(rc^2)]$
- Continuity of Φ and $d\Phi/dr$ at all boundaries

9. Dimensionless Parameters

Koronda Number

$$Ko = \kappa\, GM/(Rc^2)$$

This dimensionless parameter determines the strength of α effects for a mass M and radius R.

Vortex Strength

$$Vs = (\rho/\rho_{crit})^{(1/2)}$$

Measures how far above critical density the system operates.

10. Numerical Integration Scheme

For computational solutions:

1. Start with Newtonian $\Phi_0(r)$
2. Calculate $\alpha_0(r) = \alpha_0[1 + \kappa\Phi_0(r)/c^2]$
3. Determine modified density $\rho_1(r)$ from energy minimization
4. Solve modified Poisson equation for $\Phi_1(r)$
5. Iterate until convergence: $|\Phi_{n+1} - \Phi_n| < \text{tolerance}$

Physical Interpretation

The density-vortex emerges from the interplay between:

- **Driving force**: α gradient creates effective EM attraction
- **Self-reinforcement**: Higher density → deeper potential → larger α → stronger attraction
- **Saturation**: Eventually balanced by gravitational potential energy

This provides a **causal mechanism** for gravity through electromagnetic coupling variations in the Praesto substrate.