

Electrogravitics II: The Frank Meno Electron

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Abstract

We extend the spin-fluid kinetic analog gravity model of Paper I to massive charged particles. We show that the collision term in the spin-squared sector generates the quantum potential of the Madelung equations, reproducing the Schrödinger equation and yielding a formula for $\hbar$ in terms of the model's collision parameters. We then introduce the helical vortex as the soliton structure for the electron. The helical vortex has both poloidal circulation, which gives the spin, and azimuthal circulation, which gives the magnetic moment. The pitch of the helix determines the translational velocity and is always negative in the plasma reference frame. The vortex is stabilized by the Meno mechanism—orientation-dependent collisions that create an inward recoil pressure—and by the virial balance, which includes the Coulomb self-energy. We derive formulas for the electron charge, mass, and $\hbar$ in terms of the analog parameters. We show that the helical vortex reproduces the far-field electric (Coulomb), magnetic (dipole), and gravitational (Newtonian) fields, with a Yukawa correction at intermediate distances. We show that the model reproduces the full Lorentz force, Stern-Gerlach splitting, Aharonov-Bohm phase, and Larmor precession. We discuss the $g - 2$ anomaly and the electron electric dipole moment as targets for future quantitative work. We predict that the electron has negative active gravitational mass while the positron has positive, and we show that this is consistent with the Eöt-Wash null results because the neutron's mass is dominated by QCD binding energy, not valence quark masses. We close with a brief mention of the three families and quarks as speculative extensions.

Contents

I	Foundations	3
1	Introduction	4
2	Review of Paper I	4
2.1	Moment Hierarchy	4
2.2	The Pressure Feedback	5
2.3	The Vacuum State	5
3	The Reverse Kinetic Problem	5
3.1	The Moment Map	5
3.2	Two Informal Theorems	5
3.3	Five Classes of Kinetic Systems	6

II	The Quantum Potential and $\hbar$	6
4	The Spin-Squared Momentum Equation	6
5	Matching to Madelung	6
5.1	The Square Root as a Poisson Standard Deviation	6
6	The Formula for $\hbar$	7
III	The Frank Meno Electron	7
7	The Helical Vortex	7
7.1	Geometry	7
7.2	Degrees of Freedom	7
7.3	The Negative Pitch in the Plasma Frame	7
8	The Meno Mechanism	8
8.1	The Physical Picture	8
8.2	Derivation from the Boltzmann Integral	8
9	The Six Balance Equations	8
9.1	Poloidal Balance	8
9.2	Azimuthal Balance	8
9.3	Axial Balance	9
9.4	Radial Balance	9
9.5	Pitch Balance	9
9.6	Energy Balance (No Radiation)	9
10	The Virial Theorem and the Electron Mass	9
10.1	The Energy Functional	9
10.2	The Virial Condition	9
10.3	The Electron Mass	9
10.4	Geometric Estimate	10
11	The Formula for e	10
12	The g-Factor and the Four States	10
12.1	The g -Factor	10
12.2	The Four States	10
13	Far-Field Reproducibility	11
13.1	Electric Field	11
13.2	Magnetic Field	11
13.3	Gravitational Field	11
13.4	Yukawa Correction	11

14 Lorentz Force Sanity Check	11
14.1 Response to a Constant Spin-Squared Density Gradient	11
14.2 Response to a Constant External Spin	12
14.3 Full Lorentz Force	12
15 Stern-Gerlach and Aharonov-Bohm	12
15.1 Stern-Gerlach	12
15.2 Aharonov-Bohm	13
IV The Active Gravitational Effect	13
16 Passive vs. Active Gravitational Mass	13
17 The Prediction	13
18 Consistency with ALPHA-g	13
19 Consistency with Eöt-Wash	14
20 Comparison with the Literature	14
V Precision Tests and Speculative Extensions	14
21 The $g - 2$ Anomaly	14
22 The Electron Electric Dipole Moment	14
23 Quarks and Color	15
24 The Three Families	15
VI Discussion	15
25 Status of the Model	15
26 Falsifiability	15
27 Judging Ben Franklin	16
28 Conclusion	17

Part I

Foundations

1 Introduction

Paper I established a kinetic analog model in which the moments of a spin-fluid distribution function reproduce the structure of Maxwell's equations and the gravitational field equations. The gauge field is the spin-squared current $A^\mu = (\kappa_A \rho_s c, \kappa_A \mathbf{M})$. The gravitational potential is the base pressure P . The closure is the Euler + spin system. The model predicts a torsion-balance torque from vorticity gradients.

Paper I treated the fields as continuous. It did not address matter. This paper addresses that question. We propose that charged particles are *topological solitons* in the spin sector of the fluid, and we develop the model for the electron.

The paper is organized as follows. Part I reviews the foundations from Paper I and the reverse kinetic problem. Part II derives the quantum potential from the collision term and the formula for $\hbar$. Part III introduces the helical vortex, checks its far-field behavior, and demonstrates the Lorentz force, Stern-Gerlach, Aharonov-Bohm, and Larmor precession. Part IV predicts the active gravitational effect of the electron and positron and checks consistency with Eöt-Wash. Part V discusses the $g-2$ anomaly, the eEDM, and the three families and quarks as speculative extensions.

2 Review of Paper I

2.1 Moment Hierarchy

We work with a distribution $f(\mathbf{x}, \mathbf{v}, \mathbf{s}, t)$, where $\mathbf{v}$ is translational velocity and $\mathbf{s}$ is intrinsic spin. The transport equation is

$$\frac{\partial f}{\partial t} + \mathbf{v} \cdot \nabla f = \mathcal{C}[f]. \quad (1)$$

All forces are in the collision operator $\mathcal{C}[f]$.

Gravity sector (spin-averaged moments):

$$n = \int f, \quad (2)$$

$$nu_i = \int v_i f, \quad (3)$$

$$P_{ij} = \int (v - u)_i (v - u)_j f. \quad (4)$$

The base pressure $P = \frac{1}{3} P_{ii}$ is identified with the gravitational potential:

$$\Phi_g = -\frac{P}{nm}. \quad (5)$$

Electromagnetic sector (spin-squared moments):

$$\rho_s = \int s^2 f, \quad (6)$$

$$M_i = \int s^2 v_i f, \quad (7)$$

$$\Pi_{ij} = \int s^2 v_i v_j f. \quad (8)$$

The gauge field is

$$A^\mu = (\kappa_A \rho_s c, \kappa_A \mathbf{M}). \quad (9)$$

2.2 The Pressure Feedback

The sectors are coupled through the pressure feedback:

$$P = P^{\text{eq}} - \gamma_0 \rho_s. \quad (10)$$

The spin-squared density modifies the base pressure, which modifies the gravitational potential.

2.3 The Vacuum State

The vacuum has a uniform spin-squared density $\rho_s^{\text{vac}} = n\sigma_s^2$. The physical potential is measured relative to the vacuum:

$$\phi_{\text{phys}} = \kappa_A c (\rho_s - \rho_s^{\text{vac}}). \quad (11)$$

A soliton with $\rho_s > \rho_s^{\text{vac}}$ (a bump) has positive potential; a soliton with $\rho_s < \rho_s^{\text{vac}}$ (a hole) has negative potential.

3 The Reverse Kinetic Problem

Kinetic theory usually proceeds forward: given a distribution and a collision operator, compute the moments and derive the field equations. The reverse kinetic problem asks the opposite question: given a field satisfying field equations, does there exist a kinetic system whose moments reproduce it?

3.1 The Moment Map

The moment map is

$$\mathcal{M} : f \mapsto M^\mu(\mathbf{x}, t) = \int \mathcal{O}^\mu(\boldsymbol{\xi}) f(\mathbf{x}, \boldsymbol{\xi}, t) d\boldsymbol{\xi}. \quad (12)$$

The reverse kinetic problem asks: given F^μ , does there exist f and $\mathcal{O}^\mu$ such that $F^\mu = \mathcal{M}[f]^\mu$?

3.2 Two Informal Theorems

Theorem 1 (Trivial Realizability). Any sufficiently smooth field is a moment of some distribution.

Theorem 2 (Kinetic Realizability, informal). Any field satisfying hyperbolic field equations with a closed moment hierarchy is a moment of a kinetic system.

3.3 Five Classes of Kinetic Systems

Type	Internal space	Gauge field
I	Velocity space	Density and momentum
II	Spin space	Spin-squared density and flux
III	Velocity $\times$ spin	Mixed
IV	Higher-dimensional	Selected coordinates
V	Non-vector	Representation matrices

The spin-fluid model is a Type II construction.

Part II

The Quantum Potential and $\hbar$

4 The Spin-Squared Momentum Equation

The spin-squared momentum equation is

$$\partial_t M_i + \partial_j \Pi_{ij} = \int s^2 v_i \mathcal{C}[f] d^3 v d^3 s. \quad (13)$$

In the Euler + spin closure, $\Pi_{ij} = p_s \delta_{ij}$, giving

$$\partial_t M_i + \partial_i p_s = \int s^2 v_i \mathcal{C}[f] d^3 v d^3 s. \quad (14)$$

5 Matching to Madelung

The Madelung form of the Schrödinger equation is

$$\partial_t M_i + \partial_i p_s = -\frac{\rho_s}{m} \partial_i Q, \quad (15)$$

where Q is the quantum potential:

$$Q = -\frac{\hbar^2}{2m} \frac{\nabla^2 \sqrt{\rho_s}}{\sqrt{\rho_s}}. \quad (16)$$

Matching the two expressions gives the integral equation for the collision term:

$$\int s^2 v_i \mathcal{C}[f] d^3 v d^3 s = -\frac{\rho_s}{m} \partial_i Q - \partial_i p_s. \quad (17)$$

5.1 The Square Root as a Poisson Standard Deviation

The spin-squared density is the variance of the spin distribution:

$$\rho_s = \langle s^2 \rangle = \sigma_s^2, \quad (18)$$

where σ_s is the spin standard deviation. The square root is

$$\sqrt{\rho_s} = \sigma_s. \quad (19)$$

If the spin fluctuations are Poisson-distributed, the variance equals the mean:

$$\sigma_s^2 = \langle N_s \rangle, \quad (20)$$

where N_s is the number of spin collisions. The square root is the Poisson standard deviation.

6 The Formula for $\hbar$

If the collision term has the Poisson form $\Gamma_s \partial_i \rho_s$, then

$$\hbar^2 = \frac{2m^2 \Gamma_s}{\rho_s} \frac{\partial_i \rho_s}{\partial_i (\nabla^2 \sigma_s / \sigma_s)}. \quad (21)$$

The quantum of action is set by the spin-flip rate and the soliton profile.

Part III

The Frank Meno Electron

7 The Helical Vortex

7.1 Geometry

The helical vortex is a vortex whose core winds around a central axis. It is characterized by:

- Helix radius R : the distance from the central axis to the core.
- Pitch p : the distance along the axis for one complete turn.
- Core radius a : the thickness of the vortex core.
- Poloidal circulation Γ_θ : the circulation around the core.
- Azimuthal circulation Γ_ϕ : the circulation around the axis.

7.2 Degrees of Freedom

Mode	Symbol	Type	Role
Translation	$\mathbf{X}$	Zero mode	Particle position
Rotation	ϕ_0	Zero mode	Internal phase
Helix radius	R	Massive	Geometry
Pitch	p	Massive	Twist
Core radius	a	Massive	Core size
Poloidal circulation	Γ_θ	Topological	Spin
Azimuthal circulation	Γ_ϕ	Dynamical	Magnetic moment

7.3 The Negative Pitch in the Plasma Frame

The translational velocity of the helix is

$$V = V_{\text{ring}} + \frac{\Gamma_\theta}{2\pi R} \tan \alpha, \quad (22)$$

where α is the pitch angle and V_{ring} is the smoke ring velocity. In the plasma reference frame ($V = 0$),

$$\tan \alpha = -\frac{2\pi R V_{\text{ring}}}{\Gamma_\theta}. \quad (23)$$

Since $V_{\text{ring}} > 0$ and $\Gamma_\theta > 0$, the pitch is always negative. The electron at rest is a backward-wound helix. This is a geometric necessity: the helix must cancel the translational velocity of the smoke ring.

8 The Meno Mechanism

8.1 The Physical Picture

The Meno mechanism provides the inward force that stabilizes the vortex:

1. Particles have orientation-dependent cross-sections.
2. The shear flow in the vortex aligns the particles.
3. Aligned particles collide more often and are ejected from the core.
4. The ejection creates an inward recoil pressure.

8.2 Derivation from the Boltzmann Integral

The collision integral is

$$\mathcal{C}[f] = \int \left[f' f'_1 - f f_1 \right] \sigma(\Omega, \mathbf{s}, \mathbf{s}_1) |\mathbf{v} - \mathbf{v}_1| d^3 v_1 d^3 s_1 d\Omega, \quad (24)$$

with the orientation-dependent cross-section

$$\sigma(\Omega, \mathbf{s}, \mathbf{s}_1) = \sigma_0 \left[1 + \epsilon \hat{s}_i \hat{s}_j \hat{k}_i \hat{k}_j \right]. \quad (25)$$

The moments give:

- **Alignment term:** $-\Gamma_{\text{align}} \hat{k}_i \hat{k}_j \sigma_j$, with $\Gamma_{\text{align}} = n \sigma_0 \epsilon \sigma_v$.
- **Recoil term:** $\Gamma_{\text{recoil}} D_0 \nabla^2 \rho_s$, with $\Gamma_{\text{recoil}} D_0 = \frac{1}{3} \sigma_0 n \sigma_v \ell_{\text{mfp}} \epsilon$.

The Meno mechanism is derived, not assumed.

9 The Six Balance Equations

A stable helical vortex moving at constant velocity is constrained by six balance equations.

Balance	Determines	Type
Poloidal	Core radius a	Radial ODE
Azimuthal	Circulation Γ_ϕ	Azimuthal ODE
Axial	Velocity V	Zero mode
Radial	Helix radius R	Radial ODE
Pitch	Pitch p	Variational
Energy	No radiation	Stability

9.1 Poloidal Balance

$$\partial_\sigma p_s + \frac{\rho_s w_\theta^2}{\sigma} = \frac{\rho_s}{m} \partial_\sigma Q + \Gamma_{\text{recoil}} D_0 \Delta \partial_\sigma \Sigma_{\sigma\sigma}. \quad (26)$$

9.2 Azimuthal Balance

$$\partial_j (\rho_s w_\phi w_j) = \Gamma_{\text{recoil}} D_0 \Delta \partial_j \Sigma_{\phi j} + \eta_\rho \nabla^2 M_\phi. \quad (27)$$

9.3 Axial Balance

$$\partial_z(\rho_s w_z^2 + p_s) = \Gamma_{\text{recoil}} D_0 \Delta \partial_z \Sigma_{zz} + \eta_\rho \nabla^2 M_z. \quad (28)$$

9.4 Radial Balance

$$\frac{\rho_s w_\phi^2}{R} + \frac{\rho_s w_\theta^2}{R} = \partial_R p_s + \frac{\rho_s}{m} \partial_R Q + \Gamma_{\text{recoil}} D_0 \Delta \partial_R \Sigma_{RR}. \quad (29)$$

9.5 Pitch Balance

$$\partial_p E_{\text{spin}} + \partial_p E_P = \partial_p E_{\text{coll}}. \quad (30)$$

9.6 Energy Balance (No Radiation)

$$\dot{E}_{\text{rad}} = 0. \quad (31)$$

The helix must move below the speeds of all waves in the medium, or the radiation must be suppressed by the soliton structure.

10 The Virial Theorem and the Electron Mass

10.1 The Energy Functional

The total energy of the helical vortex as a function of the soliton size R is

$$E(R) = \frac{e^2}{4\pi\epsilon_0 R} + \frac{\gamma_0^{\text{phys}} \rho_0 \Gamma^2}{c^2} R + p_{s,0}^{\text{phys}} R^3, \quad (32)$$

where the first term is the Coulomb self-energy, the second is the kinetic energy, and the third is the pressure energy.

10.2 The Virial Condition

The virial condition $dE/dR = 0$ gives

$$-\frac{e^2}{4\pi\epsilon_0 R^2} + \frac{\gamma_0^{\text{phys}} \rho_0 \Gamma^2}{c^2} + 3p_{s,0}^{\text{phys}} R^2 = 0. \quad (33)$$

At equilibrium,

$$\frac{e^2}{4\pi\epsilon_0 R} = \frac{\gamma_0^{\text{phys}} \rho_0 \Gamma^2}{c^2} R + 3p_{s,0}^{\text{phys}} R^3. \quad (34)$$

10.3 The Electron Mass

The electron mass is the total energy at equilibrium:

$$m_e c^2 = E(R_{\text{eq}}) = \frac{e^2}{2\pi\epsilon_0 R_{\text{eq}}} - 2p_{s,0}^{\text{phys}} R_{\text{eq}}^3. \quad (35)$$

The first term is the electromagnetic mass; the second is the pressure correction. In the electromagnetic-dominated regime, the mass is

$$m_e c^2 \approx \frac{e^2}{2\pi\epsilon_0 R_{\text{eq}}}. \quad (36)$$

10.4 Geometric Estimate

Matching the electromagnetic mass formula to the observed electron mass gives

$$R_{\text{eq}} \approx 2r_e \approx 5.6 \times 10^{-15} \text{ m}, \quad (37)$$

where $r_e = 2.82 \times 10^{-15} \text{ m}$ is the classical electron radius. This is about 1/70 of the Compton wavelength $\lambda_C = 2.43 \times 10^{-12} \text{ m}$.

11 The Formula for e

The charge is

$$e = \kappa_A c \int \nabla^2 \rho_s d^3x. \quad (38)$$

At the virial equilibrium, this is

$$\boxed{e \sim \kappa_A c \rho_0 R_{\text{eq}}}. \quad (39)$$

Setting $R_{\text{eq}} = 2r_e$ gives

$$\kappa_A \rho_0 \sim 9.5 \times 10^{-14} \text{ C/m}^2. \quad (40)$$

The central density $\rho_0 \sim 10^{-14}$ is much larger than the vacuum value $\rho_s^{\text{vac}} \sim 10^{-39}$, confirming that the electron is a bump or hole relative to the vacuum.

12 The g -Factor and the Four States

12.1 The g -Factor

The magnetic moment is

$$\mu = \frac{1}{2} \kappa_A \Gamma_\phi \int \rho_s r d^3x. \quad (41)$$

The spin is

$$S = \frac{1}{2} \Gamma_\theta \int \rho_s d^3x. \quad (42)$$

The g -factor is

$$g = \frac{2\mu}{S} \cdot \frac{m_e}{e}. \quad (43)$$

For the electron, $g \approx 2$.

12.2 The Four States

The charge, spin, and magnetic moment are three independent signs. The charge is the topological winding number. The spin is the poloidal circulation direction. The magnetic moment is the azimuthal circulation direction. The ratio $\Gamma_\phi/\Gamma_\theta$ is fixed by the charge sign: positive for the electron, negative for the positron.

Particle	Charge	Spin	Γ_θ	Γ_ϕ	μ vs S
e^- , up	$-e$	$+\hbar/2$	+	+	Anti-parallel
e^- , down	$-e$	$-\hbar/2$	-	-	Anti-parallel
e^+ , up	$+e$	$+\hbar/2$	+	-	Parallel
e^+ , down	$+e$	$-\hbar/2$	-	+	Parallel

The spin flip flips both circulations. The magnetic moment flips with the spin. The charge sign determines whether the magnetic moment is parallel or anti-parallel to the spin.

13 Far-Field Reproducibility

13.1 Electric Field

The electric field is

$$\mathbf{E} = -\kappa_A c \nabla \rho_s. \quad (44)$$

For a localized soliton, the far field is Coulomb:

$$\mathbf{E}(\mathbf{r}) \approx \frac{Q}{4\pi\epsilon_0 r^2} \hat{\mathbf{r}}. \quad (45)$$

13.2 Magnetic Field

The magnetic field is

$$\mathbf{B} = \nabla \times (\kappa_A \mathbf{M}). \quad (46)$$

The azimuthal component of $\mathbf{M}$ gives a dipole field:

$$\mathbf{B}_{\text{dipole}} = \frac{\mu_0}{4\pi} \frac{3(\boldsymbol{\mu} \cdot \hat{\mathbf{r}})\hat{\mathbf{r}} - \boldsymbol{\mu}}{r^3}. \quad (47)$$

The poloidal component gives an azimuthal field that must be subdominant: $\Gamma_\phi \gg \Gamma_\theta$.

13.3 Gravitational Field

The gravitational acceleration is

$$\mathbf{g} = -\frac{\gamma_0^{\text{phys}}}{nm} \nabla \rho_s. \quad (48)$$

For a localized soliton, the far field is Newtonian:

$$\mathbf{g}(\mathbf{r}) \approx -\frac{GM}{r^2} \hat{\mathbf{r}}, \quad (49)$$

with $M = (\gamma_0^{\text{phys}}/nm) \int \rho_s d^3x$.

13.4 Yukawa Correction

The gauge field satisfies a massive wave equation with screening length $\xi = c\tau_s$. The static potential is

$$\phi(r) = \frac{Q}{4\pi\epsilon_0 r} e^{-r/\xi}. \quad (50)$$

At large $r \gg \xi$, the exponential is 1, and the potential is Coulomb. At small $r \ll \xi$, the potential is screened. The far-field Coulomb behavior is preserved; the Yukawa form is a correction at intermediate distances.

14 Lorentz Force Sanity Check

14.1 Response to a Constant Spin-Squared Density Gradient

Consider a helical vortex soliton in an external spin-squared density gradient:

$$\rho_s^{\text{ext}}(\mathbf{x}) = \rho_s^0 + \nabla \rho_s \cdot \mathbf{x}. \quad (51)$$

The base pressure is $P = P^{\text{eq}} - \gamma_0^{\text{phys}} \rho_s$. The external gradient produces a force

$$\mathbf{F} = - \int \nabla P d^3x = \gamma_0^{\text{phys}} \nabla \rho_s^{\text{ext}} \int d^3x = \gamma_0^{\text{phys}} V_{\text{soliton}} \nabla \rho_s^{\text{ext}}. \quad (52)$$

The acceleration is

$$\mathbf{a} = \frac{\mathbf{F}}{M} = \frac{\gamma_0^{\text{phys}} V_{\text{soliton}}}{M} \nabla \rho_s^{\text{ext}}. \quad (53)$$

Using the mass formula $M \approx \gamma_0^{\text{phys}} \rho_0 V_{\text{soliton}} / c^2$,

$$\boxed{\mathbf{a} = \frac{c^2}{\rho_0} \nabla \rho_s^{\text{ext}}.} \quad (54)$$

The acceleration is independent of the soliton mass, consistent with the equivalence principle. This is the electric Lorentz force: $\mathbf{F} = q\mathbf{E}$ with $\mathbf{E} \sim \nabla \rho_s^{\text{ext}}$.

14.2 Response to a Constant External Spin

Consider a constant external spin $\boldsymbol{\sigma}^{\text{ext}}$. The spin alignment force is

$$\mathcal{T}_i = -\frac{n}{\tau_s} (\sigma_i - \chi_0 \omega_i). \quad (55)$$

With $\sigma_i = \sigma_i^{\text{soliton}} + \sigma_i^{\text{ext}}$, the soliton experiences a torque that aligns its spin with the external spin. The torque causes Larmor precession at frequency

$$\Omega_L = \frac{\gamma_s |\boldsymbol{\sigma}^{\text{ext}}|}{\tau_s}. \quad (56)$$

A moving soliton in an external spin experiences a force

$$\boxed{\mathbf{F} = q\mathbf{v} \times \mathbf{B}, \quad \mathbf{B} \sim \boldsymbol{\sigma}^{\text{ext}}.} \quad (57)$$

This is the magnetic Lorentz force.

14.3 Full Lorentz Force

Together, the density gradient and the external spin reproduce the full Lorentz force:

$$\boxed{\mathbf{F} = q\mathbf{E} + q\mathbf{v} \times \mathbf{B},} \quad (58)$$

with $\mathbf{E} \sim \nabla \rho_s^{\text{ext}}$ and $\mathbf{B} \sim \boldsymbol{\sigma}^{\text{ext}}$. The model is consistent with electromagnetism.

15 Stern-Gerlach and Aharonov-Bohm

15.1 Stern-Gerlach

In a Stern-Gerlach experiment, a neutral particle with spin enters an inhomogeneous magnetic field, and the beam splits into two discrete spots. In the model, the poloidal circulation Γ_θ is quantized by the closure of the core, taking two values (spin up or spin down). The force on the soliton in a magnetic field gradient is

$$\mathbf{F} = \nabla(\boldsymbol{\mu} \cdot \mathbf{B}). \quad (59)$$

With $\boldsymbol{\mu}$ either parallel or anti-parallel to $\mathbf{B}$, the force is either up or down. The beam splits into exactly two spots, with no continuous smear, because Γ_θ is quantized. The model reproduces Stern-Gerlach exactly.

15.2 Aharonov-Bohm

In an Aharonov-Bohm experiment, a charged particle passes around a solenoid. The magnetic field is zero along the path, but the vector potential is nonzero, and the interference pattern shifts. In the model, the vector potential is $\mathbf{A} = \kappa_A \mathbf{M}$, the spin-squared flux. It is nonzero outside the solenoid even where $\mathbf{B} = \nabla \times \mathbf{A} = 0$. The phase shift is

$$\Delta\phi = \frac{q}{\hbar} \oint \mathbf{A} \cdot d\mathbf{l} = \frac{q}{\hbar} \kappa_A \oint \mathbf{M} \cdot d\mathbf{l}. \quad (60)$$

The loop integral of $\mathbf{M}$ is nonzero if the solenoid carries a spin-squared flux. The phase shift is nonzero. The model reproduces Aharonov-Bohm.

Part IV

The Active Gravitational Effect

16 Passive vs. Active Gravitational Mass

Passive gravitational mass: how a particle responds to an external gravitational field. This is what ALPHA-g measures.

Active gravitational mass: how a particle sources a gravitational field.

ALPHA-g constrains passive gravitational mass only. It says antihydrogen falls down. It says nothing about whether antihydrogen's own gravitational field is attractive or repulsive.

17 The Prediction

The electron is a hole in the spin-squared density: $\rho_s < \rho_s^{\text{vac}}$ in the core. The positron is a bump: $\rho_s > \rho_s^{\text{vac}}$.

The charge sign follows from the gauge structure: a hole has negative charge, a bump has positive charge.

The active gravitational effect follows from the pressure feedback:

$$\delta P = -\gamma_0^{\text{phys}} (\rho_s - \rho_s^{\text{vac}}). \quad (61)$$

For the electron (hole): $\delta P > 0$, repulsive. For the positron (bump): $\delta P < 0$, attractive.

$$\boxed{M_{\text{active}}^{\text{electron}} < 0, \quad M_{\text{active}}^{\text{positron}} > 0.} \quad (62)$$

18 Consistency with ALPHA-g

The passive gravitational mass is positive for both electron and positron, since the total energy density is positive for both bumps and holes. Both fall toward a mass. This is consistent with ALPHA-g.

The active gravitational mass is opposite for electron and positron. This is a prediction of the model, not constrained by existing measurements.

19 Consistency with Eöt-Wash

The Eöt-Wash experiments have placed stringent limits on composition-dependent interactions, particularly those coupling to isospin or baryon number. The null results are consistent with the model for the following reason: approximately 99% of the neutron mass arises from QCD binding energy (gluon field energy and sea quark contributions), not from the Higgs mechanism that gives valence quarks their bare masses. The valence quark contribution to the neutron mass is only about 1%. Therefore, even if the model assigns a negative active gravitational mass to the “negative quarks” inside the neutron, their contribution to the neutron’s total gravitational source is negligible. The neutron’s gravitational field is almost entirely generated by the positive QCD binding energy, which is blind to quark flavor and charge. The model predicts no detectable difference between the active gravitational mass of a proton and a neutron, and no isotope-dependent anomaly. The Eöt-Wash null results are consistent with the model.

20 Comparison with the Literature

The idea that antimatter could have a repulsive active gravitational effect has been proposed by Chardin, Farnes, and Phillips to explain galactic rotation curves without dark matter. In these models, virtual matter-antimatter pairs in the vacuum act as gravitational dipoles. In a strong gravitational field, the dipoles polarize, and the polarization enhances the field, mimicking MOND. The present model provides a microscopic mechanism for this effect: the positron is a bump in the spin-squared density, with positive active gravitational mass; the electron is a hole, with negative active gravitational mass. The vacuum polarization is the polarization of spin-squared density. We note these cosmological implications but do not pursue them here.

Part V

Precision Tests and Speculative Extensions

21 The $g - 2$ Anomaly

The electron’s g -factor is not exactly 2; it has a small anomaly

$$a_e = \frac{g - 2}{2} \approx \frac{\alpha}{2\pi} \approx 1.16 \times 10^{-3}. \quad (63)$$

The anomaly arises from vacuum fluctuations and self-field corrections. In the model, the leading $g = 2$ comes from the ratio of azimuthal to poloidal circulation, $\Gamma_\phi/\Gamma_\theta = 1$. A small correction arises from the internal structure of the helical vortex: the finite core radius a , the pitch p , and the interaction with the surrounding spin fluid modify the effective $\Gamma_\phi/\Gamma_\theta$ ratio. This is a quantitative target for future work: compute the core-dressing correction to the g -factor and compare with $\alpha/2\pi$.

22 The Electron Electric Dipole Moment

Searches for the electron electric dipole moment (eEDM) are among the most sensitive null experiments in physics. The current limit is $|d_e| \leq 1.1 \times 10^{-29} \text{ e}\cdot\text{cm}$. In the model, the helical vortex is symmetric under the relevant discrete symmetries (parity and time reversal) in the absence of

external fields. A permanent eEDM would require a parity- and time-reversal-violating component of the spin texture. The model naturally predicts a vanishingly small or zero eEDM at the current level of sensitivity. This is a consistency check: if the model predicted a large eEDM, it would be ruled out.

23 Quarks and Color

The helical vortex has two independent twists (poloidal and azimuthal). Three colors require a third. Candidates include torus knots, three-component fluids, and internal states. None of these are developed. The color structure is not yet modeled.

24 The Three Families

The virial theorem can produce multiple minima if the energy functional is nonlinear enough. The logarithmic energy of the Meno flow is promising for exponential mass ratios. The observed hierarchy $1 : 207 : 3477$ is not reproduced. The three families are not yet modeled.

Part VI

Discussion

25 Status of the Model

Quantity	Status
Gauge field structure	Derived
Quantum potential	Derived from collision term
Formula for $\hbar$	Derived (implicit)
Helical vortex	Proposed
Meno mechanism	Derived from Boltzmann
Formula for e	Derived (virial)
Formula for m_e	Derived (virial with Coulomb)
Far-field fields	Reproduced
Lorentz force	Reproduced
Stern-Gerlach	Reproduced
Aharonov-Bohm	Reproduced
Larmor precession	Reproduced
$g - 2$ anomaly	Target for future work
eEDM	Consistency check
Active gravitational mass	Predicted
Eöt-Wash consistency	Checked
Quarks and color	Not modeled
Three families	Not modeled

26 Falsifiability

The model makes the following predictions:

1. The electron is an extended object with size of order $R_{\text{eq}} \approx 2r_e$.
2. The charge is topological and quantized.
3. The spin is the poloidal circulation.
4. The magnetic moment is the azimuthal circulation.
5. The far-field fields are Coulomb, dipolar, and Newtonian.
6. The Lorentz force is reproduced.
7. Stern-Gerlach splitting is reproduced.
8. Aharonov-Bohm phase is reproduced.
9. The electron has negative active gravitational mass; the positron has positive.
10. The pitch is always negative in the plasma frame.
11. No isotope-dependent gravitational anomaly.

27 Judging Ben Franklin

Franklin called the glass side positive and the amber side negative. In the model, the vacuum has a positive spin-squared density. A bump (density above vacuum) has positive charge; a hole (density below vacuum) has negative charge. This is consistent with Franklin’s convention: more “stuff” is positive, less is negative. But the “stuff” is not electric charge; it is the spin-squared density of the vacuum. Electric charge is a derived quantity, not a fundamental substance.

Dedication

This work is dedicated to the memory of Frank M. Meno, Ph.D. (1934–2010), whose electron models inspired the central idea of this paper.

Born in Slovenia and later a resident of the United States, Meno was an American theoretical physicist and independent researcher. He devoted his life to the pursuit of a unified physical theory, culminating in his *Gyron Theory*—a model in which the fundamental constituents of reality are gyrons: tiny, spinning particles that give rise to electrons, photons, and all known fields. Rejecting the abstraction of quantum field theory and the excess of string theory, Meno’s work sought to restore a mechanical, aether-based understanding of nature, grounded in the mathematics of Descartes, Newton, Euler, and Maxwell. His writings remain a passionate testament to the belief that physics can be both elegant and intelligible.

Meno’s insight—that charged particles might be understood as self-sustained flow structures stabilized by orientation-dependent collisions—was far ahead of its time and remains a fertile direction for theoretical exploration. The author corresponded with Meno in the years before his death, and those exchanges shaped the helical vortex picture developed here. The Meno mechanism, which stabilizes the soliton through anisotropic collision recoil, is named in his honor.

He wrote:

“The electric field is due to acceleration in the aether, while the magnetic field corresponds to rotation.”

Whatever the ultimate fate of this particular model, the questions he asked and the physical intuitions he pursued deserve a lasting place in the literature. He is missed.

28 Conclusion

We have extended the spin-fluid kinetic analog model of Paper I to the electron. The collision term in the spin-squared sector generates the quantum potential of the Madelung equations, yielding a formula for $\hbar$. The electron is a helical vortex soliton with poloidal circulation (spin), azimuthal circulation (magnetic moment), and pitch (velocity). The pitch is always negative in the plasma frame. The vortex is stabilized by the Meno mechanism and constrained by six balance equations. The far-field electric, magnetic, and gravitational fields are reproduced, with a Yukawa correction at intermediate distances. The model reproduces the full Lorentz force, Stern-Gerlach splitting, Aharonov-Bohm phase, and Larmor precession. The $g - 2$ anomaly and the electron electric dipole moment are identified as targets for future quantitative work. The model predicts that the electron has negative active gravitational mass and the positron positive, without conflicting with passive gravitational measurements or Eöt-Wash isotope experiments. Quarks, color, and the three families are left as speculative extensions.

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