Physics Theory Based on the Center-of-Mass Reference Frame 1. Particle Flow Field Principle

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Abstract

This paper introduces a novel particle flow field theory. The foundation of this theory is not the point mass model and inertial reference frame, but rather the elastic particle (real particle) model and the center-of-mass reference frame. This paper applies vector analysis to derive a complete set of flow field equations in the space of moving particles. It reveals a comparable relationship between charge and mass in the center-of-mass frame, thereby unifying gravitational and electromagnetic interactions. The theory demonstrates that quantum randomness originates from the uncertainty in time and space measurements in the center-of-mass frame, and this uncertainty can be eliminated through measurement principles, leading to deterministic conclusions. The proposed theory provides unique solutions and an interpretive foundation for various fundamental physical problems, such as the structure of matter, the existence of dark matter, the nature of light, and black-body radiation phenomena. In particular, the existence of cosmic electron fluid challenges conventional understanding and has significant implications for existing physical laws.

Full Text

A Physical Theory Based on Barycenter Reference Frames I: Principles of Particle Flow Fields

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Abstract

In this paper, a new theory of particle flow fields is introduced. Instead of using the mass-point model and inertial reference frames, this theory is based

on the real-particle (elastic particle) model and barycenter reference frames. This article applies vector analysis to derive a complete set of field equations in a space permeated with moving particles. It reveals a comparable connection between charge and mass within the barycenter reference framework, thereby merging the interactions of gravitation and electromagnetism. The article argues that quantum randomness originates from the uncertainty associated with time and space measurements in barycenter frames. However, this uncertainty can be eliminated by the principle of measurement, leading to deterministic conclusions. The proposed theory provides unique solutions and interpretations for various fundamental physics problems, such as the structure of objects, the existence of dark matter, the nature of light, and the phenomenon of black-body radiation. Notably, the presence of a cosmic electronic fluid challenges our conventional understanding of the physical world and has significant implications for existing physical laws.

Keywords: barycenter reference system, particle flow fields, elastic particles, quantum uncertainty, electronic fluid, unified field theory
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2.3.3 Measurement Operations

The fundamental operations for measured quantities are defined as follows. For variables with scale factors, addition and subtraction follow linear superposition:

$$z = x \pm y = (\tilde{x} \pm \tilde{y}) \cdot x_s; \tag{1}$$
$$\tilde{z} = \tilde{x} \pm \tilde{y}, \quad x_s = y_s = z_s. \tag{2}$$

Multiplication preserves both digital and scale factors:

$$z = xy = (\tilde{x}\tilde{y}) \cdot (x_s y_s); \tag{3}$$
$$\tilde{z} = \tilde{x}\tilde{y}, \quad z_s = x_s y_s. \tag{4}$$

For functional relationships, the differential operation is defined with respect to the measurement unit:

$$z = z(x) = \tilde{z}(x) \cdot z_s, \quad dx = x_s; \tag{5}$$
$$dz = z(x + x_s) - z(x) = [\tilde{z}(x + x_s) - \tilde{z}(x)] \cdot z_s = d\tilde{z} \cdot z_s, \tag{6}$$
$$d\tilde{z} = \tilde{z}(x + x_s) - \tilde{z}(x). \tag{7}$$

The derivative operation yields:

$$\frac{dz}{dx} = \frac{d\tilde{z}}{d\tilde{x}} \cdot \frac{z_s}{x_s}.$$

Special cases for exponential and logarithmic functions with normalized units ($x_s = 1$) are:

$$e^x = e^{\tilde{x}}; \quad \ln x = \ln \tilde{x}.$$

3.2 Field Theory

The continuity equation for particle flow in barycenter frames is expressed as:

$$\frac{Dz}{Dt} = \frac{\partial z}{\partial t} + \nabla \cdot (zv).$$

For conserved quantities where $Dz/Dt = 0$, the system exhibits time-invariant behavior ($dZ/dt = 0$). The field equations relate the density ρ and current J through:

$$\rho \to \rho(r,t) = \tilde{\rho}(r,t) \cdot \rho_s, \quad J \to J(r,t) = \tilde{J}(r,t) \cdot J_s.$$

The velocity field is defined as:

$$v(r,t) = \frac{J(r,t)}{\rho(r,t)}.$$

3.4 Action Fields

The theory introduces three fundamental action fields derived from scalar and vector potentials:

$$G(r,t) := -\nabla\Phi, \tag{8}$$
$$C(r,t) := \nabla \times A, \tag{9}$$
$$D(r,t) := \nabla \cdot A = D_0(t) - \alpha \oint J(r',t) \cdot dS'. \tag{10}$$

These fields satisfy the following integral representations:

$$G(r,t) = -\alpha \int \frac{\rho(r',t)r}{|r|^3} dV', \tag{11}$$

$$C(r,t) = \alpha \int \frac{J(r',t) \times r}{|r|^3} dV', \tag{12}$$

$$D(r,t) = \alpha \int \frac{J(r',t) \cdot r}{|r|^3} dV'. \tag{13}$$

The fields exhibit distinct differential properties: G is curl-free, C is divergence-free, and D represents the scalar divergence of the vector potential.

3.5 Energy Fields

The energy densities associated with each action field are defined as:

$$E_G = \frac{1}{2}(G \cdot G), \quad E_C = \frac{1}{2}(C \cdot C), \quad E_D = \frac{1}{2}D^2, \quad E_s = \rho_s v_s^2.$$

These energy fields satisfy scaling relations where the dimensionless energy densities $\tilde{E}_G$, $\tilde{E}_C$, and $\tilde{E}_D$ are invariant under measurement transformations.

3.6 Force Fields

The force densities are derived from the energy fields:

$$F_G = \rho G = -\rho \nabla \Phi, \quad F_C = J \times C = \rho v \times C, \quad F_D = JD = \rho v D.$$

The fundamental force scale is $F_s = \rho_s(v_s/t_s)$. These force fields represent gravitational, electromagnetic, and scalar interactions respectively within the barycenter framework.

3.7 Field Equations

The action fields satisfy the following differential equations:

$$\nabla \cdot G = -\nabla^2 \Phi = -\frac{\rho}{\phi_s}, \tag{14}$$

$$\nabla \times G = -\nabla \times \nabla \Phi \equiv 0, \tag{15}$$

$$\nabla \cdot C = \nabla \cdot (\nabla \times A) \equiv 0, \tag{16}$$

$$(\nabla \cdot \nabla)A = \nabla^2 A = -\alpha_s J, \tag{17}$$

$$\nabla D = \nabla(\nabla \cdot A) = -\frac{1}{c^2}\frac{\partial G}{\partial t}. \tag{18}$$

These equations demonstrate that G is irrotational, C is solenoidal, and the vector potential A satisfies a Poisson equation with source J.

3.8 Second-Order Field Equations

The Laplacian of each action field yields:

$$\nabla^2 G = -\nabla \left(\frac{\rho}{\phi_s} \right), \tag{19}$$

$$\nabla^2 C = -\alpha_s \nabla \times J, \tag{20}$$

$$\nabla^2 D = \alpha_s \frac{\partial}{\partial t} \left(\frac{\rho}{\phi_s} \right). \tag{21}$$

These second-order equations relate field curvature to source variations and provide the foundation for wave propagation phenomena.

3.9 Motion Forces

The equation of motion in the barycenter frame incorporates all force components:

$$\frac{Dv}{Dt} = F_G + F_C + F_D.$$

This unified expression describes particle acceleration under combined gravitational, electromagnetic, and scalar forces, where the material derivative accounts for flow field convection.

4.2 Gravitational Field (F-Field)

The gravitational field constant is $G_s = v_s/t_s$. The gravitational interaction is mediated through the field $g = 1/\phi$, where ϕ represents the gravitational potential. The coupling constant is:

$$g = \frac{1}{\phi} = 6.6742867 \times 10^{-11}\,\mathrm{N \cdot m^2 \cdot kg^{-2}}.$$

The gravitational force between masses follows:

$$F_M = -g\frac{M_1 M_2}{r^2}.$$

4.3 Electromagnetic Field (C-Field)

The electromagnetic field constant is $C_s = \nu_s$. The charge-mass relation emerges as:

$$Q = (\theta\sigma)M, \quad \text{where} \quad \theta\sigma = 4.2222312 \times 10^{-32}\,\mathrm{C \cdot kg^{-1}}.$$

The electromagnetic force is:

$$F_Q = \frac{1}{4\pi\epsilon_0}\frac{Q_1 Q_2}{r^2},$$

with $\epsilon_0 = 8.8541877 \times 10^{-12}\,\mathrm{C}^2 \cdot \mathrm{N}^{-1} \cdot \mathrm{m}^{-2}$. The unified treatment shows that electromagnetic forces are scaled versions of gravitational forces through the dimensionless factor $\theta\sigma^2$.

4.4 Scalar Field (D-Field)

The scalar field constant is $D_s = \nu_s$. In the quantum limit where $\nu_s = \nu$, $v_s = c$, and $r_s = c/\nu = \lambda$, the scalar field exhibits wave-like properties with quantized energy $E_s = h\nu$. The field equations reduce to:

$$D_0(t) = \frac{1}{c^2}\frac{\partial \Phi}{\partial t} + D_0(t),$$

which governs the temporal evolution of the scalar potential in quantum systems.

4.5 Fluid System Hierarchy

The theory proposes a four-level hierarchical structure for physical systems: topson (top level), midson (middle level), bason (basic level), and hidson (hidden level). Each level corresponds to different observational scales:

- **Topson**: Macroscopic systems described by $\{1, M, V\}$
- **Midson**: Mesoscopic systems with $\{\tilde{V}, M_\alpha, V_s\}$
- **Bason**: Microscopic systems characterized by $\{N, M_i, -\}$
- **Hidson**: Sub-quantum systems with energy fields U

This hierarchy provides a framework for understanding emergent phenomena across scales.

4.7 Photon Structure

Photons are modeled as localized field excitations with characteristic wavelength λ. For typical visible light:

Table 1: Properties of Blue and Red Photons

Property	Blue Photon (450 nm)	Red Photon (650 nm)
Number density N_c	1.82250×10^5	5.49250×10^5
Mass M_c (kg)	1.65848×10^{-25}	4.99818×10^{-25}
Energy E_s (J)	4.41432×10^{-19}	3.05607×10^{-19}

Property	Blue Photon (450 nm)	Red Photon (650 nm)
Pressure Y_c (Pa)	[calculated]	[calculated]

The photon number density $n_c = \lambda^{-3}$ yields $n_c = 2 \times 10^{24}\,\mathrm{m}^{-3}$ for $\lambda_c = 0.01\,\mu\mathrm{m}$. The corresponding mass density $\rho_c = n_c M_e = 1.82 \times 10^{-6}\,\mathrm{kg} \cdot \mathrm{m}^{-3}$ suggests a cosmic electronic fluid permeating space.

5 Conclusion

This theory establishes a unified framework based on barycenter reference frames and particle flow fields, demonstrating that quantum uncertainty arises from measurement limitations rather than fundamental randomness. The hierarchical system structure and field unification provide deterministic solutions to problems including dark matter, photon structure, and cosmic background radiation. The existence of a cosmic electronic fluid challenges conventional vacuum concepts and suggests revision of fundamental physical laws.

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Note: Figure translations are in progress. See original paper for figures.