On A Mathematical Treatise Of The Ether

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Abstract

We will model the ether as a fluid field governed by Navier–Stokes equations; embedding electromagnetism by means of the velocity field and gravity as emergent pressure, and the speed of light not being constant. We will show a fluid field solution to the two-body problem which redefines gravitational constant under the evolution of cosmic time.

Introduction

The simplified equations of motion for a non-relativistic fluid field are,

$$\nabla \cdot \mathbf{V} = Q(\mathbf{x}, t) \tag{1}$$

$$\nabla \cdot \mathbf{W} = 0 \tag{2}$$

$$\frac{\partial \mathbf{V}}{\partial t} = -\nabla \Phi + \mathbf{S} + \frac{1}{\rho} \nabla \cdot \boldsymbol{\tau}, \tag{3}$$

$$\frac{\partial \mathbf{W}}{\partial t} = \nabla \times \mathbf{S} + \frac{1}{\rho} \nabla \times (\nabla \cdot \boldsymbol{\tau}), \tag{4}$$

Coupled with the modified continuity equation which models the source of the fluid field properties,

$$\frac{\partial \rho}{\partial t} = -\mathbf{V} \cdot \nabla \rho - \rho\, Q(\mathbf{x}, t) \tag{5}$$

The general fluid field is characterized by its velocity $\mathbf{V}$, it's vorticity $\mathbf{W} = \nabla \times \mathbf{V}$, it's spin $\mathbf{S} = \mathbf{V} \times \mathbf{W}$, and it's stress tensor $\tau(\mathbf{x}, t)$ The energy field Φ represents the fluid's combined potential of the pressure, kinetic energy and stress induced sources, $\rho(\mathbf{x}, t)$ is the density-tensor field; and the divergence term is $Q(\mathbf{x}, t)$.

Describing A Fluid Field

We begin by defining the fundamental quantities describing the fluid. The scope has been theoretically expanded but nonetheless it reduces to down to classical dynamics.

Definition: Density as a Scalar Field.

$$\boldsymbol{\rho}(\mathbf{x},t) = \begin{bmatrix} \rho_m(\mathbf{x},t) \\ m_q\, \rho_q(\mathbf{x},t) \\ \frac{1}{c^2}\, \rho_E(\mathbf{x},t) \\ m_\psi\, \rho_\psi(\mathbf{x},t) \\ \vdots \end{bmatrix}$$

$$\text{where:} \quad \begin{cases} \rho_m = \text{mass density (kg/m}^3\text{)} \\ \rho_q = \text{charge density (C/m}^3\text{)} \\ \rho_E = \text{energy density (J/m}^3\text{)} \\ \rho_\psi = \text{probability density (1/m}^3\text{)} \\ m_q = \text{mass per unit charge (kg/C)} \\ m_\psi = \text{quantum mass scale (kg)} \\ c = \text{speed of light (m/s)} \end{cases}$$

Collectively, these can be viewed as components of a scalar density field that fully characterizes the fluid's local state, enabling a unified treatment of mass, charge, energy, and other physical quantities.

Definition: The Stress Tensor.

The **stress tensor** $\boldsymbol{\tau}(\mathbf{x},t)$ is a symmetric rank-2 tensor field that encodes the internal forces per unit area within the fluid, generalizing scalar pressure to include anisotropic, viscous, quantum, and other internal stresses.[1] In this framework, the stress tensor is naturally decomposed into distinct gauge-like components reflecting the multifaceted nature of the fluid's internal dynamics:

[1] [3] The stress tensor is rigorously defined as a second-order tensor field $\boldsymbol{\sigma}$ that maps an oriented surface normal $\mathbf{n}$ to the traction vector $\mathbf{t} = \boldsymbol{\sigma}\mathbf{n}$, encoding internal forces within the continuum. It satisfies the balance of linear momentum $\operatorname{div}\boldsymbol{\sigma} + \rho\mathbf{b} = \rho\dot{\mathbf{v}}$ and is symmetric due to angular momentum balance. For a detailed, coordinate-free, and geometric treatment of the stress tensor and related continuum mechanics principles, see *Marsden and Hughes (1983), Mathematical Foundations of Elasticity.*

$$\boldsymbol{\tau} = \boldsymbol{\tau}_{\text{quantum}} + \boldsymbol{\tau}_{\text{viscous}} + \boldsymbol{\tau}_{\text{non-viscous}} + \cdots,$$

where each component corresponds to a specific physical mechanism:

- $\boldsymbol{\tau}_{\text{quantum}}$ represents quantum-coherent stresses arising from spatial variations in the quantum density field and quantum potential, capturing nonlocal and inherently non-classical effects.
- $\boldsymbol{\tau}_{\text{viscous}}$ accounts for classical viscous stresses generated by fluid deformation rates, shear, and bulk viscosity.
- $\boldsymbol{\tau}_{\text{non-viscous}}$ includes non-dissipative, elastic-like, or other intrinsic stresses not accounted for by viscosity or quantum coherence.

This multi-component tensorial formulation captures the interplay between classical fluid mechanics, quantum effects, and other physical phenomena within a unified tensorial framework.

The Navier–Stokes Equation for a Compressible Fluid.

We consider the momentum conservation equation for a compressible viscous fluid without external body forces[2]:

$$\frac{\partial \mathbf{V}}{\partial t} + (\mathbf{V} \cdot \nabla)\mathbf{V} = -\frac{1}{\rho(\mathbf{x}, t)} \nabla p + \frac{1}{\rho(\mathbf{x}, t)} \nabla \cdot \boldsymbol{\tau}(\mathbf{x}, t),$$

where,

- $\mathbf{V}(\mathbf{x}, t)$ is the fluid velocity field (vector field).
- $p(\mathbf{x}, t)$ is the scalar pressure field.
- $\rho(\mathbf{x}, t)$ is the fluid density, potentially a scalar density field.
- $\boldsymbol{\tau}(\mathbf{x}, t)$ is the viscous stress tensor.

Using the vector calculus identity,

$$(\mathbf{V} \cdot \nabla)\mathbf{V} = \nabla \left(\frac{|\mathbf{V}|^2}{2} \right) - \mathbf{V} \times (\nabla \times \mathbf{V}),$$

we rewrite the momentum equation as,

$$\frac{\partial \mathbf{V}}{\partial t} = -\nabla \left(\frac{|\mathbf{V}|^2}{2} \right) + \mathbf{V} \times (\nabla \times \mathbf{V}) - \frac{1}{\rho(\mathbf{x}, t)} \nabla p + \frac{1}{\rho(\mathbf{x}, t)} \nabla \cdot \boldsymbol{\tau}(\mathbf{x}, t).$$

[2] [2] See, P. K. Kundu, I. M. Cohen, and D. R. Dowling, *Fluid Mechanics*, 6th Edition, Academic Press, 2015, Chapter 6, for a detailed derivation of the compressible Navier–Stokes equations including viscous stress tensor formulations.

Define the scalar potential,

$$\Phi(\mathbf{x}, t) = \frac{1}{\rho(\mathbf{x}, t)} \left(p(\mathbf{x}, t) + E_k(\mathbf{x}, t) \right),$$

where the kinetic energy density is,

$$E_k(\mathbf{x}, t) = \frac{1}{2} \rho(\mathbf{x}, t) |\mathbf{V}(\mathbf{x}, t)|^2.$$

This allows expressing the velocity evolution as,

$$\frac{\partial \mathbf{V}}{\partial t} = -\nabla \Phi + \mathbf{S} + \frac{1}{\rho} \nabla \cdot \boldsymbol{\tau}(\mathbf{x}, t),$$

where $\mathbf{S} = \mathbf{V} \times (\nabla \times \mathbf{V})$ represents the vortex force contribution. Therefore the vorticity vector field is,

$$\mathbf{W}(\mathbf{x}, t) = \nabla \times \mathbf{V}(\mathbf{x}, t).$$

Due to fluid compressibility, the divergence of velocity generally does not vanish,

$$\nabla \cdot \mathbf{V} = Q(\mathbf{x}, t),$$

where $Q(\mathbf{x}, t)$ is the compressibility or volumetric source term.

This concludes the derivation of the general fluid field equations in the stress-tensor gauge framework, with density treated as a generalized scalar field and the viscous stress tensor explicitly included. The resulting system provides a versatile starting point to explore diverse physical regimes including electromagnetism, gravity, and quantum fields as emergent phenomena from fluid dynamics.

The Material's Properties

The equations of motion of a fluid are described by its material properties, the fluid's physical nature is the key factor in determining the resultant motion. The determining factors of physical properties of the material depend upon its **stress** and it's **density**, which are subsequently intertwined, and thus gauges are applied to study the motion of our fluid and henceforth everything within in it.

The Density ρ

The density ρ of the medium can vary in both space and time. It is a function governed by the internal flow and volumetric expansion or compression. The evolution of density in a non-homogeneous medium is governed by the continuity equation[3],

$$\frac{\partial \rho}{\partial t} = -\mathbf{V} \cdot \nabla \rho - \rho \, Q(\mathbf{x}, t)$$

[3] [2] See P. K. Kundu, I. M. Cohen, and D. R. Dowling, *Fluid Mechanics*, 6th Edition, Academic Press, 2015, Chapter 3, for a detailed treatment of the continuity equation in compressible flows.

where:

- $\mathbf{V}$ is the velocity field,
- $Q(\mathbf{x}, t) = \nabla \cdot \mathbf{V}$ is the divergence of the velocity field (a measure of local expansion or compression),

The Static Solution

To understand the long-term behavior of the medium, we take the limit as time approaches infinity,

$$\lim_{t\to\infty} \frac{\partial \rho}{\partial t} = \lim_{t\to\infty} \left(-\mathbf{V} \cdot \nabla\rho - \rho\, Q(\mathbf{x}, t)\right),$$

this gives the steady-state condition,

$$Q(\mathbf{x}, t) = -\frac{1}{\rho}(\mathbf{V} \cdot \nabla\rho) \tag{6}$$

At the steady state, the time derivative of the density vanishes, meaning the system has reached a dynamic equilibrium. Showing that local expansion or compression is exactly balanced by the advection of density in the flow. This condition characterizes how steady-state density distributions are maintained in non-uniform, compressible media.

The Non-Static Solution

The evolution of density in a compressible fluid is given by the continuity equation:

$$\frac{\partial \rho}{\partial t} = -\mathbf{V} \cdot \nabla\rho - \rho\, Q(\mathbf{x}, t),$$

where:

- $\rho = \rho(\mathbf{x}, t)$ is the fluid density,
- $\mathbf{V} = \mathbf{V}(\mathbf{x}, t)$ is the velocity field,
- $Q(\mathbf{x}, t) := \nabla \cdot \mathbf{V}$ is the velocity divergence.

To model external mass injection or extraction, we decompose the total density into an initial spatially varying density and a variable incoming mass density:

$$\rho(\mathbf{x}, t) = \rho(\mathbf{x}, 0) + \rho_m(\mathbf{x}, t),$$

where:

- $\rho(\mathbf{x}, 0)$ is the initial density distribution, which may vary with position $\mathbf{x}$,
- $\rho_m(\mathbf{x}, t)$ represents the added or removed mass density due to external input or extraction.

Since $\rho(\mathbf{x},0)$ is constant in time,

$$\frac{\partial \rho}{\partial t} = \frac{\partial \rho_m}{\partial t},$$

and the spatial gradient decomposes as,

$$\nabla \rho = \nabla \rho(\mathbf{x},0) + \nabla \rho_m(\mathbf{x},t).$$

Substituting into the continuity equation, we have

$$\frac{\partial \rho_m}{\partial t} = -\mathbf{V} \cdot \big(\nabla \rho(\mathbf{x},0) + \nabla \rho_m(\mathbf{x},t)\big) - \big(\rho(\mathbf{x},0) + \rho_m(\mathbf{x},t)\big) Q(\mathbf{x},t).$$

Rearranging to isolate the velocity divergence yields:

$$\boxed{Q(\mathbf{x},t) = -\frac{1}{\rho(\mathbf{x},0) + \rho_m(\mathbf{x},t)} \left(\frac{\partial \rho_m}{\partial t} + \mathbf{V} \cdot \nabla \rho(\mathbf{x},0) + \mathbf{V} \cdot \nabla \rho_m(\mathbf{x},t) \right).} \quad (7)$$

This shows that the velocity divergence (the source/sink) $Q(\mathbf{x},t) := \nabla \cdot \mathbf{V}$ depends explicitly on both the local time rate of change and spatial variation of the incoming mass density $\rho_m(\mathbf{x},t)$, as well as on the spatial gradient of the initial density distribution $\rho(\mathbf{x},0)$, scaled by the initial density. The total instantaneous density at each point can be denoted as

$$\rho_\delta(\mathbf{x},t) := \rho(\mathbf{x},0) + \rho_m(\mathbf{x},t).$$

- When the advection terms $\mathbf{V} \cdot \nabla \rho(\mathbf{x},0)$ and $\mathbf{V} \cdot \nabla \rho_m(\mathbf{x},t)$ are negligible (e.g., small spatial gradients or slow velocity variations), Eq. (7) reduces to,

$$\nabla \cdot \mathbf{V} \approx -\frac{1}{\rho_\delta(\mathbf{x},t)} \frac{\partial \rho_m}{\partial t}.$$

- If, further, $\rho_m \ll \rho(\mathbf{x},0)$, then $\rho(\mathbf{x},0) + \rho_m(\mathbf{x},t) \approx \rho(\mathbf{x},0)$, giving the classical approximation,

$$\nabla \cdot \mathbf{V} \approx -\frac{1}{\rho(\mathbf{x},0)} \frac{\partial \rho_m}{\partial t}.$$

Physically, the velocity divergence measures the local volumetric expansion or compression driven by the net injection or removal of mass and its transport. This result connects the macroscopic fluid kinematics (divergence of velocity) directly to the microscopic process of mass injection or removal encoded by the incoming mass density ρ_m.

The Stress τ

The stress tensor τ encodes the ability of momentum to diffuse through the fluid medium. It thus relates to the internal dynamics of the medium. The types of stress can either be homogeneous—where stress is distributed evenly—or non-homogeneous—where stress is not evenly distributed—or other reasonable forms.

A Static Fluid

A homogeneous fluid medium is one in which the medium's parameters—such as density ρ, viscosity μ, and compressibility (the bulk modulus λ)—do not vary with position. That is,

$$\nabla\rho = \nabla\mu = \nabla\lambda = 0,$$

this assumption simplifies the dynamics. First we express the evolution of the velocity field as:

$$\frac{\partial \mathbf{V}}{\partial t} = -\nabla\Phi + \mathbf{S} + \frac{1}{\rho}\nabla \cdot \boldsymbol{\tau}.$$

For a Newtonian fluid, the stress tensor takes the form[4],

$$\boldsymbol{\tau} = \mu\left(\nabla\mathbf{V} + (\nabla\mathbf{V})^T\right) + \lambda(Q(\mathbf{x},t))\mathbf{I}.$$

In a homogeneous Newtonian fluid, because all spatial gradients of medium coefficients vanish, when taking the divergence of $\boldsymbol{\tau}$, only the derivatives of the velocity field remain, yielding:

$$\nabla \cdot \boldsymbol{\tau} = \mu\nabla^2\mathbf{V} + (\lambda + \mu)\nabla(Q(\mathbf{x},t)),$$

this expresses two key mechanisms of viscous interaction:

- Shear diffusion from $\nabla^2\mathbf{V}$, which smooths out transverse velocity gradients.
- Compression from $\nabla Q(\mathbf{x},t)$ smooths out volume changes.
- The shear viscosity is $\nu = \frac{\mu}{\rho}$, and the bulk viscosity is $\frac{\lambda+\mu}{\rho}$.

Resolving the compression from the source term inside the potential, the equation becomes the classical Navier-Stokes equation:

$$\frac{\partial \mathbf{V}}{\partial t} = -\nabla\Phi + \mathbf{S} + \nu\nabla^2\mathbf{V},$$

The internal forces that arise from gradients in motion are purely a consequence of deformation; the fluid dynamics arise purely from interactions between momentum, vorticity, and pressure-like effects—not from any position-dependent medium variations.

A Non-Static Fluid

In contrast to a homogeneous fluid medium, a *non-homogeneous* fluid medium is spatially dependent; this spatial dependence must be accounted for in the evolution of the velocity field. The general medium equation is,

$$\frac{\partial \mathbf{V}}{\partial t} = -\nabla\Phi + \mathbf{S} + \frac{1}{\rho(\mathbf{x},t)}\nabla \cdot \boldsymbol{\tau}(\mathbf{x},t),$$

[4] [2] See, P. K. Kundu, I. M. Cohen, and D. R. Dowling, *Fluid Mechanics*, 6th Edition, Academic Press, 2015, Chapter 6, for a detailed derivation of the compressible Navier–Stokes equations including viscous stress tensor formulations.

here, the viscous stress tensor $\boldsymbol{\tau}$ may now depend on position, not only through gradients of velocity, but also through spatially varying viscosity[5]:

$$\boldsymbol{\tau} = \mu(\mathbf{x}) \left(\nabla \mathbf{V} + (\nabla \mathbf{V})^T \right) + \lambda(\mathbf{x})(Q(\mathbf{x}, t))\mathbf{I},$$

this introduces additional complexity into the dynamics. Notably, when taking the divergence of $\boldsymbol{\tau}$, the spatial derivatives will now act on both the velocity gradients and the variable coefficients:

$$\nabla \cdot \boldsymbol{\tau} = \nabla \mu(\mathbf{x}) \cdot \left(\nabla \mathbf{V} + (\nabla \mathbf{V})^T \right) + \mu(\mathbf{x}) \nabla^2 \mathbf{V} + \nabla \left[\lambda(\mathbf{x})(Q(\mathbf{x}, t)) \right].$$

This introduces terms representing the medium's inhomogeneities.[6]

The Material Propagation Speed c

Starting from the coupled continuity and Euler equations for an inviscid, compressible fluid, one arrives at the governing equation for density perturbations $\delta\rho(\mathbf{r}, t)$:

$$\frac{\partial}{\partial t} \left[\frac{1}{\rho} \frac{\partial \delta\rho}{\partial t} + \frac{1}{\rho} \mathbf{V} \cdot \nabla \delta\rho \right] = \nabla^2 \left(\frac{1}{\epsilon \rho^2} \, \delta\rho \right), \tag{8}$$

where $\rho(\mathbf{r}, t)$ is the background mass density, $\mathbf{V}(\mathbf{r}, t)$ the flow velocity, and $\epsilon(\mathbf{r}, t)$ the compressibility.

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Expansion and Definition of $c(\mathbf{r}, t)$

Expanding the Laplacian on the right-hand side yields

$$\nabla^2 \left(\frac{\delta\rho}{\epsilon \rho^2} \right) = \frac{1}{\epsilon \rho^2} \nabla^2 \delta\rho + 2 \, \nabla \left(\frac{1}{\epsilon \rho^2} \right) \cdot \nabla \delta\rho + \delta\rho \, \nabla^2 \left(\frac{1}{\epsilon \rho^2} \right). \tag{9}$$

This motivates the definition of the **local material propagation speed**:

$$\boxed{c^2(\mathbf{r}, t) \;=\; \frac{1}{\epsilon(\mathbf{r}, t) \, \rho(\mathbf{r}, t)}} \tag{10}$$

so that the full perturbation dynamics become

$$\begin{aligned} \frac{\partial^2 \delta\rho}{\partial t^2} &= c^2(\mathbf{r}, t) \, \nabla^2 \delta\rho + 2 \, \nabla \left(\tfrac{1}{\epsilon \rho^2} \right) \cdot \nabla \delta\rho + \delta\rho \, \nabla^2 \left(\tfrac{1}{\epsilon \rho^2} \right) \\ &\quad - \frac{\partial}{\partial t} \left[\frac{1}{\rho} \mathbf{V} \cdot \nabla \delta\rho \right]. \end{aligned} \tag{11}$$

Equation (11) is the **complete nonlinear density-wave equation**, retaining both thermodynamic and advective corrections.

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[5] [1] See, R. B. Bird, W. E. Stewart, and E. N. Lightfoot, *Transport Phenomena*, 2nd Edition, Wiley, 2007, Chapter 3, for treatment of position-dependent viscosity effects in fluid stress tensors.

[6] Note: analgous to EFEs.

Static Case

If the medium is uniform and at rest,

$$\rho(\mathbf{r},t) = \rho_0, \qquad \mathbf{V} = 0,$$

then

$$\nabla\left(\tfrac{1}{\epsilon\rho^2}\right) = 0, \qquad \nabla^2\left(\tfrac{1}{\epsilon\rho^2}\right) = 0.$$

Equation (11) simplifies to

$$\frac{\partial^2 \delta\rho}{\partial t^2} = c^2 \nabla^2 \delta\rho, \qquad c = \frac{1}{\sqrt{\epsilon\rho_0}}. \tag{12}$$

Thus the wave equation reduces to the familiar acoustic form, with a **constant propagation speed** c. This is the limiting case where perturbations travel in straight lines with no distortion.

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Case II: Non-Static, Inhomogeneous Background

For a general background $\rho(\mathbf{r},t)$ and velocity $\mathbf{V}(\mathbf{r},t)$, none of the correction terms vanish. Equation (11) then governs the full dynamics:

- The leading operator $c^2(\mathbf{r},t)\,\nabla^2\delta\rho$ describes **local wave propagation**, but now the speed varies across space and time.
- The gradient corrections,

  $$2\nabla\left(\tfrac{1}{\epsilon\rho^2}\right)\cdot\nabla\delta\rho, \qquad \delta\rho\,\nabla^2\left(\tfrac{1}{\epsilon\rho^2}\right),$$

  encode **nonlinear thermodynamic couplings**, introducing refraction, scattering, and effective potential terms.
- The final advection term,

  $$-\frac{\partial}{\partial t}\left[\frac{1}{\rho}\mathbf{V}\cdot\nabla\delta\rho\right],$$

  represents **convective transport** of fluctuations by the flow.

In this regime, $c(\mathbf{r},t)$ is no longer constant but a **dynamical field** determined by the evolving fluid background. Perturbations do not propagate as simple sound waves; instead, they are refracted, scattered, and advected, reflecting the full complexity of a time-dependent medium.

The Electromagnetic Phenomena

Maxwell originally viewed electric and magnetic fields not as abstract entities but as real stresses and motions in a continuous fluid-like ether[7]. Though the ether concept was abandoned, our treatise reignites the original notion by treating electromagnetic fields as emergent features of any fluid's internal stresses, velocities, vorticities, and compression. Thus, whether in quantum fluids, plasmas, or the ether, electromagnetism appears as a response of the fluid, restoring Maxwell's fields as real descriptors of fluid motion and structure.

Describing Electromagnetism

Electromagnetism emerges naturally from fluid dynamics when interpreted through the velocity field $\mathbf{V}(\mathbf{x}, t)$ and scalar potential $\Phi(\mathbf{x}, t)$ of a compressible, vortical medium. In this interpretation, the speed of propagation c, the permittivity ε_0, and the permeability μ_0 all arise from intrinsic fluid properties. We define the electric and magnetic fields as:

$$\mathbf{E} := -\frac{\partial \mathbf{V}}{\partial t} - \nabla \Phi, \qquad \mathbf{B} := \mathbf{W} = \nabla \times \mathbf{V}.$$

These expressions reveal that:

- The magnetic field $\mathbf{B}$ corresponds to the fluid's vorticity $\mathbf{W}$.
- The electric field $\mathbf{E}$ represents the local acceleration of the fluid and gradient of the potential.

Starting from the fundamental relations which can be derived from the explicit definitions of the electromagnetic vector fields,

$$\nabla \cdot \mathbf{B} = 0, \tag{13}$$

$$\nabla \cdot \mathbf{E} = \frac{\partial Q(\mathbf{x}, t)}{\partial t} - \nabla^2 \Phi, \tag{14}$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}, \tag{15}$$

$$\nabla \times \mathbf{B} = \nabla Q(\mathbf{x}, t) - \nabla^2 \mathbf{V}, \tag{16}$$

By using the Lorenz gauge condition, we relate the divergence of the velocity field directly to the time derivative of the scalar potential scaled by the propagation speed c.

$$\nabla \cdot \mathbf{V} = Q(\mathbf{x}, t) = -\frac{1}{c^2} \frac{\partial \Phi}{\partial t},$$

[7] [4] J. C. Maxwell, "On Physical Lines of Force," *Philosophical Magazine*, vol. 21, 1861, pp. 161–175, 281–291.

This establishes that the fluid velocity responds instantaneously to changes in the potential energy caused by variations in charge or mass distribution. Physically, this means the field adjusts locally without delay, while disturbances then propagate through the medium as waves traveling at speed c. Thus, the field dynamically "knows" about changes and reconfigures itself in a way that preserves causality, ensuring information and energy propagate at a finite, physically meaningful speed.[8]

The Two-Body Problem

The two-body problem is contextualized in the framework of fluid dynamics, such as two moving sinks in a fluid producing an effective gravitational interaction.

Density Sink Model

Mass is treated as a time-dependent density sink, i.e., a localized loss of background fluid density:

$$\nabla \cdot \mathbf{V} = Q(\mathbf{x}, t) = -\frac{1}{\rho_0} \frac{\partial \rho_m(\mathbf{x}, t)}{\partial t}, \tag{17}$$

where ρ_0 is the initial fluid density, and $\rho_m(\mathbf{x}, t)$ is the spatial mass-density field.

Pointlike Density Sinks

For two pointlike bodies at positions $\mathbf{x}_1(t)$ and $\mathbf{x}_2(t)$ with time-dependent mass injection rates $\dot{m}_1(t)$ and $\dot{m}_2(t)$:

$$\frac{\partial \rho_m(\mathbf{x}, t)}{\partial t} = -\dot{m}_1(t)\, \delta(\mathbf{x} - \mathbf{x}_1(t)) - \dot{m}_2(t)\, \delta(\mathbf{x} - \mathbf{x}_2(t)), \tag{18}$$

so that

$$\nabla \cdot \mathbf{V} = Q(\mathbf{x}, t) = \frac{1}{\rho_0} \left[\dot{m}_1(t)\, \delta(\mathbf{x} - \mathbf{x}_1(t)) + \dot{m}_2(t)\, \delta(\mathbf{x} - \mathbf{x}_2(t))\right]. \tag{19}$$

For pointlike fluid masses, the Poisson equation becomes:

$$\nabla^2 \Phi = -\frac{\partial Q(\mathbf{x}, t)}{\partial t} = -\frac{1}{\rho_0} \left[\ddot{m}_1\, \delta(\mathbf{x} - \mathbf{x}_1(t)) + \ddot{m}_2\, \delta(\mathbf{x} - \mathbf{x}_2(t))\right]. \tag{20}$$

We define the gravitational permittivity as

$$\epsilon_g = \rho_0 T^2, \tag{21}$$

[8]Explicit derivation of Maxwell's equations have been left as an exercise of to the reader.

And Newtons Gravitational Constant:

$$G = \frac{1}{4\pi\epsilon_g}$$

So that the solution to Poissons equation becomes:

$$\Phi(\mathbf{x}, t) = G \sum_{i=1}^{2} \frac{m_i(t)}{|\mathbf{x} - \mathbf{x}_i(t)|}.$$

Gravitational Permeability and Dimensional Consistency

To ensure dimensional consistency analogous to electromagnetism, we introduce a gravitational permeability μ_g defined by

$$\mu_g = \frac{1}{\epsilon_g\, c^2}, \tag{22}$$

so that the gravitational wave speed satisfies

$$c^2 = \frac{1}{\epsilon_g\, \mu_g}. \tag{23}$$

This allows us to express Newton's gravitational constant in terms of the wave speed and gravitational permeability:

$$G = \frac{c^2\, \mu_g}{4\pi} \tag{24}$$

where c is the propagation speed of gravitational disturbances in the fluid, and μ_g is the gravitational permeability with dimensions $[L/M]$.

Cosmological Mapping and Numerical Scaling

Starting from the dimensional expression

$$G = \frac{c^2\, \mu_g}{4\pi}, \tag{25}$$

we note that μ_g is defined by

$$\mu_g = \frac{1}{\epsilon_g c^2}, \tag{26}$$

so that

$$G = \frac{1}{4\pi\epsilon_g}. \tag{27}$$

Introducing a characteristic radius R of the universe and the wave speed c, we can write

$$T \sim \frac{R}{c} \quad \Longrightarrow \quad \epsilon_g = \rho T^2 \sim \rho \frac{R^2}{c^2}, \tag{28}$$

which gives

$$G \sim \frac{c^2}{4\pi \rho_0 R^2}. \tag{29}$$

Cosmologically, the critical density ρ_{crit} and the radius R satisfy approximately

$$R^2 \sim \frac{1}{\rho_{\text{crit}}}. \tag{30}$$

Substituting this relation, we obtain a numerically convenient form:

$$G \sim \frac{c^2}{4\pi} \frac{\rho_{\text{crit}}}{\rho_0}, \tag{31}$$

which matches the observed Newton constant. When $\rho_0 = 1$, it assumes the static case:

$$\nabla \cdot \mathbf{V} = Q(\mathbf{x}, t) = -\frac{1}{\rho_0} \frac{\partial \rho_m(\mathbf{x}, t)}{\partial t} = -\frac{\partial \rho_m(\mathbf{x}, t)}{\partial t}. \tag{32}$$

Change Notes For Second Version

- **Removed the black hole singularity,** although the result was interesting it is not in the scope for this general treatise.
- **Removed all relativistic mechanics,** I am hoping for there to be a paper in the future (named *Special Fluid Field Theory*) to deal with the treatise of relativistic fluids and hence obtaining Einsteins field equation's without postulating that mass-energy interactions.
- **Removed the dark forces analysis,** again, although highly valuable and interesting, it remains out of scope for this treatise and is better accompanied with data analysis.
- **Removed the appendix** to make the paper easier to read.
- **General reformulation of the paper.** Firstly, the paper has been refurnished as a whole, the unification of forces has been introduced through the **density** and **stress** tensors which accompanied the derivation of the *general fluid field equations.* The gravitational section was refined, removing relativistic motion and including a dimensionally accurate formulation of the two-body problem along with Newtons gravitational constant (with the help of Dirac's LNH to resolve the dimensional inconsistency). The electromagnetic section was reduced - Maxwell's equation are generally treated as self-evidently arising from the definition of the electromagnetic vector fields of the fluid, and finally the quantum mechanical section has been refined to show it's derivation and applicability.
- **I removed the grandiose conclusion,** the quotes listed in the conclusion are of much interest with respect to the treatise but I thought ought to keep this treatise purely scientific.
- **Future work** includes, as above, and also: conciliating the observation-problem within the context of GFFT, uncovering deeper insights about the cosmological constants and there relationship with the observable universe and expanding the scope of definitions of the density and stress tensors to explore unknown fluids and there resultant phenomena, and of all; due to the nature of theoretical study, that there may still remain some inconsistencies which will need to be addressed by revision of the paper.

Change Notes For The Third Version

Thanks to anyone who supported this work indirectly, kind words go a long way. This version, the third, has been redefined, the most important change note is that rather than creating a new framework of physics I have only subjected the ether to our analysis, the previous versions will still be publicly available for anyone who is interested. This paper has been significantly reduced in size, after this version, the theory should be much more standardized allowing for collaborative effort in all aspects and experimental or analytical evidence to be produced.

- **Changed the vocabulary**, Rather than using the loose terms such as *general fluid field theory*, I have just stuck using ether to describe this proposed fluid that permeates the cosmos.
- **Included the upmost important analysis of the dimensional consistency of Newtons gravitational constant**, the section that allows for the redefinition of the gravitational constant has now a sufficient explanation of its dimensions, this section reveals that the units disappear within approximation.

References

[1] R. Byron Bird, Warren E. Stewart, and Edwin N. Lightfoot. *Transport Phenomena*. John Wiley & Sons, New York, 2nd edition, 2007. Chapter 3 covers viscosity and position-dependent coefficients in fluids.

[2] Pijush K. Kundu, Ira M. Cohen, and David R. Dowling. *Fluid Mechanics*. Academic Press, Burlington, MA, 6th edition, 2015. Chapter 6 covers compressible Navier–Stokes and viscous stress tensor formulations.

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