LEXICON OF FUNDAMENTAL PHYSICS EQUATIONS

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Rewritten in Terms of ε₀ and μ₀

Constantes fondamentales du vide

Symbole	Valeur	Nom	Unité	Rôle physique
ε_0	8.854×10^{-12}	Permittivity of vacuum	F/m	Capacité volumique
μ_0	$4\pi \times 10^{-7}$	Permeability of vacuum	H/m	Rigidité magnétique
c	$\frac{1}{\sqrt{\varepsilon_0 \mu_0}}$	Speed of light	m/s	Fréquence propre du milieu
Z_0	$\sqrt{\frac{\mu_0}{\varepsilon_0}}$	Vacuum impedance	Ω	Résistance du vide

Relations fondamentales:

$$c^2 = \frac{1}{\varepsilon_0 \mu_0}, Z_0 = \mu_0 c, \alpha = \frac{e^2}{4\pi \varepsilon_0 \hbar c}$$

James Clerk Maxwell

Maxwell's Equations (Canonical Form)

$$\nabla \cdot E = \frac{\rho}{\varepsilon_0} \quad (1.1)$$

$$\nabla \cdot B = 0 \quad (1.2)$$

$$\nabla \times E = -\frac{\partial B}{\partial t}$$
$$(1.3)$$

$$\nabla \times B = \mu_0 J + \mu_0 \varepsilon_0 \frac{\partial E}{\partial t}$$
$$(1.4)$$

Electromagnetic Wave Equation

$$\nabla^2 E - \mu_0 \varepsilon_0 \frac{\partial^2 E}{\partial t^2} = 0$$
$$(1.5)$$

$$\nabla^2 B - \mu_0 \varepsilon_0 \frac{\partial^2 B}{\partial t^2} = 0$$
$$(1.6)$$

Explicit form:

$$\frac{\partial^2}{\partial t^2} = \frac{1}{\varepsilon_0 \mu_0} \nabla^2$$

Physical interpretation: The constants ε_0 and μ_0 characterize the dynamic response of the electromagnetic medium to any excitation.

Charles-Augustin de Coulomb

Coulomb's Law

$$F = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r^2} \acute{r}$$
$$(2.1)$$

ε₀-based reading: Electrostatic force is inversely proportional to the permittivity of the medium.

$$F \propto \varepsilon_0^{-1}$$

Michael Faraday

Law of Electromagnetic Induction

$$E = -\frac{d\Phi_B}{dt} \tag{3.1}$$

where $\Phi_B = \int \❑ B \cdot dS$ and $B = \mu_0 H$

μ₀-based reading: Induction is a **local deformation of the magnetic field** μ_0.

André-Marie Ampère

Ampère-Maxwell Law

$$\nabla \times B = \mu_0 J + \mu_0 \varepsilon_0 \frac{\partial E}{\partial t} \tag{4.1}$$

ε₀-μ₀ interpretation: Electric current locally structures the magnetic field μ_0, which in turn imposes ε_0.

Hendrik Lorentz

Lorentz Force

$$F = q(E + v \times B) \tag{5.1}$$

Medium-based reading:

$$E \to \varepsilon_0, B \to \mu_0$$

The Lorentz force is **a kinematic interaction with the electromagnetic substrate**.

Vacuum Properties

Vacuum Impedance

$$Z_0 = \sqrt{\frac{\mu_0}{\varepsilon_0}} \approx 376.73\,\Omega$$
$$(6.1)$$

Physical meaning: The vacuum **resists** the passage of electromagnetic fields. It is neither neutral, nor transparent, nor passive.

Electromagnetic Energy Density

$$u = \frac{1}{2}\left(\varepsilon_0 E^2 + \frac{B^2}{\mu_0}\right)$$
$$(6.2)$$

Reading: The vacuum **contains structured energy**, measurable and storable.

Radiation Pressure

$$P = \frac{I}{c} \Rightarrow P = I\sqrt{\varepsilon_0 \mu_0}$$
$$(6.3)$$

Interpretation: The electromagnetic field **exerts real mechanical pressure** — a direct bridge toward emergent gravitation.

Max Planck

Energy-Frequency Relation

$$E = h\nu$$
$$(7.1)$$

Propagation Frequency (ε₀-μ₀ form)

$$\nu = \frac{1}{\lambda\sqrt{\varepsilon_0 \mu_0}}$$
$$(7.2)$$

Physical reading: Planck's limit is **a resonance limit of the medium**, not an abstract singularity.

Louis de Broglie

Wave-Particle Relation

$$\lambda = \frac{h}{p} \tag{8.1}$$

Momentum (ε_0-μ_0 form)

$$p = h\nu\sqrt{\varepsilon_0 \mu_0} \tag{8.2}$$

Albert Einstein

Mass-Energy Equivalence

Canonical form:

$$E = mc^2$$

ε_0-μ_0 rewriting:

$$E = \varepsilon_0 \mu_0 m \tag{9.1}$$

Interpretation: Mass is a **density of energy stored in the electromagnetic medium** ε_0-μ_0.

Energy-Momentum Relation

Canonical form:

$$E^2 = p^2 c^2 + m^2 c^4$$

ε_0-μ_0 rewriting:

$$E^2 = \varepsilon_0 \mu_0 p^2 + (\varepsilon_0 \mu_0)^2 m^2 \tag{9.2}$$

Reading: Wave and mass are **two compression states of the same substrate**.

Hermann Minkowski

Spacetime Interval

Canonical form:

$$s^2 = c^2 t^2 - x^2$$

ε₀-μ₀ rewriting:

$$s^2 = \varepsilon_0 \mu_0 t^2 - x^2 \tag{10.1}$$

Interpretation: Spacetime geometry inherits directly from ε_0 and μ_0. Relativistic geometry is **not fundamental, it is derived**.

Erwin Schrödinger

Schrödinger Equation

$$i\hbar \frac{\partial \psi}{\partial t} = -\frac{\hbar^2}{2m} \nabla^2 \psi + V \psi \tag{11.1}$$

Medium-based Reading

$$\nabla^2 \psi \sim (\varepsilon_0 \mu_0) \frac{\partial \psi}{\partial t} \tag{11.2}$$

Message: The wave function **propagates in a medium**, it is not a floating mathematical abstraction.

Richard Feynman

Fine-Structure Constant

Canonical form:

$$\alpha = \frac{e^2}{4\pi \varepsilon_0 \hbar c}$$

ε₀-μ₀ rewriting:

$$\alpha = \frac{4\pi e^2 \hbar}{\varepsilon_0 \mu_0} \tag{12.1}$$

Reading: The fine-structure constant **encodes the geometry of the medium**, not a mysterious property of charge.

Isaac Newton

Law of Universal Gravitation

Canonical form:

$$F = G\frac{m_1 m_2}{r^2} \tag{13.1}$$

Modern Interpretation (ε_0-μ_0 based)

$$G \propto \left(\varepsilon_0 \mu_0\right)^{-1} \times \text{density of medium} \tag{13.2}$$

Interpretation: Gravitation becomes **a gradient of density of the electromagnetic substrate**.

Summary: The Unified Medium

All the great laws of physics inherit explicitly or implicitly from the constants ε_0 and μ_0.

They describe **a single electromagnetic medium that structures everything**, not independent forces.

Key Equations for Completeness

1. Maxwell Wave Equation (Proof that vacuum oscillates):

$$\frac{\partial^2 E}{\partial t^2} = \frac{1}{\varepsilon_0 \mu_0}\nabla^2 E$$

2. Gauss Laws (Foundation of the medium concept):

$$\nabla \cdot E = \frac{\rho}{\varepsilon_0}, \nabla \cdot B = 0$$

3. Energy-Momentum Relation (Bridge between wave and matter):

$$E^2 = \varepsilon_0 \mu_0 p^2 + (\varepsilon_0 \mu_0)^2 m^2$$

4. Vacuum Impedance (The medium resists):

$$Z_0 = \sqrt{\frac{\mu_0}{\varepsilon_0}} \approx 377\,\Omega$$

5. Energy Density (Substrate is active and stores energy):

$$u = \frac{1}{2}\left(\varepsilon_0 E^2 + \frac{B^2}{\mu_0}\right)$$

6. Radiation Pressure (Mechanical bridge to gravitation):

$$P = I\sqrt{\varepsilon_0 \mu_0}$$

Conclusion

Philosophical Reading

The rewriting of all fundamental equations in terms of ε_0 and μ_0 reveals a **unified vision of physics**:

- **Electromagnetic constants are not arbitrary** — they define the substrate of reality.
- **Vacuum is active** — it vibrates, resists, stores energy, and couples to matter.
- **All phenomena** (wave, matter, force, spacetime) are **manifestations of the same medium**.
- **Gravitation is emergent** from this electromagnetic structure.

This is not speculative philosophy — it is **mathematics speaking directly**.