

LEXICON OF FUNDAMENTAL PHYSICS EQUATIONS

Rewritten in Terms of ϵ_0 and μ_0

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	$\frac{1}{\sqrt{\epsilon_0 \mu_0}}$	Speed of light	m/s	Fréquence propre du milieu
Z_0	$\sqrt{\frac{\mu_0}{\epsilon_0}}$	Vacuum impedance	Ω	Résistance du vide

Relations fondamentales:

$$c^2 = \frac{1}{\epsilon_0 \mu_0}, Z_0 = \mu_0 c, \alpha = \frac{e^2}{4 \pi \epsilon_0 \hbar c}$$

James Clerk Maxwell

Maxwell's Equations (Canonical Form)

$$\nabla \cdot E = \frac{\rho}{\epsilon_0} \quad (1.1)$$

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

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

$$\nabla \times B = \mu_0 J + \mu_0 \epsilon_0 \frac{\partial E}{\partial t} \quad (1.4)$$

Electromagnetic Wave Equation

$$\nabla^2 E - \mu_0 \epsilon_0 \frac{\partial^2 E}{\partial t^2} = 0 \quad (1.5)$$

$$\nabla^2 B - \mu_0 \epsilon_0 \frac{\partial^2 B}{\partial t^2} = 0 \quad (1.6)$$

Explicit form:

$$\frac{\partial^2}{\partial t^2} = \frac{1}{\epsilon_0 \mu_0} \nabla^2$$

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 $F = \frac{1}{4 \pi \epsilon_0} \frac{q_1 q_2}{r^2} \hat{r}$ (2.1)

F is a constant since r varies inversely with ϵ_0 . If ϵ_0 decreases, the relative distance increases according to Maxwell's theory.

F est une constante puisque r varie à l'inverse de ϵ_0 . Si ϵ_0 diminue, la distance relative augmente selon la théorie de Maxwell.

Michael Faraday

Law of Electromagnetic Induction

$$E = -\frac{d \Phi_B}{d t}$$

(3.1)

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

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

André-Marie Ampère

Ampère-Maxwell Law

$$\nabla \times B = \mu_0 J + \mu_0 \epsilon_0 \frac{\partial E}{\partial t}$$

(4.1)

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

Hendrik Lorentz

Lorentz Force

$$F = q(E + v \times B)$$

(5.1)

Medium-based reading:

$$E \rightarrow \epsilon_0, B \rightarrow \mu$$

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

Vacuum Properties

Vacuum Impedance

$$Z_0 = \sqrt{\frac{\mu_0}{\epsilon_0}} \approx 376.73 \Omega \quad (6.1)$$

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

Electromagnetic Energy Density

$$u = \frac{1}{2} \left(\epsilon_0 E^2 + \frac{B^2}{\mu_0} \right) \quad (6.2)$$

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

Radiation Pressure

$$P = \frac{I}{c} \Rightarrow P = I \sqrt{\epsilon_0 \mu_0} \quad (6.3)$$

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

Max Planck

Energy-Frequency Relation

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

Propagation Frequency (ϵ_0 - μ_0 form)

$$\nu = \frac{1}{\lambda \sqrt{\epsilon_0 \mu_0}} \quad (7.2)$$

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

Louis de Broglie

Wave-Particle Relation

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

(8.1)

Momentum ($\epsilon_0\mu_0$ form)

$$p = h v \sqrt{\epsilon_0 \mu_0}$$

(8.2)

Albert Einstein

Mass-Energy Equivalence

Canonical form:

$$E = m c^2$$

$\epsilon_0\mu_0$ rewriting:

$$E = \epsilon_0 \mu_0 m$$

(9.1)

Interpretation: Mass is a **density of energy stored in the electromagnetic medium** $\epsilon_0\mu_0$.

Energy-Momentum Relation

Canonical form:

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

$\epsilon_0\mu_0$ rewriting:

$$E^2 = \epsilon_0 \mu_0 p^2 + (\epsilon_0 \mu_0)^2 m^2$$

(9.2)

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

Hermann Minkowski

Spacetime Interval

Canonical form:

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

ϵ_0 - μ_0 rewriting:

$$s^2 = t^2/(\epsilon_0 \mu_0) - x^2$$

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

Erwin Schrödinger

Schrödinger Equation

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

Medium-based Reading

$$\nabla^2 \psi \sim (\epsilon_0 \mu_0) \frac{\partial \psi}{\partial t} \quad (11.2)$$

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

Richard Feynman

Fine-Structure Constant

Canonical form:

$$\alpha = \frac{e^2}{4 \pi \epsilon_0 \hbar c}$$

$\epsilon_0\mu_0$ rewriting:

$$\alpha = e^2 \sqrt{(\epsilon_0 \mu_0) / (4\pi \epsilon_0 \hbar)}$$

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:

$$F = G \frac{m_1 m_2}{r^2} \quad (13.1)$$

Modern Interpretation ($\epsilon_0\mu_0$ based)

$$G \propto (\epsilon_0 \mu_0)^{-1} \times \text{density of medium} \quad (13.2)$$

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):

$$\frac{\partial^2 E}{\partial t^2} = \frac{1}{\epsilon_0 \mu_0} \nabla^2 E$$

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

$$\nabla \cdot E = \frac{\rho}{\epsilon_0}, \nabla \cdot B = 0$$

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

$$E^2 = \epsilon_0 \mu_0 p^2 + (\epsilon_0 \mu_0)^2 m^2$$

4. Vacuum Impedance (The medium resists):

$$Z_0 = \sqrt{\frac{\mu_0}{\epsilon_0}} \approx 377 \Omega$$

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

$$u = \frac{1}{2} \left(\epsilon_0 E^2 + \frac{B^2}{\mu_0} \right)$$

6. Radiation Pressure (Mechanical bridge to gravitation):

$$P = I \sqrt{\epsilon_0 \mu_0}$$

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**.