# Charge-Mass, $B$, and the Decompression of Electromagnetic Language

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June 2026
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**Abstract**

This note concerns the language of electromagnetism, beginning with Ørsted's experiment and moving toward Maxwell's equations through the lens of charge-mass, directional measurement, and symbolic decompression. The aim is not to replace classical electromagnetism in a single step, but to preserve the flow of the argument so that the context can be rebuilt later. The central claim developed here is that the magnetic field $B$ should not be treated only as an isolated field-object. Rather, $B$ may be read as a symbolic compression of handed, rotational, charge-mass dynamics. Where $B$ appears in the equations, one may attempt to decompress it into the charge-mass trajectory and right-hand-rule geometry that generate the measured directional condition.

## Contents

# 1 Purpose of this Note

This document is intended as a recoverable pathway back into the argument. The conversation became dense because several different layers were active at once:

- the historical experiment, especially Ørsted's compass deflection;
- the stabilised language of nineteenth and twentieth century electromagnetism;
- the symbolic compression of that language into nouns such as charge, mass, field, force, current, and $B$;
- the user's charge-mass framing, informed by practical experience with large organic mass spectrometers;
- the mathematical compression carried by $\nabla$, divergence, curl, cross product, and Maxwell's equations;
- the missing or externalised role of handedness, especially the right-hand rule.

The goal is to walk back through the argument slowly, retaining the key hinge points and equations.

# 2 Opening Observation: Ørsted and Directional Measurement

The discussion began with an article on Hans Christian Ørsted's famous experiment. The important point was not merely historical. The experiment revealed a directional effect: a compass needle turned when placed near a current-carrying wire.

In the later textbook language, this becomes:

$$\text{current} \to \text{magnetic field} \to \text{compass deflection.}$$

However, the measured event was more primitive than that language. What was directly observed was a directional change:

$$\text{maintained current arrangement} \to \text{needle rotation.}$$

The word "magnetic field" is therefore already a later symbolic stabilisation. The experiment did not directly measure an isolated thing called a field. It measured a directional relation.

## 2.1 First Hinge

The first hinge was this:

> The measured behaviour did not follow the symbolic trajectory imagined beforehand. Nature did not violate logic. Rather, the prior symbolic model failed.

This matters because it separates:

- the measured outcome,
- the geometric interpretation,
- the mathematical representation,
- the later noun-like object.

The compass did not first reveal a noun. It revealed a direction-changing event.

# 3 The Problem of Stabilised Nouns

A major theme was that nineteenth and early twentieth century physics stabilised an extremely successful language. Terms such as charge, mass, field, force, current, electron, wave, particle, and spacetime became modelling primitives.

Once stabilised, these terms hardened into nouns. Later modelling then often begins from the nouns rather than from the measurement trajectories that generated them.

A useful formulation is:

> At the end of the nineteenth century and the beginning of the twentieth, physics stabilised a language of entities. Charge, mass, field, force, energy, and spacetime became noun-like modelling primitives. Yet these nouns were originally compressed from measurement trajectories, apparatus behaviours, geometric constraints, and mathematical conventions. Modern mathematics allows us to reopen those compressed trajectories and ask whether the nouns remain the best starting point.

## 3.1 Controlled Compression

The conversation did not conclude that nouns must be abandoned. That would be impossible. We need compression in order to think and write.

The methodological point became:

> The noun is permitted, but only if its trajectory remains recoverable.

This may be called controlled compression. One may use terms such as field, charge, mass, interaction, and beam, provided that each can be unfolded back into the measurement, geometry, and symbolic choices that stabilised it.

# 4 Charge-Mass as the Measured Identity

The user's experience installing large organic mass spectrometers in the 1980s became central. A mass spectrometer does not directly see mass in isolation. It sees trajectories, curvatures, arrival times, detector hits, and beam stability.

The classical expression is usually:

$$m/z,$$

where $m$ is mass and $z$ is charge state. But this is already a symbolic decomposition. The instrument works on a coupled entity.

The proposed language is:

> Charge and mass are not first encountered as separable primitives. They are encountered as a coupled measurable interactional identity. The separation of charge and mass is a later symbolic decomposition imposed by a model, not the direct content of the measurement.

Or more compactly:

$$\mathcal{C}_{cm}$$

may denote a charge-mass identity.

This is not yet a standard physical object. It is a deliberate decompression symbol. It reminds the reader that what is measured is not pure charge or pure mass, but a coupled trajectory-bearing identity.

### 4.1 Mass Spectrometry as Interactional Geometry

The mass spectrometer may be described as an interactional geometry machine. It shapes, stabilises, selects, and sorts charge-mass identities through apparatus geometry.

The old language says:

The ion has a mass-to-charge ratio.

The decompressed language says:

The instrument stabilises and sorts charge-mass identities according to permitted trajectories within a mainta

The measurable output is therefore not a detached scalar at first. It is a directional or temporal outcome that is later compressed into scalars and ratios.

## 5 Asymmetry and Direction as the Primary Measurement

A key insight was that the measurement of charge and mass is often actually a measurement of direction.

In a magnetic sector instrument, for example, the charged entity curves. The path is altered. The detector receives or does not receive. The scalar value is reconstructed after the directional event.

The classical compression is:

$$q, \; m, \; \mathbf{v}, \; \mathbf{B} \to \mathbf{F} \to \text{deflection}.$$

The decompressed measurement order is closer to:

$$\text{directional change} \to \text{model decomposition} \to q, \; m, \; \mathbf{v}, \; \mathbf{B}, \; \mathbf{F}.$$

This reverses the emphasis. In the real measurement, directional alteration is primary. Scalars are recovered through model-fitting and apparatus calibration.

### 5.1 Second Hinge

The second hinge was:

> Charge-mass is measured as altered direction. The scalar quantities later assigned to charge, mass, and field are symbolic decompositions of a prior geometric event.

This is especially important because it exposes the geometric and asymmetric nature of the measurement. It is not merely a scalar extraction.

## 6 The Status of Interaction

During the conversation, the word “interaction” itself became unstable. It too can become a noun.

A refinement was made:

> There is no separately existing thing called an interaction. Interaction is the condition under which a measurable outcome is produced.

Thus, rather than writing:

$$A + B + \text{interaction} \to \text{measurement},$$

one may write:

$$\text{finite identities in relation} \to \text{measurable outcome} \to \text{symbolic compression.}$$

This keeps the focus on measurement. The word interaction remains useful, but it should not be treated as an extra object.

# 7 $B$ as a Function of Charge-Mass Dynamics

The most important technical hinge concerns $B$.

The classical language often treats $\mathbf{B}$ as if it were a primitive field-object. But the conversation developed a stronger claim:

> $B$ is not an independent field-object. It is a symbolic compression of a handed directional geometry produced by moving charge-mass.

In symbolic form:

$$\mathbf{B} \sim f(\text{moving charge-mass}).$$

Or, using the charge-mass notation:

$$\mathbf{B} \sim f(\dot{\mathcal{C}}_{cm}),$$

where $\dot{\mathcal{C}}_{cm}$ indicates charge-mass dynamics, not merely charge flow stripped of mass-bearing identity.

A more explicit decompression was suggested:

$$\mathbf{B} \sim \mathsf{RH} \circ \mathcal{R} \left[\mathcal{C}_{cm}(x,t)\right],$$

where:

- $\mathcal{C}_{cm}(x,t)$ denotes charge-mass identity distributed or moving through space and time;
- $\mathcal{R}$ denotes rotational or circulating structure;
- $\mathsf{RH}$ denotes the right-hand-rule orientation map;
- the composition $\mathsf{RH} \circ \mathcal{R}$ emphasises that $B$ carries handed rotational geometry.

This is not presented as a finished field equation. It is a decompression instruction.

## 7.1 Third Hinge

The third hinge was:

> Where $B$ appears in the equations, one may attempt to replace it with the charge-mass trajectory that generates the directional condition being represented.

This is stronger than merely saying that $B$ is compressed. It proposes a route for replacing the symbol with its generating structure.

## 8 The Right-Hand Rule as Missing Representation

A central insight was that the right-hand rule is usually outside the equation, but it carries essential geometric content.

In the textbook treatment, one may write:

$$\mathbf{F} = q\mathbf{v} \times \mathbf{B}.$$

But the notation does not visibly show the embodied orientation rule required to interpret the cross product. The right-hand rule is usually taught as a mnemonic, but in this framing it is part of the missing representation.

> The right-hand rule is not an accessory to the equation. It is part of the representational machinery required to recover the directional geometry that the equation compresses.

The decompressed chain is:

$$\text{moving charge-mass} \rightarrow \text{handed rotational geometry} \rightarrow B \rightarrow \text{directional change of charge-mass.}$$

This is why $B$ should not be treated as a simple vector-noun. It carries axial or pseudo-vector behaviour, handedness, circulation, and orientation.

## 9 Recap of $\nabla$, Grad, Div, and Curl

This section gives a slow recap of the nomenclature.

### 9.1 The Del or Nabla Operator

The symbol $\nabla$, called del or nabla, is written in Cartesian coordinates as:

$$\nabla = \hat{\mathbf{x}}\frac{\partial}{\partial x} + \hat{\mathbf{y}}\frac{\partial}{\partial y} + \hat{\mathbf{z}}\frac{\partial}{\partial z}.$$

It looks like a vector, but it is really a differential operator arranged to behave vectorially under the chosen coordinate convention.

It contains the instruction:

> Take local rates of change in the spatial directions $x$, $y$, and $z$.

### 9.2 Gradient: $\nabla\phi$

If $\phi(x, y, z, t)$ is a scalar quantity, then the gradient is:

$$\nabla\phi = \left(\frac{\partial\phi}{\partial x}, \frac{\partial\phi}{\partial y}, \frac{\partial\phi}{\partial z}\right).$$

The gradient turns a scalar into a vector-like directional rate of change.

Plain language:

> Gradient asks: in which direction does the scalar increase most strongly, and how rapidly?

### 9.3 Divergence: $\nabla \cdot \mathbf{A}$

For a vector quantity:

$$\mathbf{A} = (A_x, A_y, A_z),$$

the divergence is:

$$\nabla \cdot \mathbf{A} = \frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z}.$$

Plain language:

> Divergence asks whether the vector quantity is locally spreading out from a region or converging into it.

This is the source/sink type operator.

### 9.4 Curl: $\nabla \times \mathbf{A}$

The curl is:

$$\nabla \times \mathbf{A} = \left( \frac{\partial A_z}{\partial y} - \frac{\partial A_y}{\partial z}, \frac{\partial A_x}{\partial z} - \frac{\partial A_z}{\partial x}, \frac{\partial A_y}{\partial x} - \frac{\partial A_x}{\partial y} \right).$$

Plain language:

> Curl asks whether the vector quantity locally circulates around an oriented loop.

This is not just ordinary change. It is rotationally ordered change. The sign pattern and cyclic ordering carry handedness. The right-hand rule is embedded in the convention.

Thus, when one writes:

$$\nabla \times \mathbf{A},$$

one is compressing the instruction:

> Measure the oriented local circulation of **A** using the chosen right-handed coordinate convention.

## 10 Maxwell's Equations in Compact Form

In SI units, Maxwell's equations are usually written:

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

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

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

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

The compact form hides:

- source/sink assumptions through divergence;

- local circulation through curl;
- handedness through cross-product and curl conventions;
- charge-density through $\rho$;
- charge-flow through $\mathbf{J}$;
- the special symbolic status of $B$ as axial or pseudo-vector;
- the separation of charge from mass.

# 11 Maxwell's Equations Expanded in Components

Let:

$$\mathbf{E} = (E_x, E_y, E_z), \qquad \mathbf{B} = (B_x, B_y, B_z), \qquad \mathbf{J} = (J_x, J_y, J_z).$$

## 11.1 Gauss's Law for $E$

Compact:

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\varepsilon_0}.$$

Expanded:

$$\frac{\partial E_x}{\partial x} + \frac{\partial E_y}{\partial y} + \frac{\partial E_z}{\partial z} = \frac{\rho}{\varepsilon_0}.$$

Standard reading:

> Electric field divergence is associated with charge density.

Decompressed reading:

> A source-like symbolic structure is assigned to $E$, with $\rho$ acting as charge density. But $\rho$ is already a compression that separates charge from charge-mass identity.

## 11.2 Gauss's Law for $B$

Compact:

$$\nabla \cdot \mathbf{B} = 0.$$

Expanded:

$$\frac{\partial B_x}{\partial x} + \frac{\partial B_y}{\partial y} + \frac{\partial B_z}{\partial z} = 0.$$

Standard reading:

> There are no magnetic monopoles.

Decompressed reading:

> The symbolic quantity $B$ does not behave as a scalar source/sink field analogous to $E$. It presents as closed, rotational, or directional structure rather than source-divergent structure.

This is consistent with the idea that $B$ is a compression of handed rotational charge-mass dynamics.

### 11.3 Faraday's Law

Compact:

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}.$$

Expanded:

$$\frac{\partial E_z}{\partial y} - \frac{\partial E_y}{\partial z} = -\frac{\partial B_x}{\partial t},$$

$$\frac{\partial E_x}{\partial z} - \frac{\partial E_z}{\partial x} = -\frac{\partial B_y}{\partial t},$$

$$\frac{\partial E_y}{\partial x} - \frac{\partial E_x}{\partial y} = -\frac{\partial B_z}{\partial t}.$$

Standard reading:

A changing magnetic field is associated with a circulating electric field.

Decompressed reading:

A rotational spatial organisation of $E$ is associated with time variation in the compressed $B$-structure. The minus sign carries orientation and opposition, often expressed through Lenz's law.

### 11.4 Ampere-Maxwell Law

Compact:

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

Expanded:

$$\frac{\partial B_z}{\partial y} - \frac{\partial B_y}{\partial z} = \mu_0 J_x + \mu_0 \varepsilon_0 \frac{\partial E_x}{\partial t},$$

$$\frac{\partial B_x}{\partial z} - \frac{\partial B_z}{\partial x} = \mu_0 J_y + \mu_0 \varepsilon_0 \frac{\partial E_y}{\partial t},$$

$$\frac{\partial B_y}{\partial x} - \frac{\partial B_x}{\partial y} = \mu_0 J_z + \mu_0 \varepsilon_0 \frac{\partial E_z}{\partial t}.$$

Standard reading:

Current density and changing electric field are associated with circulating magnetic field.

Decompressed reading:

The rotational organisation of $B$ is associated with charge-flow and changing $E$. But $\mathbf{J}$ is itself a compression of moving charge, often written $\mathbf{J} = \rho \mathbf{v}$, and this strips out the charge-mass identity of the moving source.

## 12 Unfolding the Current Term

The standard current density is:

$$\mathbf{J} = \rho\mathbf{v}.$$

Component form:

$$J_x = \rho v_x, \qquad J_y = \rho v_y, \qquad J_z = \rho v_z.$$

Substituting into Ampere-Maxwell gives:

$$\frac{\partial B_z}{\partial y} - \frac{\partial B_y}{\partial z} = \mu_0 \rho v_x + \mu_0 \varepsilon_0 \frac{\partial E_x}{\partial t},$$

$$\frac{\partial B_x}{\partial z} - \frac{\partial B_z}{\partial x} = \mu_0 \rho v_y + \mu_0 \varepsilon_0 \frac{\partial E_y}{\partial t},$$

$$\frac{\partial B_y}{\partial x} - \frac{\partial B_x}{\partial y} = \mu_0 \rho v_z + \mu_0 \varepsilon_0 \frac{\partial E_z}{\partial t}.$$

This makes visible that $B$ is already connected to moving charge. The user's additional claim is that this should be decompressed further:

$$\mathbf{J} = \rho\mathbf{v} \quad \rightsquigarrow \quad \mathbf{J}_{cm} = \mathcal{J}\left[\mathcal{C}_{cm}, \mathbf{v}, G_A, \tau\right].$$

Here $\mathcal{J}$ is a placeholder for a charge-mass current-like expression that retains the identity, geometry, and stabilisation conditions stripped out by the usual charge-current term.

## 13 Lorentz Force and Directional Asymmetry

The compact Lorentz force law is:

$$\mathbf{F} = q\left(\mathbf{E} + \mathbf{v} \times \mathbf{B}\right).$$

Expanded component form:

$$F_x = q\left(E_x + v_y B_z - v_z B_y\right),$$

$$F_y = q\left(E_y + v_z B_x - v_x B_z\right),$$

$$F_z = q\left(E_z + v_x B_y - v_y B_x\right).$$

This expansion shows that the magnetic contribution is not a scalar push. Each force component depends on sideways combinations of velocity and $B$. The cross product carries handedness and directional asymmetry.

The decompressed version replaces $B$ with the charge-mass dynamics that generate it:

$$\mathbf{F} = q\left(\mathbf{E} + \mathbf{v} \times \left[\mathsf{RH} \circ \mathcal{R}[\mathcal{C}_{cm}(x,t)]\right]\right).$$

Even this still uses $q$ and $\mathbf{F}$, so it is not fully decompressed. But it makes one major hidden structure visible.

## 14 Possible New Formulations

The following are working formulations, not final equations.

### 14.1 Old Formulation

$$q,\ m,\ \mathbf{v},\ \mathbf{B} \to \mathbf{F} \to \text{deflection}.$$

This treats charge, mass, velocity, magnetic field, and force as separable primitives.

### 14.2 Measurement-First Formulation

$$\text{directional change} \to \text{model decomposition} \to q,\ m,\ \mathbf{v},\ \mathbf{B},\ \mathbf{F}.$$

This starts from what the apparatus actually gives.

### 14.3 Charge-Mass Geometry Formulation

$$\mathcal{C}_{cm}^{probe} + \mathcal{G}_{cm}^{source} \to \Delta\Gamma.$$

Here:

- $\mathcal{C}_{cm}^{probe}$ is the charge-mass identity being measured;
- $\mathcal{G}_{cm}^{source}$ is the maintained charge-mass geometry that produces the measurement condition;
- $\Delta\Gamma$ is the measured trajectory change.

### 14.4 $B$-Replacement Formulation

$$\mathbf{B} \rightsquigarrow \mathsf{RH} \circ \mathcal{R}\left[\mathcal{C}_{cm}(x,t)\right].$$

This is the central proposed decompression. It says that $B$ should be replaced by a representation of handed rotational charge-mass dynamics where possible.

### 14.5 $E$-$B$ Projection Formulation

The conversation also suggested that $E$ and $B$ may be treated as different symbolic cuts through one deeper charge-mass system.

$$\mathbf{E} \quad \text{and} \quad \mathbf{B}$$

may be read not as rival primitives, but as different compressed projections of a deeper charge-mass trajectory.

The $E$-language emphasises:

- separation;
- source-density;
- potential difference;
- acceleration along a line;
- charge distribution.

The $B$-language emphasises:

- motion;
- circulation;
- handedness;
- curl;
- trajectory bending;
- directional asymmetry.

## 15 Key Hinge Points

The following list is intended as a memory path back into the argument.

1. **Ørsted measured directional change.** The compass rotated. The later field language was a symbolic reconstruction.
2. **The measured behaviour did not violate logic.** It violated the prior symbolic model.
3. **Physics stabilised nouns.** Charge, mass, field, force, current, and $B$ became modelling primitives after historical stabilisation.
4. **Nouns are necessary but dangerous.** We need compression, but the compressed trajectory should remain recoverable.
5. **Mass spectrometry does not directly see mass.** It sees trajectories, curvature, detector arrival, stability, and calibration outcomes.
6. **Charge and mass are first encountered as charge-mass.** Their separation is a later symbolic decomposition.
7. **Direction is primary.** In many electromagnetic measurements, the apparatus measures altered direction or permitted trajectory.
8. **Interaction is not a separate thing.** It is the condition under which measurable outcomes become available.
9. $B$ **is generated by moving charge-mass.** It should not be treated as an independent field-object where its source trajectory can be decompressed.
10. **The right-hand rule is missing representation.** It carries handedness and asymmetry usually external to the written equation.
11. **Curl hides handed rotational geometry.** The sign structure of $\nabla\times$ contains the right-handed coordinate convention.
12. **Replace** $B$ **where possible.** The proposed path is to replace $B$ with a charge-mass equivalent or source-trajectory representation:

$$\mathbf{B} \rightsquigarrow \mathsf{RH} \circ \mathcal{R}[\mathcal{C}_{cm}(x,t)].$$

13. $E$ **and** $B$ **may be projection languages.** They may be different symbolic compressions of a deeper charge-mass dynamic rather than isolated primitives.

## 16 A Proposed Way Forward

The next step should not be to rewrite all of electromagnetism at once. A more controlled path is:

1. Take one standard equation at a time.
2. Identify the compact noun-symbols.
3. Expand the differential operators into component form.
4. Mark where handedness enters.
5. Mark where charge has been separated from mass.
6. Replace $B$ with a provisional charge-mass source expression.
7. Ask whether the resulting expression better preserves the measurement trajectory.

The first two targets should be:

$$\mathbf{v} \times \mathbf{B}$$

from the Lorentz force law, and:

$$\nabla \times \mathbf{B}$$

from the Ampere-Maxwell law.

These are the most promising because they already contain motion, handedness, rotational structure, and moving charge.

## 17 Closing Formulation

The current best formulation is:

> $B$ is not an independent field-object. It is a handed symbolic compression of moving charge-mass dynamics. Where $B$ appears in the equations, one may attempt to replace it with the charge-mass trajectory that generates the directional condition being represented. The right-hand rule is not merely a mnemonic, but part of the externalised representation required to recover the orientation and asymmetry compressed into the symbol $B$.

This keeps the mathematics available while reopening the nouns. The aim is not to discard Maxwell's equations, but to read them as compressed symbolic trajectories and to test whether a charge-mass decompression gives a clearer measurement-first formulation.