From the Fine-Structure Constant to Mass:

Constructing the Atom and Completing F = MA

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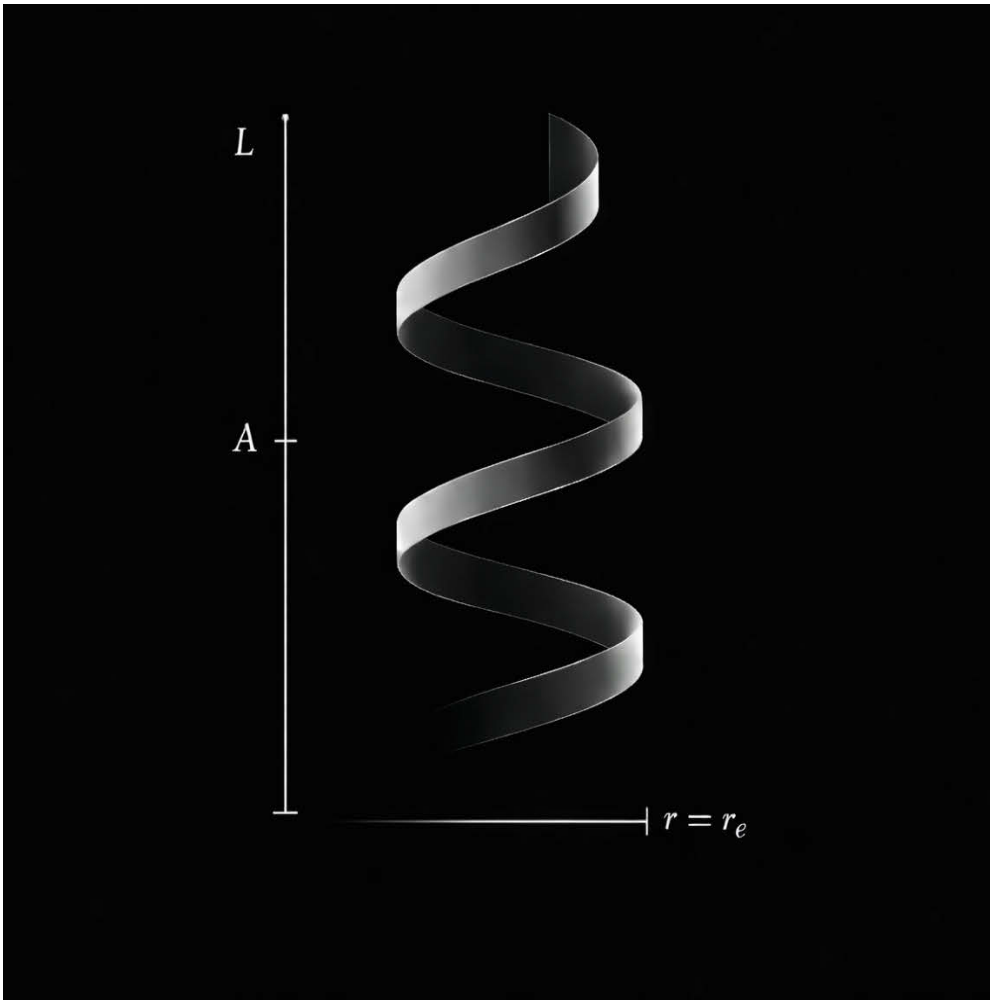

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Abstract

The fine-structure constant $\alpha \approx 1/137$ and Newton's relation $F = MA$ are among the most familiar expressions in physics. Their empirical success is unquestioned, and their operational meanings are deeply embedded in both pedagogy and practice. Yet familiarity does not guarantee understanding, particularly when a quantity is dimensionless, universal, and persistently reappears across otherwise distinct domains of theory.

This essay presents a constructive account of atomic structure in which the fine-structure constant is identified as a geometric shape ratio intrinsic to electron–proton rotor conjugation. In this account, α measures the ratio between the lateral radius of conjugating motion and the total path length required for that motion to return to closure. Each completed advance of this ratio defines a discrete act of closure and constitutes one atomic unit.

From this basis, mass is interpreted not as a primitive quantity, nor as a passive measure of matter, but as a stored memory of completed closure—an accumulated record of impulse internalized through recurrence. Newton's $F = MA$ then becomes intelligible as the expression of how external impulse interacts with the body's pre-existing internal record of stored axial impulse arising from successive completed closures.

The aim of this essay is to tell the full physical story connecting these ideas, allowing two expressions long regarded as independent—α and $F = MA$—to be understood as parts of a single constructive process.

1 The Quiet Constant

The fine-structure constant, α, enters physics quietly. It is introduced early, often in the context of atomic spectra or electromagnetic coupling, and is treated as a fixed, empirical ratio.

It is not derived in undergraduate physics. It is not explained in high school pedagogy. It is used.

And yet α is fundamentally different from most constants in physics. It has no units. It is dimensionless. It is universal. It appears not merely as a parameter in atomic theory but as a ratio that seems to govern the architecture of matter itself.

Historically, α has been explained in several ways:

As a coupling strength in quantum electrodynamics;

As a numerical ratio involving charge, Planck's constant, and the speed of light;

As an accidental feature of our universe.

But these explanations are external. They treat α as something we observe about atoms rather than something atoms must embody in order to exist.

The constant has always been there. What was missing was the physical process whose geometry α encoded.

2 What Persistence Requires

To understand α, one must ask a question physics has rarely made explicit:

What must be true for an atom to exist at all?

Atoms persist. They do not immediately radiate away. They endure across immense spans of time, forming the stable substrate of matter.

Persistence requires recurrence. If motion never returns upon itself, energy disperses. If it returns imperfectly, coherence degrades. For persistence to exist, something must close—and must do so reliably.

At the atomic scale, this closure arises through reciprocal induction between electron and proton. This interaction is not linear or static. It is rotational, phase-driven, and dynamical.

The electron does not orbit a passive proton. The proton is not a fixed anchor. The two participate in a conjugate motion in which phase advances and must return.

The simplest faithful description is that of a conjugating rotor system. Phase advances along a helical path, wrapping around an axis while progressing forward. Once this is seen, geometry becomes unavoidable.

3 The Geometry That Was Always There

Any helical motion possesses two intrinsic geometric quantities.

The first is a lateral radius—the transverse extent of motion away from its axis. The second is a path length—the total distance phase must advance before returning to its initial configuration.

Closure occurs only when these two quantities stand in a precise relationship. If the path is too short, phase fails to reconcile. If too long, coherence is lost.

That ratio is α.

The fine-structure constant is the ratio between the lateral radius of electron–proton rotor conjugation and the total path length required for phase to return to closure.

This is not a model. It is not a metaphor. It is a geometric identification.

α is dimensionless because it compares lengths. It is universal because the geometry of reciprocal conjugation is universal. It appears wherever atomic persistence exists because it measures how phase must advance before it can remember itself.

4 Closure Is an Event

Closure is gradual but with a sharp edge. It is not statistical. It is not approximate.

When phase returns exactly, the system completes a loop. A discrete unit of internal consistency is achieved. This event is the atomic act.

Physics has often assumed quantization as a primitive. But quantization is not an assumption here. It is the consequence of closure.

A conjugating rotor system cannot partially close. Either it returns or it does not. The discrete nature of atomic behavior is therefore not imposed by quantization rules; it is enforced by geometry.

5 Atomic Units, Finally Defined

Each completed α-closure—each exact return of conjugate phase—constitutes one atomic unit.

This clarifies what atomic number really counts.

Atomic number is not a count of particles. It is a count of completed closure events, accumulated over time.

An atom is therefore not an object in space. It is a history of closures.

The periodic table is not a catalog of things. It is a catalog of remembered recurrence.

Atomic number does not count particles. It counts closures.

6 Why This Took So Long to See

Classical mechanics could not see this; it had no internal phase model for atomic persistence.

Quantum mechanics could not see this; it treated quantization as primitive rather than as closure.

Even relativity could not see it; its spacetime curvature describes motion but not the internal recurrence required for persistence.

What was missing was a constructive geometric account of electron–proton reciprocity: a model in which the internal dynamics of closure are not approximated but built as the foundational act.

This is what geometric algebra now provides: a language for rotor conjugation, closure, and recurrence that reveals α as geometric necessity.

Once this is seen, the next question becomes unavoidable:

What does closure store?

7 Closure Stores Memory

What closure stores is not motion. It is not force. It is not energy flowing through space.

Closure stores impulse.

Each completed closure is a completed internal act of interaction. That interaction has occurred. It cannot be undone. It has been integrated into the system.

An atom is therefore not defined by what it is doing now. It is defined by what it has done—what it has completed—and what it remembers.

This is the definition of memory in physics: the retention of a past event as a persistent internal condition.

Mass is not a primitive. Mass is memory. Matter is the retained record of closure.

8 Accumulation Is Not Linear

Closure does not accumulate like bricks in a pile. Each new closure occurs within the existing closure structure.

Each new act of return modifies the internal topology of the whole.

Atomic structure therefore belongs to the same family as entropy, information, and phase accumulation—systems in which history matters.

Atomic number is not a count of objects. It is a depth of remembered closure.

9 Why Closure Forces Triaxiality

Memory cannot persist in one dimension—this degenerates into oscillation. It cannot persist in two—this degenerates into precession.

Only closure distributed across three independent axes permits stable revisitability.

Three-dimensional space is not a backdrop. It is the minimum geometry required for memory to exist.

10 The Sextet and the Emergence of Space

Triaxial closure imposes routing constraints. Phase must traverse orientations without contradiction while preserving reciprocity.

Fewer than six conjugation channels cannot satisfy these constraints. More than six is redundant.

The minimum stable closure system is therefore sextet-structured.

This is the origin of the quark sextet topology in the atom: not as arbitrary internal constituents, but as the minimum geometric routing system required for stable closure across three axes.

Space is not assumed. It emerges because closure requires a triaxial embedding. Matter is not placed in space. Matter constructs space by completing closure.

11 The Meaning of Mass

Mass is what remains when closure is complete.

Each closure stores axial impulse. It integrates impulse into a persistent internal state. That integration is not energetic motion but stored, stabilized impulse.

Mass is therefore a measure of internalized impulse—the memory of completed closure.

This is why mass is conserved. It is not conserved by law. It is conserved because closure is preserved.

Matter is the preservation of closure.

12 The Meaning of Acceleration

Acceleration measures change in motion. But motion is not what defines matter.

Matter is defined by closure memory.

Acceleration therefore measures how external impulse perturbs the internal closure structure.

Acceleration is not caused by force. It is the response of stored closure to interaction.

13 Completing $F = MA$

Force is not what is stored. Force is the instantaneous snapshot of interaction.

Acceleration measures the change induced by that interaction.

Mass is the stored memory that resists alteration.

Newton's equation $F = MA$ therefore becomes fully intelligible.

It expresses that the same impulse which causes acceleration does so in proportion to how much closure memory already exists.

Force is the external act.

Mass is the internal memory.

Acceleration is the resulting change.

$F = MA$ is therefore not merely an empirical relation. It is the direct algebraic statement of how impulse interacts with memory.

14 Concluding Reflections

Physics has long described bodies from the outside in: as objects in space acted upon by forces.

This essay has described them from the inside out: as histories of closure, as memories of impulse.

α is not a mysterious coupling constant. It is the geometric ratio of closure.

Mass is not an inert measure. It is the stored record of closure.

And $F = MA$ is not a law imposed on bodies. It is the expression of how external impulse interacts with internal memory.

This is not a replacement of physics.

It is physics, finally spoken from the inside out.

Required Foundational Readings

Geometric Foundations of Electron Dynamics

The modern geometric understanding of the electron as a continuously rotating physical system, often described as an internal clock, is foundational to the approach presented here.

Hestenes, D. (2025). IEEE publication on electron zitterbewegung and rotor dynamics.

Reciprocal Induction and the Protonic Inversion

The inversion of protonic structure into optical extroversion, and the resulting constructive generation of emission spectra, is treated in the canonical works on Reciprocal Induction.

Firmage, J. P. (2025). White Papers and Academy publications on reciprocal induction, rotor closure, and optical extroversion.

Closure, Memory, and the Constructive Atom

The constructive view of atoms as memories of impulse, rather than as externally-defined objects, arises directly from these geometric principles and differs fundamentally from conventional particle-count assumptions and quantum-mechanical framing of quantization.

These developments are presented in the canonical works and white papers of Joseph P. Firmage and the Academy of Science and Arts, available from:

https://JosephFirmage.com