Elementary Charges as Configurations, not Objects: Why RealQM Needs No Relativity

Claes Johnson[1]

[1]KTH Royal Institute of Technology, SE-100 44 Stockholm, Sweden ,
claesjohnson@gmail.com

July 20, 2026

Abstract

We take a single ontological step and follow its consequences: in RealQM an electron or a proton is not a standalone object but a *domain of a configuration* — a region of one coupled charge-density solution, its boundary co-determined by every other charge. On this reading an isolated electron or proton does not exist; only bound configurations (atoms, molecules, nuclei) do. Three things follow. First, the apparent defect that a free charge in RealQM merely *spreads out* — the Coulomb-plus-kinetic functional has no localised free-particle minimiser — is not a defect but the theory correctly reporting that there is no such object; every actual charge gets its size from Coulomb balance *within* a configuration. Second, RealQM then needs *no relativity*: the only thing that ever demanded a rest-energy or Compton scale was giving an *isolated* particle an intrinsic size, and with isolated particles removed the demand vanishes — all scales come from Coulomb configurations, mass is at most a scale-label, and $E = mc^2$ is never invoked. Third, the electron's magnetic moment follows without relativity as a *configuration property*: a weakly-confined electron (atom, trap) can afford the quantised current-winding that gives μ_B, while a tightly-caged one (nucleus) cannot and carries none, so nuclear moments sit at nuclear-magneton scale. The one residue this leaves is not relativity but a sharp structural question — why the winding's gyromagnetic factor is 2 rather than 1. The picture is consistent with the rest of the programme (real 3D densities, size-not-mass, the neutron as $p + e$), and it closes the free-charge problem by dissolving the free charge.

1 The step: a charge is a configuration, not an object

In RealQM [1] the electrons and protons of a system are one-electron/one-proton charge densities ψ_i supported on non-overlapping domains $\Omega_i \subset \mathbb{R}^3$, the boundaries Γ_i determined *jointly* with the ψ_i by minimisation of the Coulomb energy. An individual ψ_i is therefore not an independent thing: it is a *region of one coupled solution*, its extent and shape fixed by the presence of all the other charges. We take this literally. An electron or a proton *is* such a domain-of-a-configuration; it has no existence apart from the configuration it partakes in. The fundamental existents are atoms, molecules, and nuclei — bound configurations of charge — and "the electron" and "the proton" are abstractions read off them, not standalone objects that pre-exist and are later assembled.

This is not a new postulate grafted onto RealQM; it is what the formalism already implies, made explicit. It is also the natural end of positions already taken in the programme: that the

neutron *is* a bound $p + e$ pair rather than an elementary particle, and that a bound nucleon has no separate identity. Here we apply the same reading to the free case, where it has its sharpest consequence.

2 The free charge dissolves — and with it, a false problem

A lone electron in RealQM, with no other charge to attract it, minimises $\frac{1}{2}\int |\nabla\psi|^2$ alone; the infimum is zero, approached by spreading ψ over ever larger volume, and there is *no localised minimiser*. The same holds for a lone proton. Read as a statement about objects, this looks like a failure: the theory "cannot confine" a free particle. Read through §1, it is not a failure but a *correct report*: there is no isolated electron for the theory to confine. The spreading is the theory saying, of a would-be free charge, *no such object*.

Every charge we actually deal with is in a configuration, and takes its size from the Coulomb balance there: the Bohr scale for an electron bound to a nucleus, the femtometre scale for a proton or electron in a nucleus, the trap scale for an electron held in a Penning trap. Even the experimentalist's "free" electron is an electron weakly coupled to the fields of an apparatus — a configuration, not a bare object adrift in empty space. A genuinely field-free electron in vacuum would disperse; we never have one. The size of a charge is thus always a property of a configuration, never of an isolated particle.

3 No isolated particle, no need for relativity

The consequence for relativity is direct. The one place a *rest-energy* or *Compton* scale was forced upon us was in giving an *isolated* particle an intrinsic size: a free electron, if it is a real object, needs *something* to fix its extent, and standard physics supplies the Compton wavelength $\hbar/m_e c$ set by the rest mass $m_e c^2$ — a relativistic quantity. Remove the isolated particle and the demand disappears. Sizes come from Coulomb configurations; mass enters, if at all, only as a *scale-label* selecting which regime (atomic or nuclear) a configuration sits in, exactly the "size, not mass" reading the programme already adopts [2]. There is no free-particle rest energy to account for, so $E = mc^2$ is never invoked, and RealQM stays what it is: a non-relativistic theory of Coulomb charge densities in real space. Relativity, on this view, is not *denied* — it is simply *never needed*, because the objects whose intrinsic properties required it do not exist.

4 The magnetic moment as a configuration property

The magnetic moment makes the point concretely, and without relativity. In the current-bearing (complex, time-dependent) form of RealQM [3], the moment is that of the charge current, $\boldsymbol{\mu} = \frac{1}{2}\int \mathbf{r} \times \mathbf{J}$, and a phase that *winds in space* carries a standing current with, for a normalised electron density, the quantised value $\mu_z = -m\,\mu_B$ — *independent of the density's size*. Whether a given configuration *can* support such a winding is an energetic question: the winding costs $\Delta E \sim \hbar^2/(m_e\sigma^2)$, cheap for a large confinement scale σ and prohibitive for a small one [4]. Hence:

- a *weakly-confined* electron — in an atom, or in a trap, at large σ — can afford the winding, and carries $\mu_z = -\mu_B$; this is the "free electron's moment," now a property of its (loose) configuration, not of an isolated object;
- a *tightly-caged* electron — in a nucleus, at $\sigma \sim$ fm — cannot afford it (the cost runs to GeV, thousands of times the binding), settles in the winding-free state, and carries *no* moment, so nuclear moments come out at nuclear-magneton scale.

The Bohr magneton is thus the quantised winding a loose configuration permits, not an intrinsic rest-energy attribute; the Penning-trap electron carries it for the same reason an atomic electron can. No Compton scale, no relativity, enters anywhere.

Radiation, likewise, is charge moving in space. The companion point about radiation is of the same character. Radiation is not a "superposition of stationary states" — that is configuration-space language — but the *physical oscillation of a charge density in real space*: a charge cloud that sloshes is an antenna and radiates by the Larmor formula, driven by the current $\mathbf{J}$. Oscillation gives radiation and circulation gives a magnetic moment; both are charge in motion in three-dimensional space, within a configuration, and neither needs relativity or an isolated particle to carry it.

5 The residue: a factor of two, not relativity

This dissolves three things at once — the existence of the free charge, the need for its intrinsic size, and the need for relativity. It does not, by itself, deliver the electron's *spin* gyromagnetic factor. An orbital winding has $g = 1$ ($\mu = \mu_B$ for one unit of angular momentum), whereas the electron's measured moment corresponds to $g = 2$, with a further small anomaly $g/2 = 1.00116\ldots$. So a residue remains — but note its character has changed. It is no longer the intractable *"how does a free particle acquire an intrinsic relativistic moment?"*, unanswerable within a non-relativistic frame; it is the sharp, bounded structural question *"why is the gyromagnetic factor of the winding current* 2 *and not* 1*?"* — a question about the pattern of the current in a configuration, to be settled inside RealQM, not by importing relativity. We flag it as the open problem, and claim only that it is now the *right size* of problem.

6 Consistency and conclusion

The reading coheres with the rest of the programme. It is the same realism as ψ^2-as-charge-density and the Madelung flow made physical in real space; it is the same "size, not mass"; it is the same denial of independent identity to a bound nucleon, now extended to the free case. What it buys is a clean closure of the free-charge problem: RealQM cannot confine a free electron or proton because there is no such object to confine, and precisely for that reason it needs no rest-energy scale and no relativity — every size and every moment is a property of a Coulomb configuration in three-dimensional space. Is it possible to do physics this way? For everything the programme has treated — binding, geometry, reactions, nuclear structure, the caged electron's vanishing moment, radiation as moving charge — it appears not only possible but natural. What remains is a factor of two in the electron's spin moment, which is a question about currents, not about relativity.

References

[1] C. Johnson, *Real Quantum Mechanics as Multiphase 3D Continuum Mechanics*, manuscript, 2026; `https://claes542.github.io/RealMolecule/gallery.html`.

[2] C. Johnson, *RealNucleus: Nuclear Binding as Dual Coulomb Confinement, without a Strong or Weak Force*, 2026.

[3] C. Johnson, *Complex Time-Dependent RealQM: Currents, Radiation, and Magnetism from the Real-Space Continuum*, 2026.

[4] C. Johnson, *Magnetism as Circulating Charge: Why the Nuclear Electron Carries No Magnetic Moment*, 2026.