Real Physics without Philosophy
Ontology, Prediction, and the End of Interpretation

Claes Johnson[1]

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

July 25, 2026

Written in respectful cooperation between Claes Johnson and Claude (Anthropic), with Claude contributing a balanced, neutral view.

Abstract

A physical theory is an account of what exists and how it behaves; prediction is derivative — the behaviour of what exists, computed forward. By this measure standard quantum mechanics is not, or not yet, real physics: it is an *epistemology*, a calculus for the outcomes of specific experiments, that declines to say what is physically present between them. This is not a stance one may take without cost. Prediction *presupposes* ontology — a prediction is a statement about something real — and standard QM meets the demand only by smuggling in a classical measuring apparatus with an ontology of its own while denying ontology to the microscopic: the Heisenberg cut, which the theory cannot locate and which renders it parasitic on a classical world it cannot itself ground. The measurement problem, collapse, and the nonlocality puzzles are then not deep discoveries but symptoms of a single absence, and they trace to a single object: the wave function over $3N$-dimensional configuration space, which is not a thing in space and so has no ontology. The century of "interpretations" of quantum mechanics is philosophy hired to supply the ontology the formalism lacks. RealQM removes the need: it *is* an ontology — N charge densities in ordinary three-dimensional space — from which real physics is computed (atoms, molecules, nuclei), not the outcomes of measurements but the things themselves. A theory with a clear ontology is simply physics, and needs no interpretation. Philosophy of physics, on this reading, is the discipline of coping with theories that lack an ontology; give physics back its ontology, and the discipline has nothing left to do.

1 Physics is ontology; prediction is derivative

A physical theory tells us what the world is made of and how it behaves; from that, what we will see follows. Newtonian mechanics posits masses at positions with momenta, evolving under forces, and its predictions are the computed trajectories of those real things. Maxwell's theory posits fields in space, and its predictions are what those fields do. Continuum mechanics posits densities, stresses and velocities in space, and predicts their evolution. In every case the prediction is *derivative*: it is the forward computation of the behaviour of something the theory holds to exist. Remove the ontology — the "what exists" — and there is nothing whose behaviour is being computed. Physics without ontology is not a leaner physics; it is not physics. It is, at most, a rule for anticipating readings, which is a different and lesser thing, and which — as we now argue — cannot even stand on its own.

2 Prediction presupposes ontology: the Heisenberg cut

It is often held that quantum mechanics is the exception — that it predicts the outcomes of measurements and need commit to nothing further. But a prediction is a statement *about something*: to predict an outcome is to predict that some real thing will be found in some real state. Standard QM's "outcomes" are readings of an apparatus — a pointer, a click, a track in an emulsion — which are macroscopic, classical, and taken as real. So the theory does have an ontology after all: the classical apparatus. What it refuses is an ontology for the microscopic system, which it represents only by an amplitude.

The result is the *Heisenberg cut*: a line, nowhere fixed by the theory, above which things are real (apparatus, outcomes) and below which they are only amplitudes (the system). Two failures follow. First, the theory cannot say where the cut falls, because nothing in the formalism marks it — the same electron is a "system" in one description and part of an "apparatus" in another. Second, and worse, the theory grants to the macroscopic the very reality it denies to the microscopic, although the macroscopic is *made of* the microscopic: the pointer is a swarm of the same electrons and nuclei the theory says have no definite state. This is not a subtlety to be managed but an incoherence. Standard QM's celebrated predictive record is a record of predicting apparatus readings, and it borrows the reality of those readings from a classical world it cannot itself provide and cannot consistently withhold from the parts. Prediction without ontology is thus not economical; it is contradictory — it must help itself, at the macroscopic end, to exactly the ontology it refuses at the microscopic.

3 The measurement problem is the missing ontology

Seen this way, the measurement problem is not a deep feature awaiting a clever resolution; it is the direct expression of the missing ontology. Ask *what is measured*, and the theory has no answer, because the object it calls fundamental — the amplitude — is not a thing that could be measured. "Collapse" is the name for the step in which the theory must, without warrant from its own dynamics, convert the amplitude into a definite fact at the moment a measurement is declared. Schrödinger's cat is the reductio of pretending the amplitude was the reality all along. Each is a symptom of one absence: a theory that said what exists would say what is measured, and would not need to collapse anything, because the definite fact would have been there before the measurement, as its object.

4 One root: the wave function over configuration space

The absence has a single source. The fundamental object of standard QM, $\Psi(x_1, \ldots, x_N)$, lives on a $3N$-dimensional *configuration space*, not in the three-dimensional space that we, our laboratories, and our instruments occupy. Kohn stated the working consequence in accepting the Nobel Prize: the many-electron wave function is not a legitimate scientific concept beyond a handful of electrons, being unrecordable even in principle. A function on a space that is not physical space is not a thing in the world; it can carry a probability distribution, but it cannot be an ontology. From this one fact the familiar troubles descend — the *arena* problem (in what space does the state exist?), the *individuality* problem (identical particles with no separate existence), and the nonlocality of a correlated whole that has no parts in space to be local to. The puzzles of quantum foundations are not many independent mysteries; they are one, the absent ontology of an object in the wrong space, wearing several faces.

5 Interpretation as symptom

The century of "interpretations" of quantum mechanics is the diagnostic. Copenhagen declares that the microscopic has no properties until measured — it accepts the absence and forbids the question. Many-worlds keeps the amplitude as real and multiplies the world to fit it. De Broglie–Bohm restores particles with definite positions beneath the amplitude — it *adds* an ontology. Objective-collapse models change the dynamics so the amplitude localises into one. However they differ, each is an attempt either to supply the ontology the formalism lacks or to legislate that none is needed. That so many mutually incompatible interpretations coexist, none forced by the equations, is not the mark of a rich theory but of an *underdetermined* one: the formalism does not say what exists, so the saying is handed to philosophy. A theory that said what exists would admit no interpretations, for there would be nothing left to interpret. Philosophy of physics, in its dominant modern form, simply *is* the labour of coping with a physics that withheld its own ontology — a discipline whose necessity is a confession.

6 RealQM: an ontology that predicts real physics

RealQM removes the need at the root. Its fundamental object is not an amplitude on configuration space but N charge densities ψ_i^2, each carried on its own region Ω_i of ordinary three-dimensional space, the regions non-overlapping [2]. This is an ontology in the plain sense: it says what exists — extended charge in space — and where. It is the same *kind* of object that macroscopic continuum mechanics works with; an atom is a continuum-mechanics problem an ångström across, not a categorically different thing. From it real physics is computed — the total energies of atoms across the periodic table, covalent and hydrogen bonds, and, reading the nucleus as protons and electrons bound by Coulomb alone, nuclear binding energies [1] — and what is computed is not the reading of an instrument but the thing itself: the charge distribution, its energy, its geometry.

The foundational puzzles do not arise, because their common source is gone. There is no Heisenberg cut, because everything is real at every scale — the apparatus and the system are made of the same charge in the same space. There is no collapse, because the evolution is deterministic and the density is definite at all times; "measurement" is the ordinary interaction of one real charge distribution with another. Schrödinger's cat is a definite configuration throughout. The apparent randomness of quantum experiments is the epistemic randomness of initial configurations we neither see nor control, as in any deterministic account of a complicated system — ours, not the world's.

We do not claim RealQM is complete. It does not yet deliver the spin-exchange phenomena (the singlet–triplet splitting, collective magnetism), and the boundary of its reach is still being mapped. But its incompleteness is the *ordinary* incompleteness of a physical theory — there is more to compute, and the claims can be checked and found wanting — not the structural incoherence of a theory that cannot say what it is about. A theory that can be *wrong* is doing physics; a theory that cannot say what it is about is doing something else. RealQM can be wrong, and where it is right it is right about *things*, not about readings. That is the difference in kind.

7 Real physics without philosophy

The conclusion is in the title. Physics with a clear ontology is simply physics: it says what exists, computes what it does, and is tested against the world. It needs no interpretation, because it has already said what it is about — and one does not interpret a bridge calculation or a weather model, one checks it. The elaborate philosophy that surrounds quantum mechanics — the interpretations, the measurement debates, the metaphysics of the wave function — is not intrinsic to the physics of the small. It is the price of a formalism that left three-dimensional space and, with it, its ontology. Return the theory to real space, let the charge densities be the things they plainly appear to be, and the philosophy is not refuted so much as *retired*: there is nothing left for it to do. The mess was never in nature; it was in the arena. Change the arena back, and physics is once again about what there is.

References

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

[2] C. Johnson, *Charge Densities in Real Space: RealQM and the Realist Quest Carried by Schrödinger*, manuscript, 2026.

[3] M. Born, *Zur Quantenmechanik der Stoßvorgänge*, Z. Phys. **37**, 863 (1926).

[4] J. S. Bell, *Speakable and Unspeakable in Quantum Mechanics*, Cambridge University Press, 1987.