Cordus matter: Part 3.5 Schrodinger's Cat reconceptualised

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Abstract

Quantum mechanics is the dominant conceptual foundation for fundamental physics. Nonetheless there are effects that it does not explain, or explains only by reference to metaphysical effects. While many have wondered whether there could be a more-complete explanation, the solution has been elusive. Cordus suggests that the necessary deeper mechanics is only accessible by abandoning the premise of 'particle', and shows how to achieve this. The resulting Cordus mechanics provides a new way of thinking and a radically different conceptual foundation. This paper primarily contrasts Quantum and Cordus mechanics. In the process, Cordus re-conceptualises Heisenberg's uncertainty principle. It also provides an explanation for the paradox of Schrödinger's Cat, and shows it to be based on unrealistic and unattainable premises.

Keywords: quantum mechanics; superposition; coherence; Schrödinger's cat; Heisenberg uncertainty principle; cordus; string theory

1 Introduction

This is the last in a series of papers on the application of the Cordus conjecture to matter. The first part created a novel explanation for entanglement and proposed a new principle of locality. Part 2 described a cordus model for the electron, its orbitals, and matter more generally. Entropy was re-conceptualised in part 3, and this was used in part 4 to give new explanations of superfluidity and superconductivity. That part also came to surprising conclusions about some core concepts of quantum mechanics (QM): that QM's concept of superposition was flawed, and that coherence is a special state that cannot be assumed to be applied to any object. Thus it is appropriate that this final paper contrasts Cordus with QM. In doing so it re-conceptualises the issues with Schrodinger's Cat.

2 Contrasting interpretations: Quantum and Cordus mechanics

Quantum mechanics

Quantum mechanics originated with the idea that electrons can only take up certain steps in energy, hence quanta. However with time QM has

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come to mean more: that reality for particles is fundamentally probabilistic; and that the wavefunction is the complete reality (Copenhagen interpretation). QM is now a set of mathematics and beliefs about reality, that include probabilistic origins, wave-particle duality, wavefunction mathematics, and the uncertainty principle. QM views all matter as discrete particles that may be made of still smaller particles. The concept of 'particle' is generally one of 1-dimensional points, and this becomes the implicit premise for many applications of QM including photons. Bell's theorem is typically taken as sufficient evidence that there is no underlying set of hidden variables, thus further confirming the belief that the wavefunction is the complete reality.

At the same time the particles are understood to behave like waves. QM offers a solution, first by positing that particles are wave-packets, second by assuming that particles can be in multiple places at once (through superposition or virtual twins), third by assuming that the state of a particle can only be known as a probability, and fourth that the actual position of the particle is only determined when it is observed, hence collapsing the wave-function. Thus the QM mechanism for diffraction into fringes is wave self-interference between the wavefunctions of the particle and its virtual ghost particle.

As a mathematical method QM has impressive predictive power and ability to quantify the outcomes. Unfortunately the qualitative explanations rely on metaphysics, and this incongruence creates a perception of weirdness. There are other problems too: the idea of probabilities, e.g. path choice in interferometers, almost implies external look-up tables, or someone assigning a probability to the outcome before it takes place. This leads to observer paradoxes and causality conundrums, or to the many worlds interpretation with its own metaphysical problems. From QM perspective the weirdness is just a perception caused by our inadequate human cognition.

Cordus

The Cordus interpretation is very different. First, Cordus proposes the photon-cordus as a particuloid in place of the idea of a single small point particle. It does not support the QM 'particle' view of light and matter, but instead that the cordus can look like a particle (hence 'particuloid') from further away. Cordus debunks Bell's theorem as being constructed on the unnecessarily limiting premise of 1D particles, and therefore cannot be used to rule out hidden-variable solutions. Second, Cordus proposes that photons, and indeed all 'particles' are cordi that oscillate into and out of existence across a finite span separation, and that consequently the particuloid is effectively in two places at once. It does not support the idea of the wavefunction (hence the Copenhagen interpretation), nor of superposition (hence the many-worlds interpretation), nor the probability-is-the-reality interpretation. From the Cordus perspective these are all usefully convenient mathematical analogies that are sufficient for predictive purposes, but are invalid descriptors of reality. [23]

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[23] For example, Cordus would disagree with just about everything in the following statement: 'When a photon's state is non-deterministically altered, such as interacting with a half-silvered mirror

Third, From the Cordus perspective the probabilities of a particle being in a particular location arise simply and naturally as the cutting points on the frequency. Stop the experiment with the photon in a different part of its frequency cycle and the outcome may be different. The paradoxes disappear, and there need be no violations of causality, providing one is careful and does not confound the various types of observation. Cordus proposes there are three different types of observation, with very different outcomes for the photon.

3 Heisenberg uncertainty principle

Another area of difference is towards the Heisenberg uncertainty principle, particularly the explanation thereof. For QM the explanation is in the wave-packet, which represents the probability of finding the particle in that place. The position of the particle is indeterminate as it could be anywhere along the wave packet, and compressing the wave packet to reduce that problem will change the wavelength and therefore the momentum, and thus make the momentum indeterminate, and the converse. The Uncertainty principle is typically expressed in terms of the standard deviations of position and momentum, and the product thereof.

The Cordus perspective supports the principle, but not necessarily that particular formulation. Heisenberg's statement was built on the standard QM probabilistic premise: that variables are statistically distributed e.g. with a normal distribution. In contrast, Cordus does not specifically require that assumption, nor the product operation.

The Cordus explanation is that the free-flying cordus particuloid has no sharply measureable position, because it is not a single point particle in the first place. Position can be measured (reasonably precisely but not absolutely) by arresting it, but then it is not a free-flying cordus particle any longer, and the momentum is indeterminate. For a photon, the flight and arrested states cannot occur at the same time, because they are different stages in the life-cycle of the photon, and therefore cannot be precisely measured at the same time.

In the QM formulation there is a smooth trade-off between position and momentum. However Cordus implies that the relationship is more granular, and consists of two mutually exclusive sub-conditions: that passing observation can measure momentum and mean position, and intrusive measurement constrains position and measures force or energy.

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where it non-deterministically passes through or is reflected, the photon undergoes quantum superposition, whereby it takes on all possible states and can interact with itself. This phenomenon continues until an observer interacts with it, causing the wave function to collapse and returning the photon to a deterministic state.' (Wikipedia, http://en.wikipedia.org/wiki/Elitzur%E2%80%93Vaidman_bomb-tester last accessed 3 March 2011).

Complementarity principle

QMs use a complementarity principle: that photons have multiple properties that are contradictory. QM assumes that wave and particle duality means that both are simultaneously in existence, that the photon is truly a both a wave and a particle at any instant in time.

For Cordus the particuloid is neither a wave nor a particle but behaves as either depending on the measuring method. The measurement method unavoidably changes how the particle behaves, and this is particularly pronounced with the photon. The Experimenter's choice of method therefore limits the type of results that will be observed. Wave and particle duality are only measuring artefacts, not the reality.

4 Schrodinger's Cat

The thought-experiment

Schrodinger's Cat[24] is a thought-experiment in superposition: the basic idea is that a cat is placed in a box with a radioactive sample rigged up so that decay emits a particle which breaks a vial of poison that kills the cat. If the box is closed and no-one can see inside, what state is the cat in?

This is an extension of an idea in quantum theory that a physical system can be in multiple configurations (dead vs. alive), and therefore from the quantum perspective is *simultaneously* in all those configurations until the act of observation forces it to one particular configuration, i.e. collapses the waveform. An extrapolation of the idea is that each of the other non-selected configurations does continue, but in another parallel universe, hence the 'many worlds' theory.

While it might initially have been intended as a thought-experiment, Schrodinger's Cat has taken on a more mythical status, and is almost considered fact. It has become the visible poster-child representative of QM, particularly of superposition.

The cordus explanation is that Schrodinger's Cat is only a conundrum because of fallacious premises. First, note that there are several effects: whether or not the radioactive material decays and emits a photon; the dilemma about the state of the Cat before opening the box (alive/dead/simultaneously alive and dead); and the Observer dilemma about the effect of opening the box and looking.

Type of observation is critical

The Cordus Conjecture distinguishes between types of observation: passive, passing and intrusive. Passive does nothing (L.3.1), passing can change photons, but only intrusive detection collapses photons. Therefore

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opening the lid on Schrodinger's Cat and passively observing makes no difference: it does not affect whether or not the radioactive material will emit a photon. The photon will be emitted when it is emitted.

However there are some additional observer effects that could change the emission, the first being that letting more light (external photons) into the poison system could trigger radioactive decay. Second, if the Observer changes to an intrusive mode, then the emission outcome can be affected and even controlled. For example, intrusively detecting whether a photon has been emitted will prevent it ever reaching the poison. Or, interrogation of the radioactive material could force it to emit a photon or prevent it from doing so: the Zeno effect. Passing measurement of already flying photons will change their properties.

Then there is the matter of what the *inside surface* of the box was made from. If mirrors, then there are multiple paths by which an emitted photon's reactive end could get to the poison vial. Opening the box and thereby removing mirrors will deprive the photon of some path opportunities: it could escape the box altogether. However these are all complications, and simple passive observation, which is all the original dilemma proposed, is inconsequential. Simply looking passively does not change the cat's fate.

No superposition of undead states

A simple act of passive observation does not affect the emission of a photon nor the transmission thereof. Nor does it cause the Cat to suddenly collapse to the dead or alive state. The Cat need not exist in any superposition of undead states before the box was opened: it is simply either alive or already dead, nothing else. In an inverted way, the cat thought-experiment is often misunderstood as evidence that quantum coherence applies to macroscopic objects. From the Cordus perspective this is misplaced. The matter lemma states that superposition of states only occurs for bodies that are internally coherent. Something as large and internally dynamic (nerve impulses, flowing blood, etc.) as a Cat cannot have that CoFS coherence in the first place: initially imposing the coherence would deprive it of life. Only small, cold, inanimate things of relatively homogeneous composition can be put into body coherence.

Nor does the presence of the passive Observer do anything. Hence existential Observer dilemmas are void. Simply passively looking at the universe does not cause it to change, nor necessitate creation of another world.

Try Superposition of something smaller?

If Schrodinger's Cat dilemma collapses because of lack of coherence of the Cat, then what about replacing the Cat with an electron: something that can generally be thought of as in 'quantum superposition'? Will the dilemma still be sustained then? Is the electron simultaneously blasted and not-blasted by the radioactive decay? QM states that the electron occupies all possible quantum states simultaneously, so the electron should be in normal and high energy states simultaneously, and only collapses to one when measured.

The answer, according to the Cordus Conjecture, is *no*. While an electron does have two position modes, it does not occupy them simultaneously, nor are these different energy levels. Consequently simple passive observation does nothing to force the electron into one particular energy level. Not-observing the electron makes no difference either.

As the previous discussion noted, superposition is merely a mathematical representation of the uncertain in average *position* of the two reactive ends, and cannot be applied to two different temporal causal outcomes such as dead vs. alive. That's an important point that tends to get overlooked when QM is being interpreted, and is the fallacy at the core of the many-worlds theory.

Hidden premises in the Box

To sum up, Schrodinger's Cat thought-experiment is flawed in several crucial areas. First, it confounds passive and intrusive observation to suggest that the act of non-observation causes indeterminacy. A second erroneous premise is that of superposition: that the cat's states are simultaneously life and death. We do not see this in reality either, and Cordus asserts this premise is invalid in any situation: QM's superposition is only a mathematical simplification of a deeper and different effect. The third fallacious premise is that that the entire contents of the box, including the cat, are in macroscopic quantum coherence (this being necessary to support the superposition premise). This is not a particularly practical premise, as we never see coherence at this level, only at atomic and molecular scales, and Cordus explains why. Cordus also asserts that coherence of a whole living cat will be next to impossible to achieve.

The Cordus conjecture implies that all three premises are wrong. The Cat is either dead or alive, and opening the box (at least in the way originally proposed) is inconsequential. Nor need there be other worlds in which the Cat is in a different state. So for any one of these reasons on its own the Cat experiment is not physically realisable. The lesson it teaches is that superposition is strictly only a mathematical approximation for handling positional uncertainty, not a real physical effect, and macroscopic physical bodies cannot be assumed to be in body coherence just because some atomic structures can be in the state.

Where the weirdness arises

Coming back to the starting point, which was the weirdness of existing explanations of wave-particle duality, we can now identify why QM's descriptive explanations are weird. QM assumes that particles are 1D points (hence over-reliance on a single limited paradigm); QM assumes that coherence effects at a particle level always generalise to whole bodies (hence the conundrum of Schrodinger's Cat); QM extrapolates mathematical solutions for the problem of indeterminacy, namely superposition and wavefunction, to the physical reality. Cordus suggests those premises are all unreliable. More than anything else, the premise of

1D point particles pervades QM, and in a self-reinforcing way Bell's theorem has been influential in sustaining the belief that there are no hidden-variable solutions, i.e. that the particle really is 1D. Cordus cuts across that way of thinking: it unexpectedly delivers a hidden-variable solution, debunks the 1D premise, and expands the debate beyond the constraints of Bell's theorem.

5 Contrast: String Theory

The Cordus Conjecture relies on fibrils, and the obvious question is whether there is an implication for string theory. The similarity, at least for some versions of the Cordus conjecture, is in the idea that matter and energy are made of oscillating lines (strings). Also, String Theory suggests that the photon is an open string, as opposed to a closed loop. Most of the cordus variants here are similar to a string, but include additional concepts that are not necessarily string-like.

String theory is a mathematical rather than empirical approach. It requires the universe to have multiple dimensions, most of which are presumed hidden or too small to detect. It posits that variation in the properties of the string give rise to different particles, e.g. photons and electrons, but is not specific about what these situational variables might be or the causality. It has many flavours and mathematical variations, and it is not always easy to determine which describes our universe except by relying on the anthropic principle. It is a theory of the structure of the universe, rather than a predictor of sub-atomic structure.

The Cordus conjecture does not explicitly require String Theory, though it does not preclude it either. The two approaches start from entirely different premises, and use completely different methods. Despite some apparent similarity in results -the prediction of string-like sub-structures – there is considerable space between the two models and it would be premature to consider them conceptually linked.

6 Discussion

Quid est atomos?

What is the atom made of? This work proposes that sub-atomic particles have a cordus structure: two reactive ends joined by a fibril, with the structure being energised at a high frequency and emitting one or more hyff lines of force. They are not really particles at all.

Implications

The cordus concept was originally created to explain wave-particle duality of the photon. It turns out to be much more adaptable and powerful, in a descriptive way, than simply a solution for the photon. Cordus is a conceptual solution that shows it is possible to conceive of internal structures for the photon and other sub-atomic particles, without the usual weird metaphysical explanations.

The conceptual contribution of this work is the demonstration that it is indeed possible to create hidden-variable models, and that Bell's theorem is not a limitation. It shows that the application of logic and semantic inference to existing experimental observations can give interesting new insights. The beauty of the Cordus Conjecture is that it provides an explanation that is coherent across wave and particle effects, photons and matter, ‘particles’ and macroscopic bodies. Perhaps the biggest contribution is simply the intellectual stimulus to think differently about topics that we think we already understand.

Cordus challenges the conventional idea of 1D points, and the whole conceptual edifice built thereon. The concept that emerges here is that ‘particles’ are not actually 1D points, neither are they waves. Instead ‘waves’ and ‘particles’ are simply the external manifestations of hidden internal structures.

In this regard, Cordus suggests that Quantum Mechanics and Wave theory are subsets of a deeper and simpler reality. Cordus also shows that reality to be deterministic. It is not clear that ‘quantum’ is the best term to describe such mechanics, and in some ways Cordus is more about ‘mechanics’ than QM ever was. From this perspective Quantum Mechanics is of dubious validity as a *descriptor of reality* even if its mathematics is sufficient for quantitative purposes. Now we finally understand why quantum mechanics, which seems sufficiently accurate for individual ‘particles’, does not scale up to macroscopic bodies, something which QM itself has been unable to explain.

At this stage Cordus is simply a conceptual model and some starting mechanics that have been calibrated against several physical phenomena. Cordus started from an intuitive conjecture, and through a set of lemmas developed into a descriptive conceptual framework. What is needed next is scrutiny: does this concept stack up to the reality of other observed quantum and optical effects? Exploring this question may well require further adjustments to the concept or show it to be an unworkable conjecture. Thus the validity of the concept is an open question which is put to the wider community of scholars.

7 Conclusions

The Cordus conjecture provides a radically new perspective on fundamental particles. The conventional theories of electromagnetic wave theory and quantum mechanics, are shown to be external simplifications of the deeper set of hidden variables described by a cordus. Cordus is an integrative theory: it provides a single coherent conceptual framework for a wide range of physical effects both wave and particle. It provides natural explanations of otherwise weird quantum phenomena.

Cordus does not follow the conventional method of physics, which is derivation of beautiful mathematics and subsequent extrapolation to explanation, but it is a logical theory nonetheless: that of creating a system model by reverse-engineering known phenomena, adding conjectures and intuitive material, and noting the necessary assumptions along the way. There are many of these lemmas, and thus many potential flaws in the cordus mechanics. Notwithstanding, if the cordus conjecture is even partly correct, the consequences for conventional theories of matter are profound. Cordus suggests there is a more fundamental and coherent theory of reality than Quantum mechanics can provide. Perhaps surprisingly, this deeper theory is deterministic.

Sub-atomic particles of matter exhibit strange behaviours such as entanglement, superfluidity, and superconductivity. These effects are usually explained by quantum mechanics (QM): at least the mathematics are. This paper proposes an alternative explanation, based on the cordus conjecture. In this concept, the basic structure to any ‘particle’ is a cordus: a fibril connecting two reactive ends, with hyff force lines protruding from the ends. This structure is used to explain matter waves and the wave-particle duality thereof, entanglement and interaction at a distance, electron orbitals, coherence, superfluidity, and superconductivity. It is shown that that a hidden-variable theory is indeed possible for the photon and ‘particles’ in general. The limitations of conventional concepts of ‘particle’ are identified, and a counter argument is developed to Bell’s theorem. A revised principle of *wider* locality is proposed. Mechanisms are proposed for the absorption of the photon into matter, and the origins of entropy on a sub-atomic scale. Cordus questions the validity of quantum superposition, reinterprets coherence, and predicts what should be achievable (or not) for macroscopic bodies. Schrodinger's Cat is explained and shown to be based on unrealisable premises. Cordus also explains why quantum mechanics, which seems applicable at the sub-atomic scale, fails to scale up to macroscopic scales. Cordus offers a new conceptual framework for a deeper internal mechanics for atoms and sub-atomic particles. It provides an explanation that is coherent across multiple physical effects. Perhaps unexpectedly, cordus suggests that the internal mechanics for ‘particles’ is deterministic after all, and the probabilistic nature as recognised by QM is only an artefact of the measurement process.