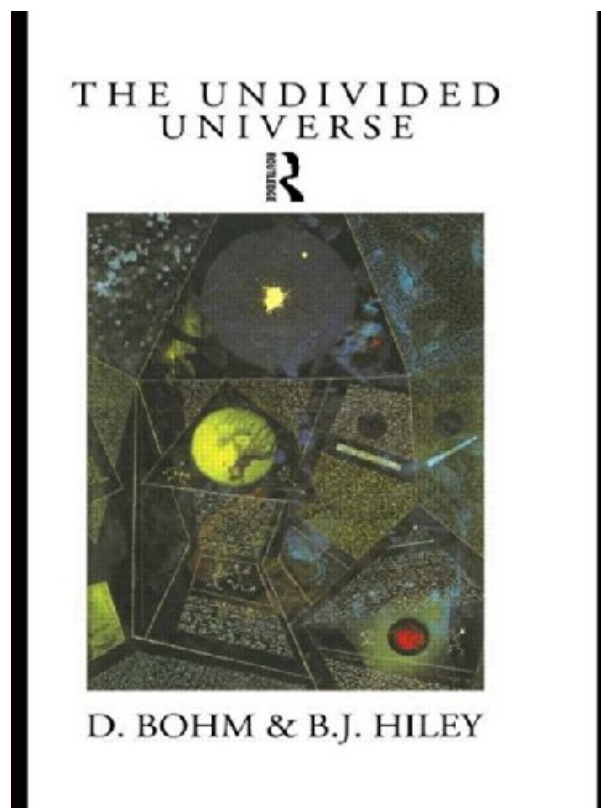


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ONTOLOGICAL INTERPRETATION OF
QUANTUM THEORY BY DAVID BOHM,
BASIL J. HILEY**



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In the *The Undivided Universe*, David Bohm and Basil Hiley present a radically different approach to quantum theory. They develop an interpretation of quantum mechanics which gives a clear, intuitive understanding of its meaning and in which there is a coherent notion of the reality of the universe without assuming a fundamental role for the human observer.

With the aid of new concepts such as active information together with non-locality, they provide a comprehensive account of all the basic features of quantum mechanics, including the relativistic domain and quantum field theory.

It is shown that, with the new approach, paradoxical or unsatisfactory features associated with the standard approaches, such as the wave-particle duality and the collapse of the wave function, do not arise. Finally, the authors make new suggestions and indicate some areas in which one may expect quantum theory to break down in a way that will allow for a test.

The Undivided Universe is an important book especially because it provides a different overall world view which is neither mechanistic nor reductionist. This view will ultimately have radical implications not only in physics but also in our general approach to all areas of life.

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Most helpful customer reviews

38 of 42 people found the following review helpful.

Intellectually stimulating, opens up a can of worms of QM problems

By JC

Bohm is one of the few genius' who didn't get much recognition in his lifetime. Had it not been MacCarthy's persecution he would have been a distinguished professor at Princeton and made more impact in Modern Physics.

His genius shows in his radically different interpretation of QM. When you read the first few chapters of his book, it gives you this "eureka" feeling and chill thru your spine. While they say currently there is no way to prove or disprove his theory as it gives the same result as Copenhagen, but I truly believe a correct theory will give insights into other fields and advance further the whole science/ civilization. Only time will tell.

You will need college level quantum mechanics knowledge to go thru the first 8 chapters, which is really the essence of the book. To read beyond that, you will probably need graduate level.

6 of 6 people found the following review helpful.

And, What is a Particle?

By Herbert L Calhoun

Beyond computing the probabilities of experimental results statistically (and then only up to the Planck length using the hidden reductionist assumption that "measurer" and "measured" are separate), quantum physics (QP) does not have a clue. Even the widely successful algorithmic formalisms of quantum electrodynamics are like taking an ontological free-ride through cosmic reality, because no one knows for sure why they work, or if, or when, they might breakdown.

Until David Bohm came along intent on fixing the problem of finding what lies at the bottom of quantum reality, QP had been content finessing the question of what exactly is a particle. This book tells how Bohm, and his ex-student, James Hiley, proceeded to grab this 800-pound gorilla by its philosophical tail and wrestled it to the theoretical ground.

In what can only be called an intellectual tour de force twenty years in the making, Bohm and Hiley -- assuming only that the universe is whole, and using a handful of emergent concepts, show how the assumption of wholeness and the new concepts, could be welded into an ontological theory that closed the philosophical hole at the center of QP, and, at the same time, resolved existing contradictions.

Before this book, certain problems (like measuring quantum processes but still being unable to understand the reality behind the measurements; addressing why the "measurer" and "measured" must be treated separately; ignoring the contradictions of non-locality inherent in Bell's theorem (but apparently successfully challenged by the EPR experiment); and addressing the meaning of the wave-particle duality in the split-slot experiment), were mysteries of QP that had to be finessed.

Beginning with what is given: that the electron is a particle with a well-defined position and momentum, always profoundly affected by an accompanying wave, the authors seek to answer the fundamental question of QP: whether there is an adequate casual theory (as opposed to the existing implied stochastic one), of the reality of the quantum system in which the particle exists?

The theory they produce here, arguably, gives a new more intuitive and more coherent interpretation of quantum mechanics, one that matches, and then goes beyond the classical stochastic theory. Its only drawback is that it can never be tested -- except that is, at the point where QP itself breaks down. But oddly this is not where the theory has been criticized. It has been criticized on grounds that it only duplicates the classical stochastic theory. Those who criticize it on those grounds, obviously give no weight at all to the fact that, in addition to giving QP philosophical closure, it also satisfactorily resolves the primary mysteries bedeviling it?

The development of the authors' theory proceeds somewhat as follows:

The ontological and epistemological machinery are first deployed and reviewed in chapters 1-3. By the middle of chapter 4, the machinery is well-defined enough to demonstrate its efficacy on both the "One-body," and the "Many-body" problems. In the former case, de Broglie's idea of a "double solution" is introduced and the role of probability is examined as it impacts quantum physics more generally. And in the latter case, Bohm's own concept of "active information" is used as an ontological interpretation of the Many-body problem.

The notion of both "active" and "inactive" information are used in the most rigorous way possible in chapter 5, as a way of introducing the process of quantum transitions. This is not an easy chapter conceptually as it requires the reader to examine quantum transitions as observations in the absence of measurement. A fuller treatment of this and other problems of measurement make up the substance of chapter 6, which in my view is the lynchpin of the entire book because so much of what follows afterwards depends on both grasping the ideas of this chapter, and believing in its utility as an integral part of the ontological interpretation. The chapter ends by revisiting some troubling quantum mysteries in light of the new philosophical machinery.

Once the reader's appetite is thoroughly whet, chapter 7 is devoted to perhaps the most troubling concept of all: that of non-locality, one that at least in theory, violates the principles of relativity. So, non-locality is the point where the rubber of Bohm's idea of wholeness meets the road. The more problematic, more fragmented and reductionist stochastic interpretations are examined in light of non-locality too, and compared with Bohm's newer ontological interpretation. It is here where the reader can see clearly why an ontology of wholeness is needed.

Chapter 8 moves from the quantum physics laboratory to the large-scale universe. The rest of the book is devoted to further exploring further how the new ontological interpretation might be applied to both the small and large scale.

Summary

At one level this is the most daunting of all of Bohm's book, especially for those who have forgotten most of their advanced calculus. But despite this, it is also the most satisfying, because one gets to see what all the fuss is about. The mathematics used is minimal in the sense that it is mostly notational, and thus no more is used than is needed. However, this does not mean that the math is always easy. Just remembering the proper meanings of various systems of notations alone can be a challenge.

But beyond the mathematics, another word of warning is also in order: Just because Bohm and Hiley's concepts are presented with devastating clarity does not mean that this newer interpretation is easy to grasp. Yet, so long as the reader views the book as an excursion through applied philosophy as well as theoretical physics, and not just mathematics, per se, he can then be expected to get the most out of it. When the ideas do come together, as invariably they will, there is joy in being able to fully appreciate what the authors were

really up to. Ten stars

5 of 5 people found the following review helpful.

A comprehensive description of a novel approach to quantum physics

By Ulfilas

This book puts forward a coherent description of Bohmian mechanics, a theory that is not widely accepted, and has also been challenged by experiment [1,2]. Even if Bohmian mechanics is unable to describe every system, it is still conceivable that this approach may be of value as a computational scheme for addressing certain problems. Because Bohmian mechanics envisions an actual particle responding to a specially modified potential, Monte Carlo calculations may be used to simulate processes such as electron transport [3,4].

[1] M. Baublitz, Phys. Rev A 51, 1677 (1995).

[2] G. Brida et al., J. Phys. B 35, 4751 (2002).

[3] X. Oriols et al. Appl. Phys. Lett. 72, 806 (1998).

[4] L. Shifren and D. K. Ferry, Phys. Lett. A 285, 217 (2001).

Bohm and Hiley also consider the philosophical implications of Bohmian mechanics, as well as that of other interpretations of quantum physics such as parallel universes.

I had heard Bohm speak while I was in grad school, but was completely snowed. All I can remember of the lecture was Bohm saying "Folding unfolding, folding unfolding...", which was meaningless to me at the time. After reading Bohm and Hiley I have a somewhat better idea what Bohm was saying--which seems to be something to the effect that the universe is an undivided whole and not just a bunch of particles wizzing around and sometimes coming together. I still have a lot of work to do, however, before I can consider myself to have a good understanding of Bohm's world view.

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