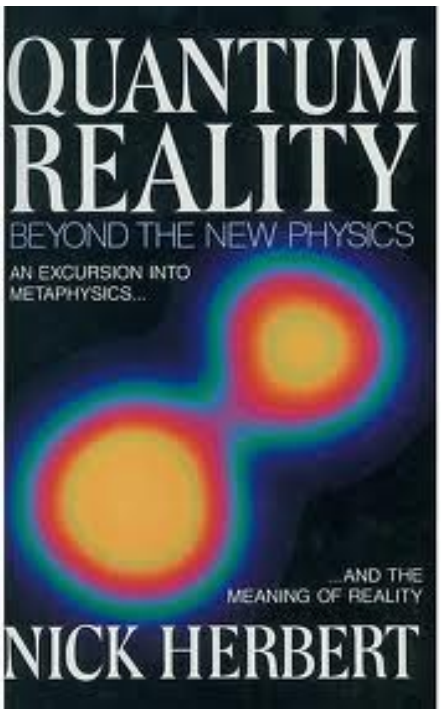

Quantum Reality

Nick Herbert

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This clearly explained layman's introduction to quantum physics is an accessible excursion into metaphysics and the meaning of reality.Herbert exposes the quantum world and the scientific and philosophical controversy about its interpretation."

Quantum Reality Details

Date	:	Published February 20th 1987 by Anchor Books (first published June 1st 1985)
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Author	:	Nick Herbert
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From Reader Review Quantum Reality for online ebook

Szplug says

Ride the particulate waveform, sweet universe of mine.

How our human consciousnesses perceive *reality* at the subphenomenal level makes for a truly extraordinary conundrum, and Herbert is an appreciably lucid and patient explicator of this primordial soup of uncertainty brought to our awarenesses through the mathematics, theorizing, and testing of many of the most brilliant physicists of the past century and a half. Even more so than other elucidators like the late Heinz Pagels, John Gribbin, and Brian Greene, Herbert comes the closest to allowing a layperson to wrap their heads around how it is, exactly, that Quantum Mechanics has driven these same scientific lawgivers and architects to the point of breakdown with its paradoxical formations and uncanny peculiarities, seemingly irreconcilable to the logical parameters that we have come to both assume and require through our own existence embedded within the natural world. What's more, he eschews the lame pop-culture analogies that so often lead one to grit one's teeth or cauliflower-cook from one's ears with two of those aforementioned peers.

Above all, Herbert constructs his work to stress, and subsequently elaborate upon, the central point that elementary particles—for which he interchangeably uses his self-coined terms *Quons* and *Quantumstuff*—whether constituting energy or matter, display particle behavior when being measured, and a wave formation when not; with the latter, of necessity, requiring that whenever one dynamic aspect of a *quons*' particle form is being determined, its conjugate aspect will prove impossible to pin down with a similar accuracy due to a continually elevating uncertainty attending to that specific quality; and that, when said *quon* is not under some manner of measurement, it *exists* as a wavelike element of fluxing probabilities that, paradoxically, concurrently displays *all* the possible attributes possible for any particular aspect that a physicist could undertake to quantify—regardless of time, space, or momentum. Indeed, as Herbert explains in a particularly startling example, the act of observation can apparently influence even the stellar pathway of photons emitted from a quasar several *billion* years ago—a stretching of the subphenomenal proxy-wave probability across an incomprehensible immensity of light-years. At such a moment—the absurdity of the contention notwithstanding—it certainly does seem that the very act of our being a conscious observer undertakes to determine, in a particular moment, the constituted reality of that very element of the universe; that said light beam's existence comprised a murky, ghostly ephemerality of possible states until our measuring gaze forced upon it the necessity of making a determination, of collapsing the wave function to the degree that it particulated in space-time with the very attributes we discover when we brought it to bear in such an enigmatic fashion.

In order to set the stage properly, the author spends a great deal of time in carefully elaborating upon the composition and behavior of waves—whether *sine*, *impulse*, *spherical*—their periodicity and phase, their frequency and amplitude, at how the latter affects their inherent energy (at the material *real* level) or probability (at the quantum *configuration* level). Especially important is the quality of *disturbance* generated when waves impact each other, and in which their energy/probability is either augmented, diminished, or maintained depending upon the congruencies in the temporal and spatial attributes they share at the moment of confluence. There is also the mysterious property of *Phase Entanglement*, in which, when any two *quons* engage and disengage with each other, their amplitudes separate but their phases remain *entangled*; this mixed phase attribution resonates with each *quon* from that point forward—a property that might perhaps point, through such as *Bell's Theorem*, towards a superluminal *information exchange* between these particles, though they be separated by hundreds of light years. A feature of particular usefulness for experimental measurement is the determination by mathematicians and physicists that any wave function can be said to be made up of, and thus capable of being broken down into, a wide variety of individual wave shapes—including their conjugate opposites—and which fact, combined with the use of analysis or synthesis

prisms to separate/combine these individual forms from/into the constituent whole, can be used to measure whatever attributes of a *quon* can be held to be represented by that(those) particular waveform(s). The fact that the conjugate waves can never be realized at a 1:1 level with their antithesis demonstrates the reality that the precise measurement of two such opposing quantum-level aspects—as, for instance, *position* and *momentum*—cannot be determined in coevality. Thus, subphenomenal uncertainty is proven mathematically, and the paradox and puzzle of such a bedrock to nature given a rigor that scientists have so far found impossible to escape from or reconcile with, absent the bizarre scenarios they have concocted to explain the unexplainable.

For this is the crux of the matter from the authorial perspective—to allow the reader to get a handle upon how, exactly, the physicists themselves have come to order this molecular level of elementary reality, one which deals in measurements so unfathomably small as to defy any manner of mental purchase. Since the phenomenal level can be well-understood with classical methodologies and terminologies, physicists would prefer to extend such to the *quantumstuff* underlying it; since, apart from the actual measurements, this has proven exceedingly problematic, there have developed eight primary schools of thought about Quantum Reality and how to address its wispily heavy presence as the shimmery white elephant in the room.

***Quantum Reality #1 & #2*:** This is the *Copenhagen Interpretation* of Bohr and its later-derived, Observer-Promoted adjunct, which holds that there is no underlying subphenomenal reality to discover; instead, we have elementary particles at the quantum level in an undefined state of fluctuating and concurrent probabilities; it is our act of observation that forces a wave function collapse and assigns a measured value to these properties. This determined value had no existence, or meaning, until a measurement created a tangible value out of a sea of possibilities. Whether atoms really exist, pondering the structure of the quantum world—such is but idle speculation, irrelevant to the quantifications imparted by observational imposition.

***Quantum Reality #3*:** The *Whole Worlds* theory, which maintains that there is no dissociative distinction between the phenomenal and subphenomenal worlds, as the quantum attributes are not localized with the *quon* but are rather an inherent part of the *experimental arrangement*. The *phase entanglement* mentioned above is a primary component of this theory, in which it is plausible that the majority of *quons* carry wave phase remembrances of their past collisions in the dawning days of the universe.

***Quantum Reality #4*:** This is the infamous *Many-Worlds* theory, primarily developed by Everett under the auspices of Wheeler. This beauty avoids many of the paradoxes and pratfalls associated with the particulate uncertainties and wave functions with a whopper all of its own: whenever a measurement forces a value to be assigned to any dynamic value of a *quon*, *every* possible option is realized, a free-for-all made possible by the assignation of a brand new parallel universe arising out of each and every quantum value implementation. Our human minds, delimited to sensory perceptions in our own space-time, cannot perceive this exponential proliferation of fully-formed universes, blossoming under the imposition of every available attribute value allowable to each and every particle; but there they are, expanding rapid-fire like the zits on a soda-chugging teenager under the cascading avalanche of observations that are brought to bear.

***Quantum Reality #5*:** An intriguing offering that places itself about halfway between #s 3 and 6, but states that we need an entirely new branch of logic, superimposed upon a Boolean framework, that will allow us to grasp and bring within the limits of our human understanding the actual nature of the alien quantum world. Using as an example the peculiar quantum properties of photon polarization, Herbert delineates a mathematical logic that endeavors to penetrate the walled mysteries that have so far repulsed us, weaving lattices of quantum logic that will allow us (partial) egress after clambering these probability-permeated barriers.

***Quantum Reality #6*:** The favored purview of so-called realist physicists like Einstein and the Copenhagen apostate Bohm. This position, called *Neorealism*, attempts to salvage as much of the classical stability as is

possible for the quantum realm. The neorealists hold that atoms exist, that *quons* have properties, that the wave functions are of the Schrödinger form and do not collapse upon measurement. Diametrically opposed to the Copenhagen majority, the fatal flaw in the Neorealist position is the juggling they have to perform to account for the almost perfect accuracy of Quantum Mechanics, including the necessity for waves and particles to communicate with each other at superluminal speeds—a thing utterly forbidden by the Special Relativity of this very school's chief proponent.

***Quantum Reality #7*:** Developed initially by the rigorous mathematical mind of John von Neumann, this is the school of the *Conscious Observer*, a sort of idealist kin for the scientific field. Von Neumann, and his ilk, deem that the only *reality* is *quantumstuff*, of which everything in the universe is composed. It is the act of measurement that is the deciding factor in the wave function collapse that causes the *Quantum Jump*, the imposition of a single reality from the sea of waveform possibilities—but the powerful math of von Neumann showed that this measurement could be initiated anywhere in the von Neumann chain that bound the stages of the event. Taking note that the only unique variable in this chain was human consciousness, von Neumann thus determined that existent reality is *created* by the conscious mind. There *is* an actual *reality*, but it can only *be* in conjunction with a consciousness that can force a fact from probability through the act of observation.

***Quantum Reality #8*:** Finally, Herbert offers up the theory established primarily by the great Heisenberg, whose self-named *Uncertainty Principle* is one of the foundational theorems of Quantum Mechanics. Heisenberg proffers a duality-riven single world, composed of the *potentiality* implicit within the *quantumstuff* waveforms, and the *actuality* present after the wave function has collapsed in order to accommodate a measurement. In other words, when nobody is looking, the universe is a soup of probability—only to convert to an existing, quantified reality when focus is brought to bear upon what had priorly been a mere bundle of promise. Theoretically capable of extending itself all the way backwards to the initializing *Big Look* from the singularly *Big Guy*, Heisenberg's QR is one where there is an omnipresent sense of something lurking *just* out of vision at the corner of one's eye.

The final section of this excellent book is the prep-work and subsequent walk-through by Herbert in order to impart upon the reader all of the implicit potentialities held within one *Bell's Theorem*, a probing of the famous EPR paradox crafted by Einstein and Co. in order to challenge the regnancy of a Quantum Mechanics that deeply troubled the genius of Relativity. By means of a construct that measures the polarization of twinned-photons by splitting them at varying angles with a rotated crystal and projecting these binary polarizations onto a phosphor screen, a somewhat obscure Northern Irish physicist named John Bell made the stunning determination that *reality is non-local*. In other words, though our phenomenal world operates at the local level—diminishing with distance, shielded, coterminous, subluminal—*reality*, the quantum bedrock, is non-local: undiminished with distance, unshielded, incongruent, superluminal. What's more, Bell's Theorem has subsequently been proven mathematically, meaning its truth no longer relies on the viability of Quantum Theory: it is a reality of it own. Herbert uses this perturbing discovery to realign the eight *schools* of Quantum Reality and work out how it impacts them all, especially in its potential links to that weirdest of quantum bunnies, Phase Entanglement.

Three stars only because Herbert, while proving himself a highly competent guide, writes with a workmanlike prose, and can occasionally get a bit bogged down, ironically most often by trying to make complicated mathematics explicable to the general reader. Tantalizing with its glimpses of the potential for faster-than-light communication and movement, whilst simultaneously dampening with its allusions to the all-too-likelihood that such communications would be at a level comprehensible only to *nature* itself, and, alas, not to the human consciousness that, as this book shows over and again, despite being profoundly confounded by the subatomic world it has uncovered, refuses to leave it be without having done everything possible to make some manner of *sense* of it all.

Hendrick Mcdonald says

An Excellent Quantum Theory Introduction

This is an excellent introduction to quantum mechanics. The writer gives only as much history as necessary, but focuses on interpreting the meaning of the theory, using a variety of analogies and alternative framing a to make sure the reader can understand the implications. Of particular note are the chapter on his 'synthesizer theorem' stating that waveforms do not need to be of the 'sin' form but rather any measurement can be thought of as have its own unique pattern, he then uses this to illustrate the implications for the uncertainty principle. There is also two chapters on interpretations of quantum mechanics, focusing on the 'measurement problem' and uncertainty. The book then proceeds to explain the EPR paradox, Bells Theorem, entanglement and its implications. The age of the book seems to have little impact on its usefulness. Highly recommended.

Paula says

I like physics and this book

P.J. Mazumdar says

This is a great book by Nick Herbert. This is a book that deals with the interpretation of Quantum Physics. But its importance is that it deals not with a 'spiritual' or 'mystical' understanding of quantum physics but with how scientists and physicists themselves interpret quantum physics. It is a book of pure science and there is no quantum mysticism involved here.

Nick Lembert discusses basically eight different interpretations of quantum physics. These include the Copenhagen interpretation, Feynman's interpretation, the 'multiple worlds' interpretation, etc. All these interpretations are the work of the greatest physicists in quantum physics. These are the ways in which the scientists understand how physics work. They are not important in getting the results of quantum dynamics, the maths of quantum physics works independently of which interpretation we may choose to believe.

And this is where Herbert shows the craziness of quantum physics: although all these interpretations are radically different from each other, they can all explain quantum physics equally well. Neither we, the non-physicists, nor the greatest physicists in the world, really know what actually is going on in this strange little world, whether the particles are behaving according to the Copehnhagen interpretation, the multiple world explanation, etc. Herbert handles this very well, we get a sense of why Feynman said, 'just shut up and calculate'. Scientists dont understand the basic reality of quantum physics either!

Another very useful thing I took away from the book was the explanation of the wave equations of Quantum Physics. Herbert does a fine job of showing what exactly waves are and how physics describes the particles as waves and what this means. This again shows up the mysteriousness of Quantum Physics in another way.

All in all, I would call this a very important book to understand the general principles of quantum physics, one that is vital because it sets out the different interpretations in a very clear and comprehensible manner.

Douglas Gates says

Helpful introductory overview of the major ideas and theories in quantum mechanics. Also has recommendations for further study.

Dave Squires says

This book reveals the behavior of subatomic particles that reflect, in reality, what science fiction and fantasy authors dream about. The true nature of reality is a hidden universe full of bizarre particles that create the appearance of the "normal" world we see. Reading this book led me to wonder how we might harness some of the hidden phenomena it describes, and thereby change our place in the universe.

Abner Rosenweig says

Quantum reality is science's elephant in the room. Many modern scientists plug along with research according to the outmoded classical view of reality, totally ignoring the unfathomably bizarre ramifications of quantum findings. Not only does QR have revolutionary implications for physics; its probability waves will eventually ripple throughout the world, transforming our understanding of the cosmos, society, and personal identity. That quantum reality and its paradigm-shifting implications are not in the forefront of our cultural zeitgeist only underscores how ignorant and myopic most people are.

Herbert's Quantum Reality was published back in 1985. It's become a classic popular introduction to the subject. It does a great job explaining the strangeness of quantum reality and how it departs from the classical worldview, and it offers a lucid description of 8 possible interpretations of quantum reality. Given the strangeness of the quantum world, maybe all 8 interpretations are correct!

Sometimes Herbert goes beyond an introductory work and gets technical in his detailed explanations of experiments, but the book is generally accessible and contains no dizzying math. I wish philosophical implications figured more heavily into the work, however I guess there's only so much one can say given that the mechanics of quantum reality are still a mystery.

Herbert fed my curiosity, but in the feeding, he only made my appetite 1,000 times greater. I must dive deeper down the rabbit hole!

Scott says

shit's fucked.

we don't know how reality works.

everyone go home.

einstein, erwin shroddinger, and john stewart bell seem to be the only physicists in the last 100 years with any common sense.

neils bohr seems like he'd be fun to party with.

William Findley says

Any sort of science that begins with “quantum” is going to be a rather confusing journey to your mind, and whether you’re willing to learn it or not, it’s best that you don’t throw your mind so far deep into it so that you’re unable to comprehend much of reality itself. Nevertheless, Herbert does an amazing job at explaining quantum reality. He does it in a way that provides just enough information, but not so much that you’re ready to doubt all scientific theories presented to you. He brings in things like sine waves and compares them to the sound waves of a piano to help the reader understand the strange nature of wave energy, but he doesn’t just just stop with the simple explanation of the waves, he continues his “easy” explanations throughout the book. Because this is a science book, there aren’t any characters or plot, just a huge amount of information being thrown at you. I’ve been in depth studying quantum theory and reality for around a year now, and this book should have been the first book I read. The world is confusing, and any science that includes the word “quantum” makes it even more confusing.

Charles Semich says

I read this book many times and continue to pick it up almost daily for a page or two of pages marked of concepts that astound or elude me. I realize the book is old and physics is a quick moving fare, however, I feel understanding what they knew 20 years ago is a solid foundation to understanding the current affairs. Plus, it's like I still have 20 years or more worth of quantum physics to catch up on!

John says

The mid-1980s saw a flood of books such as "Quantum Reality" hit the shelves, books which tried to explain the latest findings in the world of physics in layperson's terms. (We used to call this genre "physics for poets.") This book, by author Nick Herbert, is a fairly typical example, even if it does leave something to be desired in both concision and lucidity. Whereas his contemporaries, such as Michio Kaku and F. David Peat, were able to provide explanations which were easy to grasp at first blush, Herbert doesn't wield quite the same facility with words. Thus, many of the passages in "Quantum Reality" can be a chore to read. In addition, Herbert tends to reiterate concepts more than necessary, and in constructing his book, structured it such that no less than eight competing theories had to be reviewed numerous times in order to contrast them against one another in light of some central point or theme.

The specific question behind Herbert's book is intriguing enough: Which of the eight major theories then in circulation might represent the underlying reality behind quantum theory? Herbert eventually lands on a theorem devised by John Bell which suggests that at its "bottom layer," the reality behind all physics (quantum or otherwise) requires an acceptance of non-locality, implying, among other things, superluminal (faster-than-light) connections. This theorem, in the intervening 50-plus years since its formulation, has yet to be discredited, meaning that it is still a sticking point which any model of physical reality must take into account. In this sense, Herbert's focus on Bell's work as a linchpin is apropos, although he could have made his point more forcefully if he had used clearer language and organized his text in a less sprawling manner.

Jeremy says

I was lent this book by a math friend who thought I would enjoy it. It is really fascinating. The author seems to have a clear understanding of exactly what aspects of the situation are most fascinating to the laymen. The basic starting point: All of the pictures of the nature of reality proposed by the new physics are ludicrous from an intuitive standpoint. So what are we supposed to believe?

I love reading this book before bed. As a student of Tibetan Buddhism, I just find myself laughing myself to sleep every time another parallel conclusion rears it's head. Last night, it was the realization that waves have no inherent parts...

keith koenigsberg says

Much of this book was over my armchair-physicist head, BUT, among other things, Herbert has given me the first coherent explanation of Heisenberg that I can really understand. That alone is worth the price. I actually think I could now explain Heisenberg on a cocktail napkin. (I'm so much fun at parties!)

Matthew Petti says

This book has been on my shelf for 15 years and never fails to excite me when I pick it up. Theoretical physics is so fascinating and only because Nick Herbert makes it so easy to understand. The realm of quantum mechanics is so unreal and begs us to consider its philosophical and even religious ramifications. Putting the many quantum principles in perspective, Quantum Reality takes the reader on a new journey of discovery. If we really want to know what we cannot explain and see the world for what it "really" is, which is beyond our wildest dreams, this is a good place to start.

Habib says

what a fantastic book, great start into the deep reality question(s) we're facing through quantum theory. Nick Herbert does an excellent job presenting the leading reality theories and provides a better understanding of the quantum facts & theory that goes with them. His last few pages raise some intriguing questions and made me want to explore further.