By Max Tegmark Universes Parallel Home Mit

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Our Mathematical Universe

We once had to abandon the idea of earth being at the centre of the universe. Now, we need to confront an even more profound possibility: the universe itself might just be one universe among many. In Search of the Multiverse takes us on an extraordinary journey, examining the most fundamental questions in science. What are the boundaries of our universe? Can there be different physical laws from the ones we know? Are there in fact other universes? Do we really live in a multiverse? This book is a search – the ultimate search – exploring the frontiers of reality. Ideas that were once science fiction have now come to dominate modern physics. And, as John Gribbin shows, there is increasing evidence that there really is more to the universe than we can see. Gribbin guides us through the different competing theories (there is more than one multiverse!) revealing what they have in common and what we can come to expect. He gives a brilliant tour of the current state of cosmology. John Gribbin is our best, most accessible guide to the big questions of science. And there is no bigger question than our search for the multiverse.

Evaluating Philosophies

The first part deals with philosophies that have had a significant input, positive or negative, on the search for truth; it suggests that scientific and technological are either stimulated or smothered by a philosophical matrix; and it outlines two ontological doctrines believed to have nurtured research in modern times: systemism (not to be mistaken for holism) and materialism (as an extension of physicalism). The second part discusses a few practical problems that are being actively discussed in the literature, from climatology and information science to economics and legal philosophy. This discussion is informed by the general principles analyzed in the first part of the book. Some of the conclusions are that standard economic theory is just as inadequate as Marxism; that law and order are weak without justice; and that the central equation of normative climatology is a

tautology–which of course does not put climate change in doubt. The third and final part of the book tackles a set of key concepts, such as those of indicator, energy, and existence, that have been either taken for granted or neglected. For instance, it is argued that there is at least one existence predicate, and that it is unrelated to the so-called existential quantifier; that high level hypotheses cannot be put to the test unless conjoined with indicator hypotheses; and that induction cannot produce high level hypotheses because empirical data do not contain any transempirical concepts. Realism, materialism, and systemism are thus refined and vindicated.

Our Mathematical Universe

A Leading Figure in the Development of the New Cosmology Explains What It All Means Among his peers, Alex Vilenkin is regarded as one of the most imaginative and creative cosmologists of our time. His contributions to our current understanding of the universe include a number of novel ideas, two of which—eternal cosmic inflation and the quantum creation of the universe from nothing—have provided a scientific foundation for the possible existence of multiple universes. With this book—his first for the general reader—Vilenkin joins another select group: the handful of first-rank scientists who are equally adept at explaining their work to nonspecialists. With engaging, well-paced storytelling, a droll sense of humor, and a generous sprinkling of helpful cartoons, he conjures up a bizarre and fascinating new worldview that—to paraphrase Niels Bohr—just might be crazy enough to be true.

The Fabric of Reality

The essays in this book look at way in which the fundaments of physics might need to be changed in order to make progress towards a unified theory. They are based on the prize-winning essays submitted to the FQXi essay competition “Which of Our Basic Physical Assumptions Are Wrong?”, which drew over 270 entries. As Nobel Laureate physicist Philip W. Anderson realized, the key to understanding nature’s reality is not anything “magical”, but the right attitude, “the focus on asking the right questions, the willingness to try (and to discard) unconventional answers, the sensitive ear for phoniness, self-deception, bombast, and conventional but unproven assumptions.” The authors of the eighteen prize-winning essays have, where necessary, adapted their essays for the present volume so as to (a) incorporate the community feedback generated in the online discussion of the essays, (b) add new material that has come to light since their completion and (c) to ensure accessibility to a broad audience of readers with a basic grounding in physics. The Foundational Questions Institute, FQXi, catalyzes, supports, and disseminates research on questions at the foundations of physics and cosmology, particularly new frontiers and innovative ideas integral to a deep understanding of reality, but unlikely to be supported by conventional funding sources.

Permutation City

The Everett Interpretation of Quantum Mechanics

What does realism about the quantum state imply? What follows when quantum theory is applied without restriction, if need be, to the whole universe? These are the questions which an illustrious team of philosophers and physicists debate in this volume. All the contributors are agreed on realism, and on the need, or the aspiration, for a theory that unites micro- and macroworlds, at least in principle. But the further claim argued by some is that if you allow the Schrödinger equation unrestricted application, supposing the quantum state to be something physically real, then this universe is one of countlessly many others, constantly branching in time, all of which are real. The result is the many worlds theory, also known as the Everett interpretation of quantum mechanics. The contrary claim sees this picture of many worlds as in no sense inherent in quantum mechanics, even when the latter is allowed unrestricted scope and even given that the quantum state itself is something physically real. For this picture of branching worlds fails to make physical sense, let alone common sense, even on its own terms. The status of these worlds, what they are made of, is never adequately explained. Ordinary ideas about time and identity over time become hopelessly compromised. The concept of probability itself is brought into question. This picture of many branching worlds is inchoate, it is a vision, an error. There are realist alternatives to many worlds, some even that preserve the Schrödinger equation unchanged. Twenty specially written essays, accompanied by commentaries and discussions, examine these claims and counterclaims in depth. They focus first on the question of ontology, the existence of worlds (Part 1 and 2), second on the interpretation of probability (Parts 3 and 4), and third on alternatives or additions to many worlds (Parts 5 and 6). The introduction offers a helpful guide to the arguments for the Everett interpretation, particularly as they have been formulated in the last two decades.

Life 3.0

The story of a man with a vision - immortality : for those who can afford it is found in cyberspace. Permutation city is the tale of a man with a vision - how to create immortality - and how that vision becomes something way beyond his control. Encompassing the lives and struggles of an artificial life junkie desperate to save her dying mother, a billionaire banker scarred by a terrible crime, the lovers for whom, in their timeless virtual world, love is not enough - and much more - Permutation city is filled with the sense of wonder.

Science as a Process

An extraordinary and challenging synthesis of ideas uniting Quantum Theory, and the theories of Computation, Knowledge and Evolution, Deutsch's extraordinary book explores the deep connections between these strands which reveal the fabric of realityin which human actions and ideas play essential roles.

Programming the Universe

Our universe seems strangely ''biophilic,'' or hospitable to life. Is this

happenstance, providence, or coincidence? According to cosmologist Martin Rees, the answer depends on the answer to another question, the one posed by Einstein's famous remark: ''What interests me most is whether God could have made the world differently.'' This highly engaging book explores the fascinating consequences of the answer being ''yes.'' Rees explores the notion that our universe is just a part of a vast ''multiverse,'' or ensemble of universes, in which most of the other universes are lifeless. What we call the laws of nature would then be no more than local bylaws, imposed in the aftermath of our own Big Bang. In this scenario, our cosmic habitat would be a special, possibly unique universe where the prevailing laws of physics allowed life to emerge. Rees begins by exploring the nature of our solar system and examining a range of related issues such as whether our universe is or isn't infinite. He asks, for example: How likely is life? How credible is the Big Bang theory? Rees then peers into the long-range cosmic future before tracing the causal chain backward to the beginning. He concludes by trying to untangle the paradoxical notion that our entire universe, stretching 10 billion light-years in all directions, emerged from an infinitesimal speck. As Rees argues, we may already have intimations of other universes. But the fate of the multiverse concept depends on the still-unknown bedrock nature of space and time on scales a trillion trillion times smaller than atoms, in the realm governed by the quantum physics of gravity. Expanding our comprehension of the cosmos, Our Cosmic Habitat will be read and enjoyed by all those--scientists and nonscientists alike--who are as fascinated by the universe we inhabit as is the author himself.

Infinitesimal: How a Dangerous Mathematical Theory Shaped the Modern World

Physicists argue from different perspectives for and against the idea of the existence of multiple universes.

The Hidden Reality

"Legend is overdue for replacement, and an adequate replacement must attend to the process of science as carefully as Hull has done. I share his vision of a serious account of the social and intellectual dynamics of science that will avoid both the rosy blur of Legend and the facile charms of relativism. . . . Because of [Hull's] deep concern with the ways in which research is actually done, Science as a Process begins an important project in the study of science. It is one of a distinguished series of books, which Hull himself edits."—Philip Kitcher, Nature "In Science as a Process, [David Hull] argues that the tension between cooperation and competition is exactly what makes science so successful. . . . Hull takes an unusual approach to his subject. He applies the rules of evolution in nature to the evolution of science, arguing that the same kinds of forces responsible for shaping the rise and demise of species also act on the development of scientific ideas."—Natalie Angier, New York Times Book Review "By far the most professional and thorough case in favour of an evolutionary philosophy of science ever to have been made. It contains excellent short histories of evolutionary biology and of systematics (the science of classifying living things); an important and original account of modern systematic controversy; a counter-attack against the

philosophical critics of evolutionary philosophy; social-psychological evidence, collected by Hull himself, to show that science does have the character demanded by his philosophy; and a philosophical analysis of evolution which is general enough to apply to both biological and historical change."—Mark Ridley, Times Literary Supplement "Hull is primarily interested in how social interactions within the scientific community can help or hinder the process by which new theories and techniques get accepted. . . . The claim that science is a process for selecting out the best new ideas is not a new one, but Hull tells us exactly how scientists go about it, and he is prepared to accept that at least to some extent, the social activities of the scientists promoting a new idea can affect its chances of being accepted."—Peter J. Bowler, Archives of Natural History "I have been doing philosophy of science now for twenty-five years, and whilst I would never have claimed that I knew everything, I felt that I had a really good handle on the nature of science, Again and again, Hull was able to show me just how incomplete my understanding was. . . . Moreover, [Science as a Process] is one of the most compulsively readable books that I have ever encountered."—Michael Ruse, Biology and Philosophy

Our Mathematical Universe

We all make mistakes. Nobody is perfect. And that includes five of the greatest scientists in history -- Charles Darwin, William Thomson (Lord Kelvin), Linus Pauling, Fred Hoyle, Albert Einstein. But the mistakes that these great scientists made helped science to advance. Indeed, as Mario Livio explains in this fascinating book, science thrives on error; it advances when erroneous ideas are disproven. All five scientists were great geniuses and fascinating human beings. Their blunders were part of their genius and part of the scientific process. Livio brilliantly analyses their errors to show where they were wrong and right, but what makes his book so enjoyable to read is Livio's analysis of the psychology of these towering figures. Along the way the reader learns an enormous amount about the evolution of life on earth and in the universe, but from an unusual vantage point -- the mistakes of great scientists rather than the achievements that made them famous.

Most Wanted Particle

A clear, plain-English guide to this complex scientific theory String theory is the hottest topic in physics right now, with books on the subject (pro and con) flying out of the stores. String Theory For Dummies offers an accessible introduction to this highly mathematical "theory of everything," which posits ten or more dimensions in an attempt to explain the basic nature of matter and energy. Written for both students and people interested in science, this guide explains concepts, discusses the string theory's hypotheses and predictions, and presents the math in an approachable manner. It features in-depth examples and an easy-to-understand style so that readers can understand this controversial, cutting-edge theory.

Causality and Determination: an Inaugural Lecture

Peter Byrne tells the story of Hugh Everett III (1930-1982), whose "many worlds" theory of multiple universes has had a profound impact on physics and philosophy.

Using Everett's unpublished papers (recently discovered in his son's basement) and dozens of interviews with his friends, colleagues, and surviving family members, Byrne paints, for the general reader, a detailed portrait of the genius who invented an astonishing way of describing our complex universe from the inside. Everett's mathematical model (called the "universal wave function") treats all possible events as "equally real", and concludes that countless copies of every person and thing exist in all possible configurations spread over an infinity of universes: many worlds. Afflicted by depression and addictions, Everett strove to bring rational order to the professional realms in which he played historically significant roles. In addition to his famous interpretation of quantum mechanics, Everett wrote a classic paper in game theory; created computer algorithms that revolutionized military operations research; and performed pioneering work in artificial intelligence for top secret government projects. He wrote the original software for targeting cities in a nuclear hot war; and he was one of the first scientists to recognize the danger of nuclear winter. As a Cold Warrior, he designed logical systems that modeled "rational" human and machine behaviors, and yet he was largely oblivious to the emotional damage his irrational personal behavior inflicted upon his family, lovers, and business partners. He died young, but left behind a fascinating record of his life, including correspondence with such philosophically inclined physicists as Niels Bohr, Norbert Wiener, and John Wheeler. These remarkable letters illuminate the long and often bitter struggle to explain the paradox of measurement at the heart of quantum physics. In recent years, Everett's solution to this mysterious problem - the existence of a universe of universes - has gained considerable traction in scientific circles, not as science fiction, but as an explanation of physical reality.

Brilliant Blunders

Max Tegmark, one of the most original physicists at work today, leads us on an astonishing journey to explore the mysteries uncovered by cosmology and to discover the nature of reality. Part-history of the cosmos, part-intellectual adventure, 'Our Mathematical Universe' travels from the big bang to the distant future via parallel worlds, across every possible scale - from the sub-atomic to the intergalactic - showing how mathematics provides the answers to our questions about the world.

Many Worlds?

Quantum physics has revealed that objects can exist in more than one location simultaneously, even though the objects are invisible to us in all but one location, that is, parallel universes exist. This is most blatantly revealed in the mind shattering 'double-slit' experiment and is at the core of what is called 'the measurement problem,' in quantum physics. The results are startling, but this is what the science is clearly showing. It is human awareness that causes matter to fix into a single position, and reveal a single reality. The science is showing that at every moment we become aware of our reality, the universe splits into unseen parallel dimensions and we become trapped in just one of these many parallel realities. This is all powerful stuff but what does this mean for our lives? What if you could learn how to access these parallel worlds that are being created? What if you could do what many billionaires and great minds in history have done but have

only hinted at. What if you could move through parallel realities in order to achieve unfathomable greatness. Abraham Lincoln, Albert Einstein, Michelangelo, Nikola Tesla, Isaac Newton, John D. Rockefeller and many others all used this quantum mind power that is now available to you. This is one of the most powerful books you shall ever read. With research from quantum physics, psychology, biology and behavioral epigenetics, as well as many great spiritual teachings, 'Moving Through Parallel Worlds' will guide you on a path to achieving your grandest ambitions. The title, 'Moving Through Parallel Worlds To Achieve Your Dreams,' is literal - based on the 'Many Worlds Interpretation of Quantum Mechanics,' and it is also a metaphor suggesting positive life transformation. This very night, you shall be reading and then applying the concepts in this book, and that moment will be the starting point of your mastery of wealth, romance, creation, and mastery of all things in the physical world. 'Moving Through Parallel Worlds' draws on science and timeless wisdom, to guide you on a path to unlimited power and enlightenment. 'Moving Through Parallel Worlds To Achieve Your Dreams' will allow you to bridge the discontinuity in your life from the point where you are at right now, to the point where you dream that you can be. This book shall put you into alignment with all that you have imagined possible for yourself and shall show you a path even to that which you may have considered impossible. This book has emerged so that you may be lifted up, and that you may come to realize the power you have to exist in a world that is exactly as you imagine it should be. This is your moment and this book is here, just for you. Enjoy the journey!

String Theory For Dummies

Max Tegmark leads us on an astonishing journey through past, present, and future, and through the physics, astronomy, and mathematics that are the foundation of his work, most particularly his hypothesis that our physical reality is a mathematical structure and his theory of the ultimate multiverse. In a dazzling combination of both popular and groundbreaking science, he not only helps us grasp his often mind-boggling theories, but he also shares with us some of the often surprising triumphs and disappointments that have shaped his life as a scientist. Fascinating from first to last - here is a book for the full science-reading spectrum. Max Tegmark is author or co-author of more than 200 technical papers, twelve of which have been cited more than 500 times. He has featured in dozens of science documentaries, and his work with the SDSS collaboration on galaxy clustering shared the first prize in Science magazine's "Breakthrough of the Year: 2003". He holds a Ph.D from the University of California, Berkeley, and is a physics professor at MIT.

Many Worlds in One

Since the time of Einstein, ideas of parallel universes have grown from far-out concepts to mature scientific theories. Using everyday analogies and do-it-yourself models to simplify intimidating concepts, students will learn about the most fascinating topics in modern cosmology, such as the big bang theory, inflation, wormholes, and higher dimensions. Student learning is enhanced by illuminating diagrams and informative sidebars that explore related timely topics in depth. This book supports the Next Generation Science Standards' emphasis on evidence-based theories by discussing past observations and future tests of each parallel

universe theory.

Moving Through Parallel Worlds To Achieve Your Dreams

One of the most controversial, cutting-edge ideas in cosmology—the possibility that there exist multiple parallel universes—in fact has a long history. Tom Siegfried reminds us that the size and number of the heavens have been contested since ancient times. His story offers deep lessons about the nature of science and the quest for understanding.

Questioning the Foundations of Physics

Argues that recent developments in quantum physics, astronomy, and chaos theory have forced a reconsideration of the concepts of space, time, and matter. Reprint. 10,000 first printing.

Parallel Universes Explained

The Definitive Resource for Viewing the Night Sky David Dickinson, Earth science teacher and backyard astronomer, and Fraser Cain, publisher of Universe Today, have teamed up to provide expert guidance on observing the night sky. The Universe Today Ultimate Guide to Viewing the Cosmos features the best tips and tricks for viewing our solar system and deep sky objects, as well as detailed charts, graphs and tables to find must-see events for years to come. This comprehensive guide is complete with stunning and exclusive photography from top night sky photographers, as well as advice on how to take your own incredible photos. Take your recreational viewing to the next level with activities like: Finding comets and asteroids Tracking variable stars Monitoring meteor showers Following solar activity Tracking satellites Timing lunar and asteroid occultations With star charts, practical background information, technological resources and telescope and astrophotography guides, this is the ultimate resource for any backyard space enthusiast.

Is God a Mathematician?

New York Times Best Seller How will Artificial Intelligence affect crime, war, justice, jobs, society and our very sense of being human? The rise of AI has the potential to transform our future more than any other technology—and there’s nobody better qualified or situated to explore that future than Max Tegmark, an MIT professor who’s helped mainstream research on how to keep AI beneficial. How can we grow our prosperity through automation without leaving people lacking income or purpose? What career advice should we give today’s kids? How can we make future AI systems more robust, so that they do what we want without crashing, malfunctioning or getting hacked? Should we fear an arms race in lethal autonomous weapons? Will machines eventually outsmart us at all tasks, replacing humans on the job market and perhaps altogether? Will AI help life flourish like never before or give us more power than we can handle? What sort of future do you want? This book empowers you to join what may be the most important conversation of our time. It doesn’t shy away from the full range of viewpoints or

from the most controversial issues—from superintelligence to meaning, consciousness and the ultimate physical limits on life in the cosmos.

Science and Ultimate Reality

Provides evidence that human consciousness can never be reproduced and exposes the perils of artificial intelligence • Explains how consciousness transcends the brain and body through quantum theory and accounts of consciousness in the clinically dead • Shares scientific evidence of how the image on the Shroud of Turin was produced and connects these findings to evidence concerning near-death experiences • Reveals how consciousness cannot be reproduced by a machine and how attempts to do so threaten what makes us human Stephen Hawking once said that the unanticipated consequences of artificial intelligence will be the greatest threat to humanity's survival. In this book, Dr. Andrew Silverman reveals why the powerful consciousness of the human mind could never be manufactured and so cannot be reproduced with technology. Integrating extensive scientific research from three seemingly unrelated fields of study--quantum mechanics, near-death experiences, and the Shroud of Turin--Silverman reveals the pitfalls and perils of artificial intelligence and addresses the fundamentally flawed thinking that underlies it. Drawing on his work as one of the leading experts on the Shroud of Turin as well as research by scientists from NASA and Los Alamos, he shows how the image on the Shroud could only have been produced by a flash of light as intense as a nuclear explosion--a burst of light that occurred after the body was in the tomb. Sharing medical evidence of consciousness in people declared clinically dead, the author shows how the light of consciousness evidenced by the Shroud is also a consistent feature of most near-death experiences. Exploring the non-local nature of consciousness--how it transcends the physical brain and body, Silverman explains why the human mind cannot be reduced to a computer and examines what separates sentient beings from machines. He shows how getting caught up in the push for artificial intelligence and the technological quest for immortality--through the attempt to "download" our minds onto computers--will only lead us to devalue and erase what makes us unique and irreplaceable in this cold, dark universe: our humanity.

A Burst of Conscious Light

In his first book ever, the father of string theory reinvents the world's concept of the known universe and man's unique place within it. Line drawings.

Fringe Science

Publisher Description

Possibilities in Parallel

Explore the real science behind the Cartoon Network phenomenon Rick and Morty—one of television's most irreverent, whip-smart, and darkly hilarious shows—and discover how close we are to Rick's many experiments becoming a reality. Adult Swim's Rick and Morty is one of the smartest (and most insane)

shows on television. Genius alcoholic Rick Sanchez and his hapless grandson Morty have explored everything from particle physics to human augmentation and much more in their intergalactic adventures through the multiverse. With biting humor and plenty of nihilism, Rick and Morty employs cutting-edge scientific theories in every episode. But, outside of Rick’s garage laboratory, what are these theories truly about and what can they teach us about ourselves? Blending biology, chemistry, and physics basics with accessible—and witty—prose, The Science of Rick and Morty equips you with the scientific foundation to thoroughly understand Rick’s experiments from the show, such as how we can use dark matter and energy, just what is intelligence hacking, and whether or not you can really control a cockroach’s nervous system with your tongue. Perfect for longtime and new fans of the show, this is the ultimate segue into discovering more about our complicated and fascinating universe.

Parallel Worlds

Hugh Everett III was an American physicist best known for his many-worlds interpretation of quantum mechanics, which formed the basis of his PhD thesis at Princeton University in 1957. Although counterintuitive, Everett's revolutionary formulation of quantum mechanics offers the most direct solution to the infamous quantum measurement problem--that is, how and why the singular world of our experience emerges from the multiplicities of alternatives available in the quantum world. The many-worlds interpretation postulates the existence of multiple universes. Whenever a measurement-like interaction occurs, the universe branches into relative states, one for each possible outcome of the measurement, and the world in which we find ourselves is but one of these many, but equally real, possibilities. Everett's challenge to the orthodox interpretation of quantum mechanics was met with scorn from Niels Bohr and other leading physicists, and Everett subsequently abandoned academia to conduct military operations research. Today, however, Everett's formulation of quantum mechanics is widely recognized as one of the most controversial but promising physical theories of the last century. In this book, Jeffrey Barrett and Peter Byrne present the long and short versions of Everett's thesis along with a collection of his explanatory writings and correspondence. These primary source documents, many of them newly discovered and most unpublished until now, reveal how Everett's thinking evolved from his days as a graduate student to his untimely death in 1982. This definitive volume also features Barrett and Byrne's introductory essays, notes, and commentary that put Everett's extraordinary theory into historical and scientific perspective and discuss the puzzles that still remain.

The Universe Today Ultimate Guide to Viewing The Cosmos

The bestselling author of The Elegant Universe and The Fabric of the Cosmos tackles perhaps the most mind-bending question in modern physics and cosmology: Is our universe the only universe? There was a time when "universe" meant all there is. Everything. Yet, a number of theories are converging on the possibility that our universe may be but one among many parallel universes populating a vast multiverse. Here, Briane Greene, one of our foremost physicists and science writers, takes us on a breathtaking journey to a multiverse comprising an endless series of big bangs, a multiverse with duplicates of every one of us, a

multiverse populated by vast sheets of spacetime, a multiverse in which all we consider real are holographic illusions, and even a multiverse made purely of math--and reveals the reality hidden within each. Using his trademark wit and precision, Greene presents a thrilling survey of cutting-edge physics and confronts the inevitable question: How can fundamental science progress if great swaths of reality lie beyond our reach? The Hidden Reality is a remarkable adventure through a world more vast and strange than anything we could have imagined.

The Cosmic Landscape

How math helps us solve the universe's deepest mysteries One of the great insights of science is that the universe has an underlying order. The supreme goal of physicists is to understand this order through laws that describe the behavior of the most basic particles and the forces between them. For centuries, we have searched for these laws by studying the results of experiments. Since the 1970s, however, experiments at the world's most powerful atom-smashers have offered few new clues. So some of the world's leading physicists have looked to a different source of insight: modern mathematics. These physicists are sometimes accused of doing 'fairy-tale physics', unrelated to the real world. But in The Universe Speaks in Numbers, award-winning science writer and biographer Farmelo argues that the physics they are doing is based squarely on the well-established principles of quantum theory and relativity, and part of a tradition dating back to Isaac Newton. With unprecedented access to some of the world's greatest scientific minds, Farmelo offers a vivid, behind-the-scenes account of the blossoming relationship between mathematics and physics and the research that could revolutionize our understanding of reality. A masterful account of the some of the most groundbreaking ideas in physics in the past four decades. The Universe Speaks in Numbers is essential reading for anyone interested in the quest to discover the fundamental laws of nature.

Fringe Science

Pulsing with drama and excitement, Infinitesimal celebrates the spirit of discovery, innovation, and intellectual achievement-and it will forever change the way you look at a simple line. On August 10, 1632, five men in flowing black robes convened in a somber Roman palazzo to pass judgment on a deceptively simple proposition: that a continuous line is composed of distinct and infinitely tiny parts. With the stroke of a pen the Jesuit fathers banned the doctrine of infinitesimals, announcing that it could never be taught or even mentioned. The concept was deemed dangerous and subversive, a threat to the belief that the world was an orderly place, governed by a strict and unchanging set of rules. If infinitesimals were ever accepted, the Jesuits feared, the entire world would be plunged into chaos. In Infinitesimal, the award-winning historian Amir Alexander exposes the deep-seated reasons behind the rulings of the Jesuits and shows how the doctrine persisted, becoming the foundation of calculus and much of modern mathematics and technology. Indeed, not everyone agreed with the Jesuits. Philosophers, scientists, and mathematicians across Europe embraced infinitesimals as the key to scientific progress, freedom of thought, and a more tolerant society. As Alexander reveals, it wasn't long before the two camps set off on a war that pitted Europe's forces of hierarchy and order against those of pluralism and change. The

story takes us from the bloody battlefields of Europe's religious wars and the English Civil War and into the lives of the greatest mathematicians and philosophers of the day, including Galileo and Isaac Newton, Cardinal Bellarmine and Thomas Hobbes, and Christopher Clavius and John Wallis. In Italy, the defeat of the infinitely small signaled an end to that land's reign as the cultural heart of Europe, and in England, the triumph of infinitesimals helped launch the island nation on a course that would make it the world's first modern state. From the imperial cities of Germany to the green hills of Surrey, from the papal palace in Rome to the halls of the Royal Society of London, Alexander demonstrates how a disagreement over a mathematical concept became a contest over the heavens and the earth. The legitimacy of popes and kings, as well as our beliefs in human liberty and progressive science, were at stake-the soul of the modern world hinged on the infinitesimal.

Something Deeply Hidden

INSTANT NEW YORK TIMES BESTSELLER A Science News favorite science book of 2019 As you read these words, copies of you are being created. Sean Carroll, theoretical physicist and one of this world’s most celebrated writers on science, rewrites the history of 20th century physics. Already hailed as a masterpiece, Something Deeply Hidden shows for the first time that facing up to the essential puzzle of quantum mechanics utterly transforms how we think about space and time. His reconciling of quantum mechanics with Einstein’s theory of relativity changes, well, everything. Most physicists haven’t even recognized the uncomfortable truth: physics has been in crisis since 1927. Quantum mechanics has always had obvious gaps—which have come to be simply ignored. Science popularizers keep telling us how weird it is, how impossible it is to understand. Academics discourage students from working on the "dead end" of quantum foundations. Putting his professional reputation on the line with this audacious yet entirely reasonable book, Carroll says that the crisis can now come to an end. We just have to accept that there is more than one of us in the universe. There are many, many Sean Carrolls. Many of every one of us. Copies of you are generated thousands of times per second. The Many Worlds Theory of quantum behavior says that every time there is a quantum event, a world splits off with everything in it the same, except in that other world the quantum event didn't happen. Step-by-step in Carroll's uniquely lucid way, he tackles the major objections to this otherworldly revelation until his case is inescapably established. Rarely does a book so fully reorganize how we think about our place in the universe. We are on the threshold of a new understanding—of where we are in the cosmos, and what we are made of.

The Many Worlds of Hugh Everett III

Is the universe actually a giant quantum computer? According to Seth Lloyd, the answer is yes. All interactions between particles in the universe, Lloyd explains, convey not only energy but also information–in other words, particles not only collide, they compute. What is the entire universe computing, ultimately? “Its own dynamical evolution,” he says. “As the computation proceeds, reality unfolds.” Programming the Universe, a wonderfully accessible book, presents an original and compelling vision of reality, revealing our world in an entirely new light. From the Trade Paperback edition.

The Number of the Heavens

Max Tegmark leads us on an astonishing journey through past, present and future, and through the physics, astronomy and mathematics that are the foundation of his work, most particularly his hypothesis that our physical reality is a mathematical structure and his theory of the ultimate multiverse. In a dazzling combination of both popular and groundbreaking science, he not only helps us grasp his often mind-boggling theories, but he also shares with us some of the often surprising triumphs and disappointments that have shaped his life as a scientist. Fascinating from first to last—this is a book that has already prompted the attention and admiration of some of the most prominent scientists and mathematicians.

Universe Or Multiverse?

“A vivid account of what the process of discovery was really like for an insider.”—Peter Higgs “Butterworth is an insider’s insider. His narrative seethes with insights on the project’s science, technology and ‘tribes,’ as well as his personal (and often amusing) journey as a frontier physicist.”—Nature The discovery of the Higgs boson has brought us a giant step closer to understanding how our universe works. But before the Higgs was found, its existence was hotly debated. Even Peter Higgs, who first pictured it, did not expect to see proof within his lifetime. The quest to find the Higgs would ultimately require perhaps the most ambitious experiment in human history. Jon Butterworth was there—a leading physicist on the ATLAS project at the Large Hadron Collider in Geneva, Switzerland. In Most Wanted Particle, he gives us the first insider account of the hunt for the Higgs, and of life at the collider itself—the world’s largest and most powerful particle accelerator, 17 miles long, 20 stories underground, and designed to “replay” the original Big Bang by smashing subatomic particles at nearly the speed of light. Writing with clarity and humor, Butterworth revels as much in the hard science—which he carefully reconstructs for readers of all levels—as in the messiness, uncertainty, and humanness of science—from the media scrutiny and late-night pub debates, to the false starts and intense pressure to generate results. He captures a moment when an entire field hinged on the proof or disproof of a 50-year-old theory—and even science’s top minds didn’t know what to expect. Finally, he explains why physics will never be the same after our first glimpse of the elusive Higgs—and where it will go from here.

The Matter Myth

Sheds new light on discoveries that have revolutionized the field of cosmology and transformed understanding of the universe, offering an explanation of the multiverse M-theory and its implications in terms of the fate of our own universe.

Our Cosmic Habitat

Bestselling author and astrophysicist Mario Livio examines the lives and theories of history’s greatest mathematicians to ask how—if mathematics is an abstract construction of the human mind—it can so perfectly explain the physical world.

Nobel Laureate Eugene Wigner once wondered about “the unreasonable effectiveness of mathematics” in the formulation of the laws of nature. Is God a Mathematician? investigates why mathematics is as powerful as it is. From ancient times to the present, scientists and philosophers have marveled at how such a seemingly abstract discipline could so perfectly explain the natural world. More than that—mathematics has often made predictions, for example, about subatomic particles or cosmic phenomena that were unknown at the time, but later were proven to be true. Is mathematics ultimately invented or discovered? If, as Einstein insisted, mathematics is “a product of human thought that is independent of experience,” how can it so accurately describe and even predict the world around us? Physicist and author Mario Livio brilliantly explores mathematical ideas from Pythagoras to the present day as he shows us how intriguing questions and ingenious answers have led to ever deeper insights into our world. This fascinating book will interest anyone curious about the human mind, the scientific world, and the relationship between them.

Cosmological Koans: A Journey to the Heart of Physical Reality

Cosmological Koans invites the reader into an intellectual adventure of the highest order. Through more than fifty Koans—pleasingly paradoxical vignettes following the ancient Zen tradition—leading physicist Anthony Aguirre takes the reader across the world from West to East, and through ideas spanning the age, breadth, and depth of the Universe. Using these beguiling Koans (Could there be a civilization on a mote of dust? How much of your fate have you made? Who cleans the universe?) and a flair for explaining complex science, Aguirre covers cosmic questions that scientific giants from Aristotle to Galileo to Heisenberg have grappled with, from the meaning of quantum theory and the nature of time to the origin of multiple universes. A playful and enlightening book, Cosmological Koans explores the strange hinterland between the deep structure of the physical world and our personal experience of it, giving readers what Einstein himself called “the most beautiful and deepest experience” anyone can have: a sense of the mysterious.

The Science of Rick and Morty

Presents essays on the television show "Fringe" from scientists, science writers, science fiction authors, and historians that examine the show's themes and how its treatment of science compares with science in the real world.

In Search of the Multiverse

Possibilities in Parallel: Seeking the Multiverse by the Editors of Scientific American Parallel universes are a staple of science fiction, and it's no wonder. They allow us to explore the question, "what if?" in a way that lets us step completely outside of the world we know, rather than question how that world might have turned out differently. For cosmologists, the question isn't "what if the South won the Civil War?" but "what if the constants that make up the fundamental building blocks of physics were different?" Physicists argue that any slight change to the laws of physics would mean a disruption in the evolution of the universe, and thus our

existence. Take gravity, for example: too strong and stars would burn through their fuel far more quickly. If the universe expanded too fast, matter would spread out too thin for galaxies to form. The list of examples goes on – to the point where the laws of physics might seem finely tuned to make our existence possible. Short of a supernatural or divine explanation, one possibility is that our universe isn't the only one. That's the idea explored in this eBook, Possibilities in Parallel: Seeking the Multiverse. In Section 1, we explore why scientists think other universes could exist. After that, we get a look at the implications. Is it possible to have life in a universe with different physical laws? It would seem so. In "Cracking Open a Window," George Musser discusses the possibility that our universe has more than three spatial dimensions – the others happen to be very small. Other articles, including "The Universe's Unseen Dimensions," analyze the idea that our universe is one of many "branes" – three-dimensional structures stretched out over a higher-dimensional space. The concept of a parallel universe also touches time travel, and then there's the question of what the term "parallel universe" actually means. It's a triumph of the sciences that the very question of why the universe looks as it does can be asked at all. There are currently several possibilities for a multiverse, if it exists. Time and a lot of scientific spadework will reveal which one is right – and get us closer to answering those metaphysical questions: what if, why us, why now?

The Universe Speaks in Numbers

Presents essays on the television show "Fringe" from scientists, science writers, science fiction authors, and historians that examine the show's themes and how its treatment of science compares with science in the real world.