Physics of the Impossible: A Scientific Exploration Into the World of Phasers, Force Fields, Teleportation, and Time Travel Study Guide

Physics of the Impossible: A Scientific Exploration Into the World of Phasers, Force Fields, Teleportation, and Time Travel by Michio Kaku

Contents

Plot Summary

Michio Kaku, PhD is the author of "Physics of the Impossible: A Scientific Exploration into the World of Phasers, Force Fields, Teleportation, and Time Travel." Physics is simply the science of studying matter and how it exists and moves through space and time. Kaku presents physics in a number of ways so that the layperson may understand the importance of physics and how it relates to everyday life. Kaku makes many references to physics by using pop culture references, particularly to books and movies such as Star Trek, Back to the Future, Flash Gordon, The Fly, The Invisible Man, and more. Kaku uses these examples to prove or disprove the possibility of certain items such as invisibility, force fields, and teleportation.

Chapter 1: Force Fields begins with Arthur C. Clarke's Three Laws:

"I. When a distinguished but elderly scientist states that something is possible, he is almost certainly right. When he states that something is impossible, he is very probably wrong.

II. The only way of discovering the limits of the possible is to venture a little way past them into the impossible.

III. Any sufficiently advanced technology is indistinguishable from magic."

Kaku uses this as a basis to explore three levels of impossibilities in physics. Kaku breaks down various impossibilities and explains why they are impossible - at least currently - because they defy one or more areas of physics. The book is broken into four sections of these impossibilities:

Part I: Class I Impossibilities

This section covers the following topics: Force Fields, Invisibility, Phasers and Death Stars, Teleportation, Telepathy, Psychokinesis, Robots, Extraterrestrials and UFOs, Starships, Antimatter and Anti-Universes

Many of these impossibilities have been referenced in literature since ancient times and have made their way into movies and often into reality albeit in small ways. Kaku discusses each topic and explains its basic premise and corresponding scientific experiments and theories. Some of the impossibilities are considered to be something that may be able to be achieved at some time in the future, although perhaps not in the way they are portrayed in modern culture or literature.

Part II: Class II Impossibilities, covers the topics of Faster Than Light, Time Travel, and Parallel Universes. Many of these impossibilities have been referenced in literature, particularly in the works of such greats as HG Wells and Isaac Asimov. Kaku discusses each topic and explains its basic premise and corresponding scientific experiments and theories. Some of the impossibilities are considered to be something that may be able

to be achieved at some time in the distant future, although perhaps not in the way they are portrayed in modern culture or literature.

Part III: Class III Impossibilities covers the topics of Perpetual Motion Machines and Precognition. Kaku notes that there are only two things that are currently considered to be Class III Impossibilities but one must wonder if other technologies also present the same problems. Kaku states that while some things are impossible in mathematics, it is dangerous to assume that there are impossibilities in physics.

The Epilogue addresses the Future of the Impossible.

Chapters 1-3

Chapters 1-3 Summary and Analysis

Chapter 1: Force Fields begins with Arthur C. Clarke's Three Laws:

"I. When a distinguished but elderly scientist states that something is possible, he is almost certainly right. When he states that something is impossible, he is very probably wrong.

II. The only way of discovering the limits of the possible is to venture a little way past them into the impossible.

III. Any sufficiently advanced technology is indistinguishable from magic."

Kaku begins this chapter by referring to the force fields used by the television show Star Trek. Captain Kirk yells for "shields up" when the Starship Enterprise faces a threat by an outside force. The Enterprise relies upon their force fields to protect the Enterprise. Without force fields, the Enterprise would sustain damage and possible ruin.

"So what is a force field? In science fiction it's deceptively simple: a thin, invisible yet impenetrable barrier able to deflect lasers and rockets alike. At first glance a force field looks so easy that it's creation as a battlefield shield seems imminent. One expects that any day some enterprising inventor will announce the discovery of a defensive force field. But the truth is far more complicated" (Chapter 1, p. 3).

Kaku discusses the possibilities of how force fields might be used; however, they are one of the most difficult devices to be created.

Michael Faraday was a 19th century British scientist that became interested in electricity and magnetism. Faraday went to work for Professor Humphrey Davy and managed to conduct many experiments in his field. In fact, Faraday was so successful that Davy became jealous. After Davy died, Faraday continued with his experiments and had some stunning breakthroughs including a series of generators. The key to Faraday's success was the force field. Faraday proved that force fields are real.

Faraday was very unusual in several ways. Growing up in poverty, Faraday did not have the privilege of being properly schooled in mathematics. He was more or less mathematically illiterate. As a result of this lack of education, Faraday was forced to present his ideas through a series of diagrams rather than through mathematical equations. Faraday's inadequacy changed the face of modern physics. All of modern physics uses Faraday's "language" to express ideas and theories. Even Einstein, who was fascinated with Faraday, used this system and wrote his theory of gravity in this manner.

Kaku states that the crowning achievement of physics has been the isolation and identification of four forces that rule the universe. They are gravity, electromagnetism, and weak and strong nuclear forces.

While these forces may show that force fields are not possible, there are loopholes that allow force fields to exist.

Plasma can be molded and shaped by electrical and magnetic fields and then shaped into windows. Those windows can be used as force fields. The plasma window was invented in 1995 by Dr. Ady Herschcovitch at the Brookhaven National Laboratory in New York. Herschcovitch developed the plasma window to solve the problem of welding metal with electron beams, which works better than the conventional acetylene torch.

While the plasma window may work as a force field, it may be used for a wide range of applications. If combined with a laser curtain and carbon nanotube, it could withstand a great deal. However, it would also need to use advanced photochromatics, which do not exist.

Kaku discusses how force fields defy gravity. Sadly, that means that the hover boards used in "Back to the Future" are still an impossibility. However, if magnetics could be enhanced then hover boards and cars could become a reality. Kaku discusses how magnets work. When north poles are facing each other, then the magnets will repel each other. If a north pole faces a south pole, the magnets are attracted to each other.

In 1984, the first commercial auto system was created using magnetic levitation (maglev). Unfortunately, using this maglev is extremely expensive.

Kaku discusses how it is possible to create such a system if there is an invention of room temperature superconductors. High temperature superconductors are hit and miss. Therefore, force fields, at least at this time, are a Class I impossibility.

Invisibility is also used in movies like Star Trek and Harry Potter. Kaku questions if invisibility cloaks and other items are possible.

"Yet for at least a century, physicists have dismissed the possibility of invisibility cloaks, stating flatly that they are impossible: They violate the laws of optics and do not conform to any of the known properties of matter" (Chapter 2, p. 16).

There have been lab tests performed to see if the use of metamaterials could make invisibility a possibility.

"With breakthroughs occurring in this field every few months, it's not surprising that some physicists see some sort of practical invisibility shield emerging out of the laboratory perhaps within a few decades" (Chapter 2, p. 27).

Kaku brings up an interesting point about invisibility. In the stories written by HG Wells and others, the invisible person no longer has to conform to society and therefore often becomes corrupt.

James Clerk Maxwell was a 19th century Scottish physicist and master of advanced mathematics. Maxwell set out to express several revolutionary findings regarding Faraday's theories. Maxwell uncovered that magnetics, if turned, will continually move on and on, over and over much like an ocean wave.

Maxwell managed to reveal the secret of light and how it appears in waves.

Unfortunately, Maxwell died at age 48 of the same cancer that killed his mother at the very same age.

Kaku explains Maxwell's theory of light. Also discussed is the possible use of stealth technology and how it uses a hodge podge of tricks including deflecting and dispersing radar.

The development of metamaterials may be able to make things invisible. In 2006 a lab experiment was created using metamaterials. The result was that the item became invisible to microwave radiation. Kaku explains metamaterials as objects with optical properties not found in nature. By embedding tiny implants into the materials, electromagnetic waves are forced to bend in unorthodox ways. Kaku also discusses refraction and that being able to control refraction can render objects invisible.

There is one clear goal to use nanotechnology to create metamaterials that can bend visible light. Many tests have been conducted and look promising. It is necessary to use photolithography to etch onto wafer thin technology.

Plasmonics are able to squeeze light to be able to manipulate objects on a nanoscale.

Progress will continue to accelerate although scientists will need different types of beam splitter to make invisible cloaks. However, if a cloak could be invisible, all one would see would be the person's eyes.

The key to invisibility may be nanotechnology. Kaku examines the history of nanotech. Currently most nanotech "machines" are merely toys.

Holograms and Invisibility

"Another way to render a person partially invisible is to photography the scenery behind a person and then project that background image directly onto the person's clothes or onto a screen in front of him. As seen from the front, it appears as if the person has become transparent, that light has somehow passed right through the person's body" (Chapter 2, p. 31).

A hologram is a 3-D image created by lasers. However there are technical issues with this method.

Invisibility and the 4th Dimension

A more sophisticated way to achieve invisibility is by using the 4th dimension.

In Chapter 3, Kaku talks about the Death Star as a colossal weapon, the size of a moon. Kaku wonders if a Death Star weapon is actually possible. Could one vaporize a planet?

Kaku states that the concept of harnessing beams of energy is rooted in ancient myth. Zeus was famous for hurling lightning bolts at mortals while Thor's magic hammer could fire bolts of lightning. The Hindu god Indra could fire beams from a magic spear.

Everything changed with the arrival of quantum theory. Newton's laws and Maxwell's equations were successful yet were unable to explain the entire phenomena regarding the motion of planets and behavior of light.

Professor Charles Townes, along with his colleagues, produced the first coherent form of radiation in the form of microwaves. It was referred to as the "maser." Kaku explains how masers works and how lasers are currently used nearly everywhere including grocery stores and CD players.

New lasers are being discovered every day by using new materials can be used to lase. Kaku asks if any of the technology can be used to build a ray gun or saber. Can a laser energize a Death Star?

The common forms and lasers are listed and explained, including gas lasers, chemical lasers, Excimer lasers, solid-state lasers, semiconductor lasers, and dye lasers.

The reason we currently do not have ray guns to use on a battlefield is due to the lack of a portable power pack. Currently the smallest device that could power a ray gun is a miniature hydrogen bomb, which is far too dangerous to use.

Kaku states that it is possible to create a device similar to a light saber but it has the same problem - lack of a portable power pack.

The first method of harnessing fusion is known as inertial confinement. It uses powerful lasers to create a piece of the sun in a lab.

The second method that might be used to energize a Death Star is magnetic confinement, the process in which hydrogen gas is contained inside a magnetic field. He says, "There is one other possibility for simulating a Death Star laser cannon with today's known technology, and that is with hydrogen bomb" (Chapter 3, p. 47).

X-ray lasers have a great deal of scientific and military value.

In theory, it is possible to create a weapon that can destroy an entire planet. One method is to use a hydrogen bomb to create ample energy. There is no physical limit to the energy released by a hydrogen bomb. Kaku explains how hydrogen bombs work.

The second option for an advanced civilization is to use a gamma ray burster.

Gamma ray bursters were introduced in the 1970s when the Vela satellite was launched and programmed to detected "nukeflashes." Gamma ray bursters require an elaborate system of sensors to be detected.

Chapters 4-10

Chapters 4-10 Summary and Analysis

In Chapter 4, teleportation is the ability to transport a person or object from one place to another. Kaku asserts that this technology would change the course of civilization. It would alter the rules of modern warfare and cause transportation systems to become obsolete. The earliest mention of teleportation is in the bible as spirits take individuals away to the heavens or other locales.

The first time teleportation appeared in science fiction was in 1877 in Edward Page Mitchell's "The Man Without a Body." Unfortunately, the man who attempted to be teleported only succeeded in having his head transferred. Another use of teleportation in fiction was in the 1958 film "The Fly" in which a scientist attempts to teleport himself through a sort of pod. Unfortunately for the scientist, a fly gets trapped in the pod with him. The scientist and the fly merge into one very creepy entity.

Newtonian theory shows that teleportation is impossible. However, quantum theory shows that it is possible. Quantum theory states that particles can disappear and reappear. The theory was discovered by Werner Heisenberg, Erwin Schrodinger and their colleagues. Kaku discusses the history of the physicists and the far reaching effects of their theories and experiments.

Kaku states that while teleportation is possible at the atomic level, one would have to wait the lifetime of the universe to see the results.

The EPR Experiment was an experiment conducted by Albert Einstein, Boris Podolsky and Nathan Rosen. The purpose of the experiment was to kill off the concept of probability in physics.

"Bemoaning the undeniable experimental success of the quantum theory, Einstein wrote, 'the more success the quantum theory has, the sillier it looks'" (Chapter 4, p. 60).

Kaku describes quantum entanglement or the transference of information between electrons.

In 1993, Charles Bennett showed that it was possible to teleport objects using the EPR Experiment. This was accomplished not by teleporting the particle but teleporting the information contained within the particle. Although it is possible to teleport the information, it means that the atoms/particles become entangled.

In 2007, Aston Bradley from the Australian Research Centre of Excellence for Quantum Atoms showed that entanglement is not required. Kaku explains Bradley's theory. Bradley believes that these new experiments bring physicists one step closer to the fictional concept of teleportation. He says, "Ultimately, the states quantum teleportation is entirely linked to the fate of the development of quantum computers. Both use the

same quantum physics and the same technology, so there is intense cross-fertilization between these two fields. Quantum computers may one day replace the familiar digital computer sitting on our desks" (Chapter 4, p. 66).

Kaku states that quantum computers are in their infancy. In order to nobility is for quantum computer scientists require hundreds to millions of atoms vibrating in unison. Teleportation as portrayed in Star Trek would be astronomically difficult. Kaku states that while teleportation exists on an atomic level and scientists may eventually be able to teleport complex and perhaps even organic molecules teleportation on such a large scale may not take place for several decades or even centuries.

He says, "Historically, mind reading has been seen as so important that it has often been associated with the gods" (Chapter 5, p. 71).

Telepathy would allow a person to enter the mind of his rivals. Isaac Asimov, famed science fiction writer, often uses telepathy and similar gifts in his works.

Kaku states that thoughts are private and those people that believe in telepathy tend to be no more than gullible marks for charlatans and swindlers. He explains, "The first scientific studies of telepathy and other paranormal phenomenon were conducted by the Society for Psychical Research, founded in London in 1882" (Chapter 5, p. 73).

The term mental telepathy was introduces in that year by F.W. Myers. Kaku states that some of the past presidents of the Society for Psychical Research were some of the most notable men of the 19th century. The society still exists today. During the late 1800s the society was often split between scientists seeking more information and spiritualists who believed in the paranormal.

Paranormal activity changed dramatically at the height of the Cold War. Many clandestine experiments on my control telepathy and remote viewing were launched. Kaku explains remote viewing as being able to see a distant location through the mind by reading the minds of those present. The CIA sponsored several studies under the name Star Gate. It was believed that the Soviets might be using paranormal abilities including ESP in order to locate US military installations, identify spies, and to access secret documents. After a great deal of work and money the CIA concluded that Star gate had not yielded any information that assisted the agency in their intelligence operations.

During the same time scientists began to comprehend some of the physics at work inside the brain. In the late 19th century it was suspected that the brain transmitted a lecture called signals. In 1875 Richard Caton discovered that it was possible to detect a trickle signals by placing electrodes on the side of the head. Cajuns discovery eventually landed to the invention of the EEG (electroencephalograph).

Some people believe that these electrical signals could be used to read another's mind. The main problem with this concept was that the signals are extremely weak and are gibberish, indistinguishable from random noise.

Kaku discusses the humorous invention of the lie detector created by an Indian priest involving a magic donkey. Scientists believe that using an MRI machine it will be possible to decipher the thought of the living brain and be to tell if someone is lying.

It has been shown that sociopaths are often able to defeat lie detectors because they show no remorse for their actions. One such case involved CIA double agent Aldrich Ames. It means was paid huge sums of money by the Soviet Union when he sent US agents to their death by divulging secrets of the US nuclear Navy.

Lie detectors tend to measure anxiety levels. Kaku wonders how things would change if a lie detector was able to measure the brain itself. He says, "Some critics also claimed that a true ally detector, like a true telepath, could make ordinary social interactions quite uncomfortable, since a certain amount of lying is a social grace it helps to keep the wheels of society moving. Our reputation may be relevant, for example, if all the compliments we paid our bosses, superiors, spouses, a lovers, and colleagues were exposed as lies" (Chapter 5, p. 80).

Many people criticize brain scan because they are too crude to be able to measure isolated, individual thoughts. One psychologist compared brain scans to attempting to listen to the person sitting next to you at a loud and rowdy football game. The person's speech would be drowned out by the thousands of spectators.

Science fiction often employs a universal translator, a device that is able to read a person's thoughts and then transfer them to another's mind. John Haynes from the Max Planck Institute in Leipzig, Germany states that if such a device was to be built it would need to record information from a single neuron.

One of the stumbling blocks to creating practical telepathy is the enormous size of the fMRI machine. Scientists theorize that eventually it will be possible to create a handheld MRI machine that can take photos as easily as a digital camera.

Kaku asks if a futuristic MRI machine will be able to read individual thoughts, image for image, word for word as a true telepath. The answer is not clear. Many believe that this will not be possible as the brain is a neural net work, and entity that constantly rewires itself after learns a new task. Additionally thoughts in the brain are not centrally located in one area.

if a telepath will be able to read your Thoughts is it not also possible that you are able to project thoughts and to the telepath mind Kaku believes that this would be possible.

Some scientists support a neuron-mapping project, a project similar to the Human Genome Project which mapped out every gene in the human genome. Hypothetically a neuron-mapping project would be able to locate every neuron in the human brain and then create a 3-D map outlining every connection. Kaku states that this would be a monumental project considering that there are over 100 billion neurons in the brain.

Kaku discusses the movie "The Man Who Can Work Miracles" based on a short story by HG Wells. In the movie a man has given godly powers. The man begins by serving

humanity but eventually gives in to vanity and the lust for power. One of the gifts the man is given is psychokinesis which is the ability to move objects merely by thinking about them.

One of the most famous exhibitions of psychokinesis took place in 1973 on Johnny Carson's The Tonight Show. Uri Geller, an Israeli psychic, claimed that he was able to bend spoons simply by using his mind. Like Geller, Carson had started out in show business as a magician and was suspicious of Geller's claims. Carson consulted The Amazing Randi, another magician, before the show aired. Randi advised Carson to supply his own spoons for the exhibition. Carson took Randi's advice and as a result Geller was unable to perform the feat. He writes, "One problem with analyzing psychokinesis scientifically is that scientists are easily fooled by those claiming to have psychic power. Scientists are trained to believe what they see in the lab. Magicians claiming psychic powers, however, are trained to deceive others by fooling their visual senses. As a result, scientists have been poor observers of psychic phenomena" (Chapter 6, p. 91).

If psychokinesis does not conform to the forces of the universe how is it possible to harness it in the future. Once again Kaku refers to a Star Trek episode in which the crew of the Enterprise meets a race of beings similar to Greek gods. These beings are able to perform fantastic feats through psychokinesis. After a while the crew realizes that these beings are not gods but rather ordinary beings able to mentally control a central power station. Kaku states that it is within the laws of physics for a person in the future to be able to mentally manipulate a similar sensing device that would result in giving him godlike powers.

If a person is able to move objects is it also possible to transform them as if by magic? This is often accomplished by magicians through sleight-of-hand but is it possible to do so by using physics? Kaku states that through the use of nanotechnology and may be possible to use atoms to build tiny machines and possibly be able to rearrange molecules within an object until it transforms in two another object entirely.

In Chapter 7, Kaku asks if it is possible for robots to become so advanced that they eventually become a threat to our existence. Many scientists and critics say no, that it is impossible to create a machine that can think. He writes, "The idea of mechanical beings has long fascinated inventors, engineers, mathematicians, and dreamers" (Chapter 7, p. 104).

Kaku discusses the history of artificial intelligence from Greek mythology to present.

There are twin problems related to creating robots. They include pattern recognition and common sense. Although robots might be able to see better than human beings they do not understand what they see. In order to solve these problems scientists have used the top-down approach which will find a way to program rules of pattern recognition and common sense in to one entity.

There are many limitations to the Top-down Approach regarding artificial intelligence. In order to combat these problems scientists have attempted to create a bottom-up approach that will mimic evolution from childhood to adulthood.

Some scientists working on artificial intelligence are trying to break down a human's emotional system to create a different picture. They scientists often believe that emotions are a byproduct of evolution.

It is impossible to answer this question simply because there has never been an accurate or all-encompassing definition of the word consciousness.

The answer to this question is most likely yes. It is possible that robots could become dangerous once they reach the intelligence level of a monkey, an animal that is self-aware and is able to create its own agenda. He writes, "The idea of creating thinking machines that are at least as smart as animals and perhaps as smart or smarter than us could become a reality if we can overcome the collapse of Moore's Law and the common sense problem, perhaps even late in this century" (Chapter 7, p. 125).

He explains, "Hypothetical encounters with extraterrestrials, of course, have fascinated society and thrilled readers and movie audiences for generations" (Chapter 8, p. 127).

Kaku states that there are several general arguments involving the possibility of extra terrestrial life in the universe. It is believed that liquid water is a key factor in creating life in the universe. It is also surmised that carbon is a likely component in the creation of life. It is also believed that the fundamental basis of life is DNA. Without the use elements, scientists believe that the existence of life is impossible.

Kaku discusses The Search for Extraterrestrial Intelligence Project that began in 1959. The SETI project has found no indication that intelligent life exists elsewhere in the universe. Scientists continue to search for earth-like planets. However it is often difficult to find any extrasolar planets because they tend to be invisible to telescopes.

Although no one is quite sure what an extraterrestrial might look like, it is assumed that they would require some sort of the eyesight or sensing mechanism; a thumb, tentacle or claw; and the existence of a communication system.

It is possible to use the Scale Law to estimate the rough shape of aliens in space as it is used to calculate the shape of animals on earth.

There are three types of advanced civilizations. A type I civilization includes those that can harvest planetary power. A type to civilization is one that can utilize the power of the sun which gives them 10 billion times more power than a type I civilization. They type III civilization is one that will be able to utilize the power of an entire galaxy. He says, "Some people claim that extraterrestrials have already visited the earth in the form of UFOs. Scientists usually roll their eyes when they hear about UFOs and dismiss the possibility because the distances between stars are so vast" (Chapter 8, p. 147).

He writes, "The finer part of mankind will, in all likelihood, never perish - they will migrate from Sun designed as they go out. And so there is no end to life, to intellect and the perfection of humanity. Its progress is everlasting" (Chapter 9, p. 154).

Kaku discusses the possibility of starships and what it would take for them to exist and function properly. The areas addressed include Ions and Plasma Engines, Solar Sails, Ramjet Fusion, Nuclear Electrical Rocket, Nuclear Pulse Rocket, Specific Impulse and Engine Efficiency, Space Elevators, Slingshot Effect, Rail Guns to the Heavens, the Dangers of Space Travel, Suspended Animation, and Nano Ships.

The Dan Brown novel "Angels and Demons" discusses the plots of the illuminati to blow up the Vatican using an antimatter bomb. The theory behind an antimatter bomb inspection however antimatter is real. He explains, "An atomic bomb, for all its awesome power, is only about 1% efficient" (Chapter 10, p. 179-180).

Kaku discusses producing anti-atoms and anti-chemistry and creating anti-matter rocket. Also discussed is naturally occurring in antimatter.

Antimatter was discovered in 1928 by physicist Paul Dirac. Kaku discusses the discoveries of Dirac and Newton. As well as the possible existence of the anti-universe.

Part II: Chapters 11-13

Part II: Chapters 11-13 Summary and Analysis

In Chapter 11, Kaku states that traveling faster than the speed of light has often been a founding principle in science fiction but he also claims that it may be possible. Kaku discusses Einstein the Failure and his eventual turnaround and development of the Theory of Relativity. Also included are loopholes in Einstein's Theory.

Kaku compares the Alcubierre Drive to the propulsion system used in Star Trek. Alcubierre states that the ability of the enterprise to travel it works speed is one of the things that encouraged his research.

Wormholes and Black Holes are addressed as a possible way to break the light barrier. Kaku also discusses Planck Energy and Particle Accelerators.

He quotes Stephen Hawking, 'If time travel is possible, then where are the tourists from the future?' (Chapter 12, p. 216).

Time is considered to be one of the greatest mysteries of the universe. Circuit A.D. 400 St. Augustine thoroughly theorized the topic of time and its paradoxical nature. St. Augustine could not understand how the past and the future could simultaneously exist if the past no longer exists and the future has not yet occurred.

Kaku discusses the research of cosmologist Stephen Hawking. Talking believed that there ought to be a law that would make time travel impossible. Hocking proposed to be Chronology Protection Conjecture that would ban time travel in the laws of physics.

Kaku also discusses paradoxes and time conundrums. Kaku believes the time travel creates many problems including technical, social, legal, moral, and ethical.

Parallel universes are one of the favorite devices for Hollywood script writers. Kaku refers to an episode of Star Trek in which Capt. Kirk is transported to a parallel universe in which the Federation of planets is in fact an evil empire.

Kaku discusses the existence of hyperspace and string theory, his main area of expertise. Also discussed are quantum theory and quantum universes as well as the evolution of universes.

Part III: Chapters 14-15; Epilogue

Part III: Chapters 14-15; Epilogue Summary and Analysis

The world has long dreamed of creating a perpetual motion machine, one that can create an unlimited amount of energy. Kaku discusses the history as it is viewed through energy and the search for a perpetual motion machine including hoaxes and frauds that have been perpetuated by various people claiming to be scientists but were in fact charlatans.

Entropy is discussed including the work of Ludwig Boltzmann as it applies to Newtonian Theory.

If energy requires energy, is it possible to extract energy from nothing, or from a vacuum?

In Chapter 15, Kaku explores precognition. He writes, "Is there such a thing as precognition, or seeing the future? This ancient concept is present in every religion, going back to the oracles of the Greeks and Romans and to the prophets of the Old Testament. But in such tales, the gift of prophecy can always also be a curse" (Chapter 15 p. 272).

Kaku discusses noted figures in the world of prophets including Nostradamus and Edgar Cayce.

It brings about the question if we can see the future. While some experiments show that it is possible, it is generally related to very small objects or events.

There are only two things that fall into Class III impossibilities but one must wonder if other technologies also present the same problems. Kaku states that while some things are impossible in mathematics, it is dangerous to assume that there are impossibilities in physics. He explains, "It's not surprising that the debate has pitted physicist against physicist, because the goal is so lofty, if elusive. The quest to unify all laws of nature has tantalized and lured philosophers and physicists a link for millennia" (Epilogue, p. 294).

Kaku points out that there will always be things that are beyond our grasp and are impossible to explore yet the basic laws are knowable and finite.

Characters

Michio Kaku

Michio Kaku, PhD (1947-), author of "Physics of the Impossible: A Scientific Exploration into the World of Phasers, Force Fields, Teleportation, and Time Travel" is an American theoretical physicist known for co-founding the field of string field theory as well as writing the first papers on string field theory. Kaku has been published in many journals world wide, writing on various topics related to physics including supergravity, supersymmetry, superstring theory, and hadronic physics. Kaku currently works as the Henry Semat Professor of Theoretical Physics at the Graduate Center of the City University of New York. Kaku also hosts a weekly radio show, "Explorations," as well as "Science Fantastic," the only syndicated science broadcast in the U.S.

Kaku first showed his interest in physics when he created an atom smasher for a school science fair. Kaku went on to the National Science Fair where he gained the attention of noted physicist Edward Teller. Kaku was awarded the Hertz Engineering Scholarship. Kaku attended Harvard University where he graduated summa cum laude in 1968. Kaku received his PhD from the Berkeley Radiation Laboratory at the University of California.

Kaku has published many books on various science-related topics including: Hyperspace (1994), Beyond Einstein (co-authored with Jennifer Thompson) (1995), Visions: How Science Will Revolutionize the 21st Century (1998), Einstein's Cosmos (2004), Parallel Worlds (2004), Physics of the Impossible (2008), and Physics of the Future (2011). Hyperspace was a best seller and was referred to as one of the best science books of the year by the New York Times and Washington Post.

Kaku is also known for his devotion to various social concerns including global warming and nuclear disarmament.

Michael Faraday

Michael Faraday was a 19th century British scientist that became interested in electricity and magnetism. Faraday went to work for Professor Humphrey Davy and managed to conduct many experiments in his field. In fact, Faraday was so successful that Davy became jealous. After Davy died, Faraday continued with his experiments and had some stunning breakthroughs including a series of generators. The key to Faraday's success was the force field. Faraday proved that force fields are real.

Faraday was very unusual in several ways. Growing up in poverty, Faraday did not have the privilege of being properly schooled in mathematics. He was more or less mathematically illiterate. As a result of this lack of education, Faraday was forced to present his ideas through a series of diagrams rather than through mathematical equations. Faraday's inadequacy changed the face of modern physics. All of modern physics uses Faraday's "language" to express ideas and theories. Even Einstein, who

was fascinated with Faraday, used this system and wrote his theory of gravity in this manner.

Albert Einstein

Albert Einstein was a famous 20th century scientist best known for his Theory of Relativity.

Isaac Asimov

Isaac Asimov was a well known science fiction writer that addressed many areas of physics.

James Clerk Maxwell

James Clerk Maxwell was a Scottish physicist with a firm understanding of optics.

Roger Penrose

Roger Penrose is one of the physicists that believed machines are incapable of human thought.

Edwin Schrodinger

Edwin Schrodinger is the physicist that introduced the cat paradox.

Arthur C. Clarke

Arthur C. Clarke was a science fiction writer and inventor.

Isaac Newton

This is the scientist that introduced the concept of gravity.

Carl Sagan

Carl Sagen was an astronomer, author, and astrophysicist.

Objects/Places

Force Fields

Kaku begins the book with a chapter on force fields. Kaku refers to the force fields and concepts used by the television show Star Trek. Captain Kirk yells for "shields up" when the Starship Enterprise faces a threat by an outside force. The Enterprise relies upon their force fields to protect the Enterprise. Without force fields, the Enterprise would sustain damage and possible ruin.

Kaku describes force fields as being a thin, invisible and impenetrable barrier that can withstand attack from outside forces. It would seem that the advances in science would lead the way to creating these invisible barriers that could protect objects such as the Enterprise or guard cities against terrorist attacks. However, the truth is much more complex.

Kaku carries the topic of force fields throughout the first section. Kaku discusses how force fields defy gravity. Sadly, that means that the hover boards used in "Back to the Future" are still an impossibility. However, if magnetics could be enhanced then hover boards and cars could become a reality. Kaku discusses how magnets work. When north poles are facing each other, then the magnets will repel each other. If a north pole faces a south pole, the magnets are attracted to each other.

Physics

Michio Kaku, PhD (1947-), author of "Physics of the Impossible: A Scientific Exploration into the World of Phasers, Force Fields, Teleportation, and Time Travel" is an American theoretical physicist known for co-founding the field of string field theory as well as writing the first papers on string field theory. Kaku has been published in many journals world wide, writing on various topics related to physics including supergravity, supersymmetry, superstring theory, and hadronic physics. Kaku currently works as the Henry Semat Professor of Theoretical Physics at the Graduate Center of the City University of New York. Kaku also hosts a weekly radio show, "Explorations," as well as "Science Fantastic," the only syndicated science broadcast in the U.S.

Physics is simply the science of studying matter and how it exists and moves through space and time. Kaku presents physics in a number of ways so that the layperson may understand the importance of physics and how it relates to every day life. Kaku makes many references to physics by using pop culture references, particularly to books and movies such as Star Trek, Back to the Future, Flash Gordon, The Fly, The Invisible Man, and more. Kaku uses these examples to prove or disprove the possibility of certain items such as invisibility, force fields, and teleportation.

The advances in physics since Newton's day have created many things which, at one time, seemed impossible. Kaku states that physics is still not a complete science and that there are surely many more discoveries to be found.

Invisibility

Invisibility is one of the topics often referenced through books and movies. Kaku shows that it is currently impossible.

Teleportation

This science is currently impossible as it defies Newton's law.

Plasma Windows

These are items that can be created and perhaps used as force fields.

Metamaterial

This is an exotic new development that may permit things to be rendered invisible.

Nanotechnology

This is the study and creation of items on a molecular scale.

Quantum Mechanics

This is an area of science that describes nature apart from common sense.

Schrodinger's Cat

This is a paradox in which a cat in a box can be alive or dead at the same time due to an unknown series of events.

String Theory

This was discovered in 1968 by Gabriel Veneziano and Mahiko Suzuki.

Themes

Force Fields

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Physics of the Impossible

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Impossibilities

The entire premise of "Physics of the Impossible: A Scientific Exploration into the World of Phasers, Force Fields, Teleportation, and Time Travel" by Michio Kaku is the study of physics and the impossibilities that arise through the lack of advancements or sheer impossibility of certain tasks and developments in the area of physics. Kaku explains physics in its most basic sense: Physics is simply the science of studying matter and how it exists and moves through space and time. Kaku presents physics in a number of ways so that the layperson may understand the importance of physics and how it relates to every day life. Kaku makes many references to physics by using pop culture references, particularly to books and movies such as Star Trek, Back to the Future, Flash Gordon, The Fly, The Invisible Man and more. Kaku uses these examples to prove or disprove the possibility of certain items such as invisibility, force fields, and teleportation.

Kaku breaks down various impossibilities and explains why they are impossible - at least currently - because they defy one or more areas of physics. The book is broken into four sections of these impossibilities:

Part I: Class I Impossibilities

This section covers the following topics: Force Fields, Invisibility, Phasers and Death Stars, Teleportation, Telepathy, Psychokinesis, Robots, Extraterrestrials and UFOs, Starships, Antimatter and Anti-Universes

Part II: Class II Impossibilities

This section covers the following topics: Faster Than Light, Time Travel, Parallel Universes

Part III: Class III Impossibilities

This section covers the following topics: Perpetual Motion Machines, Precognition

The Epilogue addresses the Future of the Impossible

Style

Perspective

The perspective used in "Physics of the Impossible: A Scientific Exploration into the World of Phasers, Force Fields, Teleportation, and Time Travel" is that of Michio Kaku, an American theoretical physicist known for co-founding the field of string field theory and writing the first papers on string field theory. Kaku has been published in many journals worldwide, writing on various topics related to physics including supergravity, supersymmetry, superstring theory, and hadronic physics. Kaku currently works as the Henry Semat Professor of Theoretical Physics at the Graduate Center of the City University of New York. Kaku also hosts a weekly radio show, "Explorations," as well as "Science Fantastic," the only syndicated science broadcast in the U.S.

Kaku first showed his interest in physics when he created an atom smasher for a school science fair. Kaku went on to the National Science Fair where he gained the attention of noted physicist Edward Teller. Kaku was awarded the Hertz Engineering Scholarship. Kaku attended Harvard University where he graduated summa cum laude in 1968. Kaku received his PhD from the Berkeley Radiation Laboratory at the University of California.

Kaku has published many books on various science-related topics including: Hyperspace (1994), Beyond Einstein (co-authored with Jennifer Thompson) (1995), Visions: How Science Will Revolutionize the 21st Century (1998), Einstein's Cosmos (2004), Parallel Worlds (2004), Physics of the Impossible (2008), and Physics of the Future (2011). Hyperspace was a best seller and was referred to as one of the best science books of the year by the New York Times and Washington Post.

Kaku is also known for his devotion to various social concerns including global warming and nuclear disarmament.

Tone

Michio Kaku is the author of "Physics of the Impossible: A Scientific Exploration into the World of Phasers, Force Fields, Teleportation, and Time Travel." This is a work of non-fiction. The tone of the book is typically non-partisan. This is a particularly difficult tone to achieve when the author is telling personal anecdotes about his youth and his discovery of the world of physics.

Kaku offers many objective views and facts about physics in its various forms and also details much of the history and research related to uncovering the exploration of physics including impossibilities and possibilities of physics that have not yet been discovered.

While Kaku was consumed with learning about the physics, he also relates that there is a personal side to it and details how it may affect various people, including the scientists and researchers invested in applying specific theories and looking toward the future.

Kaku explores elements of physics that may be considered to be fringe science by some and outright absurdities by others. These include extraterrestrials, UFOs, teleportation and time travel. Kaku uses many references from books and movies to show how practical these things may be and how they may not necessarily be impossible or implausible from a physics point of view.

Structure

"Physics of the Impossible: A Scientific Exploration into the World of Phasers, Force Fields, Teleportation, and Time Travel" by Michio Kaku is a work of non-fiction. Kaku has published many books on various science-related topics including: Hyperspace (1994), Beyond Einstein (co-authored with Jennifer Thompson) (1995), Visions: How Science Will Revolutionize the 21st Century (1998), Einstein's Cosmos (2004), Parallel Worlds (2004), Physics of the Impossible (2008), and Physics of the Future (2011).

The work is 296 pages in length. It contains a preface, acknowledgments, 3 parts, an epilogue, notes, bibliography, and an index. The shortest part is 13 pages in length; the longest part is 19 pages in length. The average length of the parts is 19 pages.

Each chapter is separated into sections with subheadings and covers the following topics: Force Fields, Invisibility, Phasers and Death Stars, Teleportation, Telepathy, Psychokinesis, Robots, Extraterrestrials and UFOs, Starships, and Antimatter and Anti-Universes.

Part II: Class II Impossibilities covers the following topics: Faster Than Light, Time Travel, and Parallel Universes.

Part III: Class III Impossibilities covers the following topics: Perpetual Motion Machines, and Precognition.

The Epilogue addresses the Future of the Impossible.

Quotes

"So what is a force field? In science fiction it's deceptively simple: a thin, invisible yet impenetrable barrier able to deflect lasers and rockets alike. At first glance a force field looks so easy that it's creation as a battlefield shield seems imminent. One expects that any day some enterprising inventor will announce the discovery of a defensive force field. But the truth is far more complicated" (Chapter 1, p. 3).

"With breakthroughs occurring in this field every few months, it's not surprising that some physicists see some sort of practical invisibility shield emerging out of the laboratory perhaps within a few decades" (Chapter 2, p. 27).

"There is one other possibility for simulating a Death Star laser cannon with today's known technology, and that is with hydrogen bomb" (Chapter 3, p. 47).

"The first scientific studies of telepathy and other paranormal phenomenon were conducted by the Society for Psychical Research, founded in London in 1882" (Chapter 5, p. 73).

"One problem with analyzing psychokinesis scientifically is that scientists are easily fooled by those claiming to have psychic power. Scientists are trained to believe what they see in the lab. Magicians claiming psychic powers, however, are trained to deceive others by fooling their visual senses. As a result, scientists have been poor observers of psychic phenomena" (Chapter 6, p. 91).

"The idea of mechanical beings has long fascinated inventors, engineers, mathematicians, and dreamers" (Chapter 7, p. 104).

"Hypothetical encounters with extraterrestrials, of course, have fascinated society and thrilled readers and movie audiences for generations" (Chapter 8, p. 127).

"Some people claim that extraterrestrials have already visited the earth in the form of UFOs. Scientists usually roll their eyes when they hear about UFOs and dismiss the possibility because the distances between stars are so vast" (Chapter 8, p. 147).

"An atomic bomb, for all its awesome power, is only about 1% efficient" (Chapter 10, p. 179-180).

"In 1902 it was far from obvious that the young physicist Albert Einstein would be hailed as the greatest physicist since Isaac Newton" (Chapter 11, p. 198).

"Is there such a thing as precognition, or seeing the future? This ancient concept is present in every religion, going back to the oracles of the Greeks and Romans and to

the prophets of the Old Testament. But in such tales, the gift of prophecy can always also be a curse" (Chapter 15 p. 272).

"It's not surprising that the debate has pitted physicist against physicist, because the goal is so lofty, if elusive. The quest to unify all laws of nature has tantalized and lured philosophers and physicists alike for millennia" (Epilogue, p. 294).

Topics for Discussion

Do you think Kaku's opinions and observations on physics of the impossible matches that of an average physicist? Explain.

What is Kaku's opinion on the topic of parallel universes?

Why do you think Kaku makes so many references to books and movies, particularly Star Trek?

How did Faraday lay the groundwork for future physicists?

What technique did Einstein adopt from Michael Faraday?

Do you think it will ever be possible to develop an effective force field? What is Kaku's opinion?

What is Kaku's opinion on extraterrestrials? Do you agree or disagree?