Q In your book, you describe an all-encompassing "theory of everything" as the holy grail of physics. Why is a theory like that so important?

MK: When Newton worked out the laws of gravity and mechanics, that set into motion what eventually became the Industrial Revolution, which lifted humanity out of agrarian misery and poverty. When Maxwell and Faraday worked out the laws of electricity and magnetism, that set into motion the Electric Revolution, which gave us electricity, radio, TV, dynamos, and generators. When Heisenberg and Schrödinger worked out the laws of the quantum and the atom, that gave us lasers, transistors, computers and the internet. So, every time physicists explain a force of nature, it alters the destiny of the human race and the world economy.

And now, we are on the verge of a theory of everything, which can unite all the forces of the universe via an equation perhaps no more than an inch long. Eventually, this may once again alter the destiny of humanity. It may also answer the deepest questions about the universe, such as: Can we break the light barrier and reach the stars? What happened before the Big Bang? Are there other universes and dimensions? Is time travel possible? Are wormholes possible?

Q The quest for this theory captivated some of history's most famous scientists. What was it about a theory of everything that first ignited your imagination?

MK: When I was 8 years old, something happened which changed my life. All the newspapers said that a great scientist had just died. But they printed a picture of his desk, with an open book. Over the years, I discovered that this man's name was Albert Einstein, and that this book was the unfinished unified field theory, which could unify all the laws of nature into a single equation. I had to know what was in that book, and why he could not finish it. This became the focus of my life.

> "All the subatomic particles of nature are like musical notes on a tiny vibrating string."

Today, the leading (and only) candidate for this theory of everything is called string theory. I have had the privilege of working on this theory since 1968. My contribution was — along with Professor Keiji Kikkawa — to create string field theory, which can summarize string theory in an equation about 1 inch long. However, it is not the final theory, since now we know that membranes can also exist along with string.

Q How would you describe string theory?

MK: To understand string theory, imagine a rubber band, which represents a tiny, tiny electron. If you stretch the rubber band, it vibrates at a precise frequency. If you twang the band, it vibrates at a different frequency — call it a neutrino. If you twang it again, it becomes a different frequency; call it a quark. In fact, there are an unlimited number of frequencies that the band can vibrate, corresponding to an infinite number of possible subatomic particles.

So all the subatomic particles of nature are like musical notes on a tiny vibrating string. The kernel of this idea was proposed over 2,000 years ago by the great mathematician Pythagoras. He realized that a lyre string can vibrate with an infinite number of musical notes, each one corresponding to a resonance or frequency. He then proposed that the vast diversity of matter that we see around us is nothing but the harmonies found on strings. Only music, he thought, was rich enough to make sense of the vast complexity of the universe.

Q Your book *Physics of the Impossible* explores the plausibility of different sci-fi conceits, like force fields, hyperspace and time travel. Now you're teaching a course about the physics of science fiction. Why are you drawn to these concepts?

MK: When I was 8 years old, on Saturday morning, I used to watch the old *Flash Gordon* series. Ray guns. Cities in the sky. Invisibility rays. Cities under the oceans. I was hooked. Years later, I realized that my two loves, Einstein's unified field theory and science fiction, were related. In order to understand whether science fiction is possible, plausible, or impossible, you need physics. I used to go to sci-fi movies and count the number of laws of physics that are violated.

Q Do you have a personal favorite sci-fi technology or concept?

MK: My favorite science fiction novels are the *Foundation* series by Asimov, because they force you to imagine a galactic civilization 50,000 years into the future, when new laws of physics open up. Things that we consider impossible (like breaking the light barrier) might become possible. All bets are off. — ALEX ORLANDO

This interview has been edited and condensed for clarity.

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