Chance is Everything

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Published in the Weekend Section of The Advertiser newspaper

(June 24, 2000, pages 1, 3, 4)

Adelaide, Australia

MASTER of the UNIVERSE

Adelaide physicist's revolutionary theory of life and the universe
(Page 1 caption)

Flinders University theoretical physicist Reg Cahill has turned the scientific world on its ear by claiming he has found science's Holy Grail - the fabled Theory of Everything.
(Page 4 caption)

'Physics has never succeeded in linking space, time and quantum physics - process physics does so automatically'
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RELATIVITY

Albert Einstein's special theory of relativity (1905) and the general theory of relativity (1915) deal with the most fundamental ideas we use to describe natural phenomena such as time, space, mass, motion and gravity. One of the most widely known aspects of relativity is Einstein's formula $E = mc^2$, where energy equals mass times the speed of light squared. Other implications of his theories include the space-time continuum, where the universe is thought of in terms of both space and time. Einstein also found that the presence of mass or concentrated energy led to a distortion or curvature of the space-time continuum. He also predicted the stretching of light waves as the universe grows in time.

QUANTUM PHYSICS

Quantum physics describes the structure of the atom and the motion of atomic particles. Considered one of the major scientific achievements of the 20th century, quantum physics deals with the interactions of matter and radiation

in terms of observable quantities. It stems from the concept that all forms of energy are discrete units or bundles called quanta. As well as being important in theoretical terms describing the fundamental building blocks such as atoms, electrons, protons and neutrons, as well as their building blocks, quantum physics has led to the development of devices such as lasers and transistors, and helped understand chemical bonds and chemical reactions.

PROCESS PHYSICS

Associate Professor Reg Cahill's theory of process physics rejects the geometric basis of both relativity and quantum theory which imply the universe is made up smaller and smaller objects or building blocks. Professor Cahill asserts some aspects of the universe are "fundamentally unknowable" and uses randomness in the equations to represent the universe at its most fundamental levels. Structures or "scaffolding" are then built into the equations from which observable aspects of the universe emerge. Professor Cahill says that as well theoretical implications, process physics has implications for better understanding biology and building better computers,

The father of relativity, Albert Einstein, believed in order. Everything was inextricably linked and predictable - God, he said, did not throw dice.

But Einstein, who died in 1955, aged 75, and is remembered as perhaps our greatest scientist, did not have all the answers.

That upstart theory quantum mechanics, for example, which Einstein never liked because it invoked randomness, was able to explain the very make-up of matter on its smallest scale. When physicists began looking deeper into matter, quantum physics fitted the subatomic world like a glove.

For decades, physicists have tried to reconcile the two physics of relativity and quantum mechanics into one so-called grand unified theory, or GUT, and have failed.

But why not take it a step further? Why not have a theory that explains absolutely everything? A theory of everything. A TOE.: why we are here, where the universe came from, what time is, and what space is.

Such a theory should also explain what life is, what consciousness is, and perhaps even if there is a God.

Someone once quipped that the ultimate goal was to have a simple equation, small enough to fit on a T-shirt, that answered all our questions. A noble but probably unattainable goal.

Now Flinders University theoretical physicist Associate Professor Reg Cahill thinks he has moved a step closer to the TOE. Professor Cahill's theory of process physics, which has been reported in some of the world's leading scientific publications in recent months, may answer some of the most fundamental and hardest questions in science.

Professor Cahill has been working on the theory for the past 10 years to overcome shortcomings he believes are found in the mainstays of physics - Albert Einstein's theory of relativity and quantum physics.

He has broken with doctrine and believes reality and all its order is born from randomness - contradicting Einstein's famous statement about God and dice.

"Physics from the very beginning has been based on a certain mindset," Professor Cahill says. "It has been based on the notion of objects and the laws of physics that they obey, and in doing so has been very successful in explaining many things. But lots of issues can't be explained, such as why there is space, why there is time.

"We (physicists) build up models of things but really we don't understand why it is this way. Now we've come up with a whole new way of looking at reality."

Professor Cahill, who is working on the theory with doctoral students Christopher Klinger and Kirsty Kitto, says a key to the theory is realising that logic has limitations and is not applicable at reality's deepest levels. Logic emerged in the times of the Ancient Greeks as the language of reality.

Physicists still think of reality in terms of objects. They believe the universe is made up of smaller and smaller building blocks. But Professor Cahill says that at its deepest level, reality is not object-based.

He says the new theory sees logic only emerging as an appropriate language at higher levels.

Physicists, he says, are persistently looking at reality in object and geometric terms, which fails to explain the universe at the most fundamental levels.

"The problem is how to develop a theory that doesn't use assumed objects and their rules," he says.

Professor Cahill says the theory overcomes this problem by introducing "randomness' at the lowest level to incorporate the notion that at the deepest level there is an absence of laws. Deep reality, he says, is fundamentally "unknowable" and his theory manages to cope with this notion. He has introduced the randomness into some simple equations expressing the notion that reality is not object-based.

He has found that the maths describes something very much like a self-organising universe with emergent laws.

"The laws of physics are not able to explain many issues," Professor Cahill says.

"So we came up with a whole new way of thinking about reality."

"What we're saying is that this will require a complete review of how we do physics, not just a minor fix-up."

"The direction which physics is going is intrinsically flawed: its enormous success has overridden this fact."

"We're the first people to exploit the limits of logic within physics ' that's why we're starting to see some explanations for the nature of time."

Professor Cahill says a key to the theory is in figuring out how to use logic beyond its limits, because so much is unknowable.

"We have to invent fictitious objects to kick the whole process off," he says.

"We have a set of pseudo-objects to set up the scaffolding."

"Now we're staring to see a whole lot of things happen."

Professor Cahill says the theory is already going beyond high-level physics and beginning to explain the origin of life., because "the whole of reality starts to look biological in nature."

"It involves randomness and competition," he says. "It looks self-organising and self-replicating." The stability of familiar objects such as electrons, he says, also arise from that self-replication.

Professor Cahill says the theory is still in its early stages of development, but has already caused a stir.

"There's been a bit of backlash," he says. "Many physicists don't understand the questions we're asking. They have become too accustomed to a mindset. Physics has never succeeded in linking the nature of space, time and quantum physics - process physics does so automatically."

University of Adelaide mathematical physicist Dr Peter Szekeres, who has looked at Professor Cahill's theory at some length, agrees many people in the field are too quick to dismiss process physics.

He says Professor Cahill's work has some merit, although it is still early days.

"It's not a conservative theory and there is a tendency to write it off," he says.

"But I have an open mind. Reg is doing some interesting things. I think he is coming up with some interesting structures."

Dr Szekeres says many physicists have closed minds that do not accept new ideas readily. He says Professor Cahill has "played around a bit" with conventional physics.

He doubts if the theory will be able to come up with numbers that will be provable experimentally in ways that both relativity and quantum physics have proven themselves time and again.

Theoretically, he says, process physics offers some insight to some of the questions now being asked.

"I think it is a bit of a theoretical sidetrack," he says. "But it's worth some people playing around with it."

"He's really breaking up the whole idea of space and time. I think it's still a long way from getting the results you get from real physics."

Despite the backlash, Professor Cahill insists the theory makes physics more understandable. It restores a sense of simplicity, he says.

"Outside physics, there has been a lot of interest," he says.

"This is a theory of everything, but it's not a set of equations you can write down."

"You can't fit it on a T-shirt."

"But its taken away the gloom I've always felt about the mechanistic mindset of physics. We're looking at a whole new future in physics."

"The universe has a vitality we physicists have never been able to comprehend."