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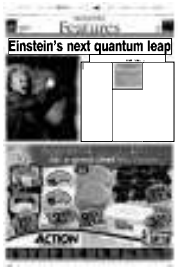

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Page 1 of 2

Einstein's next quantum leap

A century on, Albert Einstein's revolutionary ideas continue to change the world.

Technology writer **Jennifer Dudley** reports

IMAGINE a world without mobile telephones, without iPods or lasers, DVDs, digital cameras or even supermarket scanners – a world in which planes could regularly land kilometres off course.

This is a world that could exist were it not for one "miracle year" in the life of physicist Albert Einstein.

In 1905, as a 26-year-old patent clerk, Einstein developed four revolutionary ideas that would change the world for the next century and beyond.

Today is the 100th anniversary of his first world-changing theory, which earned him a Nobel Prize and paved the way for a year-long series of innovations that formed the basis of quantum mechanics and the way humans see the world.

It could also prove the basis for the next quantum leap in technology, allowing physicists to create computers and electronic devices still beyond our imagination, and could yet be used to unlock more of the universe's secrets.

Einstein was working in a Swiss patent office – a job he found interesting but not demanding – when he first began to unleash his ideas of physical science upon the world.

First, he developed ideas about light particles. For a century light had been thought to travel in waves but Einstein argued that light also bounced off physical objects such as particles – bundles of energy he called "light quanta".

He detailed his findings in a paper for a scientific journal, and his idea was found to be so revolutionary it earned him the Nobel Prize for Physics in 1921.

University of Queensland School of Physical Sciences senior lecturer Andrew White says Einstein's theory on light still underpins much of the technology used in modern society.

"In fact, it's the basis of the laser and pretty much everything related to it," he says. "It's the basis of all modern technology like mobile phones and scanners in the supermarkets – they run due to quantum effects. This theory is the basis of quantum mechanics and was the first to deal with light and matter."

It could also be the key to developing the next generation of computers, as Dr White says modern computing is almost in need of an overhaul.

"We're hitting a dead end with current technology – there's a limit to what we can do with the current paradigm and we're about to enter the second quantum technological revolution," he says.

"The parts are getting so small ... but instead of thinking (this dead end) is a bad thing, we have to turn it around and do things we couldn't otherwise do. We have to throw out all of our normal ideas about how we encode information."

But White says Einstein's theory on light will not be thrown away in this revolution, which will occur within the next "20 to 30 years" and see the development of computers and devices as yet unthought of.

While Einstein's quantum theory revolutionised science, he was to make another three important discoveries in 1905 and in what White describes as "a hell of a year".

Einstein published his next revolutionary theory just one month after his first. Based on the previous discoveries of Scottish botanist Robert Brown, Einstein developed the theory of Brownian motion and showed how the movements of tiny molecules suspended in liquid proved that atoms existed – an often questioned idea at the time.

Australian scientist William Sutherland also developed the same ideas independently and published them shortly before Einstein but is rarely credited for the discovery.

The theory of Brownian motion had vast implications for industrial applications, including mixing chemicals, and became his most widely used theory.

Two months later, in June 1905, Einstein expounded on ideas from Galileo, Isaac Newton and James Clerk Maxwell and released his theory of special relativity.

It dealt with the laws of physics and movement and how, for instance, a person on a moving train could act as if they were not moving.

More importantly, it formed the basis for Einstein's groundbreaking theory of general relativity in 1915.

His final revolutionary idea of 1905 was also his most well known. Einstein developed physics's most famous formula, $e=mc^2$ – a formula still used by modern physicists to convert matter into energy.

In recognition of these four major scientific discoveries, the United Nations named 2005 the International Year of Physics – also known as the Einstein Year.

Australian Einstein Year convenor and Australian Institute of Physics vice-president Professor David Jamieson says the recognition was well earned, as Einstein's theories are commonly used and will be used to unlock further scientific discoveries.

"Every time your pilot lands an aeroplane in the fog that depends on the Global Positioning System and Einstein's theory of relativity," he says. "The errors would be kilometres out if you just used Newton's figures. We also use his theories to understand how the sun works, converting mass into energy, and anything to do with electronic photography, including digital cameras. Even under-

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standing how magnets work."

Jamieson says Einstein's theories from 1905 were simple and yet difficult to understand as they were so "counter-intuitive that it's very hard to understand why nature works in that way".

But he says the theories have not outlived their usefulness and could help physicists unlock problems that have remained unsolved.

For instance, he says, there are still many unknowns in space, including concepts based around dark matter and dark energy.

"We know (the universe) we see around us but that is only about 5 per cent and the other 95 per cent is unknown," he says.

"Perhaps now, 100 years after Einstein, there's some 26-year-old person out there that will put together a revolutionary idea to explain it all."

EINSTEIN'S REVOLUTIONARY IDEAS OF 1905

March 17: Releases his quantum theory, stating that light is made of both particles and waves.

April 30 & December 19: Publishes papers on Brownian motion, which has implications for industry.

June 30: Publication of Einstein's Theory of Special Relativity called "On the electrodynamics of moving bodies".

September 27: Publishes a paper including his most famous physics formula, $e=mc^2$.