How quantum physics democratised music

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Surprising connections between very different areas of physics and unexpected spin-offs from theory were explored by quantum physicist Prof. Sir Michael Berry in a lecture entitled "How quantum physics democratised music" held by the IOP on 4 March.

Lasers, the invention of photography and ancient magic mirrors were all part of the mix in a lecture that ended with some rhythmic sounds generated by Riemann's zeta function applied to prime numbers.

Prof. Berry told the audience at the Institute in London: "Physics leads to technology, often after long times and in unexpected ways, but we do it not only to apply it but to understand. New technology leads to new physics."

Describing how Einstein's work on stimulated emission of radiation led to the invention of the laser in 1958, and eventually to compact disc players, he said: "It was unimaginable by Einstein in 1917 that his idea would lead to production of the brightest, purest light, and that 25 years later engineers would use it in a machine to make music."

CD players had democratised music because they could be used anywhere. Their successors –such as MP3 players and iPods – also used technology based on quantum physics, and the devices used to manufacture and advertise them relied on quantum physics too, he said. A huge range of devices, from computers to MRI scanners, depended on understanding quantum theory, and their use in research had stimulated further discoveries and opened up new areas of science.

Henry Fox Talbot, who invented photography, had democratised access to photographic images when he invented the photographic negative in 1935, enabling images to be distributed widely. This went a step further with the advent of the digital camera in the 1990s, giving individuals complete control over their own photos, he said. Digital cameras employ a charge coupling device to capture light, using a quantum process.

Prof. Berry described how "magic mirrors", which existed 2000 years ago, can reveal the relief pattern on their reverse side, in a phenomenon that was not understood until the 19th century. Exploring this phenomenon with the use of the advanced technology in digital cameras, he had been able to measure relief patterns a few hundred nanometres high.

"Previously, to have done this research I would have needed image capture equipment costing tens of thousands of pounds, but now I can do it using an ordinary digital camera and software," he said. One way in which the research could be used would be to assess the flatness of surfaces in semiconductors.

Computer simulations had enabled physicists to visualise the spreading and reconcentration of wave packets within an atom – an example of a device that relies on the application of quantum physics being then used to understand quantum physics, he said. "We theoretical physicists are never more delighted than when we find something in one area of physics that can help us to understand a completely different area of physics."

Asked how scientists could ensure that they make these connections, he said: "You have to have your eyes and ears all over the place and often you miss them."

Provided by Institute of Physics

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