Heriot-Watt scientists use hair thin optical fibre for computing

Scientists at Heriot-Watt have discovered a new method of programming optical circuits which could be critical for avoiding hacking of communications networks and ultrafast quantum computers.

Experimental physicist and Professor of Physics at Edinburgh's Heriot-Watt University, Professor Mehul Malik said: "Light can carry a lot of information, and optical circuits that compute with light – instead of electricity – are seen as the next big leap in computing technology. But as optical circuits get bigger and more complex, they're harder to control and make – and this can affect their performance. Our research shows an alternative – and more versatile – way of engineering optical circuits, using a process that occurs naturally in nature.

The team which Professor Malik led used commercial optical fibres which are already in common use in homes and businesses and has reported on their research today in the scientific journal Nature Physics. The fibres are thinner than a human hair and use light to carry data. By using the natural scattering behaviour of light inside an optical fibre, the scientists found they could precisely programme optical circuits inside.

Professor Malik explained: "When light enters an optical

fibre, it gets scattered and mixed in complex ways. By learning this complex process and precisely shaping the light that enters the optical fibre, we've found a way to carefully engineer a circuit for light inside this disorder.

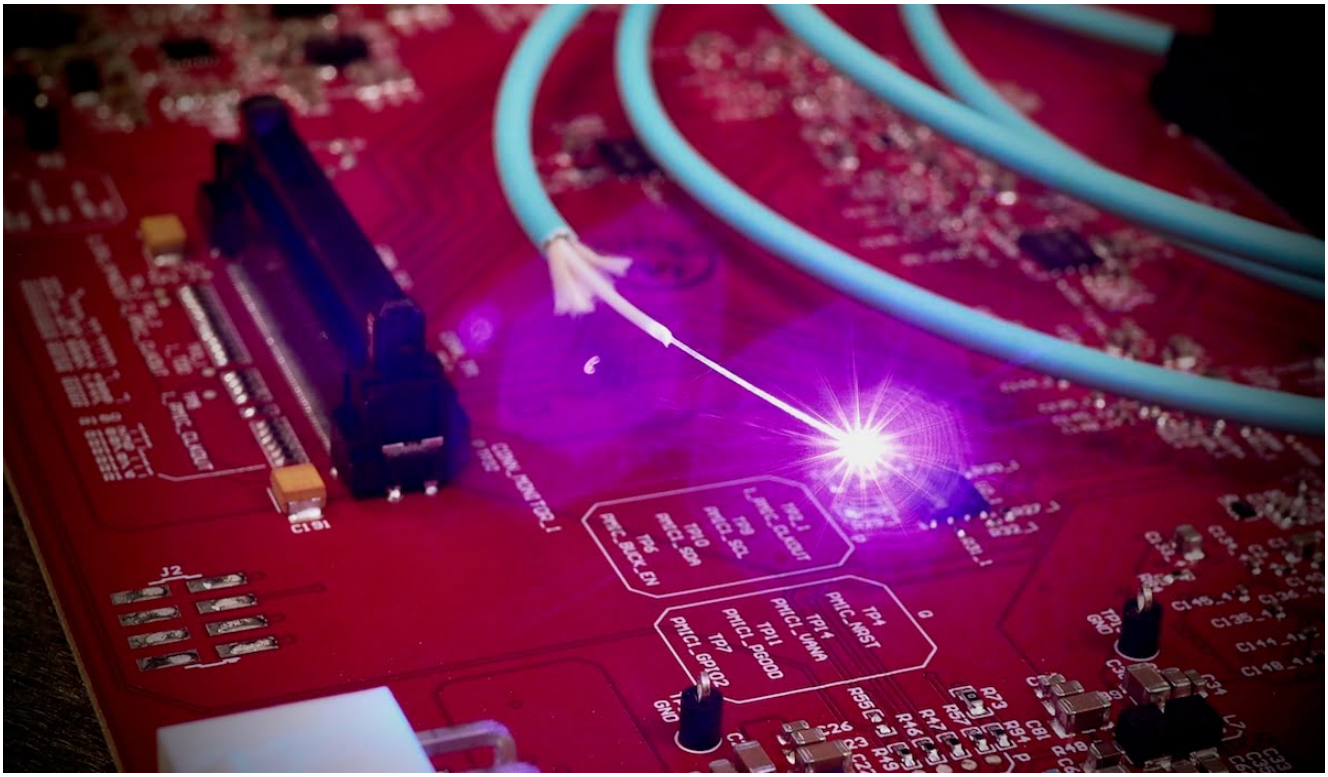
"Optical circuits are needed at the end of quantum communications networks, for example, so the information can be measured after it's travelled long distances. They are also a key part of a quantum computer, where they are used for performing complex calculations with particles of light."

It is quantum computers which could be used to unlock advances in areas such as drug development, climate prediction and space exploration and optical circuits are also used in the area of artificial intelligence to process volumes of data quickly. Professor Malik said that the power of light was in its multiple dimensions. He said: ""We can encode a lot of information on a single particle of light. On its spatial structure, on its temporal structure, on its colour. And if you can compute with all of those properties at once, that unlocks a massive amount of processing power."

Professor Malik and his research team in the Beyond Binary Quantum Information Lab at Heriot-Watt University conducted the research with partner academics from institutions including Lund University in Sweden, Sapienza University of Rome in Italy and the University of Twente in The Netherlands.

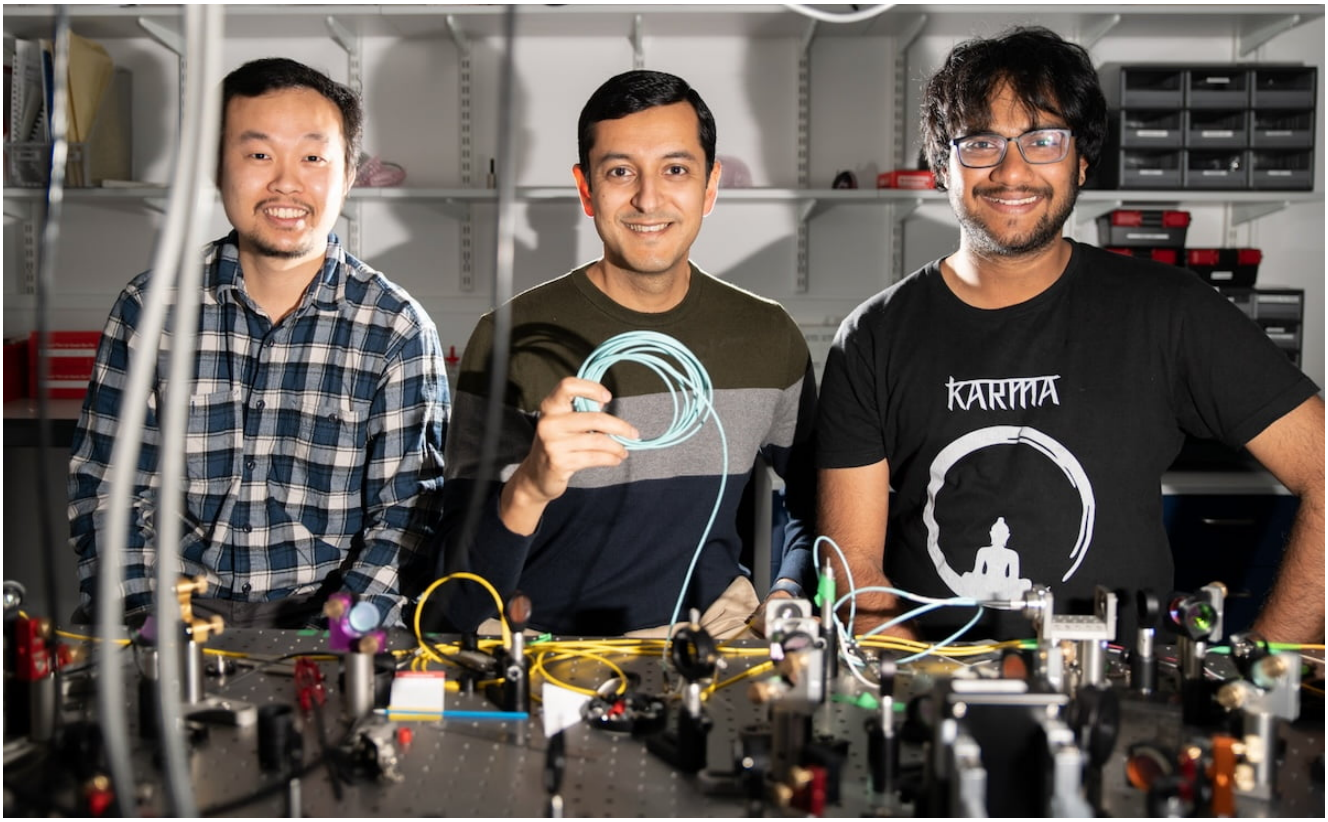
The research was funded by QuantERA, a leading European network of 39 public Research Funding Organisations (RFOs) from 31 countries, the Austrian Research Promotion Agency (FFG) – Austria's national funding agency for industrial research and development – and the European Research Council (ERC) – the European Union's funding organisation for frontier research.

Professor Mehul Malik (left) and his team at the Beyond Binary Quantum Information Lab at Heriot-Watt University.



Light travelling through an optical fibre sitting on top of a conventional electronic circuit board.

Heriot-Watt University's Edinburgh campus with the seated figure of Scottish 18th century engineer and inventor James Watt, who inspired the university's name, along with 16th century philanthropist and goldsmith, George Heriot.



From left to right – Beyond Binary Quantum Information Lab

(BBQLab) members Dr Saroch Leedumrongwatthanakun, Professor Mehul Malik and PhD student Suraj Goel.