# Research breakthrough takes supercomputing out of the lab

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In the age of high-speed computing, the photon is king. However, producing the finely tuned particles of light is a complex and time-consuming process, until now.

Thanks to the work by a team of engineers led by Professor Amr Helmy of The Edward S. Rogers Sr. Department of Electrical & Computer Engineering, a novel solution has been identified that will make the production of special class of photons faster and easier.

Advanced computing technologies – such as ultra-secure communication systems and optical quantum computers – use light to quickly relay information. To enable these technologies to work, a photon – the smallest unit of energy – has to be tightly coupled with another photon. These are known as entangled photon pairs. The current means of production uses relatively bulky optical equipment in specialized labs. The photons are also extremely delicate to construct and are very sensitive to mechanical vibrations. This complexity and associated cost currently makes the use of this technology in homes or offices impracticable.

Professor Helmy's team offers an innovative solution. These engineers have successfully designed a new integrated counterpart to the delicate laboratory equipment that could produce the entangled photon pairs using an integrated circuit. Ultimately, the entire production of the photons could be completed using a single chip. The team in Toronto along with their colleagues at the University of Waterloo and Universität

Innsbruck, have tested the first generation of these devices. They reported their findings in a recent issue of *Physical Review Letters*.

"The research offers the prospect of unleashing the potential of the powerful and underutilized quantum technologies into the main stream commercial world, out of the lab," explained Professor Helmy.

While other attempts at creating a chip-based solution didn't permit the addition of other components, Professor Helmy's team used a semiconductor chip that would function with the other existing equipment. This makes it possible to have all of the required components that traditionally exist in a laboratory be on the same chip.

Utilizing quantum optical computing will be key in solving extremely difficult computational problems, such as complex data sorting. Optical computers are much faster than any classical computer thanks to their ability to use advanced modern algorithms. Producing entangled pairs using this chip is a first and significant step towards making them commercially available and perhaps might lead to future quantum-optical gadgets.

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