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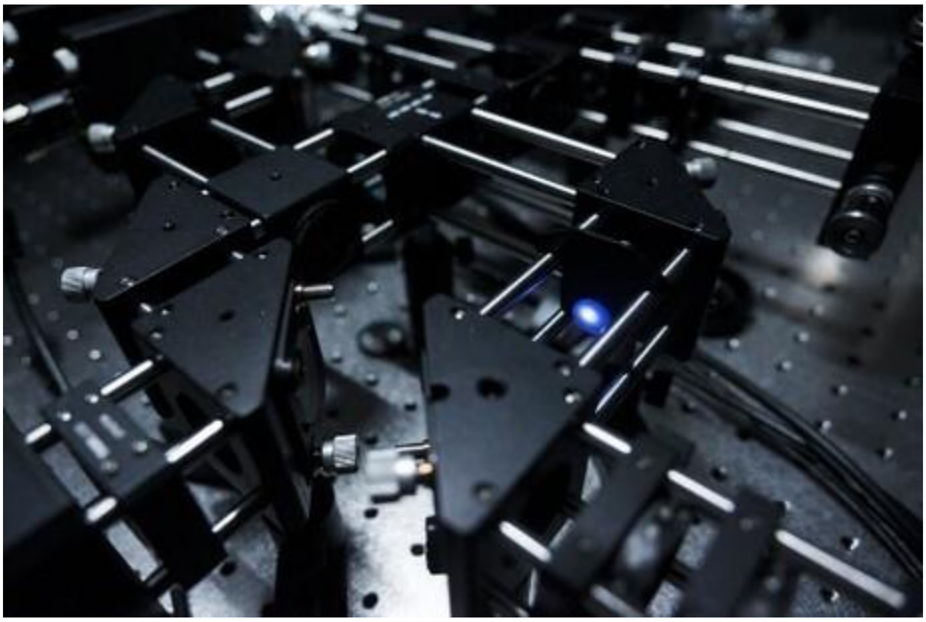

Researchers from Nanyang Technological University, Singapore (NTU Singapore) have made a discovery that could make quantum computing more compact, potentially shrinking essential components 1000 times while also requiring less equipment.

A class of quantum computers that is currently being developed relies on light particles, or photons, created in pairs and linked or “entangled”. One way to produce these photons is to shine a laser on millimetre-thick crystals and use optical equipment to ensure the photons become linked. However, this approach is too big to integrate into a computer chip.

Now, researchers from NTU Singapore have addressed this approach’s problem by producing linked pairs of photons using thinner materials that are 1.2 micrometres thick, or approximately 80 times thinner than a strand of hair. The researchers did this without needing additional optical gear to maintain the link between the photon pairs, making the overall set-up simpler.

Professor Gao Weibo, who led the research team, said the novel method to create entangled photon pairs paves the way for making quantum optical entanglement sources smaller, which will be critical for applications in quantum information and photonic quantum computing. According to Weibo, this method could also scale down the size of devices for quantum applications because many of these devices need large and bulky optical equipment, which is cumbersome to align, before they can work.

Weibo’s solution was inspired by an established method to create entangled pairs of photons with thicker and bulkier crystalline materials, which was published in 1999. It involves stacking two flakes of thick crystals together and positioning the crystalline grains of each flake perpendicularly to each other. However, the vibrations of photons produced in a pair can still be out of sync due to how they travel within the thick crystals after they are created. Additional optical equipment is therefore needed to synchronise the photon pairs to maintain the link between the light particles.

Weibo theorised that a similar two-crystal set-up could be used with two thin crystal flakes of niobium oxide dichloride, with a combined thickness of 1.2 micrometres, to produce linked photons without requiring extra optical instruments. Weibo expected this to happen because the flakes used are thinner than the bulkier crystals from earlier studies. As a result, the pairs of photons produced travel a smaller distance within the niobium oxide dichloride flakes, so the light particles remain in sync with each other. Experiments by the NTU Singapore team proved that this hunch was correct.

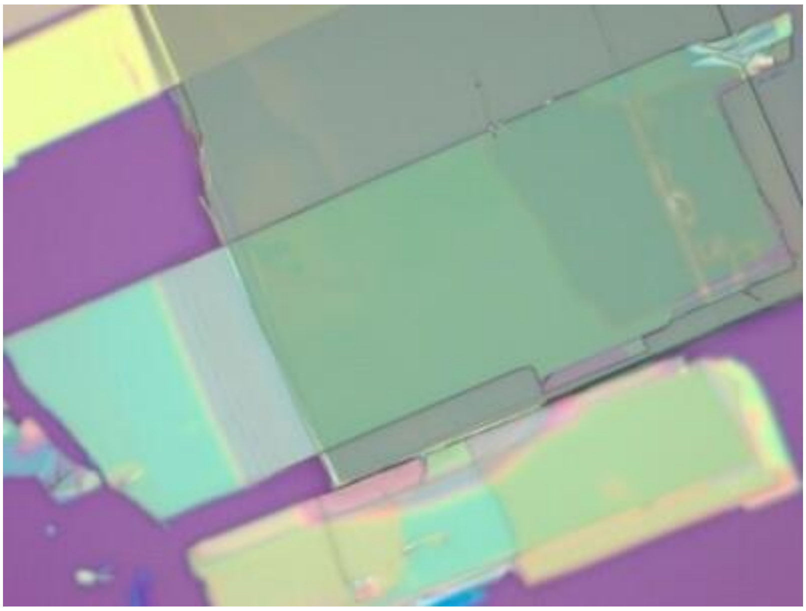

Image caption: Two thin flakes of niobium oxide dichloride stacked on each other and photographed under a light microscope. One flake's crystalline grain (grey flake) is positioned perpendicularly to the grain of the other flake (green flake). Image credit: NTU Singapore.

The researchers plan to further optimise the design of their set-up to generate more linked pairs of photons than is possible now. Some ideas include exploring whether introducing tiny patterns and grooves on the surface of niobium oxide dichloride flakes can increase the number of photon pairs produced. Another experiment will examine whether stacking the niobium oxide dichloride flakes with other materials can boost photon production.

Top image caption: A blue laser set-up for generating entangled pairs of photons in NTU Singapore's experiments. Image credit: NTU Singapore.

https://www.electronicsonline.net.au/content/assembly/news/thinner-materials-for-more-compact-quantum-computing-devices-1133690986