Quantum electronics: Two photons and chips

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Scientists at Toshiba Research Europe Limited (Cambridge, UK) believe they are on to a way of producing entangled twins of photons using a simple semiconductor electronic device. Such a chip-based source of entangled photons - light particles - would be a tremendous boon to quantum information technology.

Pairs of photons with properties that are mutually interdependent, owing to a quantum-mechanical effect called entanglement, are the basic currency of quantum-based information processing.

Entangled pairs can be used, for example, to implement quantum cryptography, an ultra-secure way of transmitting information, and quantum computing, which in principle offers much more computer power than today's conventional devices. But making entangled photons on demand is not easy.

Andrew Shields and colleagues report in last week's Nature [Nature, 12 January, pp179-182] what appear to be entangled photons being emitted from tiny blobs, called quantum dots, of the semiconductor indium arsenide, a material commonly used in solid-state light-emitting devices.

The quantum dots emit pairs of photons when their electrons are boosted to a higher energy by laser light and then release this extra energy as light. By using a magnetic field to tweak the conditions under which the photons are emitted, the researchers were able to generate pairs that appear to be entangled in their polarization states — that is, the plane of polarization of one of the pair depends on that of the other, so that a

measurement made on one of them determines the polarization of the other.

If this process can be more precisely controlled, a simple semiconductor light-emitting diode might be used as a compact, robust and reliable source of entangled pairs.

Source: Nature