Disentangling information from photons

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Theoretical physicist Filippo Miatto and colleagues from the University of Strathclyde, Glasgow, UK, have found a new method of reliably assessing the information contained in photon pairs used for applications in cryptography and quantum computing. The findings, published in *European Physical Journal D*, are so robust that they enable access to the information even when the measurements on photon pairs are imperfect.

The authors focused on photon pairs described as being in a state of quantum entanglement: i.e., made up of many superimposed pairs of states. This means that these photon pairs are intimately linked by common physical characteristics such as a spatial property called orbital angular momentum, which can display a different value for each superimposed state.

Miatto and his colleagues relied on a tool capable of decomposing the photon pairs' superimposed states onto the multiple dimensions of a Hilbert space, which is a virtual space described by mathematical equations. This approach allowed them to understand the level of the photon pairs' entanglement.

The authors showed that the higher the degree of entanglement, the more accessible the information that photon pairs carry. This means that generating entangled photon pairs with a sufficiently high dimension-that is with a high enough number of decomposed photon states that can be measured-could help reveal their information with great certainty.

As a result, even an imperfect measurement of photons' physical characteristics does not affect the amount of information that can be gained, as long as the level of entanglement was initially strong. These findings could lead to quantum information applications with greater resilience to errors and a higher information density coding per photon pair. They could also lead to cryptography applications where fewer photons carry more information about complex quantum encryption keys.

More information: Miatto FM, Brougham T, Yao AM (2012), Cartesian and polar Schmidt bases for down-converted photons, *European Physical Journal D*, DOI: 10.1140/epjd/e2012-30063-y

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