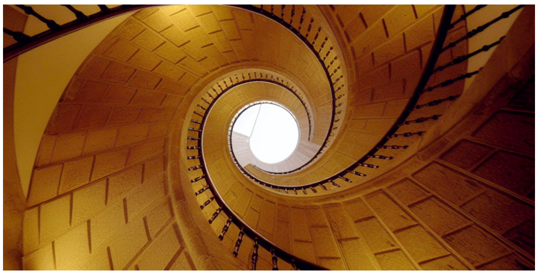

Contribution ID: **41** Type: **Talk**

Guaranteeing non-classicality in experimental quantum networks without assuming quantum mechanics

Monday 29 May 2023 12:40 (20 minutes)

Quantum technologies promise interesting new approaches to areas such as computing and communication. A branch that is becoming increasingly interesting is that of quantum networks. The technological assets for quantum networks have been developing rapidly in recent years and many implementations, often geared towards quantum cryptography, have been reported. In order to demonstrate security of quantum cryptographic protocols, a necessary condition is to guarantee that the observations of the parties cannot be reproduced when classical systems are distributed instead (i.e., to observe non-locality). However, in contrast with traditional bipartite scenarios, the standard notion of multipartite non-locality only guarantees that something quantum is happening somewhere in the network. In contrast, recently a new notion of non-locality in networks has been introduced, called full network nonlocality, that allows to guarantee that non-classical behavior is present everywhere in the network. Moreover, this notion does not assume quantum mechanics. Therefore, proofs of security based on full network nonlocality will not break if, in the future, we ever find physical systems that go beyond quantum mechanics.

In this talk I will describe several experimental observations of full network nonlocality in scenarios that are specially relevant as building blocks of large-scale quantum communication networks. The first one is a star-shaped network where three branch parties share each a bipartite quantum state with a central node that performs tripartite entanglement swapping. This is an important scenario to realize multipartite quantum cryptographic protocols mediated by a central authority. The second one is a quantum repeater scenario where we strictly enforce the network structure via space-like separation of its components. The fact that full network nonlocality is observed in a significant manner, in demanding scenarios, and with state-of-the-art technology, strongly motivates the development of multipartite quantum cryptographic protocols in networks and proofs of security based on full network nonlocality.

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Session Classification: Session 4.2