The **Vienna Center for Quantum Science and Technology** (**VCQ**)
invites you to a

COLLOQUIUM TALK

by

Paolo Mataloni

(Sapienza University of Rome)

Generalized spreading phenomena in Optical Quantum Walks

Besides their proposed applications for quantum computing, Quantum Walks (QWs) provide a general framework to describe coherent propagation phenomena. They allow indeed to describe how quantum particles move or spread among the sites of a discretized space, for instance, inside a material. Facing real systems, most of the times very far from being ideal, the difficulty to describe exactly the system itself could bring to manage very complex problems. In this perspective QWs, in which a finely controlled insertion of various levels of disorder during the evolution of the walker have been introduced, furnish a suitable framework to model such systems.

I will report on two experiments in which two different kinds of optical disordered QWs have been adopted to realize quantum simulators able to model both superdiffusive and transient subdiffusive phenomena, exhibiting anomalous spreading in space over time. The introduction of a suitable level of disorder within the QWs makes possible to explore the full range of superdiffusive and subdiffusive behaviors, ranging, for all experimentally accessible step numbers of the network, from normal diffusion to superdiffusion in the first experiment and from anomalous Anderson-like localization to normal diffusion in the second one.

Single particle QW evolution has been proven to not possess genuine quantum features since it can be described by classical wave theory. QW evolution of multiple particles, instead, needs to be featured by non-classical correlations, such as indistinguishability and entanglement. I will present further experimental results regarding multiparticle QWs adopted to observe the spreading properties of non-classical correlations, also in presence of disorder.

In general, QWs can be useful tools for the study of any kind of propagation. For instance, looking at the system from an informational point of view it is possible to understand the way Quantum Information travels coherently through a suitable disordered network. In the same context of investigating the Quantum Information dynamics in a network, recent experimental results dealing with a quantum state discrimination protocol based on a generalization of the QW model will be also presented.

Monday, 17th January 2022, 17:30

ONLINE via ZOOM

The seminar talk will be preceded by a VCQ Student talk at 17:15 by

Michele Spagnolo
University of Vienna
"Experimental Quantum Memristor"

Host: Anton Zeilinger

for further information and the zoom-link please visit vcq.quantum.at/colloquium-ws21-22