Tailored Anderson localization with partially coherent light

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Anderson localization and partially coherent light are at first sight unrelated, if one thinks in terms of interference. However, Anderson localization can be observed with non-coherent light, since a partially coherent beam can be viewed as a superposition of randomly phased components, which localize independently in a disordered media [1]. This gives rise to the question of how much transverse Anderson localization depends on the coherence properties of the propagating fields.

To answer this question, one would need to use a source of light where its coherence properties can be modified on demand. Entangled photon pairs exhibit an unique feature which relates the first-order degree of coherence of the individual photons constituting the pair to the amount of entanglement shared among them. This relationship allows to generate the sought-after tunable coherence based on the detection of one of the photons to tailor the properties of the remaining photon[2].

Using this scheme, we propose an experimental configuration where one of photons propagates in a disordered array of coupled waveguides, whereas the second one is coupled into a waveguide supporting only a limited amount of spatial modes [3]. The detection of the second photon in a limited amount of modes effectively tailor the first-order coherence properties of the first one and, by that way, also its transverse localization in a disordered medium. The scheme can be readily implemented with current waveguide-on-a-chip technology. The most important benefit of the scheme is the possibility of using many different types of waveguides on the same chip, which are thus used to tailor the first-order coherence, without the need to change the input light source.

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