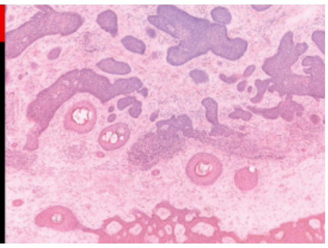
IOP Institute of Physics

Photon 2020

IOP webinars for the physics community

1–4 September 2020

ONLINE EVENT



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Abstract Details

Title: Quantum-analogous measures for space-time non-separable light

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Session: Topological and Nonlinear Photonics - Default Location, 01/09/2020, 14:00 - 15:15

Time: 14:30 - 14:45

Recent advances in structured light and topological optics have highlighted the non-trivial wave-matter interactions of pulses with complex topological and spatiotemporal structure. A characteristic example of such a pulse is the “Flying Doughnut” (FD), a few-cycle space-time non-separable (STNS) toroidal pulse with links to toroidal and anapole excitations in matter. However, little in known about the role of space-time non-separability in the propagation dynamics and light-matter interactions of such pulses.

Here, we exploit the similaritybetween the non-separability in classical light pulses and entanglement in quantum systems and ropose a quantum-mechanics-inspired methodology for the quantitative characterization of STNS pulses. In analogy to quantum entangled states, we introduce space-spectrum entangled states to describe the space-time non-separability of classical light pulses and develop a method to reconstruct the corresponding density matrix by state tomography. We apply our method to general pulses with prescribed STNS, such as the FD pulse and superpositions of Laguerre-Gaussian modes, and obtain the corresponding fidelity, concurrence, and entanglement of formation. We demonstrate that such measures dug out from quantum mechanics quantitatively characterize the evolution of spatiotemporally structured pulses upon propagation.

This work introduces a toolkit for the characterization of broadband beams and pulses with different types of space-time coupling and provides a quantitative description of the spatiotemporal structure and the propagation dynamics. Our results provide insights into light-matter interactions with ultrafast pulses and will find applications in spectroscopy, cryptography, and communications.

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Key dates

Registration deadline:

26 August 2020

Paper submission deadline:

30 October 2020

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