

# Robust nonlinear and topological quantum photonics



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## Abstract

In this talk we will discuss how to engineer the dispersion relation of photonic platforms to provide robust propagation of classical and quantum states of light.

In the first part of this talk, we will unveil how to leverage the interaction of nonlinearity with higher orders of dispersion to create novel types of solitons, wave packets that propagate unperturbed for long distances. The lowest-order member of this family is the recently discovered pure-quartic soliton but we have also demonstrated that there is an infinite hierarchy of pure-even-order dispersion solitons and exciting pulses arising from hybrid orders of dispersion. These objects have advantageous energy-width scaling laws with respect to conventional nonlinear Schrodinger solitons – arising from nonlinearity and second order dispersion – and show promise for applications in ultrafast lasers, integrated frequency combs, and low-power nonlinear devices.

Subsequently, we will cover recent developments in topological quantum photonics. Topological photonics leverages concepts from geometry and topology – the branch of mathematics that deals with global properties that cannot be changed under continuous deformation – to produce electromagnetic modes that propagate with immunity to disorder and imperfections. In the last few years, several experiments have achieved the generation and propagation of quantum states of light in these so-called topological modes, demonstrating enhanced robustness of such inherently fragile quantum states. In this talk we will focus on our recent results in this area including topological protection of spatial entanglement and the demonstration of topology as an additional degree of freedom for entanglement using CMOS-compatible silicon photonics platforms.

## Bio

Andrea is the Head of the Silicon Photonics department at Nokia Bell Labs in New Jersey, USA, where she develops new concepts and applications in nonlinear integrated optics and topological quantum photonics. From 2015 to 2019, she was the Professor Harry Messel Research Fellow and Senior Lecturer at the School of Physics of the University of Sydney, Australia. From 2007 to 2015 she was a photonics researcher and a project manager with the Aerospace and Telecom departments of Tecnalia, Spain. She received her PhD and MSc in Elec. Eng. at the University of the Basque Country (Spain) and the University of Valladolid (Spain) respectively.

She is an Optica (formerly OSA) Director at Large and the recipient of the 2018 OSA Ambassador distinction, the 2016 Geoff Opat Award of the Australian Optical Society to the top Australian Early Career Researcher, and of one of the two 2014 Ada Byron Awards to the top Women in Technology in Spain.

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