PHOTONICS AS A KEY ENABLING TECHNOLOGY

SPIE.*UNITN* event

SPIE STUDENT CHAPTER UNIVERSITY OF TRENTO - Italy

Photonics as a key enabling technology:

Young researchers in photonics

Friday 10/12/2021

University of Trento, Polo tecnologico F. Ferrari (Povo 1), Via Sommarive, 5, Povo, Trento, TN, 38123, Italy

Room A106

13.45-14.00 **Welcome Speech**

14.00-15.00 **Valeria Cimini:** ***Introduction to quantum optical metrology and multiparameter estimation***

Post-Doc in the Quantum Optics and Information group at Sapienza University of Rome

"My presentation will start introducing the necessary background to understand quantum optical metrology, presenting one of its benchmark problems consisting in the estimation of an optical phase embedded into an interferometer. I will describe how the phase estimation can be enhanced using quantum light. More specifically, I will concentrate on measurements with both single-photon states and squeezed light. To conclude I will present some current investigations about phase estimation applications in a noisy environment framing the problem in the multiparameter context."

15.00-16.00 **Davide Pierangeli:** ***Photonic computing machines***

Researcher of Institute for Complex System of the Italian Research Council (ISC-CNR) working at the physics department of the Sapienza University of Rome

"Artificial intelligence tasks across numerous applications require novel devices for fast and low-power execution. Photonic platforms are emerging as alternative computing hardware for solving optimization problems and machine learning tasks that are hard to tackle with conventional computers. In this talk, I will discuss several photonic computing machines we have experimentally implemented using spatial light modulation and optical propagation in free-space and disordered media. In particular, spatial photonic Ising machines (SPIM) can operate as an optical simulator for spin-glass systems and break large-scale combinatorial problems. Photonic extreme learning machines (PELM) perform efficient classification and regression using linear and nonlinear optical waves. Similar optical neuromorphic computing devices can also act as innovative methods to investigate complex and biological systems."

16.00-16.15 Short Break

16.15-17.15 **Stefano Biasi:** ***Hermitian and non-Hermitian physics in an optical microresonator***

Post-Doc in the Nanoscience group of the physics department of the University of Trento

"The energy conservation is a fundamental concept, which underlies our understanding of nature. It demands that a closed system exhibits real-valued eigenvalues. As a result, the physical models are based on the mathematical Hermiticity. However, the modeling of natural phenomena often requires the study of a subsystem and its interaction with the surrounding environment. This leads to the introduction of non-Hermitian systems. The main difference between Hermitianity and non-Hermitianity arises in the presence of degeneracies, i.e., when the eigenvalues coalesce. In the first case, the degeneracies are called diabolic points, while in the second one, they are called exceptional points. Here, we show how a key building block of integrated optics, namely, a microresonator, can be exploited to study non-Hermitian phenomena. Precisely, we demonstrate that, by embedding an S-shaped branch inside the microring, the whole system works on an exceptional point. This allows showing counterintuitive effects, such as the unidirectional reflection and the breaking of the Lorentz reciprocity theorem."

17.15-17.45 **Celebration of the fifth birthday of the SPIE Student Chapter of the University of Trento**