Indian Institute of Science
Quantum Technology Initiative

Special Lecture on

Quantum Photonic Technologies for Materials Characterization and Machine Learning

Speaker: **Stephen K. Gray**
Center for Nanoscale Materials
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December 22nd, 8:00 pm (IST)

Meeting Link: Join Teams Meeting

Stephen Gray is a Senior Scientist at Argonne National Laboratory. His research focuses on the classical electrodynamics and quantum dynamics of light-matter interactions in nanostructured systems, including problems in quantum plasmonics, sensing and information.

Quantum Photonic Technologies for Materials Characterization and Machine Learning

Abstract: Quantum optics experiments to characterize materials, e.g. Hanbury Brown Twiss two-photon correlation measurements to characterize quantum emitters, can be quite time consuming, i.e. require many shots to establish reliable statistics. A machine learning approach based on Bayesian statistical learning is introduced that can dramatically reduce the required number of shots [Cortes et al., APL 116, 184003 (2020)] and thus accelerate such experiments. This approach and generalizations of it will be beneficial to the validation of quantum network protocols. While we used a classical computer to carry out the machine learning in the quantum optics experiments, quantum optical technologies can also be used to perform machine learning tasks. An approach to supervised quantum machine learning based on qudits formed by photonic frequency combs was use. In particular, we study how a quantum circuit learning model [Mitarai et al., PRA 98, 032309 (2018)] can be implemented with entangled biphoton states as input, electro-optic modulators and pulse shapers as gate elements, and photon counts as output. We carry out simulations of several classification problems to validate our proposed implementation.