THE UNIVERSITY OF ARIZONA
Wyant College of Optical Sciences

Colloquium

Open to the public

Quantum Physics Modeling of Wave-Matter Interaction

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March 1, 2023
3:30 PM Refreshments, 3rd Floor Lobby
3:45 PM Seminar, Room 307

ABSTRACT

The interaction between matter and optical or acoustic waves creates fascinating physics, which will lead to exciting new phenomena as well as a deeper understanding of our universe. Making a physical model for the wave-matter interaction in an open quantum system context (i.e., a quantum system coupled to the surrounding bath), capturing important parameters, and calculating the quantum dynamics for it are not trivial because of the vast degrees of freedom present. The situation becomes even worse if one attempts to understand a quantum network where quantum subsystems are connected through weakly coupling asymptotic free fields, such as atoms in optical cavities, augmented with feedback through a beam splitter. In this talk, I will lay out the strategy to model such a complex quantum cascaded system, starting from an input-output model of a single quantum subsystem. I will also explain how the Scattering-Lindbladian-Hamiltonian (SLH) formalism leads to a simplified, effective single quantum system model out of cascading multiple quantum subsystems. Then, I will present the applications of those approaches in (1) calculating the nonlinear optical property of a 2D material, (2) qubit transfer from one quantum memory to another, and (3) calculating the quantum dynamics of a phonon-circuit memory integrated on a chip.

BIO

Daniel Soh obtained his first PhD in high-power fiber lasers from the University of Southampton, UK. He then joined Calmar Laser Inc. and, later, JDS Uniphase to develop femtosecond fiber lasers and kilowatt continuous-wave high-power lasers, respectively. After that, he moved to Sandia National Laboratories in California, where he decided to get re-educated in quantum dynamic systems and quantum information science. Daniel obtained his second PhD in quantum dynamic systems from Stanford University. Since then, Daniel has been working on various quantum information science projects, including quantum nonlinear optics, quantum networks, quantum memory, and single-photon and single-phonon detectors using topological materials.