Nonlinear quantum optics in integrated structures

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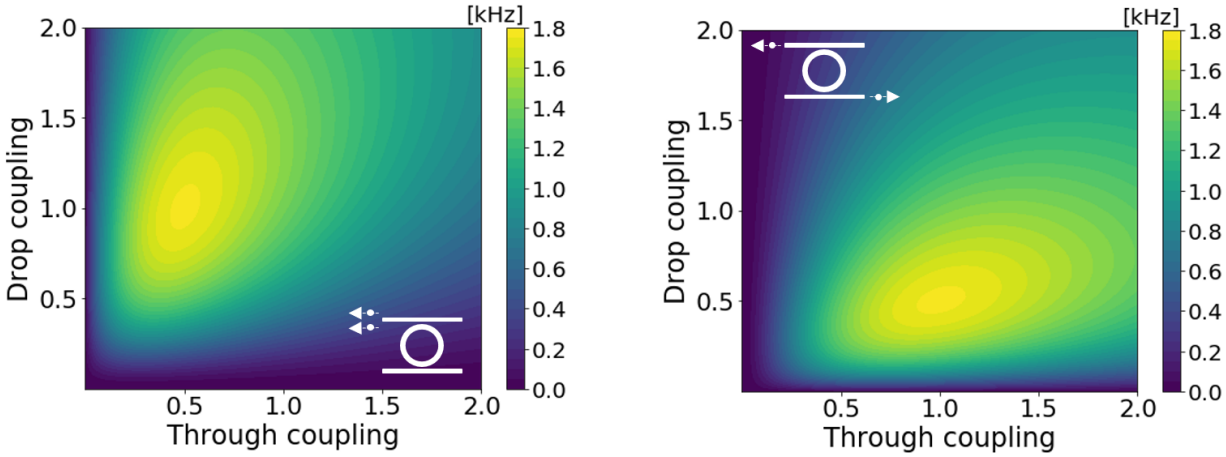
Spurred on by the goal of photonic-based quantum computing, and enabled by advances in device fabrication, much of the research in nonlinear quantum optics is now focused on integrated, "on-chip" structures that allow for nonclassical states of light to be created and manipulated in a controllable way. The creation of entangled pairs of photons, and even "squeezed light" consisting of many such pairs, is now commonplace using processes such as spontaneous four-wave mixing (SFWM) and spontaneous parametric down-conversion (SPDC).

After an introduction to the physics of these processes, and others, the project will involve numerical and analytical studies of integrated structures to understand how non-classical states of light can best be created and controlled using device structures that are feasible with current technology, or are just becoming possible. Most of the numerical work will be done using part of the *Lumerical* suite of codes (https://www.lumerical.com/products/mode/). Initial familiarity with these codes is not essential, but familiarity with Python, with electromagnetic theory, and with quantum mechanics at least at the third-year level is essential. The project is suitable for students who have completed at least their 3rd year of undergraduate study.



Our interest is in both the fundamental quantum optics involved, and in the applications to quantum information processing that are now being developed in industry; some of our work is in collaboration with colleagues there. So the project will involve issues in both fundamental and applied physics.