NSERC Summer Student Position

DEPARTMENT OF PHYSICS
UNIVERSITY OF TORONTO

"U. of T. Laser Cooling and Quantum Optics Group "

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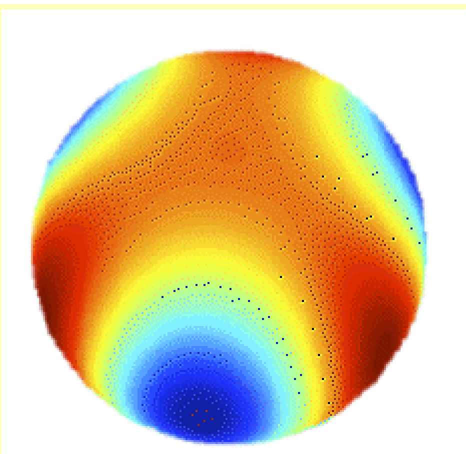
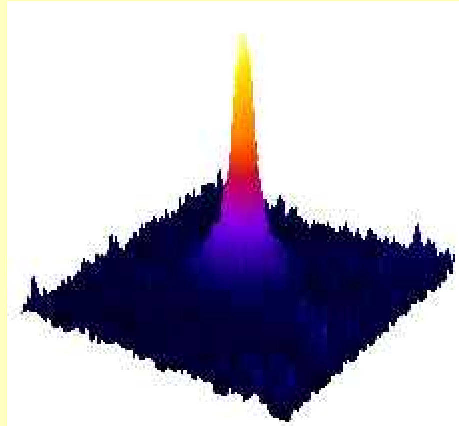
In our group, we study novel quantum-mechanical phenomena from two perspectives: ultracold atoms and ultra-correlated photons. A great deal of information, including some pictures and links to several of our articles, is available at our website.



Ultra-correlated photons: By "splitting" photons into pairs of strongly correlated photons, we are able to directly observe the quantum nature of light. Not only does this make possible tests of fundamental philosophical issues in quantum mechanics, but it has recently been realized that these correlations can be used for high-precision time measurements, ultra-secure "quantum cryptography," and even an effect known as "quantum teleportation." Our current projects include studying the application of various states of 3 and 4 photons to "quantum-enhanced metrology" and investigating the photon-statistics properties of a special narrowband photon-pair source we have developed.

Ultracold atoms: Using laser beams and magnetic fields, we can trap and cool Rubidium atoms in a vacuum chamber to Bose-Einstein condensation, essentially absolute zero for our purposes. These atoms have such small momenta that they act like quantum waves rather than classical particles. We plan on studying the quantum-mechanical tunneling of these atoms through barriers formed by intense laser beams. Other current projects include the use of ultracold atoms to build "quantum logic gates" in which a single photon is sufficient to measurably shift the phase of a second optical beam.



Undergraduate research possibilities We welcome one or two interested undergraduate students to join us for the summer, for either 3 or 4 months, to work on these projects. Although all group members are expected to be familiar with both subjects, a student would choose one of the two to concentrate on. Typical projects might include setting up a modulation system to steer laser beams and design complex shapes for our barrier potentials; building and characterizing diode modules for single-photon counting; or writing code to analyze images of trapped atoms and extract information about their quantum-mechanical wave functions.
The ideal student will have completed 3 or 4 years of physics, although exceptional 2nd-year students will be considered. Experience with optics or atomic physics or computer programming is a plus but not essential.