PHYSICS & ASTRONOMY COLLOQUIUM
UNIVERSITY OF WISCONSIN – STEVENS POINT

FRIDAY, APR 19, 2013
**2:00 PM Room A106 SCI**

Marty Lichtman
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Building a quantum computer with trapped neutral atoms

Martin Lichtman is a physics PhD candidate at UW-Madison, under the advising of Prof. Mark Saffman. Mr. Lichtman holds an Sc.B in Mechanical Engineering from Brown University, an M.S. in Aeronautics and Astronautics from Stanford University, and has worked in the fields of surgical robotics and aerospace engineering. Mr. Lichtman is fond of the physics of music, color, and chaos, and is also the 2012 US National Short Track Speed Skating champion in his age class.
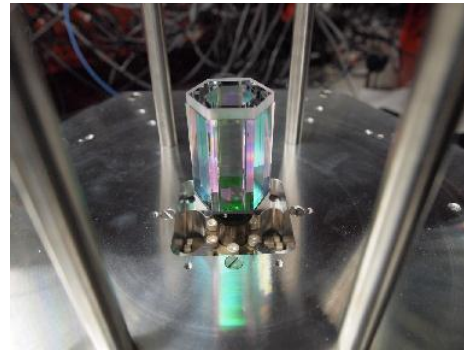
ABSTRACT: The quantum computer is on the horizon. If a system is small enough and isolated enough, it behaves according to the weird laws of quantum mechanics. One of the beautiful behaviors of a quantum system is that it can exist in a "superposition" of multiple states, at the same time. In the last two decades, physicists, including last year's Nobel laureates, have learned to control these systems. If we think of the state of these systems as a piece of information, we can store a superposition of data. Then by manipulating the system, a calculation is performed. The power of this quantum computation is that many calculations may effectively be performed at the same time. The potential speedup is immense. A functional quantum computer will certainly bring advances in cryptography, search, and physical simulation, and likely in all areas of science that have hard computational problems.

Our laboratory at UW-Madison is attempting to advance the state-of-the-art in quantum computing by building a system with 49 quantum-bits (qubits). We use the techniques of atomic physics to create magneto-optical traps (MOT) that use laser-light to hold small clouds of cesium atoms. Individual atoms can plucked from these clouds by creating blue-detuned bottles of light, big enough to hold only one atom. The rest of the cloud is blown away, leaving a 2D grid of single atoms spaced 4μm apart. Information is encoded in these atoms using the hyperfine ground states as the qubit 0 and 1. The atoms are individually addressable for single qubit operations. Entangling operations between the qubits can be performed using the large electric dipole moment of states with large principle quantum number ($n\sim100$), in a process called the Rydberg blockade. We are currently working with a 6 atom array and are in the process of scaling up to 49 trapping sites. The speaker will give an overview of quantum computation, and explain how this research is helping to realize the goals of this field.

Faculty, staff and students are cordially invited to attend.
Refreshments will be served beginning at 1:45 pm