



QUANTUM OPTICS SEMINAR

Title: Laser cooling and single ions in a Penning trap

Speaker: Richard Thompson, Imperial College London

Time: Thursday, December 1, 2005 at 12:15

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Abstract:

Laser cooling provides a powerful means to slow down atomic particles so they are nearly at rest, and ions in traps are ideal systems for the study and application of laser cooling. In the Penning ion trap, laser cooling is complicated by the fact that one of the possible types of motion, the magnetron motion, has a negative energy associated with it. As a result, the cooling is not as effective as it is for ions in the more frequently used Paul trap. “Axialisation” is a technique that can overcome this disadvantage by coupling the magnetron motion to the strongly-cooled cyclotron motion. This allows ions in Penning traps to be much more tightly localised than previously possible and opens up the possibility of using them for studies in Quantum Information Processing.

In this talk I will explain how Penning traps work and how laser cooling can lead to extremely low temperatures for trapped ions. I will then present our recent studies of laser-cooled ions in traps, including the observation of quantum jumps in single ions and axialisation of small clouds of calcium ions. This species requires several lasers for laser cooling due to the need to address all the Zeeman components of the relevant transitions in the strong magnetic field of the Penning trap. I will present our experimental measurements of the cooling process for the coupled system and discuss a theoretical treatment of axialisation in the presence of laser cooling that allows us to explain the observed behaviour.

Michael Drewsen