



## QUANTUM OPTICS SEMINAR

**Title:** The Feshbach Cocktail Party: Atoms and Molecule Mixing it Up, Resonance Style

**Speaker:** Nicolai Nygaard, NIST Gaithersburg, MD, USA

**Time:** Wednesday, October 6, 2004, 12:15-13:00

**Place:** 525-323

**Abstract:**

Feshbach resonances have made it possible to experimentally probe the crossover between Bose-Einstein condensation (BEC) and Bardeen, Cooper, Schrieffer (BCS) superfluidity in an atomic Fermi gas. By varying an applied magnetic field the strength and sign of the interatomic interactions can be varied, making it possible to continuously tune from the limiting case of superfluidity arising due to condensation of weakly bound Cooper pairs to the other extreme of tightly bound, bosonic molecules. This BCS-BEC crossover constitutes an important many-body problem of great relevance to several areas of physics.

Sweeping the magnetic field across resonance populates a stable two-body bound state thus creating diatomic molecules. At intermediate points of the crossover these bosonic molecules coexist with free fermionic atoms. We have developed a kinetic theory based on the Keldysh Green's function method to describe the nonequilibrium dynamics of the populations of both components of this atom-molecule mixture. I will briefly summarize the main conclusions derived this formalism. In addition we have studied simple ideal gas models of the atom-molecule mixture with the purpose of elucidating its nontrivial thermodynamics. In particular, I will show how this is a crucial element in the interpretation of current experiments. Finally, I will present our results on the equilibrium phase diagram of an atomic Bose-Fermi mixture coupled to heteronuclear fermionic molecules via an interspecies Feshbach resonance. Experiments on this system were recently done at MIT and JILA. We show that the Feshbach resonance can be exploited to implement a thermodynamic cooling cycle.

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