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Date: April 6, 2016  
Time: 3:30 p.m. (Refreshments in Rm. 103 @ 3:15 p.m.)  
Place: Rm. 103, Thirkield Hall, Howard University  
Host: Dr. Thomas Searles

**Spin Orbit Coupling in Ultra Cold Atomic Gases of spin-1 Bosons**

**Abstract:** Motivated by the recent advances in ultra cold atoms [1], we will discuss the physics of spin-1 bosons in the presence of a spin orbit coupling. We will first consider the effects of spin-1 bosons and the role of spin orbit coupling in the continuum [2]. We will then introduce an optical lattice, which naturally creates strong correlations that drive charge and spin density wave superfluid phases. Ramping up the lattice depth leads to the spin-1 Bose-Hubbard model [3]. This provides a controlled setting to study the direct interplay of spin orbit coupling and strong correlations. In addition to the conventional spin-full Mott and superfluid phases contained in the spin-1 Bose-Hubbard model, due to the spin orbit coupling we find new lattice symmetry breaking phases [4]. For weak interactions, the interplay between the lattice momentum and the spin-orbit wave-vector induces a phase transition from a uniform superfluid to a phase where bosons simultaneously condense at the center and edge of the Brillouin zone. This state is characterized by spin density wave order, which arises from the spin-1 nature of the system. Interactions suppress this spin density wave order, and for sufficiently strong interactions the system becomes a Mott insulator. Inside the Mott lobes with an odd-integer filling we derive the effective low energy magnetic Hamiltonian. Focusing on the quasi-one-dimensional limit we solve the strongly coupled magnetic model via its classical limit and using the density matrix renormalization group.