

Dissertation Announcement Bianca Hall

Announcing the Final Examination of BIANCA HALL for the Degree of Doctor of Philosophy in Physics

Date: Friday, November 6, 2015

Time: 9:00 a.m.

Room: PS 161

Dissertation title:

A Microscopic Theory of the Knight shift

Abstract:

This dissertation is the beginning of the development of a microscopic theory of the Knight shift. The Knight shift experiment has been used in superconductivity research throughout history, however, a complete understanding of the Knight shift in conventional as well as unconventional superconductors does not yet exist. Motivated by the results of a literature review, which discusses Knight shift anomalies in multiple superconducting materials, this research studies a new model of the Knight shift, which involves the processes involved in nuclear magnetic resonance measurements in metals.

The result of this study is a microscopic model of nuclear magnetic resonance in metals. The spins of the spin-1/2 local nucleus and its surrounding orbital electrons interact with the arbitrary constant B_0 , with the perpendicular time-oscillatory magnetic inductions $B_1(t)$, and with each other via an anisotropic hyperfine interaction. An Anderson-like Hamiltonian describes the excitations of the relevant occupied local orbital electrons into the conduction bands, each described by an anisotropic effective mass with corresponding Landau orbits and an anisotropic spin g tensor. Local orbital electron correlation effects are included using the mean-field decoupling procedure of Lacroix. The metallic contributions to the Knight shift resonance frequency and linewidth shifts are evaluated to leading orders in the hyperfine and Anderson excitation interactions. While respectively proportional to $(B_1/B_0)^2$ and a constant for weak $B_0 \gg B_1$, both shifts are shown to depend strongly upon B_0 when a Landau level is near the Fermi energy.

Outline of Studies:

Major: Physics

Educational Career:

M. S. University of Central Florida, USA, 2012

B. S. The University of Alabama, USA, 2011

Committee in Charge:

Dr. Richard Klemm (Chair)

Dr. Talat Rahman

Dr. Yanga Fernandez

Dr. Enrique del Barco

Dr. Bhimsen Shivamoggi (External Committee Member)

Approved for distribution by Dr. Richard Klemm, Committee Chair, on October 27, 2015.

The public is welcome to attend.