Jacob Alldredge
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Research:

My research focuses on methods of visualizing the world around us. Specifically I focus on magnetic scanning probe microscopy techniques and data interpretations, along with methods of reducing complex data sets to key variables to aid in interpretations. This takes the form of either inverting the data sets to find underlying structure, or model fitting of large data sets through massive parallel processing efforts. The underlying goal of such research is to measure, analysis and present magnetic data on a variety of biological and physical systems in such a way as to engage students and researchers in an intuitive manner.

Education:

1997-2001 University of Florida (Highest Honors) B.S. Physics 2001
Thesis: Fibers of Aligned Single Wall Carbon Nanotubes
2002-2008 Cornell University M.S., Ph.D.
Thesis: Understanding the Electronic Structure of Cuprates: A Local Approach

Professional Experience:

2010-Present Research Associate, University of Colorado Boulder/National Institute of Standards and Technology

Developed a new method of quantitatively measuring magnetic particles

- Created setup and the system for the measurement
- Worked on computational code and theory for the interpretation

Preformed magnetic force microscopy in collaboration with colleagues

Mentored an undergraduate SURF student

Worked to develop fast parallel GPU computing code for large scale data set reduction

- Developed/implemented a phenomenological model for the electronic structure of cuprates
- Implemented a local bosonic mode model

2008-2010 Research Associate, University of Colorado Boulder

Supervised the construction and troubleshooting of a low temperature scanning tunneling microscope

Supervised the construction of a UHV scanning tunneling microscope

Mentored undergraduate research assistants

Developed an Monte Carlo based inversion method for extracting band structure information from complicated Friedel Oscillations (quasiparticle interferences)

2002-2008 Graduate Research Assistant, Cornell University

Worked to take scanning tunneling microscopy data of High T_c superconductors and to develop models to reduce the data set to fundamental parameters

- Designed and Built a UHV sample preparation and a UHV sample transfer system to expand the range of samples that could be measured
- Developed computer cluster code for large sample set reduction
- Tested/Troubleshot advanced vibration/acoustic isolation systems
- Troubleshot a UHV low temperature scanning tunneling microscope
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2002-2003 Graduate Teachers Assistant, Cornell University

Taught engineering physics 214

Taught self tutorial physics, electro-magnetism for general education students

Taught advanced lab for physics majors, electronics lab

2001-2002 Netherlands America Foundation Fellow-Fulbright, TuDelft

Ran a low temperature UHV scanning tunneling microscope

Studied inelastic scattering in carbon nanotubes

2001 Undergraduate Teachers Assistant, University of Florida

TAed the Advanced laboratory for undergraduates, electronics lab

1998-2001 Undergraduate Research Assistant, University of Florida
2000 Research Experience for Undergraduates
1999 University Scholars Program

Helped setup a laboratory for production and characterization of single walled carbon nanotubes

- Built custom electronics
- Constructed a freeze drying system
- Aligned carbon nanotubes to form fibers for measurement
- Preformed Raman Spectroscopy on aligned carbon nanotube samples
- Preformed optical spectroscopy of samples

Publications:

"Magnetic Particle Imaging with a Cantilever Detector" JW. Alldredge, John Moreland, **Journal of Applied Physics 112, 023905 (2012)**

"Three-component electronic structure of the cuprates derived from spectroscopic-imaging scanning tunneling microscopy" J. W. Alldredge, K. Fujita, H. Eisaki, S. Uchida, and Kyle McElroy, **PRB (2012)**

"How Cooper Pairs Vanish Approaching the Mott Insulator in Bi2Sr2CaCu2O8+δ**"** Y. Kohsaka, C. Taylor, P. Wahl, A. Schmidt, Jhinhwan Lee, K. Fujita, J.W. Alldredge, Jinho Lee, K. McElroy, H. Eiaski, S. Uschida, D.-H. Lee, J.C. Davis, **Nature 454, 1072-1078 (2008)**

"Evolution of the electronic excitation spectrum with strongly diminishing hole-density in superconducting $Bi_2Sr_2CaCu_2O_{8+\delta}$" J.W. Alldredge, Jinho Lee, K. McElroy, M. Wang, K. Fujita, Y. Kohsaka, C. Taylor, H. Eisaki, S. Uchida, P.J. Hirschfeld and J.C. Davis, **Nature Physics Nature Physics, 4, 319 (2008)**.

"Fibers of aligned single-walled carbon nanotubes: Polarized Raman spectroscopy" H. H. Gommans, J. W. Alldredge, H. Tashiro, J. Park, J. Magnuson, A. G. Rinzler, , **Journal of Applied Physics 88 5** (2000)

"Fibers of Aligned Single Wall Carbon Nanotubes" J. W. Alldredge, A. G. Rinzler, , **Journal of Undergraduate Research (UF) 1 8** (2000)

Talks:

"Magnetic Particle Imagining with a Cantilever Detector"
APS March Meeting 2012

“Magnetic Particle Imaging with a Cantilever Detector”
NIST bioimaging group talk 2012

"Magnetic Particle Imagining with a Cantilever Detector"
APS March Meeting 2011

"Recovering band structure from quasiparticle interference patterns"
APS March Meeting 2010

"Phenomenological model of the bipartite electronic structure of $Bi_2Sr_2CaCu_2O_{8+x}$: Calculating super fluid density and offering insight into the phase diagram"
APS March Meeting 2009

"Understanding the Electronic Structure of Cuprates: A Local Approach"
Thesis Defense, Cornell 2008

"Atomic Scale Imaging of Quasiparticle Lifetimes in $Bi_2Sr_2CaCu_2O_{8+x}$"
APS March Meeting 2008

"Atomic Scale Imaging of Quasiparticle Lifetimes in $Bi_2Sr_2CaCu_2O_{8+x}$"
APS March Meeting 2007

"On the Spectrum of Electronic Excitations of $Bi_2Sr_2CaCu_2O_{8+x}$"
Talk given to colleagues at University of Florida 2006

"Vibration/Acoustic Isolation Techniques for Spectroscopic Mapping STS"
APS March Meeting 2004

“Exciting updates in STM”
Cees Dekker Group Talk 2001

“Inelastic Electron Tunneling Spectroscopy and the Zero Bias Anomaly”
Cees Dekker Group Talk 2000

"Optical Dichroism in Fibers of Aligned SWNT Inferred from Polarized Raman Spectroscopy"
APS March Meeting 2000

Proposals/Fellowships applications:

"New techniques for understanding electronic structure in complex disordered systems"
Air Force white paper 2012

"Intercellular Brownian assays by magnetic particle force microscopy" NRC Fellowship Feb 2012

"An m-H imager for counterfeit detection and design of next generation anti-counterfeiting technology" NIST Internal 2012

"Scanning Probe Microscope with Local Magnetic Force and Eddy Current Measurements for Bullet Fingerprinting" NIST Internal 2012

"A Low Vibration 4 K Pulse Tube system for Spectroscopic Imaging Scanning Tunneling Microscopy" NRC Fellowship November 2011

"Individual Magnetic Particles for Nanoscale Assays" NRC Fellowship August 2011

"Development of a Scanning Force Susceptometer" NRC Fellowship February 2011

"Development of a Field Portable Scanning Force Susceptometer for Magnetic Dating and Mineralogical Explorations" NSF Geophysics Instrumentation 2011

"In-Situ Characterization of Biogenic Iron Oxide Crystals for Quantitative Assessment of Neurodegenerative Diseases" NIST Internal 2011

"Development of a Scanning Probe Magnetic Particle Imager for Real Time 3D Biological Tracking on the Nanometer Length Scale" NRC fellowship November 2009

Advisors:

Undergraduate Thesis/Research Advisor	Prof. Andrew Rinzler, UF
Netherlands America Foundation Advisor	Prof. Cees Dekker, TUDelft
Ph.D. Thesis Advisor	Prof. J.C. Davis, Cornell
Research Associate Advisor	Prof. Kyle McElroy, UC Boulder
Research Associate Advisor	Dr. John Moreland, NIST