Graduate Orientation

Department of Physics
Southern Illinois University Carbondale

By

Leo Silbert
Saikat Talapatra
Overview

**FACULTY**
- Ali, Naushad
- Byrd, Mark
- Chitambar, Eric
- Jayasekera, Thushari
- Mazumdar, Dipanjan
- Migone, Aldo
- Silbert, Leo
- Talapatra, Saikat

**STAFF**
- Baer, Robert
- McCann, Suzanne
- Pleasure, Sally
- McPhail, Patrick

**RESEARCHERS**
- Dubenko, Igor
- Fortescue, Ben

**UNDERGRADUATE**
- Bachelors of Science in Physics (~50 majors)

**GRADUATE**
- Masters of Science in Physics (15-20 students)
- Doctor of Philosophy in Applied Physics (10-15 students)

**Lecturers**
- Hendley, April
- K.V.Sajesh
- West, Rick

**Graduate Committee**
- Prof. Talapatra (Chair)
- Prof. Byrd
- Prof. Chitambar
- Prof. Migone
- Prof. Silbert

**Undergraduate Committee**
- Prof. Jayasekera (Chair)
- Prof. Byrd
- Prof. Chitambar
- Prof. Mazumdar
- Prof. Silbert
Research

$1,739,223 (Total 2009-10)
$1,518,064 (Federal)

Year 2009
- Patents: 2
- Publications: 36
- Presentations: 61 (Invited: 15)
- RA supported: 10
- Post-doc & researchers: 6
- Undergraduate researchers: ~6
- High school visitors: 2

Awards
- APS Fellows
- John Wheatly Award (APS)
- NSF CAREER
- Goldwater Fellows
- Grad School Diss. Fellowship (2)
- Outstanding Diss. Awards (3)
- Dissertation Research Assistantship (1)
- NSF EAPSI Fellow (1)

Energy
- Intra departmental
- Inter departmental
- Across campus
- National Labs
- Across countries

Nanomaterials
- Composites & Bio-hybrids
- Nanotechnology
- Quantum Computing
- Theory & Modeling
Experimental Groups & Facilities

Prof. Naushad Ali
Magnetoresistance & Magnetic Refrigeration

Research Interests:
1. Use of Synchrotron Radiation in Magnetic and Superconductivity Studies
2. Colossal Magnetoresistance
3. Photoinduced Magnetization and Molecular Magnets
4. Permanent Magnetic Materials
5. Electrical, Magnetic, and Thermal Properties of Magnetically ordered Rare Earth Compounds
6. Study of Spin-Glass and Re-entrant Magnetic Phase Transitions
7. Valence Fluctuations, Heavy Fermion and Kondo Lattice in YbSi$_2$, CeSi$_x$, UPt$_{1-x}$Pd$_1$ and like systems
8. Evolution of Mn Magnetic Moments in RMn$_2$ (R=Rare Earth Y$_{1-x}$R$_x$Mn$_2$ Systems)
Experimental Groups & Facilities

Prof. Aldo Migone
Adsorption Phenomena

Research Interests:
1. Gas Adsorption on Carbon Nanohorns
2. Gas Adsorption on Carbon Nanotubes
3. Kinetics of Gas Adsorption on Carbon Nanotubes
4. Gas Adsorption on Metal-Organic Frameworks
Experimental Groups & Facilities

Complex Materials and Heterostructures
Dipanjan Mazumdar

- Thin-film heterostructures & crystal growth
- Develop materials
- Understand properties
- Compare with theory

- Device prototypes
- Transport
- Microfabrication
- Band structure

- Structure
- Magnetometry
- Transport
- Spectroscopy
- Scanning probe microscopy

- Atomic level control
- Metastable phases
- Scaling behavior
- Sharp interfaces
- Tunability

Sputtering
Pulsed laser deposition

Applications: Spintronics
Hard drive reader is a spintronic device

Photovoltaics
Thermoelectrics

BiFeO₃

Transport
Microfabrication
Band structure

Department of Physics
Experimental Groups & Facilities
Prof. Saikat Talapatra

Central Facilities
- Central Research Shop
- Elemental Analysis Services
- Genomics & Robotics Services
- IMAGE (advanced microscopy; computer graphics and photography, including conference posters)
- Mass Spectrometry Facility
- NMR Facility

Departmental Support
- Physics Electronics Shop (Mr. Bob Baer)
- Physics Machine Shop (Mr. Patrick McPhail)
- Computer Labs
Theoretical & Computational Facilities

A new computer cluster with approximately 36 nodes will be available by the end of the semester.

8 Node Intel Dual Xeon 2.8 Ghz
Faculty:
Prof. Byrd
Prof. Chitambar
Prof. Jayasekera
Prof. Silbert

20 node Intel P IV 2.4 Ghz
24 Node Intel dual Xeon 2.8Ghz.

Windows + Linux dual boot machines, Mathematica License, etc…
Theoretical & Computational Groups

Quantum Computing
Prof. Mark Byrd

Research interests:
Quantum Computing
Quantum Error Correction
Quantum Information
Quantum Control and
Simulating Quantum Systems with Quantum Systems

For More Information:

E-mail: mbyrd at physics dot siu dot edu
Web: http://www.physics.siu.edu/byrd/
Personal web page http://www.physics.siu.edu/~mbyrd
Group web page http://www.physics.siu.edu/qc
See also Qunet •
Research Interests:
structure $\leftrightarrow$ mechanical properties $\leftrightarrow$ dynamics $\leftrightarrow$ driving mechanisms
molecular dynamics simulations, liquid state theory, critical phenomena, elasticity theory
Theoretical & Computational Groups

Nanotechnology with High Performance Computing
Prof. Thushari Jayasekera
Computational Materials Physics at SIUC

What is it and Why? Novel experimental techniques allow us to create materials at the nanoscale, where device properties are engineered by changing the atomic arrangement. Atomistic simulations are important at this scale, to explain existing experimental observations and/or predict new possible experiments for device applications.

Techniques
First Principles Density Functional Theory
Density Functional Perturbation Theory
Green’s Function Technique, R-Matrix Theory
Molecular Dynamics

Current Research Projects
Electronic Structure Analysis, Thermal Management and Electron Transport of Epitaxial Graphene based Devices

Computational Challenge
In order to understand experimental observations, we need to simulate systems with a large number of atoms (with few hundred of atoms). Calculations become very intense. Parallel Computing is Required

Computer Resources
A computer cluster with approximately 36 nodes will be available by the end of the semester.

Our Recent Findings
Jayasekera et al., PRB, 84, 035442 (2011)
Jayasekera et al., PRL, 104, 146801 (2010)

Epitaxial Graphene goes n-p transition in the presence of Water molecules
Substrate Chemistry can be used to engineer the Electronic bands in Epitaxial Graphene
Area of research
Quantum information theory: As a relatively new field in science, quantum information involves the study of how quantum mechanical properties can be used in information processing tasks.

Research deals with the theory of quantum entanglement and its mathematical structure. In particular,

(i) what different forms of entanglement can exist in multipartite systems,
(ii) in what meaningful ways can entanglement be quantified or measured,
(iii) how can entanglement be manipulated by parties separated in different labs,
(iv) what types of quantum correlations exist beyond entanglement.

A primary goal is to better understand how non locality and entanglement differ as resources in quantum information processing. This objective extends toward the construction of new protocols for quantum communication and cryptography that utilize the complex structure of multipartite quantum systems.

Additional areas of interest include computational complexity theory and physics education.
Funding Support

National Science Foundation

US Department of Energy

Airforce Office of Scientific Research

Army Research Office

Office of Research Development & Administration
College of Science
So, you want to do a Physics postgraduate degree?

You have the following options:

Degree Options

Mater’s: usually 2 years - 30 months
PhD program: usually 4 years - 60 months (from Master’s)
PhD program: usually 4 years - 72 months (direct admit)

Research degrees involve:

classes: 1-2 years graduate physics courses
original research: under guidance of faculty advisor
thesis: write up results into research papers

Coming soonish...

Non-Thesis Master’s degree involves:

classes: 2 years graduate classes + lab experience
What are the requirements?

www.physics.siu.edu/programs

Class Requirements

Master’s program: PHYS 500, 510, 520, 530

PhD program: PHYS 500, 510, 520, 530, 545, 565, elective

Remember: your graduate school days are the last time anyone will provide you with direct instruction

When you are ready to defend your thesis:
Give a public defense in Neckers 440 at 4:00pm on a Friday
(Master’s: 1 week / PhD: 2 weeks, before committee defense)
Who pays for all of this?

Graduate Assistantships

TA (Teaching Assistantship)
- teaching undergraduate courses/labs
- grading undergraduate classes
- Help Desk

RA (Research Assistantship)
- funded through internal/external grants/scholarships
- funding agencies expect returns
- your advisor is responsible to funding agency

You are an integral part of the education experience for undergraduate students – be a mentor to your undergraduates
WEIGHTS:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab Report</td>
<td>60%</td>
</tr>
<tr>
<td>Pre-Lab</td>
<td>5%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>20%</td>
</tr>
<tr>
<td>Exam</td>
<td>15%</td>
</tr>
</tbody>
</table>

SCHEME:

<table>
<thead>
<tr>
<th>Percentage Range</th>
<th>Grade</th>
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<tbody>
<tr>
<td>90.0 - 100 %</td>
<td>A</td>
</tr>
<tr>
<td>80.0 - 89.9 %</td>
<td>B</td>
</tr>
<tr>
<td>70.0 - 79.9 %</td>
<td>C</td>
</tr>
<tr>
<td>60.0 - 69.9 %</td>
<td>D</td>
</tr>
<tr>
<td>0.0 - 59.9 %</td>
<td>F</td>
</tr>
</tbody>
</table>

ALL TAs - WHAT TO MAKE SURE OF…:

- …each student is playing a role in the experiment
- …walk around during the labs, quizzes, and pre-quizzes
- …quizzes and labs graded in timely manner
- …be clear when grading
TA & Grading
Consistency, Consistency, Consistency!!!

**WEIGHTS:**
- Lab Report: 75%
- Pre-Lab: 5%
- Quizzes: 20%

**SCHEME:**
- 90.0 - 100 % = A
- 80.0 - 89.9 % = B
- 70.0 - 79.9 % = C
- 60.0 - 69.9 % = D
- 0.0 - 59.9 % = F

**FOLLOW THE RUBRIC**

<table>
<thead>
<tr>
<th>SECTION</th>
<th>POINTS</th>
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<tbody>
<tr>
<td>Apparatus and Introduction</td>
<td>15</td>
</tr>
<tr>
<td>Results</td>
<td>25</td>
</tr>
<tr>
<td>Discussion and Conclusions</td>
<td>25</td>
</tr>
<tr>
<td>Error Analysis</td>
<td>20</td>
</tr>
<tr>
<td>End of Lab Questions</td>
<td>15</td>
</tr>
</tbody>
</table>

**WHAT TO MAKE SURE OF IN B-LAB…:**
- …use originality check in D2L
- …read the student conduct code on plagiarism
- …bring up any conduct code issue with the lab coordinator
SIU Online (D2L) – What to Learn

- 253/5 A – assigning groups
- Grading within D2L
  - No need for adobe
  - Adding comments
- You can get help!!! - **Center For Teaching Excellence**
  - Delivery of content and learning activities in D2L
  - Instructional education
  - Graduate teaching support
Time Management

- organize your responsibilities:
  
  * classes
  * research
  * teaching

- discipline yourself to work at each responsibility

- graduate homework is for learning technical skills and enhance understanding

- keep your advisor up-to-date with your progress
What else can you do?

General Knowledge

- join APS [www.aps.org](http://www.aps.org)
- sign up for daily updates from [www.arxiv.org](http://www.arxiv.org)
- browse journals once a week/month
- convince your advisor that conferences are useful

Networking

- maximize time with colleagues at conferences
- volunteer presentations at local/national level

Participate in departmental and institutional student organizations
Thank You!

Questions?