Why study Physics?

“If you know physics, you know a lot of good stuff” ---Jeff Champion (age 12)
Administrative Faculty, Staff and Students

Chair: Paul Champion
Executive Officer: George Alverson
Administrative Officer: Suzanne Robblee
Undergraduate Coordinator: Alain Karma
Graduate Coordinator: Mark Williams
Co-op Coordinator: Lisa Campagnoni
Undergraduate Advisors: Tim Sage, Nathan Israeloff
SPS Advisors: Don Heiman, Swastik Kar
Students: Emily Batt, Craig Levy
~30 Physics Faculty

Research

Graduate and Undergraduate Grants (NSF, NIH, DOE, etc)

- Elementary Particle/Astroparticle
- Biological Physics
- Network Science
- Condensed Matter/Nanophysics

Teaching

- Graduate Courses and PhD Advising

Undergraduate:

- Physics
- Biomedical Physics (premed advising)
- Applied (interdisciplinary) Physics
- Applied Physics and Engineering (BS/MS)
- Teaching (BS/Education)
- Research (BS/PhD)
Physics Research at Northeastern University
http://www.physics.neu.edu/research.html

➢ Nanophysics & Condensed Matter Physics (~$6M annual external funding)
  - **Nanomaterials**: Optical, magnetic, and electrical properties for device applications
  - **Nanooptics**: Negative index of refraction flat lens materials
  - **Nanomedicine**: NSF IGERT training program (2005-2015)


Epitaxial GaN Nanowires.

Metallic Nanoparticles (green) Optical Imaging of Skin Cancer


New classes of topological insulators predicted (Nature Materials, 2010)
**Biological, Biomedical & Network Physics** (~$6M annual external funding)

- **Center for Complex Network Research:** *Use of statistical physics to find laws governing the apparently random structure of real networks.*

- **Molecular Biophysics:** *Single molecule optical tweezers (DNA); Vibrational coherence and ultrafast kinetics in proteins; Novel synchrotron-based spectroscopies; Large scale computer simulations*

- **Cardiac Nonlinear Dynamics:** *Elucidate the mechanisms of life-threatening heart rhythm disorders from ion channels to cells to tissue.*
Northeastern Experimental High Energy Physics at Fermilab and CERN
Alverson/Barberis/Orimoto/Wood Group

Engaged in a global effort to address the most compelling questions in particle physics:

International collaboration (3000 physicists) at CERN (Switzerland)
• started in 2010: current world’s highest collision energy
• NEU: searches for new massive particles, upgrades for 14 TeV future operations

Funding:
Current: NSF PHY-0757561, $550k/yr
Past: $800k NSF CAREER (Barberis)
Future: NSF renewal submitted, $627k/yr

Personnel:
3 Faculty, 2 postdocs, 4 graduate students, 1-3 coop students/yr

For a 10-minute mini-lecture by D. Wood (D0 spokesperson) in NSF video
High Energy Theory Group
Haim Goldberg, Pran Nath, Brent Nelson, Tomasz Taylor

The HET group explores some of the most fundamental unanswered questions

• What will we discover at the Large Hadron Collider?
• What are the laws of physics during era of Big Bang?
• What is the nature of dark matter in the universe?
• Why is our universe mostly matter and not anti-matter?
• How long will the proton live?

PIONEERING contributions made in above areas by HET Group

• The work of HET group is being tested in many ongoing experiments: Tevatron, LHC, PAMELA, SUPER-K...
• Further tests will be performed in outer space (PLANCK, WMAP), deep underground (DUSEL), and at many other facilities.

SUPER-K experiment: Neutrino properties, proton lifetime
DUSEL will explore dark matter, neutrino physics

TheoryNet Program: Outreach to area high schools.
HET Profs connect with New England high school students and teachers.

LHC will search for Higgs particle, supersymmetry, extra dimensions, mini-black holes, strings

• NSF funding for 4 decades
• Average Hirsch 33
• Symposia SUSY, PASCOS
• Steven Hawking at NU: 1990, 91.
• 2 APS Fellows
• 1 Matthews Distinguished University Professor

PAMELA anti-matter probe

Recent graduates
• Daniel Feldman
  UMich
• Zuowei Liu
  Stony Brook
Student Services

Faculty Advisors:
• Work with you to design a program to fit your needs

Society of Physics Students (SPS):
• Weekly seminars given by invited guests
• Participation in physics-related discussions with your peers in an informal environment

Physics workshop:
• Tutoring by Physics Graduate Students

Peer tutoring:
• Select classes are available for tutoring by/for your peers
PRISM is an interdisciplinary program to promote interest in Mathematics, Physics, Biology and the sciences among college and high-school students. The goal is to engage students in the excitement of discovery and research leading to research co-op positions and further undergraduate research opportunities with faculty. The program is supported by the National Science Foundation and is run jointly by faculty from Mathematics, Physics and Biology.
Co-operative Education

- Earn hands-on experience in your field while working towards your Bachelors degree
- Make connections with people working in the field
NU Physics Co-op

4/6 month opportunities during the Fall or Spring Semester
  o July – December (Summer II & Fall)
  o January – June (Spring & Summer 1)

Begins 2\textsuperscript{nd} Semester Sophomore year
  o Must complete a 1 credit Professional Development Course
  o Must have at least a 2.0 GPA

Students typically complete 2 to 3 Co-ops
  o 1st co-op: Often on-campus research labs
  o 2nd/3rd co-op: national labs or high-tech companies

International Co-ops
  o South Africa, UK, Italy, Netherlands, German, China, Japan, Switzerland
Co-op Employers
Recent Co-op Placements

- Mass General Hospital, Beth Israel Deaconess
- Lawrence Berkeley National Lab
- Fermi National Accelerator Laboratory (Fermilab)
- Dana Farber Cancer Center
- Imugen, Intel, Grace, Amazon, Raytheon, E-ink, FIKST
- Harvard School of Public Health
- Imperial College (London)
- University of Puerto Rico (Mayaguez)
- Woods Hole (Africa)
- Spring-8 (Japan)
- CERN (Geneva)
<table>
<thead>
<tr>
<th></th>
<th>Physics</th>
<th>City of Boston-Mayor's Office</th>
<th>Mayor’s Office Constituent Advocate</th>
<th>6 Mo Co-op</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Physics</td>
<td>EMI Consulting</td>
<td>Project Analyst</td>
<td>4 Mo Co-op</td>
</tr>
<tr>
<td>1</td>
<td>Physics/Philosophy</td>
<td>Leibniz Universität Hannover (LUH)</td>
<td>Research Assistant</td>
<td>4 Mo Co-op</td>
</tr>
<tr>
<td>1</td>
<td>Biomedical Physics</td>
<td>NU-Physics Department</td>
<td>Research Asst-Single Molecule Biophysics</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>1</td>
<td>Applied Physics</td>
<td>NU-Physics Department</td>
<td>Lab Assistant</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>1</td>
<td>Physics</td>
<td>Harvard Medical School-Harvard Ctr, Biomedical Informatics (CBMI)</td>
<td>Research Assistant, Wall Lab</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>1</td>
<td>Applied Physics/Engineering</td>
<td>NU-Action Lab</td>
<td>Research Asst.</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>1</td>
<td>Physics</td>
<td>NU-Physics Department</td>
<td>Research Assistant (Nanophotonics Lab)</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>1</td>
<td>Physics</td>
<td>NU-Physics Department</td>
<td>Research Asst-Single Molecule Biophysics</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>1</td>
<td>Physics</td>
<td>Harvard Medical School-Harvard Ctr, Biomedical Informatics (CBMI)</td>
<td>Research Assistant, Wall Lab</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>1</td>
<td>Physics</td>
<td>NU-Physics Department</td>
<td>Research Assistant</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>1</td>
<td>Physics</td>
<td>NU-Physics Department</td>
<td>Research Assistant</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>1</td>
<td>Physics</td>
<td>NU-Physics Department</td>
<td>Research Assistant</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>1</td>
<td>Physics</td>
<td>NU-Physics Department</td>
<td>Research Assistant</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>1</td>
<td>Mathematics/Physics</td>
<td>Mobile Heartbeat</td>
<td>Project Assistant</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>1</td>
<td>Mathematics/Physics</td>
<td>Savings Bank Life Insurance (SBLI)</td>
<td>Actuary</td>
<td>6 Mo Co-op</td>
</tr>
</tbody>
</table>

**Academic research lab**
- National Lab

**Company**

---

**Fall 2011**

1st co-op
<table>
<thead>
<tr>
<th>Year</th>
<th>Semester</th>
<th>Course</th>
<th>Department</th>
<th>Position</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Fall 2011</td>
<td>Physics</td>
<td>NU-Physics Department</td>
<td>Research Assistant (Nanophotonics Lab)</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Physics</td>
<td>Utrecht University</td>
<td>Nanophotonics Co-op</td>
<td>4 Mo Co-op</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Physics</td>
<td>Newgrange Design</td>
<td>PCB Design Coop</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Physics</td>
<td>Woods Hole Oceanographic</td>
<td>Geophysical Research Assistant</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Biomedical Physics</td>
<td>Harvard School of Public Health</td>
<td>Research Asst.</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Biomedical Physics</td>
<td>Woods Hole Oceanographic</td>
<td>Geophysical Research Assistant</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Biomedical Physics</td>
<td>NU-Physics Department</td>
<td>Research Asst.</td>
<td>4 Mo Co-op</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Physics</td>
<td>NU-Physics Department</td>
<td>Research Assistant (Nanophotonics Lab)</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Biomedical Physics</td>
<td>QD Vision</td>
<td>Electro-Optics Lab Assistant</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Physics</td>
<td>Valeo Raytheon Systems</td>
<td>Engineering Intern</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Physics</td>
<td>Woods Hole Oceanographic</td>
<td>Geophysical Research Assistant</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Physics</td>
<td>NU- College of Computer and Engineering</td>
<td>CCIS Research Assistant</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Physics</td>
<td>Charles Stark Draper Laboratories</td>
<td>(CCIS/ECE)Student Flight Software Coop(Danis)</td>
<td>6 Mo Co-op</td>
</tr>
<tr>
<td>#</td>
<td>Field</td>
<td>Company</td>
<td>Position</td>
<td>Duration</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----------------------</td>
<td>--------------------------------------</td>
<td>-------------------------------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Physics</td>
<td>Emerson &amp; Cuming</td>
<td>EE/ECE Coop</td>
<td>6 Mo Co-op</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Physics</td>
<td>Fikst</td>
<td>Mechanical Design Co-op</td>
<td>6 Mo Co-op</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Physics</td>
<td>Smithsonian Observatory</td>
<td>Research Asst.</td>
<td>6 Mo Co-op</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Math/Physics</td>
<td>E-Ink</td>
<td>Research Asst</td>
<td>6 Mo Co-op</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>EE/Physics</td>
<td>Cern</td>
<td>Research Asst</td>
<td>6 Mo Co-op</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>CompSci/Physics</td>
<td>Motorola</td>
<td>Software Sustaining Co-op</td>
<td>6 Mo Co-op</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Mathematics/Physics</td>
<td>E Ink Corporation</td>
<td>Mechanical Testing Co-op</td>
<td>6 Mo Co-op</td>
<td></td>
</tr>
</tbody>
</table>
Boston

- Culturally diverse
- Home to world-renowned research facilities and hospitals