Physics

Department Information

- **Department Chair:**
  Alan Denton, Ph.D.
- **Graduate Coordinator:**
  Mila Kryjevskaia, Ph.D.
- **Department Location:**
  218 South Engineering
- **Department Phone:**
  (701) 231-8974
- **Department Web Site:**
  www.ndsu.edu/physics/ (http://www.ndsu.edu/physics/)
- **Application Deadline:**
  For U.S. students, one month before registration; for international students, March 1 for fall semester and September 1 for spring/summer semester.
- **Credential Offered:**
  Ph.D., M.S., Accelerated M.S.
- **Test Requirement:**
  GRE (general and subject recommended)
- **English Proficiency Requirements:**
  RA - TOEFL 71, IELTS 6, Duolingo 100; TA Grader - TOEFL 79, IELTS 6.5, Duolingo 110; TA Instructor - TOEFL 81, IELTS 7, Duolingo 115

Program Description

The Department of Physics offers graduate study leading to the Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees. Advanced work may involve specialized training in the following areas: biophysics, computational physics, condensed matter, nanomaterials, physics education research, polymer physics, soft matter physics, and statistical mechanics.

Research and academic programs are tailored to meet individual needs and interests. New students are strongly urged to visit faculty members to discuss research opportunities soon after their arrival.

Admissions Requirements

The Department of Physics graduate program is open to all qualified graduates of universities and colleges of recognized standing.

Financial Assistance

Prospective students must apply to the Graduate School and be accepted in full or conditional status before being eligible for an assistantship in the Department of Physics. Generally, graduate students are supported during the academic year by either teaching assistantships or research assistantships. The 2021-2022 academic year stipend is $19,000 for 9 months. Additional support during the summer is also possible.

In addition to the stipend, graduate assistants receive a graduate tuition waiver. Tuition waivers cover base tuition for NDSU graduate credits only. Students are responsible for differential tuition, student fees, and tuition for non-graduate level credits taken or Cooperative Education credits.

Research Equipment

North Dakota State University's Materials and Nanotechnology Center is located in the Research and Technology Park. The Center is equipped with two state-of-the-art wet labs, a synthesis lab, optical characterization facilities (optical/NIR fluorescence microscopy, laser-scanning confocal microscopy, and light scattering/reflectometry), and surface characterization facilities (nano-indentation and atomic-force microscopy). There are seven fume hoods in the lab space, as well as a number of synthesis tools, including a Beckman Coulter Optima L-80 XP Ultracentrifuge. We also have access to state-of-the-art chemical facilities in the Departments of Chemistry and Biochemistry and Coatings and Polymeric Materials, including a Photo Emissions Tech Model SS50AAA Solar Simulator equipped with a Keithley 2400 Series Source meter. NDSU's Center for Computationally Assisted Science and Technology (CCAST) provides large-scale computing resources to NDSU users.

The graduate coordinator or department chair shall assign to each incoming graduate student a temporary adviser, who shall assist in the selection of courses. During the first semester, the student is expected to discuss potential projects for thesis research with faculty members. By the beginning of the second semester, the student must have a permanent research supervisor. By the end of the second semester, the student must have filed a plan of study, selected a thesis topic, and secured two additional faculty members for the Advisory Committee.
## Master of Science

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics courses number 601-689 or 700-789</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Didactic courses numbed 601-689 or 700-789</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>PHYS 790</td>
<td>Graduate Seminar</td>
<td>1</td>
</tr>
<tr>
<td>PHYS 798</td>
<td>Master's Thesis</td>
<td>6-10</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td></td>
<td><strong>30</strong></td>
</tr>
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</table>

Students are required to attend all seminars and colloquia.

## Accelerated Master of Science

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 790</td>
<td>Graduate Seminar</td>
<td>1</td>
</tr>
<tr>
<td><strong>Choose from the following:</strong></td>
<td></td>
<td><strong>21</strong></td>
</tr>
<tr>
<td>PHYS 611</td>
<td>Optics for Scientists &amp; Engineers</td>
<td></td>
</tr>
<tr>
<td>PHYS 611L</td>
<td>Optics for Scientists and Engineers Lab</td>
<td></td>
</tr>
<tr>
<td>PHYS 613</td>
<td>Lasers for Scientists and Engineers</td>
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</tr>
<tr>
<td>PHYS 615</td>
<td>Elements of Photonics</td>
<td></td>
</tr>
<tr>
<td>PHYS 662</td>
<td>Thermal and Statistical Physics</td>
<td></td>
</tr>
<tr>
<td>PHYS 681</td>
<td>Condensed Matter Physics</td>
<td></td>
</tr>
<tr>
<td>PHYS 685</td>
<td>Quantum Mechanics I</td>
<td></td>
</tr>
<tr>
<td>PHYS 686</td>
<td>Quantum Mechanics II</td>
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</tr>
<tr>
<td>PHYS 752</td>
<td>Mathematical Methods in Physics I</td>
<td></td>
</tr>
<tr>
<td>PHYS 758</td>
<td>Statistical Physics</td>
<td></td>
</tr>
<tr>
<td>PHYS 761</td>
<td>Electromagnetism</td>
<td></td>
</tr>
<tr>
<td>PHYS 771</td>
<td>Quantum Physics I</td>
<td></td>
</tr>
<tr>
<td>PHYS 781</td>
<td>Solid State Physics</td>
<td></td>
</tr>
<tr>
<td>PHYS 798</td>
<td>Master's Thesis</td>
<td>6-8</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>

Students must meet all requirements of the Physics bachelor and master programs. For the master’s degree, students must earn at least 30 graduate credits, numbered 601-798, with these conditions:

- Up to 15 credits from this list may count toward the bachelor program requirements. It is recommended that students take the 600-level of PHYS 462/662, 481/681, 485/685, and 486/686 while fulfilling the requirements for the bachelor’s degree.
- Between 6 and 8 credits are PHYS 798 (Master’s Thesis), with the goal to publish a paper based on the thesis research, although this is not a requirement to graduate.
- At least one credit is PHYS 790 Graduate Seminar.

## Doctoral Degree

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td><strong>Required Courses</strong></td>
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<tr>
<td>PHYS 752</td>
<td>Mathematical Methods in Physics I</td>
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<tr>
<td>PHYS 758</td>
<td>Statistical Physics</td>
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<td>PHYS 781</td>
<td>Solid State Physics</td>
<td></td>
</tr>
<tr>
<td>PHYS 790</td>
<td>Graduate Seminar</td>
<td></td>
</tr>
<tr>
<td>Letter-graded courses number 601-689 or 700-789</td>
<td></td>
<td><strong>27</strong></td>
</tr>
<tr>
<td>PHYS 899</td>
<td>Doctoral Dissertation</td>
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<tr>
<td><strong>Total credits</strong></td>
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<td><strong>90</strong></td>
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</table>
Credits used to satisfy the requirements for the M.S. degree may be included in the total. Students are required to attend all seminars and colloquia.

**Preliminary Examination**

By the end of their fourth semester, students:

- submit a report that summarizes their research results so far and details a research plan for the rest of their research work;
- give a talk about their research accomplishments and plans; and
- must pass an oral examination by the supervisory committee to confirm doctoral candidacy.

Students who pass the preliminary examination and, at the time of the exam, have completed 30 credits (16 of which are didactic) will earn a master’s degree and be eligible to participate in commencement that semester. Students should choose the Ph.D. + master’s option from the drop-down menu on the Doctoral Plan of Study (https://powerforms.docusign.net/7e21cd61-31cc-4cbf-a1e1-c23b2845394c/?env=na3&acct=1ceb9a57-b6a3-4df7-b655-d64cf8f1c2d7) and on the Notification of Scheduled Examination (https://powerforms.docusign.net/0abb6387-c124-45e6-bc80-337a7635ff00/?env=na3&acct=1ceb9a57-b6a3-4df7-b655-d64cf8f1c2d7&accountid=1ceb9a57-b6a3-4df7-b655-d64cf8f1c2d7). After students have passed the preliminary examination, they should complete the exit survey and the graduation application (https://powerforms.docusign.net/71b00c0e-af21-4473-bb23-cdbd85983676/?env=na3&acct=1ceb9a57-b6a3-4df7-b655-d64cf8f1c2d7&accountid=1ceb9a57-b6a3-4df7-b655-d64cf8f1c2d7).

If the student fails the preliminary examination, they will be given the opportunity to repeat the examination in the next semester (this examination can be repeated only once). Alternatively, the student may elect to work for a master’s degree instead.

Students should submit their doctoral thesis for examination at the end of their fourth year.

**Dissertation Video**

Doctoral students are required to submit a three-minute video summarizing their dissertation research for a lay audience. The video should be produced, with guidance from the thesis supervisor, during the final semester of study and presented to the supervisory committee at the final defense.

For the oral preliminary and final oral examinations, students must submit the appropriate forms to the Graduate College.

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**Warren Christensen, Ph.D.**  
Iowa State University, 2007  
Postdoctoral: University of Maine, 2007-2009  
Research Interests: Physics Education Research, Student Content Understanding, Curriculum Development

**Yongki Choi, Ph.D.**  
The City University of New York, 2010  
Postdoctoral: University of California Irvine, 2010-2014  
Research Interests: Nano-Biophysics, Nano-electronics, Single-Molecule science

**Andrew B. Croll, Ph.D.**  
McMaster University, 2009  
Postdoctoral: University of Massachusetts, 2008-2010  
Research Interests: Polymers, Diblock Copolymers, Thin Films, Pattern Formation, Mechanics

**Alan R. Denton, Ph.D., Department Chair**  
Cornell University, 1991  
Postdoctoral: University of Guelph, 1991-94; Technical University of Vienna, 1994-95, Research Center Julich, 1996-98  
Research Interests: Soft Condensed Matter Theory, Computational Physics

**Eric K. Hobbie, Ph.D.**  
University of Minnesota, 1990  
Research Interests: Nanotechnology, Nanoparticles, Polymers, Optics and Rheology

**Andrei Kryjevski, Ph.D.**  
University of Washington, 2004  
Research Interests: First-Principles Numerical Techniques for Fermi Systems, Electronic Structure of Nanoparticles

**Mila Kryjevskaia, Ph.D., Graduate Program Coordinator**  
University of Washington, 2008  
Research Interest: Physics Education Research

**Sylvio May, Ph.D.**  
Friedrich-Schiller University, 1996
Postdoctoral: Hebrew University Jerusalem, 1997-98
Research Interests: Physics of Lipid Membranes, Biophysics, Ionic Liquids, Drug delivery

Kyle Strand, M.S.
North Dakota State University, 2017
Research Interests: Computational Soft Matter

Alexander J. Wagner, Ph.D.
University of Oxford, 1997
Research Interests: Computational Soft Matter, Phase Separation, Diffusion, Interfaces Physics

Emeritus

Ghazi Q. Hassoun, Ph.D.
University of Minnesota, 1963
Postdoctoral: University of Michigan, 1963-65
Research Interests: Foundations of Quantum Mechanics

Daniel M Kroll, Ph.D.
University of Chicago, 1973
Research Interests: Theoretical and Computational Modeling of Complex Fluids and Biomembranes

Charles A. Sawicki, Ph.D.
Cornell University, 1975
Postdoctoral; Cornell University, 1975-79
Research Interests: Acoustics, Biophysics, Geophysics

Mahendra K. Sinha, Ph.D.
Pennsylvania State University, 1961
Postdoctoral: National Research Council (Ottawa), 1964-66
Research Interests: Field Emission and Field-Ion Microscopy Adjunct

Orven Swenson, Ph.D.
Air Force Institute of Technology, 1982
Research Interests: Laser Materials Processing, Optics Education

Adjunct Faculty

Khang Hoang, Ph.D.
Michigan State University, 2007
Research Interests: Materials theory, Defect physics, Solid state Ionics

Dane Skow, Ph.D.
University of Rochester, 1990
Research Interests: High Energy Physics

Scott A. Wood, Ph.D.
Princeton University, 1985
Research Interests: Geology