Toward a PhD Degree in Physics

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Stony Brook University

Stony Brook, August 2012
The Grand Picture

Ph.D. Requirements

Placement Exam
in September,
beginning of school.

Core Courses
PHY 501 505 506
511 512 540

Required courses
Two breadth courses,
PHY 598, 599, 515

Find advisor
Helps in written exam,
needed for oral exam,
Summer job.

Comprehensive Exam
Twice a year; must pass
by end of second year.

Thesis Research
Original work to
prepare dissertation.

Oral Exam, must
be done by end of
second year.

Advancement to candidacy
MAJOR STEP!

Review
work with thesis committee
once a year.

Write
dissertation according to grad school format.
File forms, watch for deadlines.

Defend Thesis.
Printed copy of dissertation,
oral presentation.
### Typical Course of PhD Degree

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Take courses and TA.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 2</td>
<td>Start Research, Take courses in your specialty and TA.</td>
</tr>
<tr>
<td></td>
<td><strong>At the end of the second year all students should have an advisor.</strong></td>
</tr>
<tr>
<td>Year 3</td>
<td>Spend all your time on research.</td>
</tr>
<tr>
<td>Year 4</td>
<td>Spend all your time on research. Most students author their first paper during this year.</td>
</tr>
<tr>
<td>Year 5</td>
<td>Start thinking about your dissertation. Many theory students get their PhD degree at the end of the fifth year.</td>
</tr>
<tr>
<td>Year 6</td>
<td>Most experimental students get their PhD degree during this year.</td>
</tr>
</tbody>
</table>
From the Guide:

If a student already successfully passed similar courses elsewhere a student fulfill the course requirements of one or more of these core courses by taking advanced graduate courses (subject to approval by an Advising Committee appointed by the Graduate Program Director). If that is not the case you can still skip these courses by a sufficiently good performance in the corresponding parts of a placement examination given at the beginning of each fall semester (2nd year students and beyond need permission from the Graduate Program Director).

The interview took place on Tuesday and Wednesday.

The result of the placement will be known tomorrow.

Most students take the core course during their first year.
Tracks in the PhD program

In the Department of Physics and Astronomy we have four tracks:

- Physics Track
- Concentration in Astronomy
- Concentration in Physical Biology
- Concentration in Chemical Physics

The Physics Track is the default track. If you complete a Ph.D. in other tracks it will appear on your diploma.

Students in the Astronomy track have to take three astronomy courses instead of 2 physics breadth courses.

For Physical Biology the course sequence is quite different whereas for the Chemical Physics track the course requirements are the same as for Physics.

However, the main difference between tracks is the affiliation of your advisor. For the Astronomy track, he belong to the Astronomy Group. For the Track in Physical Biology, your advisor is affiliated with the Laufer Center, the Department of Physiology and Biophysics or Pharmacological Sciences. For the Chemical physics Track, she has the Department of Chemistry as her main affiliation.
Courses

Core Courses, these are required course unless you have passed the Placement exam in the subject

- PHY 501: Classical Mechanics
- PHY 505: Electricity and Magnetism (with recitation)
- PHY 511/5122: Quantum Mechanics
- PHY 504: Statistical Mechanics

Other required courses

- Breadth: Two courses in different fields outside your main area of specialization
- PHY 515: Graduate Laboratory – should be taken before the end of the second year, taking it in the third or second semester is recommended
  Can be substituted by PHY 517 (Astronomy Lab Course)
- PHY 598/599: Graduate Seminar
- PHY 600: Two semesters of teaching
- PHY 521-4: Students in the Astronomy Track should take three of the four Astronomy Courses
## Typical Course Plans

### Default

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Second Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY 501 (Classical Mechanics)</td>
<td>PHY 540 (Statistical Mechanics)</td>
</tr>
<tr>
<td>PHY 505 (Classical Electrodynamics)</td>
<td>PHY 515 (Graduate Lab)</td>
</tr>
<tr>
<td>PHY 511 (Quantum Mechanics I)</td>
<td>PHY 512 (Quantum Mechanics II)</td>
</tr>
<tr>
<td>PHY 598/9 (Graduate Seminar)</td>
<td>PHY 598/9 (Graduate Seminar)</td>
</tr>
<tr>
<td>PHY 600 (Teaching)</td>
<td>PHY 600 (Teaching)</td>
</tr>
<tr>
<td>PHY 698 (Colloquium)</td>
<td>PHY 698 (Colloquium)</td>
</tr>
</tbody>
</table>

### Astronomy Track

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Second Semester</th>
<th>Third Semester</th>
<th>Fourth Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY 523 (Galaxies)</td>
<td>PHY 521 (Stars)</td>
<td>PHY 524 (Cosmology)</td>
<td>PHY 523 (Galaxies)</td>
</tr>
<tr>
<td>PHY 501 (CM)</td>
<td>PHY 540 (SM)</td>
<td>PHY 511 (QM I)</td>
<td>PHY 512 (QM II)</td>
</tr>
<tr>
<td>PHY 505 (EM)</td>
<td>PHY 517 (Lab)</td>
<td>Other Courses</td>
<td></td>
</tr>
<tr>
<td>PHY 598/9 (Seminar)</td>
<td>PHY 598/9 (Seminar)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHY 600 (Teaching)</td>
<td>PHY 600 (Teaching)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHY 698 (Colloquium)</td>
<td>PHY 698 (Colloquium)</td>
<td></td>
<td>PHY 698(Colloquium)</td>
</tr>
</tbody>
</table>
Other Plans for Core Courses

Postponing Statistical Mechanics

<table>
<thead>
<tr>
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<th>F1</th>
<th>S1</th>
<th>F2</th>
<th>S2</th>
</tr>
</thead>
<tbody>
<tr>
<td>501</td>
<td>501</td>
<td>515</td>
<td>540</td>
<td>(CM)</td>
</tr>
<tr>
<td>505</td>
<td>505</td>
<td>515 (Lab)</td>
<td>515 (Lab)</td>
<td>(EM)</td>
</tr>
<tr>
<td>511</td>
<td>511</td>
<td>512 (QM)</td>
<td>512 (QM)</td>
<td>(QM)</td>
</tr>
</tbody>
</table>

Taking the Core Courses at a slower pace

<table>
<thead>
<tr>
<th></th>
<th>F1</th>
<th>S1</th>
<th>F2</th>
<th>S2</th>
</tr>
</thead>
<tbody>
<tr>
<td>501 (CM)</td>
<td>501 (CM)</td>
<td>540 (SM)</td>
<td>511 (QM)</td>
<td>512 (QM)</td>
</tr>
<tr>
<td>505 (EM)</td>
<td>505 (EM)</td>
<td>515 (Lab)</td>
<td>515 (Lab)</td>
<td>512 (QM)</td>
</tr>
<tr>
<td>511 (QM)</td>
<td>511 (QM)</td>
<td>578 (QM)</td>
<td>578 (QM)</td>
<td></td>
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</tbody>
</table>

If you did not have a proper undergraduate QM course, take our undergraduate QM course first (PHY 578 – renumbered as graduate course). This course does not count as credit towards your Ph.D.. If you need to take an undergraduate courses in CM, EM or SM, then you can take are renumbered undergraduate courses PHY 573, PHY 571 and PHY 578, respectively.
### Course Plan for Advanced Students

<table>
<thead>
<tr>
<th>F1</th>
<th>S1</th>
<th>F2</th>
<th>S2</th>
</tr>
</thead>
<tbody>
<tr>
<td>501 (CM)</td>
<td>611 (QFT2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>541 (Adv SM)</td>
<td>620 (Gen Rel)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>610 (QFT1)</td>
<td>612 (Particle Physics)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>557 (EP)</td>
<td>515 (Graduate Lab)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>598 (Graduate Seminar)</td>
<td>599 (Graduate Seminar)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600 (TA)</td>
<td>600 (TA)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Doing the required courses as soon as possible

<table>
<thead>
<tr>
<th>F1</th>
<th>S1</th>
<th>F2</th>
<th>S2</th>
</tr>
</thead>
<tbody>
<tr>
<td>541 (Adv SM)</td>
<td>540 (SM)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>515 (Graduate Lab)</td>
<td>620 (Gen Rel)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>610 (QFT1)</td>
<td>611 (QFT2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>559 (Biological Dynamics)</td>
<td>551 (Nuclear Physic 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>598 (Graduate Seminar)</td>
<td>599 (Graduate Seminar)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600 (TA)</td>
<td>600 (TA)</td>
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</tbody>
</table>
# Course Requirements for Physical Biology

<table>
<thead>
<tr>
<th>Physics Track</th>
<th>Physical Biology</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY 505 (Electrodynamics)</td>
<td>PHY 505</td>
</tr>
<tr>
<td>PHY 511 (Quantum Mechanics)</td>
<td>PHY 511</td>
</tr>
<tr>
<td>PHY 540 (Statistical Mechanics)</td>
<td>PHY 540</td>
</tr>
<tr>
<td>PHY 600 (Teaching Practicum), two semesters</td>
<td>PHY 600, two semesters</td>
</tr>
<tr>
<td>PHY 501 (Classical Mechanics)</td>
<td>PHY 501 or PHY 512</td>
</tr>
<tr>
<td>PHY 512 (Quantum Mechanics)</td>
<td></td>
</tr>
<tr>
<td>PHY 515 (Methods of Experimental Physics)</td>
<td>Two semesters of PHY 584 (Lab Rotations)</td>
</tr>
<tr>
<td>PHY 598/599 (Graduate Seminar)</td>
<td>PHY 665 (Journal Club), 2 semesters</td>
</tr>
<tr>
<td>Two advanced courses</td>
<td>Two life science courses from an approved list</td>
</tr>
<tr>
<td></td>
<td>PHY 558 (Physical Biology)</td>
</tr>
<tr>
<td></td>
<td>PHY 559 (Biological Dynamics and Networks)</td>
</tr>
<tr>
<td></td>
<td>PHY 561 (Biology for Physical Scientists)</td>
</tr>
</tbody>
</table>
Master Program

- Master of Science Program in Instrumentation: Please contact Prof. Metcalf
- Master of Arts Program
  - No Thesis Option: 598 and 599 (Graduate Seminar)  
    Passing 28 credits of graduate courses  
    Passing the Comprehensive Exam at the Master level
  - Thesis option: 598 and 599 (Graduate Seminar)  
    Another graduate course approved by the GPD  
    A Master Thesis (with 25 research credits (590))

To be admitted to a PhD program, here or elsewhere, you have to do well in the courses and/or research.
Options for MA Degree

Option that prepares you for employment outside academia

<table>
<thead>
<tr>
<th>F1</th>
<th>S1</th>
</tr>
</thead>
<tbody>
<tr>
<td>514 (Instruments)</td>
<td>518 (Synchrotron Radiation)</td>
</tr>
<tr>
<td>562 (Lasers)</td>
<td>565 (AMO)</td>
</tr>
<tr>
<td>515 (Graduate Lab)</td>
<td>595 (Thesis Research (6 credits))</td>
</tr>
<tr>
<td>598 (Graduate Seminar)</td>
<td>599 (Graduate Seminar)</td>
</tr>
</tbody>
</table>

During the Summer of the First year: 595 (MA thesis research – 9 credits). You also may be able to transfer up to 6 credits.

Option that prepares for transfer to a PhD program

<table>
<thead>
<tr>
<th>F1</th>
<th>S1</th>
</tr>
</thead>
<tbody>
<tr>
<td>501 (CM)</td>
<td>540 (SM)</td>
</tr>
<tr>
<td>505 (EM)</td>
<td>515 (Lab)</td>
</tr>
<tr>
<td>510 (QM)</td>
<td>512 (QM)</td>
</tr>
<tr>
<td>555 (Solid State)</td>
<td>565 (AMO)</td>
</tr>
<tr>
<td>598 (Graduate Seminar)</td>
<td>599 (Graduate Seminar)</td>
</tr>
</tbody>
</table>

You can get 4 additional credits for Thesis research during the Summer or by registering for Seminars and the Colloquium.
Option for Advanced MA Degree

Option for advanced students

<table>
<thead>
<tr>
<th>F1</th>
<th>S1</th>
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</thead>
<tbody>
<tr>
<td>501 (CM)</td>
<td>611 (QFT)</td>
</tr>
<tr>
<td>610 (QFT)</td>
<td>622 (String Theory)</td>
</tr>
<tr>
<td>622 (String Theory)</td>
<td>620 (General Relativity)</td>
</tr>
<tr>
<td>541 (Adv SM)</td>
<td>680 (Quantum Computing)</td>
</tr>
<tr>
<td>598 (Graduate Seminar)</td>
<td>599 (Graduate Seminar)</td>
</tr>
</tbody>
</table>

During the Summer of the first year you take 4 credits of 585 (special study) to add up to 30 credits.
You can also take an additional course and register for seminars.
Course Evaluations

- Since two years course evaluations are electronic
- Please complete course evaluations. This helps faculty to improve their course and helps students to select courses
- If you teach please encourage your students to complete the evaluations, for the same reasons
- To see course evaluations go to
  https://tlt.stonybrook.edu/StudentServices/Evals/Pages/
Setting up a Proxy Server

- ssh -l yourstonybrookaccount -D 9501 graduat.physics.sunysb.edu
- Will ask for a password
- One your home computer open preferences of Firefox
- Go to Connection Setting
- Select Manual Proxy Configuration
- for SOCKS Host type in 127.0.0.1
- For portnumber type 9501 (same as above)
- Choose Socks v5
- Click ok
Exams

**Placement Exam:** This exam covers the core course. If you pass it you don’t have to take the core courses. Take it this week (this exam is only offered once a year). It has four parts corresponding to our four core courses and the problems are comparable to final exam problems in these courses.

**Comprehensive Exam:** This exam is offered twice a year. Most students take it in their second or third semester, but you can also take it next week. It covers “Breadth” and “Experiment” in atomic/molecular/optical physics, condensed matter physics, nuclear physics, particle physics and astronomy.

**Oral Exam:** The oral exam consists of a presentation of some approved and interesting topic in physics or astronomy to a committee of three faculty members and should be prepared with the guidance of one of them. Usually that person is going to be your advisor.
What If You Fail the Exam

Placement Exam: No problem, just take the course(s)

Fail the Course (less than a B): Repeat the course

Fail the Course for a second time: Petition for an oral exam or to do the placement exam. This requires approval of the Graduate Program Director.

The Comprehensive Exam: Take it again.

The Comprehensive Exam at the beginning of the fifth semester: Make sure you have an advisor; She may argue your case before the faculty to set up a special oral exam.
Research

Experimental/Observational

- Astronomy (Exoplanets, Neutron Stars)
- Atomic, molecular and optical physics (Cold Atoms, Ultrafast Lasers)
- Condensed matter experiment (Graphene, Electromagnetic Materials, Powders)
- High energy experiment (CERN-Atlas, Fermilab, Neutrino)
- Relativistic Heavy Ion Physics (RHIC)

Theoretical

- Astrophysics (computational, neutron stars)
- Atomic physics (Bose Einstein Condensation)
- Condensed matter (computational, strongly correlated electrons)
- Nuclear theory (QCD, Quark Gluon Plasma, Random Matrix Theory)
- YITP (particle theory, statistical mechanics, string theory)
- Simons Institute (mathematical physics, string theory)
- Laufer Center (physical biology, protein structure)
Research Outside the Department

Research at Brookhaven National Laboratory

- Accelerator and beam physics
- NSLS-II – may work before you finish
- Lattice QCD / nuclear theory
- Condensed matter theory

Marine Sciences

- Climate Studies
- Atmospheric Physics
How to Find an Advisor, Financial Support

Start early. Try to get a summer job after the first year

Talk to professors of the courses you are taking

Watch email / bulletin board postings about research opportunities

Go to Friday afternoon seminars

Get good grades in particular in the subject you are interested in

If possible, get into a research group by the end of the first year

If you have more than one option for advisor consider the following:

  The career path of former graduates of the group
  How long does it take to get a degree
  What is the stipend
Course Registration

Most of you will register for the following courses:

- PHY 501, Classical Mechanics (3 credits)
- PHY 505, Electromagnetism (3 credits)
- PHY 511, Quantum Mechanics (3 credits)
- PHY 598/599, Graduate Seminar (1 credit)
- PHY 600, Teaching Practicum (1 credit) (this is your TA assignment and is not a real class)
- PHY 698, Colloquium (1 credit) (you are strongly urged to come to the colloquium each week).

Exceptions:

- Astronomers: take PHY 522 (Interstellar Medium) or PHY 524 (Cosmology)
- Those who passed the placement exam are not required to take the core courses
Other Courses This Semester

PHY 515: Methods of Experimental Research (aka Graduate Lab)
PHY 523: Galaxies
PHY 541: Statistical Mechanics II (aka Advanced Statistical Mechanics)
PHY 552: Nuclear Physics II (breadth)
PHY 555: Solid State I (breadth)
PHY 557: Elementary Particle Physics (breadth)
PHY 559: Biological Dynamics and Networks (breadth)
PHY 610: Quantum Field Theory I
PHY 622: String Theory
PHY 655: Advanced Graduate Seminar
PHY 680: Group Theory for Physicists
PHY 688: The Dark Universe

PHY 571, PHY 573, PHY 576, PHY 578 are renumbered undergraduate courses and do not count as credit for a Master or Ph.D. degree. You may want to take these courses if you did not have an undergraduate course in these subjects. They count as credit, tough, for an MAT (Master of Arts in Teaching) degree.
The university classifies graduate students according to their G-status

**G1**: First year graduate student with less than 24 graduate credit hours, who is enrolled in a Master's degree or graduate certificate program.

**G2**: Advanced graduate student with more than 24 graduate credits, who is enrolled in Master's degree or graduate certificate program

**G3**: First year graduate student with less than 24 graduate credits, who is enrolled in a Ph.D. program.

**G4**: Advanced graduate student with more than 24 graduate credits, who is enrolled in a Ph.D. degree program

**G5**: Advanced graduate student in a Ph.D. program who is advanced to candidacy for the doctoral degree by the first day of classes of a semester or term

The conversion from G1 to G2 is automatic after completion of more than 24 graduate credits at Stony Brook. Same for the conversion from G3 to G4. Conversion from G4 to G5 is done by the graduate school.

A student is advanced to candidacy if all graduate school and departmental requirements other than the dissertation are completed. The Graduate Program Director sends a written notice to the Dean of the Graduate School to recommend advancement to candidacy which is then granted by the Dean of the Graduate School. Students must advance to candidacy at least one year before defending their thesis.
### Summary and Credits

<table>
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<tr>
<th>Status</th>
<th>Credit earned</th>
<th>Degree sought</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>&lt; 24</td>
<td>Master</td>
<td>12-18</td>
</tr>
<tr>
<td>G2</td>
<td>≥ 24</td>
<td>Master</td>
<td>9</td>
</tr>
<tr>
<td>G3</td>
<td>&lt; 24</td>
<td>Ph.D.</td>
<td>12-18</td>
</tr>
<tr>
<td>G4</td>
<td>≥ 24</td>
<td>Ph.D.</td>
<td>9</td>
</tr>
<tr>
<td>G5</td>
<td>all reqs</td>
<td>Ph.D.</td>
<td>9</td>
</tr>
</tbody>
</table>

If a course is offered for 0-3 credits, the workload is independent of the number of credits: Zero credit does not mean zero work.

Many courses are offered with variable credits (see graduate bulletin). By adjusting credits, you can get the right total number of credits.

Swapping courses: change registration between courses with an equal number of credits.

By taking courses with zero credit, the department knows that you have fulfilled the requirement.
If you take courses outside the department, you need permission from the graduate program director.

After having advanced to candidacy you should register for 9 credits in PHY 699 (research). Explicit permission to register for others courses requires permission by the graduate program director.
Deadlines

August 26: You must have registered for at least one credit by midnight of this date – otherwise it will cost you real money.

August 27: First day of classes.

August 29: 5.30 pm, Comprehensive Exam in P131 (Math).

September 2: Last day to drop classes – if you exceed the total number of credits you could be liable for tuition. You still can add or swap classes.

September 3-4: Labor Day Holiday.

September 11: Last day to drop classes without a W

September 11: Last day to swap classes

September 11: Last day to drop classes

September 14: Department Picnic, 4-7 pm on West Meadow Beach

September 18: Last day to add classes

See: http://ws.cc.stonybrook.edu/registrar/calendar-academic.shtml for a complete academic calendar.
Living on Long Island

Team up with other students to get off-campus housing

Get a bicycle

Get a car (or a friend with a car). Working at BNL is not possible without a car.

Use opportunities on campus:

- Staller Center (concerts, movies, recitals)
- Gym, squash, racket ball, swimming, running, tennis
- Soccer
- Summer Keg
- Starbucks
- University Cafe

West Meadow Beach

NY City
What Does it Take to Become a First Class Physicist or Astronomer?

- Think independently
- Step back to analyze the big picture
- Don’t accept any ‘truth’ from any authority unless you have verified it yourself
- Question everything
- Work on hard problems