PROPOSED CHANGES TO GRADUATE PROGRAM TEMPLE PHYSICS

Graduate Program Committee: John Perdew, Peter Riseborough, Nikos Sparveris, Andreas Metz, Adrienn Ruzsinszky (January 2019)

Executive Summary: These proposed changes to the Temple Physics graduate program received unanimous support at the Physics departmental meeting of Jan. 16, 2019. They are based on agreement between the Department’s analysis and that of the External Review Committee (page 2), and on a survey of what other physics departments do (page 3).

Because our Department requires so many specific courses for the Ph.D. degree, our students are almost unable to take elective courses in graduate-level physics, including courses that would be helpful for their research specializations. To address this, we would no longer require three courses that most other departments do not require. These courses are currently titled PHYS 5302 Electromagnetic Theory II, PHYS 5502 Mathematical Physics II, and PHYS 8702 Advanced Quantum Mechanics. These courses (with new titles) would be included in a set of seven courses (page 6) that would meet a new two-elective requirement. Which elective courses would be offered in a given year would be determined by the Chair’s evaluation of student demand and faculty supply. The proposed sequence of courses is presented on pages 5 to 7. No new course is being proposed.

We (and CST) want our doctoral students to complete their dissertations within six or fewer years of graduate work. To achieve this, we want all our students to start or at least sample research in the second year of graduate study, and to defend a dissertation proposal by the end of the fifth semester. To this end, we also propose to change the Ph.D. Qualifying Exam. The written part would be moved from the end of the third semester to just before the beginning of the third semester, and would be based on the six core courses taken in the first two semesters. The oral part of the qualifying exam would be moved typically to the end of the fifth semester, and would become an Early Research Progress Exam in which the student would present the research proposal to a putative dissertation committee. A student who passes this exam is elevated to candidacy for the Ph.D. One who does not would get a second chance six months later. To protect the rights of the student, the Chair or Graduate Chair would attend this second-chance exam.
Although the consequences of the oral exam remain as important as always, we believe that the new oral exam will be much less stressful for the student. The exam will cover a limited topic, the student’s research proposal and research progress, and the examiners will be known by the student. The examiners may even make helpful suggestions for the research.

Relevant recommendations from the External Review Committee:
Campuzano, Hertzog, Skillman, Hill (January 2018)

“The number of required courses is quite high compared to peer institutes, and this is after a recent reduction by one course. … Currently, with all the required courses, there is almost no room for electives (and a given student might benefit from a course outside of physics, e.g., statistics or computer science).”

“Looking forward, if the program is successful in expanding its AMO effort and expanding into astrophysics, there will be room for more advanced classes in these fields. The program should discuss a transition into a curriculum with more elective courses and fewer required courses. It would appear that one place that would afford such flexibility is to convert the three-semester sequence in quantum into a two-semester sequence, and to convert the two-semester sequence in electricity and magnetism into a one semester course. There are obvious losses in doing so, but, in both cases, this would align the program with what is typical in other physics graduate programs, and provide the most likely path forward to achieving the desired change.”

“The Committee strongly suggests that the oral component of the qualifier exam be dropped. … These random question oral exams have fallen into disfavor nationally, and The Committee is not aware of any other programs using them today. It is difficult to prepare for such an exam and these stressful situations have been compared to hazing. … The program might consider adding an oral exam in the third year, after the student has sufficient research experience to present and defend their research.”

The Temple Graduate Program Committee agrees with these suggestions, and proposes a detailed plan to implement them. We want our students to be able to take advanced elective courses, and to start or at least sample research in the second year of graduate study. The following table is from us:
Comparison of PhD course requirements in Physics (2019)

<table>
<thead>
<tr>
<th>University.</th>
<th>Temple (current)</th>
<th>Temple (proposed)</th>
<th>Pitt</th>
<th>Penn State</th>
<th>Cornell</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRC 2010 PhD program rank.</td>
<td>128-155</td>
<td>23-80</td>
<td>4-21</td>
<td>8-35</td>
<td></td>
</tr>
</tbody>
</table>

Course:

<table>
<thead>
<tr>
<th>Course</th>
<th>Temple</th>
<th>Temple</th>
<th>Pitt</th>
<th>Penn State</th>
<th>Cornell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyt. Mech.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>EM Theory I</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Math. Phys. I</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Quantum Mech. I</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Quantum Mech. II</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Stat. Mech.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Math. Phys. II</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EM Theory II</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adv. Quantum Mech.</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solid State Phys.</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elem. Particle Phys.</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colloquium</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teaching practicum</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research &amp; ethics</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prelim. Prep.</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adv. Lab.</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Required electives</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>3*</td>
</tr>
<tr>
<td>Semesters before prelim.</td>
<td>3</td>
<td>2</td>
<td>2-4</td>
<td>2</td>
<td>1-3</td>
</tr>
<tr>
<td>Oral component of prelim.</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

*or more, depending on the subfield and special committee
PROPOSED CHANGES TO THE PHYSICS GRADUATE PROGRAM

Temple University Physics: Required Courses for the Ph.D.

Current Required Courses, December 2018 (credits):

*Semester 1*
PHYS 5101 Analytical Mechanics (3)
PHYS 5301 Electromagnetic Theory I (3)
PHYS 5501 Mathematical Physics I (3)
PHYS 8001 Practicum Teaching of Physics (1)

*Semester 2*
PHYS 5302 Electromagnetic Theory II (3)
PHYS 5502 Mathematical Physics II (3)
PHYS 5701 Quantum Mechanics I (3)
PHYS 5002 Physics Research and Ethics (1)

*Semester 3*
PHYS 5702 Quantum Mechanics II (3)
PHYS 8102 Statistical Mechanics (3)
PHYS 9994 Preliminary Exam Preparation (1)
Preliminary Exam (written and oral, on courses)

*Semester 4*
PHYS 8701 Advanced Quantum Mechanics (3)
PHYS 8702 Solid State Physics (3)
PHYS 8703 Introduction to Elementary Particles Physics (3))

*Beyond Semester 4*
PHYS 9998 Pre-Dissertation Research/Elevation to Candidacy (4)
Analysis: This curriculum makes it difficult for students to take advanced courses in their fields of research specialization, because there are too many required courses and because students on RA’s can only take courses if their faculty advisors pay their tuition from grants. The curriculum also slows the entry of graduate students into research, which must happen earlier now that they have typically only six years to complete the degree.

Conservative proposal for curricular change: Replace some required courses by a required menu selection of electives. Electromagnetic Theory II, Mathematical Physics II and Advanced Quantum Mechanics would remain as electives, with changes in course titles.

Proposed Required Courses (credits): (with no course not already in the catalog, and no course removed from the catalog)

Semester 1
PHYS 5101 Analytical Mechanics (3)
PHYS 5501 Mathematical Physics (3)
PHYS 5701 Quantum Mechanics I (3)
PHYS 8001 Practicum Teaching of Physics (1)

Semester 2
PHYS 5301 Electromagnetic Theory (3)
PHYS 5702 Quantum Mechanics II (3)
PHYS 8102 Statistical Mechanics (3)
PHYS 5002 Physics Research and Ethics (1)

Ph.D. Qualifying Exam (written part, on core coursework) by end of summer
Two elective courses must be taken, but more are allowed. Full-time students with assistantships must take at least 6 credits per semester until all required courses have been completed. {Students with research assistantships cannot take courses other than PHYS 9998 and 9999 without arrangement to pay tuition. Students need to find financial support, typically as research assistants, by the end of Semester 4. }

**Semester 3**

PHYS 8702 Solid State Physics (3)

PHYS 8703 Nuclear and Elementary Particle Physics (3)

(These courses can be substituted by other PHYS 870x courses that present an entire subfield of modern physics and may be developed in the future.)

Informal research rotations begin

**Semester 4** (Students selecting electives should consult with their research or graduate advisors. A list of electives that meet this requirement follows.)

Elective 1 (3)

Elective 2 (3)

PHYS 9994 Preliminary Exam Preparation (1) (early research)

**Beyond Semester 4**

PHYS 9994 Preliminary Exam Preparation (1) (early research)

Early Research Progress Exam (the oral part of the Qualifying Exam), preceding elevation to candidacy. This exam and the elevation to candidacy should ordinarily not occur later than the end of the fifth semester.

PHYS 9998 Pre-Dissertation Research/Elevation to Candidacy (1/semester)

(Most students will not take PHYS 9998, because they will be elevated to candidacy upon completion of PHYS 9994.)

PHYS 9999 Dissertation Research (1/semester)
Total required credit hours: 32 credit hours of PHYS non-999x or non-research courses, and at least 6 credit hours of research courses PHYS 9994 + 9998 + 9999 (with a minimum of 2 credit hours from PHYS 9999)

*Courses meeting the two-elective requirement (not offered every year):*

PHYS 5502 Computational and Mathematical Physics (3)
PHYS 5302 Advanced Electromagnetic Theory (3)
PHYS 8020 Topical Seminar (3)
PHYS 8701 Quantum Field Theory (3)
PHYS 8704 Many-Electron Theory (3)
PHYS 8705 Advanced Topics in Nuclear and Particle Physics (3)
PHYS 8702 Solid State Physics or PHYS 8703 Nuclear and Elementary Particle Physics (if not taken before)
Other 870x courses to be developed in the future

*Changes of course title:*

PHYS 5101 Analytical Mechanics I -> PHYS 5101 Analytical Mechanics
PHYS 5501 Mathematical Physics I -> PHYS 5501 Mathematical Physics
PHYS 5502 Mathematical Physics II -> PHYS 5502 Computational and Mathematical Physics
PHYS 5301 Electromagnetic Theory I -> PHYS 5301 Electromagnetic Theory
PHYS 5302 Electromagnetic Theory II -> Advanced Electromagnetic Theory
PHYS 8020 Topical Seminar II -> PHYS 8020 Topical Seminar I
PHYS 8030 Topical Seminar III -> PHYS 8030 Topical Seminar II
PHYS 8701 Advanced Quantum Mechanics -> PHYS 8701 Quantum Field Theory
Changes of course description

PHYS 5701 Quantum Mechanics I {Remove the PHYS 5101 prerequisite}

New course

PHYS 5000 Topical Seminar {a graduate course, open to undergrads by permission}

Changes in qualifying exam: {The written part, on the six core graduate courses and on undergraduate physics, will be given at the end of the summer of the first year. The students will have access to sample written exams. The oral part or Early Research Progress Exam, given by the student’s research committee, will occur at the end of the 5th semester or earlier, preceding elevation to candidacy. A student who fails this exam has a second chance 6 months later. The Department Chair or Graduate Chair will be present for the second attempt.}

Changes in M.S. requirements: {Required courses PHYS 5302 Electromagnetic Theory II and PHYS 5502 Mathematical Physics II will be replaced by PHYS 8702 Solid State Physics and PHYS 8703 Nuclear and Elementary Particle Physics, or other PHYS 870x courses that present an entire subfield of modern physics and may be developed later. The 30-credit requirement will remain unchanged. For the “coursework-only track”, the written part of the qualifying exam will be given in the summer at the end of the first year, and based upon the six core courses offered in the first year.}

PHYS 5000 Topical Seminar. 3 Credit Hours

This course considers special topics in Physics, not considered in our other courses.

Level registration restrictions: Must be enrolled in one of the following levels: Graduate. But open to advanced undergraduates by permission of the instructor.

Repeatability: This course may not be repeated for additional credits.

Effective dates: These changes will apply to students admitted in Fall 2019 and later.