MS Program

Physics Department

College of A&S

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Primary Faculty:

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I. Program Overview

The Physics MS program prepares students with a Physics BS degree (or the equivalent) to understand, analyze, and explain published physics and physics-related research. This provides the necessary background for the student to start original physics or physics-related research, or to contribute productively to research in other quantitative disciplines. Our program aims to train students to use analytical and experimental skills to formulate and solve problems as part of a team, and to effectively and honestly communicate their research. There is a non-thesis and a thesis option in the MS program. The typical path a student entering with a Physics BS degree will follow is to take 2 years’ worth of courses that introduce the student to the fundamental techniques of the major physics subdisciplines (astrophysics, particle physics, and condensed matter physics) at the level necessary to begin original research. For the non-thesis option, the student’s mastery of these basic techniques is tested in two written qualifier exams, typically taken by the end of the second year. The MS is awarded if the student successfully completes these exams at a high enough level (“pass at the MS level”). For the thesis option, starting in the second year the student explores an original research problem under the direction of a faculty advisor. The aim of this research exploration is to produce and write-up a current literature review and detailed research proposal. This review and proposal is presented at the MS thesis defense to the faculty advisor and other physics faculty members.

II. Program Outcomes

Existing P-1 form program learning outcomes (PLOs):

1) Develop knowledge across the subdisciplines of physics beyond that expected for a baccalaureate degree in physics.
2) Students in the thesis option will develop expertise at a level appropriate to the Master’s degree in the area of physics through substantive work on an original research project.
3) Students in the non-thesis option will develop a broad knowledge in multiple areas of physics at a level appropriate to the Master’s degree through extensive advanced coursework.
4) Students will develop their mathematical and computational tools for analyzing and describing physics.
5) Students will be prepared for PhD level research.
6) Students will develop communication skills using research level physics nomenclature.

Revised PLOs:

Upon completion of the physics MS program, students will be able to:

1) identify and describe the broad fundamental concepts of physics;
2) analyze physics problems using fundamental physics concepts and appropriate mathematical models;
3) solve physics problems using analytic, computational, observational, or experimental methods;
4) present clearly organized oral explanations of physics topics at a level appropriate to the audience at hand;
5) recognize and practice ethical behavior in the conduct of science.
### III. Curriculum/Program Map

<table>
<thead>
<tr>
<th>PLO</th>
<th>7000</th>
<th>8000</th>
<th>8090 8091</th>
<th>TA eval</th>
<th>Qual I</th>
<th>Qual II</th>
<th>Ethics wkshps</th>
<th>NSF ethics exam</th>
<th>8072</th>
<th>Posters</th>
<th>MS Defense</th>
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<tbody>
<tr>
<td>#1</td>
<td>E</td>
<td>D</td>
<td>D</td>
<td>A</td>
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<td>#3</td>
<td>E</td>
<td>D</td>
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<td>A</td>
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<tr>
<td>#4</td>
<td>E</td>
<td>D</td>
<td>D/A</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>A</td>
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<td>#5</td>
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<td>E/D</td>
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**Key:**
- **PLO** = Program Learning Outcomes, see part I
- **E** = Emerging, **D** = Developing, **A** = Assessed

**Curriculum components:**
- **7000** = Block of 7000-level courses (1st year)
- **8000** = Block of 8000-level courses (2nd year and beyond, specialized topics)
- **8090, 8091** = Advanced seminar and colloquium courses
- **TA eval** = Student evaluations of graduate teaching assistants
- **Qual I** = part I of the qualifier exam (typically end of 1st year)
- **Qual II** = part II of the qualifier exam (typically in the 2nd year)
- **Ethics wkshps** = “Ethics in teaching” and “Ethics in research” yearly departmental workshops (required of all students)
- **NSF ethics exam** = National Science Foundation online ethics exam
- **8072** = Research for the MS (only for MS thesis option)
- **Posters** = poster presentations in department poster contest (only for MS thesis option)
- **MS defense** = Final MS thesis defense (only for MS thesis option)
IV. Methods and Measures

Assessment tools. The following materials are used for assessment:

a) final exam performance in the 7000 and 8000 block courses
b) attendance and participation scores for advanced seminars and colloquium courses
c) student evaluations of graduate teaching assistants
d) grades on the quals I & II (fail, pass at MS level, pass at PhD level)
e) participation in the “Ethics in teaching” and “Ethics in research” physics department workshops
f) result of the NSF online ethics exam (pass or fail)
g) grades in “Research for the MS” (satisfactory or unsatisfactory progress)
h) judges’ evaluations of department poster session presentations
i) result of the MS thesis defense (pass or fail)

Assessment methods.

Each instructor will use (a) to rank each student as “needs improvement”, “meets expectations”, or “exceeds expectations” with respect to PLOs #1-3 at the level shown in part II above. A common evaluation rubric will be developed by the graduate committee for the 7000 and 8000-level core courses, and collected by the GAC each semester (see section V below).

Program assessment goal (PAG): 90% of students on average meet or exceed expectations of progress to the stated PLOs.

The seminar and colloquium course instructors will use (b) to rank each student as “needs improvement”, “meets expectations”, or “exceeds expectations” with respect to PLOs #1 & #4 at the level shown in part II above.

PAG: 90% of students on average meet or exceed expectations of progress to the stated PLO.

Teaching performance feedback in (c) will be used to rank each student as “needs improvement”, “meets expectations”, or “exceeds expectations” with respect to PLO #4 at the level shown in part II above.

PAG: 90% of students on average meet or exceed expectations of progress to the stated PLO.

The qualifier exam subcommittee (QES) of the graduate committee will use (d) as a final assessment of PLOs #1-3. For students not taking the MS thesis option (d) will also be used as the final assessment of PLO #4.

PAG: 75% of students will achieve PLOs #1-4.

Grades and judges’ evaluations for (g) & (h) will be used to determine progress towards PLO #4 for MS thesis option students at the level shown in part II above.

PAG: 95% of MS thesis option students will meet or exceed expectations of progress to the stated PLO.

Each student’s thesis committee will use (i) as a final assessment of PLO #4 for MS thesis option students.

PAG: 95% of MS thesis option students will achieve PLOs #4.

The Graduate Assessment Coordinator (GAC) (see part IV below) will use (e) to assess students’ progress toward PLO #5, and will use (f) as a final assessment of PLOs #5.

PAG: 100% of students will achieve PLO #5.
The use of the assessment tools and methods is summarized in the table below:

<table>
<thead>
<tr>
<th>PLO</th>
<th>Assessment Tool and stage (E, D, A) of assessment</th>
<th>Course(s) where assessment occurs</th>
<th>Timeline</th>
<th>Person Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>(a), (b): E,D (d): A</td>
<td>7000-level courses (E)*</td>
<td>(a), (b): end of each semester (d): 1st or 2nd year.</td>
<td>faculty teaching courses, GPD, QES, GAC.</td>
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<td>8000-level courses (D)* qual I exam (A)</td>
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<td>#2</td>
<td>(a), (b): E,D (d): A</td>
<td>7000-level courses (E)*</td>
<td>(a), (b): end of each semester (e): 1st or 2nd year.</td>
<td>faculty teaching courses, GPD, QES, GAC.</td>
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<td>8000-level courses (D)* qual II exam (A)</td>
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<tr>
<td>#3</td>
<td>(a), (b): E,D (d): A</td>
<td>7000-level courses (E)*</td>
<td>(a), (b): end of each semester (e): 1st or 2nd year.</td>
<td>faculty teaching courses, GPD, QES, GAC.</td>
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<td>8000-level courses (D)*</td>
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<tr>
<td>#4</td>
<td>(b): E (c), (g), (h): D (d), (i): A</td>
<td>8090 &amp; 8091 courses (E)</td>
<td>(b), (c), (g): end of each semester (d): 2nd year (h): yearly.</td>
<td>faculty teaching courses, GPD, QES, GAC.</td>
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<td>8072 course (D) TA evaluations (D)</td>
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<td>Poster competition (D) thesis defence (A)</td>
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<tr>
<td>#5</td>
<td>(e): E,D (f): A</td>
<td>teaching ethics wkshp (E)</td>
<td>(e): 1st and 2nd year.</td>
<td>GAC.</td>
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<tr>
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<td>research ethics wkshp (D) NSF ethics exam (A)</td>
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</table>

* A common evaluation rubric will be developed by the graduate committee for the 7000 and 8000-level core courses, and collected by the GAC each semester (see section V below).

IV. Assessment Infrastructure

The graduate director will appoint each year a “graduate assessment coordinator” (GAC) whose role will be to collect all the material described in part III above. The graduate program coordinator (in the front office) will help the GAC to organize and store these records.

A subcommittee of the graduate committee, headed by the GAC, will analyze the collected material at the end of each academic year and prepare a report describing progress at each level (E, D, A) towards each PLO. This will be done by computing the absolute numbers and percentage of each relevant student cohort (as determined in the table in part II), which has progressed “more slowly than expected”, “at the expected rate”, or “more quickly than expected” towards the given level of each PLO.

This subcommittee will also be responsible for organizing a schedule of faculty reviews of the selection of student course work used in the assessment material (a) in the list in part III above. These reviews will be used by the subcommittee to identify any potential mismatches between the program curriculum and to recommend changes in course learning outcomes.

The above report and recommendation will be distributed to the full physics faculty for discussion and possible action.
V. Findings

Here you will describe and explain in this section any multi-year patterns and trends that your assessment efforts have identified, including a description of any relevant relationships to national standards.

N/A

VI. Use of Findings

In this final section, you will describe how your program intends to make use of the program-level assessment data it has gathered.

- How will this information be presented to and discussed among the faculty?
- How might this data or these discussions result in review and possible revision of course or program learning outcomes and pedagogical strategies?

See section IV above.