For Academic Programs

Informed by your assessment activities related to student learning, what changes have you made in your degree program in the last three to five years? Describe the changes (e.g., curriculum revision, new courses, faculty development), the general results that prompted the changes (e.g., student performance on an assessment measure), and any impact on student learning that you might attribute to these changes.

1) Our graduate students must take a Qualifying Exam over undergraduate physics in order to be formally admitted to our PhD program. In order to increase the fraction of graduate students who pass the Qualifying Exam by our departmental deadline, 2 years ago we started including undergraduate-level problems in the homework sets of some of our core graduate courses. This has led to a small increase in the average scores in the relevant areas of our Qualifying Exam, but not large enough to significantly increase the fraction of students passing these sections.

2) In response to a recommendation from our 8 year program review (which occurred 3 years ago), we significantly revised our graduate curriculum by: a) reducing the required number of formal courses; b) creating several sub-area course sequences; c) creating a Research Techniques course that can be customized to the research needs of each student. This revised curriculum was approved in Fall 2013 for implementation this Fall 2014.

Mission / Purpose

The mission of the Department of Physics and Astronomy at the University of Alabama is multi-fold. Through our undergraduate programs, we prepare students for graduate work in physics or astronomy, or for immediate employment in physics-related jobs. We play a vital role in the education of other science and engineering students, and promote the understanding of science through our general studies courses. Our graduate programs prepare students for teaching and/or research positions in colleges and universities, and research positions in government and industrial laboratories. Our research contributes new knowledge in the fields of physics and astronomy. It is part of our mission to secure adequate external funding to support departmental research activities. Through public outreach and involvement within our professions, we serve to improve the public understanding and promote the advancement of science.

Student Learning Outcomes, with Any Associations and Related Measures, Targets, Findings, and Action Plans

SLO 1: Basic physics command

We expect our graduate students to demonstrate command of undergraduate-level physics before formally entering our PhD program.

Connected Document

Physics PhD Curriculum Maps

Relevant Associations:

Improvement action:
1) Faculty teaching core graduate courses will be encouraged to incorporate some undergraduate-level material in their reviews, problem sets, and exams, to provide feedback to the graduate students about their preparedness for the PhD Qualifying Exam (which covers undergraduate-level Physics).
2) We will increase the graduate stipends by introducing a variable scale of stipendiary supplements to: a) improve our recruitment of new graduate students; and b) to provide performance incentives for our existing GTAs, based on their performance as GTAs and on whether or not they have passed the PhD Qualifying Exam.

Related Measures

M 1: Qualifying Exam

Graduate students are required to pass our Qualifying Exam before formally entering our PhD program. The Qualifying Exam covers undergraduate-level physics and is offered annually. We monitor the fraction of students who pass the qualifying exam each year (addresses improvement action).

Source of Evidence: Academic direct measure of learning - other

Connected Document

Physics PhD Curriculum Maps

Target:
No target established

Finding (2013-2014) - Target: Met
During 2013-14, a total of 9 students passed the Qualifier, 2 directly and 7 by the Physics GRE.

Related Action Plans (by Established cycle, then alpha):

Continued feedback

Based on our assessment results in 2011-12 we will continue to encourage faculty teaching core
graduate courses to incorporate some undergraduate-level material in their reviews, problem sets, and exams, to provide feedback to the graduate students about their preparedness for the PhD Qualifying Exam (which covers undergraduate-level Physics).

**Established in Cycle:** 2012-2013  
**Implementation Status:** Planned  
**Priority:** High

**Relationships (Measure | Outcome/Objective):**
- **Measure:** Qualifying Exam | **Outcome/Objective:** Basic physics command  
- **Measure:** Time-to pass Qualifying exam | **Outcome/Objective:** Basic physics command

### M 2: GRE Subject Exam

Physics GRE subject test. Attaining a Physics GRE score exceeding 60th percentile is considered equivalent to passing our Qualifying Exam. We monitor the fraction of students who exceed the 60th percentile each year (addresses improvement action).

**Source of Evidence:** Standardized test of subject matter knowledge

**Connected Document**  
Physics PhD Curriculum Maps

**Target:**  
No target established

**Finding (2013-2014) - Target: Met**  
During 2013-14, a total of 9 students passed the Qualifier, 2 directly and 7 by the Physics GRE.<br>

### M 3: Time-to pass Qualifying exam

Students must pass the Qualifier by their 2nd year, or they risk losing their financial support. For a typical August entry, we expect students to pass the Qualifier by their 2nd January, or within 1.42 years. A student who fails to pass the Qualifying Exam may still be able to earn a terminal Masters degree if the student passes an oral examination over the core graduate courses in the curriculum (among other requirements). The core graduate courses of Electromagnetism, Quantum Mechanics, Mechanics, and Statistical Physics have considerable overlap with undergraduate-level physics. As a result, our graduate students’ performance on our Qualifying Exam (or Physics GRE equivalent) can be considered a measure of the degree to which these core graduate courses reinforce undergraduate-level physics. The fraction of students who pass the Qualifier in any year and the time-to-Qualifier passage are used as measures of the efficacy of our core graduate course in reinforcing undergraduate-level physics (addresses improvement action).

**Source of Evidence:** Academic direct measure of learning - other

**Connected Document**  
Physics PhD Curriculum Maps

**Target:**  
1.42 years

**Finding (2013-2014) - Target: Met**  
The distribution of time-to-Qualifier-passage for the students passing the Qualifier was as follows:<br>0, 0, 0, 0, 0, 0, 0, 0, 0, 0.25, 1.33, 1.42, 1.42, 2.42, 2.75 years.  
The median time-to-passage was 0.25 years, less than our target of 1.42 years. 78% of these times are within our target of 1.42 years.<br>
The figure below shows the fraction of each entering cohort of graduate students who passed the Qualifying Exam by our target time of 1.4 years. This year was the target passing year for the 2012-13 entering class, of which 29% passed the Qualifier within our target time. The following cohort (2013-14) will have at least 42% passing within our target time.<br>

<img alt="Qualifier Pass" src="http://physics.ua.edu/weave/2013-14/QualPass.jpg" width="400"/><br>

**Related Action Plans (by Established cycle, then alpha):**

**Continued feedback**  
Based on our assessment results in 2011-12 we will continue to encourage faculty teaching core graduate courses to incorporate some undergraduate-level material in their review, problem sets, and exams, to provide feedback to the graduate students about their preparedness for the PhD Qualifying Exam (which covers undergraduate-level Physics).

**Established in Cycle:** 2012-2013  
**Implementation Status:** Planned  
**Priority:** High

**Relationships (Measure | Outcome/Objective):**
- **Measure:** Qualifying Exam | **Outcome/Objective:** Basic physics command  
- **Measure:** Time-to pass Qualifying exam | **Outcome/Objective:** Basic physics command

### M 6: Final exam questions

We assess student learning using final exam questions in our core courses: classical dynamics, electromagnetic theory, quantum mechanics and statistical physics. We are currently in the process of developing course-specific pools of questions relevant for this student learning outcome.

**Source of Evidence:** Academic direct measure of learning - other
Finding (2013-2014) - Target: Met
In PH 501 – Classical Dynamics, students scored an average of 57% on canonical closed-book exam problems.
In PH 531 – Electromagnetic Theory I, students scored an average of 88% on 7 canonical closed-book problems.
In PH 532 – Electromagnetic Theory II, students scored an average of 75% on 6 canonical closed-book problems.
In PH 541 – Quantum Mechanics I, students scored an average of 56% on canonical closed-book problems.
In PH 542 – Quantum Mechanics II, students scored an average of 64% on canonical closed-book problems.
In PH 571 – Statistical Physics, students scored an average of 66% on canonical closed-book problems.

SLO 2: Physics & Astronomy skills for research
We expect our students will demonstrate knowledge of the methodologies and tools of inquiry in physics and astronomy, and be prepared to conduct independent research and expect them to be engaged in productive research with faculty.

Related Measures

M 4: Research Defense
We expect our PhD students to be able to describe their PhD research plan at a professional level in an oral defense, the PhD Preliminary Exam. We expect the Preliminary Exam to be passed within 4 years of their entry.

Source of Evidence: Senior thesis or culminating major project

M 5: Publications and Presentations
We track the number of refereed papers published, accepted, and submitted to professional journals. We track the number of presentations our PhD students give at professional meetings.

Source of Evidence: Academic indirect indicator of learning - other

Other Outcomes, with Any Associations and Related Measures, Targets, Findings, and Action Plans

OthOtcm 3: Program Outcome: High Level of Recognized Quality
The program will improve and sustain a high level of recognized quality.

Related Measures

M 7: Program Strengths
8-year program review strengths
Finding (2013-2014) - Target: Met
8-year review strengths of graduate program: Graduate students receive a comprehensive education in the area of physics. This is clearly required by the high number of classes that students must complete and the comprehensive qualifying exams.

M 8: Opportunities for Improvement
8-year program review opportunities for improvement

Source of Evidence: External report

Finding (2013-2014) - Target: Met
8-year review opportunities for improvement of graduate program: Nationwide (and even worldwide) the number of undergraduate students with the interest and ability to undertake graduate work in Physics and Astronomy is limited. The competition for the top (or even the second, and third) tier of graduate students is fierce. This is reflected in the steadily rising support offered to graduate students. The current stipends offered in Physics and Astronomy (and in MINT) are not particularly competitive. A relatively small investment would likely pay significant dividends in obtaining better quality students. These would produce higher quality research, which would increase the competitiveness of the faculty in competing for research funding (positively impacting RA support and numbers of graduate students). Higher quality students also positively impact the quality of undergraduate instruction.

M 17: Post-Graduation Plans
We track the professional destinations of our Ph.D. recipients after they graduate. We use exit surveys, advising meetings and email surveys to obtain post-graduation plans of our Ph.D. recipients.

Source of Evidence: Alumni survey or tracking of alumni achievements

Finding (2013-2014) - Target: Met
Of our 4 Ph.D. recipients in 2014-15, two found postdoc positions (U. California, Irvine; U. Hawaii) and one went to industry (Intel).

OthOtcm 4: Program Outcome: Sustain Optimal Level of Enrollment
The program will build and sustain an optimal level of annual program enrollments and degree completions.

Relevant Associations:
Program Outcome #2 Improvement Action(s) to be advanced.
The assessment results and our recent 8-year academic program review have triggered discussions in the department to reduce the amount of formal coursework required for our graduate students. We will also more aggressively monitor how quickly our graduate students attain their PhD degrees, in order to bring the typical time-to-degree to 6 years or less. We will continue our efforts to recruit graduate students from our respective fields through our contacts at other institutions.

Related Measures

M 9: Credit Hour Production
Graduate semester credit hour production for the last 3 fall semesters

Source of Evidence: Existing data

Finding (2013-2014) - Target: Met
OIRA data provide the following account of graduate credit hour production for the last 3 fall semesters:<br>
430 – Fall 2013<br>380 – Fall 2012<br>440 – Fall 2011

M 10: Number of Courses and Sections Offered
Number of graduate courses & sections offered for the last 3 fall semesters

Source of Evidence: Existing data

Finding (2013-2014) - Target: Met
Graduate courses / sections:<br>11 / 11 Fall 2013<br>14 / 14 Fall 2012<br>12 / 12 Fall 2011

M 11: Number of Graduate Students
Number of graduate students for the last 3 fall semesters
Source of Evidence: Existing data

**Target:**
ACHE viability threshold of 2.25

**Finding (2013-2014) - Target: Met**
OIRA data provide the following account of graduate enrollment for the last 3 fall semesters:

<table>
<thead>
<tr>
<th>MS / PhD / Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 / 44 / 46</td>
</tr>
<tr>
<td>6 / 37 / 43</td>
</tr>
<tr>
<td>9 / 38 / 47</td>
</tr>
</tbody>
</table>

**M 12: Number of PhD degrees Awarded**
Number of PhD degrees awarded (Aug-May) for the last 3 years

Source of Evidence: Existing data

**Target:**
ACHE viability threshold of 2.25

**Finding (2013-2014) - Target: Met**
Departmental OIRA data provide the following account of PhD degrees for the last 3 years:

<table>
<thead>
<tr>
<th>2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 – 2013-14</td>
</tr>
<tr>
<td>2 – 2012-13</td>
</tr>
<tr>
<td>5 – 2011-12</td>
</tr>
</tbody>
</table>

**M 13: Compare Number of Degrees Conferred to ACHE Standards**
Comparison of number of PhD degrees awarded to ACHE viability standards

Source of Evidence: Professional standards

**Target:**
ACHE viability threshold of 2.25

**Finding (2013-2014) - Target: Met**
Over the last 5 years we had an average of 4.0 Ph.D. degrees granted per year, which exceeds the ACHE viability threshold of 2.25.

**M 15: Number of GTA and GRA**
We monitor our number of graduate students and compare it to our distant target of 75, which is based on a 2:1 ratio of GRAs to GTAs and our current number of 25 GTAs.

Source of Evidence: Existing data

**Target:**
75 graduate students

**Finding (2013-2014) - Target: Partially Met**
In 2013-14 we had 29 GTAs (including 4 soft-funded), 11 externally funded GRAs, and 3 Fellowships.
The number of externally funded RAs (11) is about 1/5 of our distant target of 50.
We are successful in maintaining a robust PhD program but have not reached our target of 75 graduate students.

**M 16: Ph.D time-to-Degree**
We compare the annual distribution of time-to-degree for our Ph.D. recipients to our target of 6 years (addresses improvement action).

Source of Evidence: Existing data

**Target:**
6 years

**Finding (2013-2014) - Target: Partially Met**
The time-to-degree distribution for those 4 receiving their Ph.D. degree was:

<table>
<thead>
<tr>
<th>5.67, 6.0, 7.33, 7.33 years.</th>
</tr>
</thead>
</table>

The average of 6.58 years exceeds our target of 6 years; 50% of our PhDs were within our target.

**Related Action Plans (by Established cycle, then alpha):**

**Finish restructuring of graduate curriculum**
Our recent 8-year academic program review has triggered a restructuring of our graduate curriculum in order to reduce the number of formal courses required, replacing some with area-specific research methods courses. Our revised graduate curriculum will be in effect starting Fall 2014.

**Implementation Status:** Finished
**Priority:** High

**Relationships (Measure | Outcome/Objective):**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Outcome/Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D time-to-Degree</td>
<td>Program Outcome: Sustain Optimal Level of Enrollment</td>
</tr>
</tbody>
</table>

**OthOtcm 5: Program Outcome: Highly Valued by Graduates and Constituencies**
The program will be highly valued by its program graduates and other key constituencies it serves.
Related Measures

**M 5: Publications and Presentations**
We track the number of refereed papers published, accepted, and submitted to professional journals. We track the number of presentations our PhD students give at professional meetings.

Source of Evidence: Academic indirect indicator of learning - other

Connected Document
Physics PhD Curriculum Maps

**M 17: Post-Graduation Plans**
We track the professional destinations of our Ph.D. recipients after they graduate. We use exit surveys, advising meetings and email surveys to obtain post-graduation plans of our Ph.D. recipients.

Source of Evidence: Alumni survey or tracking of alumni achievements

Details of Action Plans for This Cycle (by Established cycle, then alpha)

Continued feedback
Based on our assessment results in 2011-12 we will continue to encourage faculty teaching core graduate courses to incorporate some undergraduate-level material in their reviews, problem sets, and exams, to provide feedback to the graduate students about their preparedness for the PhD Qualifying Exam (which covers undergraduate-level Physics).

Established in Cycle: 2012-2013
Implementation Status: Planned
Priority: High

Relationships (Measure | Outcome/Objective):
- Measure: Qualifying Exam | Outcome/Objective: Basic physics command
- Measure: Time-to pass Qualifying exam | Outcome/Objective: Basic physics command

Finish restructuring of graduate curriculum
Our recent 8-year academic program review has triggered a restructuring of our graduate curriculum in order to reduce the number of formal courses required, replacing some with area-specific research methods courses. Our revised graduate curriculum will be in effect starting Fall 2014.

Established in Cycle: 2012-2013
Implementation Status: Finished
Priority: High

Relationships (Measure | Outcome/Objective):
- Measure: Ph.D time-to-Degree | Outcome/Objective: Program Outcome: Sustain Optimal Level of Enrollment
Mission / Purpose

The mission of the Department of Physics and Astronomy at the University of Alabama is multi-fold. Through our undergraduate programs, we prepare students for graduate work in physics or astronomy, or for immediate employment in physics-related jobs. We play a vital role in the education of other science and engineering students, and promote the understanding of science through our general studies courses. Our graduate programs prepare students for teaching and/or research positions in colleges and universities, and research positions in government and industrial laboratories. Our research contributes new knowledge in the fields of physics and astronomy. It is part of our mission to secure adequate external funding to support departmental research activities. Through public outreach and involvement within our professions, we serve to improve the public understanding and promote the advancement of science.

Student Learning Outcomes, with Any Associations and Related Measures, Targets, Findings, and Action Plans

SLO 1: Basic physics command

We expect our graduate students to demonstrate command of undergraduate-level physics before formally entering our PhD program.

Connected Document
Physics PhD Curriculum Maps

Relevant Associations:

Improvement action:
1) Faculty teaching core graduate courses will be encouraged to incorporate some undergraduate-level material in their reviews, problem sets, and exams, to provide feedback to the graduate students about their preparedness for the PhD Qualifying Exam (which covers undergraduate-level Physics).
2) We will increase the graduate stipends by introducing a variable scale of stipendiary supplements to: a) improve our recruitment of new graduate students; and b) to provide performance incentives for our existing GTAs, based on their performance as GTAs and on whether or not they have passed the PhD Qualifying Exam.

Standard Associations

SACS 3.3.1
3.3.1.1 Educational programs, to include student learning outcomes

Strategic Plan Associations

University of Alabama
1.1 Promote and enhance areas of academic, scholarship, and research excellence.
3.14 Provide career preparation and employment services that lead graduates to satisfying and productive careers and professions.

Related Measures

M 1: Qualifying Exam

Graduate students are required to pass our Qualifying Exam before formally entering our PhD program. The Qualifying Exam covers undergraduate-level physics and is offered annually. We monitor the fraction of students who pass the qualifying exam each year (addresses improvement action).

Source of Evidence: Academic direct measure of learning - other

Connected Document
Physics PhD Curriculum Maps

Target:
No target established

Finding (2012-2013) - Target: Met
During 2012-13, a total of 5 students passed the Qualifier, 1 directly and 4 by the Physics GRE.

M 2: GRE Subject Exam

Physics GRE subject test. Attaining a Physics GRE score exceeding 60th percentile is considered equivalent to passing our Qualifying Exam. We monitor the fraction of students who exceed the 60th percentile each year (addresses improvement action).

Source of Evidence: Standardized test of subject matter knowledge

Connected Document
Physics PhD Curriculum Maps
Target: No target established

Finding (2012-2013) - Target: Met
During 2012-13, a total of 5 students passed the Qualifier, 1 directly and 4 by the Physics GRE.

M 3: Time-to-pass Qualifying exam
Students must pass the Qualifier by their 2nd year, or they risk losing their financial support. For a typical August entry, we expect students to pass the Qualifier by their 2nd January, or within 1.42 years. A student who fails to pass the Qualifying Exam may still be able to earn a terminal Masters degree if the student passes an oral examination over the core graduate courses in the curriculum (among other requirements). The core graduate courses of Electromagnetism, Quantum Mechanics, Mechanics, and Statistical Physics have considerable overlap with undergraduate-level physics. As a result, our graduate students' performance on our Qualifying Exam (or Physics GRE equivalent) can be considered a measure of the degree to which these core graduate courses reinforce undergraduate-level physics. The fraction of students who pass the Qualifier in any year and the time-to-Qualifier passage are used as measures of the efficacy of our core graduate course in reinforcing undergraduate-level physics (addresses improvement action).

Source of Evidence: Academic direct measure of learning - other

Connected Document
Physics PhD Curriculum Maps

Target:
1.42 years

Finding (2012-2013) - Target: Met
The distribution of time-to-Qualifier-passage for the students passing the Qualifier was as follows: 0, 0.83, 1.25, 1.25, 2.42 years. The median time-to-passage was 1.25 years, less than our target of 1.42 years. 80% of these times are within our target of 1.42 years.

The figure below shows the fraction of each entering cohort of graduate students who passed the Qualifying Exam by our target time of 1.4 years. This year was the target passing year for the 2011-12 entering class, of which 44% passed the Qualifier within our target time.

The fraction of students who passed their Qualifying Exam by their 2nd year has dropped this year and we also observed that of those passing most passed via GRE rather than the departmental Qualifying Exam. We will continue to monitor this recent development.

Related Action Plans (by Established cycle, then alpha):
For full information, see the Details of Action Plans section of this report.

Feedback
Established in Cycle: 2011-2012
Faculty teaching core graduate courses will be encouraged to incorporate some undergraduate-level material in their reviews, p...
3.3.1.1 Educational programs, to include student learning outcomes

**Strategic Plan Associations**

University of Alabama

1.1 Promote and enhance areas of academic, scholarship, and research excellence.
3.14 Provide career preparation and employment services that lead graduates to satisfying and productive careers and professions.

**Related Measures**

**M 4: Research Defense**

We expect our PhD students to be able to describe their PhD research plan at a professional level in an oral defense, the PhD Preliminary Exam. We expect the Preliminary Exam to be passed within 4 years of their entry.

Source of Evidence: Senior thesis or culminating major project

**Connected Document**

Physics PhD Curriculum Maps

**Target:**

4 years

**Finding (2012-2013) - Target: Met**

This year (June-May) we had 5 graduate students pass their Preliminary Exams. The times to passing their preliminary exams were: 3.33, 3.67, 3.75, 3.75, 4.0 years. The average time was 3.7 years, less than our target of 4 years, while the median was 3.75 years, also within our target.

**M 5: Publications and Presentations**

We track the number of refereed papers published, accepted, and submitted to professional journals. We track the number of presentations our PhD students give at professional meetings.

Source of Evidence: Academic indirect indicator of learning - other

**Connected Document**

Physics PhD Curriculum Maps

**Target:**

No target established.

**Finding (2012-2013) - Target: Met**

Many of our graduate students participated in research which was published, accepted, or submitted to refereed journals this year: 7 graduate students were co-authors on 21 refereed papers with 5 faculty. In addition, 8 graduate students were co-authors with 7 faculty on 8 submitted or accepted papers. 8 graduate students were co-authors on 9 professional presentations with 6 faculty this year.

**Other Outcomes, with Any Associations and Related Measures, Targets, Findings, and Action Plans**

**OthOtm 3: Program Outcome: High Level of Recognized Quality**

The program will improve and sustain a high level of recognized quality.

**Related Measures**

**M 7: Program Strengths**

8-year program review strengths

Source of Evidence: External report

**Target:**

No target established.

**Finding (2012-2013) - Target: Met**

8-year review strengths of graduate program: Graduate students receive a comprehensive education in the area of physics. This is clearly required by the high number of classes that students must complete and the comprehensive qualifying exams.

**M 8: Post-Graduation Plans**

We track the professional destinations of our Ph.D. recipients after they graduate. We use exit surveys, advising meetings and email surveys to obtain post-graduation plans of our Ph.D. recipients.

Source of Evidence: Alumni survey or tracking of alumni achievements

**Target:**

No target established.

**Finding (2012-2013) - Target: Met**

Of our 2 Ph.D. recipients in 2012-13, one found a postdoc position (at Forschungszentrum Jülich in Germany) and one is searching for a postdoc position. The majority of our recent PhDs have been able to find good jobs immediately upon graduation.

**M 9: Opportunities for Improvement**

8-year program review opportunities for improvement
**OthOtcm 4: Program Outcome: Sustain Optimal Level of Enrollment**
The program will build and sustain an optimal level of annual program enrollments and degree completions.

**Relevant Associations:**
Program Outcome #2 Improvement Action(s) to be advanced.
The assessment results and our recent 8-year academic program review have triggered discussions in the department to reduce the amount of formal coursework required for our graduate students. We will also more aggressively monitor how quickly our graduate students attain their PhD degrees, in order to bring the typical time-to-degree to 6 years or less. We will continue our efforts to recruit graduate students from our respective fields through our contacts at other institutions.

**Related Measures**

**M 10: Credit Hour Production**
Graduate semester credit hour production for the last 3 fall semesters

Source of Evidence: Existing data

**M 11: Number of Courses and Sections Offered**
Number of graduate courses & sections offered for the last 3 fall semesters

Source of Evidence: Existing data

**M 12: Number of Graduate Students**
Number of graduate students for the last 3 fall semesters

Source of Evidence: Existing data

**Target:**
ACHE viability threshold of 2.25

**Finding (2012-2013) - Target: Met**
In 2012-13 we had 43 graduate students, 6 of whom were MS-only students. There were 2 Ph.D. degrees awarded (Aug-May). Over the last 5 years we had an average of 4.2 Ph.D. degrees granted per year, which exceeds the ACHE viability threshold of 2.25. We are successful in maintaining a robust PhD program but have not reached our target of 75 graduate students.

**M 13: Number of PhD degrees Awarded**
Number of PhD degrees awarded (Aug-May) for the last 3 fall semesters

Source of Evidence: Existing data

**Target:**
ACHE viability threshold of 2.25

**Finding (2012-2013) - Target: Met**
In 2012-13 we had 43 graduate students, 6 of whom were MS-only students. There were 2 Ph.D. degrees awarded (Aug-May). Over the last 5 years we had an average of 4.2 Ph.D. degrees granted per year, which exceeds the ACHE viability threshold of 2.25. We are successful in maintaining a robust PhD program but have not reached our target of 75 graduate students.

**M 14: Compare Number of Degrees Conferred to ACHE Standards**
Comparison of number of PhD degrees awarded to ACHE viability standards

Source of Evidence: Professional standards

**Target:**
ACHE viability threshold of 2.25

**Finding (2012-2013) - Target: Met**
In 2012-13 we had 43 graduate students, 6 of whom were MS-only students. There were 2 Ph.D. degrees awarded (Aug-May). Over the last 5 years we had an average of 4.2 Ph.D. degrees granted per year, which exceeds the ACHE viability threshold of 2.25.

**M 15: Ph.D. Time-to-Degree**
We compare the annual distribution of time-to-degree for our Ph.D. recipients to our target of 6 years.

Source of Evidence: Existing data

**Target:**
Finding (2012-2013) - Target: Partially Met
The time-to-degree distribution for those 2 receiving their Ph.D. degree was: 5.75, 8.33 years. The average of 7.0 years exceeds our target of 6 years; 50% of our PhDs were within our target.

M 16: Number of GTA and GRA
We monitor our number of graduate students and compare it to our distant target of 75, which is based on a 2:1 ratio of GRAs to GTAs and our current number of 25 GTAs.
Source of Evidence: Existing data
Target:
75 graduate students
Finding (2012-2013) - Target: Partially Met
In 2012-13 we had 43 graduate students, 37 of whom were in the Ph.D. program. We had 29 GTAs (including 4 soft-funded), 9 externally funded GRAs, and 4 Fellowships. We are successful in maintaining a robust PhD program but have not reached our target of 75 graduate students.

OthOtcm 5: Program Outcome: Highly Valued by Graduates and Constituencies
The program will be highly valued by its program graduates and other key constituencies it serves.
Related Measures

M 17: Post-Graduation Placement
We track the professional destinations of our Ph.D. recipients after they graduate. We use exit surveys, advising meetings and email surveys to obtain post-graduation plans of our Ph.D. recipients.
Source of Evidence: Alumni survey or tracking of alumni achievements
Target:
No target established.
Finding (2012-2013) - Target: Met
Of our 2 Ph.D. recipients in 2012-13, one found a postdoc position (at Forschungszentrum Jülich in Germany) and one is searching for a postdoc position. The majority of our recent PhDs have been able to find good jobs immediately upon graduation.

M 18: Exit Survey Results
Results from departmental exit survey for PhD graduates
Source of Evidence: Exit interviews with grads/program completers
Target:
No target established.
Finding (2012-2013) - Target: Not Reported This Cycle
To few responses to report.

Details of Action Plans for This Cycle (by Established cycle, then alpha)
Feedback
Faculty teaching core graduate courses will be encouraged to incorporate some undergraduate-level material in their reviews, problem sets, and exams, to provide feedback to the graduate students about their preparedness for the PhD Qualifying Exam (which covers undergraduate-level Physics).
Established in Cycle: 2011-2012
Implementation Status: In-Progress
Priority: High
Relationships (Measure | Outcome/Objective):
Measure: Time-to pass Qualifying exam | Outcome/Objective: Basic physics command

Restructuring of graduate curriculum
Our recent 8-year academic program review has triggered a restructuring of our graduate curriculum in order to reduce the number of formal courses required, replacing some with area-specific research methods courses. We will be submitting our revised graduate curriculum to the College for review early this Fall 2013.
Established in Cycle: 2011-2012
Implementation Status: In-Progress
Priority: High
Relationships (Measure | Outcome/Objective):
Measure: Final exam questions | Outcome/Objective: Basic physics command | Physics & Astronomy skills for research
Responsible Person/Group: Curriculum committee

Continued feedback
Based on our assessment results in 2011-12 we will continue to encourage faculty teaching core graduate courses to incorporate some undergraduate-level material in their reviews, problem sets, and exams, to provide feedback to the graduate students about their preparedness for the PhD Qualifying Exam (which covers undergraduate-level Physics).
Established in Cycle: 2012-2013
Implementation Status: Planned
Priority: High

Finish restructuring of graduate curriculum
Our recent 8-year academic program review has triggered a restructuring of our graduate curriculum in order to reduce the number of formal courses required, replacing some with area-specific research methods courses. Our program assessment in 2012-13 has contributed to the restructuring of the curriculum and we will be submitting our revised graduate curriculum to the College for review soon.
<table>
<thead>
<tr>
<th>Established in Cycle:</th>
<th>2012-2013</th>
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<tbody>
<tr>
<td>Implementation Status:</td>
<td>Planned</td>
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<tr>
<td>Priority:</td>
<td>High</td>
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</tbody>
</table>
Mission / Purpose

The mission of the Department of Physics and Astronomy at the University of Alabama is multi-fold. Through our undergraduate programs, we prepare students for graduate work in physics or astronomy, or for immediate employment in physics-related jobs. We play a vital role in the education of other science and engineering students, and promote the understanding of science through our general studies courses. Our graduate programs prepare students for teaching and/or research positions in colleges and universities, and research positions in government and industrial laboratories. Our research contributes new knowledge in the fields of physics and astronomy. It is part of our mission to secure adequate external funding to support departmental research activities. Through public outreach and involvement within our professions, we serve to improve the public understanding and promote the advancement of science.

Student Learning Outcomes, with Any Associations and Related Measures, Targets, Findings, and Action Plans

SLO 1: Basic physics command
We expect our graduate students to demonstrate command of undergraduate-level physics before formally entering our PhD program.

Connected Document
Physics PhD Curriculum Maps

Relevant Associations:
Improvement action:
1) Faculty teaching core graduate courses will be encouraged to incorporate some undergraduate-level material in their reviews, problem sets, and exams, to provide feedback to the graduate students about their preparedness for the PhD Qualifying Exam (which covers undergraduate-level Physics).
2) We will increase the graduate stipends by introducing a variable scale of stipendiary supplements to: a) improve our recruitment of new graduate students; and b) to provide performance incentives for our existing GTAs, based on their performance as GTAs and on whether or not they have passed the PhD Qualifying Exam.

Related Measures

M 1: Qualifying Exam
Graduate students are required to pass our Qualifying Exam before formally entering our PhD program. The Qualifying Exam covers undergraduate-level physics and is offered annually. We monitor the fraction of students who pass the qualifying exam each year (addresses improvement action).

Source of Evidence: Academic direct measure of learning - other
Connected Document
Physics PhD Curriculum Maps

Target: No target established
Finding (2011-2012) - Target: Met
During 2011-12, a total of 8 students passed the Qualifying Exam, 6 directly and 2 by the Physics GRE.

M 2: GRE Subject Exam
Physics GRE subject test. Attaining a Physics GRE score exceeding 60th percentile is considered equivalent to passing our Qualifying Exam. We monitor the fraction of students who exceed the 60th percentile each year (addresses improvement action).

Source of Evidence: Standardized test of subject matter knowledge
Connected Document
Physics PhD Curriculum Maps

Target: No target established
Finding (2011-2012) - Target: Met
During 2011-12, a total of 8 students passed the Qualifying Exam, 6 directly and 2 by the Physics GRE.

M 3: Time-to-pass Qualifying exam
Students must pass the Qualifier by their 2nd year, or they risk losing their financial support. For a typical August entry, we expect students to pass the Qualifier by their 2nd January, or within 1.42 years. A student who fails to pass the Qualifying Exam may still be able to earn a terminal Masters degree if the student passes an oral examination
over the core graduate courses in the curriculum (among other requirements). The core graduate courses of Electromagnetism, Quantum Mechanics, Mechanics, and Statistical Physics have considerable overlap with undergraduate-level physics. As a result, our graduate students’ performance on our Qualifying Exam (or Physics GRE equivalent) can be considered a measure of the degree to which these core graduate courses reinforce undergraduate-level physics. The fraction of students who pass the Qualifier in any year and the time-to-Qualifier passage are used as measures of the efficacy of our core graduate course in reinforcing undergraduate-level physics (addresses improvement action).

Source of Evidence: Academic direct measure of learning - other

**Connected Document**  
[Physics PhD Curriculum Maps](#)

**Target:**

1.42 years

**Finding (2011-2012) - Target: Partially Met**

The distribution of time-to-Qualifier-passage for the students passing the Qualifier was as follows: 0, 1.25, 1.42, 1.42, 2.42, 2.42, 3.00, 3.42 years. The median time-to-passage was 1.92 years, greater than our target of 1.42 years. 50% of these times are within our target of 1.42 years. The figure “2012 MS&PhD time to pass qualifying exam” shows the fraction of each entering cohort of graduate students who passed the Qualifying Exam by our target time of 1.4 years. This year was the target passing year for the 2010-11 entering class, of which 67% passed the Qualifier within our target time.

The fraction of students who passed the Qualifying Exam by their 2nd year continued to improve this year. In particular, the number who passed via the departmental Qualifying Exam (as opposed to the Physics GRE) continued the improvement first seen last year: passes via Qualifier : GRE = 6 : 2 (2012), 5 : 3 (2011), 3 : 4 (2010), 1 : 4 (2009). We believe this recent improvement is due to: 1) increasing (by an hour) the amount of time students could take to work on each section of the exam; and 2) emphasizing that continued GTA support is contingent upon passing the Qualifying Exam in a timely manner.

**Connected Document**  
[2012 MS&PhD time to pass qualifying exam - Copy](#)

**Related Action Plans (by Established cycle, then alpha):**

**Feedback & stipends**

1) Faculty teaching core graduate courses will be encouraged to incorporate some undergraduate-level material in their reviews, problem sets, and exams, to provide feedback to the graduate students about their preparedness for the PhD Qualifying Exam (which covers undergraduate-level Physics).

2) We will increase the graduate stipends by introducing a variable scale of stipendiary supplements to: a) improve our recruitment of new graduate students; and b) to provide performance incentives for our existing GTAs, based on their performance as GTAs and on whether or not they have passed the PhD Qualifying Exam.

**Established in Cycle:** 2011-2012  
**Implementation Status:** In-Progress  
**Priority:** High

**Relationships (Measure | Outcome/Objective):**  
**Measure:** Time-to pass Qualifying exam  
**Outcome/Objective:** Basic physics command

**SLO 2: Physics & Astronomy skills for research**

We expect our students will demonstrate knowledge of the methodologies and tools of inquiry in physics and astronomy, and be prepared to conduct independent research and expect them to be engaged in productive research with faculty.

**Connected Document**  
[Physics PhD Curriculum Maps](#)

**Related Measures**

**M 4: Research Defense**

We expect our PhD students to be able to describe their PhD research plan at a professional level in an oral defense, the PhD Preliminary Exam. We expect the Preliminary Exam to be passed within 4 years of their entry.

**Source of Evidence:** Senior thesis or culminating major project

**Connected Document**  
[Physics PhD Curriculum Maps](#)

**Target:**

4 years

**Finding (2011-2012) - Target: Met**

This year (June-May) we had 3 graduate students pass their Preliminary Exams. The times to passing their preliminary exams were: 3.25, 3.67, 3.75 years. The average time was 3.55 years, less than our target of 4 years, while the median was 3.67 years, also within our target.

**M 5: Publications and Presentations**

We track the number of refereed papers published, accepted, and submitted to professional journals. We track the number of presentations our PhD students give at professional meetings.
Finding (2011-2012) - Target: Met
Many of our graduate students participated in research which was published, accepted, or submitted to refereed journals this year. 12 graduate students were co-authors on 33 refereed papers with 12 faculty. In addition, 5 graduate students were co-authors with 5 faculty on 6 submitted or accepted papers. 12 graduate students were co-authors on 14 professional presentations with 11 faculty this year.

M 6: Final exam questions
We assess student learning using final exam questions in our core courses: classical dynamics, electromagnetic theory, quantum mechanics and statistical physics. We are currently in the process of developing course-specific pools of questions relevant for this student learning outcome.

Finding (2011-2012) - Target: Met
In PH 501 – Classical Dynamics, students scored an average of 57% on 4 canonical closed-book exam problems.

In PH 531 – Electromagnetic Theory I, students scored an average of 69% on 13 canonical closed-book problems.

In PH 541 – Quantum Mechanics I, students scored an average of 61% on 4 canonical closed-book problems.

In PH 542 – Quantum Mechanics II, students scored an average of 64% on 4 canonical closed-book problems.

Related Action Plans (by Established cycle, then alpha):
Restructuring of graduate curriculum
In PH 501 – Classical Dynamics, students scored an average of 57% on 4 canonical closed-book exam problems.

In PH 531 – Electromagnetic Theory I, students scored an average of 69% on 13 canonical closed-book problems.

In PH 541 – Quantum Mechanics I, students scored an average of 61% on 4 canonical closed-book problems.

In PH 542 – Quantum Mechanics II, students scored an average of 64% on 4 canonical closed-book problems.

Established in Cycle: 2011-2012
Implementation Status: In-Progress
Priority: High

Relationships (Measure | Outcome/Objective):
Measure: Final exam questions | Outcome/Objective: Physics & Astronomy skills for research

Measure: Number of GTA and GRA | Outcome/Objective: Program Outcome: Sustain Optimal Level of Enrollment

Measure: Time-to-Degree for Ph.D Recipients | Outcome/Objective: Program Outcome: Sustain Optimal Level of Enrollment

Implementation Description: Our recent 8-year academic program review has triggered a restructuring of our graduate curriculum in order to reduce the number of formal courses required, replacing some with area-specific research methods courses. We will be submitting our revised graduate curriculum to the College for review early this Fall 2012.

Other Outcomes, with Any Associations and Related Measures, Targets, Findings, and Action Plans

OthOtcm 3: Program Outcome: High Level of Recognized Quality
The program will improve and sustain a high level of recognized quality.

Related Measures

M 7: Program Strengths
8-year program review strengths

Source of Evidence: External report

M 8: Opportunities for Improvement
8-year program review opportunities for improvement

Source of Evidence: External report
M 9: Post-Graduation Plans
We track the professional destinations of our Ph.D. recipients after they graduate. We use exit surveys, advising meetings and email surveys to obtain post-graduation plans of our Ph.D. recipients.

Source of Evidence: Alumni survey or tracking of alumni achievements

Target: No target established.

OthOtcm 4: Program Outcome: Sustain Optimal Level of Enrollment
The program will build and sustain an optimal level of annual program enrollments and degree completions.

Relevant Associations:
Program Outcome #2 Improvement Action(s) to be advanced.
The assessment results and our recent 8-year academic program review have triggered discussions in the department to reduce the amount of formal coursework required for our graduate students. We will also more aggressively monitor how quickly our graduate students attain their PhD degrees, in order to bring the typical time-to-degree to 6 years or less. We will continue our efforts to recruit graduate students from our respective fields through our contacts at other institutions.

Related Measures

M 10: Credit Hour Production
Graduate semester credit hour production for the last 3 fall semesters

Source of Evidence: Existing data

M 11: Number of Courses and Sections Offered
Number of graduate courses & sections offered for the last 3 fall semesters

Source of Evidence: Existing data

M 12: Number of Graduate Students
Number of graduate students for the last 3 fall semesters

Source of Evidence: Existing data

M 13: Number of GTA and GRA
We monitor our number of graduate students and compare it to our distant target of 75, which is based on a 2:1 ratio of GRAs to GTAs and our current number of 25 GTAs.

Source of Evidence: Existing data

Target: 75 graduate students

Finding (2011-2012) - Target: Partially Met
In 2011-12 we had 47 graduate students, 39 of which were in the Ph.D. program. We had 27 GTAs (including 6 soft-funded) and 16 externally funded GRAs.

We are successful in maintaining a robust PhD program but have not reached our target of 75 graduate students. The average time to PhD exceeds our departmental target.

Related Action Plans (by Established cycle, then alpha):

Restructuring of graduate curriculum
In PH 501 – Classical Dynamics, students scored an average of 57% on 4 canonical closed-book exam problems.

In PH 531 – Electromagnetic Theory I, students scored an average of 69% on 13 canonical closed-book problems.

In PH 541 – Quantum Mechanics I, students scored an average of 61% on 4 canonical closed-book problems.

In PH 542 – Quantum Mechanics II, students scored an average of 64% on 4 canonical closed-book problems.

Established in Cycle: 2011-2012
Implementation Status: In-Progress
Priority: High

Relationships (Measure | Outcome/Objective):
Measure: Final exam questions | Outcome/Objective: Physics & Astronomy skills for research
Measure: Number of GTA and GRA | Outcome/Objective: Program Outcome: Sustain Optimal Level of Enrollment
Measure: Time-to-Degree for Ph.D Recipients | Outcome/Objective: Program Outcome: Sustain Optimal Level of Enrollment

Implementation Description: Our recent 8-year academic program review has triggered a restructuring of our graduate curriculum in order to reduce the number of formal courses required, replacing some with area-specific research methods courses. We will be submitting our revised graduate curriculum to the College for review early this Fall 2012.

M 14: Number of PhD degrees Awarded
Number of PhD degrees awarded (Aug-May) for the last 3 fall semesters

Source of Evidence: Existing data

**M 16: Compare Number of Degrees Conferred to ACHE Standards**
Comparison of number of PhD degrees awarded to ACHE viability standards

Source of Evidence: Professional standards

**M 17: Time-to-Degree for Ph.D Recipients**
We compare the annual distribution of time-to-degree for our Ph.D. recipients to our target of 6 years (addresses improvement action).

Source of Evidence: Existing data

**Target:**
6 years

**Finding (2011-2012) - Target: Partially Met**
The time-to-degree distribution for those 5 receiving their Ph.D. degree was:
5.75, 6.38, 6.38, 7.33, 7.67 years.

The average of 6.70 years (median 6.38) exceeds our target of 6 years; 20% of our PhDs were within our target.

We are successful in maintaining a robust PhD program but have not reached our target of 75 graduate students. The average time to PhD exceeds our departmental target.

**Related Action Plans (by Established cycle, then alpha):**

**Restructuring of graduate curriculum**
- In PH 501 – Classical Dynamics, students scored an average of 57% on 4 canonical closed-book exam problems.
- In PH 531 – Electromagnetic Theory I, students scored an average of 69% on 13 canonical closed-book problems.
- In PH 541 – Quantum Mechanics I, students scored an average of 61% on 4 canonical closed-book problems.
- In PH 542 – Quantum Mechanics II, students scored an average of 64% on 4 canonical closed-book problems.

**Established in Cycle:** 2011-2012
**Implementation Status:** In-Progress
**Priority:** High

**Relationships (Measure | Outcome/Objective):**
- **Measure:** Final exam questions | **Outcome/Objective:** Physics & Astronomy skills for research
- **Measure:** Number of GTA and GRA | **Outcome/Objective:** Program Outcome: Sustain Optimal Level of Enrollment
- **Measure:** Time-to-Degree for Ph.D Recipients | **Outcome/Objective:** Program Outcome: Sustain Optimal Level of Enrollment

**Implementation Description:** Our recent 8-year academic program review has triggered a restructuring of our graduate curriculum in order to reduce the number of formal courses required, replacing some with area-specific research methods courses. We will be submitting our revised graduate curriculum to the College for review early this Fall 2012.

**OthOtcm 5: Program Outcome: Highly Valued by Graduates and Constituencies**
The program will be highly valued by its program graduates and other key constituencies it serves.

**Related Measures**

**M 18: Exit Survey Results**
Results from departmental exit survey for PhD graduates

Source of Evidence: Exit interviews with grads/program completers

**M 19: Post-Graduation Placement**
We track the professional destinations of our Ph.D. recipients after they graduate. We use exit surveys, advising meetings and email surveys to obtain post-graduation plans of our Ph.D. recipients.

Source of Evidence: Alumni survey or tracking of alumni achievements

**Target:**
No target established.

**Details of Action Plans for This Cycle (by Established cycle, then alpha)**

**Feedback & stipends**

1) Faculty teaching core graduate courses will be encouraged to incorporate some undergraduate-level material in their reviews, problem sets, and exams, to provide feedback to the graduate students about their preparedness for the PhD Qualifying Exam (which covers undergraduate-level Physics).

2) We will increase the graduate stipends by introducing a variable scale of stipendiary supplements to: a) improve our recruitment of new graduate students; and b) to provide performance incentives for our existing GTAs, based on
their performance as GTAs and on whether or not they have passed the PhD Qualifying Exam.

Established in Cycle: 2011-2012
Implementation Status: In-Progress
Priority: High

Relationships (Measure | Outcome/Objective):
Measure: Time-to pass Qualifying exam | Outcome/Objective: Basic physics command

Restructuring of graduate curriculum

In PH 501 – Classical Dynamics, students scored an average of 57% on 4 canonical closed-book exam problems.
In PH 531 – Electromagnetic Theory I, students scored an average of 69% on 13 canonical closed-book problems.
In PH 541 – Quantum Mechanics I, students scored an average of 61% on 4 canonical closed-book problems.
In PH 542 – Quantum Mechanics II, students scored an average of 64% on 4 canonical closed-book problems.

Established in Cycle: 2011-2012
Implementation Status: In-Progress
Priority: High

Relationships (Measure | Outcome/Objective):
Measure: Final exam questions | Outcome/Objective: Physics & Astronomy skills for research
Measure: Number of GTA and GRA | Outcome/Objective: Program Outcome: Sustain Optimal Level of Enrollment
Measure: Time-to-Degree for Ph.D Recipients | Outcome/Objective: Program Outcome: Sustain Optimal Level of Enrollment

Implementation Description: Our recent 8-year academic program review has triggered a restructuring of our graduate curriculum in order to reduce the number of formal courses required, replacing some with area-specific research methods courses. We will be submitting our revised graduate curriculum to the College for review early this Fall 2012.
## Curriculum Map I (Student Learning Outcomes)

<table>
<thead>
<tr>
<th>Course</th>
<th>Basic physics command</th>
<th>Physics &amp; Astronomy skills for research</th>
<th>Course</th>
<th>Basic physics command</th>
<th>Physics &amp; Astronomy skills for research</th>
<th>Course</th>
<th>Basic physics command</th>
<th>Physics &amp; Astronomy skills for research</th>
<th>Course</th>
<th>Basic physics command</th>
<th>Physics &amp; Astronomy skills for research</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH 501</td>
<td>✔</td>
<td>✔</td>
<td>PH 531/PH 532</td>
<td>✔</td>
<td>✔</td>
<td>PH 541/PH 542</td>
<td>✔</td>
<td>✔</td>
<td>PH 571</td>
<td>✔</td>
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<tr>
<td>PH 571</td>
<td>✔</td>
<td>✔</td>
<td>PH 597/AY 597</td>
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<td>AY 501/520/533/550/570/620</td>
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<td>PH 699</td>
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</table>

## Curriculum Map II (Assessment Measures)

<table>
<thead>
<tr>
<th>Course</th>
<th>Basic physics command</th>
<th>Physics &amp; Astronomy skills for research</th>
<th>Course</th>
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<th>Physics &amp; Astronomy skills for research</th>
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<th>Basic physics command</th>
<th>Physics &amp; Astronomy skills for research</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH 501</td>
<td>Measure 1.1: Summative assessment; qualifying Exam, administered annually</td>
<td>Measure 2.1: Summative assessment; PhD Oral defense during Prelim, by end of 7th semester. Measure 2.3: Course embedded assessment; Final exam questions.</td>
<td>PH 531/PH 532</td>
<td>Measure 1.1: Summative assessment; qualifying Exam, administered annually</td>
<td>Measure 2.1: Summative assessment; PhD Oral defense during Prelim Measure 2.3: Course embedded assessment; Final exam questions.</td>
<td>PH 541/PH 542</td>
<td>Measure 1.1: Summative assessment; qualifying Exam, administered annually</td>
<td>Measure 2.1: Summative assessment; PhD Oral defense during Prelim, by end of 7th semester. Measure 2.3: Course embedded assessment; Final exam questions.</td>
<td>PH 571</td>
<td>Measure 1.1: Summative assessment; qualifying Exam, administered annually</td>
<td>Measure 2.1: Summative assessment; PhD Oral defense during Prelim, by end of 7th semester.</td>
</tr>
<tr>
<td>Measure 1.2: Summative assessment; Physics GRE subject test, administered annually</td>
<td>Measure 2.3: Course embedded assessment; Final exam questions.</td>
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<tr>
<td>Measure 1.3: Time to pass qualifying Exam.</td>
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</table>

**Common Experience**

<table>
<thead>
<tr>
<th>PH 597</th>
<th>Measure 2.2: Research Publications &amp; Presentations</th>
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</table>

**Required Task**

<table>
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<tr>
<th>AY 501/520/533/550/570/620</th>
<th>Measure 2.1: Summative assessment; PhD Oral defense during Prelim, by end of 7th semester.</th>
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<table>
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<tr>
<th>PH 699</th>
<th>Measure 2.1: Summative assessment; PhD Oral defense during Prelim, by end of 7th semester. Measure 2.2: Research Publications &amp; Presentations</th>
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