

**UGC Report on 2016 Physics Academic Program Review**  
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**A. Introduction**

The Physics department offers two undergraduate degree programs: a B.S. in Physics and a B. A. in Physics Education for Secondary Teachers (with concomitant Maryland State Certification in high school teaching). The total number of Physics majors has stabilized at  $\pm 150$  students, 15% of whom are female and 19% – minorities, the latter a relatively high figure in comparison with a national average of 5%. Over the period of the review, the department graduated an average of 19 students per year. Between one quarter and one third of the graduating students go on to graduate school in physics and engineering fields.

In addition to the majors in the program, there is a minor in physics and a minor in astronomy. Each of these minors have single-digit numbers of students, with the majority of the astronomy minors being physics majors and the majority of the physics minors being mathematics majors.

There are 21 full-time faculty members in the department. The department has three research centers affiliated with the NASA Goddard Space Flight Center: the Center for Space Science and Technology (CSST) and the Joint Center for Earth Systems Tracking (JCET), and the Goddard Earth Sciences and Technology Center (GEST). Since their inception, these three centers have brought in over \$150 million in grants and contracts to UMBC faculty and research scientists. Moreover, many of the research faculty at these centers have a commitment to teach one 3 credit course every 2 years and also mentor graduate students and serve on thesis committees.

**B. Students' Learning Outcomes**

The department's previous use of three representative physics courses to assess student learning outcomes within four broad learning objectives has been updated and extended to include PHYS 303 (Thermal and Statistical Physics), PHYS 321 (Intermediate Mechanics), and PHYS 407 (Electromagnetic Theory), thus covering the entire range of undergraduate physics. Assessment within these courses includes specific exam problems and homework assignments. The assessment data are reviewed by the entire faculty during an annual meeting and the process is documented in a yearly report of the department's assessment committee, the findings of which go to the Dean of the College. The external reviewers characterize this assessment plan as ambitious and exemplary.

Learning Outcomes are also assessed indirectly through end-of-semester key course questionnaires and exit surveys given to graduating seniors.

**C. State of the Discipline; Program Modifications; Program Changes**

The department's research is centered in four main areas: astrophysics, atmospheric physics, condensed matter physics, and quantum optics and quantum information. The department has identified goals and methods to improve curriculum and research in these areas. Past upgrades to the department's infrastructure have enhanced the ability of the

faculty to compete for external research dollars, now amounting to more than \$16M per year.

In the period covered by the review, the introductory physics sequences were modified. Under an NIH-funded grant, the laboratory portion of the algebra-based sequence, PHYS 111 and PHYS 112, was upgraded to reflect material a life-sciences approach, and a physics-majors-only section of the PHYS 121 course was introduced. In an effort to promote more undergraduate research experiences for physics majors, a new undergraduate research course, PHYS 299, was added.

#### **D. Undergraduate Curriculum**

The B.S. includes 42 credits of required physics classes and 25-26 credits of other courses in math, chemistry, and computer science. The B.A. includes 32 credits in physics and 31 credits of other science-related courses, as well as 33 education credits and 9 Social Science/Arts and Humanities credits.

The department also supports the university through general education and introductory physics courses. There are eight courses which are designated [Sci] and thus may be taken to fulfill the general education program. PHYS 330L satisfies the writing-intensive GEP requirement. The number of student credit hours in these courses has risen steadily over the past ten years.

#### **E. Research Opportunities for Undergraduates**

To support undergraduate involvement in research, the department has a set of three research-credit courses, which can be taken multiple times. In these courses, undergraduate students are directly involved in the scholarly research of faculty, sometimes leading to results publishable in refereed scientific journals. The external reviewers note that it can be hard for students to connect with a faculty researcher, and recommend inviting the second year physics majors to the already existing seminar series given by the faculty for the first year graduate students.

#### **F. Undergraduate Advisement**

All new undergraduate students, including transfer students, are advised by the department's Undergraduate Program Director, starting with summer orientation. Each of the new majors then meets individually with the Undergraduate Program Director in mid-semester to review progress and plan courses for the following semester. Continuing students are assigned an appropriate faculty advisor and meet at least once a semester. Each of these faculty members advise up to twelve undergraduate students.

#### **G. Council of Majors; Undergraduate Honors; Awards; Recognition**

The department hosts a chapter of the Society of Physics Students (SPS), the professional association of physics majors, which attracts about half of the physics majors. SPS arranges for brown-bag discussions and guest lectures on specific topics of interest. The department also has a chapter of Sigma Pi Sigma, the Physics Honors Society. In addition, several physics department undergraduates are inducted into Phi Beta Kappa every year.

The department sponsors an annual award for the Outstanding Graduating Seniors in Physics, and each year chooses the recipient of a \$1,000 Alumni Association award for the outstanding physics student of that year.

#### **H. Faculty Development; Teaching Evaluation**

The department has a formal mentoring program for new faculty which includes assignment of a senior member of the department acting as mentor. There are also in-class teaching evaluations and newly-instituted “teaching luncheons,” introduced as a way to spread newer pedagogical methods throughout the curriculum.

New faculty hires are encouraged to attend the American Physical Society’s annual workshop on teaching effectiveness, and all faculty members are expected to take advantage of UMBC’s Faculty Development Center. The teaching effectiveness of part-time faculty and adjuncts is closely monitored by the Graduate Program Directors, the Director of Undergraduate Programs, and the Chair.

#### **I. Additional Comments; Summary Evaluation**

The department has been remarkably successful over the period of the review, with a strong undergraduate program that prepares students for graduate programs and full-time employment, and research programs which are gaining in strength and recognition, with a concomitant growth of external funding. The external reviewers find that the department is well-run and positioned for significant growth.

Future challenges include an urgent need for more teaching assistantships in order to keep up with the department’s increased enrollment; more space for faculty; and at least one more faculty member for Atmospheric Physics program, which the external reviewers characterize as “an outstanding and unusual program that sets the UMBC physics department apart from similarly sized programs.”

In the department’s own words, its most impressive attribute may be the degree of esprit de corps that exists among the faculty, staff, and students.