UCC Program Review Committee summary of review

Program – Department of Physics & Astronomy

This program includes the following degrees, minors, and certificates:

- B.A. Physics
- B.S. Physics
- B.S. Applied Physics
- B.S. Physics Meteorology
- B.S. Physics Astrophysics
- B.S. Physics – Honors Tutorial College
- B.S. Engineering Physics – Honors Tutorial College
- B.S. Astrophysics – Honors Tutorial College
- Physics minor
- M.S. Physics
- Ph.D. Physics

Recommendation

This program is found to be viable, see report for commendations, concerns, and recommendations.

Date of last review – AY 2009

Date of this review – AY 2016

This review has been sent to school director and the dean, their joint response is attached.

This review has been sent to the Graduate Council, they have no comments to add.
Department of Physics and Astronomy
Program Review
March 28, 2016

Review Committee:

External Reviewers: David Campbell, Professor, Physics Department, Boston University; Betsy Beise, Professor, Department of Physics, University of Maryland

Internal Reviewers: Krisanna Machtmes, Chair, Educational Studies, Patton College of Education; Sarah Poggio, Associate Professor, department of Political Science, College of Arts & Science (chair); C. Scott Smith, Associate Professor, School of Music

Executive Summary

The review committee found the undergraduate and graduate programs of the Department of Physics and Astronomy to be not only viable but thriving. We found the department highly effective in its research and teaching missions and that its members contribute actively to broader service in the University and larger community. In coming to this conclusion, the review committee met with various groups of faculty, staff, and students in the Department of Physics and Astronomy on February 25 and 26, 2016, and reviewed the department’s self-study report. The review includes the following programs offered by the department:

- Physics (B.A., B.S.), Applied Physics (B.S.), Astrophysics (B.S.), and participation in the interdisciplinary Physics/Meteorology (B.S.)
- Physics and Astronomy (M.A., M.S.)
- Physics (Ph.D.)

The committee commends the department for excellence in teaching and research, collegial atmosphere, and informal mentoring of pre-tenure faculty as well as graduate and undergraduate students. There are some areas of concern of which the department is aware and is proactively involved in moving towards a solution. These challenges include the maintenance and refurbishment of aging facilities and the small number of faculty in the areas of Biophysics and Astronomy, and have important implications for the department’s teaching and research mission. The committee also has some recommendations that build on the highly collegial and effective foundation of the department.

Commendations

- The review committee recognizes that the Ohio University Department of Physics and Astronomy has developed a viable and appropriate curriculum across its various graduate and
undergraduate programs and is also effective in delivering this curriculum to students. Students at all levels also benefit from active colloquium and seminar series organized by various research institutes in the department, the opportunity to work closely with faculty on research projects, and accessibility and collegiality of the department. This is evident in the high level of success in undergraduate students applying for graduate programs and in graduate students in applying for post-doctoral fellowships and academic and industry positions.

- The department and its faculty should be congratulated for their high level of achievement in research, consistently maintaining excellent publication records and external funding. The external reviewers noted that while the department has experienced a slight decline in external grant funds awarded this is consistent with national forces and the department is generally very successful in securing such funds.

- An outstanding characteristic of the department that contributes to its success in both teaching and research is its overall collegiality. This collegial environment integrates undergraduate and graduate students, faculty (tenured, pre-tenure, and non-tenure faculty) and staff. It produces valuable informal mentoring of undergraduate students by graduate students and faculty and mentoring for graduate students by multiple faculty in the department. The departmental practice of informally meeting for lunch weekly in Baker Center and the use of the common room by a range of students and faculty are two examples of how the department, its faculty, and leadership foster this collegial atmosphere. This extends to the department’s staff who administer and maintain teaching labs, research labs, facilities, and equipment through their dedication and excellent teamwork.

- The mentoring of pre-tenure track faculty also deserves special recognition. Pre-tenure faculty indicated that their colleagues in the department were very helpful in acclimating them to the department culture, facilitating excellence in teaching, and procuring grants to fund their research. Pre-tenure faculty indicate that they have a clear understanding of their requirements for tenure across teaching, research, and service and feel that the feedback that they receive from the yearly evaluation provides them with useful information on their progress toward tenure and promotion. They report choosing a faculty mentor from among the tenured faculty in their first semester on campus, meeting with their mentors regularly, and having their classes evaluated by their mentors. They also note the role of the research institutes within the department in helping them develop and enhance funding networks to support their research. The pre-tenure faculty also noted that their teaching loads and repeated courses, as well as their reduced service obligations, permitted them time to focus on their teaching and research and build successful teaching records for promotion and tenure.
As noted above, there are several research institutes within the department including the Astrophysical Institute (ApI), the Nanoscale and Quantum Phenomena Institute (NQPI), and the Institute for Nuclear and Particle Physics (INPP). These institutes contribute significantly not only to the research mission of the department but also its teaching mission. They provide a cushion for funding faculty labs and research should there be any gaps between grants, thus providing greater stability for faculty and graduate students. They also provide significant research and educational opportunities for graduate and undergraduate students. These institutes and departmental faculty that direct and participate in them organize events and programming, including bringing notable speakers to campus to present colloquia for students and the public and other forms of public outreach. The institutes are also key in encouraging coordination across units within the college and between colleges.

The department’s efforts to support and training teaching assistants are laudable. For example, students who served as teaching assistants for the “Scale Up” approach to calculus-based general physics reported meeting with faculty to prepare for their roles in this active learning approach. In addition, teaching assistants report meeting regularly with faculty who serve as lab coordinators to receive training for specific lab sessions. Teaching assistants also noted that their peers served as resources for developing their teaching, a situation created in part by the collegial and team-oriented atmosphere maintained by the department.

Areas of Concern

In the department self-study and in meetings with the review committee, the maintenance and upkeep of Clippinger Labs was a major concern; the labs and equipment are vital to the department’s research and teaching missions. In addition, many of the facilities serve faculty and students in other units in the College of Arts and Science as well as other colleges. More broadly, the maintenance of the facilities and equipment weigh heavily on the department. While faculty and staff are committed to maintaining and using the available resources to the fullest extent, this has stressed department resources. For example, the department has had to pick up funding a staff line out of grant funds to insure maintenance of its facilities.

Specific concerns including the deteriorating roof and resulting leakage, inadequate electrical systems, aging HVAC systems, crowded teaching lab facilities, the lack of a clean room, and issues with structural vibration in the building were mentioned in the report or by faculty during the review. While there are both immediate and longer-term plans to address these concerns, these issues with the Clippinger Labs facility itself continue to be a serious concern for the department.
● In response to plans to refurbish Clippinger Labs, the department is also concerned about the demolition of the Clippinger Research Annex. Current plans provide for an annex to Clippinger Labs that requires the demolition of the annex. The annex currently houses a great deal of equipment including the liquid helium recovery plant which was a substantial investment by the department which greatly reduced the costs associated with their research, thereby making their research grants far more productive. The demolition of this facility requires a great deal of planning and coordination to protect these critical department investments.

● The small number of faculty in particular research areas, most notably in the areas of Astronomy/Astrophysics and Biophysics is a significant concern. Each of these groups now has only three faculty members, down from four in the past few years. The Biophysics group lost a faculty member to another institution and the Astronomy group saw one of its members promoted to a senior administrative role. While these positions may not be able to be replaced directly, some means of stabilizing these groups must be developed. Based on comparisons to other programs, the external members of the review committee note that the breadth of the programs and specializations offered by the department are appropriate and in fact position the department to contribute in meaningful ways across units within Ohio University (including the Biology, Chemistry and Biochemistry, Geological Sciences, and Mathematics, as well as the Russ College of Engineering).

● There is no enhanced formal pre-tenure review process in preparation for tenure (e.g., third year review). This is not problematic for the current collegial department with its large contingent of tenured faculty. Tenured faculty seems invested in the success of their pre-tenure colleagues. There is also no formal mentoring program for associate faculty. However, after tenure and promotion, tenured faculty maintain relationships with their mentors in the department. Again this collegial informal process appears to have served the department well. If the composition of the department changes or tenured and tenure-track faculty experience difficulty on navigating the tenure and promotion process the department may want to consider evaluating its current procedures and establish a more formal mentoring program.

● The department monitors and recognizes the need to move graduate students from teaching assistantships to fellowship or grant funded research assistantships in faculty members’ labs within their second or third year in the program. This is an area that requires continued attention by the department as it conditions the number of students the department can recruit with funded positions and the transition to funded research assistant positions is essential to graduate students’ scholarly development as noted in the self-study. It is evident that the department succeeds in this via active monitoring. While this is not a concern per se, the small number of faculty in particular areas particularly if these are higher demand requires
careful coordination, monitoring, and advising to maintain this department practice and provide these essential experiences to graduate students.

- While undergraduate and graduate students in the department both commend the department for its collegial atmosphere and informal mentoring, students noted the lack of formal advising processes for careers, particularly outside the academic route, and for graduate school and fellowship application procedures. For example, an undergraduate student noted unfamiliarity with the timing of the application process as well as the nature of the physics section of the GRE. It is important to note that the same student also positively mentioned the willingness and dedication of individual faculty in assisting with these processes.

- Several undergraduate students expressed concern over the sequence of math and physics courses. Some noted their experiences were likely dependent on their own choices or on their status as transfer students. Part of this issue stems from the department relying on other departments for required courses in the program. While it is evident that the department does coordinate across units to ensure the provision of these courses for their students, there may also be issues in sequencing arising from the fairly recent Quarters to Semester transition (Q2S) or disconnects in advising students on these issues.

Several undergraduate students also expressed concern over the limited specialized undergraduate course offerings. Given the size of the department and the teaching loads expected for research active faculty, this situation will be challenging to improve. Perhaps coordination with other nearby institutions could help ameliorate this situation.

**Recommendations**

- The review committee recommends that the department consider bridging retirement positions or exploring opportunities to expand undergraduate offerings by coordination with outside institutions. This will require close collaboration with the administration to secure bridging/replacement faculty positions to alleviate some of the pressures of offering the appropriately diverse and well-designed curriculum. In addition, there may be opportunities to coordinate across research groups in the department when considering replacement hires to mitigate the small number of faculty in areas like Astronomy and Biophysics (for example, a joint biophysics and condensed matter position would help to alleviate the issues faced by the biophysics group in delivering their curriculum and managing faculty sabbaticals). Other possible strategies might include an additional Group II faculty member and the possibility of coordinating with regional campus faculty to assist with Athens campus teaching.

- The review committee also recommends that the department provide more formal advising, perhaps through programming or workshops, to assist undergraduate students with preparing
for the GRE, particularly the physics subject test, and the graduate school application process. Some of this programming could likely be coordinated through the Society of Physics Students.

- The early graduate and undergraduate students would also benefit from more formal programming and advising about career paths outside of academia. Again, some of this programming could likely be coordinated through the Society of Physics Students.

Introduction

Overall Program

a. Is the current number and distribution of faculty sufficient to carry out the broad overall mission of the Department (Teaching; Research, Scholarship and Creative Activity; Service)?

The faculty are currently able to carry out the overall mission of the Department, but there are areas with very few faculty members, namely Astrophysics and Biophysics, which have significant implications for the department’s teaching mission in these areas. In addition, throughout the Department, there is concern among faculty about how to cover the curriculum during faculty sabbaticals.

b. Is the level of the Department’s RSCA appropriate for the program given the size of the faculty and the resources available to the Department? Is the Department’s level of external funding at an appropriate level?

The department is able to meet its departmental service obligations and contributes through its service to the College of Arts & Sciences and Ohio University. The department also maintains an appropriate level of scholarship given its size and resources. This is discussed in more detail for specific research areas below.

Nuclear and Particle Physics

The Institute for Nuclear and Particle Physics is a core area of research, comprising about a third of the faculty, with a strong funding profile. The Edwards Accelerator Laboratory, with its 4.5 MV tandem Van der Graaf, is a unique university resource, providing excellent hands-on opportunities for graduate and undergraduate students. It is used by an external community for both basic and applied research, as well as by faculty and students in the department, bringing both resources and visibility to the program. The facility also provides opportunities for development and testing of new instrumentation for other major facilities such as the NSCL at Michigan State University, soon to be home of the national $730M Facility for Rare Isotope Beams. It is notable that the department as a whole decided to
strategically invest in this area through its next tenure-track hire. Other members of the group have well-established programs at two of the field’s major research facilities—Jefferson Laboratory and the Relativistic Heavy Ion Collider at Brookhaven National Laboratory, as well as internationally. The members of the theory group are productive and highly visible and respected within their field.

The Edwards Accelerator Laboratory would benefit from a full-time staff member to manage administration for outside visitors who come to carry out their research. Currently this position is only half-time due to cuts in department staffing.

Astrophysics

The Astrophysical Institute group currently consists of three active faculty members in the department plus Prof. Shields who is current the Vice President for Research & Creativity and Dean of the Graduate College. Their research explores a wide range of cosmological phenomena, including supernovae, black holes, dark matter, gravitational lensing, and baryon acoustic oscillations. The group has a well-funded, active research program, which includes participation in the MDM consortium giving them partial ownership in two telescopes at Kitt Peak, AZ. However, it is challenging for just three faculty members to deliver the required coursework for the B.S. in Astrophysics. The group offers a large, popular introductory course for general education in addition to the major sequence. Graduate student demand for research projects in this area is high, but the small number of faculty, not lack of research funding, limits the number of students pursuing this area. One additional faculty member would provide an opportunity for growth in this popular research area, both by providing an additional mentor and by the possibility of additional research funding to support them.

Biophysics

The Biophysics group has three faculty members, down from four at the time of the last review due to a departure in 2011. The group has managed remarkably well in maintaining its research (publications and funding have remained solid) and graduate student mentoring (there are currently six graduate students in the group) responsibilities, in part by using connections to other units at OU and elsewhere who share common interests. All three member of the biophysics group belong to the Condensed Matter and Surface Science (CMSS) Program and individual faculty are involved in interactions with the Neuroscience Program, the Quantitative Biology Institute, and other departments including biology, mathematics, biomedical engineering and chemical and biomolecular engineering. These connections help leverage the faculty members’ research and enable the group to “fight above its weight,” but it is clear that biophysics would benefit greatly from the addition of a fourth faculty member. This would enable the department to serve the needs of the many graduate and undergraduate students who wish to study in this increasingly important area of
physics. Given the constraints on overall faculty numbers, a creative solution might be to seek a new faculty member who links the biophysics and nano-condensed matter areas and could add to the strength of both the biophysics and condensed matter physics efforts. Indeed, the faculty member who left in 2011 was active in both groups.

**Condensed Matter Physics**

With a total of eleven Group I faculty, the condensed matter physics group is the largest single group in the department. It covers a wide range of topics in this broad subfield and is both well-funded and well-recognized. Its members play leading roles in the cross-campus interdisciplinary programs, including the Condensed Matter and Surface Science (CMSS) program and the Nanoscale and Quantum Phenomena Institute (NQPI). The modest amount of direct state funding for the CMSS (~$150K/year) is carefully and effectively managed and supports fellowships, workshops, and one staff person. In the case of the NQPI, a Graduate Education and Research Board (GERB) award in 2008 of $165/year in base funding gave it important continuing resources. The department made a wise investment (of nearly $1 million) in the experimental condensed matter physics effort by bringing a helium liquefier on line in 2011 and recycle its helium, saving the department roughly $150K/year. The prospect that this facility might have to be moved to make room for a new building is something that must be handled with great care, as the expense and lost research effort caused by any major down-time for this facility could be very great. The condensed matter group supports a large number of graduate students, with the experimental members averaging between four and five students each. Apart from the possible complications with the helium liquefier, the primary concerns of the group include its demographics (the last condensed matter hire was nine years ago) and the deferred maintenance on its facilities.

**c. Is the level of service, outside of teaching, appropriate for the program given its size and the role that it plays in the University and broader communities it interacts with? Is the Department able to fulfill its service mission?**

The department is currently able to meet its departmental service obligations and contributes through its service to the College of Arts & Sciences and Ohio University.

**d. Does the Department have an appropriate level of financial resources, staff, physical facilities, library resources, and technology to fulfill its mission?**

The department has a lean but efficient administrative staff who appear to work well together to support all aspects of department operations. However, the department’s strong research profile results in over 200 accounts to manage, as well as a high volume of administration for travel, unique research equipment purchases, facilities maintenance, and grants
administration. Loss of one staff member during recent budget cuts, along with the introduction of several enterprise level software systems has stressed the operation of the unit.

In addition, the Astronomy faculty lack access to a key journal in their field, the Monthly Notices of Royal Astronomical Society. This is apparently due to a restructuring of a state contract with the publisher.

Undergraduate Programs

a. Is the program fulfilling its service role, adequately preparing non-majors for future coursework and/or satisfying the needs for general education?

The department has a large variety of introductory physics courses, enabling it to provide the appropriate level and pedagogical approach for its different non-major student constituents (chemists, biologists, engineers, potential physics teachers, etc.). These are mostly presented in the standard format involving lectures, discussion sections, and laboratories. These are well organized and coordinated by a master Group II instructor and are using state of the art technologies, including the LON-CAPA (Learning Online Network with Computer-Assisted Personal Approach) system for delivering and grading homework in service courses. These courses provide more than adequate preparation of non-majors for future coursework and for purposes of general education. In particular, the large introductory astronomy course A1000, is an excellent example of a general education physics/astronomy course.

b. Is the program attracting majors likely to succeed in the program? Is the number of majors appropriate for the program? Is the program attracting a diverse group of students?

The department is indeed attracting a number of majors who have succeeded in the program, and it is undertaking efforts to enhance further its recruitment, including revamping its web page and reaching out to local community colleges. There appear to be some challenges in dealing with central admissions, but these can presumably be resolved. The department currently has a total of ~80 undergraduate majors and are seeing a slight increase in incoming majors (~35/year). There remains a substantial amount of attrition, with an eventual graduating rate of about 10 physics majors per year (although many of the “attrited” students move to other majors at OU. Physics is working on improve their retention rate for majors, focusing on advising and the freshman seminar (PHYS 210/1901) which informs students about various career options and long-term prospects. The diversity of the undergraduate students (in contrast to the graduate students) reflects to a large extent the diversity of the regional population and the major underrepresented group in the department
are women students: in last year’s class, there were 23 men and one woman among the regular majors. Interestingly, the physics majors who are in the HTC (Honors Tutorial College) program, were more gender balanced, with three men and three women. Importantly, the department is encouraging a very active Women in Physics group, which has recently expanded to include undergraduates, and provides an important support group and, in the words of one student, “a comfortable environment for discussions.” An interesting fact is that the Society of Physics Students group has had a woman serving as President in several recent years.

c. Does the undergraduate curriculum provide majors with an adequate background to pursue discipline-related careers or graduate work following graduation? Are students able to move into discipline-related careers and/or pursue further academic work?

The department has a formal curriculum committee which regularly monitors and recommends changes to the curriculum. The Q2S (Quarters to Semesters) switch in 2012 was a major opportunity to reconsider courses and led to many changes, including an unfortunate reduction in the number of service courses. In addition, the undergraduate and graduate quantum classes were combined, which did not work well for the undergraduate students. These courses have now again been separated. Given the limited number of faculty in certain key areas—for instance, astronomy—the department is coping fairly well with providing a full range of undergraduate physics courses. Ideally, they would be able to offer a few more optional/advanced courses, and this might be possible by linking with other area universities (including OSU and Kent State) using video technology. This option should be considered. The undergraduate students expressed some concern about the advanced physics labs (in particular, the electronics labs) with the primary complaint being aged equipment and inadequate space. One faculty member is currently leading a major update of these advanced labs. Importantly, the issues caused by a limited selection of advanced courses and somewhat outdated formal labs are more than compensated by the extraordinary success of the departments in involving undergraduates in “real” research with the faculty. Nearly 90% of students who graduated during the seven year review period had at least one research internship in a faculty member’s lab, outside of regular course work. In this regard, the three physics-related institutes play a crucial role. This research experience provides outstanding preparation for graduate school and/or discipline-related careers. Ohio University physics graduates are very well prepared to go forward into physics-related careers or further academic work. One area in which both students and faculty agreed some improvements are need was in formal preparation for post-college opportunities, including earlier advising about graduate programs and preparation for the Graduate Record Examination (GRE). This should be easy to implement, given the collegial atmosphere and cooperative attitude of the physics majors.
d. Are the resources and the number of and distribution of faculty sufficient to support the undergraduate program?

Given the considerable service teaching responsibilities not just in numbers of students but in the variety of courses, as well as the desire to offer as many advanced courses for physics majors as possible, the department is on the edge of having the appropriate number of faculty to manage all its responsibilities. This is particularly true for the astrophysics group, where the three faculty members have to cover the large general education course as well as specialized courses for majors. In the present financial situation, there is no easy solution to this problem by simply gaining the additional resources and increasing the faculty head count. It is also essential to recognize that increasing the teaching responsibilities of Group I research active faculty would be a serious mistake, as it would put OU at a significant competitive disadvantage vis-à-vis its peers. The addition of a Group II faculty member focused on intermediate courses for majors might be a possible solution or coordinating with regional campus faculty as appropriate.

e. Are pedagogical practices appropriate? Is teaching adequately assessed?

The department has a large variety of introductory physics courses, enabling it to provide the appropriate level and pedagogical approach for its different student constituents (non-majors in service courses, engineers, physics majors, potential physics teachers, etc.). These are mostly presented in the standard format involving lectures, discussion sections, and laboratories. These are all well organized and coordinated and are using state of the art technologies, including the LON-CAPA (Learning Online Network with Computer-Assisted Personal Approach) system for delivering and grading homework in service courses and the PRS (Personal Response System) or “clickers” for obtaining immediate feedback on students’ comprehension in lectures. The department also undertook an experiment in a novel pedagogical approach—the “SCALE-UP” methodology, which originated at North Carolina State University (see https://en.wikipedia.org/wiki/SCALE-UP ), which requires more hands-on interactive student involvement and additional TAs. After testing this approach for two years, the department decided to abandon it for the present, given inconclusive results on improved student comprehension, the present classroom facilities, and the likely reduction in the number of TAs that could be assigned to the course. Nonetheless, the openness of the department to novel pedagogical strategies is to be commended and encouraged, and reflects their strong commitment to undergraduate education. As this example demonstrates, the department is very active in assessing its teaching. Finally, the department has a number of students in the Honors Tutorial College (HTC), which requires individual (in some cases, small group) instruction, and they have successfully taken on this responsibility despite their limited faculty numbers. In sum, the department’s pedagogical practices are definitely appropriate and thoroughly assessed.
f. Are students able to move into discipline-related careers and/or pursue further academic work?

From our remarks in the previous sections and from the data on student outcomes discussions in the self-study, it is clear that a large majority of the graduating seniors go on to graduate study (56%) or into discipline-related positions in the workforce (38%). The department’s efforts to track their graduates and to use this information to assess its programs is exemplary.

Graduate Program

a. Is the program attracting students likely to succeed in the program? Is the number of students appropriate for the program? Is the program attracting a diverse group of students?

The graduate program attracts qualified students who are likely to succeed in the program, and the number is appropriate for the number and size of programs. The students are somewhat limited in terms of gender and racial diversity as are many physical science and engineering programs student populations, but there is considerable ethnic diversity in the program. The diversity of the department’s students is comparable to the national norms in the discipline. The department’s strong efforts at community outreach and the vibrant “women in physics” group are examples of ways in which they actively try to advance diversity within their discipline.

b. Does the graduate curriculum provide an adequate background to pursue discipline-related careers following graduation?

The graduate curriculum is appropriate to enable students to pursue discipline related careers after completion of their degrees. During the transition from quarters to semesters, the department revised the curriculum and continues to do so as students move through the new curriculum and calendar. The department is actively monitoring student experiences with these changes and making adjustments as needed. The department also added a computational physics course to the graduate curriculum, a timely addition that reflects the growing need for this skill in most research areas in physics.

c. Does the program provide adequate mentoring and advising to students to prepare them for discipline-related careers?

There is a great deal of intellectual interaction among graduate students and the graduate faculty. Graduate students who serve as teaching assistants receive departmental training and
are mentored by faculty. Graduate students are productively engaged with faculty mentors in research, and some participate in international collaborations. However, it might be helpful to initiate a more formal advising process or a series of workshops to prepare students specifically for their job search and developing the materials needed to apply for positions outside academia and for fellowships.

d. *Are the resources and the number of and distribution of faculty sufficient to support the graduate program?*

Essential faculty are available, and essential resources are provided. However, with only three faculty in the astrophysics and biophysics program areas, these areas may not be able to meet student demand. An additional faculty member in each of these areas to support and mentor students could enable this area and the overall program to grow. In addition, the facilities are deteriorating as noted above. The maintenance and upkeep of Clippinger is vital to the department’s teaching mission. In addition, many of the facilities serve faculty and students in other units in the College of Arts and Science as well as other colleges so these facilities play a role in the College’s and university’s teaching missions. More broadly, the maintenance of the facilities and equipment weigh heavily on the department.

e. *Does the program offer appropriate financial support to graduate students?*

The financial support appears to be within discipline norms.

f. *Are students able to move into discipline-related careers?*

Measures of student success suggest that students are quite successful in moving into discipline related careers.

g. *For doctoral programs, questions related to D.I.B. of*  

These questions are answered on the following pages.

**Quality Standards**

1. **Program Faculty**

A level of faculty productivity and commitment shall be required commensurate with expectations of graduate program faculty as indicated by the following:
• The number and qualifications of graduate faculty members are judged to be adequate for offering the graduate degrees in the specified areas, and faculty supervise an appropriate number of students.

• The preparation and experience of the faculty are appropriate for offering the graduate degree in an intellectually challenging academic environment as demonstrated by active scholarship and creative activity judged by accepted national standards for the discipline.
  ○ Faculty members have achieved professional recognition (nationally, internationally).
  ○ The faculty garners significant external funding, as defined by disciplinary norms, which enhance the graduate program.
  ○ Directors of dissertations and a majority of committee members generate new knowledge and scholarly and creative activity as determined by disciplinary norms.

According to a review of the physics department faculty curriculum vitae, the faculty are highly qualified to deliver a doctoral program. All have doctoral degrees in physics, astrophysics, or a closely related field, and all are nationally recognized in their sub-disciplines. With 75 graduate students and 25 tenure-track faculty, the student to faculty ratio is healthy. Research funding averages approximately $150K per year per faculty member, with an average annual funding rate for the department of $3.9M.

2. Program Graduates Since the Most Recent Review

A level of student satisfaction, student accomplishment, and graduate accomplishment exists as evidenced by the following:
• Students express satisfaction with advisement, teaching, and program support services.
• The structure and conduct of the program lead to an appropriate degree completion rate and time-to-degree.
• The predominant employment of graduates within three to five years after graduation is in fields consistent with the mission of the program.
• Graduates demonstrate preparation for career-long learning and success as indicated by periodic surveys of career changes, job satisfaction, and relevance of doctoral training to various career opportunities.
• Accomplishment and potential of program graduates to generate new knowledge or new initiatives in teaching, public service, and/or other practice.

Measures of student success in the program suggest that graduates are able to meaningfully engage in academic and non-academic careers in the field that produce new knowledge
and/or contribute to new initiatives in teaching, public service, and practice in the field. For example, as the self-study indicates students have received invitations to present their work at international conferences, published in important journals in the field, and successfully competed for and received awards and scholarships for their research.

3. Program Vitality

A vital graduate program is dynamic and should possess the following indicators:

- The environment of the program promotes a high level of intellectual interaction among students, graduate faculty, and the larger academic community;
- The curriculum has been updated during the period under review with disciplinary developments;
- Essential resources are provided (e.g., library materials, computer support, laboratory facilities and equipment, student financial support, etc.); and
- Requirements for completion of the degree are deemed appropriate to the degree.

The graduate program is well run and dynamic, as discussed in the main body of the report. There is a high level of intellectual interaction among students and the graduate faculty. The text of the report identifies the details. Graduate students who are teaching assistants receive departmental training and are mentored by faculty who are the primary instructors. They are actively engaged with faculty mentors in research, and they participate in community outreach initiatives offered by the department. Some students participate in international collaborations. The transition from quarters to semesters mandated a significant revision of the curriculum, and this process is ongoing as experience with the new calendar system continues. One example is a course that was shared between graduate students and undergrads – the department has determined that there is a need to separate them in order to better serve the graduate students. A modern addition to the graduate requirements is a course in computational physics, since this is now a skill widely used across most research areas in physics. Essential resources are provided, although the laboratory facilities are marginal if the department is to further excel in its research mission. The building has reached its full capacity. The Astronomy faculty lack access to a key journal in their field, the Monthly Notices of Royal Astronomical Society. This is apparently due to a restructuring of a contract with the publisher.

4. Program Demand

A graduate program should be able to demonstrate that there is demand on the part of prospective students and that it is fulfilling a clear need through the following:

- Student demand/enrollment during the period under review: application ratio, student GPA and GRE scores, or other indicators as appropriate; and
- The extent to which the program meets community, region and state needs and occupational societal demands.

Student demand and enrollments are good and are addressed in more detail the report. The doctoral program in physics does not specifically address community or regional needs, but it addresses a national need for a strong, educated, STEM workforce through creation of graduates who go on to technical careers in academia, federal laboratories, and the private sector. Employment and career success of graduates is high, as indicated in Appendix F of the self-study. A potential opportunity is that the astrophysics program area has only three faculty, and student demand is such that if there were one additional faculty member to support and mentor students it could grow and enhance the graduate program overall.

5. Program Interactions

Graduate programs do not exist in isolation but rather in relation to and in comparison to similar programs in the discipline at other institutions and to cognate areas in the same institution. Information regarding appropriate interactions should include:
- Centrality of the program to advanced study in the specific discipline(s) regionally or nationally;
- The ability of the faculty and students to make a particular contribution in this field;
- Interactions, including interdisciplinary, among graduate, undergraduate, and professional programs, as appropriate;
- Interactions with and in collaboration with similar programs at other universities and organizations; and
- Programmatic access to special leveraging assets such as unique on-campus or off-campus facilities, non-university experts or collaborative institutions in the discipline, industrial or other support, endowments, as well as special funding opportunities.

The department has strategically focused on four areas of research, giving the program both breadth and depth, but also coherence. The experimental nuclear physics group has a unique on-campus facility in the Edwards Accelerator Laboratory. They also carry out research at all three of the primary national accelerator facilities of the field. The theoretical group is active in the international nuclear theory community. The astrophysics group has partnership in an observatory that guarantees access for at least one month per year. The condensed matter and biophysics groups have strong collaborations with other engineering and science units on campus.
6. Program Access

There should be evidence that the program has established or seeks to establish an appropriate level of diversity among its faculty and its graduate student body, as evidenced by:

- Trends and expectations in student demographics; and
- Proven efforts to sustain and enhance diversity of faculty and students.

As in many physical science and engineering programs, diversity among both the faculty and students is somewhat limited. However, this department is comparable to the national norms of its discipline. An active “women in physics” group provides a welcoming environment, along with networking and professional development opportunities for students.

7. Assessment Mechanisms Used in Program Review

Since quality indicators are increasingly becoming an integral part of ongoing program review, an enhanced recognition of the uses of outcomes assessment in the review process provides a useful tool for program improvement, as demonstrated by:

- A summary of the appropriate outcome measures used to assess program quality; and
- Procedures must be in place to ensure the use of assessment data for continuous quality improvement of the program.

Graduate student success is evaluated through traditional measures: through selectivity measures on admissions, through course grades and degree completion, and through publications, conference presentations, and placements after graduation. Learning objectives for the program were identified in the self-study and are appropriate to the program. The department chair and graduate director monitor the quality of the incoming class, graduation rates, and placement rates on an annual basis. The department intends to create a graduate assessment committee in AY2016 to gather data to assess outcomes on an ongoing basis. Apparently the program was given an “excellent” rating by the university’s own review of graduate programs in 2008-2009.
To: Scott Sparks, Acting Chair, UCC Program Review Committee
From: David Ingram, Chair, Department of Physics & Astronomy
      Robert Frank, Dean, College of Arts and Sciences
Date: August 26, 2016
Subject: Response to the Site Review Committee’ Report of the Department of Physics & Astronomy seven-year review.

Thank you for forwarding the reviewers report. The Department and College really appreciate the effort that the reviewers put into this review and thanks them for the detail Commendations and Recommendations. We would like to take this opportunity to respond to some of the committees Concerns.

Concerns

Clippinger

The Committee clearly understood the challenges faced with the conditions of Clippinger Laboratories. These conditions are also a challenge for the three other departments in the building. The short term plans are for the roof to be replaced this year. This should remove one of the constant risks for extensive and expensive damage to research teaching equipment including computers hosting research data and students grades. In the longer term, a plan for renovating and refurbishing Clippinger is scheduled for final approval by the Board of Trustees this August. As the Clippinger renovation plans move forward, a major concern is the relocation or replacement of the helium recovery system currently located in the Clippinger Research Annex, due for demolition in phase 4 of the renovation plan.

Undergraduate Program

The concern expressed by the undergraduate students over the sequence of math and physics courses is real and is being addressed. In one case there is a course making its way through the curricular process that will be taught by physics faculty when a course with similar outcomes from math is not available. The Department leadership has been in discussions with the chair of the Mathematics Department to identified particular curricular issues that have arisen over the last three years. He is aware that some staffing issues he has faced have had an impact on the frequency of some courses and the way some of those courses have been offered.

We are aware of the desire of our undergraduates to have more specialist elective courses available to them. We are monitoring the model being used by Classics and World Religion to share the delivery of classes between them and a corresponding department at Miami University. This is an idea being actively investigated by other physics departments in the country as a way to improve the quality of undergraduate programs and the efficiency with which programs are delivered.

We plan to provide more career support and, in particular, provide more information on the process to follow for those undergraduates interested in graduate school. This had previously, several years ago, been provided by a now retired faculty member. We are only just realizing that this is still needed by the current generation of students. It is with mixed feelings that we will give advice on the GRE. Both the astrophysics and the physics professional societies have indicated that this test should not be used for graduate admission. It has the same demographics short comings that other standardized tests, such as those taken in K-12 grades, wherein certain groups are given an unexplained advantage and others appear
to put at a disadvantage. Further, the data show that the GRE is not a good predictor at success in completing a Ph.D.

Graduate Program

The reviewers’ report provides confirmation that our graduate students felt the need of better career advice. We had just been made aware of this through a survey done in preparation this review. Our first year advisor and more particularly, our second year graduate student advisor encourage graduate students to consider what they plan to do on graduation. We have a course available on alternate years for graduate students interested in an academic career. We rely on individual Ph.D. advisors to provide advice to students in their final years. However, we have discovered recently that our graduate students want more advice on non-academic career paths. We plan to address this though inviting alumni back to discuss their career path with students. We noticed that recent visits by alumni had been very popular with the graduate students and that they want more opportunities to meet alumni.

Faculty

While the department has have no formal annual date for a pre-tenure review, every year the pre-tenured faculty are reviewed at a meeting of the department P&T committee. This includes all tenured faculty. Prior to the review, the pre-tenured faculty member’s PDFA is made available and at the meeting the mentor of the pre-tenured faculty member presents their view of the progress their mentee is making towards tenure. This meeting, which the chair of the department attends, informs the chair as to the wording of the letter regarding progress to tenure required for all pre-tenured faculty by February 1st. Thus, the department considers that there is a process for continuous assessment which we consider is better than a single pre-tenure review.

The number of faculty in Astrophysics and Bio-physics was noted as a concern. The department has a retreat in October this year at which retirements and other opportunities for recruiting faculty will be discussed. Any plan for increasing the size of the current faculty will need to be considered in the larger context of college needs and budget.