Report of the Review Committee for the Physics Department at Juniata College

March 22 and 23, 2009

Preliminary

The review of the Physics Department at Juniata College was carried out on March 22 and 23, 2009, by Abby Hinkle, B.S., E.I.T., of Boynton Beach, Florida, Andrew Kortyna, Ph.D., of Easton, Pennsylvania, and Joseph E. Wiest, Ph.D., of Buckhannon, West Virginia. Ms. Hinkle is a 2005 graduate of Juniata College and Pennsylvania State University in the collaborative 3/2 Physics and Civil Engineering Program, and works at the firm of Simmons and White, Inc. as a civil engineer; Dr. Kortyna graduated in 1984 with a B.S. in Physics from Juniata College, did his graduate work at Wesleyan University, and is now an Assistant Professor in the Department of Physics at Lafayette College; Dr. Wiest is a Professor of Physics at West Virginia Wesleyan College, is a board member of the NASA-West Virginia Space Grant Consortium, and serves as an external evaluator for the American Association of Physics Teachers.

A rather thorough report on the Physics Department at Juniata had been prepared by the faculty and staff of the Department and had been sent to each member of the review team prior to arrival on campus. The report followed the format and recommendations of the American Association of Physics Teachers on the review and evaluation of a physics department. Information on each course, the programs offered, present students and alumni, and faculty and staff of the Department was provided. Strengths and weaknesses of the Department, improvements made in the Department since the last review nine years ago, and the goals of the Department for the future were discussed in the report.

Drs. Kortyna and Wiest arrived in Huntingdon, Pennsylvania on Sunday afternoon of March 22 and began their work with a dinner meeting with the full-time faculty of the Physics Department of Juniata. A recent history of the Department and the College was presented, and a question and answer session was held. Ms. Hinkle arrived later that evening and convened with the review team the following morning.

The bulk of the on-campus review was completed on Monday, March 23, beginning with a breakfast meeting in the company of the full-time faculty of the Department at 8:00 A.M. A schedule of the upcoming day’s events was provided and a continuation of the discussion from the past evening’s meeting ensued. Following breakfast, a tour of the Department’s space and facilities was led by Dr. Jamie White, chair of the Department. There was time provided to meet and talk with each faculty and staff member of the Department, time to meet several students who were majoring within the Department, and time to hear of the students’ experiences in the department and of their future plans. As the day progressed, the review team was able to meet with chairs and/or faculty of the Education, Mathematics, Chemistry, and Biology Departments, as well as with the provost of the College, Dr. James Lakso. Lunch was held with a cross-section of physics students representing the different program tracks that may be followed, according to career interests. Additional time was provided in the afternoon for review team members to receive a more in-depth look at the laboratories, the machine shop, and the research projects that students have been able to engage in with faculty. A refreshment break was held in the student
lounge of the Department where students could chat informally with the reviewers. The day ended with a dinner meeting between the review team and the faculty of the Department. This was a good forum for the members of the review team to state observations, ask questions, make suggestions, and to discuss practices in other physics departments of comparable colleges.

The following is a summary of recommendations being made by this review committee:

1. Hire a technician whose main responsibility would be to maintain the Department’s inventory of laboratory equipment.
2. Add a fourth faculty line to the Department. This line would permit an already strong department to become an outstanding department.
3. Complete the ongoing renovations of the Brumbaugh Academic Center.
4. Offer upper-level courses taught by physics faculty in Quantum Mechanics and Solid State Physics. Also, consider introducing a capstone experience.
5. Strengthen contacts between the Department and various engineering programs to enhance both the 3/2 engineering program and the opportunities for physics majors to attend engineering graduate school upon graduating from Juniata.
6. Consider establishing a medical-physics track within the Department.
8. Look into the Department of Energy, the National Institutes of Health, and the National Aeronautics and Space Administration for grant funding for the Department, while continuing work with the National Science Foundation.

Details and rationales concerning these recommendations can be found in the final section of this report.
Findings of the Review Team

It was evident that the department had spent considerable time gathering a wealth of data and information about the last nine years of operation. The case was made that the Department had made progress in many ways so that it was now a much more solid contributor to the College. Whereas in the past there were several introductory classes with large enrollments and upper division major classes with a small handful of students, the number of introductory classes had been trimmed to some extent but their content continued to meet the needs of several other departments and they had also grown significantly in enrollment. The upper level major classes, which formerly consisted of three or four students, had more than doubled, with certain classes such as Electronics now drawing 18 students and some of the advanced classes drawing 10 or 12 students. A spike in interest was reported in the first-year class with some 20 students expressing interest in one of the programs offered by the Department. While some more specialized courses in the upper level lag in enrollment compared to courses needed by all students in their departmental program, it is abundantly evident that the Department has made demonstrably solid progress overall and is poised for continued growth in the future.

The self-study makes it clear that the Department has also grown in how it serves the students of the College, other departments, and the public at large. It is impressive that the Department participates in MCAT Exam study sessions, (the MCAT being essential for admission into all medical schools), offered by the Health Professions Committee. The Department has demonstrated an increase in student MCAT scores by those students who take advantage of the review sessions. Topical classes are also offered by departmental faculty to engage students from across the College to discuss and debate timely issues such as nuclear power, and students with a serious interest in music have been taught a course in musical acoustics. Even more significant are the Department’s efforts to address the national shortage of science teachers in high schools across the nation, with physics being one of the most difficult positions to fill. The Physics Department, partnering with the Education Department, has created a model program to attract students into physics education at Juniata and to support and sustain their interest as they go through their four-year program.

It was unusual but heartening to see that the physics faculty provided the guidance and opportunity for physics education students to prepare some of their future high school classroom materials as part of their upper level course work. Students who wish to prepare for graduate school in physics are given the opportunity to spend summers at a national laboratory such as Pacific Northwest National Laboratories in Washington State, where Jim Borwardt has excellent contacts, or at NIST where an alumnus of the department is a staff scientist. There are also up-to-date research opportunities available to students on campus, such as using lasers to investigate atomic and optical physics under Jamie White. Several engineering universities have formal partnerships with the College. Students who are interested in engineering, which they are introduced to early in their studies, are able to have the faculty and alumni assist them in gaining early engineering experiences by engaging in summer internships at corporations. Since there is biophysics interest among the faculty in the department, students also have a means of relating physics to medicine and continuing on to medical school.

The support offered by the faculty of the Department to all students who take their classes is demonstrated in the self-study and during the site visit. The faculty post office hours where they
invite and encourage students to visit their offices for individual and small group help. Many colleges state that they foster this type of faculty–student interaction and that they encourage their faculty to implement such goals, but this appears to be done more effectively and actively at Juniata. It helps that the Physics Department has a wonderful adjunct in Mary Atchley, who gets to know the entry level students in the seven introductory laboratory sections that she teaches or assists with. She is then able to assist the full-time faculty in meeting the needs of the students outside of class through additional office hours and study sessions. It is also impressive to learn that Ms. Atchley helps introductory physics students with homework problem sets. There is also a talented adjunct, Mark Pearson, who has an extensive and prestigious background in physics, biology, and engineering, and who is available to help sophomore through senior students in classes and with needs outside of class. The number of hours that Norm Siems devotes to beginning and advanced students each week is a sign of a master teacher who takes his work very seriously and enjoys it thoroughly. Jamie White and Jim Borgardt also have many office hours available to students and work with them in many different ways throughout the week.

The Department’s self-study is honest about its perceived weaknesses. The faculty acknowledge a problem of keeping their laboratory equipment in good working condition; as there is no technician specifically available to oversee this continuing need. They see a rather heavy teaching and work load for their faculty and a relatively small number of full-time people in their department. They also see a growing number of physics majors and a need to change their curriculum somewhat to provide a more modern and up-to-date background for their majors. Senior scores on the Graduate Record Exam are good but could be improved if the students had the opportunity to take all of the courses covered on the exam. Most of the topics on the exam are being covered in classes, but a few are not. A need for finishing the renovation of the physics wing of Brumbaugh Hall is also stated.

Observations of the Review Team on Site

The conclusion that the review team came to after meeting and speaking with a cross-section of the students majoring in the Department is that they are bright, engaged, and know what they want to do in life after college. The students are confident, appreciative of the opportunities that their department and their College are providing them, and enthusiastic about what they are doing. It is very good to see that they are very much at ease with the faculty in their department and that they appreciate the mentoring that they receive from the faculty. The students have several attractive and interesting career tracks to choose from in the Department, and they enjoy working together as they are able to pursue different goals. They are most appreciative of the skills and depth of knowledge that they find in their departmental faculty and the degree of interest that their faculty take in them. They take abundant advantage of the student lounge in the Physics wing of Brumbaugh Academic Center, and find the laboratories open during the evening to be good places to study, plan public physics shows, hold physics club meetings, and interact with the faculty and staff.

It is clear that students majoring in this department have ambitious goals and that many are achieving their goals. The students are being provided a rich background, and they are being accepted into competitive summer research and internship programs. Those who are graduating with proper high school teaching credentials receive good appointments. Students are accepted
into engineering schools where they are successful in completing their engineering degree, and they are accepted into good graduate schools in physics where they are successful in completing higher degrees. What might the program do to prepare the graduates even better during their four years at Juniata? In comparing their program with other good undergraduate physics programs one notes several issues. First, not all students take a course in Quantum Mechanics. All of modern physics rests upon a foundation in a Quantum Mechanics course. Second, there is no course available in Solid State Physics. The knowledge of instruments that modern physicists use in the laboratory and a modern understanding of materials are developed in the theories taught in a Solid State Physics course. Finally, there is no senior course available that ties all of their undergraduate learning together, which is often referred to as a capstone course. A capstone course provides an excellent review of topics covered on the Graduate Record Exam in physics and provides better preparation for graduate school.

The members of the faculty have excellent backgrounds for the classes they teach and for the other work that they do. Full-time faculty are augmented by adjunct faculty who also have some remarkable skills. Jamie White has a background in laser physics, condensed matter (another name for solid state physics), and acoustics. Norm Siems has a background in nuclear physics, astronomy, and astrophysics. Jim Borgardt has a background in atomic and nuclear physics, thermal physics, and advanced mechanics. Mark Pearson has a remarkable background in biophysics, bioengineering, and advanced optics that is difficult to find at an undergraduate institution. Mary Atchley has a gift in experimental physics and a wealth of patience to help all students (of various majors) successfully complete laboratory experiments, learn experimental techniques, and analyze experimental data. All of the faculty have the necessary background in quantum mechanics and the common courses shared by all physicists such as mechanics, thermodynamics, electricity and magnetism, relativity, optics, etc. They are all very appreciative of the Physics wing of the Brumbaugh Academic Center and the good space and layout available there. The faculty problems they face consist of a need to complete the renovation of the Physics wing, a need to clean out and reorganize some rooms, and a constant need for a technician to oversee the maintenance of the equipment for all of the labs. The faculty also express some frustration in having the background to offer key upper-level courses, such as Quantum Mechanics, but not having the opportunity. It is clear that the faculty of the Department have a very heavy teaching load at 4.6 equivalent FTE faculty with only three full-time faculty members.

It is good to see that the department has an active Society of Physics Students chapter where students and faculty can gather together after classes are over for the day to share stimulating and informational programs. Outside speakers are invited, students are informed about summer research and internship positions and are told how to apply for them, alumni are able to return and share their experiences with students, and faculty are able to communicate the tracks and career choices that students can follow with a physics concentration. This organization serves as another avenue for student-faculty interaction. Students and faculty also cooperate in preparing a physics show that they put on at the college, in local malls, and in other public spaces. They also get together for a cookout at one of the faculty members’ homes during the year. The student lounge in the Physics Department serves as an ideal space where faculty and students can informally come together, and where students always have a place to relax and study. The Department also has a policy of leaving the labs open so that when classes are not meeting in the rooms, students can find a quiet place to study or to use a computer. Since the faculty offices are
nearby, students can easily find them and receive extra help. The faculty and staff of the Department are to be commended for the positive environment that they have created, and for the ease and closeness that the students feel with them. This not only creates more engaged students but also serves to build a stronger department that prospective students find attractive.

The chairs of the mathematics and other natural science departments indicate that there is significant support for the Physics Department on campus. The majors in the other natural sciences take particular physics courses as requirements; and physics students have a very good reputation as conscientious, bright, and responsible students in their mathematics and chemistry classes. The Physics Department is regarded as an essential part of the sciences at Juniata. Both the Biology Department and the Chemistry Department expressed interest in closer ties with physics. It was suggested that physics might engage in some interdisciplinary biophysics research with biology or teach an upper-level biophysics course that advanced biology, pre-med, and physics students might take as an elective. Both physics and chemistry students take courses from each other’s departments, and there are many common interests that exist between the two departments. It was suggested that physics and chemistry might engage in some interdisciplinary research of interest to both departments, such as nanoscience. The Mathematics Department has many physics students in both their calculus sequence and their differential equations class, where they are found to be among their best students.

It was also informative and helpful to speak with the Provost of Juniata College, Dr. James Lakso. He presented a perspective on how the College is doing today and how the economic downturn is affecting the College. He provided recent College history and discussed the role of faculty and departments in the College. It was apparent that he was aware of the history and the goals of the Physics Department. He made some helpful suggestions on a roadmap that the Department might follow in reaching its goals. The review team appreciated that Dr. Lakso had come from the Juniata faculty, that he knew the departments and faculty intimately, that he had guided the academic component of the College in making significant progress during his time in office, and that he still taught a class to keep abreast of students’ attitudes and interests and maintain a connection with the day-to-day life of the faculty. The members of the review committee commend Dr. Lakso on the excellent academic reputation that Juniata College enjoys, on creating an environment that fosters loyalty of the faculty to the College, and on encouraging and supporting a love of learning that is obvious in faculty and students on campus.

**Recommendations of the Review Team**

It was found by members of the physics review team that the Physics Department at Juniata College has made excellent progress since their last review nine years ago. It is well integrated into the College with its faculty serving on many major college committees and taking part in many activities, both in and out of the classroom, that enrich the lives of many students, both physics majors and non-physics majors, at the College. They take part in scholarly research, they take their teaching roles seriously, and they are devoted and committed teachers. They have excellent space in Brumbaugh Academic Center which they use very effectively. Their courses are kept up-to-date and they serve many students from both inside and outside of their department. The faculty are readily available to all of their students outside of class hours, and it is apparent that they want to see their students succeed. They mentor their majors very
effectively. They keep in touch with their alumni, welcome them back to campus to interact with present students, and let them know in various ways that they are very important to the College. The Department maintains modern and well-equipped laboratories, and provides effective experimental instruction for beginning students and excellent research experiences for their upper-level students. The research experiences viewed by the review committee are of an advanced nature and are of current interest to the research community in physics. The department is distinguished in that it is able to boast a graduate who has won a Nobel Prize in physics. This graduate, Bill Phillips, remains a steadfast supporter of the department and its students. Dr. Phillips makes student research positions available to Juniata students at the National Institute for Standards and Technology (NIST). This is a rare and commendable alumnus.

The Department is quite strong with dedicated and loyal full-time faculty, adjunct faculty, and staff, and it has grown considerably in students that it serves over the nine years since its last review. However, the Department has identified some problems and weaknesses that it would like to remedy. The renovation of the Physics wing of the Brumbaugh Academic Center needs to be finished to make the space fully effective and attractive to prospective students. The Department has a very heavy teaching load which amounts to 4.6 equivalent faculty members, whereas there are only three full-time faculty currently in the Department. Although the Department has many laboratories that it teaches, there is no technician specifically responsible for maintaining the laboratory equipment. It is common for physics departments to have a full-time technical assistant to perform this role. It is essential for this technician to be directly supervised by the Physics Chair such that he or she is effectively integrated into the physics program. The Department teaches a wide array of modern physics courses but lacks its own upper-division courses in Quantum Mechanics and Solid State Physics. These two courses are mainstays of most physics departments and are expected of students who take the Graduate Record Exam in physics. The addition of these two courses should improve the GRE scores of seniors in the Department. The department presently does not teach a capstone course to tie the four years of undergraduate physics courses together for its seniors.

It is noted by the review team that members of the Department’s faculty do apply for and receive outside grants to sponsor research by faculty and students. It is suggested that the Department consider joining the consortium of colleges and universities in Pennsylvania that is sponsored by the National Aeronautics and Space Administration (NASA). This consortium exists in most states of the nation and is particularly interested in finding strong institutions in the natural sciences to aid in making them stronger in that role. NASA exists because of a physics professor at a small college in Massachusetts, Robert Goddard, who did early experiments in rocketry and flight. The NASA consortium has many grant programs available to help a department develop its research, curriculum, and public outreach. It is also suggested that the department look into the grant programs of the Department of Energy and the National Institutes of Health (where the departmental interest in biophysics would fit in very well).

It is noted that the enrollment in the Department’s upper-level classes has grown from a very few students to an average of about 7.5 students per class, that this year’s senior class has about 12 students, that the first-year class began with about 20 students in the fall, but that the sophomore and junior classes are smaller. It is recommended that the Department use its four-year engineering physics option to shore up its upper-level enrollment so that the classes average about 10 students or a little larger. Such enrollment would be considered to be excellent in a
physics department of a college the size of Juniata and would be indicative of a strong, mature physics department with a full faculty of active teachers and scholars. It is recognized that the Physics Department at Juniata has this kind of potential. In order to achieve this goal, it is recommended that the Physics Department continue its present offerings of several tracks for majors. However, it is also recommended that the Department consider contacting the deans of engineering and heads of several engineering departments at desirable engineering schools, including the Pennsylvania State University, to learn about the best engineering graduate school options for physics majors as well as to update the current collaborative efforts that Juniata has with its 3/2 physics and engineering program. Graduates of physics departments make ideal graduate students in engineering at universities, particularly those physics departments that offer courses like statics and dynamics and make their students aware of engineering fields, as Juniata does.

The present 3/2 engineering option of the Physics Department is an ideal program for students who desire a B.S. in engineering and go immediately to work, and this program has worked well at Juniata. However, engineering schools are in great need of graduate students, offer them excellent fellowships, and see that they receive high-paying jobs upon graduation. It is also the desire of many undergraduates to be able to attend a small college for their undergraduate degree and then to be able to do their career training in engineering at the graduate level. Setting up the engineering physics program so that students can follow this track and publicizing it effectively is expected to draw more talented students to study physics at Juniata and should enable the Department to meet its upper-level class enrollment goals. The Department has a strong record of helping to prepare students for medical school, so it may also want to consider creating a track in medical physics, which is a highly needed and well-paying position in major hospitals. An undergraduate needs to follow a physics major, take introductory classes in chemistry and biology, and then study the field of medical physics at the graduate level. Such a program would need to be publicized in order to bring in additional students to study physics at Juniata, but would fit in quite easily with the offerings of the Department.

It is recommended by the review team that the College find a way to enable the Physics Department to hire a fourth full-time faculty member. A fourth faculty member would allow what is now a good program to develop into an excellent program. While the existing Department is working very efficiently with the faculty it has, it is stretched too thin at present to be able to fulfill all of its goals and to become a stronger unit of Juniata. A fourth faculty member would permit the Department to regularly offer a full suite of core upper-level courses and put more energy into its service duties. A fourth faculty line would allow all present faculty to have more reasonable loads so that there can be a more reasonable balance of teaching and scholarly research in the department, as well as allowing the public contributions that this group of faculty like to make. The additional faculty member would enable the Department to apply for and bring in more outside grants, and develop programs that would be expected to bring in additional students. Joining groups like the NASA consortium and forming alliances with graduate schools in engineering would become much more plausible with such an individual. It is expected that the fourth faculty member would be an excellent investment that would soon pay for itself in additional grant revenue and in additional students. The four-member physics department, with adequate technical and staff assistance, would place the College and the Department among a very good group of colleges. Juniata College already has this kind of reputation in her region, and this would simply bolster her reputation and standing both within the region and beyond.