

**Academic Program Review Final Report
For the Department of Physics at the University of Maryland Baltimore County**

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Kenneth J. Voss
Professor
University of Miami

George R. Welch
Professor and Department Head
Texas A&M University

We offer the following specific points.

- 1) The department is well run and collegial, and has a well thought out self-study.**
- 2) The addition of five TA lines, with the multiplicative effect of additional externally funded RA's, would address several areas of the university's strategic plan.**
- 3) The new faculty need more space and now is the perfect time to allocate available space in the physics building.**
- 4) The Atmospheric Physics program would be enhanced with the addition of at least one more faculty member.**
- 5) The department needs to consider a change to its upper-division undergraduate curriculum to allow more advanced study (that is, follow-on semesters in E&M and quantum mechanics) and to move quantum mechanics to the first semester of the senior year to facilitate better preparation for the GRE.**
- 6) The educational assessment plan is excellent and needs to be implemented.**

Overall the Physics Department is being very well run and, in our discussions with every level of the department, appears to be a very collegial group. This is a commendable achievement and is not universal. The department has recently made some very good junior and senior faculty hires, and the move towards atmospheric physics, with the JCET and Goddard collaboration, is a strong addition. In particular, we feel that Michael Hayden has been a superb department chair. This is an extraordinarily difficult job and the extent to which he has continuously moved the department forward while keeping a very high level of collegiality in the department is outstanding and commendable. The department also has an excellent program for involving undergraduates in their research, and they are advertising their successes, which then attracts more/better undergraduates.

In our discussion with both undergraduate and graduate students, the overwhelming impression was that they were happy with the mentoring they were

receiving and the quality of the program. There were a couple of areas for the undergraduate curriculum that the students mentioned and we thought might be improved.

While all of the seniors we met with were choosing between very good graduate schools in physics or related fields, we agreed with the self study that an additional semester of Electricity and Magnetism (E&M) and Quantum Mechanics (QM) would be helpful for those moving on to graduate school. However the current curriculum schedule, as laid out on the department web page, has E&M I and QM I in the first and second semester of the senior year, respectively. The students pointed out, and we agree, that these courses should be moved into the junior year or first semester senior year, which would allow the students better preparation for the GRE exam, and allow time for a second semester of either or both courses (or a combined course as described in the self study). This would put the program more in line with other undergraduate programs. We do think that the department has done a good job with developing a nice sequence of upper division physics labs, and the students were very appreciative of their experience in these labs.

Undergraduate research is an important component in this department, but students point out that it can be hard to connect with a faculty researcher. One small, and easy suggestion would be to invite the second year physics majors to the already existing seminar series given by the faculty for the first year graduate students. While it would be “over the head” of many of these students, it would help them understand the breadth of research in the department (and in physics in general), and give them ideas about which areas/groups they could engage with.

For the graduate students, the class schedule for the physics program is standard as laid out. The atmospheric physics program is an outstanding and unusual program that sets UMBC physics apart from similarly sized programs, however it could be improved with the addition of at least another faculty member. We are concerned that the atmospheric physics program is barely at critical mass in terms of faculty. The department’s self study suggests that their immediate needs in terms of faculty hiring are in the areas of nanostructures and condensed-matter physics. We respectfully feel that it was not clear that the department’s long-range plan has been kept current recently. We think that an additional faculty member in atmospheric physics, perhaps in modeling, could benefit the department more than in the areas of nanostructures and condensed-matter physics, which are expensive and incredibly competitive. This is bolstered by comments we heard from graduate students about the lack of choices in graduate classes in atmospheric physics.

The proposed directions of growth of the department are in line with the university plans, however to really grow to the potential of what they could add to the university would require a few (5) more TA lines to both help with the educational mission and allow the growth of the graduate program. The department is doing very well with averaging a 2:1 ratio of RA:TA support, but several faculty members discuss being constrained by the number of students available. It does not make sense to us to have faculty worried about whether they include student support in a

proposal (which would be an obvious benefit in many ways to the university) because they are not sure if there will be sufficient graduate students to fill the position. The university's strategic plan also mentions recruiting graduate students (Sec 2.2) and supporting faculty to build research capacity (2.1). It makes sense to us to add TA lines, which seem to be needed, to a department that will give you a three for one leverage in graduate students in the end.

The department self-study describes an assessment plan that was in place from 2008-2014 and a successor assessment plan that is currently being implemented. These are impressive and are a great model for others to follow. (In our experience, even the prior assessment plan would be considered adequate in many universities.) The new assessment plan is very ambitious and the department should be credited for focusing on specific issues in its assessment goals. In our discussions though, it seems that because this plan is new and ambitious it remains for the department to follow through and utilize data from the assessment to bring change to its teaching. If the follow through on this plan is completed as described it will be very informative for the faculty and will be a very productive exercise.

The instructors who are teaching the majority of the introductory, first year, classes seem to be working very hard at both bringing in new ideas in Physics Education Research (PER) and testing which of these ideas really work in their environment. These instructors, within themselves, are working together to do the best job for the students possible. The self-study describes teaching luncheons, which would be a very important way to get other faculty involved. While it seems all of the faculty we met with were interested in improving the undergraduate teaching, it is not clear whether these teaching luncheons were really happening with the instructor's involvement. It is difficult to find extra time for these types of activities, but they are important to bringing the newer pedagogical methods throughout the curriculum.

The level of scholarly work by members of the faculty is generally high and on average it is suitable for the department. In particular, we find the level of research achievement by the assistant professors to be very high. This is generally true for the full professors as well. The number of "terminal" associate professors (that is, associate professors with little or no realistic probability of advancement) is unusually high compared to the number of tenured and tenure-track faculty in the department. This may not be of major concern because of the statistical fluctuations inherent in small numbers and because most of these faculty members are involved in a variety of scholarship activities. They also contribute to the mission of the department by teaching more than the more research active members. There is a bit of concern about morale, but Dr. Hayden seems to be doing everything he can to help in this respect. We do not offer any specific guidance other than to watch this situation and prevent it from becoming a festering point in the future.

Regarding resource utilization, we think the resources are being used very effectively. It is not normal for physics departments to generate revenues so we have no specific recommendation about how this should be done.

Regarding collaboration with other units, the department has hired an excellent cadre of three lecturers who are active in education research. It seems likely that the department will need to increase this group in the future. If the university has a larger program in education research, this would be an excellent opportunity for collaboration. Furthermore, we were given an interesting plan proposed by Dr. Martins to develop a center that would require collaboration with several other units in the University. This would be an exciting development and the Atmospheric Physics area is the natural area to explore interdisciplinary interactions. In particular, we were told that there was a new faculty member in chemistry that worked in the area of atmospheric chemistry, and this person should be encouraged to offer a class suitable for both chemistry and atmospheric physics graduate students.

Without a doubt, the department's call for more teaching assistantship support is its highest priority. After being remarkable flat for many years, this funding increased in 2011 and 2012, presumably in response to the previous academic program review. It increased again in 2015, but came down again in 2016. The department points out that its enrollment has increased noticeably in this time (an increase of 20% in student credit hours) while it is arguable that the number of TAs was too low even before this increase.

Our experience with physics departments at major research universities is that about 1/3 of graduate students are supported by teaching assistantships, with 2/3 being supported by grants and fellowships. Thus, more teaching assistantships will give the department leverage to multiplicatively increase its graduate student population. Doing so will have many positive benefits for the university beyond helping the department to teach its undergraduates. It will facilitate the research growth of what is already one of the more productive departments on campus. This will contribute to indirect cost return as well as the research stature of the university.

Another immediate need of the department is more space. The department is replacing retiring faculty with young research-active faculty, and this process will continue in the near future. However, today's active researchers cannot get by with nothing but an office. Experimentalists obviously need labs, but even theorists need space for their postdocs and graduate students. Postdoc offices invariably turn into problem solving areas that are not conducive to sharing between groups, which makes apportioning space even harder. Furthermore, as the department increases its graduate student enrollment it will need more office space for TAs and advanced students as well. The university could easily provide more office space to the physics department using the space formerly held by the dean of the College of Arts, Humanities and Social Sciences that is located in the Physics Building.