The University of Tennessee at Chattanooga
Physics Program
Academic Program Review
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External Reviewer:
Carl K Frederickson, PhD
Professor and Chair
Department of Physics and Astronomy
University of Central Arkansas.

Summary
The BS Physics program is housed in the Department of Chemistry and Physics and the University of Tennessee at Chattanooga. This is a solid program facing challenges that are not unique to UTC. There are unique advantages that this program has regarding partnerships with the community in Chattanooga. These advantages provide a lot of potential for future growth. I have included a bulleted list of areas that I determined were Strengths, Weaknesses, and Things to Consider. I will go into each of these in more detail in the report.

Program Strengths
I determined these areas to be strengths of the program. These are activities that the department should continue.

- New partnership in Quantum Information Science
- Participation in the DALI program through APS
- Active, quality SPS Chapter
- Support for student research in the summers.

Program Weaknesses
I determined these areas to be weaknesses of the program. These are activities that the department will need to address going forward. Please see the full explanation of each of these items below.

- Teaching labs
- Enrollments

Program Area Things to Consider
These are areas that the department should consider as they move forward. They are not weaknesses but are areas things could improve/expand the program in the future.

- Course Schedules
- Courses used for program assessment should be taken by all students.
- Developing a Chem/Phys track
- Boosting the use of the Observatory/Planetarium for outreach and recruiting.
- Webpage coverage of the physics program

Program Strengths

New partnership in Quantum Information Science

The Quantum Initiative (QI) is a program that can put the physics program on the map. This initiative has the potential to attract students from across the country. It will be important to maintain the support and to market it well. The opportunities that are being developed in partnership with the EPB Quantum Network and Qubitekk are unique to the Chattanooga area. This will provide a field of study that is normally associated with a large R1 institution.

There are challenges along with the benefits. Marketing this program needs to be a department wide initiative. This program could attract students interested in quantum chemistry as well as physics. This interdisciplinary nature of the initiative is displayed in the enrollment of PHYS 3999r class this spring semester. The certificate being offered is another access point for the initiative.

The QI is an excellent candidate for a graduate program. Inclusion in the current Computational Science: Computational and Applied Mathematics, Ph.D. program is a possibility. It may be more practical to develop a Quantum Information Science MS program. This would provide an opportunity for a 4+1 program and to develop dual listed courses at the Senior and Masters level.

Participation in the DALI program through APS

The American Physical Society (APS) in collaboration with the American Association of Physics Teachers (AAPT) are dedicated to improving the teaching of physics nationally. As part of this drive, the two societies have developed the Effective Practices for Physics Programs (EP3) (APS, 2024) web site. This site contains a guide to help develop high quality physics programs. As part of this effort the Departmental Action Leadership Institute (DALI) program was established in 2022. The faculty in the UTC Physics program is a member of the second cohort of institutions to participate in this program. DALI's are designed to lead to "sustainable improvements to undergraduate education" in a physics program. The participation by faculty at UTC shows a strong commitment to continuous improvement of the program and its outcomes.

Active, quality SPS Chapter

I spoke with, and was impressed by, the students in the UTC Chapter of the Society of Physics Students. These students along with faculty in the department have developed a vibrant community of physics majors. Two things are most worthy of note. First is the construction of a LEGO-based model of the Watt (Kibble) Balance. This project led the club to collaborate with a representative from the National Institute of Standards and Technology (NIST) to correct errors in the example codes. Adding to the experience for the students was the requirement to write a proposal submitted to SPS National to fund the project.

I was also very impressed with the student's efforts to support the department's mission of education. The SPS Chapter holds regular tutoring sessions, available to students free of charge. While the SPS students noted that some students will leave "tips" that are used to fund chapter activities, they are not required. This effort enhances the education experience of the majors doing the tutoring as well as the students seeking help. It serves to build community within the department.

Support for student research in the summers.

The availability of summer funds to support student research adds to the quality of this program. Student research is considered a high impact practice. Students who participate in a research project as undergraduates are more likely to graduate. The Department of Chemistry and Physics has a very well-funded endowment that can be used to support student research over the summer. This affords students the opportunity to make significant progress on an original research project, while also being able to support themselves. It works similar to the summer programs sponsored by NSF (REUs) and the Department of Energy (SULIs) which provide support for students to complete a research experience at larger R1 institutions.

This is an aspect of housing the chemistry and physics programs in one department that is beneficial to students in both programs. The nature of the faculty expertise should encourage students to participate in interdisciplinary projects. This will provide a more realistic image of research outside of academia; better preparing students for future careers.

Program Weaknesses

I determined these areas to be weaknesses of the program. These are activities that the department will need to address going forward. Please see the full explanation of each of these items below.

Teaching labs

The teaching labs used for freshman courses need an update. While the labs for upper division courses are adequate, those for first-year courses need updates. The data acquisition equipment in use in the first-year labs has been out of production for quite some time. The platform has been updated 4 times. There needs to be a regular plan to review and update lab equipment and activities. These labs may be the only interaction students have with the physics program. They need to provide a quality impression as this may be where new majors are recruited.

Enrollments

The 5-year average number of graduates annually from the program is 5 (rounded from 4.6). This is not a large number but is not unusual for a physics program. Given 5 tenured/tenure-track faculty this comes out to roughly 1 per faculty line. While this is not a lot of graduates, it should be viewed along with the large teaching loads maintained by the faculty in service to other programs at UTC. There are factors that could grow these numbers substantially in the future. The new QIS program could provide an influx of students. I list this as a weakness more to stress the importance of recruiting students for the future. The current number of majors does not allow for any stress. It would not take the loss of (or failure to recruit) many students before the number drops to an unacceptable level.

Program Area Things to Consider

These are topics that the department should consider as they move forward. They are not weaknesses, but ideas that could improve/expand the program in the future.

Course Schedules

The use of recitation sessions for the upper division courses is interesting. I have not encountered this before. I can see both a benefit and drawback to these sessions. Even for 3-rd and 4-th year students, office hours are a mystery. The recitations are a way of mandating students participate in an office hour-like activity. That said, they also add to the scheduled contact hours that each faculty member is responsible for. This could have the effect of reducing the number of classes that can be scheduled. The question here is the balance between the extra learning time and possible lost opportunities for other class topics. This is something that the program should consider in their next curriculum review.

Courses used for program assessment should be taken by all students.

The Physics program Self Study identified seven program learning objectives. These have recently been redesigned with five objectives. While designed to be specifically for a physics program these are not unlike the learning objectives published by the Applied and Natural Science Accreditation Commission (ANSAC) of ABET. The new objectives provide a more efficient overview. They provide the program with a strong gauge of the quality of the program. My main concern here is the choice of courses for assessment of the program objectives. The assessment results presented in the self-study as well as the newer (five objective) assessment plan rely on assessments in courses that are not seminal and/or are not required for graduation. The newer assessment plan relies on a 2nd-year course PHYS 2300 to assess student learning objective 1 Demonstrate Knowledge and Competence. It could hardly be expected of students to have achieved this objective in what could very well be their first physics class. I suggest that the program level assessments be conducted for all objectives in courses required for graduation and taken primarily by 4th-year students. This will provide a better understanding of the program outcomes. Developing a curriculum map noting in what courses the objectives are introduced, reinforced, and then ultimately assessed, can provide a clear path for the process.

Developing a Chem/Phys track

One aspect of the interdisciplinary department that should be exploited is the close link between chemistry and physics. It should be possible to provide students interested in studying both disciplines with a path to a degree that does just that. Developing a Chemical Physics track under the BS Physics program would provide just such a path.

Observatory/Planetarium

Increase the use of the Observatory/Planetarium for outreach and recruiting. Only 600 visitors/year is not using this facility to its full potential. The drawback to this is the location of the facility well off campus. The active SPS Chapter could be a source of support to run more outreach programs at the site. Hiring a dedicated astronomer will help to enhance the visibility of this valuable asset.

Webpage

The webpage has a noticeable lack of information on the physics program and its students. There is no information about a very active SPS Chapter. The Faculty Research Interest link directs you to the Faculty and Staff roster page to learn more about research. This required you to find other links to finally reach a description of a research program. The research link should lead to a page where each faculty member has provided a brief (one or two paragraph) description of the research opportunities available in their labs. Using this page to highlight the interdisciplinary opportunities in both chemistry and physics could serve to increase student participation.