University of Washington  
Seattle, WA  
AIP Career Pathways Project  
Site Visit Report  
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I. Institutional Setting

The University of Washington (UW) is the oldest public university on the West Coast, established in 1861, and currently the largest in the Pacific Northwest. Approximately 40,000 students attend UW, of whom some 28,000 are undergraduates. About 7,000 bachelor’s degrees are awarded annually, of which around 60 have been in physics in recent years. The 2011 class looks to be even larger, on the order of 75 students. In many rating systems, the University is in the top 20 nationally. The School of Medicine is recognized in particular. The departments of Computer Science, Mathematics, Classics, Psychology, Physics, Creative Writing, and Germanics are also national leaders. The physics department has a long history of being very highly ranked nationally and has been traditionally well supported in terms of faculty FTE.

The physics department tenure stream faculty consists of 36 professors, 1 associate professor, and 6 assistant professors. In addition there are 4 research professors and a number of visiting, adjunct, and affiliated faculty members. General Physics is presented in both calculus-based (required for the physics major) and algebra-based versions. In addition, there are physics classes targeting non-science and liberal arts students. A *Physics by Inquiry* series that would build on either general physics sequence is available, primarily for pre- and in-service teachers. A challenging sophomore course in the mathematical methods of physics has been seen as a “gatekeeper” course for the physics major. Historically, the single-track physics major would build upon this foundation with required courses in theory and experiment, together with a few upper division electives. Starting in Fall 2011 there will be four distinct tracks to the bachelor’s degree: Comprehensive (similar to the current requirements), Applied, Biological Physics, and Teacher Preparation.

Academic advisement goes on at a number of levels. All transfers from Community Colleges (half the total number of physics majors) have their transfer credits evaluated by a single transfer advisor. Each student is encouraged to meet with a faculty advisor annually, but there is no enforcement mechanism. The Undergraduate Advisor, a staff member, meets with each student who declares a physics major. Students are encouraged to meet with the
Undergraduate Advisor as often as they wish, but at least once more to establish an academic plan.

II. The Site Visit

Chair Blayne Heckel, assisted by Undergraduate Advisor Margot Nims, graciously hosted the site visit team. The site visit team was able to meet with seven faculty members with major involvement in the undergraduate curriculum including the Faculty Advisor, the Chair for Undergraduate Affairs, the Director of the Physics Education Research Group, and the Society of Physics Students (SPS) Advisor. In addition, the site visit team met with the Dean of the Natural Sciences Division of the College of Arts and Sciences, the Associate Director of the Career Center, the SPS officers, the graduate student leader of the UW Physics and Astronomy Career Development Organization (CDO), and Undergraduate Advisor Margot Nims. The site visit team was able to share dinner with an alumnus who has found success in STEM industrial positions and a pizza lunch with roughly two dozen current students. The itinerary appears as an appendix, as does information on the choice of the University of Washington as an institution to visit. Dr. Heckel was very accommodating of every request of the site visit team.

The site visit team was impressed by the physics department’s historic commitment to international leadership in physics research and to providing its students with a rigorous grounding in both theory and experimental technique. At the same time, the team was very appreciative of the tremendous effort that had gone into re-imagining the curriculum in terms of four tracks: comprehensive, applied, biophysical, and teaching. This revision has thoughtfully built upon the educational traditions of the department and the perceived needs of current students. The team found the students bright, energetic, and self-directed. The outgoing and caring Undergraduate Advisor was seen to play a critical role in the department’s guidance of its students.

III. The Curriculum

The Place of the Physics Major in the University Curriculum

Many students come to the University of Washington intending to major in Physics. Another large group comes to the university expecting to major in other subjects, but they discover that those majors are oversubscribed and have been capped: limited to those students who’s GPA exceeds a departmental standard. Thus, one of the most important contributions to the department’s large size is this fact that all engineering majors are capped and that chemistry and biology majors - the majors most commonly chosen by pre-health science students - are effectively capped. However, the number of physics majors is not capped. Thus, science students who find that they are not going to make it into the major of their choice have a
pathway to their careers of choice via the physics major. The physics major offers a very attractive alternative for these students with their strong emphasis on upper division labs and the ability of physics majors to take courses in engineering, biology, and chemistry. It is estimated that 25% of all physics majors were unable to become engineering students and became physics majors instead. Another source of majors is the group of students headed for these other majors who, while taking physics their first or second year, discover that they like physics better than their intended major. Engineering majors turned physics majors are very likely to be interested in STEM careers directly after graduation.

Curricular Overview

The curriculum for physics students at UW is about to change. Currently, there is one track for all students. Washington is on a quarter calendar; each student typically attends three terms per academic year. In the new curriculum, there will be four distinct tracks. Let us first consider the current one-track curriculum:

Lecture Courses

The University of Washington lecture courses cover the standard physics curriculum in a generally standard format. The predominant mode of instruction is faculty-delivered lectures accompanied by problem set assignments for students to complete. The major innovation is the replacement of traditional recitation sections with Tutorials for which the teaching assistants act as a resource. The strength of this curriculum for the students is the rigor of the coursework, the faculty members’ mastery of the material, and the practice of solving a wide array of problems.

The introductory sequence for majors covers Mechanics, Electromagnetism, Oscillatory Motion, and Waves. These courses are taught with lectures, laboratories, and the *Tutorials in Introductory Physics*, developed by McDermott at UW. These tutorials give a very well defined structure to the introductory courses. These may be an important factor in preparing students to think about how to apply their physics knowledge to practical situations. The site visitors were informed that the Engineering faculty had become strong advocates of the Tutorials, valuing the training that they provided for their students. At the moment, the laboratory component of the introductory course is relatively standard, but the number of contact hours in the laboratory sections has recently been reduced from three to two hours, with pre- and post-lab exercises graded by WebAssign. Essentially concurrent with the introductory physics sequence, students take a math sequence in Calculus and Analytical Geometry. In the second year, students take the two-term Elementary Mathematical Physics Sequence. Both students and faculty spoke of the significance of these courses. The students consider this to be a gatekeeper course for the major. Many faculty members regard success in these courses as a prime predictor for success in the major. Second year students also take courses in Thermal Physics and Introductory Quantum Mechanics. These second year students also take courses in
Matrix Algebra and Multivariate Calculus. Over the junior and senior years, students take courses in electromagnetism and at least one in Quantum Mechanics or Modern Physics. There are additional restricted electives in upper division physics. Students are also required to broaden their horizons with coursework in sciences other than physics, mathematics, and computer science, including coursework in the history and philosophy of science.

**Laboratory / Experimental Physics Courses**

The University of Washington provides students with a wealth of opportunities to develop skills in electronics and experimental methods. While there is only a three-course requirement for graduation, the site visitors were left with the impression that most students sampled more than the minimum requirement. The richness of the laboratory/experimental curriculum may equip students well for positions in STEM industries upon graduation.

Education in experimental methods begins with the laboratory of the introductory sequence described above. Students are required to take the first course of what is officially a two-term series in analog and digital electronics, though many regard the Application of Computers to Physical Measurement course as the third term of this sequence. This is a LabVIEW™-based computer-interfacing course. These courses are typically taken in the second and third years. Many of the people with whom we spoke regarded this three-term sequence as very important for students who are interested in careers in industry, and the LabVIEW™-based course especially valuable for obtaining a position in industry. There is a two-course laboratory requirement beyond the first electronics course. Students may choose the two remaining electronics courses as well as advanced laboratory courses in Optics, as well as three Modern Physics laboratories that cover topics including Atomic, Molecular, Solid State, Nuclear, and Particle Physics. Each advanced laboratory course has a complete stock of equipment and a separate room, so that experimental equipment may be set up and remain in place, providing for great continuity of instruction and learning.

**Research**

Research opportunities at the University of Washington were reported to be available to all students. There are laboratory opportunities within the department and in other departments and laboratories on campus. The site visitors did not hear much discussion of students taking advantage of opportunities off-campus, such as REUs, but that may simply reflect the sample of students with whom the site visitors spoke. Everyone agreed that research experience would be valuable to graduates seeking STEM employment, as well as those seeking to proceed to graduate school. In addition, students and faculty both spoke of the process of finding and securing a research position in a laboratory as being of significant value.

To graduate, each student must earn 3 credits for research through a combination of 1-3 credit courses in supervised independent study, an Honors Seminar, Independent Research, or a
seminar on Current Problems. This requirement engages students in using the skills developed in the lecture and laboratory coursework. The effect of this requirement is to have students either conduct laboratory work (which may be computational) in a research setting or participate in a seminar on cutting edge physics research topics. It was estimated that two thirds of all students opt to fulfill this requirement by undertaking research. The site visit team understood this to be research undertaken at the University of Washington, including the independent Applied Physics Laboratory (APL) on campus, which welcomes physics students. The APL has external funding to support these students. Students reported that interested students could always find a research position on campus, but that one needed to be pro-active in one’s search. Faculty members indicated that an important step in the process of finding a position was for the student to develop an answer to the question, “What can you do [for the research group]? Many students learn to answer this question in terms of the skills that they have acquired in the electronics laboratory courses. In addition to the electronics courses, many students acquire valuable, salable skills in the machine shop. The department’s machine shop is outstanding, and students have the opportunity to work with many different tools. While this is not necessarily a part of the formal curriculum, students and faculty alike recognize its value. Students reported that they expected industrial firms to ask them the same question, “what can you do?” The students expressed appreciation for both the experience they gained in the research and in the search for a research position.

Students are encouraged to present their research at the Annual UW Undergraduate Research Symposium, which is a campus-wide event held at Mary Gates Hall. Participation in this symposium is required for students in the Mary Gates Research Scholarship program (described later). Faculty members encourage participation, but they report that some students might benefit from stronger encouragement.

The department does not have a senior thesis requirement, which might partly be due to the perception that the faculty would have too many undergraduate students to advise if one were in place. Students do not have formal mentors. There is an Undergraduate Advisor, Ms. Margot Nims, who advises all students on such matters as declaring the major, negotiating the paperwork, learning of department activities, and being sure that all is in place for graduation. For the discussion of curricular matters, each physics major is assigned a faculty curricular advisor to address questions of course selection and educational goals.

Conversations about the Current Curriculum

Faculty and students shared many thoughts about their experience with the current curriculum.

In speaking with students about the curriculum, the site visit team learned a great deal. Students majoring in physics reported that their primary contact with the faculty was with the instructors of the second and third year courses, both lecture and laboratory. To these students, these faculty members represented the “face of the department”. While students
expressed satisfaction with the electronics courses, concerns were raised about the modern physics laboratories. They expressed the belief that it was more important to learn how to create experiments that it was to “simply” recreate classic experiments. That was how the students we met understood the modern physics labs. Faculty spoke of these courses in very different terms. The site visit team was impressed with the care for the pedagogical impact of the modern physics laboratory expressed by the lead instructor, David Pengra. To the faculty, it is important that students master the use of laboratory notebooks, learn to write comprehensive reports, develop the necessary theoretical understanding, and engage in serious error analysis. The modern physics labs were designed to teach to these needs. To the faculty, these laboratories were of far less of a “cookbook” style than the introductory sequence laboratories, with each quarter ending with one original experiment. The students with whom we spoke did not generally seem to recognize this increased originality.

The site visit team was told that a significant number of physics majors start in the local community colleges. The articulation agreements are clearly formulated, and well-qualified students transfer into the university easily. It was reported that there were good connections with the local community colleges, which may well be due to their close proximity. This is probably true across the university. It may well be that students who enter the university through the community college path are more likely to pursue careers upon graduation, and this may also contribute to the high success rate for UW graduates in seeking STEM career positions.

Motivations for Adopting Multiple Tracks to the Bachelor’s Degree in Physics

Unlike engineering, which has a higher GPA requirement than the campus-wide requirement of a C (2.0) average, the physics major only requires the campus-wide minimum. To maintain manageable class sizes, engineering departments have entrance requirements that include GPA standards above B (3.0), varying by department to achieve agreed upon class sizes. Many students intent upon engineering studies find that they are not permitted to do so. Many choose physics as major in which to continue to pursue their vocational goals. As a result, the physics program engages more students than some faculty members deem wise, questioning the preparedness of a good number of their students. About a quarter of the students majoring in physics were originally intending to major in engineering, employing physics as an alternative path to their objectives. The industrial career orientation of most students pursuing engineering studies would appear to play a significant role in the success of the university’s physics bachelor’s degree graduates in obtaining STEM positions upon graduation.

The curriculum revision at the University of Washington was inspired by a number of concerns and aspirations. There was concern that the single-track curriculum was not well attuned to the students who took up physics as an alternative pathway after being denied entrance to engineering majors. The single-track major engaged students in advanced theoretical coursework for which some may lack both interest and preparation, and it may not include
course and laboratory experiences that would be of great value in their later careers. Another aspiration was to take advantage of the great expertise of the Physics Education Group at the university, of which few physics majors availed themselves toward the end of obtaining certification to teach physics at the secondary level. In addition, the department, the division, and the school of engineering had agreed to initiate a biophysics emphasis. This effort would include the hiring of new faculty, primarily in the physics department, but with some responsibilities in engineering departments. Out of all these concerns and aspirations, a four-track physics curriculum was designed, approved, and was scheduled to go into effect Fall 2011. The four tracks are Comprehensive (a slight revision of the previous single-track), Applied, Teacher Preparation, and Biophysics.

The Multiple Tracks of the New Physics Requirements

All four tracks require the introductory physics series, second year courses in thermodynamics, modern physics, particles/symmetries (previously an elective), only the first term of the mathematical methods class, a newly minted Introduction to Research course at the sophomore level, and in the upper division two terms of electrodynamics and one of quantum mechanics, as well as the first electronics course. Overall, this represents an earlier emphasis on research and does not require all students to pursue mathematical methods as far. The new balance between flexibility about mathematical technique with the early introduction of research is seen as boon to students across the spectrum of preparation and interest.

The comprehensive option does go on to include the second course in mathematical methods, more upper division theory classes (allowing some credit for astrophysics classes taught in the astronomy department), similar electives as in the single-track and eliminating the required coursework from outside of physics. This is excellent preparation for graduate studies in physics and astrophysics.

The applied physics option makes the second term of mathematical methods optional, providing alternatives in Math and Applied Math, a broader list of upper division lecture courses, requires a sophomore level experimental physics lab in addition to the upper division laboratories of the comprehensive track, includes laboratories among the electives, and requires some coursework outside of physics. This constitutes a less specialized, more experimental track, and one would expect it to provide better preparation to commence a STEM career upon graduation.

The University of Washington Education Research Group has long been known for its studies of student learning in physics, mediation of misconceptions, and advocacy of active learning. Its influence upon the teaching of physics at the university has been most noticeable in the adoption of The Tutorials in Introductory Physics in the introductory physics sequence. The site visit team was told that the engineering departments have particularly appreciated this pedagogical innovation in the physics course. The group has been very successful in its studies
of physics learning among both physics majors and non-majors at the university. Its primarily coursework has been to equip in-service teachers. So far, few physics majors have chosen to prepare for a career in secondary school physics teaching through the department. The new Teacher Preparation track attempts to bring together outstanding physics students with the great expertise of the group, to train well-qualified physics teachers. The track differs from the comprehensive by requiring fewer upper division laboratories and lecture courses, substituting three courses in physics pedagogy. The research requirement is replaced by credit for student teaching. Given the tremendous need for well-prepared secondary physics teachers, the site visit team wishes this endeavor every success.

The biophysics option is the most radical departure from the comprehensive curriculum. It reduces the mathematics requirement by a course, and it specifies only two upper division lecture courses beyond the common physics requirements: the first terms of Quantum Mechanics and Statistical Physics. The advanced laboratory requirement is fulfilled in chemistry and biology lab courses, the research requirement is in bio-related topics, the elective is restricted to the upper-division biophysics course, and the courses outside the department are increased to seven in chemistry (at least 3) and biology (at least 2). As biophysics is a rapidly growing field, this track seems a fine response to growing student demand and research opportunities.

Over the past decade, many physics departments have adopted multiple-track programs to the physics degree. Many of these departments were inspired to do so by the 2003 SpinUP report that found multiple-track programs to be common among physics departments that were thriving at that time. A number of adoptees of multiple-track curricula have found that their numbers of majors and their student satisfaction have both increased. There is every reason to think that this should be true at the University of Washington as well. In particular, the applied physics track may prove to be especially appealing to precisely those students likely to pursue STEM careers immediately upon graduation, as it emphasizes knowledge and skills that are likely to be useful in the workplace.

IV. Undergraduate Research Opportunities

1. The Physics Department
Within the department, there are many grant-funded research groups pursuing cutting-edge science. Most of these groups have positions available for undergraduates. Between the opportunities to work with faculty members in the department and the programs described below, the site visit team did not hear of students who wanted an undergraduate research experience and who were denied one. On the other hand, as mentioned previously, students were required to present a clear understanding of what they could contribute to any particular research group. Each group had expectations of its members.
2. The Applied Physics Laboratory
The Applied Physics Laboratory is an important source of undergraduate research opportunities for students in the sciences and engineering. This lab on campus is funded with “soft” money, with roots in Oceanographic and Fishery Sciences. It has no direct connection with the physics department – despite its title. Research is carried on in a variety of fields especially related to the atmosphere and the oceans. Working with these scientists in research gives students experience in physics-related areas, employing very sophisticated measurement devices.

3. The Mary Gates Scholarship Program
The Mary Gates Scholarship program is sustained by a well-supported endowment. It offers undergraduates scholarships for research across the curriculum. The yearly symposium offers undergraduates the opportunity to publicly present their research in poster or verbal presentation form. It has increased the level and amount of undergraduate research done on campus. In addition, since the program is a source of student financial support, it has shifted the typical starting point at which undergraduates first engage in research from the upper division years to the lower division years.

V. Extracurricular Support

Advising

1. Undergraduate Academic Advisor
The position of the Undergraduate Academic Advisor and the person who holds that position appear to be crucial to the success of many physics undergraduates at the UW. This is a non-faculty, staff position. Ms. Margot Nims has served in this role in the physics department for many years; she has 25 years experience at the university. She does not have a background in science or engineering. She has taken a very pro-active role in helping students connect with faculty members to do research and to connect students with potential employers. She serves an important role as a warm and enthusiastic personal connection to the department. Throughout the site visit, faculty members, students, and alumni pointed out the significant role that Ms. Nims plays in the lives of physics undergraduate students. For students attempting to navigate this large department in a large complex university she serves a very critical role. She not only makes sure students are taking the courses that they need to successfully pursue the physics major, she also helps them be aware of events and opportunities in the department and on campus that might be of interest and might potentially help their careers. Her friendly demeanor attracts students and puts them at ease. While the department has no formal procedure to track its graduates, Ms. Nims acts as an anchor for alumni who wish to remain in contact. She is able to use these contacts to provide advice and job leads to current students.

2. Transfer Application examination by the Physics Faculty Advisor

Career Pathways Project
About half the majors in the department have transferred to the university from community
colleges and other schools. A single physics faculty member devotes many hours of his time to
determine what courses the student has taken and which are suitable for transfer towards a
physics degree. There are decisions that can only be made by a physics faculty member because
of the detailed knowledge of the department’s courses and prerequisites that are needed.
Because of the care and detail this faculty member puts into his evaluations, students are saved
from considerable distress and possibly considerably extra time to attain the degree.

**Career Guidance**

1. Center for Career Services
   This Center is a source of information about careers and how to prepare for them—in terms of
classes, skills, and ways of favorably presenting one’s self. It is very active and keeps the
physics department well informed via the Undergraduate Academic Advisor. In addition to very
successful jobs fairs, they run seminars and workshops all year. There are workshops targeting
students at all stages of their academic careers, seeking to provide guidance as students make
career decisions. The Career Guide, which they publish yearly, gives detailed direct advice on
how to prepare a resume, prepare for an interview, etc., and also describes how to obtain help
from the center. The staff keeps detailed statistics on how UW graduates use their services.
While the Undergraduate Academic Advisor is well aware of the work of the Center, the faculty
member who spoke with the site visit team seemed relatively unaware. There is no systematic
effort by the department, in either curricular or extra-curricular venues, to acquaint students
with the Center or its staff. Students told the site visit team that physics students rarely visit
the Center, but they do receive e-mails about job leads from the Undergraduate Physics Advisor,
who maintains a list-serve for physics students. The students indicated that physics students
rarely attended general career fairs organized by the Center, as they had heard of few
opportunities there for physics students. At career fairs targeting engineering students, they
did not feel particularly welcome. It was the impression of the site visit team that the Center
and its staff would welcome closer interactions with the physics department.

2. The UW Physics and Astronomy Career Development Organization
   The UW graduate students in physics and astronomy, with support from their departments,
have formed the Career Development Organization (CDO). This organization is devoted to
informing students about the opportunities for employment in industrial positions and
informing industrial research and development laboratories of both the varieties of research
conducted at the university and the excellence of its students in performing that research. The
premier event is the annual “Networking Days”. This one and a half day meeting brings
together 10 to 15 industrial research scientists (potential employers) and 30 to 45 students.
There are 15 twelve-minute research presentations by students and there are also poster
presentations. Students described this event to the site visit team as “mass interview light”,
which the team took to mean that all the presenters were in effect interviewing for short
periods of time. There is a continuous thread of networking throughout the event. It is
common for one or two students to be hired as a direct result of the event. In addition, the CDO arranges tours at industrial laboratories in the area and presentations by representatives of local high tech industry.

This is a very powerful program. Currently, it is primarily a graduate student program. The organizers indicate that they strive to invite undergraduates through the Society of Physics Students organization, but most of the undergraduates that we met were unaware of the program or its events. As the Career Pathways Project is primarily concerned with the employment of recipients of bachelor’s degrees in physics, we ardently hope that communication between the CDO and the undergraduates will improve soon.

Student Community

1. The Society for Physics Students (and Sigma Pi Sigma)
   At UW this organization is student run with minimal direction, but strong support, on the part of the faculty. As demonstrated by the officers with whom the site visit team spoke, these students have wider interests than a straight physics degree; they were doing research in near infrared silicon photonics, nuclear astrophysics, opto-electronics, and biophysics. What the club does varies greatly from year to year depending on the particular set of officers. The club does have a long tradition of a weekly “Lunch Box” where the invited physics department speaker gives a special seminar to the students on the same topic as the research seminar that s/he will give to the faculty and graduate students later that day. The club also organizes lab tours for current students, so they can get a feel for what kind of research is done in the department. They have also gone off campus to tour LIGO and the Hanford B reactor. They have movie nights and a planetarium night. In some years they have sent teams to visit high schools or have invited high school students to campus, even hosting a chess tournament.

   There is a room set aside for their use. This room serves as a gathering place for students to work on problems together, socialize, and to catch up on sleep. The officers indicated to the site visitors that club members were more likely to be planning to go on to graduate school than the typical UW physics undergraduate; that applied physics students were less likely to be members of the club. This seemed in no way to be a planned outcome, but the consequence of individual student predilections.

   Sigma Pi Sigma did not receive much mention in our conversations. It appears to be operating smoothly as a distinction bestowed upon academically outstanding graduates, but it does not appear too have much activity during the year that distinguishes it from the activity of the SPS chapter. Since 2007, an average of 7.5 students have been so recognized each year, out of an average graduating class of about 60.

   In general, the SPS chapter seems to serve its members well. They are pleased with the activities conducted and the weekly opportunity to interact with the seminar speaker. If the
site visit team understood correctly, there was at the time of the visit an active core of 10-15 students with a halo of occasionally active students. At the beginning of the year, there were noticeably more students who were active. Given that 60 or more students graduate each year, this is a small portion of all physics students. The chapter is a welcome home for these students, but there are many students who do not engage for various reasons. These may include the need to work and the challenges of being a commuter student, as many UW students are. In particular, the site visit team noted that the students tend to all be graduate school bound. The chapter is well positioned to expand its reach to a larger portion of the physics student body and perhaps a broader range of student interests.

VI. Students and Alumni

1. Current Students
The students with whom the site visitors met appeared bright, energetic, and committed to hard work. The team found a variety of interests from the applied to the pure, from experiment to theory. All appeared to have undergraduate research as a part of their educational plan; those who had completed projects were proud of their work. There were no signs of dissatisfaction with their experience at UW. This year’s graduating class of 75 was well above the typical 60 bachelor’s degree recipients per year.

UW students are the academic elite of the Pacific Northwest. They arrive from high schools with GPAs of 3.8 (4.0 = A) and from community colleges with even higher GPAs. The department provides a challenging and comprehensive program of study.

2. Alumni

A dinner with 3 alumni had been planned. Ill health and communications issues reduced this to one alumnus. The site visit team did find the dinner to be congenial and informative. It must be noted that even the alumnus who arrived did so despite knowing he would face an hour’s traffic delay on his route. He persisted, because he “…had promised Margot that he would come.” This is another reflection on the Undergraduate Academic Advisors significance and the quality of the person currently occupying that position.

We learned of the alumnus’s career at UW. He had taken the electronics and interfacing courses just as LabVIEW™ was adopted as a programming environment. He remained as a master’s degree student and became a TA for the interfacing class. In developing the laboratory exercises for the course, he became well known to both the local National Instruments LabVIEW™ support team and the LabVIEW™ users community of the Seattle area. With this background, he has proceeded through a sequence of well-remunerated positions in LabVIEW™ consulting and implementation. He had found the electronics and interfacing curriculum, required of undergraduates, to be an excellent foundation for a career in STEM industry. He subsequently hired 2 UW students to assist him on projects. Unfortunately, he
found mentoring and supervising them to be very time consuming, and he is far less likely to hire students in the future.

The department chair indicated that there is no systematic effort to maintain contact with its alumni. There is no regularized system for alumni feedback to the department. On the other hand, Ms. Nims keeps informal contact with students even after they move on from the university. This is according to the interest of the individual alumni. There have been job opportunities passed on to students by Ms. Nims that have come from these alumni. On the other hand, the Career Development Organization (DCO) of the physics graduate students does seem to maintain strong contact with interested alumni in industry, who are leaders in bringing industrial representatives to the CDO job fair. The department chair indicated an interest in improved tracking of alumni after graduation, but facing limited resources of staff and funding, this has not reached the top of the priority list.

VII. The Regional Context

It is impossible to assess the work of the UW physics department without an appreciation for the Seattle region as a technology hub and the university’s role in that hub. Seattle is the high tech center of the entire Pacific Northwest. The University of Washington is the premier public and research university in the entire region. Boeing and Microsoft are two of the six largest employers in the state (the university is actually the largest). These two high tech giants are surrounded by a host of supporting and synergistic companies. There is a strong attraction for the region’s best and brightest to come to the leading university and to be near this high tech hub. The university then has the responsibility to prepare these students well for those industrial opportunities. The site visit team saw in the physics department a commitment to high standards in research and academic rigor. There is a strong experimental component in the middle and upper division periods of the physics major that prepares students in both electronic technique and experimental method. The department has unique opportunities and capitalizes upon them.

VIII. Suggestions of the Site Visit Team

The department provides a rigorous program of theoretical and experimental training to a well-equipped student body. It has put great thought into a curricular revision that provides a number of tracks to the bachelor’s degree. It is of course presumptuous of any site visit team to offer advice after a visit of only a day and a half. Nonetheless, the team notes here opportunities that the department might profitably pursue.

1. The team believes that it would be useful to devote resources to a formal system that would track the careers of physics students after graduation. This could benefit current students in terms of potential career advisors and sources of job leads. It would also be easier to invite alumni back to the university to speak of their post-
UW careers. Some schools have found records of alumni careers significant in recruiting the best students to their institutions and departments. It might also aid departmental development efforts.

2. The team did not observe a strong working relationship between department faculty and the Career Center, although the Undergraduate Academic Advisor does provide some contact. The career center professionals are well trained to guide students in assessing their strengths and matching them up with appropriate careers, to assist in the preparation of resumes, to provide mock interviews for practice, and to seek out leads for non-academic positions. Some departments have found it beneficial to their students to require initial contact with the Career Center early in their academic careers (as part of a physics class), so that the students will be familiar with its services and able to take advantage of them throughout their undergraduate careers.

3. The CDO, which does excellent work, intends to involve undergraduates in its programs, but there is little evidence that it has been successful in doing so. A little assistance from faculty members to effect this might yield a great benefit to undergraduate students.

4. The team encourages the department to support the new track in Physics Education. Secondary schools in the region have a great need for well-prepared physics teachers. The UW Physics Education Research Group has unusual expertise to prepare students to be excellent teachers.

5. The team encourages the department to continue its work to revise the introductory laboratories, to better prepare the students for the excellent experimental physics courses that build upon them.

6. The faculty transfer advisor does a remarkable job with the heavy load of transfer students to advise. The site visit team suggests that some formalization of this process be done by admissions, such as accepting particular courses for equivalency to UW physics, mathematics, and chemistry courses to reduce the load on the transfer advisor to a more manageable level.

7. The undergraduate academic advisor role is critical to retaining students in the department all the way through to graduation. The current incumbent displays an excellent balance of knowledge and caring demeanor that serve the department well. This is a position to be greatly valued and strongly supported, both for the knowledge and the nurture it now provides. The team encourages the department, even in the midst of harsh financial pressures, to preserve this position both now and in the future.

IX. Conclusions

The physics department at the University of Washington is well positioned to educate its students in all aspects of physics, many of which are valued in industry. It is located within a high tech hub and attracts the strongest students in the region. It pursues internationally
recognized research and maintains high academic standards. There are a few activities of the department that we would like to cite in particular for their value in preparing students with the bachelor’s degree in physics for STEM employment, as they might serve as models for other departments:

1. There is an intensive laboratory curriculum at both the middle and upper division levels, including an electronics and interfacing program in the sophomore year that enable students to acquire a valuable set of skills, including many that are desired by STEM employers.
2. There are abundant undergraduate research opportunities on campus.
3. The Undergraduate Academic Advisor performs extremely well in assisting students in negotiating the curriculum and being a conduit to students of information about career opportunities (interfacing with both the Career Center and alumni contacts).
4. For each set of students, across a wide range of interests and abilities, there are faculty members who will support them. This is embodied in the new curriculum of four tracks. The comprehensive track supports those interested and ready to proceed to graduate school; the biophysicists and a superior biology program support those who wish to apply physics to biological problems; the Physics Education Research Group will support rising secondary teachers; and there are faculty members ready to support the applied track with electronic and experimental laboratories, excellent shop facilities, and opportunities to take engineering courses and do engineering research. The team encourages the department to exercise patience in adoption of the new multi-track curriculum. Other distinguished physics departments (e.g. MIT and Stanford) have found multi-track programs to lead to greater student numbers, student satisfaction, and student quality.
5. There are communities of students, including a well-supported Physics Club (SPS). The SpinUP report on successful physics departments has noted the importance of student communities to the sustenance of high numbers of physics majors.
6. The Career Development Organization, organized by the physics graduate students, which brings together students and industrial employers is a valuable model of making connections between physics students and industrial career opportunities.
Appendix I
Site Visit Schedule

University of Washington
Department of Physics

AIP Site Visit Schedule

Wednesday – May 25

2:00-2:30    Prof. Blayne Heckel (Chair)
2:30-3:00    Prof. Bob Van Dyke (Faculty Advisor)
3:00-3:30    Morgot Nims (Undergraduate Advisor)
3:30-4:00    Tour (Amy at front desk)
4:00-5:00    Society of Physics Students Officers: Alexander Sprott (President),
              Nathan Gilgren (Secretary), and Blake Freeman (Treasurer)
6:00-6:30    Dinner: meet by front office (w/ alumni)

Thursday – May 26

8:00-3:30    Prof. Michael Schick (SPS Advisor)
8:30-9:00    Sr. Lecturer David Pengra (Advanced Labs; Lower Division Lab Revision)
9:00-9:30    Divisional Dean Werner Stuetzle
9:30-10:00   Prof. Marjorie Olmstead (Chair for Undergraduate Affairs)
10:00-10:30  Prof. Gerald Seidler & Prof. Oscar Vilches
10:30-11:00  Diane Martin (Associate Director, Center for Career Services,
              134 Mary Gates Hall)
11:10-11:30  Prof. Lillian McDermott (Physics Education Group Director)
11:30-12:00  Prof. Leslie Rosenberg
12:00-1:30   Lunch: Pizza with current students
Appendix II
Site Visit Criteria
April 25, 2011

During the fall of 2010, the National Science Foundation (NSF) funded a joint project of the American Institute of Physics (AIP) Education Division and the AIP Statistical Research Center (SRC). This project is entitled, “Expanding the STEM Workforce by Equipping Physics Bachelor’s Degree Recipients and their Departments to Address the Full Range of Career Options.” The award is described at http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=1011829.

Over the course of the next three academic years, we will conduct 7-9 site visits to physics departments with strong records of preparing students with bachelor’s degrees in physics and placing them immediately into careers in STEM fields. The departments were selected to represent 5 different types of physics departments: public and private bachelor’s-granting physics departments, departments that award a master’s as their highest physics degree, and small and large PhD-granting physics departments.

Data collected by the SRC in several different annual surveys were used to identify physics departments that:
- have a strong record of granting physics bachelor’s degrees compared to other physics departments within their type; and
- are among the national leaders in terms of the percent of their recent physics bachelor’s who entered the STEM workforce within one year of earning their degrees.

The above two criteria were used to identify the top ten physics departments in each of the 5 categories. To further refine this list, the Principal Investigators reviewed the web sites of all the physics departments that met the above criteria to select those that included the best information about the careers commonly pursued by physics bachelor’s. The final selections were made with an eye toward providing some geographic balance.

One of the goals of these site visits is to identify the effective practices in the preparation of physics undergraduates for STEM career pathways and for informing majors about STEM careers. We will use what we learn to equip departments to improve in this area through written documentation of the effective practices and to convene workshops to assist departments in implementing these practices. This knowledge will help us to break through misconceptions about the opportunities available to those who have earned the bachelor’s degree in physics. Our goals are to better prepare physics majors for the workforce, to draw more students into the major from all demographic groupings, and to help generate a better, larger, and more diverse STEM workforce.

In the case of the University of Washington, the initial statistical data indicated that with 60% of its bachelor’s degree graduates finding STEM employment within a year of graduation (2007-9), it was the fifth highest university in this category. Granting a mean of 58 bachelor’s degrees (2006-8), it was third among universities granting PhDs as the highest physics degree. In perusing the department website, the PIs were particularly struck by the department’s Career Development Organization, which brings students with industrial and national laboratory physicists for a day and a half of science and networking. The PIs also noted that the Undergraduate Handbook begins and ends with career considerations.