Physics Department Ten Year Review

Report of the Review Committee
Executive Summary

The Review Committee carried out the bulk of its work during the months of October to December 2008. The Committee studied the Department's voluminous Self Study document as well as other materials provided by the Graduate School, the Department and individual members of the faculty. Preliminary interviews were conducted with selected groups and individual faculty members prior to the Site Visit. Based on these sources, as well as the meetings during the Site Visit, the Committee discussed the issues, refined its thinking through a vigorous exchange of views, and based on that, crafted its Report. This, by the very nature of the process, is a low resolution snapshot of the Department.

Overall, the Department has maintained a stellar record of research and education. It continues to rank among the top twenty physics departments in the nation. It has a distinguished faculty with an enviable record of accomplishments. It enjoys the benefits of an excellent physical facility. Its undergraduate program is robust and of high quality although the spread of talent among its undergraduates suggests that a two track system may be beneficial. Publications, research funding and awards continue on a strong pace. From all external appearances one might say that the Department is in great shape and they should continue on their historically strong trajectory.

And for much of the program that would be a correct assessment. But, unfortunately, there are some serious issues that need urgent attention. By and large these come under the heading of leadership and faculty renewal. Although the Department was ranked at #14 (NRC Report) at the time of the previous review in 1997, and had ambitions to move up a few notches, this has not happened. Instead, the fears expressed in that earlier report have been realized. It can be argued that the Department has slipped seriously in its ranking (US News and World Report has them at #20). Normally Department rankings are fairly stable (it is very difficult to move up by much). This drop, even if not as severe as these numbers suggest, is still very worrisome. But the problem is more serious than that because in the last few years the Department has lost four distinguished faculty members in the prime of their careers, may well lose two more this year, and is facing the loss through retirement in the next five years of a good fraction of the 15 faculty members who will be over the age of 65 this year. This poses a huge challenge for the Department not only to replace the experience and stature that has been and will be lost,

but to do so in a period of severe financial constraints. Even if one allows for the possibility of some reduction in total faculty count for Physics given shifts in national and intellectual priorities, the task is still daunting. If one assumes a **minimum** start-up package of roughly $500K per faculty member for even 15 faculty appointments all at the assistant professor level (which would not be a prudent mix) the cost would approach $10M over the next five years! It is not an exaggeration to say that the Department faces a crisis, and valiant efforts will need to be made by the Department and the institution, despite the current fiscal difficulties, to prevent a further loss of stature, morale and competitiveness. A serious plan of action is urgently needed and this must be done with the full engagement of new leadership in the Department (the current chair is stepping down), the faculty, the College and the Provost's office. This cannot be adequately addressed by doing business as usual.

It is the opinion of the non-physicist members of the Committee (the internal members) that Physics is too important a Department at the UW to be allowed to fail. It is one of the core intellectual centers of any great university. It provides the foundation for many other disciplines that benefit directly from advances made in physics. It should be a key player in collaborations across campus in tackling many of society's most nettlesome problems. And it also provides those soaring concepts and insights about the nature of the universe that humans have always sought to understand. How can a university of the stature of the UW not do everything in its power to ensure the ongoing vitality of such a critical component of its intellectual portfolio?

This is the heart of the challenge facing the Department and the University. Our recommendations seek to deal with this dilemma. We also address other operational issues inherent in the Ten Year Review process. And although we summarize the recommendations here as part of the Executive Summary, the Committee believes that they cannot be fully understood or appreciated without seeing them in the context in which they emerge in the full Report. Hence we urge the reader to take the time to peruse the full report and use the Executive Summary as a shorthand reminder. The importance of the Department to this university warrants the investment of that much time and effort.

Respectfully submitted by the Committee:

Albert J. Berger, Professor, UW Department of Physiology and Biophysics
Andrew R.Baden, Professor and Chair, Department of Physics, University of Maryland
Alvin L. Kwiram, Professor Emeritus, UW Department of Chemistry, and
Vice Provost for Research Emeritus, (Committee Chair)
M. Brian Maple, Professor and Chair, Department of Physics, and Director, Institute for Pure and Applied Physical Sciences, University of California, San Diego
Paul Yager, Professor and Acting Chair, UW Department of Bioengineering

Recommendations

We recommend that attractive and competitive counteroffers be extended to those faculty members currently in discussions with other institutions with the goal of having them remain at the UW.

We recommend that the faculty hiring commitment in Experimental Particle Physics (the so-called Goussiou commitment) be honored.

We concur with the commitment to maintain the strength of CENPA and recommend that a senior faculty member be hired to fill the position formerly held by Professor Wilkerson.

We recommend that the present undergraduate degree in Physics be continued and strengthened, and that any changes in tracks or degree programs be discussed and coordinated with the relevant departments.

The RC recommends that the Department work with the Graduate School to seek a solution to the summer support problem for international students.
We recommend that the evening MS degree should be transferred to Educational Outreach, and that the Graduate School should work with the Department to facilitate this.

We recommend that the PhD graduate degree be continued.

We recommend that the telecommunications line into the building and the switches be upgraded to 10 Gbps bandwidth (the modern standard in most other universities), if they are not yet at that level, and 1 Gbps links within the building, at least to selected offices/labs, to be funded largely by central funds.

We recommend that a group of senior leaders in the large-scale physics areas (nuclear/particle/astrophysics …) engage in serious strategic thinking and priority setting in order to develop a consensus about the focus of future recruiting efforts.

We recommend that the Department develop a plan for significant long-term expansion of its table-top physics programs, especially in condensed matter physics and biophysics, which would have the greatest overlap with work in other units on campus. Such expansion should not be at the expense of the high quality atomic and precision measurements programs that have played such an important role in the history of the Department.

We recommend that an external advisory committee be constituted to review the current work in condensed matter physics and biophysics, and to recommend selected options for future growth and development of these programs.

We recommend that the Provost appoint a committee to review the TA stipend levels at the UW, how they impact our competitive situation in recruiting graduate students, and what steps might be taken to relieve the departments of the burden of tapping their endowment and other flexible funding in order to support the instructional program.

We recommend that an interim review be conducted in five years (but not requiring another Self Study) to assess progress in dealing with the issues noted in this Report.

Ten Year Review of the Physics Department
University of Washington

Site Visit: November 6 & 7, 2008

The Review Context:

The Review Committee (RC) was appointed at the end of July, 2008. An organizing meeting was held on September 16 involving representatives from the Graduate School, the UW members of the RC and one of the external members (by telephone). A draft charge letter was circulated to members of the Committee, revised, and officially transmitted to the RC on September 19 (See Appendix A). Shortly thereafter, members of the RC received two voluminous documents: the Self Study prepared by the Physics Department and the document from the previous Ten Year Review of 1997 (Report submitted in 1998). The RC began immediately to plan informal meetings, in advance of the Site Visit, with selected groups within the Department. The external members were invited to participate by telephone but were not expected to do so. Only two sessions were held because of the short time period and the travel schedule of the RC members. The first took place on October 6 with the Condensed Matter Experimental Group (45 minutes) and with the Particle Physics Theory Group (45 minutes). The second set was held on October 30 with the Nuclear Physics Group combined with members of the Institute for Nuclear Theory (INT); the Condensed Matter Theory Group; and the Particle Physics Experimental Group combined with Astrophysics (each 45 minutes). In all these meetings Drew Baden participated by phone with the internal members of the RC. In addition, the RC Chair met with a number of faculty members individually, as well as the Department chair in advance of the Site Visit. The Site Visit was held on November 6 and 7, with all RC members present. We were graciously received by the Department leadership and staff and we were well cared for. The agenda for the Site Visit is attached as Appendix B. The report that follows outlines the findings and recommendations or the RC.

Background:

Physics is the foundation of the sciences. It seeks to understand some of the most profound questions humans can ask. It is fundamental to all the other sciences, as well as medicine and engineering, which often draw upon its discoveries for subsequent advances in their own fields.

The education of students in physics is as critical today as it has ever been. One can argue that as the world becomes more technically complex, a working knowledge of physics and the underlying scientific processes are increasingly important for an educated electorate. Furthermore, a research university that emphasizes discovery as a core value must have a dynamic research program in physics to inform, complement and enhance other areas of science and engineering, and to attract quality researchers who can anchor a top-notch research and educational program.

The Physics Department continues to be one of the most distinguished departments in the University. It can boast a Nobel Prize winner (recently retired) as well as seven current members

of the National Academy of Sciences, a number which compares favorably with leading physics departments. As the Self Study record shows, the members of the Physics faculty have made truly significant contributions in many areas of physics.

However, physics is also facing challenges as a discipline. Physics is, at its core, written in the language of mathematics. From the successes during World War II to the post-sputnik era, preparation in mathematics and science was encouraged and well supported in the US, and there was robust funding for research in physics. This fostered the growth of undergraduate and graduate programs in physics at many state universities around the US, the UW among them. The UW's program in physics is an excellent example of a very successful 20th-century Physics Department. However, in recent decades, other fields of science, engineering and medicine have expanded and gained greater visibility in the public square and with policy makers. This shift has been characterized by the often-heard statement that the 21st century is the era of biology. Indeed, the change in the federal funding see-saw has been so substantial that leading science establishment figures have called for increased funding for the physical sciences to redress a perceived imbalance, and because of their importance as foundational for the life sciences (as well as other disciplines). In this rapidly changing context, UW Physics stands at a crossroads, and needs to decide whether to simply extrapolate the 20th century model, or whether it needs to restructure itself around principles, intellectual areas, and research methods that will be vital for success in the 21st century. The answer to that question is important not just for the Physics Department, but also for all the other disciplines on campus that depend on a strong Physics Department for their own success.

As indicated above, the previous Ten Year Review was conducted in 1997. One of the striking statements in the Report of that Review Committee was the following:

> "The Physics Department is excellent, currently ranked #14 in the nation in the NRC surveys of PhD programs. … The Department can realistically aspire to move into the top 10. However, the Department is fragile because of its faculty age profile, and there is real danger of it seriously slipping in the coming decade."

The promise expressed by that Committee has not been realized for a number of reasons, some alluded to in the statement, and some beyond the control of the Department. The most recent US News and World Reports survey (the new NRC ranking is not yet available) ranked the UW Physics graduate program at 20th in the nation—a sizeable drop in the last decade. There was a sense among the RC members that, without serious intervention, the perceived decline would continue. One of the principal activities of the Committee was to explore the causes of that perceived decline, and to suggest possible remedies.

Since 1997, thirteen faculty members have retired (Baker, Cook, Ingalls, Stern, Brown, Puff, Dehmelt, Thouless, McDermott, Vilches, Bardeen, Adelberger, Fortson), and four tenured faculty (Stubbs [0.5 FTE], Strassler, Hogan [0.5 FTE], Wilkerson) have taken positions elsewhere (competitively recruited - through June 2008). The number of new faculty added during that period includes five tenured faculty (Watts, Strassler, Rosenberg, Gundlach, Shaffer) and twelve assistant professors (Cobden, Garcia, Karch, Aganagic, Andreev, Blinov, Goussiou, Gupta, Tolich, Romalis,Vokos, Morales)[1]. Of the assistant professors hired, three left before achieving tenure – Aganagic, Romalis, Vokos.) One faculty member's appointment was

adjusted from 0.5 FTE to 1.0 FTE (Boynton, who for some years had had a 0.5 FTE appointment in Astronomy). Thus the number of faculty members in the Physics Department has remained roughly constant during this period at about 42 FTE. (The Wilkerson position will probably be filled next year and another position has been approved for next year at the assistant professor level.) Many of those who have retired or are near retirement age have had very distinguished careers, and such departures represent a palpable loss to the Department, not only in terms of visibility but also in terms of research funding. Thus Physics, which for years had received more funding for research than any other Department on upper campus, has now been displaced from that position by dynamic growth in other departments. Nevertheless, the program remains vibrant not only in research and graduate education but also in its undergraduate degree program.

Over the years the Department has taken a number of calculated steps to revitalize programs and to retain its competitive stature. Just a few years prior to the 1997 Review the Department had made a strategic decision to change the focus of the Nuclear Physics Lab from its historic role in accelerator-based physics to a new direction in neutrino research. Although that was a difficult decision, it has paid handsome dividends as the discovery of neutrino mass, by a team including UW faculty members, has since demonstrated. The Center for Nuclear Physics and Astrophysics (CENPA) is now arguably the strongest experimental program in the Department.

Likewise, the Institute for Nuclear Theory had only been established at the UW in the early 90's. Since the 1997 review it has expanded its programs even more and has brought international recognition to the UW. The quality of the senior staff recruited to the INT has been stellar. The combination of INT with the ongoing work in nuclear physics in the Department clearly makes the Nuclear Physics program one of the strongest such aggregations in the nation.

[1](Faculty members in INT are not included in this tally.)

Current Issues in the Department:

The Department faces some serious issues. In particular, a number of distinguished faculty members have left in the last five years: Stubbs, Strassler, Wilkerson, and Hogan. Other key faculty members are in discussions with highly ranked peer institutions. Moreover, there are a number of distinguished faculty who will be 70 or beyond next year (Boynton, Schick, Boulware, Lubatti, Rothberg, Cramer, McDermott), and who are likely to retire in the next few years. Another seven (van Dyck, Chaloupka, Ellis, Robertson, Bertsch, Fain and Burnett) will be 65 or older next year. (Bertsch is not on a State line.) The loss of a significant fraction of these 15 faculty members over the next five years poses a serious challenge both in terms of replacing them but also in the loss of their experience, visibility and grant support. In the age range from 45 to 60 there is an average of one faculty member per annual age bin, and likewise in the range from 33-45 there are 12 faculty members.

Given the loss of senior distinguished faculty members already noted, and the impending retirement of a number of others, it is imperative that every effort be made to retain those currently being courted by other institutions. **We recommend that attractive and competitive counteroffers be extended to those faculty members currently in discussions with other institutions, with the goal of having them remain at the UW.**

The RC also learned that there is a standing commitment to hire a junior faculty member in Experimental Particle Physics. The Department has a long and rich tradition of excellence in this field, and there are high expectations that important new physics will emerge from the work at the Large Hadron Collider (LHC). However, of the five members of the current group, three are nearing retirement, and without new appointments, the group may not have the necessary critical mass to be effective. Therefore, it is critical that the bar be set very high for this next appointment to ensure that group can have a significant impact on both the current LHC program as well as on the upgrade program that is now getting started.

We recommend that the faculty hiring commitment in Experimental Particle Physics (the so-called Goussiou commitment) be honored.

The RC was informed that a search has been approved at a senior level for the position recently vacated by John Wilkerson in CENPA. **We concur with the commitment to maintain the strength of CENPA, and recommend that a senior faculty member be hired to fill the position formerly held by Professor Wilkerson.**

In addition, the RC was told about two Condensed Matter "targets of opportunity" as well as two "targets of opportunity" in the area of dark matter. The RC believes that, however worthy these candidates may appear to be, the proposed recruitments must be evaluated within a much larger context. We will return to that discussion later. But first we consider some of the core activities of the Department.

The undergraduate program.

As one would expect of a Department ranked in the top 20 in the nation, the programs in the Physics Department are strong both in teaching and research. The number of majors in the undergraduate degree program in Physics has seen steady growth and the Department has recently granted between 60 and 80 BS degrees each year. This represents one of the largest undergraduate Physics programs in the nation. Indeed, over the last half dozen years it has been first or second in total number of bachelor's degrees awarded, and consistently in the top five. The number of degrees has grown by roughly 100% since the 1997 Review, significantly more than the 1997 projections (20% minimum and as high as 60%). In this connection it is also worth mentioning the pioneering work that has been done by the Physics Education Group over the years. The work of this group no doubt also contributes significantly to the quality of the undergraduate education that students receive.

The Department has had a very strong NSF funded Research Experience for Undergraduates (REU) program over the years, and this brings excellent students to campus in the summer from other institutions. Unfortunately, the Department has difficulty competing for these students for entry into graduate school because of the financial package that it can offer. Many of the UW physics majors also participate in undergraduate research, although they would like to see a listing of undergraduate research opportunities in the Department on the website.

Undergraduate teaching in Physics falls into two general categories: teaching of majors, and teaching of non-majors. These two functions have different goals. Teaching non-majors is largely a service function for other departments and programs on campus. There is a sense that

this function is carried out well, although some concern was expressed about whether the material was uniformly presented in a manner that was interesting enough to be palatable for the non-majors. Because these service courses are so important for students in other disciplines, it is imperative that the Department assign its most effective teachers to these courses.

Teaching the majors is more problematic. Several years ago an ad hoc committee was constituted to review the undergraduate program. A number of recommendations were submitted to the Department. A few of these have been implemented, but the status of the program should be reviewed. Two key recommendations were to raise the threshold somewhat for entry into the major and to introduce more of the flavor of contemporary physics at the lower division level. The latter appears to have been implemented although it has caused some concerns for both students and faculty because of the "churning" of the curriculum during the transition. Presumably things will settle down with time.

The threshold problem is more complex. The Department has a threshold GPA of 2.0 for entry into the Physics major. The ad hoc committee felt this was too low because it forced the faculty to lower the rigor of the material taught at the upper division level in order to accommodate all the students. This is a consequence of only having one set of courses (one track) for majors. One way to address that is to raise the threshold to 2.5 or so in order to improve the homogeneity of the majors. However, it is argued that as long as students wish to take a physics major at the UW, they should have the option of doing so as long as they satisfy institutional requirements. Further, this issue is amplified because the physics major is apparently often chosen as a default major for those students who cannot meet the much higher threshold for entry into the College of Engineering departments. Thus Physics becomes the "fall-back" major for aspiring engineers. Clearly, raising the threshold for a Physics major would then simply shunt these students into some other major whether in science or elsewhere. There is an obvious difference of opinion in the Department about which strategy the Department should follow.

There is a closely related problem that might point the way to a solution to the threshold dilemma. The students to whom we spoke (who were largely majors and on their way to graduate school), as well as members of the faculty, noted that the majors fell into a putative bimodal distribution, with a graduate-school-bound cohort, and a second cohort that tends to be less well prepared (even in the majors-oriented classes). There has been active discussion within the Department of splitting the major into two tracks— something more like an "Applied Physics" degree (or possibly a BA degree) in addition to the normal Physics BS degree more appropriate for students planning on graduate work. The "Applied Physics" track could be chosen by the many double majors that Physics serves, some of whom are also majors in an engineering discipline. (It might also be worth exploring the merits of involving the Applied Physics Program in the College of Ocean and Fishery Sciences to see if collaboration might be of mutual benefit. Alternatively, one could imagine an undergraduate degree or at least a "concentration" in biophysics in collaboration with the School of Medicine.) It is not clear whether this proposal has been discussed outside the Department. Such a discussion with the College of Engineering should occur before the Department proceeds with such a plan. The RC considers such a two-degree program a reasonable option, resources permitting, but is not well enough informed about the details or the resource implications to offer an opinion. In any case, such a two-track system could obviate the need to raise the threshold unduly. There will always be students at the bottom end of the distribution who will "slow down" the students at the top

end who are bound for graduate school. With a single track, the temptation will always be to raise the threshold incrementally until a "suitably narrow" distribution of the brightest students is achieved. This may not serve institutional, college or student goals well in the long run. Again, the RC views this as a serious problem, and we urge the Department as well as the College to consider it thoughtfully.

The major is generally considered to be quite rigorous. It was noted by some faculty members that the level of mathematical preparation of all students has declined substantially in recent years ("even those who do calculus cannot actually perform an integration"). Part of the curriculum revision included an increase in mathematical physics credits in the Department rather than requiring comparable (full) courses in the Mathematics Department (to keep the total credits for the BS unchanged). This approach (of teaching more of needed mathematics material in the Physics Department) should be carefully weighed at the Dean's level to ensure that there is not unnecessary duplication on the one hand or that the Mathematics Department's program is not undermined on the other.

Despite the concern about mathematics skills, it should be noted that the graduates report a high degree of satisfaction with their studies in Physics, and appear to find it an excellent stepping-stone toward their career goals. Roughly 25% go on to graduate school in physics, about 25% go on to do advanced studies in other fields of endeavor, and the remainder go to into the workforce or "other". In an era when it is difficult to attract quality students into the sciences in the numbers that seem necessary in a technological society, the Department is to be commended for its success in maintaining a robust BS degree program.

We recommend that the present undergraduate degree program in Physics be continued and strengthened, and that any changes in tracks or degree programs be discussed and coordinated with the relevant departments.

The graduate program:

The PhD program, comprised of approximately 130 students, is doing well. The graduate students indicated that overall they are satisfied with the program. They also praised the work of Professor Sharpe, the Graduate Faculty Advisor, as well as Jennifer Lehner, Graduate Advisor (staff).

One of the goals of the Department is to improve the quality of the students admitted to the program, which are generally drawn from the second tier of graduate student applicants. In part this may reflect inadequate student stipends compared to those offered by peer institutions. We will return to this issue later in this Report. The overall acceptance rate is reasonable given the challenges described above; about 25% of the students offered admission into the program matriculate. (See page 183 of the Self Study.)

The research opportunities within the Physics Department are limited for the number of students in the program. Approximately one-third of the students, particularly those in Condensed Matter, do their research with adjunct faculty members, because the Physics faculty members in this area do not appear to have sufficient funding to support the number of students interested in doing research in Condensed Matter Physics. This limits the number of students working in this

area (especially in the Department), and results in difficulty in recruiting new students interested in Condensed Matter.

Another aspect of the admissions process that requires attention is the limited number of international, women, and minority students. Apparently international students have been less favored in the admissions process than students from the United States in part due to the difficulty of supporting them during the summer term after their first year when they are not yet supported on a grant. Given the fact that TA support is limited in the summer, and the Department would have to guarantee a full 12 months of support for international students to satisfy their visa requirements, the resulting cost is greater than the Department feels it can manage. However, sometimes the quality of international students is higher than the domestic students that the Department can attract. Hence, if more international students were admitted they could enhance the quality of the graduate program. **The RC recommends that the Department work with the Graduate School to seek a solution to the summer support problem for international students.**

The graduate students mentioned that there was inadequate follow-up by the Department between their initial recruitment contact and the time when admissions decisions are made. It is important that the Department continuously communicate with the applicants during this critical period. In addition, it was noted that the level of graduate student mentoring and career counseling should be expanded. For example, if first year students were encouraged to apply for NSF individual fellowship support, it could yield direct benefits for the Department.

In terms of recruiting graduate students, it was noted by the RC that the Department does not feature the role of adjunct faculty members as part of the dynamic research opportunities at the UW. Another suggestion was to make short (30 minute) web seminars available for prospective students. It was also noted that the website does not reflect the range of research programs in the Department such as quantum computing and other newer activities.

The department has had an effective evening Master's degree program for many years that has served high school teachers and military officers among others. This is often an attractive professional development option for those working in the field who seek more advanced training. Discussions have been underway to consider transferring this activity to Educational Outreach. This step would relieve the Department of the obligations to fund the faculty positions for this activity and might even generate some income for the Department. The RC feels this path is being actively explored by the Department and we have no additional recommendation to make.

We recommend that the evening MS degree should be transferred to Educational Outreach, and that the Graduate School should work with the Department to facilitate this.

We recommend that the PhD graduate degree be continued.

<u>The Physics Education Group.</u>

The Department has benefited substantially from the leadership that the Physics Education group has provided at a national level in emphasizing pedagogical research in order to improve the teaching of physics at all levels. This group is arguably the most visible and highly regarded

physics education group nationally. It pioneered many of the ideas that are now widely followed (with the help of published manuals and teaching and tutorial materials). It has been an important factor in enhancing the quality of courses in the Department and has provided quality support to the teaching program. It has done excellent work in strengthening in-service teacher training programs through its summer workshops. It also has engaged in outreach to the community more than any other division in the Department. The Education Group has also been very successful in competing for federal grants to support these activities. Funding for such activities will in all likelihood continue to be strong given the concern about science teaching in the nation. The Department and the Physics Education group can be proud of what has been accomplished. In normal times, the RC would recommend continued investment in this program because of the variety of benefits that it provides. However, these are not normal times. If Physics is required to contract, given global trends and fiscal realities, then the Department will have to take a close look at the appropriate level of staffing in the Education group, taking into account the physics education landscape in the future, the prospects for major advances in pedagogy, the competitive position of the UW compared to other programs and the balance within the Department. The RC makes no recommendation on what course of action the Department should take, but we consider a close examination of the above and other relevant issues to be critical to that analysis. Among the avenues that should be considered are combining STEM educational efforts underway across the campus, including those in the College of Engineering, under common leadership and funding.

Diversity and Outreach:

The Department is committed to diversity. Diversity is broadly defined by the Department to include issues related to gender and ethnicity, but also international educational background, family responsibilities, political and religious outlooks, career goals, and research areas and approaches.

The Department's record of diversity compares favorably with the national average for undergraduates, graduates, and faculty, as follows.

Undergraduates: The percentage of women physics majors has been about 20% for the past 10 years, mirroring the national average. The number of Educational Opportunity Program Physics majors has increased 3-fold during the past 10 years, from an average of 7 in 1998-2000 to roughly 20 in 2005-2007, increasing from 3.5% to 8.5% of the total major population.

Graduates: The fraction of women enrolled in the graduate program is about 20%, close to the national average; the fraction that receive a Ph.D. degree is ~10 %, also close to the national average for physics. It was stated that there has been only one African American graduate student in the past fifteen years. Apparently there is not one now, although there is one African graduate student.

Faculty: The current ladder rank faculty consists of five women (a sixth moved to another university a few years ago) and 39 male members (including four INT members). Of the men, 2 are Asian Americans (one in INT), 3 are Hispanic Americans (two current – one recently hired, and one retired but still teaching,). UW Physics is doing well on a national scale in terms of female faculty, and has made serious efforts to hire a number of women. Efforts to hire underrepresented faculty have been less successful.

For the past several years, the Physics Department has increased efforts to improve the climate for all students through increased communication and several structural changes. Students have

made suggestions, some of which have been implemented, to address various issues related to diversity: a site visit from the APS Committee on the Status of Women in Physics (CSWP), an opportunity in the Department to discuss the CSWP Report, and the creation of a Diversity Committee to discuss issues suggested by students. During the past five years, the Department has acted on various issues raised by the CSWP as well as suggestions from students, faculty, and staff. Measures that have been implemented are outlined in the Department's Self Study.

The UW Physics Department has a significant involvement in outreach. The Physics Education Group (PEG) is particularly active in this area. The PEG has an extensive program of outreach to K-12 teachers and school districts in the Seattle area and nationwide. For 11 years, the PEG has been invited to make presentations at national AAPT and APS workshops for about 100 new physics faculty (sponsored by AAPT and APS). During the past 10 years, the PEG has conducted about 25 workshops in Europe, Asia, and South and Central America on Physics by Inquiry as well as workshops on using Tutorials in large introductory courses. The group has offered courses and workshops for faculty, scientists, K-12 teachers, and graduate and undergraduate students in other units, such as the Mathematics Department, the College of Education Teaching and Learning Partnerships, and the College of Education Masters in Teaching (MIT) program. The PEG works regularly with various Seattle-area projects.

As another example of outreach, one of the Physics Department faculty members, Jeff Wilkes, has arranged to have cosmic ray detectors placed in high school classrooms to demonstrate the detection of high energy "cosmic ray" particles.

The Department hosted an NSF supported summer quarter Research Program for Undergraduates (REU) program from 1995 through 2006. The program attracted a large number of women students and provided them with research opportunities that were not available at their home institutions. Each year, one or two of the REU students were recruited to the graduate program at UW. The REU grant was not renewed for 2007, but was renewed for 2008. A stronger emphasis has been placed on recruiting students from underrepresented groups, with a target of 20% participation by 2010. A coordinated outreach program involving minority-serving institutions is being pursued for both the REU program and the graduate program.

In summary, the Department receives high marks for their efforts and progress in diversity and outreach, although there is obviously room for improvement in these two areas, here and nationally.

Infrastructure and Facilities:

The infrastructure in the Department is, for the most part, very good. The building is in excellent shape, and the labs in the basement are impressive. One could argue that there is underutilized table-top laboratory space in the building, which should be considered an important resource for the Department in future hiring and in working collaboratively with other departments across the campus. The Department has done a terrific job in providing a very nice undergraduate lounge that the students really appreciate. This is important for student morale and to make them feel that they are an integral part of the Department.

Information Technology (IT) infrastructure could use some attention. From the information we received, there is a single 1 Gbps fiber into the building, with Cat 5e cabling inside the

building. Although Cat 5e is capable of 1 Gbps networking, the network switches in the building only support 100 Mbps traffic. For most faculty members, 100 Mbps to the desktop is more than adequate for web access. However, research requirements are typically more demanding, and this is especially true for the researchers at the UW. For instance the high energy experimental group is about to receive data from the LHC, and the volume of these data is breathtaking: GRID experts believe that the LHC requirements could dominate long distance network trafficking in the coming years. As it is, it sometimes takes Professor Savage the better part of a week to download needed data. (This is the software equivalent of the water-line problems in the old Physics building that contributed to Professor Gabrielsi's departure.)

In addition, the UW has very active groups in cosmology and nuclear experiment, as well as in nuclear theory where progress in research is tied to computation. This is especially true for Professor Savage's efforts in lattice QCD. For a modest investment, the university could see a significant return via grants. **We recommend that the telecommunications line into the building and the switches be upgraded to 10 Gbps bandwidth (the modern standard in most other universities) if they are not yet at that level, and that 1 Gbps links be provided within the building, at least to selected offices/labs, the costs to be funded largely by central funds.**

Challenges: Future Directions

The future for Physics may not look much like the past. There have been seismic shifts in focus and emphasis within the scientific community over the past 50 years. Even within physics itself, for example, traditional nuclear physics, which has been a foundational element in the Department's reputation, has morphed significantly in recent decades, and today much of the cutting edge research dubbed "nuclear physics" tends to overlap strongly with particle physics or astrophysics. This is evidenced in part by the topics covered by the INT workshops. To the extent that the faculty size in Physics may continue to contract somewhat in the coming years because of budgetary constraints at the University level, it is imperative that the Department consider an out-of-the-box approach in thinking about its future. It has been suggested that one way to do this is to abandon the traditional labels, for planning purposes at least, and consider grouping the work of the Department into two broad areas of physics that for shorthand we will label **large-scale physics** and **table-top physics.**

For the former, we suggest that the faculty ask what the most promising areas of research will be for the Department in the **combined** areas of nuclear physics, particle physics, astrophysics, etc. Where can the Department be truly competitive and play a leadership role in the future? What are the exciting new areas that will dominate this sector of physics research ten years from now? Where are some of the groundbreaking advances likely to occur? There are distinguished faculty members in the Department that can address these issues in meaningful ways as they have done in the past. This task is urgent. **We recommend that a group of senior leaders in the large-scale physics areas (nuclear/particle/astrophysics …) engage in serious strategic thinking and priority setting in order to develop a consensus about the focus of future recruiting efforts.** Whether such a group would want to avail themselves of outside advice is up to them. The RC believes that the business-as-usual approach that seeks to argue for a one-for-one replacement of faculty vacancies as they occur in each subgroup is not viable and will not

serve the long-term best interests of the Department. A radical, collective, cooperative rethinking will be essential for the Department to maintain its position of excellence.

The other broad area that we have dubbed table-top physics for simplicity, represents a parallel though somewhat different challenge. This area would encompass condensed matter physics, biophysics, chemical physics, applied physics, atomic and molecular physics, precision measurements, quantum computing, gravitational physics, and so on. Indeed, there is some concern that table-top physics has suffered some decline in recent years primarily in the Physics Building itself (although atomic physics is doing well and table-top physics is alive and well in CENPA.) If there is not a critical mass of students engaged in experimental physics in the Physics Building there are consequences in terms of student morale, in recruiting and in maintaining a vibrant infrastructure of shops and support staff .

There is another important consideration for the table-top areas. In an era when interdisciplinary research will play an increasingly important role, and when funding will continue to shift to these areas that are perceived by the public as more urgent for society, the Department needs to seriously review its historic pattern and develop a pro-active strategy to expand the program in these areas and to foster more collaborations with other departments. This is perceived by colleagues in other units around campus as a crying need. They would like more involvement of faculty from the Physics Department. Physicists can make significant contributions to many of the problems being addressed in the life sciences or in materials, photonics, national security, energy and many other critical areas of research. Unfortunately, in the past, UW physics has been a minor player in such collaborations. This problem is recognized by the Department, but there has been no clear path identified for expanding research in these areas that has the support of the majority of the faculty. Further, there may be an unspoken view that some of these areas are not as intellectually demanding and compelling as other areas. Hence, support for recruiting in these areas often is somewhat anemic or is saddled with unrealistic expectations that other departments should help pick up part of the tab. These and other factors have continued to undermine any serious effort to develop a robust, focused effort in a number of areas that would fall under the rubric of table-top physics. Consequently, areas such as condensed matter physics and biophysics represent a much smaller fraction of the Department's activities than is the case in many other leading peer institutions.

We recommend that the Department develop a long-term plan for significant expansion of table-top physics programs, especially in condensed matter physics and biophysics, which would have the greatest overlap with work in other units on campus. Such expansion should not be at the expense of the high quality atomic and precision measurements programs that have played such an important role in the history of the Department.

The above recommendation immediately raises the problem that the Department has struggled with in the past. What should those areas of emphasis be and how can the resources be marshaled to recruit top tier candidates? (It has been noted that because of the high start-up costs for table-top experimentalists, there is a tendency to revert to default options like hiring in theory or high energy physics where start-up costs are borne by other parties. This is a shortsighted strategy that will not yield satisfactory results for the long-term.) The Condensed Matter group has worked diligently to develop a proposed roadmap for the development of that area of the Department. The plan seems to have tacit support from a majority of the faculty. However, the

Condensed Matter group may benefit significantly from validation of its ideas by having them evaluated by an independent group of experts.

Given the recent history of issues in Condensed Matter Physics at the UW, an independent assessment could be a critical step in establishing broad buy-in and a serious commitment to action. **We recommend that an external advisory committee be constituted to review the current work in condensed matter physics and biophysics, and to recommend selected options for future growth and development of these programs at the UW.** The committee should be composed of i) knowledgeable individuals from around campus with a strong interest in these research areas and ii) at least two and preferably more distinguished scientists from outside the UW who work in these fields. We will leave it for others to decide whether to add a member of the current UW Physics group. This group could also be charged with identifying outstanding candidates for appointment to the faculty. It may be that the administration will need to invest in a senior person (possibly including a commitment to a couple of new faculty positions) to provide leadership and critical mass in some selected area of research. The RC recognizes that such initiatives are often opportunistic and the Department may want to have several options in order to optimize its chances of getting truly stellar recruits.

A few additional comments that relate to these issues are rather obvious but are probably worth stating explicitly. The presence of a first rate Medical School suggests that an expanded emphasis on biophysics – which has very substantial upside potential not only in terms of funding but also in the level of intellectual challenges as well as student interest, should be factored into the Department's long-term staffing plans. The Department needs to ask itself what strategic alliances with other departments at the UW could strengthen areas like condensed matter and biophysics. Although predictions are always fraught with difficulty, the probability is quite high that research related to human health will continue to receive substantial research funding into the distant future. And as medicine moves inexorably toward the molecular level and focuses on complexity, the importance of physics and the toolkit it could bring to the solution of these challenges is unquestioned.

The RC believes that the Department needs to think about ways to engage with other partners whether on campus in interdisciplinary research or with the Applied Physics Laboratory on campus, or with the Pacific Northwest National Laboratory (PNNL). These are strategic assets that Physics ignores at its own peril. And such considerations should go beyond a simple observation, "well, they don't do things we are interested in". The Department should engage in serious strategic discussions with such entities to determine whether, in collaboration, entirely new vistas might be profitably explored for mutual benefit. For example, PNNL boasts one of the largest computer facilities in the stable of DOE laboratories. The Physics Department has rightfully argued that large scale computing will become increasingly important for its research. Would a focused partnership benefit both parties? Similarly, the LIGO experiment is partially located physically in this State. To what extent does this provide a strategic advantage to the Department? Is there an opportunity to participate in LIGO in a manner that would be genuinely beneficial. The RC does not mean to suggest by these examples that these are directions the Department should take but merely to suggest them as examples of the kind of analysis of strategic assets and partnerships that could advance the program. The Department will need to be even more creative than in the past in dealing with an increasingly resource constrained environment. And we emphasize that such strategic thinking should not founder on historical

impressions, but should be developed *de novo* with an eye to developing genuine partnerships that **create** the future for both partners.

In addition to these urgent problems of intellectual focus that would be daunting in the best of times, this review comes at a time of fiscal crisis at the UW, the State of Washington and at federal agencies. It may be necessary for Physics to prepare for leaner times, and to focus on achieving high quality in a smaller number of areas. Of critical importance to developing a viable path forward is creation of a viable decision-making process. Today the Department seems particularly fragmented, and seems to have lost that elusive but essential quality of collegiality that characterized the Department in the past. While each subdivision of the Department sees clearly what is necessary to advance its own aims, there is no sense that the Department *as a whole* has a similar vision. There is urgent need for the faculty to adopt a "hang together or hang separately" attitude. Each member of the faculty should examine his or her own attitude, and invest some energy to ensure that the spirit of collegiality is recaptured. Although this can be encouraged by a new Chair, ultimately it must be seen as a task for the faculty as a whole. It starts with individual faculty members who share a burden for the future of the Department, and are willing to transcend their individual agendas and cooperate to create a vision for the future.

Having expressed our views probably more frankly than wisely (and recognizing the limitations of our insights into the Department's culture, values and goals) the RC hastens to add a caveat. We have enormous respect for the intellectual quality, integrity and good sense of the Physics faculty members. Ultimately they have to decide on the areas they wish to emphasize. We are simply stating what appear superficially to be reasonable options to outside observers. Our advice is offered in the spirit of helping the Department forge a new vision in order to maintain its stellar quality and leadership within and beyond the institution. So, whereas the details of a new strategy need to be defined by the faculty, the general concerns expressed by the RC should be taken seriously. We know of no one better qualified to define the future of the Department than the current faculty. But they will have to come together with a common purpose of transforming the Department for the 21st century, building on the enviable legacy that its forerunners established in the 20th century.

Challenges: The Crushing Burden of Start-Up Costs for New Faculty:

There has been a steady growth in the cost of the start-up packages required to recruit new faculty members. This is an issue not only for this Physics Department but is increasingly true for many departments in the sciences and engineering in all research intensive universities. There is no obvious alternative when competing for top talent. This problem undermines the Department's ability to manage its own financial affairs in a flexible manner. One of the few reliable revenue streams for the Department is the Research Cost Recovery (RCR) program. However, much of this income has to be devoted to the start-up package for new faculty appointments under the present institutional policy that requires the Department to contribute a third of the total. Thus, if a new junior faculty appointment requires $750K for start-up, the Department contribution is $250K. If two such appointments are made in a single year the cost to the Department is roughly the same as the entire RCR income. This leaves little funding to support a faculty member who may urgently need a piece of minor equipment, or to support a pilot program, or to provide adequate funding for seminar programs, and so on. This is

obviously a serious issue for Physics and for many other departments. The RC does not have a recommendation[2] but wishes to point out how crippling this issue is for departments and how it distorts priorities with respect to areas the departments might wish to hire in. For example, it has been noted that often a hire in nuclear or particle physics wins out by default over condensed matter or atomic physics because the start-up costs are lower thanks to support by third parties (DOE).

[2] However, creative methods of financing are clearly called for. A stronger alliance between the Chair of Physics and the Advancement Office (formerly Development) is one such option. Note that in order to make such a funding option viable, Physics will have to learn how to "sell itself" to a general audience. Clearly areas of more direct relevance to society would be more marketable, which suggests that it might be wise to expand the emphasis on table-top physics such as CMP and biophysics, as examples. But the importance of sustaining curiosity driven physics and probing the fundamental questions of the universe should not be discounted.

Challenges: Graduate Student (TA) Stipends:

As indicated elsewhere in the Report (The graduate program section), the Department has to deal with the inadequate TA stipends at the UW. These stipends, which are negotiated between the United Auto Workers union and the Graduate School, and codified in a formal contract (the UW/UAW contract), are limited by the funds available in the UW budget for the instructional program. Unfortunately, the levels established are not competitive with peer institutions on the national level. Thus the low stipend has a negative effect both on student recruitment and the morale of the admitted students. Consequently, Physics, and a number of other departments on campus, are required to supplement their TA salaries (the problem is most serious for the first year graduate students although 2nd year students who have not yet picked an advisor require continued supplementation as well). The typical supplement for Physics averages $2500 per student per year, and for some students the supplement is as high as $5000 to be competitive. For a class of 20 entering students this amounts to roughly $50K. (Despite this supplementation, it was noted in the meeting with graduate students that the UW offer came with the least competitive financial package.) This is an intolerable burden for the Department, especially when its limited flexible resources are also required for start-up packages. In order to address this problem, the Department has to use precious endowment and other resources that should be devoted to other tasks. Even then, the stipends are still not fully competitive and there is little flexibility to make targeted recruitments of especially promising students whether minority, women or REU students.

Indeed, it can be argued that stipends for entering students at the UW should be **higher** than that of our peer institutions for several reasons. First, most of our graduate students in the sciences have to be recruited from distances roughly 1000 miles or more from Seattle (Southern California represents the closest major population density). This means that students face increased travel costs (at least $500-$1000 per year) to visit their families. Students include these costs in their calculations when considering the offers they have received. Second, the quality of our graduate students has profound ramifications for the quality of teaching (they serve as TAs), the quality of the research that is done at the UW, and the ultimate quality of our graduates and alumni. These more subtle factors are rarely considered when discussing TA stipends. But if they were weighed properly, they would suggest that a modest additional

investment in the stipend of graduate students would be the best investment the State could make.

There are other issues associated with graduate student support and recruiting that are related to institutional policies on summer support, registration levels, tuition waivers and the like that should be reviewed with any eye toward making the UW more competitive in recruiting better students. This problem goes well beyond the Physics Department and is something the institution should address.

The RC recommends that the Provost appoint a committee to review the TA stipend levels at the UW, how they impact our competitive situation in recruiting graduate students, and what steps might be taken to relieve the departments of the burden of tapping their endowment and other flexible funding in order to support the instructional program. This committee should consider the factors outlined above as well and others as appropriate in order to develop a clear analysis of how to make the UW more competitive for the best students.

Challenges: Recruitment of a New Chair

The current chair, David Boulware is stepping down at the end of this academic year after serving as chair for two terms (ten years). His knowledge of UW politics, operations and administrative attitudes is widely acknowledged. He has also been faced with some very difficult issues in the last few years, and the increasing level of tension in the Department has thwarted his efforts to gain consensus on major topics.

A Search Committee has been appointed to identify candidates that could be recommended to the Dean. This is a challenging assignment, given the issues outlined above and the deepening financial problems the institution will face. There are no doubt highly qualified internal candidates, but they may tend to be somewhat compromised by past associations. They may also be reluctant to assume this responsibility given the realities they would face. The right person to lead the department must have a strong vision for how to move the Department (as a whole) forward, but also should have the respect of the faculty based on a strong and active Physics-based research program. The RC considered the possibility of bringing in an outside chair, and felt this might be feasible if it would simultaneously support a strategic direction the Department wishes to pursue. The broad features of this personnel issue have been discussed with the Search Committee and the Deans and are not appropriate for this Report. Suffice it say that this will require serious resources. Nevertheless, the benefits of such a strategy in terms of assuring the future academic and fiscal strength of a 21st century Physics department merit serious consideration of an outside chair. The RC feels that appointing someone from the UW but outside the Physics Department as chair would not be appropriate.

Challenges: Funding threats.

The Department might be well advised to constitute a working group of faculty plus a couple of individuals from outside the Department to do a serious assessment of funding trends for physics research. Some observers believe there is a gradual secular shift in emphasis from the historic dominance of physics toward other fields such as biology, the life sciences, and engineering - fields that address perceived societal needs. There is also some concern about the possibility of a

subtle shift of dominance in particle physics from the US to Europe plus increasing competition from Asia. Although one hopes there will continue to be robust funding in the US for those areas of physics that ask some of humankinds most profound questions about the nature of the universe, a hard-nosed assessment of what topics will enjoy the strongest funding 10 years from now, and where the intellectual excitement and center of gravity will be would be useful, however unpredictable such things are.

Summary:

The RC is genuinely impressed with the intellectual vigor, the stature and the visibility of the UW Physics Department. The underlying foundation of education and research is strong and the Department is blessed with an outstanding facility. It also enjoys one of the most important ingredients for future success: the presence of distinguished faculty who know how to recognize high quality research and intellectual talent. The RC is unswerving in its belief that a distinguished university must have a distinguished physics department. The current collision of improbable events constitutes something of a perfect storm that is reflected not only in the loss of a number of key faculty members and a rash of pending retirements, but also in the current financial crisis. The RC believes the loss of key talent to other institutions must be halted and a systematic plan for restructuring be developed. In the short term this may require more resources than the administration feels it can reasonably spare. But this would be the time to "take out a loan" both to protect a vital asset and to ensure a high rate of return in the future. Permitting serious further erosion in key faculty assets may well make a return to the high stature of the past much more costly than intervention now, and for that reason, may mean it is a very unlikely outcome. The UW should not let that happen.

Because of the serious challenges addressed above, we recommend that an interim review be conducted in five years (but not requiring another Self Study) to assess progress in dealing with the issues noted.

Signed by all Members of the RC: Andrew Baden, Albert Berger, Alvin Kwiram, Brian Maple, Paul Yager

fn:Physics Ten Year Review – Report of the RC Final.doc
ALK/121208

Attachments: Appendices

APPENDIX A

THE GRADUATE SCHOOL
UNIVERSITY OF WASHINGTON

Box 353770 G-1 Communications Seattle, WA 98195-3770
Telephone: 206-543-5900 Fax: 206-685-3234 Web: http://grad.washington.edu

September 17, 2008

Department of Physics Review Committee
Alvin L. Kwiram, Professor Emeritus, UW Department of Chemistry, and
Vice Provost for Research Emeritus, Box 351700 (Committee Chair)
Albert J. Berger, Professor, UW Department of Physiology and Biophysics, Box 357290
Paul Yager, Professor and Acting Chair, UW Department of Bioengineering, Box 355061
Andrew R. Baden, Professor and Chair, Department of Physics, University of Maryland,
1107 Physics Building, College Park, MD 20742-4111
M. Brian Maple, Professor and Chair, Department of Physics 0354, and Director, Institute for
Pure and Applied Physical Sciences, University of California, San Diego,
900 Gilman Drive, MC 0360, LaJolla, CA 92093-0360

RE: Charge to Committee for the Department of Physics Review

Dear Review Committee:

Thank you once again for agreeing to serve on the committee to review the degree programs offered in the Department of Physics at the University of Washington (UW). Now that the members of the review committee have had the opportunity to meet with the administrators involved with this review, we are writing to present you with a more detailed charge for the review process.

As background information, the Department currently offers Bachelor of Science (B.S.), Master of Science (M.S.) in the Applications of Physics and Doctor of Philosophy (Ph.D.) degree programs. The last comprehensive review of the Department of Physics was completed in April 1998. At that time, the College of Arts and Sciences Council and the Graduate School Council recommended continuation of the Department's authorization to offer the degree programs.

For this review, the possible recommendations range from suspension of student entry into the Department's degree programs to a recommendation for continuing status with a subsequent review in 10 years. Shorter terms can be recommended if you deem it appropriate. Equally important to this status recommendation, your review can offer the Department and the administration an independent assessment of the "health" of the Department and advice on how it can be improved.

Based on our experience, we suggest that the external reviewers be relied upon as content experts who can evaluate the quality of the Department from a national perspective. They are also likely to be able to comment on recent developments in the field and their incorporation into the Department. Indeed, it is crucial to initiate your work before the site visit to ensure a thorough and rigorous review. We encourage you to communicate with David Boulware, Professor and Chair of the Department, so that he knows your interests and expectations, particularly for the site visit, and to communicate with other key faculty, if time permits.

The two-day site visit on **November 6-7, 2008,** will culminate with an exit discussion, divided into two portions. The Dean and Associate Dean of the Graduate School, the Dean and Divisional Dean for Natural Sciences in the College of Arts and Sciences, the Associate Dean for Undergraduate Academic Affairs, and a representative from the Office of the Provost will participate. The first portion of the exit discussion will include the Department Chair and other faculty members he may invite, while the second portion, the executive session, will include only the

review committee and administrators. We will request your formal recommendation regarding the continuance of the degree programs early in the second portion of the exit interview. We will also ask you to describe your plan for completing the written report in a timely manner.

We request that your committee submit its written report within 4 weeks of the site visit. Specifically, the **written report is due December 5, 2008**. A written response will then be provided by the Department and is due on **January 16, 2009.** When the response is available, the internal members of the committee will be asked to attend a meeting of the Graduate School Council to present review committee findings, and to discuss how to implement the recommendations from your report. A letter summarizing the Council's recommendations for implementation will be forwarded to the Provost for her consideration and action.

Please note that upon completion of program reviews, the primary review documents become public documents and are placed on the UW Office of the Provost's web site. These documents include the self-study, the review committee report, the Department's response to the report, and the Graduate School letter to the Provost describing the Graduate School Council's recommendations on the review.

The most important objective of your review is an assessment of the academic and educational quality of the Department. Important questions include:

1) Are they doing what they should be doing?
2) Are they doing it well?
3) How can they do things better?
4) How should the University assist them?

Additional questions to consider in your discussions with faculty are the following.

1) What is the Department's future intellectual direction as a research unit?
2) In anticipation of faculty retirements, what is the Department's plan to insure that is national ranking is maintained? What areas of research should be the Department's focus?
3) By what mechanism does the Department employ to determine its priorities?
4) In what ways do the Department's faculty groups work with undergraduate students?
5) How does the University's commitment to transfer students impact the Department's undergraduate program?

Thank you for your time and effort. Please contact Augustine McCaffery, Senior Academic Program Specialist, at amccaf@u.washington.edu with questions you may have about the review.

Sincerely,

Gerald J. Baldasty
Vice Provost and Dean

James Soto Antony
Associate Dean for Academic Programs

c: Douglas J. Wadden, Executive Vice Provost for Academic Affairs and Planning, Office of the Provost
Ana Mari Cauce, Dean, College of Arts and Sciences
Werner Stuetzle, Divisional Dean, Natural Sciences, College of Arts and Sciences
John D. Sahr, Associate Dean, Undergraduate Academic Affairs
David G. Boulware, Professor and Chair, Department of Physics
Jacob K. Faleschini, President, Graduate and Professional Student Senate
Augustine McCaffery, Senior Academic Program Specialist, The Graduate School

APPENDIX B

UNIVERSITY OF WASHINGTON
The Graduate School
Department of Physics Review Site Visit
November 6-7, 2008
AGENDA

WEDNESDAY, NOVEMBER 5		
6:00 P.M.	Review Committee Dinner	Campagne

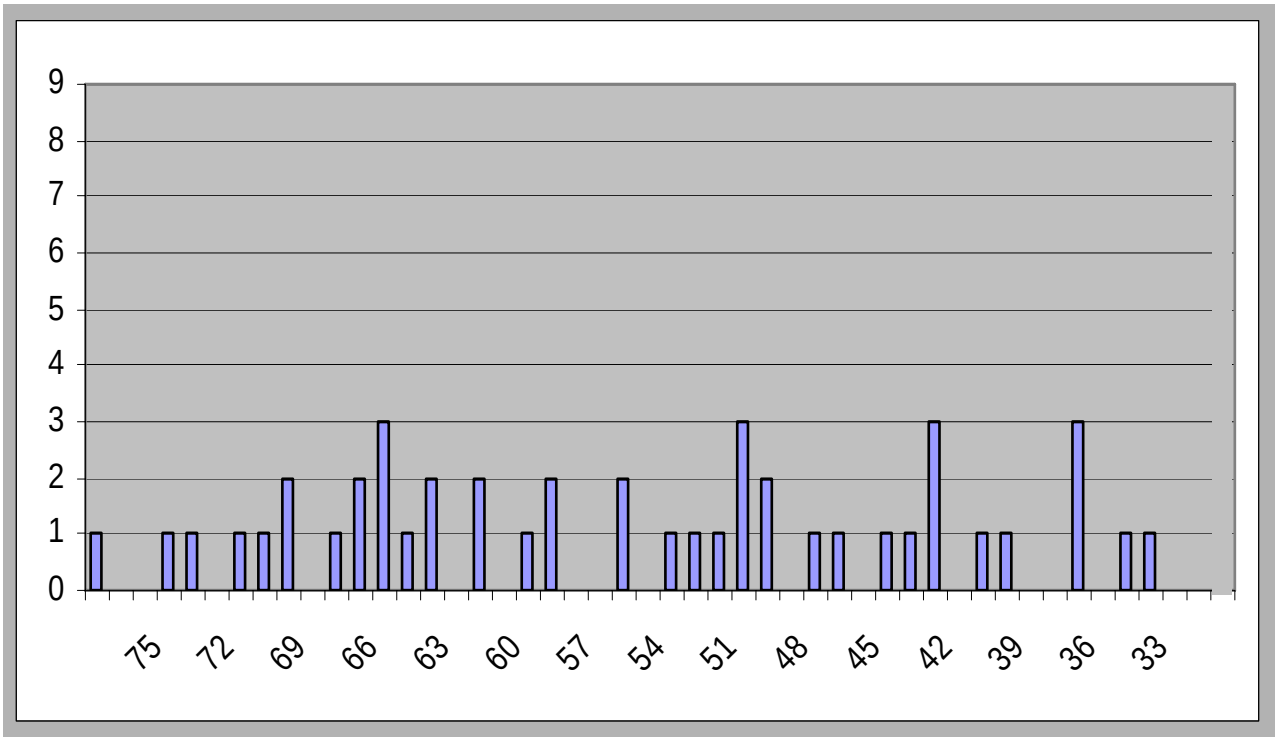
THURSDAY, NOVEMBER 6	**C-121D Physics-Astronomy Bldg. (unless otherwise marked)**
8:00–9:00 A.M.	David Boulware, Professor and Chair (Associate Chairs John Rehr and Blayne Heckel, and Jeff Wilkes to join at 8:30)
9:00–9:30	Atomic Physics
9:30–10: 00	Astrophysics
10:00–10:30	Institute for Nuclear Theory
10:30–10:45	**Break**
10:45–11:15	Physics Education Group
11:15–11:45	Nuclear Theory
11:45 A.M.–12 15 P.M.	Center for Experimental Nuclear Physics & Astrophysics (including Eöt-Wash Group)
12:15–1:15	Lunch - Review Committee **Catered Box Lunches**
1:15–1:45	Condensed Matter Experiment
1:45–2:15	Biological Physics
2:15–2:45	Paul Boynton (General Education Committee)
2:45 – 3:00	**Break**
3:00 – 3:30	Condensed Matter Theory
3:30–4:00	Graduate Students
4:00 – 4:30	Undergraduate Students **(PAB B135)**
4:30 – 5:00	Staff
5:00 – 5:30	Particle Theory

UNIVERSITY OF WASHINGTON
The Graduate School
Department of Physics Review Site Visit
November 6-7, 2008
AGENDA

FRIDAY, NOVEMBER 7	**C-121D Physics-Astronomy Bldg.**
8:00–8:30 A.M.	Steve Sharpe (Graduate Student Faculty Advisor)
8:30–9:00	Paul Hopkins (Chemistry Chair)
9:00–9:30	Bob Van Dyck & Margot Nims (Undergraduate Program)
9:30–10:00	Elementary Particle Experiment
10:00 A.M.–12:00 P.M.	Review Committee Executive Session
12:00 – 2:00 P.M.	Review Committee Lunch (**Catered)** Executive Session - continued
2:00–3:00	Exit Discussion *Department of Physics* David Boulware and faculty *College of Arts and Sciences* Ana Mari Cauce, Dean Werner Stuetzle, Divisional Dean, Natural Sciences *Undergraduate Academic Affairs* John Sahr, Associate Dean *The Graduate School* James Antony, Associate Dean for Academic Programs Augustine McCaffery, Senior Academic Program Specialist *Office of the Provost* Douglas Wadden, Executive Vice Provost
3:00–4:00	Exit Discussion – without Department faculty
4:00–4:30	Review Committee Debriefing

APPENDIX C

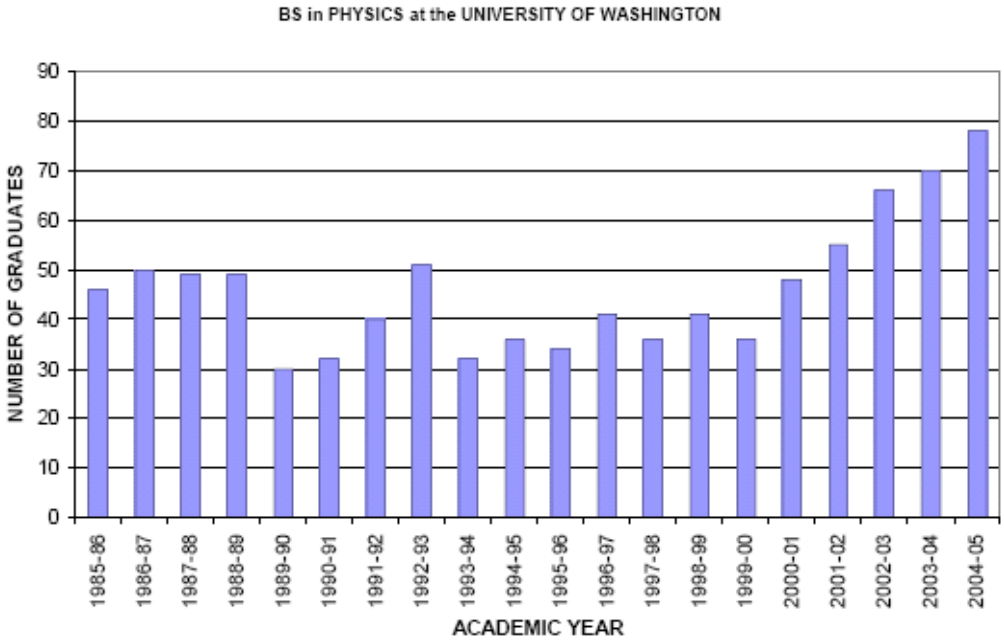
Physics Department
Faculty Age Distribution

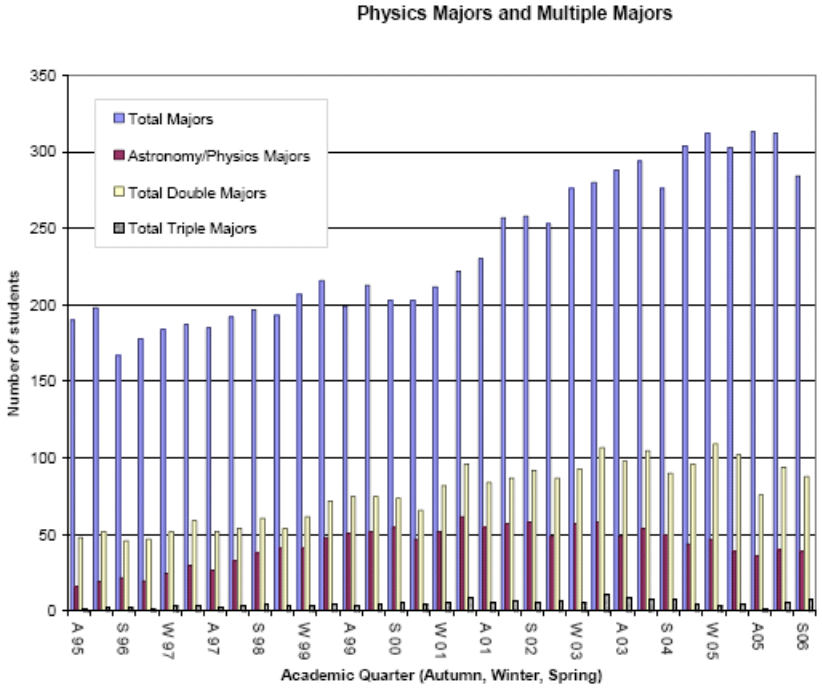


AGE

NOTE: Data include 4 INT faculty positions but not vacant Wilkerson position.

APPENDIX D





Enrollment Data for the Physics Bachelor of Science Degree Program