S.99-63

SIMON FRASER UNIVERSITY

OFFICE OF THE VICE-PRESIDENT, ACADEMIC

MEMORANDUM

To: Senate

From: J. M. Munro, Chair
Senate Committee on Academic Planning

Subject: External Review – Department of Physics
(SCAP Reference: SCAP 99 - 31)

Date: October 14, 1999

For Information

Attached are:

- the Report of the External Review Committee for the Department of Physics and the Response to the Report of the External Review Committee

J. M. Munro

Response to the Report of the External Review Committee
Department of Physics

Our external review committee, consisting of W.P. Halperin (Northwestern University), C. Murray (Bell Laboratories), M.B. Walker (Toronto) and P. Percival (internal member) has provided a constructive report that comments on all aspects of the Physics Department's activities. We agree with many of the points of view and recommendations of the committee. Below, we respond in order to each of the recommendations in the report.

Research Programs

(a) Semiconductors

This area has long been a priority for the department and we are gratified that the program is recognized as being 'extremely strong'. Of course, we are aware that the area of nanostructures provides many opportunities for fundamental as well as applied research and would very much like to mount an experimental program in this area. We have recently taken some initiatives to strengthen this area further: (i) We have nominated Dr. Karen Kavanagh for an NSERC University Faculty Award. Dr. Kavanagh is a well known materials scientist with expertise in semiconductor heterostructures. (ii) We are applying through the CFI program for a focused ion beam facility. If this application is successful, we will have greatly enhanced our capability to carry out research on all sorts of nanostructures.

(b) Thin magnetic films/surface science

The department is conscious of the fact that successors to Arrott, Cochran and Heinrich must be found if this very successful and visible program is to survive. Although our recent searches in experimental condensed matter physics were fairly general, we did state in the advertisements that surface science and ultra thin magnetic films were priority areas. One of the two experimentalists hired in 1998 (Dhirani) in fact is a surface scientist albeit not with expertise in magnetism. We will continue to make hiring in this area a high priority.

The potential problem in electron microscopy may already be solved. Dr. Karen Kavanagh (mentioned above) is an expert in electron microscopy. If she accepts our offer, she will take over Professor Curzon's facility and provide us with state of the art capability in this area for the foreseeable future. Of course, if she does not come, the issue will have to be revisited.

(c) Soft condensed matter

We agree that finding a successor to Michael Wortis within the next few years is crucial for the health of the program in soft physics. In the current search for a junior theorist, the search committee identified an extremely promising and accomplished young theorist working in theoretical biophysics and recommended a bridging appointment for this individual. If this initiative is successful, we will have gone a long way toward ensuring continuity in the soft condensed matter area. It would also be useful to appoint one additional experimentalist in this field to complete a very solid group.

(d) Intercalation compounds/superconductors

The department agrees that it must address the issue of what to do with positions that become available in these subfields in the near future While some discussion has taken place, no consensus has emerged. There are a number of areas of condensed matter that are not represented in the department or that could be strengthened. For example, an appointment in the area of μSR spectroscopy or condensed matter physics at ISAC could be attractive. As well, strengthening the synchrotron radiation group has its attractions.

(e) High energy/medium energy/astrophysics and plasma physics

The department has no intention of mounting an effort in plasma physics. However, we do believe that the diversity brought to the department by members with research programs in fields other than condensed matter physics is important. We see at least two opportunities to retain this diversity: (i) It may be possible to appoint a leading Canadian researcher, Dr. Guy Savard, presently at Argonne National Laboratory, to the half position that became vacant with the death of Otto Haeusser, with the remaining salary and much of the start up funding supplied by TRIUMF. Negotiations to bring this initiative to fruition are currently in progress. (ii) The position that will become available through the retirement of Professor Palmer in 2000 could be used, for example, to make an appointment in Astrophysics.

Faculty Recruitment

(a) Maintaining a competitive edge

There are seven different recommendations in this category, all of which we agree with in principle. The review committee has correctly identified the difficulties that we face in attracting and retaining the high quality young faculty needed to maintain our visibility in the research community. In the 97-98 hiring season, we were able to offer salaries higher than the nominal aP4 salary at which all new appointments are authorized and we hope that we will be able to continue to do so. This past year, start-up funds for new experimentalists were also adequate, in part because of the CFI program. We also believe we have sufficient laboratory space, at least for the near term and, of course, provide new faculty members with reduced teaching and service loads.

However, given the attitude of the Government of British Columbia and the culture of Simon Fraser University, an overall reduction of the Physics

Department's teaching load to two courses per year per faculty member is not realistic at this time.

(b) The need for a strategic plan

We generally agree with the ideas expressed in this section. Given the sheer number of retirements, it is quite important to develop a vision of the department's future so that areas of strength rather than isolated research efforts are developed. We prefer to hire well rather than quickly. In this context, it is particularly important that searches be kept alive until a successful conclusion is reached, as pointed out in the report.

(c) Recruitment organization

The committee seems not to have appreciated that SFU Policy A10.01 states that the Department Chair shall act as chair of search committees unless an alternate arrangement is, in each instance, approved by the Dean. The present Chair certainly intends to continue past practice and chair each search committee unless there are highly unusual circumstances.

Undergraduate Program

We are pleased that the review committee recognizes the effort that the department as a whole puts into its classroom and laboratory-based teaching. The most important issue in undergraduate studies pointed out in the review is scheduling, particularly the multiple offering of lower division courses (two or three times per year in most cases). Our current scheduling of first year courses reflects their large enrolment: with perhaps one exception, offering any of the PHYS 100 to PHYS 121 courses less frequently would lead to unacceptably large classes in the single semesters when the courses were available. There may be some room for efficiency at the second year level, where the current schedule reflects the conflicting demands of the physics and engineering science programs. As we have done for the past decade, we continue to work with engineering science to match our course offerings to their timetable.

We feel that the multiple offering of at least a few third-year courses is unavoidable if we are to offer a realistic coop program in physics: students must be able to take part of their upper division courses in the summer. The overlap of the electromagnetism courses at the third year level, identified in the review, will be dealt with by the physics undergraduate studies committee within two months. We have also experimented with placing two courses (PHYS 395 and PHYS 484) on-line without standard lectures. While the students found the on-line delivery of material acceptable, the three faculty teaching the courses have not noticed a decrease in the amount of instructional time compared to regular courses, perhaps because of the long hours spent in helping students debug code, perhaps because of the overhead in setting up the courses. We don't see on-line delivery of these specific courses as being detrimental, but we also don't see a gain in efficiency.

The review also recommended that teaching loads be reduced by streamlining course offerings. Right now, we offer a minimal number of courses to satisfy our honours program and service commitments to other departments, and the available faculty almost exactly balances the 55-58 course offerings per year. While we may be able to reduce course offerings by perhaps 5%, a wholesale reduction in teaching load by 30%, to the average of most research-intensive universities, cannot be accomplished without gutting our programs: we would need more faculty positions.

Graduate Program

1) We agree that recent course offerings for graduate students have not been adequate. Part of the explanation was that while we were three positions short, we had to cut back on course offerings and that graduate students (perhaps unfairly) suffered the most. We hope that with our recent two hires and the further hires that are in the offing that this problem will be alleviated.

2) We have already adopted one of the suggestions, that of encouraging adjunct faculty to offer courses. For example, in 98-3 M. Vetterli taught a course on particle physics. But more of these should be encouraged.

3) Concerning the length of time taken to complete the MSc program, we agree that 6 semesters should be the goal (and much closer to the average). A few points:

(i) our best MSc students often go to the PhD program directly, which raises the average MSc completion time.

(ii) in the past few years, we have been admitting a higher number of students who need remedial coursework. Some, but not all, of these are qualifying students. Those who are not are taking more courses, which slows down their degree.

This having been said, there is still room for improvement. The three steps that can have some effect are:

(i) encouraging students to take all 5 classes during their first two semesters. Probably, it's better to plan it so that they take 2 classes in the Fall and 3 in the Spring. Obviously, this requires our being able to offer enough classes in the Spring.

(ii) reducing the TA load for students. This obviously costs money, and it's not clear who would/could/should pay for this.

(iii) making sure that supervisors do not have unrealistic expectations concerning the amount and thoroughness of research done for the MSc. degree. This is hard to enforce, but it is something that supervisory committees should be doing.

Facilities and Infrastructure

(a) Computing Resources

The external review of Academic Computing Services is essentially silent on the subject of research computing, at least of the number crunching variety. This makes it increasingly urgent that the Faculty of Science develop a policy of its own with regard to computational infrastructure. The Physics Department clearly has an important stake in this.

(b) Library Services

The library external review recommends sweeping changes to the operation of the library. We will have to see how those recommendations that are accepted affect service.

(c) Instrument Shops

We agree with the points made in this subsection. Although the technician who instructed new graduate students in machining has retired, we will make every effort to continue this valuable service.

Staff: Technical and Professional

We are pleased that the external review committee appreciated the competence and dedication of our support staff and have chosen to remark upon it in their report. We are in complete agreement with their assessment. The issue of a backup for the departmental assistant, Dr. Sada Rangnekar, is not a simple one since the other members of the support staff belong to a different employee group and crossover in duties is strongly discouraged in the collective agreement of the CUPE members. Nevertheless, the current Department Chair certainly recognizes the problem since he handled part of Dr. Rangnekar's portfolio during an absence some years ago. A creative solution will have to be found.

Diversity

The Department agrees that it would be useful, from many points of view, to have a larger number of women faculty members. In particular, an appointment of a woman to a senior position would presumably go a long way toward reducing the service burden on our two existing women faculty members. The VP Academic has provided an opportunity for us to make such an appointment and we have identified a suitable candidate and made an offer (contingent on success in the current NSERC UFA competition). We do wish to point out, however, that the average percentage of women faculty in 14 medium to large Canadian physics department is 3.6% compared to 8.5% in our department. Indeed, the department of the Canadian member of the review committee has one woman in a faculty complement of fifty seven!

We believe that the current low enrollment of women in our graduate program is a fluctuation. Certainly, a few years back it was at least three times as high. We will continue to aggressively recruit potential women graduate students.

Simon Fraser University
Department of Physics
Report of the External Reviewers

VPA's Comments

The external reviewers of the Physics Department praised the Department for pursuing its niche as a centre of excellence in various sub-areas of condensed matter physics, and encouraged the Department to develop a longer term recruitment strategy designed to perpetuate and reinforce this niche.

According to the reviewers, the Department's success in pursuing this strategy will depend on its success in increasing starting salaries for new faculty, reducing teaching loads from two courses annually to one, and providing start-up research grants that are at least triple current values. This represents a significant challenge to the Faculty of Science's budget and to current University policies and practices.

The reviewers recommend earlier contact between new graduate students and faculty in order to identify research interests at an earlier stage in graduate student preparation. The reviewers also recommend that the total elapsed time for the completion of graduate degrees should be brought more into line with norms in the discipline, especially by reducing the time for completing Masters degrees.

Finally, the reviewers encourage the Department to become more competitive in attracting a higher proportion of women and designated minorities into faculty positions in order to diversify the teaching faculty and provide role models for prospective students. This task should be given a high priority in the Department's recruitment strategy.

David P. Gagan
Vice-President, Academic

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Report of the External Review Committee
for the
Department of Physics
Simon Fraser University
June 4, 1998

1. Executive Summary

The excellent research programs in physics at Simon Fraser University are built on a tradition of research in condensed matter physics taking advantage of hiring opportunities for developing focus areas in this sub-discipline. Some faculty with research specialties outside of condensed matter physics have provided important breadth in research and in teaching at the graduate level. The review committee recommends continuing this strategy. However, imminent changes in the faculty ranks will lead to as many as twelve additional vacancies in seven years requiring that this strategy be implemented within a more specific and longer range plan than has been developed so far. The committee believes that it is crucial that such a strategic recruitment plan be formed and that it should be as specific as possible in identifying the research directions of the department. It should be revisited in each recruitment season to reexamine departmental priorities with an eye to taking advantage of new outstanding recruitment possibilities. The plan should also specifically address available resources including major laboratory equipment and facilities, both those current and those needed for new faculty additions.

The plan should be explicit in its outline of the administrative mechanism for recruitment. The committee recommends that in those years in which multiple searches are conducted that different faculty members serve as chairs of the search committees. If there are special circumstances it may be appropriate that the chair of the department also serve as a search committee chair. Searches should be conducted on a multiyear basis until they are successful in each of the broadly designated areas within which the search is held.

The committee recommends that special attention be paid to improving the competitive position that Simon Fraser must adopt to be successful in recruitment during the next seven years. Maintaining a competitive edge is becoming increasingly more difficult in the present global hiring environment. The issues of start-up funding, initial salary, and space, are some of the most important. If the competitive position is not addressed then the physics department, despite its reputation, will soon fall behind. The committee recommends that the strategic recruitment plan be implemented with an understanding to be worked out between the administration and the department as to how to improve its competitive edge.

The committee recommends that course offerings be streamlined to reduce the average teaching load and that this also will help in maintaining a competitive recruitment position.

2. Introduction

Simon Fraser University has one of the best condensed matter physics research programs in Canada, as measured by external grant research support, external recognition and citations of journal papers. Over the last three decades the department has focused on condensed matter physics, and has built up a substantial international reputation in that area. The department has at present twenty three faculty, two joint appointments, and several adjunct professorships. This focus of the department has also led to collaboration and collegiality which is a tribute, in part, to the dedication and guidance of the chair, Professor Robert Frindt.

Since the last department review in 1990, the department has made four faculty appointments at the assistant professor level and two joint appointments at the assistant professor level. These appointments have been made in the broad area of experimental condensed matter physics except one in theoretical high energy physics. Since 1990, two of the assistant professors have been promoted to associate professor, leaving only two assistant professor positions in the department and two joint appointments at the assistant professor level. The department can foresee the departure of twelve faculty due to retirements by the year 2005. In addition, since 1995 the department has suffered the loss of six faculty due to an untimely death, two resignations, and three retirements. The research programs will be greatly affected by these losses and so it should be a high priority for the department to consider the impact of each new appointment on the overall focus and quality of the research.

The physics department, including the faculty, teaching assistants, and the technical staff, have a clear commitment and enthusiasm for both undergraduate and graduate teaching. In part, what distinguishes physics at Simon Fraser from other departments at other universities is the attention paid to, and the corresponding success of their teaching programs. Initiatives such as, computational physics, computer assisted personalized approach to problem assignments (CAPA), the undergraduate microcomputer laboratory, and Co-op programs are very good examples.

3. Research Programs

The department of physics has strong research programs in several sub-areas of condensed matter physics. This emphasis on sub-areas has been a factor in the successful recruitment of new faculty and graduate students and in developing the quality of research programs in these areas. We suggest that continued focusing on a few research areas is an appropriate strategy to maintain and further develop the department's reputation and research standing. In the following few paragraphs we discuss the present research thrust areas and comment on their strengths and weaknesses. This is not to be construed as a definitive evaluation of the research programs which is not possible given the limited time available to us. However, we suggest that the focused-research-area approach is a good framework for the department to use in developing its own plan. Details, and the research areas themselves, may change in the course of further development of a plan, but the emphasis on coherent focused areas with common infrastructure needs, should be a key feature.

a) Semiconductors: This area is extremely strong, further enhanced by the recent addition of research in MOCVD growth and, applied device physics, the latter with a joint appointment in Engineering Sciences. We note that the 1990 visiting committee recommended the addition of semiconductor growth to the department. Some key issues facing this sub-area are: Is there an opportunity for more interaction with those doing synchrotron radiation physics, and if so, what will be the affect of upcoming retirements in that field? The program could be strengthened and enhanced by adding more effort in mesoscopic physics/quantum nanostructures, in experiment or theory. Present interactions with the University of British Columbia (UBC) provide some mitigation of the high equipment and processing costs of the semiconductor program and extramural collaborations could be increased in order to take advantage of possible funding opportunities. It is crucial to strengthen industrial interactions in order to support equipment costs and continue to produce graduate students with skill sets desired by industry.

b) Thin magnetic films/ surface science : Traditionally this has been a strong program, however the retirements by Arrott and Cochran and the imminent retirements of Heinrich, Curzon, and Crozier by 2005 will completely deplete this sub-area. Significant equipment now exists in the laboratories and will become underutilized if new faculty appointments in films and surface science are not made in the next few years. The acquisition of a focused ion beam instrument would allow the creation of a research area in magnetic nanostructures that would have synergy with the semiconductor thrust area and also possibly be shared with those performing nanostructured semiconductor physics. The department should consider the possibility of building such a program. Major equipment exists in the laboratories which will become underutilized in the next few years. The electron microscopy capability will discontinue soon owing to a faculty retirement in that area. The department must evaluate the impact this will have on their future, and not just current, research programs. Simon Fraser plays a leadership role on behalf of Canadian science through its involvement with the PNC-CAT at the Advanced Photon Source. Developing and protecting this investment is also an important consideration.

c) Soft condensed matter: This research sub-area is very strong in theory and simulations. Since the last departmental review in 1990, this area has been further strengthened by new experimental appointments in nonlinear dynamics and liquid crystals, and light scattering from vesicles, a move consistent with a suggestion by the previous visiting committee. The present research group has an emphasis on the study of membranes, involving both theory and experiment. They have initiated good interactions with UBC, including holding joint courses, and have made a new joint appointment with the Biochemistry program which could enhance that interaction as well. The major issue facing this subgroup is the retirement of their senior member, Wortis, by 2002. If the department wants to maintain a top group in soft condensed matter physics it will have to make one or two key faculty appointments in this field.

d) Intercalation compounds/superconductors: Traditionally this has been a strong research area in the department; however most researchers will have gone into administration or retired by 2005. The department needs to look carefully at how possible new hires in this area could interact constructively with others in thin films/magnetism and semiconductors or, alternatively, be prepared to rebuild a group that will operate more independently by making several key appointments in this thrust area.

e) High energy/medium energy/ astrophysics and plasma physics: For many physics departments these broad areas of research are a substantial core of activity. In contrast, at SFU, the few positions here are complementary to other research activities and provide diversity important for the general physics culture and training of students. It is desirable that this group not be reduced to a single individual by attrition (all but one retire by 2005), so that several new appointments should be made in these fields. It is particularly important that individuals hired in these areas should have interactive personalities capable of forging productive research links outside the department, in addition to their important interactions within the department.

4. Faculty Recruitment

a) Maintaining a competitive edge

The Physics Department has built an enviable reputation for the high quality of its research programs in the area of condensed matter physics. Given the large number of retirements in the near future, and the competition among universities and industry for the best people, it is imperative for SFU to take certain steps in a number of areas if it is to maintain its current stature as one of the top physics departments in Canada. We believe that the department would profit from reviewing its current position in a number of areas:

1) Starting salaries for new faculty. An initial offering less than \$50k is not competitive on the North American scene.
2) Startup funds for new faculty. Major new recruitment will spread already thin university resources even more thinly; yet strong startup is mandatory to compete with the best experimental candidates, who are getting packages from \$250-750k at assistant to associate professor ranks.
3) Laboratory space. Sufficient space for research laboratories for new faculty is mandatory. The needs for space allocated to professors emeriti should be reexamined in this context.
4) Teaching loads in general. The norm in US research universities, for established researchers, is one course of three lectures per week in two of the three semesters per year. A further reduction of teaching responsibilities below this norm of two courses per year is especially important for new faculty who are just starting their research programs.
6) Service requirements for junior faculty. All junior faculty should have very limited committee responsibilities until their tenure review has been completed.
7) Mentoring for junior faculty. A senior member of the Department or a Departmental Committee should be assigned to each new faculty member to have responsibility for advising on grant applications, an appropriate level of committee responsibility, and helping the young faculty member to promote his/her accomplishments through invited seminars, etc.

b) The need for a strategic plan

It is imperative that the department have a strategic plan covering the next seven years. The demographics of the physics department will change very substantially, as has been discussed above and in the department's self study report. In this period it is expected that there will be at least 12 departures from the faculty ranks and there may well be more. For example, in just the last two years there has been an unanticipated loss of three faculty. This uncertainty must be combined with the uncertainty associated with successfully concluding searches. Will the department be able to attract this many top faculty in so short a period of time? We believe that the answer to this question hinges critically on developing a seven year strategic plan for recruitment that targets specific research areas in more detail than the present physics three-year plan, dated November 1997. The critical thinking required in reaching consensus on such a plan will stand in excellent stead as a benchmark for progress in the very extensive recruitment period that lies ahead. Furthermore, it can be a very attractive recruitment tool to show candidates in a given year clear evidence of how the department sees itself developing in the future. This is particularly true when the department envisages multiple hiring in a specific subdiscipline in which several individuals will share common infrastructure. A strategic plan should be revisited each recruitment season and if and when there are unexpected opportunities. Overall, a strategic plan encourages communication within the department and will promote efficiency in planning for research space and departmental resources in order to start and support junior faculty laboratories. Such a plan naturally opens a dialogue between the Dean's office and the department and, with this administrative support, encourages continuity in faculty searches that have not been successfully concluded.

c) Recruitment organization

The chair of a search committee has a very special responsibility which must be exercised creatively and with as much cooperation and consensus from within the department as is possible. It is generally our feeling that the department chair, having extensive administrative responsibilities in other areas, should be chair of a search committee only if there are special circumstances such as specific knowledge of the professional sub-area in which the search is being conducted.

We believe that there should be a clear agreement between the department and the Dean's office that searches be automatically continued if they are not successfully concluded in a given year owing to a declination or the lack of an appropriate candidate.

5. Undergraduate Program

The undergraduates whom we interviewed were an articulate group who presented their goals and concerns well and who were very positive about their educational experience at SFU. From all of our contacts during the review process it was clear that the faculty, technical staff, and lab instructors are dedicated to offering a high quality undergraduate program and are working well to accomplish this. The physics laboratories are regarded by the students as challenging and requiring perhaps more time than is ideal, but most importantly they are seen to have very significantly advanced the students understanding of physics. What appeared to impress the students was the process of learning by "doing" through their personal involvement in the laboratories. From an educational point of view the process of extended laboratory experience is superior to that of " just taking data". The principal academic concern of the undergraduate students was that they find that their prerequisite mathematics courses in the areas of differential equations, vector calculus, and linear algebra provide them limited preparedness for applications in physics. The few comments which we received from the students concerning the Co-op program were mostly positive, although jobs having greater science and engineering involvement would have been appreciated in one case. The Co-op program is also seen by faculty as an important reason the students come to SFU. On the social side, there is a need for better facilities in the student's common room. The department should make a significant effort to improve this undergraduate space.

It should be possible to introduce some streamlining in the undergraduate curriculum. A number of courses are given more than once in the same year. (For example, in 1997, in addition to multiple offerings of first year courses, PHYS 211 and 221 were given three times, 244, 324, 326 and 385 were given twice). Perhaps this has its historical origin in the needs of the semester system and Co-op program. The financial constraints on the University and the Department are now such that it is highly desirable to streamline the program offerings. Our recommendation is that each course be given only once in each calendar year. Because of the requirements of the Co-op program, and in order to maintain the current high quality of the physics offerings, this will require considerable planning in cooperation with other departments in the Faculty of Science and in the Faculty of Applied Sciences. Perhaps a broad based committee reporting to the Deans of Science and Applied Science could accomplish these objectives. One of the first uses of the savings realized should be to reduce the teaching load in physics which, as noted elsewhere, is above the norm for physics departments of North American research universities.

6. Graduate Program

The graduate students we met impressed us with their articulation of interests and directions for research. Some students have indicated a need for greater breadth in course offerings and this was reiterated by a number of faculty. One of our concerns is the above normal level of teaching responsibilities of the faculty and consequently adding to the core graduate curriculum is not a recommended solution. Rather it might be possible to have special topics courses offered by adjunct faculty or visitors, as has been done in the past. Directed independent study for small groups might be arranged to gain specific technical skills at an advanced level, such as in many body theory. Possibly some courses taken off-campus could complement the present program. Additional seminar courses might be organized to provide breadth in the course offerings. The required graduate seminar is an excellent program. In addition a faculty seminar would be advisable to give first year graduate students an introduction to the research programs in the department. Some of the graduate students have asked for more contact with the faculty early in the graduate program to help them focus on areas of interest and to make them more familiar with research in the department as a whole. Such programs are the norm in many institutions.

The time for completion of the Masters program, on average, is 9 semesters which is high in comparison with other physics programs but better than average for many other disciplines at Simon Fraser. However, we feel that 9 semesters is too long. Specifically the time spent in the Masters program adds significantly to the total period before graduation with a Ph.D. for those students who continue with their graduate work. The average time in the Ph.D. program alone is 4.8 years, which combined with the 3 year average in the Masters program, leads to a relatively long period in graduate study. For the physics department at Simon Fraser to be attractive to the best graduate students this period should be shortened. We note that this issue was raised by the previous review committee who recommended a cap in funding to ensure that the time for completion be decreased. We urge that the department reconsider the problem and directly confront their traditional goals for the Master's degree, and balance these with the present requirements of 17 semester hours of course work, a thesis based on publishable original work, and a relatively heavy teaching assistantship responsibility of 14 hr/week (department self-study report, 1998).

7. Facilities and infrastructure

a) Computing resources
The decentralization of computing services occurring at many universities is perhaps also in the process of taking place at SFU. One possibility that should be considered as a part of the decentralization of resources is to have a systems person associated with the Faculty of Science available to help faculty with computing setup, maintenance, and software installation, possibly on a partial cost recovery basis. In this respect it should be noted that the physics department has been extremely successful in hiring high quality technical staff and maintaining and fostering a productive spirit and attitude among its technical staff. It would be an opportunity therefore to have the physics department play a significant role in the hiring and supervision of such a systems person.

b) Library services
The central library services appear to be well managed. The fact that arrangements have been made to have many scientific journals available 'on-line' is an indication that the library staff is well acquainted with recent developments and is reacting efficiently.

c) Instrument Shops
Instrument shops play a significant role in modern research laboratories. Continuing institutional support for central shop facilities is crucial for forefront work in the experimental sciences and in particular in condensed matter experimental work. At the present the central machine shop has a reasonable staff and the back log of approximately one month is fairly typical of other institutions. However, special attention from the central administration needs to be paid to ensure that such facilities are viable. The student machine shop is very important to the physics department and it is equally important that there are skilled technical staff available in the department who help the students learn the fundamentals of design and construction of equipment using both the student shop and the main instrument shop facilities. Active use of instrument shops is a key to successful graduate student training in experimental physics.

The availability of an electronics shop is also very important to the Physics Department's experimental programs. The glass shop is less used by physics researchers but is important nonetheless.

8. Staff: technical and professional

We found the technical staff, including laboratory and administrative staff, to be very competent and effective. Dr. Rangnekar, the Departmental Assistant, is responsible for much of the administrative management and performs this crucial job superbly. One concern is that there may not be sufficient cross-training or back-up such that in Dr. Rangnekar's absence the department can operate smoothly. Consequently the department might consider either new, or possibly shared support for an additional staff person, or perhaps redirection of effort in order to provide this important additional administrative function.

We met separately with the laboratory and technical staff and, as noted above, found that they have a clear commitment to supporting the department's mission in teaching and research and that their level of expertise is very high. The department is very fortunate to have these individuals. Their role in the teaching laboratories is crucial. Also of particular note is the personal interaction the staff have with the graduate students which is of substantial help in the technical training of experimental physics.

The secretarial staff, although small in number, are very efficient, as was abundantly clear, for example, in the arrangements made for the review process and the external committee's visit.

9. Diversity

The department has one assistant professor and one joint appointment at the assistant professor level who are women, among the 23 faculty positions. This is 1.5 more women faculty than were in the department in 1990, but is still remarkably low compared to the pool of women Ph.D.'s in North America. It was pointed out specifically to us by the graduate students that there are only 3 women in the 50 graduate students in the department. While this may be a fluctuation, we note that the small numbers in the department might be a cause for concern with the interview and admissions process for graduate student appointments. This may also be the case for faculty appointments, particularly so with the large number of new faculty positions that are foreseen. Consequently we believe that additional attention needs to be paid to diversity in hiring. Given the small numbers of women and minorities in the department at present at both faculty and graduate student level recruitment of the best of these populations may be difficult and will need special planning and some creative approaches. We did not separately interview any women faculty or graduate students or other traditional underrepresented groups, and so we cannot comment on any possible discrimination that may have been faced by these populations, but it appears to us that the atmosphere in the department is very collegial and quite professional. Since there is an expectation of women faculty membership on a number of university committees, women faculty members become unfairly overloaded with committee work compared to their male colleagues. The administration, as well as the department, need to take this into account in their committee assignments and in tenure cases.

Review committee:

William P. Halperin (chair), Northwestern University
Cherry Murray, Bell Laboratories, Lucent Technologies
Michael B. Walker, University of Toronto
Paul Percival (internal member), Chemistry Department