

**SIMON FRASER UNIVERSITY**  
**Senate Committee on University Priorities**  
**Memorandum**

**TO:** Senate

**FROM:** John Waterhouse  
Vice President, Academic  
Chair, SCUP

**RE:** Report of the External Review of the Department of Physics (SCUP 06-30) **DATE:** June 20, 2006

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At its June 14, 2006 meeting SCUP reviewed the report of the External Review of the Department of Physics, the response from the department, and the response from the Dean of Science.

**Motion**

that Senate concurs with the recommendation of the Senate Committee on University Priorities that the Department of Physics and the Dean of Science be advised to continue pursuing the following as priority items:

Planning

The department should continue the strategic planning process with particular attention to defining the department's major activities, research focus, and involvement in SFU Surrey, and involving all Physics faculty in the discussions.

The department should re-evaluate the administration of the Department to consider possible staffing alternatives and structures, and the provision and maintenance of appropriate office equipment and infrastructure.

Undergraduate Program

The department and the Faculty of Science should focus efforts on recruiting and supporting students, linking students to faculty members, providing advising and career information, attracting non-science students to Physics courses, and making efforts to increase the participation of women students in Physics.

Graduate Program

The department should review the graduate admissions committee and process to ensure that the graduate program is coordinated with the needs and directions of the department and recruitment activities are at an appropriate level.

c: D. Boal  
M. Plischke

SIMON FRASER UNIVERSITY  
MEMORANDUM

RECEIVED

OCT 17 2005

Vice President  
ACADEMIC

To: Bill Krane, Associate Vice-President  
Academic

From: Michael Plischke, Dean  
Faculty of Science

Re: External Review, Department of Physics

Date: October 13, 2005

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I have in hand the report of the External Review Committee (ERC) for the Department of Physics as well as the Department's response dated September 29, 2005. This review committee was composed of a particularly distinguished group of scholars and their report, separate from the specific recommendations, contains a wealth of sound advice and well-thought-out suggestions that will serve the Department well in the years to come. The Physics Department has accepted almost all of the recommendations and my comments will therefore be quite brief. I am extremely pleased that the ERC considers the Department to be very strong in research and that the hires of recent years are seen to be excellent. This bodes well for the future of the Department.

The ERC identified two recommendations as being of paramount importance:

1. *Start an in-depth planning exercise which covers all of the Department's major activities and concerns.*
2. *Invest more effort and resources in recruiting Physics students into the undergraduate program.*

The Department has initiated the planning exercise referred to in the first recommendation with an aggressive completion schedule. This process is being carried out in the spirit suggested by the ERC, *i.e.*, all faculty members including the most recent arrivals are actively involved.

As far as recommendation 2 is concerned, the ERC makes a number of concrete suggestions that the Department expects to implement. One of these is to go to a system of direct admission into the Physics program. I am pleased to report that after the Department's response was submitted, the Science Chairs agreed to implement direct admission into all programs in time for the fall semester of 2006.

One of the areas of concern highlighted by the ERC is the lack of faculty available to supervise graduate students in theoretical soft condensed matter/biophysics. This has certainly been an issue over the past few years. The ERC recommends making one faculty appointment in this area, ideally a mid-career or senior academic. Although I do not wish to anticipate the outcome of the Department's planning exercise, I do find this suggestion attractive. I should mention that this situation will be improved within a year: the Chair, David Boal, who works in this area, has decided to step down two years ahead

of schedule, a considerable loss to the Faculty's administrative capability but a commensurate gain for scholarship.

In summary, I consider this external review to have been a most worthwhile exercise and look forward to working with the Department as it implements the recommendations.

*M. Plischke*

Michael Plischke

C: David Boal

## Physics Seven-year Review

### Departmental Response to the External Review Report (April, 2005)

29 September, 2005

Through the fall semester of 2004 and spring of 2005, the physics department prepared for its regular, but infrequent, seven-year external review. The most important preparations included a departmental retreat held on Bowen Island in November 2004, the first such meeting in at least a quarter-century, and the writing of a lengthy self-study based on the retreat and other departmental meetings. The external review itself took place in March-April 2005, with the review committee's report arriving at the department within the two following months.

The recommendations contained in the report encompass a range in specificity, from the need for voice mail to the broad issues of strategic planning. The department has already acted to resolve many of the recommendations and will undertake the planning exercise beginning in October, to be complete by July 2006. This document is the department's response to all items except the planning exercise. Our response is organized according to the recommendations on pages 4-6 of the external review committee's report. This document has been circulated to all faculty and staff for commentary, and has been approved by departmental faculty.

#### 1. Strategic planning

##### *Recommendations*

- 1.1 Start an in-depth planning exercise which covers all of the Department's major activities and concerns.
- 1.2 Reevaluate the other service and teaching duties of the junior faculty to ensure that they can fully participate in the planning exercise without jeopardizing their research programs.
- 1.3 SFU: Provide additional resources to the Department to cover the cost of a sessional lecturer, outreach officer, or other service staff to free faculty time for planning and implementation.

##### *Response*

- 1.1 The department will undertake a major review of its research and teaching activities, as well as define the role it wishes to play as a national and international research center. This exercise will take place during the 2005-6 academic year, with the departmental plan to be complete by July, 2006. A draft membership for a long-range planning committee has been circulated to the department as of 27 September.

- 1.2 All faculty will be expected to contribute to the plan, but junior faculty will not be asked to take on the task of writing sections of the planning document itself.
- 1.3 The department may need one sessional appointment and some extra secretarial help in conducting the review.

## 2. Research and Faculty Hiring

### *Recommendations*

- 2.1 One or two faculty appointments in theoretical physics should be a priority, with an emphasis on particle physics or related areas and on soft matter/ biophysics.
- 2.2 The Department should have a full and open discussion on the direction of the particle physics/ cosmology theory effort.
- 2.3 SFU: Fix the problems with Facility Management as they apply to smaller projects.

### *Response*

- 2.1 In 2005 we hired a theorist with very broad interests in condensed matter physics. For 2006 we are searching for one or two cosmologists whose research programs overlap with either particle physics or astrophysics. The difficulties that we face in strengthening the complement of theoreticians include:
- (i) Drs. Plischke and Boal, soft matter / biophysics theorists, both have administrative positions which strongly curtail their research time. Dr. Plischke's term as Dean runs through to his retirement in 2010. To rectify the shortfall in biophysics theory, we would need a bridging appointment to his retirement.
- (ii) Dr. Clayman, now director of the Great Northern Way campus, is still on the department's books as a faculty member, although he no longer has a physics research program, nor has he taught for many years. Under its current hiring plan, the department will use Dr. Clayman's CFL to hire a theorist with research interests at the cosmology / particle physics boundary. To expedite this appointment, a bridging position would be required against Dr. Clayman's retirement in 2008.
- 2.2 The direction of the cosmology / particle theory group will be discussed as part of the department's planning exercise in Response 1.1.
- 2.3 The department experienced severe delays in implementing laboratory renovations during 2004-5, delays that prevented two faculty hired in August and September 2004 from moving equipment into their labs until June 2005. Such delays are crippling to a new faculty member, and tarnish SFU's reputation as a research-oriented university.

## 3. Graduate Program

### *Recommendations*

- 3.1 All faculty in soft matter/biophysics theory should make an effort to supervise physics graduate students. If necessary, the Chair should obtain additional teaching

release to facilitate this.

3.2 The coordination between the graduate admissions committee and the needs of the Department should be strengthened.

3.3 The graduate admissions committee should include a member from each research subgroup of the Department, with particular emphasis on the experimental groups. The mandate of this committee should be extended to include recruitment.

3.4 Consider working with UBC to provide some graduate courses via a video link.

3.5 SFU: Provide more resources to the Department for graduate student funding in a way which rewards both the overall size of the program as well as the quality of the program as measured by external scholarships and time to completion.

#### *Response*

3.1 After some reassignment of teaching duties, all soft matter / biophysics theorists except the Dean of Science are available to supervise graduate students.

3.2 The current graduate studies committee has two major duties, one to deal with recruitment and admissions and the other to deal with curriculum revisions. Increasing recruitment remains an ongoing issue that the committee hopes to address with a more proactive strategy in the future. Public relations activities at every level including talks with potential graduate students at other universities, will be increased. The prime consideration for admission to graduate studies remains merit. However, the composition of the graduate studies committee will reflect the department's research specialties in order to better communicate the opportunities available for new students in each research subdiscipline.

3.3 The memberships in all committees are being reviewed to more fairly distribute the committee load and ensure equitable representation of research specialties on various committees.

3.4 Shared graduate courses have been successfully undertaken with UBC in the past using SFU downtown as a venue. The graduate studies committee will consider whether a video-based course would be helpful; thanks to WestGrid, resources are available in the physics department for conducting such courses.

3.5 The need for supplemental graduate funding remains critical to the viability of the physics graduate research program. In order to compete with UBC and other institutions, the department had to allocate almost 10% of its Fund-11 budget to top-up offers of admission for incoming students in 2005-6, a situation which is unsustainable. SFU should continue to press the provincial government for increased funding for graduate students.

#### 4. Undergraduate Program

##### *Recommendations*

4.1 Invest more effort and resources in recruiting honours Physics students into the undergraduate program. Suggestions include recruiting from first year Physics classes,

developing more flexible physics streams, which combine with many other subjects, and developing a direct-entry Physics stream.

4.2 Develop a more hands-on approach by faculty to advising undergraduate Physics students, possibly by assigning each physics major to a faculty member.

4.3 Develop courses aimed at non-science students which make use of the research base of the Department. One suggestion is a "Big Questions" course aimed at addressing the questions which fascinate both scientists and non-scientists.

4.4 Purchase projectors for the undergraduate laboratories.

4.5 Provide career counseling to undergraduate students starting in Level-I. This should be part of the recruitment effort - making sure that Level-I students understand the range of opportunities available for graduates with training in physics, including a combined training in physics and other disciplines.

#### *Response*

4.1 Several recruiting strategies have been implemented, as discussed in Response 6.1 below. As of September, 2005, we have four first year sequences, several of which differ only in pedagogy, not content:

PHYS 101/102 – oriented towards biological science students

PHYS 120/121 – general physics for science and engineering students

PHYS 125/126 – advanced physics, recommended for physics specialists

PHYS 140/141 – equivalent to PHYS 120/121 but taught in a laboratory format.

A new biology-based curriculum is being developed for PHYS 101/102 to be implemented beginning in summer 2006. We hope that PHYS 125/126 will offer a challenging, exciting course more likely to capture the imagination of potential physics students. A new undergraduate degree program has been developed in biophysics; this proposal is now working its way through the conventional approval process. If adopted in full, this program will require resources such as a senior laboratory.

Lastly, direct-entry is being considered for the Faculty of Science as a whole, but it is not without administrative pitfalls.

4.2 A mentoring program where each student would be paired with a faculty member was adopted by the department more than a decade ago, but was administratively cumbersome to implement. To make such a program functional, secretarial resources would have to be devoted to ensuring advisory meetings took place, *etc.* We have recently approved a modified mentoring program where the advising load will be spread to more faculty members by having each program advised by a different faculty member (*i.e.*, Applied Physics, Chemical Physics, Physics, Honours Physics, Mathematical Physics), such that faculty will not need to become overly acquainted with the nuances of our many programs. Several faculty members have already volunteered to participate and we hope to implement this scheme in the fall semester, 2005. The physics advisor will support this program by providing faculty with information about the programs and a list of students and contact information.

4.3 As part of the physics contribution to the new university-wide undergraduate curriculum requirements, two courses aimed at non-science students are being



developed or updated – PHYS 190 Introductory Astronomy and a new course on the physics of music, PHYS 192 Logarithm and Blues. Other courses will be developed as resources permit.

4.4 Four new projectors were purchased at a cost approaching \$10K as of August, 2005.

4.5 The department has hosted several career events entitled "Meet an employed physicist" where former students were invited in to speak about their career-related experiences. More secretarial resources will be needed to sustain this effort.

## 5. Administration and Staff

### *Recommendations*

5.1 Reevaluate the administration of the Department to consider possible staffing alternatives.

5.2 Install another phone line and voice mail for the Departmental office. More importantly, figure out why such problems occur and are not quickly fixed.

### *Response*

5.1 The division of responsibilities among departmental secretarial and administrative staff will be examined during the 2005-6 academic year, leading up to the retirement of the current DA, Sada Rangnekar in June 2006. In order to provide several months overlap, transition funds will be sought to hire Dr. Rangnekar's replacement in April, 2006.

5.2 Voice mail has been ordered for the two administrative assistants in the general office; a second phone line will be installed if voice mail alone does not solve the communications problems.

## 6. Outreach

### *Recommendations*

6.1 Broaden the Department's outreach activities to include outreach to Level-I Science students and coordinate this effort with recruitment into the Physics undergraduate program.

### *Response*

6.1 We have now instituted physics book prizes in first year as well as a series of more accessible presentations following the regular weekly colloquium, which is aimed at third-year students and beyond. Under consideration at the Faculty of Science level is a physics proposal to offer summer internships in research to highly capable students who have completed their first year of undergraduate studies.

## 7. Diversity

### *Recommendations*

7.1 Greater effort and attention should be put towards recruitment of undergraduate and graduate students, with a commitment to increase the participation of women. Suggestions are provided in the text below.

### *Response*

7.1 The department has undertaken a number of initiatives in this direction, and will continue to pursue ways of improving gender balance in the physics student population:

1. Women now make up 20% of our faculty complement and 40% of our teaching technicians; no Canadian physics department has a higher female representation. As they assume larger roles in the teaching program, these new faculty and staff will certainly present a different face to undergraduates than was the case a decade ago.
2. A new major program in biophysics is under development. Such programs have been very successful at other universities for increasing the number of women who are interested in a physics degree.
3. We will ensure that there is female representation in every first year course, either as instructor, TA or guest lecturer.
4. Several new social venues have been established this year to build a departmental community which is more friendly, supportive and nurturing to students generally. These activities will target not just continuing SFU students, but also exchange students and summer students visiting through the NSERC USRA program. Further, we hope to better involve physics students at all levels through their participation in the three principal departmental committees, including Outreach and Liaison.

## 8. Work Environment

### *Recommendations*

- 8.1 Involve all faculty in strategic planning for the future of the Department.
- 8.2 Ensure the senior lecturers are full participants, along with the regular faculty, in developing a vision for the undergraduate programs and that they are given the support and recognition they deserve.
- 8.3 Implement a mentoring program for junior faculty.
- 8.4 The Departmental Administrator should meet regularly with the administrative staff in his/her role as their supervisor.
- 8.5 The Department and the Departmental Administrator should try to keep the administrative staff informed on departmental activities and changes.

### *Response*

- 8.1 All professorial and instructional staff were invited to the departmental retreat and

departmental meeting to discuss the self-study document prepared for the external review. The latter document was also circulated to all technical and administrative staff for comment; the Chair also met with members of staff individually to discuss their job responsibilities. No changes are being contemplated to this process in next planning exercise.

8.2 At SFU, senior lecturers and professors collectively form the faculty of the university. Within physics, at least one senior lecturer sits on the undergraduate studies committee at any given time. The planning process in the department does not distinguish between subsets of faculty.

8.3 Given that the hiring frenzy of the past few years is diminishing, and that only 20% of the faculty are within 15 years of retirement, there is neither the intense demand, nor the senior faculty complement, to adopt this as a formal strategy. In most cases, collaborations are being established with junior faculty, and some mentoring occurs through this and interactions with the Faculty of Science grants facilitators. Nevertheless, the Chair has been reminded of the issue.

8.4 and 8.5. These recommendations will largely be implemented by the successor to the current DA, Dr. Rangnekar, in the spring of 2006 when he retires. In the meantime, Dr. Rangnekar is meeting more frequently with one of the administrative staff to document the procedures used in his position.

## 9. Surrey Campus

### *Recommendations*

9.1 SFU: Bring together multiple departments to develop an interdisciplinary vision for the Surrey campus.

### *Response*

9.1 The physics department has spent a substantial amount of time trying to chart a teaching and research course at Surrey, which can be executed with less than five faculty. It's next to impossible to identify any physics field that can be pursued without appropriate experimental facilities; until a fully-serviced science building is constructed with floor loads well above the current 50 lbs/sq.ft., we will not be able to mount a Surrey-specific program. Awaiting the emergence of a broader vision of the Surrey campus, our plan is to hire faculty who can benefit from the existing physics strengths and facilities on Burnaby Mountain.

# Report of the External Review Committee

Department of Physics  
Simon Fraser University

April 2005

Catherine Kallin, McMaster University  
Matthias Neubert, Cornell University  
David Weitz, Harvard University

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## Executive Summary

The SFU Physics Department has long enjoyed a reputation in North America as a research-oriented department with the strongest soft condensed matter group in Canada and one of Canada's top few groups in condensed matter physics overall. Although some strength has been lost through retirements and, in particular, the international impact of the soft condensed matter/biophysics effort has slipped somewhat, the overall research potential of the Department remains as high as ever through excellent new hires. The research of the Department has broadened over the past decade; it has maintained considerable strength in both soft condensed matter/biophysics and in semiconductor physics, and now includes small groups in particle physics and in atomic physics. Particle physics is an important area for breadth, particularly in the training of theoretical students, and atomic physics has recently undergone a renaissance and is an attractive area to students. In addition to their strength in research, the Department also stands out as a leader in North America in recruiting and retaining excellent women faculty in Physics. The Department deserves to be strongly commended for this initiative which can only result from much effort and attention. The Department also stands out for their friendly and collegial environment which was evident to us and was commented on by numerous faculty, staff and students. This combination of research strength, diversity and collegial environment gives the Department a strong base to further build on.

The Departmental self-study states that almost all of their effort has been focused on hiring in recent years and this is clear both from the very positive outcomes of their hiring and from the weaknesses that are apparent in other areas. Departmental hiring appears to have been largely driven by opportunities and this worked well because there were many opportunities through retirements and growth, and all the research groups benefited from this. However, now that the pace of renewal is slowing and there are more distinct groups, the Department is finding it more difficult to function as smoothly in this opportunistic mode. Although all groups described the environment as friendly and collegial, some individuals expressed concerns that significant rifts could form in the future due to hiring issues and that there was a reluctance to openly discuss contentious issues.

The solution to both these problems – possible discord in hiring and other areas suffering from neglect – is for the Department to pull together and forge a plan and vision for their future. It became clear to us during the interviews that the 5 year plan offered in the Department's submission is not the result of in-depth discussion and planning by the Department. Although we offer some suggestions as to future appointments in the research sections below, we feel strongly that the Department will benefit the most from developing their own plan. We see the lack of a planning process to focus the Department as its greatest shortcoming. Since such a process and its implementation takes significant time, energy and creativity, it will only work if the Department actively chooses to make this commitment. As we see it, the Department can either continue on

as it has or it can choose to become more activist and invest in in-depth planning. If it continues on its current course, it will still do quite well; however, if it put in the effort to adopt a more activist planning process, it has the potential to do significantly better and to become an even stronger department.

Another area of concern to us is the Physics undergraduate program. The Department views the undergraduate program as healthy overall because the service teaching load of the Department has increased along with the increase in Science students. However, the number of Physics majors and, in particular, honours students is very small. Although this is not atypical across North America, some Physics Departments have shown that it is possible to increase these numbers with more innovative approaches and we offer several suggestions to the Department in this report.

The graduate program is reasonably healthy, although the overall size is about 25% below what one might expect for such a research-intensive department and the number of students holding external scholarships is also lower than expected. In addition, there is currently a lack of supervisors for students interested in theoretical physics, which should be taken into account when the Department sets its hiring priorities. The difficulty of recruiting excellent graduate students is not surprising, given the generally small size of undergraduate honours Physics programs in North America. Hence, this problem is not completely decoupled from problems in the undergraduate program. More generally, a departmental vision and plan will also help in graduate recruitment, not only for the specific ideas it will generate, but because a well-focused department is also more attractive to students.

Our most important recommendations to the Department are:

*Start an in-depth planning exercise which covers all of the Department's major activities and concerns.*

*Invest more effort and resources in recruiting honours Physics students into the undergraduate program. Suggestions include recruiting from first year Physics classes, developing more flexible physics streams which combine with many other subjects, and developing a direct-entry Physics stream.*

In the next section, we list our recommendations, which are then discussed in detail in the following sections.

## Recommendations

The supporting arguments for these recommendations can be found in the sections below. Most of our recommendations are directed toward the Physics Department. However, the few which are directed toward the upper administration, are noted with SFU.

### *Strategic Planning*

Start an in-depth planning exercise which covers all of the Department's major activities and concerns.

Re-evaluate the other service and teaching duties of the junior faculty to ensure that they can fully participate in the planning exercise without jeopardizing their research programs.

SFU: Provide additional resources to the Department to cover the cost of a sessional lecturer, outreach officer, or other service staff to free faculty time for planning and implementation.

### *Research and Faculty Hiring*

One or two faculty appointments in theoretical physics should be a priority, with an emphasis on particle physics or related areas and on soft matter/ biophysics.

The Department should have a full and open discussion on the direction of the particle physics/cosmology theory effort.

SFU: Fix the problems with Facility Management as they apply to smaller projects.

### *Graduate Program*

All faculty in soft matter/biophysics theory should make an effort to supervise physics graduate students. If necessary, the Chair should obtain additional teaching release to facilitate this.

The coordination between the graduate admissions committee and the needs of the Department should be strengthened.

The graduate admissions committee should include a member from each research subgroup of the Department, with particular emphasis on the experimental groups. The mandate of this committee should be extended to include recruitment.

Consider working with UBC to provide some graduate courses via a video link.

SFU: Provide more resources to the Department for graduate student funding in a way which rewards both the overall size of the program as well as the quality of the program as measured by external scholarships and time to completion.

### *Undergraduate Program*

Invest more effort and resources in recruiting honours Physics students into the undergraduate program. Suggestions include recruiting from first year Physics classes, developing more flexible physics streams which combine with many other subjects, and developing a direct-entry Physics stream.

Develop a more hands-on approach by faculty to advising undergraduate Physics students, possibly by assigning each physics major to a faculty member.

Develop courses aimed at non-science students which make use of the research base of the Department. One suggestion is a "Big Questions" course aimed at addressing the questions which fascinate both scientists and non-scientists.

Purchase projectors for the undergraduate laboratories.

Provide career counseling to undergraduate students starting in Level 1. This should be part of the recruitment effort – making sure that Level 1 students understand the range of opportunities available for graduates with a training in physics, including a combined training in physics and other disciplines.

### *Administration and Staff*

Reevaluate the administration of the Department to consider possible staffing alternatives.

Install another phone line and voice mail for the Departmental office. More importantly, figure out why such problems occur and are not quickly fixed.

### *Outreach*

Broaden the Department's outreach activities to include outreach to Level 1 Science students and coordinate this effort with recruitment into the Physics undergraduate program.

### *Diversity*

Greater effort and attention should be put towards recruitment of undergraduate and graduate students, with a commitment to increase the participation of women. Suggestions are provided in the text below.



*Work Environment*

Involve all faculty in strategic planning for the future of the Department.

Ensure the senior lecturers are full participants, along with the regular faculty, in developing a vision for the undergraduate programs and that they are given the support and recognition they deserve.

Implement a mentoring program for junior faculty.

The Departmental Administrator should meet regularly with the administrative staff in his/her role as their supervisor.

The Department and the Departmental Administrator should try to keep the administrative staff informed on departmental activities and changes.

*Surrey Campus*

SFU: Bring together multiple departments to develop an interdisciplinary vision for the Surrey campus.

## Strategic Planning

The SFU Physics Department stands out as a collection of strong researchers, with some stellar activity, in a collegial environment. They have aggressively and astutely seized opportunities. Their strengths, as we see them, have been: a very strong core strength in condensed matter to build on within a mid-sized university, a supportive administration, mountain and ocean views, and a collegial and cooperative environment. This combination, together with good judgment in hiring, has made them a good department with outstanding research potential.

While acknowledging their many achievements and strengths, we believe the Department as a whole is underachieving and they could be even better if they want. To fully realize their potential and to take the Department to the next level – not only in research, but in the undergraduate and graduate programs, outreach and administration – we believe they will need to place more emphasis on leadership and invest significant time and energy in strategic planning to develop a vision for the Department. Both the Department and the SFU administration needs to decide if this is what they want because, if they do, it will require both time and resources. The time commitment of the faculty will not be short-term (although it will be most intense initially) as a fully engaged team actively promoting the Department and its initiatives at all levels requires an ongoing commitment. The payoff is that the Department will be in a position to create (rather than simply seize) opportunities, they will achieve more than they think is possible, they will preserve their collegial environment despite differences in opinions on hiring issues, and they will develop more resilience. Although retention issues did not come up during our interviews (perhaps it is the mountains and ocean) the planning exercise itself builds support and commitment which is valuable for faculty retention.

The three of us come from departments with planning cultures and this is the environment we like to work in, despite its demands on our time and energy. From our interviews, it is not clear to us whether the SFU Department wants to adopt this approach as many faculty seemed quite content with the current situation. We believe this is a critical decision the Department needs to make. They can continue on as before and still be reasonably successful or they can choose to make a commitment to leadership, planning, vision and activism, in which case they will achieve significantly more.

If the Department does decide to undertake an in-depth planning exercise, then, contrary to the opinion of the previous reviewers, we think it is essential that the junior faculty be fully engaged in this process. Their input is critical as they lend new perspectives to old problems and, our experience is that, they will end up in a short time owning the Department because of their ideas, ambition and ability to inspire students with their combined youth and success. However, it is also essential to protect the junior faculty's research time. This can be done by making sure not to waste their time, offloading other service duties from them, and reducing their teaching. This typically requires resources which the administration needs to provide to hire lecturers or sessionals and possibly other service people. For example, a staff member with a B.Sc. or M.Sc. in Physics, can be effective at outreach and related activities, freeing faculty time to devote to planning

and implementation. However, with vision and commitment, the Department should be able to attract new resources to the University in the longer term.

If the Department and the University decide they want to invest in this initiative, the Department will need to decide on a process. To assist them, we offer some suggestions for this process in the Appendix.

*Recommendation: Start an in-depth planning exercise which covers all of the Department's major activities and concerns.*

*Recommendation: Re-evaluate the other service and teaching duties of the junior faculty to ensure that they can fully participate in the planning exercise and implementation without jeopardizing their research programs.*

*Recommendation to SFU: Provide additional resources to the Department to cover the cost of a sessional lecturer, outreach officer, or other service staff to free faculty time for planning and implementation.*

## **Research**

Over the next five years the Department anticipates hiring six new faculty, in addition to any faculty hired at the Surrey campus. Priority areas for hiring should be discussed in the context of a 5 year planning process for the Department. Here, we review each of the research groups and offer suggestions where one or two appointments may have significant impact. However, other than noting a particular need in particle theory and theoretical soft-matter/ biophysics, we do not prioritize these suggestions as they should be discussed within the context of an overall Departmental plan.

## **Condensed Matter**

Condensed matter physics has always been the core of the Physics Department at SFU which has long been recognized as one of the largest and strongest groups in Canada. This effort has become significantly more diverse over the years, starting with the establishment of a soft condensed matter group (described below with biophysics). The quantum condensed matter group, which now includes atomic physics, is both outstanding and diverse, with well-established strength in semiconductors and magnetics and with emerging strength in correlated electrons and atomic physics.

Semiconductors and Magnetic Materials: We group these together as they share many common features even though they are noticeably distinct in their relative size. This is a stellar group of senior researchers and their high impact and stature is well documented by their substantial research funding, awards, invitations and publications. They also supervise a relatively large number of graduate students – about 30% of the Department total.

There is no one below the rank of Professor in this group. This provides the group and the Department with a valuable opportunity. What is their vision for the future? Certainly the area of spintronics and magnetic nanomaterials can be expected to be a vibrant and important area well into future decades and this is one route the Department could take if they can develop a plan for how they will compete internationally and how this area will interface with other strengths at SFU. Alternatively, they could look farther into the future to areas that are not yet well established within physics. For example, they might consider developing a program in some area of biotechnology, such as semiconductors or quantum dots applied to biology, as mentioned below under Biophysics. This debate – whether to stay in a similar area or move to a new area, needs to start now so that appropriate opportunities can be seized or created.

Correlated Electrons: In contrast to semiconductors and magnetics, this effort is staffed only by junior faculty. The quality and potential for leadership is outstanding. This is an important area in the Department for breadth as research in correlated electrons – which focuses on discovering and understanding materials which exhibit novel electron behaviour – currently accounts for roughly half of all quantum condensed matter physics in North America. This small group capitalizes on their close proximity to UBC by obtaining valuable samples from UBC and using the unique muon facilities at TRIUMF. The UBC correlated electron group currently has the world's best samples of YBCO, the most widely studied high temperature superconductor, and these samples are highly sought after by all the top groups in the world. The UBC effort relies completely on a single crystal grower funded by soft-money. This, combined with the fact that of the two star researchers at UBC maintaining this effort, one is nearing retirement and one is under continual threat of having his also substantial administrative talents exploited, leads one to ponder whether this stellar center could shift to SFU in the future with the hire of a single crystal grower. More generally, the recruitment of a materials scientist, particularly one who would interact with other departments, such as Chemistry, could have a substantial impact.

Atomic Physics: This is another dynamic young group, in a relatively new and exciting area where there are, as yet, no large groups in Canada but major competition from US national labs and institutes. This area is very attractive to students. This group and the Department need to develop a plan for the future of this group and how it will impact on other strengths and possibly on other departments. Given the general need for theorists in the Department, an obvious next step would be to add a theorist who would interact with this experimental group and, ideally, also have overlapping interests with the other condensed matter theorists.

Condensed Matter Theory: This excellent small group covers a very broad range of interests, including correlated electrons, semiconductors, nanophysics, disordered systems and even touches on biophysics. Theoretical physicists tend to work with smaller groups than experimentalists and many of North America's top theorists have only 3 or so students in their groups. Therefore, this group's current size (2.5 students per supervisor) is relatively strong. The most recent faculty hire will be an important addition to this group as his interests fit between the quite distinct interests of the two

current members. Having filled this gap, the group should now develop a vision for their future – a vision which should enhance the experimental efforts as well and connect to other theoretical initiatives in the Department. A theorist who would interact strongly with the atomic experimental effort but also connect to the existing condensed matter theory would be an ideal addition to this effort and should attract more graduate students.

### **Biophysics/Soft Condensed Matter**

The soft condensed matter and biophysics group at SFU has, for many years, been strong and highly visible externally. It is widely recognized, at least in the US, as the leading effort in Canada in soft condensed matter and biophysics, and is considered to be quite competitive internationally.

Three of the four experimentalists in this group are women, so that this group contributes significantly to the diversity of the Department.

The group is currently going through some rather significant changes, some expected, but also several that are unexpected. The retirement of Mike Wortis, while expected, has nevertheless resulted in the loss of a key leader of the group, not only among the theorists, but also for the group as a whole. This has been exacerbated by the less anticipated events of one prominent faculty member becoming Dean, and another one becoming Chair. While both remain research active, their activities have been noticeably curtailed, and their participation in the group and their availability to students, have both been reduced. This has had a significant impact on the group and on the Department.

These changes have been ameliorated somewhat by the addition of two new faculty, one a theorist and the second an experimentalist, both in biophysics. However, despite this success, there is still a lack of theorists, which is particularly acute for incoming graduate students who do not have many options. In the short term, this is partially offset by the presence of an additional active adjunct professor and by the continued efforts of retired faculty and faculty in the senior administration to take part in the community. However, an additional theorist is urgently needed, and the committee recommends making this a hiring priority.

In addition, in the short term, the committee suggests that the Chair consider getting additional teaching relief so as to be able to play a larger role in the research group, where his presence would be highly beneficial.

On the experimental side, the group is relatively young. With the sudden absence of the senior theorists, the group as a whole finds itself without someone to provide leadership in maintaining the high external visibility that it has enjoyed up to now. The committee views this as a serious issue; other universities will begin to establish biophysics groups, and for SFU to retain its position of leadership within Canada, some effort will have to be made to rebuild the leadership within the group. The committee urges the now “young” senior members to assume some of the burdens and responsibilities of leadership to

ensure continued strength and visibility. However, the committee also urges the Department to make the strengthening of this group a priority. The committee feels that this group would benefit considerably from the addition of a senior faculty member who would be willing to assume a leadership role, and who would ensure that the group retains its very strong external visibility.

The committee suggests that the Department consider carefully building on the strength and external visibility that the group currently enjoys. For example, the interdisciplinary nature of this field makes it a natural for joint appointments with the new health sciences initiative. The Department should explore these opportunities with the VP Research, who expressed strong support for such initiatives during his meeting with the committee. These should be new opportunities and initiatives for the Department that would not come at the expense of positions in other groups. The committee also suggests that the Department consider opportunities to build collectively on its strengths. For example, the strengths in both semiconductors and biophysics might be exploited for research that explores the direct interfacing between semiconductor electronic devices and living cells. This is an extremely challenging but very interesting field that is growing rapidly. Such an initiative would move both the semiconductor and the biophysics groups in a new direction.

There were concerns expressed to the committee about the lack of graduate students for this group. This seems to be an issue that can also best be addressed by a collective effort of the whole group to ensure that it receives the same recognition within Canada that it enjoys within the US. This will surely help attract students to the group.

*Recommendation: Hiring a theorist in this area should be a priority. The group is in need of leadership and a senior hire should be considered, along with interdisciplinary opportunities for hiring.*

### **Particle Physics/Cosmology**

Experimental particle physics at SFU currently consists of a group of two faculty members (and their students), who are members of D0, an experiment currently taking data at the Fermilab Tevatron (Batavia, IL), and of ATLAS, one of the two flagship experiments at the Large Hadron Collider (LHC) under construction at CERN (Geneva, Switzerland). The LHC is expected to begin operation in the summer of 2007 and to run for approximately two decades. For a long time, the LHC will be the only energy-frontier particle physics facility in the world.

The SFU group, while small in number of faculty, is well positioned to make important contributions to the Canadian effort on LHC. This is mainly due to their participation in the WestGrid computing effort and because of their relations with TRIUMF at the UBC Campus, which is hoping to host a Tier-1 computing center for ATLAS. Computing and data processing for the LHC experiments will require computer resources of a new dimension in Science and Technology, with projected data volumes of several Petabytes

per year. These data are will be stored and processed at a few Tier-1 and Tier-2 centers in Europe, the US, and Canada, and then made available to users worldwide. A leading involvement in the Canada WestGrid effort gives SFU researchers a leading position in the ATLAS experiment for years to come.

Particle physics is on the verge of a new era with potentially profound discoveries. Ever since the unfortunate termination of the Superconducting Supercollider (SSC) project in the US in the early 1990s, particle physicists world-wide have been looking forward to the construction and operation of the LHC project at CERN, which will open up a new energy regime beyond the currently explored weak-interaction scale of about 100 GeV (Giga electron-volt). It is widely expected that the LHC will provide answers to some deep puzzles in Nature, such as the origin of mass, the origin of electroweak symmetry breaking, and perhaps about dimensions of space-time beyond those we are familiar with from everyday life. Physicists look forward to finding the Higgs boson (the particle that gives mass to everything in the Universe), supersymmetric partners to the known particles (if supersymmetry turns out to be realized in Nature), and perhaps new spatial dimensions. Once the LHC begins to deliver physics data, sometime in 2008-2009, particle physics expects to be at the forefront of fundamental science for decades to come. In view of these exciting prospects, particle physics should attract an increasing number of students, and the Department should consider whether they want to further boost their profile in this area by adding a third experimentalist.

Having said this, the committee feels that strengthening theoretical particle physics theory is a more urgent need for the Department. The Department currently has only a single theorist doing research in this area. After some unsuccessful attempts to hire another particle theorist, the Department is now considering the possibility of devoting two faculty positions to a search in theoretical cosmology.

The past decade has seen a revolution of our understanding of the Universe, culminating in a "Standard Model of cosmology", which has many connections with fundamental questions in particle physics. There is compelling evidence for the existence of dark matter, which most physicists believe may consist of heavy elementary particles produced in the early history of the Universe. While the Standard Model of particle physics does not contain a candidate for dark matter, such candidates exist in many extensions of the Standard Model such as supersymmetry or extra dimensions. Similarly, there is growing evidence for another, mysterious form of energy density in the Universe called dark energy, which may or may not be Einstein's infamous cosmological constant. Particle physics and string theory have a hard time explaining the apparent value of the cosmological constant (or coming up with an alternative mechanism for dark energy). In fact, understanding the origin of dark energy is believed by some to be the most profound challenge to modern physics.

The committee feels that it is a worthwhile objective for the Department to try to attract one or two theorists working at the interface of particle physics and cosmology. While taking the department into a new and exciting direction (cosmology), this would also benefit the particle-physics experimentalists. At the same time, interactions with the

experimental group would allow the theorists to stay connected with discoveries that will be made at the LHC. However, it is our impression that there has not been a full and open discussion in the Department about the plans for hiring in particle theory or cosmology, even though the self-study targets two positions to this area. There is also no consensus within the small, 3-person, particle physics group about priorities for hiring in particle physics. Given their overall size, the Department should avoid building two separate groups in the general area of particle physics and cosmology. The particle physics group and the Department needs to have a full and open discussion to reach a consensus on hiring in this area.

*Recommendation: While we believe that hiring a theorist in this area should be a priority, to lend critical mass to the research effort, both for the existing faculty and for graduate students working in this area, it is most important that the Department have a full and open discussion on the direction of the particle physics/cosmology theory effort.*

### **Experimental Facilities**

Finally, we comment on a problem which was brought to our attention by several of the new faculty. These faculty experienced, or are experiencing, considerable delay in getting their laboratories up and running due to problems encountered with SFU's Facility Management as it applies to small projects, such as individual labs. This is in striking contrast to the efficient help the faculty receive from the Departmental technicians. We are sure that SFU is aware of the significant investment made in these faculty and their research laboratories and that it should not be jeopardized by problems with the facility which oversees laboratory renovations. We strongly recommend that these problems be rectified.

*Recommendation to SFU: Correct the problems with Facility Management as they apply to small projects.*

### **Graduate Program**

The size of the graduate program, about 2 students/faculty member on average, is comparable to other Canadian universities, but a bit smaller than some of the most research intensive physics departments which SFU should be competing with. UBC, Toronto and McMaster, for example, all have about 2.8 students/faculty member. The SFU program can be expected to increase in size as some of the newest faculty members become established, but this will require both additional resources and a more aggressive and effective recruitment strategy.

The state of the graduate program elicited varied comments from the Department. There was a recurring theme of there not being enough high quality graduate students. However, there were also some groups who had more qualified students than they could support and who were turning away potential graduate students. Even more serious, there were some highly qualified graduate students who were admitted, but who could



not find theory advisors to work with and who instead went to UBC to find research advisors.

The lack of potential advisors available to theory students is a serious problem. The Department has been trying for years to hire another high-energy theorist, which is clearly needed, and would go a long way to addressing this problem. In addition, the sudden loss of three senior soft condensed matter/biophysics theorists from the ranks of potential student advisors has exacerbated this problem. Moreover, although a new biophysics theorist has been added, he is not taking physics students at this point, further exacerbating the problem. The committee urges all the soft condensed matter/biophysics theorists to take graduate students, to the extent that their current situation allows. This will help the theory effort in the Department considerably.

The committee feels that there should be stronger coordination between the admissions and the needs of the Department. The needs of the Department have changed considerably over the past few years. While the need for theory students has decreased, the need for experimental students has increased markedly with the addition of so many new experimental faculty who are building up their research groups. This need should be addressed by modifying the admissions committee. It currently consists of 3 theorists and one experimentalist. It should be broadened to include a representative from each subgroup in the Department, with particular emphasis on the experimental groups. The admission of students should be better coordinated with the needs of the Department and of the individual groups. Working within the inevitable uncertainties and indecisiveness of incoming graduate students, choices should be made to better match the needs of the faculty. In addition, the committee suggests that the role of the admissions committee be broadened to include recruiting. The Department has to aggressively recruit students to obtain the number and quality of students it needs. This recruitment duty should be shared by all members of the Department.

The committee lauds the fact that the Department has identified diversity as an important issue in attracting incoming graduate students. However, to date, the Department has not been successful in implementing such a change, even though it has been extremely successful in achieving diversity among the faculty. The committee suggests that some of the women faculty members become more involved in the recruitment process, both on the committee and on the follow-up recruiting effort, particularly in terms of achieving a diverse group of graduate students. The impact on a student of being recruited by a women physicist would be considerable.

There were numerous complaints from the faculty about the cost of graduate students, and the problems that SFU has in competing with UBC, particularly because of their tuition waiver. There was considerable sentiment that SFU should make a similar concession. The committee received different numbers for the cost to faculty of supporting a graduate student, but none of the numbers seemed unreasonable or excessive compared to the cost at other Canadian universities. However, it was noted that a significant fraction of faculty pay additional support to relieve their students from some of the teaching assistantship duties. Given that a full teaching assistantship is fairly

onerous (210 hours per semester) we feel that this is to be encouraged. However this means that significantly increasing the stipend using grant dollars would, overall, probably hurt the Department as relatively few groups could really afford this and it would likely result in fewer students being bought out from teaching duties. Unlike the Department, we do not feel strongly that SFU should match the UBC tuition waiver, since UBC is only one of many institutions that SFU needs to compete with. However, we do recommend that the University consider increasing the funds they provide to the Department for graduate student support. Tying such support both to the size of the program and to the quality, as measured by external scholarships and time to completion, for example, is a good approach which typically leads Departments to work even harder on recruitment and supervision.

For their part, the Department should try to counter the competition with UBC and other institutions with more creative and aggressive recruiting techniques. The committee was struck by the unwarranted sense of inferiority that the Department as a whole exhibited towards UBC. We urge the Department to emphasize the areas that distinguish it from UBC, and to aggressively recruit students using the advantages SFU enjoys compared to UBC. The graduate students we met with said they came to SFU because of its friendly and not-too-large Department which offered more individual attention and/or because of its particular strengths, such as in semiconductors or biophysics, for example.

Finally, there was concern expressed about the limited range of courses offered to graduate students. This is a problem faced by all physics departments, where teaching resources are low, while the interests of the faculty continue to diversify, and the demand for the range of courses increases as students increasingly work on interdisciplinary research. To meet these challenges, while not overloading the scarce teaching resources, the committee suggests exploring creative solutions with UBC. For example, the possibility of video link of the lectures was suggested.

*Recommendation: All faculty in soft matter/biophysics theory should make an effort to supervise physics graduate students. If necessary, the Chair should obtain additional teaching release to facilitate this.*

*Recommendation: The coordination between the graduate admissions committee and the needs of the Department should be strengthened.*

*Recommendation: The graduate admissions committee should include a member from each research subgroup of the Department, with particular emphasis on the experimental groups. The mandate of this committee should be extended to include recruitment.*

*Recommendation: Consider working with UBC to provide some graduate courses via a video link.*

*Recommendation to SFU: Provide more resources to the Department for graduate student funding in a way which rewards both the overall size of the program as well as the quality of the program as measured by external scholarships and time to completion.*

## Undergraduate Program

The Department views its undergraduate teaching program as being healthy overall. They have instituted a new course for first year physics, aimed at physics majors or other capable students, who received an A in grade 12 physics. This seems like an excellent idea that will offer additional options while simultaneously relieving some of the pressure on the other physics streams.

The service teaching load is the major effort and concern for the Department, as the number of faculty positions is tied to the full time equivalent which is dominated by service students. This number seems to be holding roughly constant as a ratio of science students.

However, the review committee is concerned about the undergraduate program. The number of physics honors and major students is very low and is even dropping further. [Over the past 5 years, on average about 5 or 6 honours physics students have graduated each year, and last year only 3 honours students graduated.] This does not seem to be a major priority to the Department; however, the committee feels that it should be a priority. There are some small things that could be done to increase this number; these would benefit both the Department and the field of physics as a whole. Increases by just a few students would represent a dramatic increase over the current numbers. The committee recommends that the Department consider adapting some of the techniques used by other universities.

For example, McMaster targets all students who receive an A+ in first year physics and tries to recruit them to enter the honours physics program. Since most of these would otherwise major in the life sciences, which is oversubscribed, the threat to other departments is minimal. However, the potential gain to physics is large. This brings highly capable students into the program, ones who have already been vetted. This is not to imply that physics is only interested in A+ students, but simply that this is a group which we expect will do well in physics, and it makes sense to invest the time and effort in recruiting them. At McMaster, every student achieving A+ in first year physics receives a letter from the Chair, inviting the student to the Chair's office to receive a book prize (Shankar's Basic Training in Mathematics: A Fitness Course for Science Students). Furthermore, the department offers them a summer job if they decide to enroll in the physics program as part of the incentive. This also can be very beneficial to a research group, as a student might then work in the same group for up to four years, making the investment in training much more worthwhile. Furthermore, recruiting A+ students makes teaching the upper level undergraduate physics courses more enjoyable. McMaster currently graduates about 12 honours physics students per year and continues to work to increase this number. (There are separate Engineering Physics, Medical Physics and 3-year Physical Science Majors programs.)

Another suggestion to consider is to have flexible double majors/honours for physics students, with fields such as economics, business, mathematics, chemistry or biology.

The students would receive degrees in physics and something else. To be effective, this requires a reduction in the number of physics courses required for the degree. However, this recognizes the fact that employment of physics students is often not in areas traditional for physicists, but instead is in fields where the problem-solving ability learned in physics can be applied. In some universities, this has been quite successful in increasing the enrollment of physics majors.

In addition, the possibility of direct-entry into Physics should be considered. This would allow the Department to closely link their high school outreach program to recruitment into their undergraduate programs. At McMaster, Mathematics implemented a direct-entry program several years ago and since then their undergraduate enrollment has increased about 30%. A direct-entry program can coexist with the general first year Science program. It makes sense for the University to aid in increasing the enrollment in undersubscribed programs such as Physics by allowing for varying admission and recruitment formats.

A successful undergraduate majors program may require more resources. The job of undergraduate advisor to the service students is quite onerous and time consuming. Therefore, additional resources may be required to advise the undergraduate physics majors. However, since the number of these students seems destined to remain relatively low, even under the best of circumstances, one solution would be to have all faculty contribute, with each physics major being assigned to a particular faculty advisor. This would require each faculty member to advise only a few students, and sharing the load this way should make it far less onerous. This idea was also suggested by the undergraduate students interviewed by the committee.

Another area of concern was the co-op program, which seems to attract fewer and fewer physics students, and the ones that it does attract are primarily those with lower grades. It seems apparent that the good students are finding opportunities for employment without the assistance, and the concomitant cost, of the co-op program. By contrast, less capable students are more reliant on the co-op program, but are unable to find positions even with the assistance of the co-op program. Moreover, the lack of good candidates makes prospective employers more reluctant to take part in the program. One suggestion that might help, given this reality, is to give better career advice to the students to encourage them to seek positions that go well beyond traditional physics positions, recognizing that careers for physicists also extend well beyond those companies that traditionally hire physicists.

Regarding the new breadth requirements, the Department should view this as an opportunity to develop courses which excite both their faculty and students. Often these more general courses designed to appeal to non-science students can benefit from a team teaching approach since they are typically interdisciplinary in nature. For example, at McMaster the physicists have created a "Big Questions" course aimed at non-science students. It is team-taught and addresses such questions as: How did the universe begin? What is life, how did it begin and why does it exist? Will the universe end? It is in its first year and already has an enrollment of 221 students. SFU might consider a similar

course, drawing on existing expertise in particle physics and biophysics and coordinating with other departments to add additional expertise.

We were asked to comment on the pedagogy for teaching large classes. Physics, with its emphasis on problem solving and use of high level mathematics, is probably one of the more difficult subjects to teach effectively to very large classes. However, the Department has developed at least a couple useful tools in this regard. For example, they make effective use of CAPA, while also recognizing its limitations. We heard several very positive comments on the demonstrations for first year, including the excellent technical support the Department provides for these demonstrations. These must certainly be a positive ingredient in teaching large classes.

Finally, we comment on a few other points connected to the undergraduate program, but in no particular order. The Department is considering adding a biophysics stream, perhaps replacing the undersubscribed physics and physiology stream, and this seems like an excellent idea given the Department's strength in biophysics. We were told the newest faculty were typically given the choice of the few left over courses after the more senior faculty made their selections. If so, we recommend that the new faculty have a more active role in choosing their course assignments. We are concerned about how the senior lecturers are integrated into the Department an issue is discussed further in the section on Work Environment. We also heard that a single projector is shared among 5 undergraduate laboratories and recommend that additional projectors be purchased for this purpose.

*Recommendation: Invest more effort and resources in recruiting honours Physics students into the undergraduate program. Suggestions include recruiting from first year Physics classes, developing more flexible physics streams which combine with many other subjects, and developing a direct-entry Physics stream.*

*Recommendation: Develop a more hands-on approach by faculty to advising undergraduate Physics students, possibly by assigning each physics major to a faculty member.*

*Recommendation: Develop courses aimed at non-science students which make use of the research base of the Department. One suggestion is a "Big Questions" course aimed at addressing the questions which fascinate both scientists and non-scientists.*

*Recommendation: Purchase projectors for the undergraduate laboratories.*

*Recommendation: Provide career counseling to undergraduate students starting in Level 1. This should be part of the recruitment effort – making sure that Level 1 students understand the range of opportunities available for graduates with a training in physics, including a combined training in physics and other disciplines.*

## Administration and Staff

*Departmental Administrator:* The administrative structure of the Department appears to be fairly informal with less documentation and communication than is typical of a department this size. While this style seems to have worked well for the Department in the past, with a somewhat larger and more diverse faculty, more interdisciplinary activities and a changing landscape for funding and recruitment, it is time to review this structure. There is concern about the impending retirement of the Departmental Administrator after many years of valuable service. This retirement should be looked at as an opportunity to reevaluate the administration of the Department and to consider possible staffing alternatives.

*Administrative Staff:* The administrative staff had a list of requests and comments for us, many of which would seem simple to rectify, leading us to conclude that they either did not have, or did not feel they had, the avenues for continual input and feedback that they should. For example, two of them share a single phone line, they do not have an answering or voice mail service and their printer is very slow. These relatively minor cost savings do not justify the loss of efficiency and accessibility to the Department's front line service for students and visitors. Also, their work area could probably benefit from some reorganization and cleanup as it seemed to be partially serving as a storage area as well. The staff feels that they are not always kept informed of departmental activities which is a problem when students and visitors come to them for information. They mentioned that they see a lot of students who come to them rather than to the designated advisor. This is not necessarily a bad thing, provided this job is acknowledged and they are given adequate information and resources. The administrative staff, like faculty, lecturers, technicians and other employees, are an important part of the departmental team. Finally, the staff also mentioned the lack of a readily accessible staff lounge, something that would need to be addressed by the University, as it has been at other Canadian universities.

*Technical Staff:* We heard numerous positive comments about the technical support, particularly in relation to new faculty who are building up their research laboratories. Although, again, the supervision of the technical staff seemed rather informal, this did not appear to be causing any difficulties, as the staff felt their concerns were generally adequately addressed by both the past Chair and current Chair. However, it may be worthwhile to look into this just to make sure the system is robust as the Chair passes from one faculty member to another. The morale of the technical staff seemed high, with recent hires and much interesting work to be done with new faculty labs and with the Surrey campus. Some dissatisfaction was expressed with the discretionary budget for supplies and with the overall salary scale and how this might impede recruiting more highly qualified technicians in the future.

*Recommendation:* *Reevaluate the administration of the Department to consider possible staffing alternatives.*

*Recommendation:* *Install another phone line and voice mail for the Departmental office.*

*More importantly, figure out why such problems occur and are not quickly fixed.*

## **Outreach**

After several years of dormancy, the Physics Department has now engaged in a dedicated and planned outreach effort, which should be vigorously pursued beyond the events organized on the occasion of the 2005 World Year of Physics. The Department organizes a series of public lectures on topics of interest to the general public. They are also organizing Physics Open House presentations for elementary school students, and developing material that can be used by science teachers for physics instructions in schools.

The committee recommends that these efforts be reinforced, and that still more resources be put into them. While outreach is partially a service activity, it can also boost the visibility of the Department and aid them in their recruitment and fundraising initiatives. For recruitment, it would be advisable to strengthen the outreach effort to attract undergraduate students. For instance, a targeted recruitment of top first-year science students, as discussed under the Undergraduate Program, would enhance the chances for attracting top-quality undergraduates and at the same time is likely to increase the percentage of women in the student population. Typically, outreach activities are most effective when the department picks activities that it enjoys and knows that it can do well. In this respect, including outreach in the departmental planning exercise is likely to generate additional worthwhile ideas.

*Recommendation: Broaden the outreach activities to include outreach to Level 1 Science student and coordinate this effort with recruitment into the Physics undergraduate program.*

## **Diversity**

At the faculty level, the Department is a leader in North America in building a physics department where women are both well represented and fully participating in leadership activities. With a 20% representation of women, the Department stands well ahead of all Canadian physics departments (except for McMaster which is also at 20%) and ahead of all major US physics departments. For this achievement the Department is to be strongly commended. This does not happen by accident, but requires considerable attention and effort. Having said all this, and we are confident that the Department will agree, 20% is still not good enough and more effort will be required. The Department plans to make use of the NSERC UFA program, and this initiative should be strongly supported.

However, the Department has not enjoyed such success in diversity in their undergraduate and graduate programs. The percentages given by the Department are 18% of undergraduates and 10% of graduate students (although the students themselves felt the actual participation by women was lower). While it is difficult to know for sure what the reason is for the low number of women students, our impression is that faculty hiring enjoys a very high level of attention and effort while the educational programs do

not. Women will not swarm to these programs simply because there are women faculty. Attracting women students requires the same kind of effort and attention that is paid to attracting women faculty.

The percentage of women physics students at SFU is similar to those at many other Canadian physics departments. However, with effort, it is possible to do considerably better. At McMaster 30% of the undergraduates and 26% of the graduate students in Physics & Astronomy are women, despite the fact that the Medical Physics undergraduate and graduate programs, which attract many women, are separate from this department. McMaster has found that simply working aggressively to recruit A+ students has had the largest effect on the numbers of women in their undergraduate program. This is because there are more women than men in the Faculty of Science and, consequently, more women get A+ in first year physics courses. Also, any active recruitment process for undergraduate students puts the faculty into direct contact with those students and this personal attention is what is needed to effectively recruit women (and many men).

At McMaster, the number of women graduate students increased during the years when the Associate Chair (who has responsibility for the program) was a woman (both Catherine Kallin and Christine Wilson have served in this role). However, it should not be necessary to have a woman in this role, provided the Associate Chair is fully committed to increasing the number of women students and gives potential students personal attention.

*Recommendation: Greater effort and attention should be put towards recruitment of undergraduate and graduate students, with a commitment to increase the participation of women.*

### **Collegiality/Work Environment**

It is the committee's impression that the Physics Department at SFU enjoys an atmosphere of collegiality that extends to all its major research groups and their interactions with other departments on campus. We believe this is essential to the inspiring working environment in the Department which, besides the academic excellence of the faculty, is responsible for the high quality of the research conducted at the department.

In various discussion with faculty the committee detected some undertones of resentments resulting, perhaps, from a lack of communication between different research groups, or between the Chair and the faculty, on some strategic issues concerning future directions of the Department, for instance with regard to hiring of new faculty or the choice of future directions in research. We recommend that the Department implement mechanisms to ensure that the faculty is fully involved in strategic planning. Besides reducing the risk of misinformation and potential misunderstandings, this will enhance a feeling of a team effort, where the Department as a whole feels that it is directing its future in a right direction.



It is the committee's impression that junior faculty, postdoctoral researchers, and graduate students enjoy working at SFU, that they receive plentiful help from their colleagues and supervisors, and that they find excellent working conditions for their research. We heard considerable praise for the collegiality of the Department and the generally good relations of junior people with the more senior faculty members. Nevertheless, several junior faculty said they would like to have a formal mentoring program which assigns a senior mentor to each new faculty. We recommend that the Department institute such a program. Examples are readily available from other institutions.

There did appear to be some issues related to the senior lecturers, who felt insufficiently integrated and sometimes undervalued by the faculty. Given the important role of the senior lecturers in teaching physics courses and in implementing new methods into the undergraduate program, we recommend that they be better integrated by the faculty and supported as much as possible in their often difficult job.

The committee also recommends that the faculty improve the integration of the administrative staff into the daily business of the Department. The staff should be informed about important events in the Department and about the arrival of new faculty members and postdoctoral researchers. We also recommend that the Administrative Supervisor have regular meetings with the secretarial staff to ensure that potential problems are identified early on and are dealt with promptly. This will help to enhance the efficiency of the secretarial office and provide a smoother mode of operation.

Students, faculty and staff all commented on the lack of adequate space for research, offices, storage and meetings. The shortage of office space is expected to ease somewhat when space is transferred from the Dean's office to Physics. Certainly, the Department needs to actively pursue opportunities to develop new research space as it has done in the area of Materials Research. Additional opportunities should be identified as part of the planning process to accommodate the expected growth as well as the current shortage. The administration should support such initiatives and provide matching funds for office space and other uses which typically cannot be funded externally.

*Recommendation: Involve all faculty in strategic planning for the future of the Department.*

*Recommendation: Ensure the senior lecturers are full participants, along with the regular faculty, in developing a vision for the undergraduate programs and that they are given the support and recognition they deserve.*

*Recommendation: Implement a mentoring program for junior faculty.*

*Recommendation: The Departmental Administrator should meet regularly with the administrative staff in his/her role as their supervisor.*

*Recommendation: The Department and the Departmental Administrator should try to keep the administrative staff informed on departmental activities and changes.*

### **Surrey Campus**

The committee recognized the concerns that the new Surrey campus engendered among some of the faculty. However, the committee also felt that the Physics Department was taking a constructive approach by viewing this as a potential opportunity. An excellent example of this was the new studio physics course that the Department was trying at Surrey. Such innovative approaches to first-year physics are certainly worth exploring, and the committee commends this effort.

The committee also supports the idea espoused by the VP Research to use the Surrey campus as an opportunity to establish a completely new, interdisciplinary center. The forefronts of scientific research are becoming increasingly interdisciplinary, making the traditional departmental structure of the university less suited to the demands of modern research. One means that many universities are currently exploring to surmount this problem is the establishment of multidisciplinary centers, focused on a particular important problem, and independent of the traditional departments. SFU has the opportunity to truly think outside of the box and establish such a center at Surrey. For example, good suggestions that were made to the committee included a center for biotechnology or a center for innovative science education. Such centers would bring faculty from different disciplines together to work on problems, and would create a coherent effort that would have a good chance of significant contributions. If done right, such a center would clearly distinguish SFU within Canada. However, this effort would surely require a commitment that transcends the Physics Department; it would take leadership from the upper administration of the University. Moreover, if the center were to truly achieve its potential, it would need a strong commitment from the University, and would certainly require new senior faculty to lead it. The committee strongly supports such an initiative, and urges the Physics Department and the University to work to establish it. In addition, it should be recognized by the Department that any new physics positions would be dedicated to the chosen field of the center, and would therefore not help the Department meet its presently identified faculty needs.

*Recommendation to SFU: Bring together multiple departments to develop an interdisciplinary vision for the Surrey campus.*

### **Appendix on Strategic Planning Process**

The following are the steps used in planning by the Physics & Astronomy Department at McMaster, which is similar in size to SFU Physics, and which developed an inclusive, in-depth planning culture only in the last decade so that memories of the initial process are still relatively fresh. The planning exercise is typically, but not necessarily, led by the Chair. It is important that whoever does lead this effort is able to set a tone of optimism and of frank and respectful discussion.

1. Decide on the scope of the plan. This should include **all** important activities of the Department, such as faculty hiring, undergraduate and graduate programs, outreach, research facilities, space, administration, diversity, advancement, etc.
2. Agree on the principles which will be used to decide whether a research area will or will not be continued and whether a new area will be started. For example, existing strength is not, in itself, an argument for continuing an area, but can be one ingredient together with student interest, potential for new discoveries, ability to compete nationally and internationally, etc.
3. Choose the subgroups which will write reports and present on each topic (i.e. undergraduate education, outreach, etc.). Let faculty choose their own topics as much as possible – you want to aspire to having a stellar, innovative undergraduate program not to just adding a few more students.
4. Have each research group present an overview of their field (why it is important, what are the major open questions, how does their effort fit into the international scene and connect to other areas, ...) and to present their vision of the future of their field and SFU's possible role in that future. Each group should also be asked to present on a new research area which is not currently represented at SFU. Also, invite related departments, such as Chemistry or Biology, to present their plan to your department if they have one.
5. After the subgroups circulate their reports, hold a series of meetings (we needed 5 or 6) to discuss these, stimulate additional ideas, build a consensus and, finally, forge a plan and vision. Make sure you tackle the difficult issues, guided by the principles you developed.
6. Expect to continually work to improve your plan, as well as to implement it, until it is largely achieved and you are ready for the next round. A visionary plan will aid in securing new resources, both from the University and from external sources.