Review of the Department of Physics University of Regina

External Reviewers:

Dr Charles Gale, Professor of Physics, McGill University

Dr Gerald Gwinner, Professor of Physics, University of Manitoba

Internal Reviewer:

Dr Esam Hussein, Dean of Engineering and Applied Science

Site Visit Date: 21 - 22 March 2016

Report Date: 1st June 2016

Executive Summary

The Department of Physics at the University of Regina is one of the smaller PhD-granting departments in Canada. Through specialization in the field of subatomic physics (SAP) since the 1980's, the Department has succeeded at positioning itself as one of the leaders in this field in the country, with an international reputation. The recent focus on nuclear imaging opens a new door to an attractive applied and industrial physics study and research program that will be attractive to a wider variety of students and researchers. The unit maintains comprehensive graduate and graduate programs in spite of its modest number of instructors. It also carries a sizeable service load, by teaching general physics courses to the University student population at large.

Undergraduate Teaching and Learning

- The Department of Physics offers a set of quality physics degrees, with access to appropriate and modern laboratories. The small student-to-instructor ratio was noted as a plus by the Review Committee (RC), as it was by the interviewed students. The student involvement in research definitely enhances their overall experience. The number of undergraduates enrolled in a physics major could increase without jeopardizing the quality of the program.

Graduate Teaching and Learning

- Graduate students are attracted by excellence and reputation, which the department currently has in subatomic physics. Within realistic staffing plans, the department needs to maintain this specific excellence, while carefully growing the program towards a related, applied field, medical imaging. This process has started.
- Adjunct faculty members are needed to provide additional interdisciplinary breadth, funding sources, teaching resources, and public exposure; again most readily recruited in medical physics.
- Paleo-physics work at the Canadian Light Source is interesting, but needs to be more firmly established to have impact, and student involvement needs to be clearer.
- There appears to be a relatively complicated multi-tier accreditation system for involvement in graduate studies. There should not be any unnecessary bureaucratic hurdles to have adjuncts involved.
- Currently, there seems to be no representation of Physics graduate students at the university level, due to the small size of the program. This must be remedied.

Research

- The Review Committee determines that the Department of Physics' research productivity and impact have been very considerable, and that research excellence is a clear strength of the unit. The Committee's consideration has included numbers of publications, quality of research journals, success in peer-reviewed funding exercises, and key positions in international experimental collaboration subcommittees.

Service

- Given the size of the department, its contribution to service internally and externally is remarkable.
- With its low enrollment, the department should focus on outreach service aiming at introducing physics to potential undergraduate and graduate students.

Staffing

- The Department of Physics cannot be reduced in size without jeopardizing its mission of teaching, research, and service to the community.

Financial Resources

- The budget allocation for the department seems to be directly related to the number of service students, and most of the budget is accordingly located to support TAs in service courses. This makes the department very vulnerable to external factors beyond its control.

Role in Meeting the University's Strategic Plan

- The department is implicitly fulfilling many of the aspirations of the U of R Strategic Plan, but no deliberate actions seem to be undertaken to meet the objectives of the Strategic Plan.

Preamble:

The Review Committee (RC) for the University of Regina's Department of Physics consisted of two external reviewers: Professor Charles Gale (McGill University) and Professor Gerald Gwinner (University of Manitoba), both physicists. The internal reviewer was Professor Esam Hussein, Dean of Engineering and Applied Sciences. The RC was provided with a Self-Study Report from the Department of Physics that provided details of the unit's research profile, of undergraduate and graduate programs, as well as the academic CVs of the instructors. The committee conducted a site visit of the department on March 21 and 22, 2016. The site visit included meetings with academic administrators of the University and of the Department of Physics. In Physics, the RC met with professors, with laboratory instructors and support staff, and with undergraduate and graduate students. Several phone/web meetings were also held. They involved Dr. Neil Alexander, Director of the Fedoruk Centre, Saskatoon; Dr. Reiner Kruecken, Deputy Director, TRIUMF; Dr. Hugh Montgomery, Director, Jefferson Laboratory; Dr. Dean Chapman, Science Director, and Dr. Pawel Grochulski, Bio/Life Sciences Manager, both at the Canadian Light Source. The reviewers also had opportunity during the site visit to tour the instructional laboratory facilities, as well some of the research lab areas. We wish to express our thanks to all for being extremely helpful in answering the committee's queries, and explaining the operation of the Department within the University. We further thank Dr. Nader Mobed (Head of the Department of Physics and Associate Dean) for shepherding much of our visit and for answering the committee's questions during and after our meetings. The agenda for the Cyclical Review Committee's site visit is found in Appendix A.

Report Format:

The RC has divided this report in the following sections:

- Undergraduate Teaching and Learning
- Graduate Teaching and Learning
- Research
- Staffing
- Service
- Financial Resources
- Role in the University's Strategic Plan

Within each of those sections, special consideration was given to (when appropriate) the themes defined by the Academic Review Policy:

- The priorities and aspirations of each unit and the extent to which they are being realized
- The challenges and opportunities faced by the unit
- The structure and quality of undergraduate and graduate programs and instruction

- The contribution of each program to related disciplines and fields of study
- The scope and significance of research being pursued
- The degree to which academic programs meet students' learning needs and goals
- The characteristics of staffing complements
- The degree to which the unit is meeting its internal and external service responsibilities
- The role the unit plays in meeting the University's vision, mission, goals and priorities
- The financial resources of the unit

Finally, this report contains "Assessments" and "Recommendations". The former are succinct statements summarizing the committee's view on a given aspect of its review. The latter are more formal, and should be interpreted as such. The Assessments also are part of the Executive Summary, and the Recommendations are summarized at the end.

Undergraduate Teaching and Learning

Structure

The Department offers four-year, 120 credit-hours programs leading to a B.Sc. in Physics or Co-Op Applied Physics, in addition to a more specialized B.Sc. Honours in Physics. The emphasis of the B.Sc.in Applied/Industrial Physics is on Electronics and Modern Physics. The Department also offers a Co-Op B.Sc. Honours degree. The B.Sc. programs focus on understanding core physics subjects. The Department also offers a minor for non-physics majors. In addition, the Department has a considerable service-course responsibility: it delivers introductory courses to students in the Faculties of Science (Biology, Chemistry, Biochemistry, Geology, Pre-Medicine, Pre-Dentistry, Pre-Veterinary, and Pre-Optometry), Engineering and Applied Science (first-year, Electronic System Engineering), Education (Secondary B.Ed. program in Physics), Media, Art and Performance, Kinesiology & Health Studies, and Business Administration. The number of undergraduate students in service courses is large (a total of 1143), the number of undergraduate students studying Physics as a major or a minor is relatively small, 43 and 2, respectively. These enrolment numbers have remained roughly constant over the past 5 years[1].

Quality of Program

The Physics undergraduate program is comparable in course content to similar offerings at other Canadian universities. The Review Committee assesses that the selection of physics courses offered by the unit defines a set of physics programs (BSc and BSc Honours) with substance. Final-year undergraduate students are offered hands-on research experience: a definite plus.

[1] Enrolment figures were taken from the Department of Physics Self-Study Report.

However, the Review Committee did note that the Honours program does not have a written thesis component (it relies on seminar presentations), as is typically required from students in many schools. In our view, an Honours thesis offers the opportunity to develop good writing skills, and to showcase and document the students' achievements, while putting these in the wider context of a literature search. In addition, a mandatory course on statistics early on in the programs could also lead the students to a deeper understanding of the uncertainties related to the analysis of laboratory experiments.

The Department of Physics is not a large unit, on the scale of Canadian physics departments, yet its undergraduate degrees represent a solid and somewhat standard collection of courses. Owing to the limited number of faculty members, students risk not being exposed to a wide variety of physics elective courses that can enable them to explore the breadth of the field. In this context, an eventual shortage of instructors would threaten the integrity of the program in general, and a lack of instructors to teach the more theory-intensive physics courses would also threaten its quality. This specific aspect will be addressed in the section on staffing.

A review of the curriculum (which has started and is progressing) is strongly encouraged. In this review, the Committee encourages the consideration of alternate teaching methods like the flipped classroom and peer instruction, for example. In an effort to modernize and diversify its course offering while attracting students with an interest in multi-disciplinary science, the Department is invited to consider the creation of joint degrees that build on local areas of strength (physics & math, physics & computer science, etc.). A multidisciplinary course offering may be helped by the inclusion of a larger number of adjunct professors. Those could bring expertise that is complementary to what is already present in the department. An accelerated BSc/MSc program has the potential to attract more students – both undergraduate and graduate – and to increase retention. Finally, during its visit, the RC was informed of the existence of an observatory with optical telescopes. Upgrading and maintaining this astronomy laboratory may also help to improve the undergraduate student experience, and offer an interesting outreach aspect (with "star nights", for instance).

Quality of Instruction

The small class size in Physics majors is a major advantage in the quality of teaching. However, the modest number of instructors could result in a limited exposure to a wider variety of research activities, and even of courses. Students majoring in Physics seem in general to be satisfied with the quality of the teaching and the accessibility of instructors. The committee has not met with students taking Physics service courses, but the Dean of Engineering (a member of the committee) indicated, however, that the Physics Department is very responsive to the needs of engineering students and has been accommodating of the increasing enrolment in his Faculty.

Meeting students' learning needs and goals

Physics undergraduate programs are traditionally aimed at either preparing students for graduate studies (Honours B.Sc.), or seek to garner practical skills (Applied Physics B.Sc.) However, the focus of faculty's expertise on subatomic physics and the consequentially limited number of faculty members capable of offering a wide variety of elective courses could be seen as a limit to student options. Also, a meeting with students revealed that Applied Physics students, and those interested in computational physics, could also benefit from more exposure to computational packages such as MATLAB, simulation tools such as ANSYS, COMSOL, symbolic manipulation software, and open source packages such as Elmer and MOOSE. Finally, it was noted that multidisciplinary and accelerated Masters programs can also help in attracting more students and enhancing the experience of students without significant additional resources.

Assessment: The Department of Physics offers a set of quality physics degrees, with access to appropriate and modern laboratories. The small student-to-instructor ratio was noted as a plus by the RC, as it was by the interviewed students. The student involvement in research definitely enhances their overall experience. The number of undergraduates enrolled in a physics major could increase without jeopardizing the quality of the program.

Recommendations:

- The review of the undergraduate curriculum already started by the Department of Physics should continue.
- The unit is strongly encouraged to consider means to diversify, and eventually increase, its undergraduate Physics major population. These may include an upgrade of the undergraduate curriculum and the consideration of alternative teaching approaches.
- The unit should consider the development of joint majors with other departments, a possible accelerated B.Sc./M.Sc., and the inclusion of adjunct professors to diversify its academic palette.
- The Honours program should require a written thesis.

Graduate Teaching and Learning

Structure

The Department offers M.Sc. and Ph.D. programs in Physics. Due to the nearly complete focus on experimental subatomic physics over the past two decades, research opportunities for students

exist by and large only in this field, with limited opportunities in astronomy and paleo-physics. An exciting new direction is emerging now in medical imaging, founded on the department's world-class strength in subatomic detector design. At the present, adjunct faculty play no apparent role in broadening the scope of the program.

The current enrolment of around 10 graduate students (around 2-3 per research-active faculty) is one of the most pressing challenges for the department. About one third of the students are local, the remainder international. Despite a comparatively good funding situation of the subatomic group, the limitation to grow the graduate program appears to be of a financial nature. Clearly, there is no lack of high-quality research projects both in subatomic and imaging.

While it is impossible to prescribe an exact number for a successful program, a guideline might be about 15-20 graduate students for 5-6 research-active faculty. Pursuing aggressively new sources of scholarships would go a long way towards achieving such a goal. As this expansion is driven by the move into medical/nuclear imaging, new sources of student support will emerge, possibly tied to industrial partnerships, for example MITACS. If collaborations with Chinese colleagues can be formed, the China Scholarship Council fellowships are also a possibility that should be seriously considered. In terms of internal support, the committee was not convinced that all avenues for matching support from the Faculty of Graduate Studies have been fully explored. Experience elsewhere shows that without direct departmental intervention, individual faculty members are often not aware of matching, or don't pursue it for various reasons. A few such opportunities would go a long way to support the growth target. Student co-supervision by adjunct faculty and faculty members from other academic units is another strategy successfully employed by other departments across to country to grow and diversify their programs.

Quality of Program

The focus on a few select, world-class, high profile, experiments in subatomic physics has allowed the department to provide research opportunities for graduate students of the highest calibre – this fact must not be underestimated. The department recruits graduate students on an individual basis (instead of admitting a "class"), which is the suitable mode for a program of this size. As a result, the relatively narrow scope of the program does not necessarily pose a problem in terms of the quality of graduate student research training. Nevertheless, opportunities in a related, applied program such as medical imaging would be highly beneficial to give students the choice of more directly applied research training. In addition, students would be able to avoid lock-in and could shift their studies as their interests evolve: e.g. pursing applied imaging work for a Ph.D. after carrying out fundamental research in subatomic physics for the M.Sc. or vice versa.

Quality of Instruction

Graduate teaching is strongly constrained by the faculty's obligation to field extensive undergraduate offerings, in particular service courses. The two theorists currently active in the department cannot make significant contributions to graduate teaching due to their commitment to administrative tasks and to the undergraduate program. As a result, core graduate courses such as quantum mechanics, electrodynamics, statistical mechanics, and possibly quantum field theory, cannot be offered in-house on regular basis or even at all. Online courses shared with other institutions make sense for specialty subjects but are sub-optimal for core courses, from an academic and pedagogical point of view. The need to take online courses was the graduate students' primary concern voiced during the site visit. The department still administers a written comprehensive exam, which in view of the low enrolment numbers appears inefficient.

Contribution to related disciplines and fields of study

With the hiring of the Fedoruk Chair in Medical Imaging, the department has as a chance to attract a significant number of additional graduate students which are drawn to applied and interdisciplinary research. A network of adjunct faculty should be created that ties into this research theme.

Meeting students' learning needs and goals

From a research point of view, the program is extremely well positioned to meet the graduate students' learning needs. The collaborative research at national facilities such as Jefferson Lab allows for state-of-the-art graduate research projects. Students from Regina work alongside of fellow students from prestigious universities: not many programs at smaller universities can provide such opportunities. Experimental subatomic research provides training in wide variety of topics, from the complex concepts of the underlying physics itself to extensive computational skills, including large-scale simulations with software such as GEANT, very advanced data analysis on truly "big data", and the hardware of particle detectors including electro-optics and massively parallel readout electronics. The examples of careers of U of R graduates provided by the department indicate that this training is highly valuable. Yet, not all training needs to be at such a high level, with the corresponding duration of training. An applied M.Sc. stream, as discussed above, would address needs and goals largely orthogonal.

Assessment:

- Graduate students are attracted by excellence and reputation, which the department currently has in subatomic physics. Within realistic staffing plans, the department needs to maintain this specific excellence, while carefully growing the program towards a related, applied field, medical imaging. This process has started.

- Adjunct faculty members are needed to provide additional interdisciplinary breadth, funding sources, teaching resources, and public exposure; again most readily recruited in medical physics.
- Paleo-physics work at the Canadian Light Source is interesting, but needs to be more firmly established to have impact, and student involvement needs to be clearer.
- There appears to be a relatively complicated multi-tier accreditation system for involvement in graduate studies. There should not be any unnecessary bureaucratic hurdles to have adjuncts involved.
- Currently, there seems to be no representation of Physics graduate students at the university level, due to the small size of the program. This must be remedied.

Recommendations:

- A new faculty hire in theory is badly needed to support core courses in the graduate program. Ideally, a guaranteed replacement of the retiring faculty member (Lolos) is required to support the program. See section on staffing for additional possibilities.
- Highest priority must be given to fielding a reasonable number of graduate courses, in particular core courses, in-house, on a regular basis.
- Consider the creation of an accelerated B.Sc./M.Sc. program to attract more graduate students with a focus on medical imaging, and possibly other areas of synergy, e.g. with the Faculty of Engineering.
- Explore aggressively scholarship opportunities outside the traditional sources suitable for subatomic physics. Ensure at the departmental level that faculty members exhaust all internal possibilities for support.
- For a program with low enrolment, a written comprehensive examination is likely not an effective use of resources. Its usefulness should be revisited.
- Bring adjunct faculty into the program for the diversity of the program, to increase the graduate enrolment and the graduate course offerings.
- Address issues that make the program less attractive to students, paying close attention to aspects such as international differential fees.

Research

The Department of Physics at the University of Regina has made a strategic choice in what concerns the research themes being pursued by department members. The unit has chosen to concentrate on the field of subatomic physics. More specifically, all of the research faculty in the unit – except one (Mobed) – are experimental physicists that travel to accelerator facilities to perform measurements, often as members of large international experimental collaborations. For example, department members play leading roles in the GlueX and F_π collaborations at the Thomas Jefferson National Accelerator Facility (JLab, Newport News, VA), have recently joined the T2K Collaboration (operating at J-PARC, Japan), and are users of the TRIUMF (Vancouver, BC) facilities and infrastructure. Notably, the unit now hosts the Fedoruk Chair in Nuclear Imaging. This recent addition broadens somewhat the research focus of the department, and seeks to build on its hardware expertise to develop detectors and analysis techniques for medical physics and plant imaging.

> ***Assessment:*** The Review Committee determines that the Department of Physics' research productivity and impact have been very considerable, and that research excellence is a clear strength of the unit. The Committee's consideration has included numbers of publications, quality of research journals, success in peer-reviewed funding exercises, and key positions in national and international experimental collaboration subcommittees.

The reviewers also note that the collaboration between department members is effective in boosting productivity, in addition to providing a positive background to the department's several other professional activities. However, personnel considerations are especially sensitive in a unit this size which boasts a significant research emphasis; those will be discussed in the section on staffing.

The Review Committee recognizes that building on a strong disciplinary foundation is a key to research success. However, a modern university environment also benefits from interdisciplinarity. Apart from obvious benefits from an intellectual point of view, a broader research palette has the potential to attract a larger community of undergraduate, graduate, and postdoctoral trainees. Importantly, this may be achieved without sacrificing research excellence. In this context, this review welcomes the creation of the Fedoruk Chair, and encourages the unit to pursue its strategy of using its detector-building expertise to branch out into other research areas such as health/medical science and (plant) imaging. In addition, a further rapprochement with the Canadian Light Source and the Fedoruk Centre carries the potential of obtaining additional resources and/or support as common research threads may be developed. Finally, the inclusion of adjunct professors (from industry and hospitals, for example) and associated faculty

from other academic units[2] should seriously be considered; they could add to the pool of talent already present in Physics.

> **Recommendation:** The Department is to be commended for its excellent research dossier in the field of experimental subatomic physics. The unit is encouraged to build on its expertise and successes to explore avenues to broaden its research focus.

Service

External

The Department participates in high-profile national and international organizations, such as the Southeastern Universities Research Association (SURA) and the Canadian Institute for Nuclear Physics (CINP). Huber is the CINP's Executive Director and Papandreou is Past Chair of the Canadian Association of Physicists' Division of Nuclear Physics (DNP). The Department also maintains the web sites of the DNP and of the CINP, as well as its own website. It operates Facebook and Twitter accounts, and has a YouTube channel. In addition, the Department participates in public events, such as the Science Pub series talks (at Bushwakker Pub) and other evening public talks. The Review Committee also encourages the department to reach out to its alumni and to use them as ambassadors and role models.

Internal

The Department participates in science fairs for the Regina region, the Faculty of Science Annual Open House (Rendez-vous), and the Science and Kinesiology Summer camps. Currently, as part of the its activities, the department's Outreach, Recruitment and Retention Committee is communicating with the Regina Public and Private School Division Liaison, high school councillors and science teachers, and U of R recruiters to explain the Physics programs and career opportunities in Physics. The Department is encouraged to continue these outreach activities.

Assessment:

- Given the size of the department, its contribution to service internally and externally is remarkable.

[2] For example: Computer Science, Chemistry, Mathematics & Statistics, Engineering, and Kinesiology.

- With its low enrollment, the department should focus on outreach efforts aiming at introducing physics to potential undergraduate and graduate students.

> **Recommendation:** The department should elaborate a recruitment strategy that involves reaching out to schools and youth in general.

Staffing

Currently the Departments has 10 full-time academic staff members: 4 full professors (one to retire in June 2016), 1 associate professor, 1 assistant professor, 2 lecturers, and 2 laboratory instructors. In addition, the Department has an associate member from Campion College and two research scientists. The Department shares an administrative assistant with the Dean's Office.

The staff level is comparable in size to other programs at U of R offering comparable degrees. However, unlike other comparable units, the Department carries strong service components. One of the faculty members, a theoretician, carries heavy administrative duties as an Associate Dean and as Department Head. This makes it difficult for the Department to offer courses on theoretical physics at the undergraduate and graduate levels. The position of the TRIUMF Research Scientist, when vacated, is also unlikely to be replaced at least with full funding as it is currently, thus weakening the research capacity of the Department. The funding for the Fedoruk Chair position in Nuclear Imaging is limited to a maximum of five years, with no renewal plans. Long-term plans should be in place to ensure sustainability of the Fedoruk Chair as well as the theoretical physics teaching and research activities. Involvement of adjunct faculty members can help bridge some of the existing gaps.

> **Recommendation:** In view of the unit's commitment to deliver a complete graduate experience and of the importance of theoretical physics in the graduate curriculum, the institution is encouraged to revisit the current situation where a theoretical physicist in the department carries a considerable administrative load.

The review recognizes the importance of service teaching by the Department of Physics, and of the necessity of offering a balanced and well-rounded physics curriculum to its majors and graduate students. The review committee thereby acknowledges the important pedagogical role played by lecturers, lab demonstrators, and associated support personnel.

Assessment: It is the view of these reviewers that the Department of Physics cannot be reduced in size without jeopardizing its mission of teaching, research, and service to the community.

One of the senior members of the Department of Physics who is still active in research (Lolos) is slated for retirement this summer. In view of the unit's sustained and successful research, the reviewers assert that a replacement is necessary to maintain the research thrust and impact of the unit and to continue to offer a vibrant learning environment, in accordance with the University's 2015 – 2020 Strategic Plan.

Recommendation: The institution should make every effort to replace the retiring faculty member. Based on material at hand (report and visit) and on the requirements related to offering complete graduate and undergraduate curricula, the Committee would favour a hire in theoretical physics. Also, in view of its research accomplishments and of its teaching record, the unit and institution are strongly encouraged to consider using excellence-based funding (e.g. the Canada Research Chairs program, named Chairs, possible joint positions) to recruit and augment its faculty roster beyond this single replacement.

Financial Resources

The Department currently has a unit operating budget of $82,941. Most of this budget (80 %–85%) is used to pay laboratory teaching assistants (TAs) and markers for large first year classes, while the rest is used for capital and non-capital expenditure. The Department also received funding from outside the unit to support TAs and sessional lecturers, as well as major lab upgrades and equipment purchase. The Department offers about six course sections via sessionals. The use of sessionals is attributed to faculty attrition, but is likely also due to the increase in enrolment in first-year courses and the teaching release provided to the Associate Dean/Department Head. The fact that 80% or more of the Department operating budget is used to provide TAs for service courses may indicate that the budget allocation for the Department is mostly based on the number of service course it delivers.

***Assessment*:** The budget allocation for the department seems to be directly related to the number of service students, and most of the budget is accordingly located to support TAs in service courses. This makes the department very vulnerable to external factors beyond its control.

Recommendation: The department should seek additional sources of funding to supplement its core budget.

Role in meeting University's Strategic Plan

The University of Regina's current strategic plan has three emphases: student success, research impact and commitment to our communities, with sustainability and indigenization as overarching themes. It is interesting to notice that the unit's self-study report did not refer at all to the University's Strategic Plan, or for that matter the Faculty of Science's Strategic Plan. This is unfortunate as a unit's support is surely influenced by its ability to meet the University's strategic priorities. The assessment below is therefore based on the observations of the Review Committee.

Student Success

Although the Department reported that the "total number of undergraduate students majoring in Physics is 43, it also reported that the "average number of physics graduands per year is 4". Given that this is a four-year program, these numbers indicate a significant attrition rate of more than 60%[3]. Graduate and undergraduate students who met with the committee were generally happy about the quality of their education, though some complained about accessibility to a wide variety of courses. The professors are approachable, well-liked and care about their students. Effort must be made, however, to provide more support to students taking service courses.

Research Impact

The research impact of the Department is focused on the area of subatomic physics, enabling it to have impact at the international stage at a level far exceeding what is expected of a department of this size. There is also potential growth and recognition through the newly created chair in medical imaging. The research funding received by peer-reviewed bodies, in particular NSERC, reflects the good standing faculty members in the Department have among their peers.

[3] According to Dr. Mobed, in year 1 (all numbers are averages), there are 20 self-declared physics majors. This number is reduced to 10 in year 2, and year 3, usually has around 5 students. Finally, 4 students complete the program. So the attrition rate from year 1 to year 2 is about 50%, from year 2 to year 3 there is another 50% reduction, little attrition occurs from year 3 to year 4. The overall rate of attrition from year 1 to year 4 is between 75% and 80%.

Commitment to Communities

The Department is connecting to national labs in Canada, the United States, and Europe; participates fully in the Faculty of Science's outreach activities, and organizes public talks. The Department has a number of faculty members who possess the eloquence to speak to the public and are encouraged to participate in the local media to explain to the public some of the mysteries of science.

Sustainability and Indigenization

The sustainability theme may appear not to fit directly with the mandate of a physics department, but some physics departments have made an effort in this area and have created "Physics of Sustainability" programs. The creation of an entire new stream is perhaps somewhat ambitious here, but some elements of these interdisciplinary streams could be used as inspiration. The committee notes that the unit already offers a course on Physics of Energy and the Environment. There is also room for physics to explain and understand some of the aboriginal practices and instruments using basic principles. Exploring the themes of sustainability and indigenization will stimulate student interest, connect the Department to local indigenous communities, attract aboriginal students to physics, and may even lead to interesting research topics.

Assessment: The department is implicitly fulfilling many of the aspirations of the U of R Strategic Plan, but there appears to be little explicit action undertaken to meet the objectives of the Strategic Plan.

Recommendation: Given that decisions and budget allocations at the University level are guided by the Strategic Plan, the department should consider to be guided by it as well. The department should therefore develop a plan to address the goals of the University's Strategic Plan and use its principles when making request for resources.

Summary of Recommendations

(In order of appearance in the text)

1. The review of the undergraduate curriculum already started by the Department of Physics should continue.
2. The unit is strongly encouraged to consider means to diversify, and eventually increase, its undergraduate Physics major population. These may include an upgrade of the undergraduate curriculum and the consideration of alternative teaching approaches.
3. The unit should consider the development of joint majors with other departments, a possible accelerated BSc/MSc, and the inclusion of adjunct professors to diversify its academic palette.
4. The Honours program should require a written thesis.
5. A new faculty hire in theory is badly needed to support core courses in the graduate program. Ideally, a guaranteed replacement of the retiring faculty member (Lolos) is required to support the program. See section on staffing for additional possibilities.
6. Highest priority must be given to fielding a reasonable number of graduate courses, in particular core courses, in-house, on a regular basis.
7. Consider the creation of an accelerated BSc/MSc program to attract more graduate students with a focus on medical imaging, and possibly other areas of synergy, e.g. with the Faculty of Engineering.
8. Explore aggressively scholarship opportunities outside the traditional sources suitable for subatomic physics. Ensure at the departmental level that faculty members exhaust all internal possibilities for support.
9. For a program with low enrolment, a written comprehensive examination is likely not an effective use of resources. Its usefulness should be revisited.
10. Bring adjunct faculty into the program for the diversity of the program, to increase the graduate enrolment and the graduate course offerings.
11. Address issues that make the program less attractive to students, paying close attention to aspects such as international differential fees.
12. The department is to be commended for its excellent research dossier in the field of experimental subatomic physics. The unit is encouraged to build on its expertise and successes to explore avenues to broaden its research focus.
13. The department should elaborate a recruitment strategy that involves reaching out to schools and youth in general.
14. In view of the unit's commitment to deliver a complete graduate experience and of the importance of theoretical physics in the graduate curriculum, the institution is encouraged to revisit the current situation where a theoretical physicist in the department carries a considerable administrative load.

15. The institution should make every effort to replace the retiring faculty member. Based on material at hand (report and visit) and on the requirements related to offering complete graduate and undergraduate curricula, the Committee would favour a hire in theoretical physics. Also, in view of its research accomplishments and of its teaching record, the unit and institution are strongly encouraged to consider using excellence-based funding (e.g. the Canada Research Chairs program, named Chairs, possible joint positions) to recruit and augment its faculty roster beyond this single replacement.
16. The department should seek additional sources of funding to supplement its core budget.
17. Given that decisions and budget allocations at the University level are guided by the Strategic Plan, the department should consider to be guided by it as well. The department should therefore develop a plan to address the goals of the University's Strategic Plan and use its principles when making request for resources.

Appendix A: Agenda of the Review Committee's Site visit

University of Regina

PHYSICS ACADEMIC UNIT REVIEW 2016

Schedule for Physics Department External Unit Review Site Visit: Monday 21 March, 2016

Monday 21 March	Who	Participants	Where
7:30 a.m.	*Opening Breakfast*	*T Chase, C Gale, G Gwinner (D Malloy)*	*Holiday Inn, Albert Street*
9:00	Dr Daniel Gagnon [Dean of Science]	**Review Team**	**LB 237**
9:20	Dr Nader Mobed [Department Head (Department of Physics)]	**Review Team**	**LB 237**
9:40	Lamont Stradeski [Director, Executive Reporting Services]	**Review Team**	**LB 237**
10:00	*Break*		
10:30	Physics Dept. Unit Review Steering Committee	**Unit Review Team, Physics Dept. Unit Review Steering Committee**	**LB 237**
11:00	Physics Undergrad and Grad Coordinators	**Unit Review Team, Physics Undergrad and Grad Coordinators**	**LB 237**
11:30	Teleconference with Dr Neil Alexander [Director of Fedoruk Centre (Saskatoon)]	**Unit Review Team and Dr Alexander**	**LB 237**
12:00 - 1:30 p.m.	*Lunch*	*Unit Review Team only*	*University Club*
1:30	Dr Armin Eberlein [Dean of Faculty of Graduate Studies and Research]	**Unit Review Team**	**LB 237**
2:00	Videoconference with Dr Kruecken [Deputy Director, TRIUMF (Vancouver)]	**Unit Review Team, Dr Kruecken**	**LB 237**
2:30	*Break*		
3:00	Jefferson Laboratory Research at U of R (tour and discussion)	**Unit Review Team, Physics Researchers**	**Physics Research Labs**
3:30	Tour of Physics Teaching Labs	**Unit Review Team, Physics Lab Instructors and Faculty**	**Physics Teaching Labs**
4:00	Physics Undergraduate Students	**Unit Review Team, Physics Undergraduate Reps**	**LB 237**
4:30	Physics Graduate Students	**Unit Review Team, Physics Faculty and Staff, Research Scientist, PDFs.**	**LB 237**
5:00 – 6:00 pm	*Meet and Greet Social*		*University Club*

Schedule for Physics Department External Unit Review Site Visit: Tuesday 22 March, 2016

Tuesday 22 March	**Who**	**Participants**	**Where**
8:00	Dr Thomas Chase [Provost and Vice-President (Academic)]	**Review Team**	**LB 237**
8:30	Dr Dave Malloy [Vice-President (Research)]	**Review Team**	**LB 237**
9:00	Teleconference with Dr Montgomery [Director, Jefferson Lab Virginia]	**Unit Review Team, Dr Montgomery**	**LB 237**
9:30	T2K Research at U of R (tour and discussion)	**Unit Review Team, Physics Researchers**	**Physics Research Labs**
10:00	***Break***		
10:15	Individual Physics Faculty and Staff upon request	**Unit Review Team, Individual Physics Faculty and Staff upon request**	**LB 237**
10:30			
10:45			
11:00			
11:15	Teaching Focused Faculty and Lab Instructors	**Unit Review Team, Teaching Focused Faculty and Lab Instructors**	**LB 237**
12:00 - 1:30 p.m.	***Lunch - Unit Review Team only***	**Unit Review Team**	***University Club***
1:30	HOLD- CLS has not responded		
2:30	Raymond Deschamps [Consultant, Research and Development] and Sally Gray [Director, Research Office]	**Review Team**	**LB 237**
3:00	**Wrap up**	**Review Team**	**LB 237**
3:30 - 4:00	**Post-Review Meeting**	**AVP Academic, Dean of Faculty, & Review team**	**LB 237**