

January 30, 2017

Dr. Allen Herman
Chair
Council Committee on Academic Mission

Re: Academic Unit Review

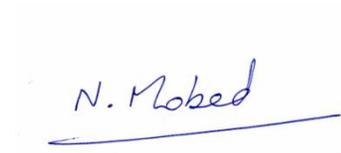
Dear Dr. Herman:

I am writing in response to your letter of October 24, 2016 in connection with the Physics Department Academic Unit Review (AUR) Report. Attached please find the response of the Physics Department to the AUR Report.

This submission consists of two parts.

- I. Itemized comments on the topics listed in your letter of October 24, 2016
- II. Itemized response to the recommendations of the AUR Report

Sincerely,

A handwritten signature in blue ink that reads "N. Mobed". The signature is written in a cursive style and is underlined with a single horizontal stroke.

Nader Mobed
Professor and Head
Department of Physics

PART I

Itemized Comments on Topics Listed in the Academic Unit Review Manual (OPS-130-005)

- **The priorities and aspirations of each unit and the extent to which they are being realized**

The Department of Physics has a long-standing record of excellence in research and a strong record of teaching. Over the years, the Department has made outstanding contributions to public services and outreach. The Department's strategic goal is to maintain strong performance in all areas of academic endeavour by careful planning for future and by addressing the existing shortcomings. To achieve this goal, the Department has taken steps to utilize its existing strengths in experimental subatomic physics to incorporate applied physics into its research and teaching goals.

An immediate priority of the Department is to take steps to increase the number of physics majors by implementing the complementary strategies of updating the physics curriculum and incorporating applied physics as a focus of departmental activities. These strategies have been discussed at length in the Unit Self-Study, AUR Report, and the Department Response to the AUR Report. In order to ensure continued success in subatomic physics research, it is imperative that we hire a new research-active theorist to maintain the quality of our graduate program. This area of immediate need is elaborated upon in the Self-Study and further discussed in the AUR Report and subsequent parts of this document.

The Department is very pleased to acknowledge the recent support it has received from the University as follows.

- The appointment of Fedoruk Chair in Nuclear Imaging Technologies in 2015 has enabled the Department to make strides in creating a focus in applied physics with tremendous potential for interdisciplinary research and teaching.
- The permission to initiate a search to hire a tenure-track faculty member in experimental subatomic physics will allow the Department to continue its tradition of research excellence and success in this area.

- **The challenges and opportunities faced by the unit**

The low Physics major enrollment compared to other Science programs has been a long-standing challenge. The Canadian Association of Physicists (CAP) 2014 Summary of Physics Departments shows that our graduation rate, normalized to the size of the faculty complement,

is roughly half of the national average. Our goal is to close the gap with the national average in 4 years. Strategies to accomplish this goal were elaborated in the Unit Self Study and also in the Department Response to the AUR Recommendations.

Another challenge is our inability to offer a reasonable number of core graduate courses in-house and on a regular basis. This has an adverse long-term effect on our graduate program which in turn impacts the Department's long-standing record of excellence in subatomic research. The challenge, in large part, is related to an acute shortage of theoretical physicists in the Department. The AUR Report has identified this issue as a priority item.

In research, the Department is in an excellent position to capitalise on its record and take advantage of present and future research projects in fundamental and applied physics. Our faculty play leading roles in national and international subatomic research facilities including Jefferson Laboratory (USA), Mainz Microtron (Germany), T2K (Japan), SLC (Saskatoon), and TRIUMF (Vancouver). Further, the Department is broadening its research and teaching goals to include applied physics, with emphasis in nuclear and medical imaging, as a focus area. An aspect of expansion into applied is to increase the enrollment of our undergraduate and graduate Physics majors. Taking advantage of these opportunities is contingent upon Department's ability to adequately resource the existing areas of excellence in subatomic physics while also providing support to the expanding endeavours in applied physics.

- **The structure and quality of undergraduate and graduate programs and instruction**

The Department offers B.Sc., B.Sc. Honours, B.Sc. in Applied Physics, and a minor in Physics. All the undergraduate programs have a Co-op option. Our programs are standard in structure, and are of high quality in content and delivery as recognized in the AUR Report. We are in the process of reviewing and updating our programs as recommended by the AUR with the view of enhancing accessibility and improving retention. Other important goals of these updates include diversification of the course topics and addition of flexibility to the program thus enabling students to explore their interests in fundamental and applied physics. The Department is also actively exploring alternative teaching approaches. These considerations may lead to a major overhaul of the program delivery in years to come. A more detailed discussion of this topic is presented in the Unit Response to the AUR Report.

The Department offers M.Sc. and Ph.D. in experimental subatomic physics and related areas such as nuclear imaging. The program structures are standard, as they contain core physics graduate courses, formal and reading courses in the area of specialization, and a successful completion of thesis on an original research topic supervised by faculty. While the scope of graduate courses is of high quality, the Department's ability to offer core classes in-house and in a timely fashion has been hampered by a shortage of theorists as discussed previously. We have taken advantage of distance delivery technologies to enable our students to take courses from U of S and UBC on occasional basis. However, the AUR Report urges the Department to give high

priority to in-house course delivery. The research component of our graduate programs is of highest quality in terms of research projects and their supervision. There are currently 13 graduate students in the Department. This number is 1.5 times higher than the national average according to the 2014 CAP Summary, normalized to the number of research-focused faculty members in the Department.

- **The contribution of each program to related disciplines and fields of study**

Offering physics classes in support of other programs is an important component of our undergraduate teaching. Currently, most programs in the Faculty of Science and all programs in the Faculty of Engineering and Applied Science require 6 credit hours of introductory physics. A number of degrees in the Faculty of Education, Faculty of Kinesiology and Health Studies, and Faculty of Arts require physics courses in their programs. Further, students from other Faculties may choose Physics as a Science elective in their programs. The enrollment in physics service courses has increased from 895 to 1202 between the years 2006-2015. This is largely due to increase in the Engineering enrollments and to a lesser extent due to enrollment increase in Science and other Faculties.

The service courses are taught by faculty members and an experienced sessional instructor. The Department strives to maintain a high quality of delivery of service courses. This is reflected in the consistently strong course/instructor evaluation of our courses by students.

- **The scope and significance of research being pursued**

The Department's main focus of research is subatomic physics. Physics faculty members are leading high-profile research projects in a number of premier research laboratories in Canada, Germany, USA, and Japan. The scientific goal of research in subatomic physics is to understand the structure of matter and symmetries of nature at a fundamental level. The T2K collaboration in Japan which includes a 7 member team from U of R (faculty, research scientists, postdoctoral fellows, and graduate students) was the recipient of the 2016 Breakthrough Prize in Fundamental Physics. The GlueX project at Jefferson Laboratory, with significant involvement (7 members) and leadership from U of R, has been classified by the United States Department of Energy as a discovery potential experiment, indicating that it has Nobel Prize winning potential. The form-factor program at Jefferson Lab (7 members) and at the Mainz Microtron has yielded a wealth of publications that were driven by U of R. The Departmental research in experimental subatomic physics has been very well-funded by NSERC and other external funding agencies. The Department has a strong publication record with enviable citation index. The funding details and the research impact are presented at length in the Unit Self-Study.

The Department has made strides to add applied physics with a focus on nuclear and medical imaging as an active area of research and teaching. This new area of applied research at U of R is led by the Fedoruk Chair in Nuclear Imaging Technologies at the Physics Department. The research area is well funded and has tremendous potential for interdisciplinary and

multidisciplinary research including Health and Radiation Physics, Threat Detection, and Food and Agriculture Security.

- **The degree to which academic programs meet students' learning needs and goals**

Our undergraduate curriculum, particularly when coupled to summer or Co-Op research projects affords skills to our students that allow them to successfully compete in local or national awards. A significant number of our students have received NESERC Undergraduate Summer Research Awards. Over the years, two of our best students have received the President's Medal and Governor General's Gold Medal. Most of our honours students pursue graduate studies in Canada and USA and perform well in their studies and subsequent research careers. In particular, our department has graduated more than a dozen B.Sc. Honours students that have continued towards Medical Physics and now occupy staff positions at hospitals in Regina, Saskatoon, Edmonton and Winnipeg, among others. Our former students are generally employed in a wide variety public and private sector positions making contributions to all aspects of society based on their educational background. A sample list of occupations of our former students along with their testimonials was presented in the Unit Self-Study.

That said, we are cognizant that our low Physics major enrollment has to be addressed with a revitalization of the curriculum without compromising the rigour and quality of the program. In addition, maintaining the quality of our graduate program necessitates hiring a new theorist at earliest possible opportunity.

- **The characteristics of staffing complements**

The academic-staff complement of the Physics Department consists of 7 faculty members (5 experimentalists and 2 theorists) and 2 laboratory instructors (1 tenured and 1 term appointment). In addition, the Department makes use of sessional instructors to teach some sections of first year service courses. The Physics Department Office is supported by one Administrative Assistant who has shared responsibilities with Dean's Office.

Four of the five experimentalists in the Department lead successful research programs in fundamental and applied physics. Of the remaining three faculty members, two are teaching focused (currently holding the rank of Lecturer), and one carries a heavy administrative load. The two teaching-focused faculty members make significant contributions to all aspects of the undergraduate program delivery. Thus, there is an acute shortage of research- active theorists in the Department. This shortage has a number of adverse consequences for teaching and research goals of the Department, the most important of which is our inability to offer in-house graduate courses as was noted in the AUR Recommendations. Hiring a new research-active theorist is among the highest staffing priorities of the Department. Future staffing decisions must carefully consider a balance between existing areas of research strength and the growth the area of applied physics.

- **The degree to which the unit is meeting its internal and external service responsibilities**

In terms of teaching, the Department fulfills its services responsibilities to other academic units very well as detailed above under the heading “the contribution of each program to related disciplines and fields of study”.

The Department has a well-deserved reputation for playing a leading role in public outreach activities in multiple arenas and at various levels as documented in the Unit Self-Study. To give a flavour of these contributions, here is a partial list of events and activities: Regional and National Science Fairs, Science Rendez-vous, Science Pub Series (at Bushwaker Pub), liaising with Public and Private School Divisions, liaising with Sciematics (Saskatchewan Science and Mathematics Teachers).

Our faculty members play leading roles in high profile national and international professional organizations such as the Canadian Association of Physicists (CAP), Canadian Institute of Nuclear Physics (CINP), Southern Universities Research Association (SURA), Saskatchewan Centre for Cyclotron Science Research Advisory Committee, Plant Phenotyping and Imaging Research Centre.

To conclude this section, here is a quote from the AUR Report: “Given the size of the department, its contribution to service internally and externally is remarkable.”

- **The role the unit plays in meeting the University's vision, mission, goals and priorities**

The Department makes notable contributions to the University’s strategic goals. We are cognizant that our contributions to some aspects of the strategic plan fall short and need improvements. Here are comments on specific aspects of the Universities strategic goals.

- **Student Success:** Our physics majors receive quality education and in general are successful in achieving their goals and career aspirations. That said, we are cognizant of low-enrollment and high attrition rate among the physics majors. Initial steps have been taken to remedy this long-standing challenge and an in-depth review of the undergraduate curriculum is underway as detailed above and in the Unit Response to the AUR Report below. Incorporating applied physics in our teaching and research goals is a complementary strategy to address the enrollment issues. Our service teaching is of high-quality, and is appreciated by students. The success rate in Physics 109 and 119 typically exceeds 85%.
- **Research Impact:** The Department has a high research impact in experimental subatomic physics. This is evidenced by leading roles assumed by our faculty members in high-profile research projects at national and international laboratories. A new emerging area of high-impact research in the Department is nuclear and medical imaging. The sizeable and sustained external funding from NSERC and other funding agencies is a further evidence of impact of the research conducted by our faculty members. Here is a quote from the AUR Report. “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.”

- **Commitment to Communities:** The Department continues to make significant and sustained contributions to professional communities and public at large. Commitment to professional communities includes playing leadership roles in national and international scientific laboratories and the governance of professional bodies. The Department fully participates and frequently organizes outreach and promotional activities for the Department, Faculty, and University. Examples of commitment to communities by the Department was presented above under the heading “The degree to which the unit is meeting its internal and external service responsibilities .“
- **Sustainability and Indigenization:** The Department is seeking ways to contribute to these two aspects of the University’s strategic plan. A first steps in this direction includes incorporation of examples indigenous practices in the course PHYS 103 which was recently created as a transition class. In addition, we plan to offer the course PHYS 140 (Physics of energy and environment) on a regular basis in support of other academic programs.
- **The financial resources of the unit**

The Physics Department operating budget is based on a yearly request submitted by the Department to the Faculty of Science. On average, 80% of the budget is spent on teaching assistant salaries (LAB TAs and markers), 10% on non-capital expenditures (departmental membership dues, seminar speakers, office supplies), and 10% on capital expenditures (maintenance, replacement, and purchase of new equipment for undergraduates). The TA budget of the Department is further augmented by up to 3 Graduate Teaching Assistantships provided by FGRS. Over the years, special request submitted by the Department to Faculty of Science for major lab upgrades and equipment purchase have been favourably considered subject to the availability of funds. In sum, the Department is able to operate effectively within its budget allotment.

The program delivery requires employing sessional lecturers for some sections of first-year service courses. The budget for sessional stipends comes from two different sources: Faculty of Science, and Centre for Continuing Education (CCE). To date, all reasonable requests for the sessional lecturer support have been accommodated.

PART II

Unit Response to the Recommendations of Academic Unit Review (AUR) Report

Undergraduate Teaching and Learning

Recommendation 1: The review of the undergraduate curriculum already started by the Department of Physics should continue.

Unit Response: We agree. Steps in this direction have been taken with the aim of making the preprogram more accessible and diverse while also increasing the efficiency of course offerings. Specific actions taken to date for 2xx, 3xx, and 4xx courses include the following.

- Based on student feedback and the departmental review of syllabi, the prerequisites and the course numbering for high attrition classes have been modified to enhance student retention and success. (Approved by the Science A&S Committee, January 2017.)
- A list of approved 3xx and 4xx physics electives have been created to enable the students to experience a broader range of topics in pure and applied Physics. (Approved by Science A&S Committee, January 2017.) These changes are resource neutral.

Recommendation 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.

Unit Response: We agree. The Department offers B.Sc., B.Sc. Honours, and B.Sc. in Applied Physics. The majority of physics majors are enrolled in B.Sc. and B.Sc. Honours. A strategy for increasing the enrollment of undergraduate physics majors is to create a focus for the applied physics to recruit more students into that area. We have made progress in strengthening the applied physics program by hiring a faculty member in Nuclear and Medical Imaging. The following items pertain to this development.

- The Bachelor of Medical Imaging (BMI) is a joint program between SaskPoly and U of R administered by the Faculty of Science. Effective Fall 2017, the program will be housed in the Department of Physics, with the goal of active efforts for student recruitment into this area. (Approved by Executive Council, October 2016). To this end, admission requirements to BMI have been broadened so that qualified diploma holders from institutions other than SaskPoly may also be considered for admission into the program. (Approved by Science A&S Committee, January 2017.)
- We are in the process of scheduling a meeting between the Physics Department and SaskPoly to discuss a gradual and substantive overhaul of the BMI program with the goal of making it more attractive for SaskPoly graduates as well as other qualified diploma holders as discussed above.

- As a part of gradual build up of the applied physics program, two new courses have been created PHYS 219 (Introductory Radiation Science and Biophysics, Approved by Science Council 2016), PHYS 377 (Introductory Electronics, pending the approval of Science A&S Committee). These classes will also enrich the regular physics program.

Given the current high attrition rate in the first two years of the program, another proposed strategy for student recruitment and retention involves a substantive overhaul of the first two years of the program with the goal of making the program more accessible to a broader group of students with varying levels of academic proficiency and aptitude. The rationale for this strategy is that currently many students find the program too challenging. Thus, to improve our recruitment and retention efforts, we need to offer more conceptually oriented, less technical classes. These ideas are being currently explored cautiously by the Department. This is because a paradigm shift of this nature would require a reallocation of existing resources within the Department, or allocation of new teaching resources to the Department by the University.

Alternative teaching approaches are under active consideration. In their sabbatical applications, two physics academic staff members (one lecturer and one lab instructor) list the exploration of new teaching techniques as a high priority item for their sabbatical. These colleagues will be on sabbatical during the academic year 2017-2018.

Recommendation 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.

Unit Response: We agree in principle. Here is the current status of developments on these topics.

- With the gradual development of the applied physics program and a focus on nuclear and medical imaging, collaborative teaching (undergraduate and graduate) and research with other departments and units are being considered and discussed. In the Faculty of Science, Departments of Biology and Computer Science have been consulted. Discussions with the Faculty of Engineering and Applied Science have been ongoing for some time. A note of caution is in order here. Our experience indicates that unless the joint major programs are carefully thought through, they will not succeed. During the Academic Program Review (APR) process in 2012, ten B.Sc. combined/joint majors were closed because of their low enrollments. B.Sc. in Industrial/Applied Physics with emphasis on Computational and Physical Modelling was one such program.
- The feasibility of creating a course-based MSc in Applied Physics perhaps in collaboration with the Faculty of Engineering has been discussed. We have further considered creating a Post Degree certificate or diploma in Health and Radiation Physics. Such efforts would require allocation of new resources to the Department or reallocation of some of the existing resources within the Department. As the Department maintains a strong focus on fundamental subatomic physics, a reallocation of resources is not a practical option at this time.

- At the time the AUR report was produced, the Department had 3 adjunct professors of whom 2 were contributing to undergraduate teaching as well as graduate supervision whereas the third one was significantly involved in graduate student supervision by serving on PhD advisory committees. In December 2016, the list of our adjunct professors grew to 5. The new adjunct professors from Jefferson Laboratory and the College of William and Mary serve on PhD advisory committees of our students. With the further development and overhaul of the BMI program, the department plans to initiate the appointment of physicists and other professionals from the Allan Blair Cancer Clinic at the Pasqua Hospital as adjunct professors. The new adjuncts would contribute to teaching of specialized courses in the applied physics and BMI program, and would contribute to the graduate student supervision in these areas.

Recommendation 4: The Honours program should require a written thesis.

Unit Response: We agree. This has already been done along with the package of program updates discussed under the Unit Response to Recommendation 1 above. The written Honours thesis requirement was implemented by reviewing those of other Canadian universities as well as the Honours thesis requirement of the Department of Chemistry and Biochemistry. In terms of programming this was done by creating two new courses PHYS 498 (Senior Research, 0 credit) and PHYS 499 (Honours Thesis, 3 credits). The course creations were approved by Science A&S in January 2017.

Graduate Teaching and Learning

Recommendation 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.

Unit Response: We agree. In the annual budget submission process, the Physics Department has identified hiring a research-focused theorist among the highest of its staffing priorities. The Physics Department was fortunate to receive permission to fill the position vacated by the retirement of Dr. George Lolos (experimentalist). However, the sustainability of our highly successful research programs in experimental subatomic physics, in particular the Jefferson Lab programs, necessitated filling this position by an experimental subatomic physicist. Hiring a new subatomic theorist continues to remain among the highest staffing priorities of the Department. The Department has made further efforts to deal with this issue. In a recent submission to the Faculty of Science and the University, the Department had proposed that a vacant CRC Tier-II position be filled by a subatomic theorist/phenomenologist.

Recommendation 6: Highest priority must be given to fielding a reasonable number of graduate courses, in particular core courses, in-house, on a regular basis.

Unit Response: We agree. In the past few years, our students have taken several core graduate courses from U of S and UBC via distance delivery methods. Our graduate students have raised concerns about

this method of course delivery especially as it relates to core courses. Our inability to offer core graduate courses in-house and on a regular basis is related to academic staff shortages in particular research-active theorists. Hiring a new theorist will go a long way in implementing this recommendation. Here is the current status of affairs.

- In the short run, the more flexible offering of senior undergraduate courses as outlined in response to Recommendation 1 above, will free-up some resources to teach core graduate courses.
- The Department intends to review its graduate curriculum and create a suitable list of 400/800 cross-listed courses to further enhance the efficiency of course offerings. This is what is done by a number of other Science Departments at U of R and U of S. That said, there are core courses that can not be cross-listed without compromising the quality of graduate experience. The only long-term solution to this challenge is addition of a new theorist to staff complement.

Recommendation 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.

Unit Response: We agree in principle. Aspects of the unit response to this recommendation were included in response to Recommendation 3 above. Those will be reproduced below for completeness sake.

- With the gradual development of the applied physics program and a focus on nuclear and medical imaging, collaborative teaching (undergraduate and graduate) and research with other departments and units are being considered and discussed. In the Faculty of Science, Departments of Biology and Computer Science have been consulted to-date. Discussions with the Faculty of Engineering and Applied Science have been ongoing for some time. A note of caution is in order here. Our experience indicates that unless the joint major programs are carefully thought through, they will not succeed. During the Academic Program Review (APR) process in 2012, ten B.Sc. combined/joint majors were closed because of their low enrollments. B.Sc. in Industrial/Applied Physics with emphasis on Computational and Physical Modelling was one such program.
- The feasibility of creating a course-based MSc in Applied Physics perhaps in collaboration with the Faculty of Engineering has been discussed. We have further considered creating a Post Degree certificate or diploma in Health and Radiation Physics. Such efforts would require allocation of new resources to Department or reallocation of some of the existing resources within the Department. As the Department maintains a strong focus on fundamental subatomic physics, a reallocation of resources is not a practical option at this time.

Recommendation 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.

Unit Response: We agree. Following the AUR site-visit, the Department Head met with the Dean of Faculty of Graduate Studies and Research in May 2016 to ensure that the Department is aware of full range of opportunities for graduate scholarships. The conclusion was that our students apply and receive their fair share of standard scholarships and fellowships. In that meeting, the Head was also made aware of a number of international collaborative research scholarships granted by participating countries on research topics of mutual interest. The main issue there was that the research interests of the Department were different from those of participating institutions/countries. Here is the current status of our efforts in this direction.

- With the broadening research focus of the Department to include applied physics and nuclear imaging, we will more closely monitor opportunities for internal and external scholarships.
- In Fall 2016, a group from our department met with a Mitacs representative to explore the possibilities for graduate student funding. The Mitacs programs “Accelerate” and “Globalink” were identified as areas for further exploration.
- Our applied research program in nuclear and medical imaging has attracted funding for graduate student support from the Fedoruk Centre for Nuclear Innovation.

Recommendation 9: For a program with low enrolment, a written comprehensive examination is likely not an effective use of resources. Its usefulness should be revisited.

Unit Response: We agree in principle. Some preliminary discussion on this topic has taken place within the Department. The following steps are being contemplated.

- We will undertake a review of the requirements and format of Physics PhD comprehensive/qualifying examinations in Canadian universities.
- We will attempt to align our requirements with those of other Physics Departments.

Recommendation 10: Bring adjunct faculty into the program for the diversity of the program, to increase the graduate enrolment and the graduate course offerings.

Unit Response: We agree. Aspects of this recommendation were addressed in the unit response to Recommendation 3 above. Those are reproduced below for completeness.

- At the time the AUR report was produced, the Department had 3 adjunct professors of whom 2 were contributing to undergraduate teaching as well as graduate supervision whereas the third one was significantly involved in graduate student supervision by serving on PhD advisory committees. In December 2016, the list our adjunct professors grew to 5. The new adjunct professors from Jefferson Laboratory and College of William and Mary serve on PhD advisory committees of our students. With the further development and overhaul of the BMI program,

the department plans to initiate the appointment of physicists and other professionals from Allan Blair Cancer Clinic at the Pasqua Hospital as adjunct professors. The new adjuncts would contribute to teaching of specialized courses in the applied physics and BMI program and would contribute to the graduate student supervision in these areas. A few of these potential adjunct professors are U of R Physics alumni and have had a longstanding relationship with the Department.

Recommendation 11: Address issues that make the program less attractive to students, paying close attention to aspects such as international differential fees.

Unit Response: We agree. The following is a summary of steps taken to-date to address issues raised by our graduate students.

- The requirement of a written PhD comprehensive examination will be revisited as discussed in connection with Recommendation 9 above.
- Serious efforts and planning will be made to offer core graduate courses on a regular basis in-house as discussed in connection with Recommendation 6 above.
- The issue of differential fees for international students has been discussed at various fora by students and faculty. We will continue to discuss the topic to ameliorate the situation.
- The graduate coordinator will meet with students as a group twice per year to specifically address the student concerns and provide feedback to the Department.

Research

Recommendation 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.

Unit Response: We concur. The Department has a longstanding history of research excellence in experimental subatomic physics. Building upon the existing strengths, in the past few years, the Department has taken steps to diversify its research and teaching goals to include applied physics with a focus on nuclear and medical imaging. Here is the chronology of developments and the current status of our efforts.

- The first physics faculty member in applied physics was appointed as a Fedoruk Chair in Nuclear Imaging Technologies in 2015.
- Start-up funds from the Fedoruk Centre have been used by the above Chair to support students and postdoctoral researchers, as well as to build a plant imager, the first of its kind in Canada.
- Multidisciplinary research in plant imaging, food security, and threat detection is being actively pursued with involvement from departments of Biology and Computer Science as well as Faculty of Engineering at U of R. Some funding from Global Institute for Food Security (GIFS) at U of S has been obtained to hire postdoctoral personnel in support of this area of research .

- Within the next two years, the Department will develop a comprehensive plan for the diversification of its research goals. The aim of this plan is to ensure that the existing areas of research excellence in subatomic physics and the growth in applied physics research are adequately resourced.

Service

Recommendation 13: The department should elaborate a recruitment strategy that involves reaching out to schools and youth in general.

Unit Response: We concur. The Department of Physics plays a leadership role in a number of outreach activities at the Department, Faculty, and University levels. The organization of the annual Regina Regional Science Fair for the past three decades, and the Canada-Wide Science Fair in 1997 and 2017 (in planning) are examples of such leadership.

- As of 2014, the Department has formed a standing committee on outreach, recruitment, and retention. The activities of the committee include visiting Regina area schools and hosting events for pupils, teachers, and counselors at the Physics Department teaching and research laboratories. In 2014-2016, ten such activities took place.
- In general, the activities were successful in terms of organization, participation, and follow-up contacts. It is very likely that these events will generate interest in Science.
- The Department is collaborating with undergraduate students to build up interest and possible fund raise to refurbish our Astronomy facility on the top floor of the Classroom Building, as this has tremendous outreach potential.
- The Department will continue its efforts to arrive at effective multifaceted approaches to recruitment and retention.

Staffing

Recommendation 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.

Unit Response: We concur. The demography, resource distribution, history, and internal affairs of the Department have resulted in the current arrangement. With the term of administrative appointment nearing its end, the issue will be partially resolved. That said, an acute shortage of theorists in the department remains a challenge as discussed in connection with Recommendation 5 above and Recommendation 15 below.

Recommendation 15: The institution should make every effort to replace the retiring faculty members. 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.

Unit Response: We concur. Some aspects of this recommendation were discussed in connection with the unit response to Recommendation 5 above. That piece is reproduced below for completeness sake. Additional itemized responses are provided.

- In the annual budget submission process, the Physics Department has identified hiring a research-focused theorist among the highest of its staffing priorities. The Physics Department is fortunate to have received permission to fill the position vacated by the retirement of Dr. George Lolos (experimentalist). However, the sustenance of our highly successful research programs in experimental subatomic physics, in particular the Jefferson Lab programs, necessitated filling this position by an experimental subatomic physicist. Hiring a new subatomic theorist continues to remain among the highest staffing priorities of the department.
- In the past, the Department has been successful in recruiting faculty using excellence-based funding. The appointment of Fedoruk Chair in Nuclear Imaging Technologies in 2015 is the most recent example of such an arrangement. Further in that direction, The Department will continue to pursue opportunities to submit applications for a Canada Research Chair consistent with the strategic priorities of the University.
- The University of Regina is a member of TRIUMF as well as SURA. These memberships were granted because of the longstanding leadership of the U of R physicists to research in subatomic physics, and the U of R commitment to support that research. As a member institution, we are actively exploring the possibility of securing bridge-funded positions in fundamental and applied physics sponsored by TRIUMF and Jefferson Laboratory.

Financial Resources

Recommendation 16: The department should seek additional sources of funding to supplement its core budget.

Unit Response: We agree in principle. At this time we are unclear about how we might approach the implementation of this recommendation. Currently, the departmental budget allocation by the Faculty of Science is based on student enrollments, TA and laboratory equipment needs, partial support for seminar speakers, and supplies needed to run the department office. We will deliberate on this topic in our future Department meetings.

Role in meeting University's Strategic Plan

Recommendation 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.

Unit Response: We concur. The following are comments on some specific aspects of the University's Strategic Plan.

- **Student Success.** The report identifies a significant attrition rate of more than 60% among physics majors. As a way of responding to this challenge, a major overhaul of the undergraduate curriculum is underway and new teaching methods are being explored as detailed in the Unit Response to Recommendations 1-4 of the AUR report. In addition, the department is exploring the possibility of enhancing the role of Physics Undergraduate Society in mentorship of junior physics students.
- **Research Impact.** The high profile of the Departmental research in national and international arenas in experimental subatomic physics is acknowledged in the AUR report. The potential impact of the newly created research area in medical imaging is also recognized. We certainly concur with these assessments.
- **Commitment to Communities.** The Department's significant and notable contributions to the professional community, the university community, and public at large are recognized in the AUR Report. A number of enthusiastic and eloquent colleagues in the Department have redoubled their efforts and commitments in this area.
- **Sustainability and Indigenization.** The Department will take the following steps to explicitly promote sustainability and indigenization through its course offerings.
 - We have recently created a course PHYS 103 (Essential Physics: Ideas and Applications) to facilitate the transition from high school to university. This course will include physics examples of indigenous practices. If all goes as planned, the course will be offered in summer of 2017 for the first time.
 - The course PHYS 140 (Physics of Energy and the Environment) was created 5 years ago, but we have not had the resources to offer the course to date. Based on a request from the Department of Geography and Environmental Studies, we plan to offer this course on a regular basis starting Fall 2018.

The Department will continue to explore further avenues to incorporate the themes of sustainability and indigenization into its activities.