

# CARLETON UNIVERSITY COMMITTEE ON QUALITY ASSURANCE

## Cyclical Review of the Undergraduate Programs in Physics

### Final Assessment Report and Executive Summary

This Executive Summary and Final Assessment Report of the cyclical review of Carleton's undergraduate programs in physics is provided pursuant to articles 4.2.5-4.2.6 of the provincial Quality Assurance Framework and articles 5.1.9.23-24 and 5.1.9.26-27 of Carleton's Institutional Quality Assurance Process (IQAP).

### EXECUTIVE SUMMARY

Carleton University offers the following undergraduate programs in physics:

- BSc Honours Applied Physics
- BSc Honours Physics (Experimental)
- BSc Honours Physics (Theoretical)
- BSc Double Honours Mathematics and Physics
- BSc Combined Honours Biology and Physics
- BSc Combined Honours Chemistry and Physics
- BSc Physics (Major)
- Minor in Physics

These programs are administered by the University's Department of Physics, an academic unit in the Faculty of Science.

As a consequence of the review, the programs were categorised by the Carleton University Committee on Quality Assurance (CUCQA) as being of **good quality with international presence** (Carleton's IQAP 5.1.9.12). No report is being required by CUCQA.

The report of the external reviewers (the Review Committee) spoke most positively of the manner in which the programs 'fulfill, and sometimes exceed, the academic requirements and standards associated with physics programs at research-intensive universities in Canada and elsewhere in the world,' of the opportunities for research experience on the part of senior undergraduates in a department with an international presence and reputation in research, and of plans developed in conjunction with the Dean of the Faculty of Science for the replacement of retired teaching faculty. CUCQA was also impressed by continuing activities on the part of the Department to review and improve its programs.

Nonetheless, the Review Committee identified seven opportunities for improvement and enhancements to the programs. While CUCQA did not feel it appropriate to request a report

from the Department on these, it did feel that five of these should be addressed in the Action Plan:

1. Improving and refining program-level learning outcomes.
2. Meeting challenges with regard to space.
3. Reviewing the training of teaching assistants.
4. Reviewing techniques and methods to improve the effectiveness of physics student mentoring and program advising.
5. Reviewing program options in terms of their academic relevance.

The Action Plan submitted by the Department undertakes to address these issues, with a statement of who will be responsible for undertaking the necessary work, and a detailing of the timelines for undertaking and completing the work.

## **Action Plan for the Cyclical Review of the Undergraduate Physics Programs**

Submitted May 13, 2014 by Stephen Godfrey, Chair of the Department of Physics Undergraduate Program Review Committee

The Carleton University Committee on Quality Assurance (CUCQA) reported that they categorized the undergraduate programs in Physics as being of **good quality with international presence**. The Physics Department is gratified to see that an independent external review recognizes the results that have come from the hard work and thought that has gone into developing our programs.

The CUCQA did not think it necessary to request a report from the Department regarding any of the recommendations made by the external reviewers. However, the CUCQA felt that the recommendations need to be addressed in the action plan, which is the final step in all cyclical program reviews. In particular, there are two recommendations made by the external reviewers that the CUCQA commented on. The first is with respect to learning outcomes, the second with regard to space.

### **1. Learning Outcomes**

A significant part of the Cyclical Review submission consisted of learning objectives and outcomes. The external reviewers commented that “Development of such expanded outcome statements provide a road to eventually build overall degree outcome statements, beyond just the content definitions, to clearly communicate the high-quality skills provided by a degree in physics.” The external reviewers had previously commented on the character of these high-level skills: “By the very nature of the discipline, degrees in physics concentrate on problem-solving skills, on the ability to obtain results to complex problems through analytical thinking and logical reasoning, and on the ability to present and communicate these results to a wide variety of audiences.” The CUCQA writes that “it feels that considering program-level outcomes first as the basis for the development of course-level outcomes most often results in a more successful exercise overall” and “strongly encourages the Department to follow this latter path”.

It should be stressed that in the discipline of physics there are globally recognized standards that require that every physics degree program must contain specific core material. Internationally, there are expectations that graduates of a physics program will have mastered core physics material and acquired a high level of math skills. In addition, physics graduates are generally expected to have some computer programming skills. If a program diverges from this globally recognized core knowledge and set of skills our degree will not be recognized, and this will put our students at a serious disadvantage. This puts very tight constraints on the content of a physics degree which must be kept in mind when constructing the learning outcomes of different undergraduate physics programs.

Given that a significant part of the self-study submission consisted of program-level outcomes, we interpret the suggestion of the CUCQA to consider program-level outcomes as a communication problem. We propose to review the program learning outcomes and refine them if necessary to better articulate the skills that a physics graduate should have. This falls within the purview of the Physics Department Curriculum Committee. Once the Curriculum Committee reviews and refines the program-

level learning outcomes, they will be brought to the Physics Department Faculty Board for approval. We expect this to be a prolonged process as we have a large number of faculty on sabbatical next year, including all of the most experienced senior faculty, in addition to an experienced faculty member who will be on leave due to her Killam Fellowship. As a consequence it will be challenging to deal with the normal administrative responsibilities of our department even without this additional task.

## **2. Space**

The Physics Department has a number of serious space issues. The first is that during a period of cutbacks the advanced undergraduate physics laboratory space was reduced to handle 6-10 students at most. In the intervening years undergraduate physics enrollment has increased significantly and the lab is overcrowded. Providing adequate well designed laboratory space is also a safety issue. This has been recognized by the Dean of Science and the Physics Department understands that this will be addressed as part of the space reallocation resulting from the INCO wing expansion. Specifically, as space becomes available in the Herzberg building due to people relocating to the INCO wing, the lab adjacent to the advanced undergraduate physics lab, currently occupied by the Department of Earth Sciences, will be turned over to Physics for the purpose of expanding the advanced undergraduate physics lab.

A second longstanding space issue is the lack of adequate study space for our undergraduates. This issue came up in the previous cyclical review which recommended that suitable study space be found for undergraduate students in physics. This recommendation was never implemented and has been repeated in the current review. This is a longstanding issue that we expect the Dean of Science will address through the reorganization of the Science Faculty computer labs. Undergraduate student study space is a priority for the use of the vacated computer labs with physics student study space a high priority.

## **Other Recommendations**

In the response to other recommendations in the external reviewer's report the Department stated:

3. The department will review its TA training to see if it can be improved. We will also see how we can reinforce our expectations of our TAs with respect to the professionalism of a TA position and our expectations for the grading of assignments and lab reports.
4. The Physics Department undergraduate advisor and the Undergraduate Administrator will reflect on ways to improve the effectiveness of physics student mentoring and program advising.
5. The Physics Department Curriculum Committee will review the program options. The two programs specifically mentioned by the external reviewers were (1) the Biology and Physics program and (2) the Applied Physics program and its relationship to the Honours Physics (experimental stream) program. The Biology and Physics program is a joint program with the Department of Biology so this must be done in collaboration with the Department of Biology.

Recommendation	Action	Responsibility	Timelines
1. Learning Outcomes	The program-level learning outcomes given in the IQAP self-study submission will be reviewed and will be refined if necessary.	Chair and Curriculum Committee, followed by discussion and approval by the Physics Department Faculty Board	Meetings with the CUCQA to start in Fall 2014, with revisions of the learning outcomes to follow.
2. Space	<ol style="list-style-type: none"> <li>To expand the Advanced Undergraduate Physics Laboratory to accommodate increased enrollment.</li> <li>To create a suitable undergraduate physics study space as recommended by the external reviewers and also in the previous cyclical review.</li> </ol>	Chair and Dean of Science	<ol style="list-style-type: none"> <li>July 2015 as it will take time to relocate existing users and then renovate the new space.</li> <li>2015</li> </ol>
3. Review TA Training	Review TA Training	Chair and Scientific Officer	By June 2015
4. Reflect on student mentoring and advising	To reflect on ways to improve the effectiveness of physics student mentoring and program advising	Chair, Undergraduate Associate Chair, and Undergraduate Administrator	By June 2015
5. Review program options	Review the undergraduate physics programs	Curriculum Committee	By June 2016 (so that the senior faculty on sabbatical who know the history behind the undergraduate physics programs can contribute to the discussion)