

# Final Assessment Report

## Physics

### Graduate and Undergraduate Programs (reviewed 2013-16)

#### A. Summary

1. The Department's Self Study was considered and approved by the Academic Review Committee of Senate on January 6, 2016.
2. The Review Committee consisted of two external reviewers: Jeff Hutter (University of Western Ontario), Frank Marsiglio (University of Alberta) and an internal reviewer, Stefan Brudzynski (Brock University).
3. The site visit occurred on March 30-April 1, 2016.
4. The final Reviewers' Report was received on May 3, 2016.
5. The Dean of Graduate Studies response from Mike Pyley was received on May 23, 2016.
6. The Senate Graduate Studies Committee response was received on May 25, 2016
7. The Senate Undergraduate Program Committee response was received on May 27, 2016.
8. The Department's response was received on June 16, 2016.
9. The Dean of Mathematics and Science response from Al Castle was received on Sep 7, 2016.

The academic programs offered by the Department of Physics which were examined as part of the review were:

BSc in Physics

BSc in Physics with concentration in Applied Optics and Laser Technology

BSc in Biophysics

BSc in Computing and Solid-State Device Technology

BSc/BEd (I/S)

MSc in Physics

PhD in Physics

This review was conducted under the terms and conditions of the IQAP approved by Senate on June 6, 2011.

The reviewers assigned the programs an outcome category as follows:

**Good Quality:**

- BSc in Physics
- BSc in Biophysics
- BSc in Computing and Solid-State Device Technology
- BSc/BEd (I/S)
- MSc in Physics
- PhD in Physics

**Non-Viable:**

- BSc in Physics with concentration in Applied Optics and Laser Technology

## B. Strengths of the Program

The reviewers identified the following strengths:

Essentially all faculty members are research active, with several members able to both retain their NSERC Discovery grants and even procure NSERC equipment grants. The wise decision by the Department many years ago to focus on condensed matter physics has resulted in a greater-than-critical mass of researchers (including students) in this area. A recurring theme in our visit was the collegiality in the Department.

Most faculty members supervise graduate students and regularly supervise undergraduates in the program. The supervision of undergraduates often results in publications published (and sometimes led by) undergraduate students. This “teaching” component of the Department has been very effective, and is truly one of its strengths.

Undergraduate students benefit from very high standards in their courses and professors clearly dedicated to teaching and monitoring of their students. The advanced lab courses (3<sup>rd</sup> year and beyond) are highly regarded by the undergraduates. The first-year astronomy course has been very successful.

The MSc program is strong with graduates finding positions elsewhere or having the option of continuing in the PhD program. While it is still early, the PhD program, initiated in 2010, has been off to a great start. Three students have graduated from the program and the Department boasts two Vanier Canada Graduate Scholarship winners. The reviewers noted that enrolment numbers are impressive for a university with Brock’s graduate student population.

## C. Opportunities for Improvement and Enhancement

### Recommendation 1

We recommend that an additional faculty member, specifically in the area of biophysics, be hired into Physics in advance of the next retirement, if possible.

In its response, the Department stated:

We find ourselves in a complete agreement with this recommendation. An additional faculty was to be considered by the University at the earliest possible opportunity, as stated in the University response to the review of our application for a Ph.D. in Physics in 2010. As the University emerges from its declared budgetary position of "structural deficit", we continue to hope that this promise will be realized.

The Faculty Dean stated:

Given the current budgetary constraints faced by the University, it is not possible to guarantee new hiring in advance of retirements. Nevertheless, the department's response is appropriate and strong arguments can and will be made to replace all positions as soon as possible.

### ARC Disposition of the Recommendation

ARC considers the recommendation to be worthy of consideration but outside of the jurisdiction of the Committee. It is expected that the program will proceed through normal channels of advocacy for these faculty resources.

### Implementation Plan

Recommendation not accepted.

## Recommendation 2

We recommend a careful evaluation and overhaul of the first-year Physics offerings, particularly in Physics 1P21/1P91.

In its response, the Department stated:

The Introductory Physics courses are our largest-enrolment courses (outside of our Astronomy science context courses) and consume the bulk of our teaching resources. A majority of students taking those courses could be classified as “reluctant learners”, taking the Physics courses only because their programs require it. They often take Physics in later years, sometimes just prior to graduation (Y4). The three-course combination is somewhat unusual compared to other Universities, but it allows us to cater to a wide range of students who take only one or at most two of the three half-courses: natural science majors are recommended to take 1P21/91 + 1P22/92; biological and applied health majors 1P21/91 + 1P23/93. Only the Physics majors are required to take all three. Given the current faculty complement in the Department (see Recommendation 1) it is not practical to introduce additional courses geared toward specific majors, at least at the moment.

The Department described several initiatives related to improving student success (enhanced tutorial sessions, flipped classroom, use of clickers), stating that “Together, these small incremental changes should alleviate some of the major concerns noted by the Reviewers”. The Department expressed surprise that the Reviewers found the Y1 final exams to be at a higher difficulty level than at their home institutions. The Department noted that it is “constantly reviewing and revising the course content and methods of delivery to respond to the challenges of poor math skills of the incoming students and a lack of tradition and support for the culture of learning for mastery at the University.” The Department stated that “In May 2016, the Department has formed an ad-hoc curriculum review subcommittee that will continue to monitor the effect of these measures through the Fall term, and to devise necessary adjustment for the Winter term.”

The Faculty Dean stated:

We are concerned with the low progression rates for year 1 PHYS courses. At present, the notable difference between PHYS 1P21/1P22 and PHY 1P91/1P92 consist of the lab component. The rest of the course is essentially the same. This may be inadequate. We encourage the Department to follow the example of other Math & Science departments by offering different courses that cater to different types of students. This would require a revision of the courses’ learning objective and assessment tools. We have no reason to doubt the observation made by the reviewers on the “level of difficulty” of final examinations. We welcome the Department’s willingness to look into this issue further. We encourage the Department to appreciate that the minimum 50% clause on the final examination is not common in the Faculty of Math & Science (the average is around 30% paired with high midterm weight). We believe that there are multiple ways to improve the progression rates in Year 1 PHYS without compromising the academic integrity of the courses and programs. Those rates must improve.

The Senate Undergraduate Program Committee (UPC) stated:

[The reviewers] suggest that students whose programs require first-year physics but who are not physics majors could perhaps “take their physics requirements later in their respective programs (2nd or 3rd year)”.

The suggestion that the first year physics requirement be taken later in nonmajor students’ programs is presumably based on those students attempting physics after acquiring a stronger mathematical (calculus) background (e.g. MATH 1P97/1P98 or MATH 1P05/1P06) in their first year of studies. UPC notes that the recommended course sequence patterns for majors outside Physics are determined by those individual programs, although students are free to change that order, so long as prerequisites are met. The development and implementation of first-year physics courses for nonmajors (if pursued) should be done after consultation with other units and is more likely to be implementable than requesting those units change their existing course sequence patterns.

### **ARC Disposition of the Recommendation**

ARC considers the recommendation to be accepted and in the process of implementation. The Committee encourages the Department to continue its curriculum review, utilizing the curriculum map developed for the Self Study, to review first year Physics offerings as well as address several of the Reviewers’ following recommendations.

#### **Implementation Plan (1<sup>st</sup> Priority)**

Responsible for approving:	Department
Responsible for resources:	Department
Responsible for implementation:	Department
Timeline:	Dean of Mathematics and Sciences to report by the end of academic year 2016/17

### Recommendation 3

We recommend the use of *Matlab*, and possibly *Maple*, software for numerical work and computations in Physics courses.

In its response, the Department stated:

We feel the Reviewers may have formed a false impression of the rigid confinement of our majors to a particular brand of plotting/fitting software; this is not the case. We do consider it important that elementary introduction to the ideas of computer programming take place as early as possible in the students' academic careers....

One possible explanation for the incorrect impression may be that our "introduction to physica programming" tutorial is typically given in the first lab of our Y2 Mechanics course (2P20); as we moved the course recently from Fall to Winter semester, we should have moved this introduction to earlier in the year. By the time it was given in January of 2016, the students had already developed their own ways of performing simple plots, and were reluctant to learn an alternative. In the coming years we will correct this by offering an introductory review of all computer tools in September, instead of January.

The Faculty Dean stated:

In our views, the Department of Physics believes strongly in forming students who are proficient with computational tools and methods and that, at the end of their undergraduate studies, graduates are indeed proficient in this regard. What this recommendation says, and we appreciate the point made as we hear it occasionally from students themselves, is that in Year 1, more standard tools should be used (MATHLAB [sic] is the most standard software). A reasonable implementation of this recommendation is for the Department to consider using MATHLAB [sic] in year 1 and other less widely used but appropriate tools in higher years for PHYS majors.

### ARC Disposition of the Recommendation

ARC considers the recommendation to use these particular software packages to be not accepted. The Committee believes that the Department is best positioned to determine which software to use and when it should be introduced in order to graduate students who are proficient with computational tools and methods.

### Implementation Plan

Recommendation not accepted.

#### Recommendation 4

The labs in first- and second-year Physics courses require some adjustment/attention.

In its response, the Department stated:

A lack of laboratory space, and the budgetary constraints prevent us from running all labs in sequence for all students. By necessity, several different experiments are being done in Y1 labs at all times, and some students may take them approximately in-sync with the lectures, while others may end up taking them completely out-of-sequence..... We are making a significant change this year [2016-2017]: we are almost doubling the number of lab sections, and making them smaller, so that all students are able to tackle the labs on their own....The more general issue of the appropriateness of the labs to the course material has been added to the agenda of the curriculum review subcommittee.

The Faculty Dean stated:

We are pleased to see that the Department will be looking at the integration of labs with course material this coming year. We have been concerned students working on labs for which the material was not discussed in lecture. It will be important to clarify and list explicitly all the concerns about labs and to propose changes for each and every one (be it space, scheduling, organization, guidance and supervision, quality of instruction by TA's, compliance with academic integrity policies, compliance with privacy, etc.). We look forward to departmental recommendations for changes.

#### ARC Disposition of the Recommendation

ARC considers the recommendation to be accepted and in the process of implementation. The Committee expects that the curriculum review referenced in response to Recommendation #2 will also address first- and second-year labs.

#### Implementation Plan (1<sup>st</sup> Priority)

Responsible for approving:	Department
Responsible for resources:	Department
Responsible for implementation:	Department
Timeline:	Dean of Mathematics and Sciences to report by the end of academic year 2016/17

### Recommendation 5

We recommend that the Dept. of Physics discuss coordination of the coverage of topics in required courses offered by the Dept. of Mathematics.

In its response, the Department stated:

The communications with the Mathematics Department are strong and ongoing. Unfortunately, like the Physics Department, they are operating under multiple constraints and many of their courses must serve multiple clients, including their own majors. In 2016-17 we are introducing a special topics' course (PHYS 3V94, Methods of Mathematical Physics) that will be given by a Physics faculty. We hope this will help to fill the gaps for our majors left by a recent revision of the Math course sequence, and to give our majors an opportunity to practice their math skills in the context of Physics problems. If successful, and if the manpower allows, we are planning to continue to offer this course regularly. In some sense, this is a return to the past practice of a MATH 2F95 course being taught by a Physics faculty.

The Faculty Dean stated:

Communications between the two departments is smooth and ongoing. Perhaps organization and sequencing of material in year 1 and 2 courses ought to be discussed again by the curriculum committees.

### ARC Disposition of the Recommendation

ARC considers the recommendation to be accepted and in the process of implementation. The Committee expects that the Departments of Physics and Mathematics and Statistics will continue to explore opportunities for cooperation.

### Implementation Plan (1<sup>st</sup> Priority)

Responsible for approving:	Department
Responsible for resources:	Department
Responsible for implementation:	Department
Timeline:	Dean of Mathematics and Sciences to report by the end of academic year 2016/17

## Recommendation 6

We recommend that all senior students majoring in Physics be required to enroll in either the senior thesis course or another project course that requires written work and/or presentations.

In its response, the Department stated:

Several courses already require that students perform independent projects, and present the results: PHYS 2P32, 3P91, 3P92. Depending on the instructor, some other courses in the past have used term projects in lieu of the final exams (PHYS 3P41, 3P70). Supervision of full thesis projects creates a significant unscheduled teaching load on the faculty, and extending this level of supervision to majors students is not practical at the given faculty complement.... The curriculum review subcommittee will investigate whether a literature-review-based equivalent thesis project course or a separate literature-review-based course credit at the fourth-year level may be introduced in our next calendar submission, but this must not undermine our tradition of involving our undergraduates in research and the deep focus of the 4F90/91 thesis projects.

The Faculty Dean stated:

We are satisfied with the department's response.

UPC stated:

UPC notes that the advantage of implementing this recommendation is that research-based capstone courses are likely to be highlighted in students' Experiential Education components of their undergraduate degrees, when the formalized list of these opportunities are finally released.

### ARC Disposition of the Recommendation

ARC considers the recommendation accepted for consideration by the Department. The Committee expects that the curriculum review referenced in response to Recommendation #2 will consider the possibility of a senior thesis or project course for all Physics majors.

### Implementation Plan (2<sup>nd</sup> Priority)

Responsible for approving:	Department
Responsible for resources:	Department
Responsible for implementation:	Department
Timeline:	Dean of Mathematics and Sciences to report by the end of academic year 2017/18

### **Recommendation 7**

We suggest that certain rooms (even labs) be set aside for use as classrooms on an as-needed basis to reduce timetable conflicts.

In its response, the Department stated:

This is already very much the case, and we routinely make use of the Physics conference room (a re-configured Physics Chair's office, as the faculty acting as Chairs simply use their own offices for that) and the undergraduate laboratories if necessary (H300). The latter are less than ideal, as they contain a lot of equipment and poor sight-lines to the board. It must be pointed out that the Department does not "own" any teaching spaces; we frequently have difficulties scheduling small-group seminars that exceed 9 people in attendance (the capacity of the former Physics Chair's office). We would welcome very much if a reasonable-size classroom could be given over to Physics for our unscheduled teaching, for example a space similar to the former Chemistry Library (E201, cap. 20).

The Faculty Dean stated:

We welcome a review of all existing space used for instructional purposes with an outline of its pros and cons. We also welcome ideas for adapting the existing space for improved curriculum delivery. Based on the review and needs analysis, we would support the Department's claim for an adequate classroom dedicated to PHYS activities.

UPC stated:

UPC notes that individual Departments have little latitude in maintaining/acquiring "ownership" of rooms suitable for instruction at Brock, so that this recommendation is not easily implementable.

### **ARC Disposition of the Recommendation**

ARC considers the recommendation to be worthy of consideration but outside of the jurisdiction of the Committee. The Committee expects that the Department, with the assistance of the Dean, will proceed through normal channels of advocacy to address this recommendation.

### **Implementation Plan**

Recommendation not accepted.

### **Recommendation 8**

We suggest that the Department provide students with outlines of suggested timetables and degree paths for their programs.

In its response, the Department stated:

Perhaps the Reviewers did not notice that we do provide precisely that on our website, as a note of explanation, with sample schedules, for all Y1 courses. We find that for Y2 and above, the flexibility offered by individual academic advising works better than a set of sample schedules....All of the Physics faculty certainly are willing to listen to the concerns of the students, and do. The Department only has faculty acting as program advisers, we do not have any advising staff as in most other programs in other Faculties.

The Department gave examples of existing efforts to improve advising and made suggestions on possible ways to move forward on this issue.

The Faculty Dean stated:

To our knowledge, Physics majors are very well advised by the faculty members and the department. The Faculty of Math & Science has academic advisors available and knowledgeable of the PHYS related programs. Certainly, typical study plan could be put together at little cost and used as general guides for students.

The Dean of Graduate Studies stated:

From the perspective and application to the students in the MSC and PhD programs, the Dean, FGS supports this recommendation.

### **ARC Disposition of the Recommendation**

ARC considers the recommendation to be current practice. The Committee encourages the program to promote the location of the degree path information to Physics students.

### **Implementation Plan**

No further action required.

## Recommendation 9

We recommend the elimination of low enrolment courses to reduce teaching needs and/or free up resources for teaching duties either in first-year or in the new course- based MSc program.

In its response, the Department stated:

We are assuming the reference here is to the 10th paragraph of Section 6. The courses identified there, unfortunately, do not offer an opportunity for savings: PHYS/MATH courses are actually courses offered through the Department of Mathematics and Statistics and do not count toward the Physics teaching load. The only course that could be removed from regular offerings is PHYS 4P61 (Nuclear Physics) which is already offered only in alternate years.

We will change the scheduling for this course from every two years to occasional, to help with the teaching load, but this is a marginal change. We will continue to hope that additional faculty is hired (see the Recommendation 1), and we will continue to look for savings through alternate-year scheduling of additional courses. However, in the short-term, as the new M.Sc. in Materials Physics begins next year, we anticipate an increase in the average teaching loads. The "low-enrolment" criterion is a difficult one, as most of our courses are arguably low enrolment, compared to large popular programs in other Faculties, yet must be taught to maintain the integrity of our programs.

The Faculty Dean stated:

The Department has traditionally been conservative in its teaching deployments and will continue to show the same rationality in balancing the needs of senior students with budgetary constraints and critical floors for offerings.

The Dean of Graduate Studies stated:

While workload and decisions regarding the teaching of courses is not in the purview of the Dean, FGS supports this recommendation.

### ARC Disposition of the Recommendation

ARC considers the recommendation to be accepted for consideration by the Department. The Committee expects that the curriculum review referenced in response to Recommendation #2 will consider the future of low enrolment courses and the deployment of teaching resources.

### Implementation Plan (1<sup>st</sup> Priority)

Responsible for approving:	Department
Responsible for resources:	Department
Responsible for implementation:	Department
Timeline:	Dean of Mathematics and Sciences to report by the end of academic year 2016/17

## Recommendation 10

Unless a new injection of will occurs in the immediate future, we recommend termination of the combined program with the Niagara College of Applied Arts and Technology.

In its response, the Department stated:

A re-negotiation of the Articulation Agreement with Niagara College is currently under way. The provincial government has been strongly encouraging of the University-College collaborations and a streamlining of the transfers of students between programs. The joint programs have served us well as recruitment tools and we have graduated a small but highly successful group of students from this program. We believe in its merit, and we have a significant level of “ground-level” support from our counterparts on the Niagara College faculty. We have already asked our Provost and Vice- Provost to get involved in the negotiations, as the will to do the work at the level of the faculty must have institutional support for the joint program to succeed. We are hopeful this will happen in the near future. If it does not, the program will be eliminated, by default.

The Faculty Dean stated:

Ground-level support has to include promotion of the programs and must materialize in increased enrolment. Only viable enrolments make convincing rationale for continuation. We are far from viable enrolments at present.

UPC stated that it “has already been notified that this is to be the case”.

### ARC Disposition of the Recommendation

ARC considers the recommendation to terminate the program with Niagara College to be not accepted as there has been a new injection of will from the Department, Dean’s Office and counterparts at Niagara College. The Committee understands that a new agreement is being negotiated which will utilize the resources of both institutions to develop a strong, viable program.

### Implementation Plan (1<sup>st</sup> Priority)

Responsible for approving:	Department, Dean
Responsible for resources:	Department, Dean
Responsible for implementation:	Department, Dean
Timeline:	Dean of Mathematics and Sciences to report by the end of academic year 2016/17

### Recommendation 11

Every effort should be made to continue and enhance both online and in-class delivery of the first-year Astronomy course, which has been a resounding success.

In its response, the Department stated:

We wholeheartedly agree, as we are proud of the success of our Astronomy courses. We see this Recommendation as directed at the Administration of the University, to continue to renew our ILTA position beyond the current three-year term. Without such a renewal, the Astronomy course delivery will not be possible.

The Faculty Dean stated:

The ASTR courses are examples to emulate across the Faculty of Math & Science.

### ARC Disposition of the Recommendation

ARC considers the recommendation to be accepted. The Committee encourages the Department to advocate for the resources necessary to continue and enhance the delivery of the first-year Astronomy course.

### Implementation Plan (1<sup>st</sup> Priority)

Responsible for approving:	Department
Responsible for resources:	Department
Responsible for implementation:	Department
Timeline:	Dean of Mathematics and Sciences to report by the end of academic year 2016/17

## Recommendation 12

We recommend that the Faculty lobby on behalf of its departments to locate dedicated IT staff in the Faculty of Mathematics and Science to serve the needs of the departments concerning local issues.

In its response, the Department stated:

We agree, and support this Recommendation wholeheartedly. Two more resignations/firings (including that of a project manager formerly in charge of FMS-related projects) from the ITS in the month since the Review only exacerbated the difficulty of our IT situation. We continue to hope that our Faculty's needs will be acknowledged and addressed through the creation of a dedicated IT support person or a group within FMS, outside of the "fortress walls" of central ITS.

The Faculty Dean stated:

IT support is crucial to all Departments in the Faculty of Mathematics and Science and this support is currently lacking. We are working IT services and senior administration to address this issue and hope to see an appropriate resolution in the near future.

### ARC Disposition of the Recommendation

ARC considers the recommendation to lobby for dedicated IT staff in the Department to be accepted and in the process of implementation. The Committee recognizes that the lack of IT resources is having a negative effect on the academic quality and viability of the Physics programs. The Committee believes that this issue is of high importance and will bring it to the attention of the Senate Information Technology and Infrastructure Committee and include it in the next ARC Semi-Annual Report to Senate.

### Implementation Plan (1<sup>st</sup> Priority)

Responsible for approving:	Department, Dean of Mathematics and Science
Responsible for resources:	Department, Dean of Mathematics and Science
Responsible for implementation:	Department, Dean of Mathematics and Science
Timeline:	Dean of Mathematics and Sciences to report by the end of academic year 2016/17

### Recommendation 13

We recommend that resources continue to be allocated to the Faculty of Mathematics and Science machine and electronic shops and that some provision be provided to allow graduate students more hands-on experience in these shops.

In its response, the Department stated:

Again, we wholeheartedly agree. We had raised the issue of student access to machine shop facilities in the past, and were unable to overcome the concerns over liability. We do feel that student/faculty access to some shop facilities would be a terrific addition to the training we provide, and we join the Reviewers in encouraging the University to review their current position. Perhaps, a Machine-Shop-supervised mandatory safety training could be developed, and a limited set of machine tools could be set aside for student/faculty use.

The Faculty Dean stated:

Continued support for Technical Services, including the Machine, Electronics and Glass-blowing Shops, is crucial for continued research and teaching support not just in the Mathematics and Science but also in Applied Health and Social Sciences Faculties. We strongly support these services and shall continue to do so. It is currently not clear how graduate student training in these services could be realized without compromising safety or shop efficiency, but consultation with the personnel in these shops should yield some possible measures.

### ARC Disposition of the Recommendation

ARC considers this recommendation to be in two parts.

- a. The Committee considers the recommendation to allocate resources for machine and electronic shops to be not accepted as it lies outside the jurisdiction of the Committee.

### Implementation Plan

Recommendation not accepted.

- b. The Committee considers the recommendation to make some provisions to allow graduate students more hands-on experience in these shops to be accepted. ARC expects that the Department is best-positioned to determine strategies to move forward with this part of the recommendation.

### Implementation Plan (1<sup>st</sup> Priority)

Responsible for approving:	Department
Responsible for resources:	Department
Responsible for implementation:	Department
Timeline:	Dean of Mathematics and Sciences to report by the end of academic year 2016/17

## Recommendation 14

We recommend that communication increase between the Department and the Library, both to prioritize holdings and to facilitate the training of graduate students and students in undergraduate thesis projects in the effective use of Library facilities.

In its response, the Department stated:

As a part of the September orientation session (see Recommendation 8), we will ask for a regular contribution from our Science Librarian in a form of an orientation seminar on the use of the Library resources. Currently, we do offer such an orientation session to all incoming graduate students; we will broaden it to include all students, and ask the Library to provide some year-specific orientation for undergraduates.

The Faculty Dean stated:

We encourage the Department to include input from the librarian in orientation sessions and perhaps as part of undergraduate course work.

The Dean of Graduate Studies stated:

The Dean, FGS agrees with the recommendation. For the graduate programs, perhaps the GPD can make it a regular item on his/her activity list to survey the students and faculty regarding their library needs, and then meet with a Library representative to ensure that these needs are communicated, and a response from the Library received.

### ARC Disposition of the Recommendation

ARC considers the recommendation to be accepted and in the process of implementation. The Committee encourages the Department Library representative and GPD to work with their Liaison Librarian on a strategy to address this recommendation.

#### Implementation Plan (1<sup>st</sup> Priority)

Responsible for approving:	Department
Responsible for resources:	Department
Responsible for implementation:	Department
Timeline:	Dean of Mathematics and Sciences to report by the end of academic year 2016/17

### Recommendation 15

We recommend that the new Materials Physics course-based MSc program be carefully monitored to assess its usefulness, and whether or not it is detrimental to the other programs in Physics.

In its response, the Department stated:

We intend to do just that. If the program fails to bring additional students and resources into the Department, we will not hesitate to terminate it. However, we do feel that the program has a strong potential for success, and may even become a larger-enrolment program for domestic students as well; its applied focus and an absence of a research thesis requirement make it an attractive option for students aiming for industrial careers.

The Faculty Dean stated:

The Department's response to the recommendation is appropriate. The plan for this program from the outset was to monitor growth and continued demand for a period of five years. The expectation is that the program will flourish and the students attracted to this program will contribute positively to the graduate student experience in all Physics graduate programs.

The Dean of Graduate Studies stated:

The Dean, FGS strongly supports this recommendation.

### ARC Disposition of the Recommendation

ARC considers the recommendation to be accepted and in the process of implementation.

#### Implementation Plan (1<sup>st</sup> Priority)

Responsible for approving:	Department
Responsible for resources:	Department
Responsible for implementation:	Department
Timeline:	Dean of Mathematics and Sciences to report by the end of academic year 2016/17

### **Recommendation 16**

We suggest that Department money be set aside to provide “Departmental USRAs,” to attract even more students to summer research positions.

In its response, the Department stated:

A systematic implementation of this Recommendation would require a modest increase in the Departmental budget, under the control of the Dean of the FMS. We would certainly welcome such a change. In the meantime, we will make every effort to find potential students suitable for specific projects, and seek out funding for each. Several such projects have been supported by the Dean in the past; we hope this continues.

The Faculty Dean stated:

This recommendation will be very difficult to implement even though it would be desirable to do so. The Faculty budget is very severely constrained. We encourage departmental members to submit applications for University programs such as “Match of Minds” in addition to nominating students for NSERC USRAs.

The Dean of Graduate Studies stated:

While this recommendation calls for the allocation of resources to develop these Departmental USRA-type awards, and resource allocation is not in the purview of the Dean, FGS, the Dean, FGS supports this recommendation as a means of developing potential MSc applicants (especially domestic students) to the graduate program in Physics.

### **ARC Disposition of the Recommendation**

ARC considers the recommendation to be not accepted as it lies outside the jurisdiction of the Committee. The Committee expects that the Department will use its funds as it deems appropriate.

### **Implementation Plan**

Recommendation not accepted.

## D. Summary of Recommendations:

First Priority:

Recommendations 2,4,5,9,10,11,12,13b),14,15

Second Priority:

Recommendations 6

Not accepted:

Recommendations 1,3,7,13a),16

Not requiring further action:

Recommendations 8