

**REPORT OF THE ACADEMIC PLANNING COMMITTEE
TO THE REGULAR November 2017 SENATE**

FOR INFORMATION

Eighteen-month follow-up from ACAPLAN's recommendations from the Program Review for the following program: **M.Sc. in Physics**

Below is an excerpt from the Institutional Quality Assessment Process at Laurentian University approved at the Quality Council in June 2011.

PROCESS FOR FOLLOW-UP

No later than 18 months after Senate submission, those responsible for implementing the changes writes a report to the Dean and to ACAPLAN, on the actions it has taken in response to the review.

**QUALITY ASSURANCE – CYCLICAL PROGRAM REVIEW OF LAURENTIAN
UNIVERSITY'S PHYSICS DEPARTMENT
M.Sc. in Physics**

1. Departmental plan

“That the Physics Department elaborates a clear plan detailing 1) the direction of the department is taking in the next 5 years, 2) required changes to its programs to achieve these goals 3) the human and physical resources required.”

During the Department of Physics Retreat on May 19, 2015, it discussed the directions that the M.Sc. Program should follow in 3 different fields:

- A. Condensed Matter Physics.** 1) The Condensed Matter Physics is in a difficult position: It needs experimentalists as well as theorists in order to have critical mass to grow. Presently, the Department has 2 theorists and no experimentalists. The outcome of the discussions was that the best option for the growth of Condensed Matter would be to join forces with Medical/Biomedical Physics and establish research in interdisciplinary common areas as soft condensed matter, biological systems, applications in imaging tissue and cells. In this vein, the recommendation/request is that the new faculty to be hired could have her/his research in this interface, creating synergies between the two fields. This would improve the chances of obtaining NSERC funding for the new area. 2) Not many changes are required in the Program other than a new course(s) after the new areas are defined. This could happen in years 2 or 3 within the 5-year plan. 3) Once the issues discussed above are resolved, resources will be needed to build a new lab specialized in the new area of the research bridging Condensed Matter and Biomedical Physics. The most important step will be the hiring of a faculty member with the experience and leadership to guide the research in this new research area.

B. Medical/Biomedical Physics. At the same Retreat, on May 15, 2015, it was also discussed and agreed that the Medical/Biomedical Physics field should be strengthened and should be the main thrust of the Department. The reasons are well known: i-) The Department at the undergraduate level has a very strong program in Radiation Therapy that attracts excellent students who, in turn, produce very strong 4th year research projects. These are good students that the Department would be willing to attract for the M.Sc. program; ii) The Biomedical Physics Program has been very successful in attracting students. The numbers are increasing consistently as the Biomedical Physics program offers many paths into the health care sector. This program has been constantly evolving in the last years and now it presents a unique combination of fundamental sciences, radiation Physics, research, interprofessional education and Indigenous content, along with a multitude of path options (enabled by a great variety of options of elective courses). The Department would also be willing to attract students coming out of this Program to the M.Sc. in Physics in the area of Medical Physics; iii-) Adjunct faculty at the Northeast Cancer Centre has been participating in the teaching of undergraduate and graduate courses as well in the supervision of undergraduate and graduate students. These allow for more capacity and possibilities in this field.

1) The plan for this field is to expand its scope by changing the Medical Physics part of the M.Sc. program in order to create a M.Sc. in Medical Physics accredited by the Commission on Accreditation of Medical Physics Education Programs (CAMPEP). This is, however, a large enterprise: it would require changes in the format of the courses, increase in the number of committed faculty members and extensive support from the administration. In view of that, the Department has decided to take this process in steps:

- I. Make more graduate courses in Medical/Biomedical Physics at the graduate level available. Some courses needed to be de-banked, others had not been considered for teaching in a while and simply needed to be brought back to the Department's active courses list. This step has been completed;
- II. With the changes recently made in the requirements for acceptance to the M.Sc. in Physics program (see Appendix 1), Medical Physics field, students in the Biomedical Physics and RT program have the option of being accepted directly in the M.Sc. program. This brings the M.Sc. Physics in the Medical Physics closer to what will be required for the CAMPEP accreditation. We have been seeing a lot of interest by our own undergraduate students. Due to this, it is expected that the demand for the four graduate courses in this field will increase. This step has just been completed (see attached);
- III. The previous step is a preparation for this final step that is the work to meet CAMPEP requirements for accreditation. These requirements can be found at <http://www.campep.org>. The work on this step is underway.

2) As mentioned above, significant changes will be needed to achieve this goal. The Department is going to work together with the Dean and VP Academic as well as with the Cancer Centre to achieve this goal; 3) Resources should be provided according to the recommendations of the CAMPEP. In addition, more

space for students, lab equipment and space is urgently needed to support the program.

C. Particle Astrophysics. The Particle Physics group has grown, as 4 new Research Scientists at SNOLAB have become Adjunct Professors in the Department and a new faculty member, Dr. Caio Licciardi, has been hired in the context of the CFREF (Canada First Research Excellence Fund) CPARC (Canadian Particle Astrophysics Research Centre). In addition, in the context of the CFREF - CPARC, the group will be able to hire 2 technologists and ¼ of an Administrative Assistant time. 1) The plan is to increase and improve the promotion of the group in order to attract more students (one faculty member has been assigned to work in student attraction in conjunction with the University's team). As for the graduate courses in the field, the Department, in conjunction with TRIUMF, has successfully delivered an online course in Nuclear Particle Physics. Physicists at TRIUMF taught this course and 7 students from the Department attended it and successfully passed. The idea is to continue this trend as it increases the number of courses available to our students; 2) In principle, everything is going well and no changes are required in the near future; 3) More space for students and lab space is needed urgently to support the ongoing and future work.

DEAN'S COMMENTS:

Providing faculty support to the biomedical physics option has been a high priority for the Faculty. The new faculty will provide support for the growing number of students in the field and provides replacement for a retired faculty.

2. Increase the number of faculty

“Consider expanding the involvement of faculty from other LU departments in contributing to the graduate program (research and/or teaching).”

Due to the very technical aspect of Physics, it is not straightforward to find faculty from other departments that can contribute to the teaching of the Physics courses and to the research. Computer Science and Math are the closest. With the new version of the M.Sc. in the field of Medical/Biomedical Physics, there are opportunities to have faculty from the Biology and Chemistry/Biochemistry departments to teach some courses and/or have their courses included in the program. These discussions are underway. The same applies for research projects in this field. There are some discussions with the Engineering department as well for the field of Particle Astrophysics.

“Explore avenues to increase the contribution of researchers from other regional institutions to the program.”

We have attracted the interest of faculty from other Universities to co-supervise our students (e.g. Université de Montréal and Chalk River Laboratories, TRIUMF). This is an avenue that we will continue to explore.

3. Increase in the number of students

3.1 Future of the Medical Physics Specialty

“Decide whether this graduate specialty is to be expanded or not.”

As noted in the item **1.B.** the Department has decided to expand the Medical/Biomedical Physics field;

“If Medical Physics is to be expanded, elaborate a clear plan leading to

CAMPEP accreditation.”

As also explained in item **1.B.** the plan is underway and its first 2 steps have been completed. For the 3rd and last step, it is need more involvement of the Dean and VP Academic as more resources and commitment are needed.

“If Medical Physics is to be expanded, hire 1 faculty in this field.”

The Department has submitted numerous requests to the Dean in order to increase the number of faculty members in the field of Medical Physics, warranted by the consistent increase in the numbers of students in the Biomedical Physics Program and by the success of the Radiation Therapy Program. The hiring of faculty members in the field of Medical/Biomedical Physics will also impact directly the success of the plans for the M.Sc. program in this field. No hires in this field will jeopardize ongoing work and the accomplishment of the objectives;

3.2 Increase the number of graduate students in Particle Physics

As explained in item **1.C.**, the Particle Astrophysics group has grown and is working with the web team at Laurentian to improve the group’s promotion in order to attract more students. In addition, the Department has plans to reapply for its own Ph.D. program. The Ph.D. program should help to attract students that would not come for a M.Sc. only;

3.3 Future of the Condensed Matter Specialty

“Decide whether this graduate specialty is to be expanded or not.”

See the discussion in item **I.A.**

4. Dealing with the small size of the program.

“Consider alternative methods of course offering.”

“Consider establishing a partnership with other universities to increase the variety of course offering.”

As explained in item **1.C.**, the Department has successfully offered a “distance course” taught by scientists at TRIUMF. This course was delivered to a group of Universities in partnership, which included Laurentian University. This course was considered very successful, giving us the option of utilizing this method for other courses.

5. Course in Computational Physics and Numerical Methods

“Explore non-traditional ways to teach this course.”

Training sessions delivered by Adjunct faculty from SNOLAB and Post-docs is the way we found to best deliver topics in Computation Physics and Numerical Methods to our students. It gives them the basic training to be able to do their research. As most of these students have the opportunity of working in international collaborations their skills improve naturally.

6. Student Progress Evaluations

“Ensure that students and their supervisory committee meet regularly (at least once a year, and twice during the first year).”

“Ensure that students receive feedback from their supervisory committee immediately after their regular meeting.”

“Ensure that a set of core Physics graduate courses are offered every year.”

“Review the course requirements to ensure that students can finish their course work during their first year into the program.”

“Come up with a strategy to make it easier for students to complete their degree within 2 years.”

The meetings with the supervisory committee are happening more regularly. There is more control over the progress of the students. There has been continuous effort to offer the core graduate courses every year. However, with the modifications in the M.Sc. program, there are no more mandatory courses. The supervisory committee has the discretion and flexibility to decide which courses each student has to take in order to fulfill the required number of course credits. This measure should help to resolve the problems and conflicts originated from a rigid set of core courses (see Appendix 2).

7. Metrics to assess the success of graduated students

“Keep track of student performance through clearly defined outcome measures (e.g. time to completion, rate of graduation, awards received, etc).”

Some of this information is already available on Tableau. We are working to customize Tableau to our specific needs.

“Follow-up on the success of recent graduates, e.g. through surveys or social media (e.g 6 and 24 months after graduation).”

This proves to be a difficult task, even for the Alumni Department. We succeed in having information about students that stay in contact, i.e., continue to work in the field.

8. Faculty to receive credits for teaching small classes

“Consider cycling courses to limit low enrolment.”

Cycling courses is a regular practice when needed.

9. Graduate coordinator to receive teaching dispensation

“Explore ways to reduce the teaching load to the graduate coordinator.”

This topic has been extensively discussed with the Dean but no agreement has been reached.

10. Additional Technicians

“Hire one additional Physics technician.”

The Department has requested multiple times a second full time technician and a part time technician. However, due to budget constraints, the Department has only obtained a part-time technician.

Thanks to the CFREF's, led by Queens' University, successful application (with Laurentian University as one of the partner Universities) the Particle Astrophysics group, as mentioned before, will be able to hire two technicians and ¼ of the time of an Administrative Assistant. This alleviates the situation of the Particle Astrophysics group but do not completely resolve the Department's problems. The hiring of the needed number of technicians by Laurentian University and the renovation of our labs (the only ones left untouched by the modernization of the University) are both essential for the delivery of high-quality education to our undergraduate and graduate students.

DEAN'S COMMENTS:

A new full time technologist has been hired by the Department effective September 1, 2017.

I agree and support the Department request for renovating their labs, especially the first year lab, as the Department of Physics was one of the few science departments that were not included under the campus modernization plan.

11. University to improve funding to better balance resources available to the students working in other specialties

“Explore ways to provide faculty with additional financial support to hire graduate students. This is especially important for faculty looking to renew competitive Federal research grants.”

“Consider modifications to the Laurentian University Research Fund guidelines to help support faculty working in fields with limited funding possibilities.”

“Provide support to faculty seeking alternative sources of funding.”

No support has been received even though many requests have been submitted by the Department. On the contrary, the support for the Library has diminished and many Journal subscriptions have been cancelled. These setbacks make research for faculty working in fields with limited funding even more challenging. The Department has tried unsuccessfully to revert this trend. It has been an enormous let down to our research program.

12. Foreign student fee-waivers

“Increase the number of foreign student fee-waivers available to competitive programs with low enrolments.”

Requests have been submitted to the Deans.

DEAN'S COMMENTS:

A new policy on making international students eligible for GTA's is presently under consideration.

13. Student Life

“Ensure that graduate students are made aware of the services provided by the Liaison office, Laurentian International, and the Center for Academic Excellence.”

“Ensure that graduate students are made aware of the Computer Skills workshops provided by the department.”

The Department strives to support and guide its students the best way possible. The Department's office has provided a lot of support to students. The fact that students have direct representation in the Department Meetings assures that their needs are known and fulfilled. Students in the Department have many opportunities to meet face-to-face with the faculty and the Chair. We believe that students' requests are met.

B.S C. BIOMEDICAL PHYSICS (HONOURS 4-Year)

FIRST		SECOND YEAR		THIRD YEAR	FOURTH YEAR
PHYS 1206 E/F Physics for Life Sciences I (3 cr)	PHYS 1207 E/F Physics for Life Sciences II (3 cr)	PHYS 2506 E Medical Radiation Physics (3 cr)	PHYS 3506 E Physics of Medical Imaging (3 cr)	INTE 3307 E Clinical Research Methods in Interdisciplinary Practice (3 cr)	PHYS 4115 Research and Thesis (6 cr)
MATH 1036 E/F Calculus I (3 cr)	MATH 1037 E/F Calculus II <u>or</u> MATH 1057 E/F Linear Algebra I (3 cr)	INTE 2116 E Introduction to Oncology (3 cr)	PHYS 3306 E Radiobiology and Radiation Protection (3 cr)	ADDITIONAL MANDATORY COURSES	
CHMI 1006 E/F General Chemistry I (3 cr)	CHMI 1007 E/F General Chemistry II (3 cr)	STAT 2126 E Introduction to Statistics (3 cr)	PHYS 3507 E Physics of Radiation Therapy (3 cr)	The five mandatory courses below can be taken during 2 nd , 3 rd or 4 th years: --- PHYS 2006 Introduction to Electricity and Electronics (3 cr) --- PHYS 2016 Modern Physics (3 cr) --- PHYS 2606 E Biophysics of Fluids (3 cr) --- PHYS 2616 E Physics of Hearing and Vision (3 cr) --- PHYS 3616 E Use of Lasers and Fibre Optics in Health Sciences (3 cr)	
BIOL 1506 E/F Biology I (3 cr)	Elective or Mandatory	INTE 2126 E Interprofessional Education in Health Care (3 cr)	PHYS 2117 E Experimental Physics (3 cr)		
BIOL 2105 E/F Human Anatomy & Physiology (6 cr)		Elective or Mandatory	COSC 2836 E Computer Software for the Sciences (3 cr)	Sciences (3 cr) NOTES: <ul style="list-style-type: none"> Students can take a maximum of 27 elective credits at the 1000 level. 	

Summary of

Computer Science	3 credits	Biology	9 credits	Chemistry	6 credits
Integrated Studies	9 credits	Math and Statistics	9 credits	Physics	42 credits
Electives	42 credits				

Total number of credits to graduate: 120

STUDENTS SHOULD CONSULT WITH AN ACADEMIC ADVISOR IN THE DEPARTMENT OF PHYSICS AT THE BEGINNING OF EVERY ACADEMIC YEAR

M.Sc. in the Medical Physics Field Stream Option**List of Elective Courses needed to be considered for admission in the M.Sc. Medical Physics Field**

- **PHYS 2406 – Mechanics I**
- **PHYS 2017 – Electricity and Magnetism**
- **PHYS 3416 – Introduction to Quantum Mechanics (Instructor has to waive PHYS 2407 – Mechanics II prerequisite)**
- **MATH 1037 – Calculus II (If MATH 1057 – Linear Algebra was taken as a mandatory course) or
MATH 1057 – Linear Algebra (If MATH 1037 – Calculus II was taken as a mandatory course)**
- **One of the following courses**
 - **PHYS 3036 – Thermodynamics**
 - **PHYS 3116 – Advanced Laboratory I**
 - **PHYS 4067 – Instrumentation**
 - **MATH 2066 – Introduction to Differential Equations**

Total number of elective courses credits for the stream: 15

Remaining elective credits to be taken: 27 (must include 12 credits in Humanities and/or Social Sciences)

APPENDIX 2

M.SC. IN PHYSICS

APPROVED FIELDS OF STUDY

- Medical Physics
- Particle Astrophysics
- Condensed Matter Physics

M.SC. IN PHYSICS - THESIS OPTION

A student in this option must successfully:

1. complete two full graduate courses (12 credits) to be approved by the supervisory committee members; and
2. prepare and defend a thesis (PHYS 5000) on a topic in one of the department's research areas.

M.SC. IN PHYSICS - COURSE WORK PROGRAM

A student in this option must successfully:

1. complete a minimum of three full graduate courses (18 credits) to be approved by the supervisory committee members; and
2. prepare a critical review essay (PHYS 5005) that involves independent library research.

M.Sc. in Physics – List of typical courses per field

Condensed Matter Physics

Course Code	Course Title
PHYS--5000EL	Thesis
PHYS--5005EL	Critical Review Essay
PHYS--5226EL	Selected Topics in Applied Physics
PHYS--5227EL	Selected Topics in Theoretical Physics
PHYS--5406EL	Quantum Mechanics I
PHYS--5407EL	Quantum Mechanics II
PHYS--5426EL	Quantum Statistical Physics
PHYS--5437EL	Advanced Solid State Physics
PHYS--5456EL*	Surface Physics
PHYS--5506EL	Advanced Electromagnetic Theory I
PHYS--5507EL	Advanced Electromagnetic Theory II

Medical Physics

Course Code	Course Title
PHYS--5000EL	Thesis
PHYS--5005EL	Critical Review Essay
PHYS--5226EL	Selected Topics in Applied Physics
PHYS--5227EL	Selected Topics in Theoretical Physics
PHYS--5406EL	Quantum Mechanics I
PHYS--5506EL	Advanced Electromagnetic Theory I
PHYS--5606EL	Medical Radiation Physics
PHYS--5607EL	Radiotherapy Physics
PHYS--5616EL	Radiation Biophysics and Protection
PHYS--5617EL	The Physics of Medical Imaging

Particle Astrophysics

Course Code	Course Title
PHYS--5000EL	Thesis
PHYS--5005EL	Critical Review Essay
PHYS--5226EL	Selected Topics in Applied Physics
PHYS--5227EL	Selected Topics in Theoretical Physics
PHYS--5406EL	Quantum Mechanics I
PHYS--5407EL	Quantum Mechanics II

PHYS--5426EL Quantum Statistical
Physics

PHYS--5506EL Advanced Electromagnetic

Theory I PHYS--5507EL Advanced Electromagnetic

Theory II PHYS--5706EL Non--Accelerator

Particle Physics