TO: Mike Mahon
President and Vice Chancellor

DATE: February 7, 2014

FROM: Robert A. Boudreau
Chair, Academic Quality Assurance Committee

RE: Department of Physics and Astronomy, Academic Quality Assurance Review

In accordance with the U of L *Academic Quality Assurance Policy and Process*, the Academic Quality Assurance Committee approved the review of the Department of Physics and Astronomy at its January 24, 2014 meeting.

The Self Study Committee for this review was comprised of David Siminovitch (Program Review Coordinator), Mark Walton, and Steve Patitsas. The review produced four documents:[1]

1. *Self-Study Report, Department of Physics and Astronomy* (received September 18, 2013) – Developed by the Physics and Astronomy Self Study Committee.
2. *External Review Report for the Department of Physics and Astronomy, University of Lethbridge* (received November 18, 2013) – External Review Report by Mark Gallagher (Lakehead University) and Rainer Dick (University of Saskatchewan), based on their site visit of October 17-18, 2013.
3. Program Response (received December 16, 2013) – response of the Self Study Committee to the external review.
4. *Dean's Response to the Quality Assurance Review of the Department of Physics and Astronomy* (received January 17, 2014) – response to the review, written by Craig Cooper, Dean of the Faculty of Arts and Science.

[1] All documents are available upon request.

Self Study

The Self Study Report noted some of the strengths of the department:

- Faculty members are committed to research and they cover a wide range of research areas in theoretical and experimental physics. Departmental research groups are emerging, such as the Astronomical Instrumentation Group and the Theoretical Physics Group.
- Faculty members are committed to effective teaching.
- Faculty and staff are organizing community outreach activities, such as laboratory tours for high schools and columns in the local newspaper.
- Undergraduate involvement in research is a hallmark of the U of L.
- Faculty receive full salary when on study leaves and can also access Professional Supplement funds.
- Faculty members are generally collegial at the U of L and there are several multidisciplinary projects across disciplines.
- The department is committed to offering undergraduate courses for students outside the Physics major.
- The department interacts well with other institutions in the region. Examples of these interactions are the Canadian Prairies Theoretical Physics Network and the Institute for Space Imaging Science.
- The U of L's liberal education approach gives Physics graduates some advantages over graduates from other Canadian universities.
- Graduates successfully pursue a wide range of careers and graduate studies.
- In 2007, the department added an advanced lab course to the B.Sc. Physics.
- All undergraduate physics programs include a capstone course that exposes students to current research in physics using seminars and speakers.
- Starting in 2009, Physics majors have had an Honours Thesis option.
- Students can get co-op placements in industry or academia.
- First offered on an unfunded basis in 1993, the M.Sc. program has matured and is now adequately funded, with nine students currently taking an M.Sc. in Physics and Astronomy. Graduates from the Master's program have successfully pursued a variety of postgraduate careers.
- Physics and Astronomy faculty are supervising Ph.D. students under the multidisciplinary science Ph.D. programs.
- There are graduate courses available as series or topics courses in experimental physics and theoretical physics. The department will request that these courses be regularized and appear in the graduate Calendar.
- The administrative support of graduate studies has improved. Physics and Astronomy has its own Graduate Committee that, for its departmental area, vets graduate student applications, coordinates the Ph.D. Comprehensive Examinations, and oversees M.Sc. and Ph.D. defences.

- The use of graduate students to teach lab sections in introductory physics courses reduces teaching pressure on faculty members.

The Self Study Report also discussed several weaknesses:

- Departmental faculty members have a heavy teaching load.
- Faculty do not receive teaching credit for graduate student supervision or for teaching Independent Study and Applied Study courses.
- The department finds it a challenge to provide a liberal education while offering a competitive physics degree.
- Physics majors can fulfill the General Liberal Education Requirement (GLER) by taking any Arts and Science course, however tenuous the value to their program. Moreover, some courses on the GLER science list are not science courses.
- Students in first year physics courses are not sufficiently prepared for these courses in terms of the required mathematics, and so physics instructors have to teach the necessary calculus.
- The number of Physics majors is typically small, which makes it difficult to get more resources for Physics and Astronomy.
- The lack of national accreditation for physics undergraduate programs may disadvantage the B.Sc. Physics in comparison to programs like the B.Sc. Chemistry that can be nationally accredited.
- The department shares Administrative Assistants with two other departments. One Administrative Assistant is shared with the Department of Biological Sciences, and another with the Department of Chemistry and Biochemistry.
- The technical support available to the department is inadequate. The existing electronics shop and machine shop support the needs of the entire Faculty of Arts and Science and are under resourced. There is no high-level support for software issues that researchers encounter.
- The frequency of course offerings varies, depending on the level. Courses above the second year level can sometimes only be offered in alternate years.
- There are no graduate courses in core physics subjects.
- Recruiting qualified graduate students is challenging.
- Faculty member web pages are outdated.
- The additional financial support for international graduate students cannot be maintained in the current fiscal climate.
- Changes to NSERC Discovery Grants disadvantage the department in obtaining research grants from that organization.

Several potential opportunities for the department were noted in the Self Study:

- The Honours Thesis option gives Physics majors the opportunity to strengthen their education.
- The sharing of graduate teaching with other institutions through the Western Universities Deans Agreement may allow a better selection of courses for graduate students.
- The new science building, currently in planning stages, should alleviate the space issues facing the department.
- Physics is becoming more valued in other disciplines, which opens the possibility of collaborations with other departments.
- The possibility of recruiting excellent graduate students exists.

The report presented potential threats:

- Cuts in government funding for the university will provide ongoing budget challenges. Resulting impacts include: loss of funding for markers in undergraduate courses; cuts in funding for the departmental speaker series; inability to replace retiring faculty members; increasing difficulty of getting study leaves; inability to hire more technical staff to replace those who retire; and the possibility of increased teaching loads.
- Changes to the NSERC Discovery Grant program disadvantage smaller institutions like the U of L. Several department faculty members have lost their Discovery Grant and a summer research award program is in jeopardy.
- Funding opportunities for research equipment have decreased.
- There is a gap between Research Chairs with reduced teaching loads and those with normal teaching loads.
- The morale of natural scientists in the Faculty of Arts and Science is low.

In conclusion, the Self Study Report listed some future directions:

- Establish a teaching load of three courses—two undergraduate courses and one graduate course.
- Hire a research scientist/technician to design, build, and troubleshoot lab instrumentation.
- Establish tutorials for first year physics courses.
- Develop mathematics courses designed for Physics majors.
- Develop a Science Core of introductory courses in mathematics, physics, chemistry, and biology.
- Create a Physics and Astronomy lounge and meeting room.
- Hire a full time Administrative Assistant.
- Review liberal education at the U of L.

External Review

The External Review Report noted the strengths of the Department of Physics and Astronomy:

- In spite of its small size, the department is a major part of the research profile and success of the U of L and of the institution's aim to be recognized as a comprehensive university. It contributes over 7% of the U of L's research revenue with less than 3% of its faculty.
- The Department contributes significantly to the U of L's Mandate Statement, Fundamental Principles (from the Strategic Plan), and the Letter of Expectation (between Alberta Innovation and Advanced Education and the U of L).
- The Department contributes to the liberal education mission of the U of L in two important ways. First, by offering the Bachelor of Science and the Bachelor of Arts and Science degrees in Physics. And second, by offering well-subscribed first year courses in Astronomy and Physics.
- The department has played an important role in the transition to a comprehensive university by: training graduate students; consistently applying for external research funding; and maintaining strong research programs. The current graduate enrolment of 15 is impressive for a department of nine regular faculty members.
- At the national and international levels, the department is known for its research, particularly in: infrared and sub-millimetre astronomy and instrumentation; quantum gravity; and atomic and molecular imaging of physical processes. Its level of expertise in these areas is unique in Alberta. To maintain this position the department must at a minimum keep its complement of nine faculty members and three academic assistants.
- The undergraduate program curriculum reflects the current state of the discipline and contains all core material needed for an honours major in Physics.
- Student access to experiments is impressive. Introductory courses have a weekly laboratory.
- Laboratories are modern, spacious, and well-equipped.
- Faculty members' expertise transcends almost the full range of the physics discipline and includes both theorists and experimentalists.
- Graduates of the undergraduate program are successful in getting places in good graduate schools.
- The Ph.D. program strictly adheres to its requirements of a thesis and a comprehensive examination with written and oral components.
- Admission standards for the undergraduate program are quite stringent.
- Admission requirements for the M.Sc. program are very similar to other programs across Canada.
- Retention and graduation rates are similar to other physics departments across the country.
- The impressive post-graduation activities of graduates point to the quality of the undergraduate and graduate programs.
- Faculty have a strong record of accomplishment in research. Publication rates are high, but unevenly distributed, in high quality journals. The department has a Tier II Canada

Research Chair, a U of L Board of Governors Research Chair, and a University Scholar. In 2012-13, the department secured $1.2M in research revenue.

- The B.Sc. in Physics is a solid program with a good balance between breadth and depth. It prepares students well for graduate study, or for a technology-related career in industry or public service.

The body of the report discussed several weaknesses and challenges:

- The department is stretched thin between contributing to liberal education, training undergraduate physics students, graduate training, and research. The current complement of nine faculty members and three academic assistants is too small.
- Faculty course loads are high, and are hurting faculty member's chances of receiving external research funding.
- With a small faculty complement, providing sufficient graduate courses is difficult. Current offerings of at least six credit units only covers minimal course requirements for a thesis-based M.Sc. program. This program requires a minimum of two courses, but the national standard is four required courses.
- The low level of technical and administrative support makes it unlikely that graduate programs and current research funding levels can be maintained.
- The lack of a B.Sc. Honours in Physics may disadvantage students for entry into graduate studies, as admission requirements for physics graduate programs usually include an honours degree.
- There is a lack of support and resources for the graduate programs. The Ph.D. program does not have advanced formal training in core physics subjects. The department should at a minimum offer bi-annual graduate courses on advanced quantum mechanics, electrodynamics, general relativity, and one of statistical physics, condensed matter physics, or imaging/spectroscopy.

The report contained the following recommendations:

1. Consider introducing an honours degree in undergraduate physics. One way of doing this would be to add a mandatory six-credit Honours Thesis to the existing course requirements and reducing open electives to 12 courses.
2. If one of the current faculty members retires, advertise for a faculty position to maintain and boost research expertise in at least two of these research areas: infrared/sub-millimetre astronomy, quantum gravity, and imaging/spectroscopy. The recruited faculty member should be qualified to teach advanced graduate physics courses in core physics subjects or support graduate training in signature research areas.
3. Consider reducing the number of PHYS 1000 lecture sections per academic year from three to two. This would allow more attention to be paid to graduate training and research.
4. Form a committee of the Chairs of the Biology, Chemistry and Biochemistry, and Physics and Astronomy departments and ask them to: (1) study the use, capacity, and work order filling times of the Arts and Science technical shops; and (2) study the possibility of supporting additional positions for technical staff by accepting external work orders in the shops.
5. Consider creating an administrative commons for the departments of Biology, Chemistry and Biochemistry, and Physics and Astronomy, with three administrative staff members

having primary responsibilities for particular aspects of admin support. Oversight of this commons should reside with the Dean, with day to day direction the purview of a collegium of the three department Chairs.

There was one additional recommendation, taken from the body of the report:

- At a minimum, maintain the complement of nine faculty members and three academic assistants. This is important in preserving the Department's research programs and graduate programs.

Program Response

In their Program Response, the Self Study Committee commented on the five major recommendations front the External Review Report:

Recommendation:	**Response:**
1. Consider introducing an honours degree in undergraduate Physics. One way of doing this would be to add a mandatory six-credit Honours Thesis to the existing course requirements and reducing open electives to 12 courses.	Agreed. The Faculty of Arts and Science should begin exploring this possibility as soon as possible. The Department of Physics and Astronomy is working on a plan to implement an Honours program.
2. If one of the current faculty members retires, advertise for a faculty position to maintain and boost research expertise in at least two of these research areas: infrared/sub-millimetre astronomy, quantum gravity, and imaging/spectroscopy. The recruited faculty member should be qualified to teach advanced graduate physics courses in core physics subjects or support graduate training in signature research areas.	Agreed. A search for a replacement faculty member is critical for the future of the department.
3. Consider reducing the number of PHYS 1000 lecture sections per academic year from three to two. This would allow more attention to be paid to graduate training and research.	The underlying purpose of this recommendation, to boost graduate programs by moving teaching resources from undergraduate to graduate, is valid. The lack of Ph.D. courses was highlighted in the quality assurance review of the Ph.D. program.
4. Form a committee of the Chairs of the Biology, Chemistry and Biochemistry, and Physics and Astronomy departments and ask them to: (1) study the use, capacity, and work order filling times of the Arts and Science technical shops; and (2) study the possibility of supporting additional positions for technical staff by accepting external work orders in the shops.	The problem of technical support is larger. Over the last decade, research activity in the Faculty has at least doubled, but technical support resources have stayed the same. The department's access to machining support has declined since the retirement of one of the key technical support people two years ago. To address this, a committee should investigate and report back by late Spring 2014. This committee should be similar to the past Technical Services Advisory Committee that has representatives from all the science departments that rely on Technical Services.

Recommendation:	Response:
5. Consider creating an administrative commons for the departments of Biology, Chemistry and Biochemistry, and Physics and Astronomy, with three administrative staff members having primary responsibilities for particular aspects of admin support. Oversight of this commons should reside with the Dean, with day to day direction the purview of a collegium of the three department Chairs.	Agreed. The anticipated growth of the Astronomical Instrumentation Group over the next five years makes will only exacerbate the problem of lack of administrative support.

The Program Response closed with some additional commentary not directly related to the External Review recommendations:

- There are deeper issues related to interdepartmental relations that were not mentioned in the report. A 1981 review acknowledged these issues and recommended that strong interdepartmental committees be formed. The Self Study Committee endorses this recommendation.
- Evaluating a department's performance should consider factors beyond just enrolment, such as research grants.
- Pre-med or pre-dentistry students are advised to declare as certain majors, but not as a Physics major. However, at the University of Saskatchewan, Physics majors are very successful in being accepted to medical school. Pre-med or pre-dentistry students should be give the option of declaring themselves as Physics majors.
- The External Reviewers and the Self Study Committee agree that the U of L should consider developing a science core for all B.Sc. degrees.

Dean's Response

In his response to the review documents, Dean of Arts and Science Craig Cooper addressed the recommendations in the External Review Report and the Program Response:

Recommendation:	Dean's Response:
1. Introduce an Honours degree.	Agreed. A broader discussion is needed, however, that encompasses four points: (1) if the department should develop an Honours degree or not; (2) revisiting GLER and how it functions in Arts and Science; (3) potentially loosening the requirement for high school Physics 30; and (4) a Science Core.
2. Replace the retiring faculty member.	Another faculty member who was an Academic Assistant III is now on a tenure-track appointment. This keeps the departmental complement of nine faculty members. The department will, however, need to add another Instructor. This will be done, pending additional resources.
3. Increase graduate course offerings.	PHYS 1000 sections should be reduced from three to two, which will free up resources for graduate teaching. Reducing the sections to one may have a negative impact on other science programs that require this course. There is a similar concern with reducing PHYS 1050 from two sections to one.

Recommendation:	Dean's Response:
4. Improve technical and administrative support.	Lack of capacity in technical and administrative support is a concern. Some steps have already been taken. The Technical Services Subcommittee is in the process of being reactivated. This committee will establish its terms of reference and will monitor and coordinate technical support for the benefit of the departments of Physics and Astronomy, Chemistry and Biochemistry, Biological Sciences, and Neuroscience. As a short-term solution for administrative support, the administrative person in the Alberta Water and Environmental Science Building will assist the Department of Physics and Astronomy on a part-time basis. Longer term, the concept of an "administrative commons" will be explored, and could be the administrative structure for the Science Building.

The Academic Quality Assurance Committee is satisfied that the Department of Physics and Astronomy academic quality assurance review has followed the U of L's academic quality assurance process appropriately, and acknowledges the successful completion of the review.

Sincerely,

ORIGINAL SIGNED BY:

Robert A. Boudreau

Chair, Academic Quality Assurance Committee

Cc: Andrew Hakin, Provost and Vice President (Academic)