Report of the Academic Unit Planning Review Panel for the Department of Physics and Physical Oceanography Memorial University of Newfoundland

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0. Background

The members of the review panel read the Department's Self Study Report and then met members of the Department and administration over three days, from February 11-13, 2016 (see attached schedule). We then wrote the present report, which represents our consensus perspective of the Department.

We thank all those who met with us for providing their insights and perspective on the Department. We found that everyone was receptive to our questions and thoughtful in their responses. It is clear to us that the members of the Department are fully engaged with its functioning. The strength and reputation of the Department in research, in teaching, and in daily operations positively reflects their continued engagement. Our report should help the Department to continue to thrive by highlighting some challenges it faces, and possible paths forward.

0.1 Overall Impressions

The Department is well respected within the university. Members of the department are collegial, engaged, and hard-working. The Department is the only Physics and Physical Oceanography Department in Canada and it is the only one focussing on just three research directions: Physical Oceanography, Experimental Condensed Matter Physics and Theoretical Condensed Matter Physics. The Department has a laudable record of service teaching, and works hard to provide a diverse curriculum to Physics and Physical Oceanography students at the undergraduate and graduate levels.

The Department has a large proportion of international graduate students (approximately 80%), a large number of support staff (almost 1:1 with faculty). The faculty complements in physical oceanography, theoretical physics and experimental physics are 6, 6, 7. The proportion of theoretical to experimental physics is almost 1:1, which is large.

Change is ongoing. There have been recent increases in the graduate student cohort, following initiatives at the university level. There is going to be a dramatic increase in the faculty of engineering, with larger service teaching demands anticipated. The provincial and federal funding landscapes are threatened and in flux, respectively. Significant university building changes and renovations are imminent. These changes are pressuring already stretched members of the Department. Proactive engagement with these changes is important.

0.2 Previous Review

We obtained a copy of the previous (2003-4) academic unit planning self-study, report, and action plan from www.mun.ca/vpacademic. The resulting changes (2004-6) were summarized on p.6-8 of the 2015 self-study. The earlier recommendations appear reasonable, and were acted upon when within the purview of the department. Some of these issues (curriculum, engagement with students) are perennial, and have arisen again, given the length of time between the AUP exercises. Since the earlier action plan (2004), the Department has hired 7 faculty [Plumer and Yethiraj in 2005, Saika-Voivod in 2006, Tarasov in 2007, Munroe in 2010, Evstigneev in 2014, and Wallin in 2015], and now has a complement of 19 (with 6 in physical oceanography) -- close to the target of 20 from the previous AUP. Two Tier II CRC faculty were

hired after the earlier AUP (Chen in 2004, and Tarasov in 2007), and renewed since. Tarasov's last renewal finishes in 2017, while Chen's has already finished.

The current self-study report (2015) that was made available to the review panel contained sparse information about the research funding and output of the Department. In an appendix, the report lists five to six "Selected Publications" for each department member (some dating back to 1996), and information about NSERC Discovery Grants is not included. The panel requested more detailed information on publication and funding before the on-site visit, but did not receive any. We recommend that this information be included in future AUP self-study reports, together with a more detailed departmental strategic plan.

1. Four focus areas

We have identified four core areas of focus for this report: space, undergraduate teaching, student recruitment and a strategic plan. In this section, we outline why these areas are important now, together with our corresponding recommendations. We also provide specific suggestions on how to implement some of these recommendations in subsequent sections. A list of all of our recommendations, including some that fall outside of these focus areas, is provided at the end of this report.

1.1 Space

The University is constructing a new building for the Faculty of Science, which is planned to be completed in 2019. The Department will stay in the Chemistry Physics building, which is separated from the new site by the four lane Prince Phillip Drive. The current building will undergo substantial renovations. It looks like the new science building together with the planned renovations will severely impact the Department.

- *Laboratory moving*. The Department's office- and laboratory spaces need to be vacated for the renovations of the current infrastructure and *then moved back into the renovated space*. Moving experimental laboratories is a substantial undertaking that requires careful planning and execution, financial support from outside the department, and accommodation of appropriate fume-hoods, power, space, water, and cryogens. Any gaps of experimental efforts that arise from the multiple moves will significantly impact productivity, recruitment and retention of graduate students, and subsequent research funding and sustainability.

- *Fractioning of research space*. Certain facilities used by the Department will be moved to the new science building. This includes the cryogenic and the NMR facilities, severely affecting three experimental research groups (Morrow, Quirion, and Yethiraj) and possibly others, depending on the final location of the atomic force microscopy facility used by Poduska and Merschrod (Chemistry). Specific concerns are the supply of liquid helium at affordable costs, the transport of NMR samples between buildings, and the management of dispersed research groups.

While research and office space currently appears decent, there is no good social space for faculty or graduate students since the room available for this purpose is often used for meetings. We also note that access to larger lecture theatres for first year classes could reduce teaching demands on faculty.

Additionally, the theoretical/CMP group does not have a coherent research space for graduate students (while labs are the heart of experimental groups) which would strengthen informal cross-training and community. Given the departmental emphasis on theoretical research, this amounts to a significant space issue – but one that could be addressed by restructuring currently available space.

Recommendation 1. A departmental space committee should identify space needs and solutions, coordinated with strategic goals of the Department (i.e. hiring plans). This committee should:

1A. Plan to minimize the disruption of research and teaching activity during building renovation. Individual plans should be made for each experimental (and teaching) laboratory, and financial arrangements made to implement them (at the Dean's level). Ideally, a way to only move labs once during renovations should be found.

1B. Plan to smoothly function after the renovations, in particular to minimize the impacts of divided experimental labs between buildings, and cryogen supplies. Again, these plans should be made lab by lab and should be budgeted at the Dean's level.

1C. As renovation and building plans firm up, the departmental space committee should regularly discuss space needs and concerns with the Dean of Science.

1D. Find coherent office space for graduate theory students, in order to provide stronger informal cross-training and community building.

We encourage the Dean of Science to move ahead with a new, faculty-wide space committee to proactively deal with emerging space issues associated with the new science building and renovations of existing buildings. We recommend that the Department has direct representation on that committee, to closely tie the faculty level planning with that of the Department.

1.2 Undergraduate Teaching

The numbers of physics majors and minors in the Department are impressive, and are consistent over the report period 2004-2014. More than 15 majors graduate in most years, with roughly 5 minors per year -- leading to more than 100 majors since 2004. The number of honours students is also consistent, with 60 honours since 2004. The proportion of honours students pursuing the joint physics and applied mathematics honours degree has been increasing since 2010, and currently represents over 50% of the graduating honours students. The decreasing numbers of pure physics honours students then limits the ability of the Department to offer a variety of advanced physics courses, and also impacts potential graduate recruitment opportunities.

One impediment to students taking the physics-only degree programme appears to be the inflexibility in the course requirements for third- and fourth-year courses. For example, the course PHYS 3900 (Physics Laboratory I) is required for the physics honours (and major) programme, but not for four of the five joint honours programmes. Students may perceive this course as hard because it is labour intensive (though ultimately rewarding), and this perception may deter students from the physics honours programme. We

also noticed the perception of a dearth of enticing courses at the third- and fourth-year in the physics-only honours programme.

The Department is currently undergoing an undergraduate curriculum review. This provides an opportunity to thoroughly revise the course and programme offerings throughout the programme. It should aim at expanding enrolment in third- and fourth-year courses, increase the flexibility of course offerings for the physics-only degree programme, retain and increase the number and quality of physics-only honours students, and create a pool of well-trained candidates for recruitment into the MSc programmes.

Recommendation 2. The Department should reform the undergraduate curriculum. We suggest the following:

2A. Because the healthy service component of most physics courses in lower years dilutes the community of physics students in those classes, and because the first year classes are split due to the lack of large classrooms, a "streamed" approach could be implemented starting in the first year. One course in every year could be aimed at the level and interests of physics-honours students.

2B. Remove, merge, or reform individual courses that impede growth of the physics honours programme.

2C. Develop new courses that could reflect and highlight exciting areas of physics, aligned with faculty interests, to attract and retain physics students in upper years.

2D. Tweak existing programmes and streams to increase the stability of course offerings, so that faculty can generally expect stable course assignments. Course turnover should have a target of, e.g., every five years. This will allow faculty to invest more effort in course and material development and delivery, and should improve the quality of and engagement with existing courses.

2E. Proceed with the creation of the Computational Physics and Ocean Physics programmes. These reflect current strengths and interests of the Department.

1.3 Student Recruitment

Many of the activities of the Department depend on the strength, diversity, commitment, and engagement of its students, both undergraduate and graduate, as well as postdocs and research associates. Here we focus on undergraduate and graduate recruitment into the degree programmes.

Undergraduate student numbers support faculty complement and leverages the impact of the Department into the broader university and provincial community, while quality enables and requires interesting physics degree offerings and healthy upper level courses. Graduate student numbers meet some of the strategic goals of training at the national and university level, while quality enhances research productivity and profile of the Department.

In the self-study, the Department has set itself a challenge to increase the overall quality of graduate students, while maintaining their number. We have also identified recruitment of undergraduate students

into the physics honours programme is an important goal, both to support exciting upper year course offerings, and to tie into the goals of graduate recruitment.

Recommendation 3. The Department should increase the number of physics honours students, aiming to double their number.

This ambitious goal requires more than tweaks, but offsets the proportion of joint honours students with Mathematics. We offer suggestions on how to achieve this goal in Section 2 below (Undergraduate Program).

Recommendation 4. **The Department should increase the number of graduate students with NSERC fellowship funding, with a target of 10% of the graduate students.**

The present number is 1, with the current graduate student numbers the target would be 5. Using this concrete goal will focus efforts on local, regional, and Canadian recruitment where MUN name recognition and the reputation of the Department can be used to advantage. Striving towards this goal will have a positive spill-over effect on other Canadian recruiting. The panel offers suggestions on how to reach this goal in Section 3 below (Graduate Programme).

Recommendation 5. The Department should continue to enhance the recruiting of strong international graduate students.

As the current percentage of the Department's international graduate students is at about 80%, supporting domestic recruiting aimed at excellence is going to be difficult without similar excellence in international recruiting as well. The panel offers suggestions on how to achieve this goal in Section 3 below (Graduate Program).

Recommendation 6. The Department should enhance the training and experience of graduate students.

Recruiting excellent students must be followed by excellent training. Among other things, this provides sustainable "word-of-mouth" and preserves and expands the strengths that graduate students contribute to the Department. Due to the international composition of the graduate student group, the suggested training should include cultural aspects. The panel offers suggestions on how to achieve this goal in Section 3 below (Graduate Program).

1.4 Strategic Plan

A strategic hiring plan is an urgent issue to be addressed immediately. The current self-study does not voice strategic priorities for hiring. Nevertheless, future faculty hires impact space needs and programme possibilities. In view of the upcoming changes related to the construction of the new science building, the

timing for the strategic plan and its ensuing space plan should be pursued without delay. Once in place, it can justify space and hiring needs, and smooth faculty searches. We address some considerations for strategic planning in section 5 below (Strategic Considerations).

Recommendation 7. The Department should formulate a strategic hiring plan.

This should not focus merely on the next hire, but rather a hiring strategy for the next five to ten years in the context of anticipated retirement, programme initiatives, research synergies, and space needs. Specific research directions should be designated, so that targeted searches can be persuasively lobbied for and effectively undertaken. We recommend that research excellence should be the starting point of strategic planning.

2. Undergraduate Program

The Department offers, individually and in conjunction with other departments, an impressive range of B.Sc. degrees and joint degrees: Physics Honours, Major, Minor; Environmental Physics Honours, Major; Applied Mathematics and Physics Joint Honours, Major; Biochemistry and Physics Joint Honours; Chemistry and Physics Joint Honours; Computer Science and Physics Joint Honours, Major; Earth Sciences and Physics Joint Honours, Major; Geophysics and Physical Oceanography Joint Honours. The faculty and staff are dedicated, committed and devoted to providing a high-quality undergraduate education in Physics, including both degree programs for physics students as well as "service" courses for non-physics students.

The Department uses a range of modern teaching techniques to deliver the first-year courses, including problem-solving tutorials in which students work on problems in small, peer-instructional groups. Computers are extensively incorporated into laboratory instruction for data acquisition and analysis. The facilities used for the first-year labs are in a good state, well equipped and up-to-date, with computers for student use and screens for demonstrations. There is an impressive team of Laboratory Instructors and Instructional Assistants to run, support, organize, and deliver the first-year laboratory sessions. The Instructors and Assistants are dedicated, enthusiastic and committed. They are a valuable resource within the Department.

The third-year laboratory exercise-based course (PHYS 3900) is an important, effective course. In addition to teaching physics by performing sophisticated experiments, this course strengthens valuable "soft skills", such as time management, report writing, proposal writing, the use of LaTeX and data analysis. Students recognize and appreciate the quality of this course and the breadth of knowledge and skills they acquire and develop through the course. However, the course has a reputation of being hard because it involves a lot of work. This may be a factor in students choosing to pursue one of the joint degrees rather than the pure physics degree, with negative impact on the number of students enrolled in the upper-level pure physics courses. The numbers of students taking most third- and fourth-year courses are low. For example, the current enrolments (Winter 2015-16) are: 1 in PHYS 3061, 7 in 3151, 7 in 3220, 9 in 3230, 67 in 3300, 0 in 3400, 16 in 3600, 2 in 3650, 0 in 3751, 2 in 3800, 10 in 3900, 0 in 4205, 5 in 4220, 2 in 4400, 1 in 4500, 0 in 4820, and 3 in 4851. The enrolment is particularly low in the fourth-year courses that are required only by those students doing a purely Physics degree (e.g., 4400, 4500). There does not appear to be an overall trend in the enrolment in these courses, but natural year-by-year fluctuations cause the numbers to teeter on the minimum enrolment and interest and hence viability.

Recommendation 8. The third-year course PHYS 3900 should be revisited with a view to reduce the unfavourable reputation it appears to have amongst some potential physics students. Whether this is strictly perception (requiring outreach into second year), or whether it is substantive (requiring recalibration of the workload), corrective action appears to be needed.

The low enrolment in physics honours classes is contrasted by a relatively large one in physics classes with a significant service enrolment from students outside of physics (e.g. in PHYS 3300 and PHYS 3000). This dilution of physics classes results in less cohesion of the physics cohort and informs our **Recommendation 3** (the Department should increase the number of physics honours students, aiming to double their number). We suggest the following measures (see also Recommendation 2):

3A. More motivated, high-achieving high school students may consider physics with a streamed approach in the first year. This streaming could be done through enhanced labs, or with dedicated courses, but would also help retain stronger students in physics in the transition from first to second year.

3B. We recommend that the Department targets second year undergraduates through in-house outreach (such as student-requested research talks or small-group faculty led professional mentoring), and community building, to enhance their identity as physics students and participation in the physics community early in their undergraduate career. This will help retain students in the transition from second to third year.

3C. The Department is already doing excellent school outreach, which should continue. We recommend involving undergraduate students (of all years) in this outreach to further foster the undergraduate community. Also building a stronger pipeline of graduating students into the Faculty of Education will provide job opportunities for graduates and will support high-school links for feeding into the first year class.

Recommendation 2E supported the development of Computational Physics and Ocean Physics programmes. The Department should also explore what strategic commitments would be needed (and what opportunities gained) by developing Engineering Physics or Medical Physics. We did not have enough detail to be able to advise on either of these directions, though both seem potentially promising.

3. Graduate Program

Graduate student numbers increased 2-3 fold from 2001 to 2008, and have subsequently remained at approximately 50 students. During this expansion the proportion of PhD students decreased to approximately 1:3 but has since grown towards a 1:1 ratio. This implies good retention of MSc students into the longer PhD programme. The fraction of physics to physical oceanography graduate students is about 3:1, the same as the relative faculty complements. Significantly, the proportion of international students has grown substantially since 2008, and is now approximately 80% of the student population. The expansion and “internationalization” has been enabled by the healthy grant support of faculty in the department, by fellowships available from the School of Graduate Studies, by teaching assistantships, and by the modest (by Canadian standards) minimum annual stipend.

While graduate student numbers reflect healthy research funding and activity within the Department, graduate student excellence drives research outcomes and reputation and so sustains the Department. Our Recommendations 4-6 are aimed at excellence.

To implement **Recommendation 4** (to increase the number of graduate students with NSERC fellowship support to 10% of the student population), we suggest the following measures:

4A. MUN undergraduates should be encouraged to apply to NSERC fellowships locally. Enhancing undergraduate honours numbers and training will then, synergistically, grow this pool.

4B. Individual faculty should target MUN undergraduates for graduate work, especially at the MSc level, and especially if the programme, mentoring, and field-specific research opportunities are competitive with other programmes in Canada. Providing opportunities for undergraduates to participate in CUPC and AUPAC, which the Department already does, allows the students to make informed choices and improves the resulting fit.

4C. MUN should focus recruitment in the region (Atlantic Canada), where its name recognition and reputation can be more efficiently managed and highlighted. Undergraduate summer research experiences for non-MUN students may be an avenue to grow this direction. This may include the organization of undergraduate summer schools that could attract out-of-province students.

4D. Recruitment of NSERC students is a competitive enterprise. Offering compelling research experiences is not always enough -- significant funding top ups are often required. The Department should provide SGS funds in these circumstances.

4E. Recruitment of students must be a collective enterprise. The Department should subsidize student visits, and those students should talk with a variety of potential supervisors during their visits.

4F. Recruitment of strong students from outside MUN requires individual effort, since it requires relationship building with the potential students and with their undergraduate student supervisors. This includes outreach efforts during invited seminars, and at national and regional student events such as CUPC, AUPAC, and CCUWIP.

To implement **Recommendation 5** (The Department should continue to enhance the recruiting of strong international graduate students) we suggest the following:

5A. MITACS offers competitive project-based funded undergraduate research experiences for some international partners. While limited in scope, this provides visibility and the opportunity to develop relationships with strong international students that can lead to graduate recruitment. The Department should pursue MITACS opportunities where possible.

5B. Given the growing international graduate population at MUN, the Department should coordinate with SGS to provide targeted recruitment, screening, orientation, and support.

5C. It is the combined responsibility of individual faculty and the Department as a whole to accept graduate students into the programme. The minimum standard should be that all students graduate with excellent training and research experiences, in a timely manner, with financial support throughout their

degree. A modest reduction of graduate student admission numbers may be necessary to meet this standard.

To implement **Recommendation 6** (the Department should enhance the training and experience of graduate students) we suggest the following:

6A. We recommend that the Department increases the minimum graduate stipend towards the national median. While the stipend net of fees, and in light of local costs, appears liveable, a low stipend will turn off excellent students with multiple offers. We caution that low stipends will hamper efforts to strengthen the student body. As in 5C., a modest reduction of graduate student numbers may result from increases of the minimum stipend. However, we believe that it will benefit the Department as a whole.

6B. We recommend a one-day orientation programme for all new graduate students, in conjunction with a graduate handbook outlining research, supervision, community, and teaching expectations for their graduate career.

6C. We support a comprehensive curriculum review and reform at the graduate level, which the Department has already planned. Care should be taken to have the graduate programme both attractive and useful to undergraduate honours students considering an MSc, and to international students without extensive laboratory training. One possible course to consider is a "professional skills" course, to address literature review, refereeing, scientific writing, critical reading, and presentation skills. This could include teaching pedagogy. Another possibility is an "experimental tools" course, to address contemporary experimental tools and techniques available to the department and the underlying physics informing them.

4. Strategic Considerations

Faculty are uniquely intertwined in the Department. They often stay with it for more than 30 years, financially supporting and training graduate and undergraduate students in research, fostering collaborations between departments, teaching undergraduate and graduate students. The heart of strategic planning, therefore, will be future faculty retirement, recruitment, and retention.

For **Recommendation 7** (the Department should formulate a strategic hiring plan), we suggest the following considerations:

7A. Since the last review, the Department hired, renewed, and retained two CRC tier II chairs (Chen and Tarasov). Tarasov's renewal will end in 2017. We strongly urge the Department to pursue new CRC (at the tier I or tier II level), as it is a proven path to recruit excellent faculty.

7B. The Department's ratio of theoretical to experimental physics faculty is approximately 1:1. This is roughly double the typical ratio in physics departments in Canada. This ratio affects space and startup funding needs, collaborative opportunities, programme offerings, and student quality requirements. The Department should reflect on what that ratio should be, and include it as an explicit (rather than implicit) strategic goal. We note that while it is generally a "buyer's market" for theorists, since they have fewer industrial opportunities, this is not a compelling reason to hire them disproportionately.

7C. Compelling theoretical research requires excellent students, and so a large proportion of theoretical researchers strongly feeds into our Recommendations 4-6.

7D. Compelling experimental research requires significant investment in research space. Research space is a timely concern, given the new science building and building renovations. Future experimental hiring directions need to be identified now, with adequate laboratory space available for their research. We note that future research involving liquid helium cryogen may be precluded by the current plans of the new science building.

7E. Compelling experimental research also requires significant investment in startup funds, and competitive startup (at the $200k-$500k level) is often required to successfully recruit strong candidates and set them up for success. The annual budget cycle does not allow the department to "bank" startup funds, and CFI opportunities are slow and uncertain from the point of view of prospective faculty. We strongly suggest that the Department works proactively with the Dean to develop creative approaches to bank startup funds for experimental hires. This may, e.g., require delaying approved experimental hires.

7F. Envisaged engineering physics or medical physics programmes may require new faculty with suitable professional accreditation. While close collaboration with the Faculty of Engineering and the Faculty of Medicine may provide some of those positions, this will also imply a long term strategic commitment for future hires. Individual faculty outside of the traditional strength of the Department, in e.g. astrophysics, is another way in which programme considerations might affect strategic hiring directions. We recommend that any such strategic programme initiatives only be undertaken if research excellence can be maintained with all hires.

5. Faculty and Staff

Administrative Staff. The administrative staff has seen a significant increase in their tasks, particularly in grant- and university-related paperwork. They are "stretched". Within a year, both the Department's administrative staff specialist D. Corbett and the graduate program coordinator J. Simmons are retiring. Each has over 20 years of experience. The Department must search broadly to recruit exceptional people to fill those positions, particularly in light of upcoming renovations and any changes in the graduate programme. Appropriate overlap (bridging) between current and new staff should be built into the process.

Laboratory Instructors and Instructional Assistants. There are concerns amongst the Laboratory Instructors and Instructional Assistants about differences in expectations as to their roles and responsibilities between themselves and the Faculty/Department, about the opportunities for promotion and career, and about the level of compensation they receive for their jobs. This largely falls within the larger MUN Human Resources landscape. A recommendation to the University regarding this was made in the previous AUP Review (2003 APR report, recommendation 5(iii)). However, the current 2015 Department self-study report (p.7) states that "on the whole the problem remains", which was confirmed in the interviews conducted for the present review.

Recommendation 9. The Department should support their Laboratory Instructors and Instructional Assistants in their requests to Human Resources for evaluation of their roles and responsibilities, and in their desire for improved career advancement opportunities and improved compensation. Possibilities for professional development should also be explored and supported.

Systems Administrators. Three system administrators are well appreciated and integrated into the Department. They support research, administration and teaching labs. While the computer equipment is adequate in the Department, the internet network linking the Chemistry Physics building to the rest of the campus is too slow. This impacts their work, but also research and teaching within the building.

Recommendation 10. Network speeds should be improved to campus norms as soon as is practical. This is unlikely to be a "within building" problem, so could be addressed by the university (with the Dean's support) even before renovations to the Chemistry Physics building.

Faculty teaching. The Department undergoes a big effort to deliver a wide range of undergraduate courses, in particular the courses required by the wide range of joint degree programmes. The quantity, frequency and timing of these courses to make the various joint programmes work amount to extra load on faculty. We encourage the Department to rationalize the curriculum, and to limit changes year-to-year, in order to stabilize work-load on faculty. More stability can lead to better delivery, and more time to innovate rather than cope.

Faculty research and funding. The panel has elicited online data from NSERC and has found an average departmental NSERC operating grant of about $27K, comparable to the university average of about $30K. The self-study shows substantial research revenues from other sources (Industry, CFI, RDC, AIF). The webpages of the Department members show an average of about 2.3 research publications per person per year, over the last ten years. We find the Department's funding achievement and research output good.

6. Community Service

The Department engages in professional and outreach services locally, nationally and internationally. The panel strongly encourages this activity, which promotes the visibility of the Department and of MUN as a whole.

In their local engagement, Department members give regularly presentations and demonstrations to different community groups, such as Sparks and Brownies (Girl Guides of Canada), Women in Science (WISE), junior high school students, Engineering summer camps, MUN MedQuest, Science in the Mall, the Shad Valley program, and they volunteer as judges (including the Chief Judge for the past 15 years) at the Eastern Newfoundland Regional Science Fair.

On the national level, Department members are serving on NSERC committees (Grant Selection Committee, Polanyi Committee, Committee on Grants and Scholarships, Research Management Committee of the NCE Marine Environmental, Observation, Prediction and Response Network). The Department has been, and continues to be, involved in the Canadian Association of Physicists in the roles of the president of the CAP, members of the executive, chairs of divisions of the CAP, selection committee members for various CAP prizes. Two Department members are currently associate editors for the Canadian Journal of Physics.

Members of the Department are engaged internationally in European Commission reviews and the international management committee for the Overturning in the Subpolar North Atlantic Program (OSNAP). They have organized and co-organized several national and international conferences, including

"Magnetic North" workshops, conferences of the Canadian Meteorological and Oceanographic Society, the annual CAP congress and Centre Européen de Calcul Atomique et Moléculaire workshops.

Several Department members are repeatedly appearing and in the media talking about physics and oceanography related topics (BBC, CBC, local media).

7. University Support

The Department has potential access to two ships: the Marine Institute ships *Anne Pierce* and *Shamook*. Scheduling them for research or for teaching is difficult because their primary role is to serve as platforms for training at the Marine Institute. Moreover, with an operating budget of about 100K/year it is not realistic for the Department to directly purchase ship time. On the other hand, the Department offers the course PHYS 6314 in Field Oceanography, which is taken by students from different departments (Physics and Physical Oceanography, the Marine Institute, Earth Sciences, Ocean Sciences and Engineering). A fieldwork course needs access to the field, namely the ocean.

Recommendation 11. The Department should pursue "in kind" contributions of ship time from the Marine Institute, perhaps in conjunction with outreach activities of the Marine Institute. We note that this access could be useful even while the ships are at dock. Alternatively, we recommend that the university pursues occasional access for students on a more formal basis with the Marine Institute.

List of Recommendations

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4B. Individual faculty should target MUN undergraduates for graduate work, especially at the MSc level, and especially if the programme, mentoring, and field-specific research opportunities are competitive with other programmes in Canada. Providing opportunities for undergraduates to participate in CUPC and AUPAC, which the Department already does, allows the students to make informed choices and improves the resulting fit.

4C. MUN should focus recruitment in the region (Atlantic Canada), where its name recognition and reputation can be more efficiently managed and highlighted. Undergraduate summer research experiences for non-MUN students may be an avenue to grow this direction. This may include the organization of undergraduate summer schools that could attract out-of-province students.

4D. Recruitment of NSERC students is a competitive enterprise. Offering compelling research experiences is not always enough -- significant funding top ups are often required. The Department should provide SGS funds in these circumstances.

4E. Recruitment of students must be a collective enterprise. The Department should subsidize student visits, and those students should talk with a variety of potential supervisors during their visits.

4F. Recruitment of strong students from outside MUN requires individual effort, since it requires relationship building with the potential students and with their undergraduate student supervisors. This includes outreach efforts during invited seminars, and at national and regional student events such as CUPC, AUPAC, and CCUWIP.

Recommendation 5. The Department should continue to enhance the recruiting of strong international graduate students.

5A. MITACS offers competitive project-based funded undergraduate research experiences for some international partners. While limited in scope, this provides visibility and the opportunity to develop relationships with strong international students that can lead to graduate recruitment. The Department should pursue MITACS opportunities where possible.

5B. Given the growing international graduate population at MUN, the Department should coordinate with SGS to provide targeted recruitment, screening, orientation, and support.

5C. It is the combined responsibility of individual faculty and the Department as a whole to accept graduate students into the programme. The minimum standard should be that all students graduate with excellent training and research experiences, in a timely manner, with financial support throughout their degree. A modest reduction of graduate student admission numbers may be necessary to meet this standard.

Recommendation 6. The Department should enhance the training and experience of graduate students.

6A. We recommend that the Department increases the minimum graduate stipend towards the national median. While the stipend net of fees, and in light of local costs, appears liveable, a low stipend will turn off excellent students with multiple offers. We caution that low stipends will hamper efforts to strengthen the student body. As in 5C., a modest reduction of graduate student numbers may result from increases of the minimum stipend. However, we believe that it will benefit the Department as a whole.

6B. We recommend a one-day orientation programme for all new graduate students, in conjunction with a graduate handbook outlining research, supervision, community, and teaching expectations for their graduate career.

6C. We support a comprehensive curriculum review and reform at the graduate level, which the Department has already planned. Care should be taken to have the graduate programme both attractive and useful to undergraduate honours students considering an MSc, and to international students without extensive laboratory training. One possible course to consider is a “professional skills” course, to address literature review, refereeing, scientific writing, critical reading, and presentation skills. This could include teaching pedagogy. Another possibility is an “experimental tools” course, to address contemporary experimental tools and techniques available to the department and the underlying physics informing them.

Recommendation 7. The Department should formulate a strategic hiring plan.

7A. Since the last review, the Department hired, renewed, and retained two tier II CRC (Chen and Tarasov). Tarasov’s renewal will end in 2017. We strongly urge the Department to pursue new CRC (at the tier I or tier II level), as it is a proven path to recruit excellent faculty.

7B. The Department’s ratio of theoretical to experimental physics faculty is approximately 1:1. This is roughly double the typical ratio in physics departments in Canada. This ratio affects space and startup funding needs, collaborative opportunities, programme offerings, and student quality requirements. The Department should reflect on what that ratio should be, and include it as an explicit (rather than implicit)

strategic goal. We note that while it is generally a "buyer's market" for theorists, since they have fewer industrial opportunities, this is not a compelling reason to hire them disproportionately.

7C. Compelling theoretical research requires excellent students, and so a large proportion of theoretical researchers strongly feeds into our Recommendations 4-6.

7D. Compelling experimental research requires significant investment in research space. Research space is a timely concern, given the new science building and building renovations. Future experimental hiring directions need to be identified now, with adequate laboratory space available for their research. We note that future research involving liquid helium cryogen may be precluded by the current plans of the new science building.

7E. Compelling experimental research also requires significant investment in startup funds, and competitive startup (at the $200k-$500k level) is often required to successfully recruit strong candidates and set them up for success. The annual budget cycle does not allow the department to "bank" startup funds, and CFI opportunities are slow and uncertain from the point of view of prospective faculty. We strongly suggest that the Department works proactively with the Dean to develop creative approaches to bank startup funds for experimental hires. This may, e.g., require delaying approved experimental hires.

7F. Envisaged engineering physics or medical physics programmes may require new faculty with suitable professional accreditation. While close collaboration with the Faculty of Engineering and the Faculty of Medicine may provide some of those positions, this will also imply a long term strategic commitment for future hires. Individual faculty outside of the traditional strength of the Department, in e.g. astrophysics, is another way in which programme considerations might affect strategic hiring directions. We recommend that any such strategic programme initiatives only be undertaken if research excellence can be maintained with all hires.

Recommendation 8. The third-year course PHYS 3900 should be revisited with a view to reduce the unfavourable reputation it appears to have amongst some potential physics students. Whether this is strictly perception (requiring outreach into second year), or whether it is substantive (requiring recalibration of the workload), corrective action appears to be needed.

Recommendation 9. The Department should support their Laboratory Instructors and Instructional Assistants in their requests to Human Resources for evaluation of their roles and responsibilities, and in their desire for improved career advancement opportunities and improved compensation. Possibilities for professional development should also be explored and supported.

Recommendation 10. Network speeds should be improved to campus norms as soon as is practical. This is unlikely to be a "within building" problem, so could be addressed by the university (with the Dean's support) even before renovations to the Chemistry Physics building.

Recommendation 11. The Department should pursue “in kind” contributions of ship time from the Marine Institute, perhaps in conjunction with outreach activities of the Marine Institute. We note that this access could be useful even while the ships are at dock. Alternatively, we recommend that the university pursues occasional access for students on a more formal basis with the Marine Institute.

PHYSICS AND PHYSICAL OCEANOGRAPHY

Academic Unit Planning

Site Visit Itinerary (February 11-13, 2016)

Thursday, February 11th Room: C3024		Friday, February 12th Room: C3024		Saturday Feb 13th
8:00 AM 9:00 AM	Welcome Breakfast – Panel meets with Dean of Science, Dean of Grad Studies, and AUP Coordinator **(A2029)**			**Panel: Draft Report** **Room: C3024**
9:00 AM 9:30 AM	Organizational Meeting: Panel and AUP Coordinator	9:00 AM 9:30 AM	Organizational Meeting: Panel and AUP Coordinator	
9:30 AM 10:30 AM	Departmental Head Tour of Facilities	9:30 AM 10:00 AM	Physical Oceanography Group: Afanassiev, Demirov, deYoung, Munroe, Tarasov, & Zedel	
		10:00 AM 10:30 AM	Administrative Staff: Coombs, Corbett, Simmons, and Wade	
10:30 AM 11:00 AM	Dr. Lagowski – Department Head	10:30 AM 11:00 AM	Safety Committee: Beaulieu, Deacon, Poduska, Wells, and Whelan	
11:00 AM 11:30 AM	Undergraduate Students	11:00 AM 11:30 AM	Lab Instructors and Assistants: Bromberek, Deacon, Hayden, Jerrett, Men, Pittman, Shorlin, and Wells	
11:30 AM 12:00 PM	School of Graduate Studies: Andrew Kim	11:30 AM 12:00 PM	CMP/Experimental Group: Andrews, Beaulieu, Chen, Morrow, Poduska, Quirion, and Yethiraj	
12:00 PM 1:30 PM	Lunch with Unit Head and Deputy Heads	12:00 PM 1:30 PM	Panel Working Lunch	
1:30 PM 2:00 PM	System Administrators: Jerrett, Perry, & Stevenson	1:30 PM 2:00 PM	~~Dr. Stephanie Curnoe~~ (Cancelled)	
2:00 PM 3:00 PM	Graduate Studies Committee	2:00 PM 3:00 PM	Meeting with the whole department	
3:00 PM 3:30 PM	Graduate Students, Postdocs, and Research Assistants	3:00 PM 3:30 PM	Panel confers for exit meetings	
3:30 PM 4:30 PM	Undergraduate Studies Committee	3:30 PM 4:00 PM	Exit Meeting with Dean of Science (by phone) (Panel shares preliminary findings)	
		4:00 PM 4:30 PM	Exit Meeting with Unit Head (Panel shares preliminary findings)	
4:30 PM 5:00 PM	CMP/Theoretical Group: Curnoe, Evstigneev, Lagowski, Plumer, Saika-Voivod, and Wallin	4:30 PM 5:00 PM	Exit Meeting with Unit Head, Faculty, Staff, and Students (Panel shares preliminary findings)	
5:00 PM	Suggested time for panel to confer	5:00 PM	Suggested time for panel to confer	
7:00 PM	Working dinner for panel to discuss meetings and report writing	7:00 PM	Working dinner for panel to discuss meetings and report writing	

Review Panel Members:

Dr. Marco Merkli, Department of Math and Statistics **(Panel Chair)**

Dr. Colin Farquharson, Department of Earth Sciences

Dr. Andrew Rutenberg, Department of Physics and Atmospheric Science, Dalhousie University

Dr. Yves Gratton, Department of Physical Oceanography, Institut National de la Recherche Scientifque (INRS)