

External Review: Department of Astronomy and Astrophysics (DAA) University of Toronto

Site Visit: April 12 and 13, 2010

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Summary

The External Review Committee engaged in nearly two days of intensive interviews involving all available faculty, staff and graduate students in the DAA. Our impressions are based on both the on-site visit and extensive review of the Self-Study document compiled by the Department. Overall, we find that the DAA continues to flourish in a culture of academic excellence that leads to world-class status in the field of astronomy and astrophysics. The remarkably collegial environment contributes to a high morale among faculty, staff and students. In the following report, we expand upon these findings, discuss modest challenges faced by the Department, and suggest ways to enhance its current profile and provide recommendations. The recommendations are also repeated without context in an appendix.

1 Personnel

1.1 Faculty Complement

The Department of Astronomy and Astrophysics (DAA) is the only university department in Canada devoted solely to astronomy and astrophysics. The DAA currently has 9.5 full-time equivalent (FTE) faculty members, which is down slightly from 10.15 in 2000. Most of this variance arises because the current Chair, Peter Martin, was seconded from the Canadian Institute for Theoretical Astrophysics (CITA), thereby increasing the effective DAA complement to 10.0 FTE. It is the smallest department among its immediate cognate units in the FAS.

The DAA is closely linked to two other academic units, CITA and the nascent Dunlap Institute (DI), units that add research strength and capability at the graduate level in astronomy and astrophysics. Among these units, however, the DAA alone is responsible for delivering the undergraduate curriculum on the St. George campus. Each DAA faculty member is actively and successfully engaged in research. They have a collective *Hirsch* index, normalized to years in the profession, of 1.50, which is remarkably high and indicates a sustained level of recognized scientific productivity. By objective measures – such as average grant per faculty, research productivity or graduate student supervision – DAA faculty members enjoy a comparable success rate to CITA faculty.

The DAA has internationally recognized strength in the broad subfield of extragalactic astronomy and cosmology, with two faculty members named in the ISI Highly Cited Researchers compilation for their work in this field. Other notable strengths are in the subfields of star formation,

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exoplanets, and high-energy astrophysics related to compact objects. The balance between breadth and focus seems about right for the overall size of the department.

With Peter Martin’s imminent return to CITA and the likelihood that an internal faculty member will become the next Chair, there is a critical need for an immediate additional faculty appointment for the DAA (see also §4.2). The DAA has had a long-standing priority that the next faculty hire should be in the area of instrumentation and/or computational astrophysics, and we concur that this continues to make sense given the complexion of contemporary astronomy and the current research interests represented in the Department. ***We recommend that the DAA immediately proceed to the recruitment of a new Faculty member with priorities in the areas of Instrumentation and Computational Astrophysics.*** Not only would this hire be consistent with the Department’s current academic plan, but it is crucial for a healthy renewal of the faculty complement required to enhance the research profile of the department, and to assist with the teaching and supervision of more high-quality students.

The scientific interests of the DAA have been broadened recently through an increasing emphasis on instrumentation development and by providing space and funds for associated laboratory work. The DI will also focus on experimental astronomy and instrumentation. Though a detailed staffing plan for the DI awaits the appointment of its first Director, faculty appointments will likely be joint positions with other academic units. In fact, as we understand it, at least three of the four planned DI positions are to be joint appointments with the DAA. ***We recommend that the majority of the DI joint appointments be with the DAA.*** Joint appointments with the DAA will help address concerns arising from the heavy burden placed upon the relatively few DAA staff to service all the undergraduate teaching on the St. George campus, as well as assuming the major responsibility for administering the graduate program, including teaching. Judicious selection of these appointments could bring the DAA back into alignment with its strategic academic plan. Moreover, an appropriately structured DI will generate considerable synergies with both the DAA and CITA, particularly if all are co-located (see §2.2).

Successful instrumentation development requires a facility on which instruments can be tested and utilized to enhance their effectiveness. In past reports, including the Harris-Steidel (2007) examination of the graduate program, a similar concern was noted in the context of graduate student training. Most of the U of T’s peer institutions in the US have guaranteed access to an observatory telescope. Even if these are not necessarily first-tier facilities, they provide the necessary outlets for training observational astronomers as well as a context for experimental work and instrumentation development. This is yet another area that will require a strategic approach if the emphasis on instrumentation in the DAA and the DI is to be sustained on a world-class level.

There are two other units, UTSC and UTM, which have faculty members in the graduate astronomy program administered by the DAA. In the Self-Study document provided to the Review Panel, the Chair noted that “By university protocol, the graduate Chair is supposed to be consulted re: academic planning and to participate in all search committees for which the candidate would be in the Astronomy and Astrophysics graduate Department.” This is an important protocol that has been incorporated into the Academic planning of the DAA, whose Chair serves as the Chair of the graduate program. Recent lapses in this protocol were noted. Clearly, this is a complicated internal situation, and the limited insight we have had into these issues gives us some pause in commenting on specific details. We believe that it is in the University’s best interests to ensure that the astronomy programs at these sites contribute to the overall strength and reputation of astronomy and astrophysics at the U of T. For this reason, we endorse a strong astronomy and physics presence at

these sites, whose faculty and students should contribute significantly to the graduate program and research profile of the University. Though beyond our mandate, *the possibility of establishing a separate Physics & Astronomy Department should be seriously considered for both UTSC and UTM.*

We commend Peter Martin for his outstanding stewardship of the DAA over the past decade, especially during a recent period of base and one-time-only budget reductions.

1.2 Administrative Staff

The administrative staff unanimously agreed that they worked in a friendly environment. While staff morale is high overall, there are some concerns. Individual workloads have increased over the past two years, largely due to duties associated with the closing of the DDO and particularly with the launching of the DI. The Department Manager estimates that in excess of 0.5 FTE has been added cumulatively to staff workloads in the past year to handle DI-related matters. With more activity anticipated, the extra workload is unlikely to diminish until the DI is a fully functioning unit, presumably with its own administrative staff. For this reason, *if the latter is further delayed, some form of relief from the current burden on the administrative staff should be considered.*

The most critical staffing issue involves the Department's IT support, which now is the responsibility of a single individual, the Computing Facilities Manager, who must manage a very complex system of over 290 active computers on 3.5 subnets in 3 locations. Part-time student support has proven to be a mixed blessing because of the unreliability of some students who must balance this work with their academic schedule. The fallback for many in the DAA is "self-management", a stop-gap that can expose the entire network to risk and lead to even more work for the Computing Facilities Manager in the long run to "undo" ill-implemented upgrades, etc.

The current Chair noted that the DAA is under-resourced with respect to administrative staff compared with its cognate departments. Part of this problem is undoubtedly due to its small size and the rest is likely a product of historical evolution of which we are unaware. There does not appear to be a simple solution to this challenge as the staff complement is the minimum required to ensure adequate administration of departmental affairs, including undergraduate and graduate programs, finance, IT and the overall management of a department that must interface with the central administration. The staff consists of capable and dedicated individuals who contribute a great deal to the success of the DAA and the removal of any one, particularly the Computing Facilities Manager, would constitute a single point failure.

One possible long-term solution that should be explored seriously involves the sharing, where appropriate, of administrative and technical resources among the DDA, CITA and the DI. One might imagine in this context that the greatest efficiencies would be realized if these units were also co-located, i.e., in the same building (see §2.2).

A particular issue arises with respect to the DAA Library, which is still physically located in the Burton Tower. The Review Panel met with the departmental librarian and was impressed with her level of engagement in the many issues that confront science libraries today. She is a valuable departmental resource and has worked diligently on streamlining operations. The library retains a strong acquisitions policy for monographs, which helps the library maintain its distinction as the most comprehensive astronomy collection in Canada. Circulation rates amount to about 300

volumes taken out each term. At the same time, we Reviewers were surprised to see stacks of bound journals, most of which are readily available on-line, including extensive back issues. In this age of ready availability of on-line information, the role of libraries as repositories has diminished, yet it is undeniable that the intellectual environment for astronomical study and research is enhanced by the DAA library. *Some thought might be given as to how the space occupied by the Library might be better utilized to foster collegial exchanges within the stimulating environment of a reading room.* Perhaps such changes could be considered in light of a comment we heard that the Library would be better located in the AB building.

2 Organizational Structure

2.1 CITA and the DI

Over the past two-and-a-half decades, the DAA and CITA, though formally independent organizations, have together established a solid international reputation in astronomy and astrophysics. The DAA is now eagerly looking forward to the launching of the DI whose presence, if appropriately integrated with the DAA, could further enhance the stature of astronomy and astrophysics at the U of T. We note, however, there are substantial anxieties related to the delay in opening the DI and uncertainties associated with its administrative support. While we recognize that it is the responsibility of the directors of DAA, CITA, and DI to act collegially and cooperatively, *we recommend that the Dean of the Faculty of Arts and Science (FAS) ensure that the impact and international profile of this combination is maximized for the benefit of the University.*

2.2 Facilities and Location

Most of the DAA faculty and graduate students, as well as all the administrative staff, are now “temporarily” located in the AB site, near to, but separated from CITA. Three DAA faculty members chose to remain in the Burton Tower on floors adjacent to the CITA faculty and staff. In addition, their graduate students and the graduate students supervised by CITA staff are separated from those in the AB building. The Harris-Steidel (2007) report noted that communications were already deteriorating even within the short interval between the DAA move to the AB and the issuance of their report. The situation has certainly not improved in the meantime. There is no question that communications among the DAA faculty and graduate students and between the DAA and CITA personnel have been impaired by the partial move into the AB. This is very unfortunate as the close proximity of CITA and the DAA has long been a contributing factor to the strength of both groups.

It is our understanding that the DI is to be located in the AB. This is highly desirable and it was gratifying to learn that the DAA and DI faculty are to be integrated into a common environment rather than partitioned into distinct sections. This policy will help facilitate collegial interactions among the faculty and students, taking advantage of all potential synergies. It would be ideal to extend the same principles to the integration of CITA staff into a common space with the DAA and the DI, possibly into a new building on the AB site. *We recommend that the DAA, the DI and CITA be located in a single building, and strongly urge the University to assign this the highest priority in the next capital campaign to avoid further erosion of the collegial ties between CITA and the DAA and to ensure that the new DI is also able to benefit from the presence of CITA.*

We appreciate, however, that capital campaigns can be protracted. If this appears to be the

case, we urge the University to investigate whether additions to the AB building itself would serve the purpose. In particular, *we suggest a professional engineering evaluation of whether adding another floor on top of the current AB building is a viable option.*

3 Undergraduate Program

We commend the DAA for adopting creative and innovative approaches to enhance the undergraduate enrollment of non-science majors in response to an earlier external review, becoming one of the most effective and efficient physical science departments as measured by the AS indicator A1 (FCE undergraduate enrollment divided by the faculty FTE). Among the 10 cognate science departments in the FAS, 9 have smaller A1 indicators than the DAA. Student evaluations in these very large introductory classes are very positive, suggesting that modern pedagogical approaches and methods are working well, though this needs to be monitored using more objective measures.

The UofT has long benefitted from the presence of John Percy, who has been a leader in advocating the importance of teaching and providing much appreciated advice on teaching, not only to his colleagues but to the Canadian community as a whole. Professor Percy noted that careful thought has been given to pedagogy and that a bi-weekly Education Discussion Group is active in the DAA. This brings in expertise from outside the department to improve teaching techniques.

It is not surprising that the DAA takes undergraduate teaching seriously and that recruitments over the past decade have included individuals with outstanding teaching and communications skills. In this context, the recent success of Michael Reid in lecturing the very large Astronomy courses 101 and 201 (1350 students each) is quite noteworthy. Such large classes require a qualitative change in approach to teaching.

Due to the temporary nature of Reid's position, we are concerned about the future of these important courses when his current contract ends. We understand that Lecturers play an important role in undergraduate education among most Science Departments in the FAS, apart from the DDA which has none. This leads us *to suggest that the DAA consider the appointment of a Lecturer to supplement the faculty teaching complement. This appointment should be in addition to the faculty position required to replace the current Chair.*

In this way, further enrollment growth is quite possible. This issue goes beyond mere teaching relief for already busy researchers; some students who take these large "distribution courses" will one day occupy influential leadership positions in society. It is essential for the health of a contemporary democracy that its leaders be scientifically literate and share an appreciation of the wonders of the natural world. It is worthwhile to devote a great deal of attention to such courses to ensure that they enhance the student experience.

With regard to the 101 and 201 courses, we acknowledge that FAS has contributed appreciably to its successful transformation by providing, among other forms of support, a substantial increase in the number of teaching assistantships for these large classes. This has allowed the large classes to include tutorial sections that provide the students with opportunities to experience scientific discovery in a more intimate setting. The department has employed a dedicated staff member to organize the TAs and to develop demonstrations for the class, including the operation of a small planetarium. In addition, this staff member is revitalizing the campus observatory facilities. All this demonstrates a concrete commitment to providing a meaningful undergraduate learning experience.

We also note the active role played by a department graduate student in organizing the student tutorials. An important side benefit of this activity is the opportunity for the graduate student TAs to become familiar with teaching and to that end, the department is encouraged to give more attention to mentoring these students and facilitating their training as teachers through mechanisms like the University Center for Teaching Support and Innovation.

The overall undergraduate program in astronomy and astrophysics appears to be healthy, with a variety of degree options, an appropriate range of course offerings, and reasonable enrollments. As we understand it, there are of the order of 100 undergraduates enrolled in the astronomy programs (for all three years when students have a declared major). This includes about 30 “specialists”, with the rest divided between “majors” and “minors”. Student satisfaction with their courses appears good in the survey results provided in the “Self Study” document, and quite consistent with the norms across the FAS. While student surveys are useful for gauging the students perceptions of the course and the lecturer, we found no ready statistics to help us ascertain the *strength* of the undergraduate program; in particular, there seems to be no compilation of the academic or professional trajectories of these undergraduate astronomy students. ***We therefore urge the FAS to implement an exit survey of final-year undergraduates and to follow their (academic) trajectories. This will allow, among other things, a more objective determination of the strength of the program.***

Because the DAA takes undergraduate instruction very seriously, it must carefully prioritize its allocation of resources due to its relatively small size. Whereas this has had little apparent impact on research output, there is some evidence that it has impacted graduate teaching (see §4.2). Caution must be exercised not to allow undergraduate teaching to constrain unduly other scholarly activities such as graduate education for which the DAA is highly regarded. This issue speaks to the need to increase the faculty complement and to find creative ways to share the common load of teaching as well as administrative burdens on the St. George campus.

Finally, ***we also suggest for future external reviews that arrangements be made for the evaluation committee to speak with a small, but representative sample of undergraduate students.***

4 Graduate Program

4.1 Graduate Students

The DAA currently is home to some 35 graduate students, approximately 60% Canadians, and the remaining 40% international students, including from the US. The Review panel shared lunch with these students at a well attended meeting over the noon-hour. We were pleased by the frank discussion of a wide range of issues and the number of thoughtful comments and suggestions made to us. Our impression is that the vast majority of these students were pleased with the choice they made and are happy to be members of the DAA at the University of Toronto.

From what we were able to ascertain, this is a strong cohort of students, from quite diverse locales, working on a broad range of astrophysics topics. We were disappointed by the decreased emphasis on recruiting international students, a direction which could deleteriously affect the profile of the program internationally. International students not only allow for a broader pool from which to select the most talented students, but ultimately lead to international networking that enhances the DAA’s visibility and prominence. ***We suggest that the DAA should try to retain the 60% / 40% split of Canadian to international graduate students.***

The students themselves are quite keen to ensure that good students continue to be recruited into the Program. Curiously, a similar note was struck by the past Associate Chair for the Graduate Program, Howard Yee, who commented that good and satisfied graduate students lead to more success in recruitment. The students on the other hand, were concerned that the department appears to lack an organized strategy toward graduate recruitment. Simple things, such as new posters and an improved website describing the DAA Program, would in their view help considerably. *We recommend that the DAA consider more involvement of the senior graduate students in the recruitment of new students, both at the campaign level and also at the admissions level.*

Most of the graduate students seemed pleased with their duties as TAs, including, and especially, the tutorials associated with the large undergraduate courses. *We suggest that TAs avail themselves of the opportunities provided by the University for training, and that a program for TA mentorship be considered (i.e., where senior TAs mentor junior TAs).*

Quite a few of the graduate students articulated the concern that inflation has effectively eroded the minimum salary for graduate students. They made their own comparisons among Canadian universities in different cities, with quite varied costs of living, as well as with some US universities. *They feel that their support level, all factors considered, is relatively low. If this becomes a widespread impression, it could seriously affect the recruitment of new graduate students.*

One concern is that the DAA does not obviously attract students from their peer group of American universities. In our discussion, Professor Yee noted that perception is important and that in his view, the main factor in successful recruitment of American students was the relative value of the Canadian to the US dollar. This can perhaps be put to the test in the next recruitment season. *Nevertheless, it would seem that a more strategic approach to graduate recruitment would be worthwhile.*

Under Howard Yee's leadership of the graduate program over the past 5 years, the quality of the graduate students has improved noticeably in the eyes of at least some of the people we talked to. Whereas the CITA faculty previously supervised relatively few DAA graduate students (only 4 students had listed start dates between 2001 and 2005, inclusively), they have taken on ~ 13 graduate students from DAA over the past four years. We attribute this substantial increase in large part to the perceived enhancement in their preparation and backgrounds. Professor Yee's view is that the overall quality of the applicants has not really changed but that the success rate for recruiting the top candidates has improved. *"First choice success rate" is an important metric in any recruitment exercise and we suggest that it would be useful to future reviewers if that were tracked systematically.* The correlation of the metric with external events and internal activities would be very helpful in devising an optimal recruitment strategy. A high quality graduate program has contributed significantly to DAA's well regarded international reputation. *The DAA must continue to monitor and explore ways of enhancing the quality intake to its graduate program.*

4.2 Graduate Teaching and Research Program

Early in this decade, the DAA instituted a "direct entry" PhD program that emphasized the early involvement of students in advanced research. Students are required to participate in two short research projects with different faculty members in order to get them launched more quickly into

this important facet of their graduate education. The formal requirements for the graduate student program were reduced to four one-semester astrophysics courses and an oral exam that emphasized the sub-field in which the student was to do his or her dissertation. The Harris-Steidel report noted that while both retention rates and time to completion had improved, there was a perception that the department was failing to produce well educated and versatile scientists because of the high research-oriented focus of the program.

In response, the DAA is developing a two-step PhD examination process. The single oral exam is to be split into two parts: one testing astrophysics breadth, and the other a student's proposed thesis research. The first part is to be based on a standardized test bank of material deemed essential knowledge for all PhD graduates in Astrophysics. ***We concur with the proposed restructuring of the oral exam.***

With regard to the low number of required astronomy and astrophysics courses, the faculty and students are of mixed opinion as to whether this is a good development or not. There seems to be a broad consensus that the introduction of two early research projects is an excellent development. However, this has clearly come at the expense of the formal classroom course requirements. Even with the changes in the PhD examination, there remains some concern, which we share, that the students who complete the DAA graduate program will not be as broadly educated in astrophysics as they should be.

One solution is that students may still enroll in the traditional program that proceeds through an MSc degree that emphasizes course work. This is an option that should be particularly appealing to those interested in theory and needing a deeper exposure to advanced physics and mathematics than a typical observational or experimental astronomer. ***A second and more general solution is to strengthen the advisory committee structure to ensure that students receive sound advice on improving their general background knowledge.*** Such advice is particularly important in the first year of the program at a time when the students are still searching for a dissertation topic and supervisor. We comment further on this issue below. Sound background preparation will be important under the new qualifying examination format, which will include a distinct test of comprehensive knowledge.

Compounding this issue is something we were surprised to learn from the graduate students. There is widespread agreement among the graduate students concerning the lack of structure, and consistency in DAA's graduate courses. The graduate students we met expressed a consensus view that the graduate courses, in general, are not well taught, and that the expectations for the students' background, work load, and level of difficulty varied widely from course to course. For example, some of the students with predominantly physics backgrounds were dismayed upon discovering "hidden pre-requisites" in the form of presumed knowledge about astronomy after enrolling in certain courses. In the course of our visit, we did hear that staffing the graduate courses is generally secondary to ensuring that the undergraduate courses are well taken care of. The realities of the numbers involved may indeed force priorities of this kind, implicitly, if not explicitly. Whatever the reason, it is unfortunate that there is a perception that graduate teaching matters less than undergraduate teaching. ***We therefore urge the DAA to offer a suite of carefully organized and well-taught graduate subjects.***

The graduate student survey results from 2005 and 2007 were provided in the Self Study document. The 2007 results for question blocks 1 and 2 appear to be consistent with the more recent comments we heard. (For example, question 1.4: rate the overall quality of graduate level teaching by faculty: there were no "excellent" ratings and fully 50% of the respondents gave a "poor" rating.

The corresponding values for other departments at U of T were 18.4% excellent and 13.5% poor.) The only caveat to note in the reported results is that the participation ratio in the survey was low.

In view of the high satisfaction ratings in undergraduate teaching, coupled with the outstanding research accomplishments of the faculty, we do not believe the problem with the graduate courses is an intrinsic inability to teach or communicate. Instead, we reluctantly accept that there is some substance to the perception that graduate teaching has, in general, a lower priority with the DAA faculty. However, we also note that overall, the students expressed a high level of overall satisfaction with their program. The problem revealed here is undoubtedly related to the many constraints to be juggled by a small department that has been under some financial pressure for some time now. The formal graduate courses have suffered, yet the faculty continues to provide strong guidance in the development of the students' research program. All in all, this is evidence that the department is stressed by the fact the entire teaching load for astronomy and astrophysics falls on the members of the DAA. *It is unlikely that all teaching demands can be met without some increase in the faculty complement, which would allow for a rebalancing between teaching at the undergraduate and graduate levels (see §1.1).*

We might also note here that a number of the DAA faculty have been fully or partially "bought out" of teaching duties through prestigious awards arising from their research accomplishments. The Department, which is suffering from a serious structural financial deficit, has been using some of the external funds directed toward teaching relief for other purposes. This again is an unfortunate side-effect of the present financial stress the DAA is suffering through. The remarkable achievements of the DAA, for example the award of three very prestigious NSERC Steacie awards in the recent past, is a strong indication of the high quality of this small department. *We would urge the FAS to address the financial stress under which the DAA is operating, which, we believe, would help remove the small blemishes on the Department's reputation arising in the area of graduate teaching.*

Another general source of concern among the graduate students is that faculty-student communications were far from optimal. The "first-year committees", in general did not seem to be functioning as well as they should, and not adequately providing students with the best advice on the coursework that they should be pursuing. *Several of the students suggested that DAA should consider cutting the number of faculty members on the first-year committee to two, and adding a senior graduate student. We think that this suggestion has substantial merit.* The first-year committee should proactively identify and address incoming students' background weaknesses, including the assignment of coursework beyond the minimum required. As a complement to this, several graduate students expressed a willingness to serve on various committees, including possibly graduate admissions, as a way of becoming more involved and fostering better student-faculty communications.

Finally, we end the discussion of the graduate program on an overall very positive note. It is important to point out that the overwhelming majority of the DAA graduate students, notwithstanding the above concerns, have an extremely positive opinion of being part of the DAA graduate program. They were rather proud to be at U of T, and were very pleased with their decision to do their graduate work in the DAA.

5 Summary of Recommendation, Suggestions, and Notes

The following is the list of highlighted areas extracted verbatim from the body of this report.

Recommendations

- §1.1 – We recommend that the DAA immediately proceed to the recruitment of a new Faculty member with priorities in the areas of Instrumentation and Computational Astrophysics.
- §1.1 – We recommend that the majority of the DI joint appointments be with the DAA.
- §2.1 – We recommend that the Dean of the Faculty of Arts and Science (FAS) ensure that the impact and international profile of this combination [DAA, CITA, DI] is maximized for the benefit of the University.
- §2.2 – We recommend that the DAA, the DI and CITA be located in a single building, and strongly urge the University to assign this the highest priority in the next capital campaign to avoid further erosion of the collegial ties between CITA and the DAA and to ensure that the new DI is also able to benefit from the presence of CITA.
- §4.1 – We recommend that the DAA consider more involvement of the senior graduate students in the recruitment of new students, both at the campaign level and also at the admissions level.
- §4.2 – We [...] urge the DAA to offer a suite of carefully organized and well-taught graduate subjects.

Suggestions:

- §1.2 – If [a fully functioning DI] is further delayed, some form of relief from the current burden on the administrative staff should be considered.
- §1.2 – One possible long-term solution that should be explored seriously involves the sharing, where appropriate, of administrative and technical resources among the DDA, CITA and the DI.
- §2.2 – We suggest a professional engineering evaluation of whether adding another floor on top of the current AB building is a viable option.
- §3 – [We] suggest that the DAA consider the appointment of a Lecturer to supplement the faculty teaching complement. This appointment should be in addition to the faculty position required to replace the current Chair.
- §3 – We also suggest for future external reviews that arrangements be made for the evaluation committee to speak with a small, but representative sample of undergraduate students.
- §4.1 – We suggest that the DAA should try to retain the 60% / 40% split of Canadian to international graduate students.
- §4.1 – We suggest that TAs avail themselves of the opportunities provided by the University for training, and that a program for TA mentorship be considered (i.e., where senior TAs mentor junior TAs).

- §4.1 – “First choice success rate” is an important metric in any recruitment exercise and we suggest that it would be useful to future reviewers if [graduate student recruitment] were tracked systematically.
- §4.2 – Several of the students suggested that DAA should consider cutting the number of faculty members on the first-year committee to two, and adding a senior graduate student. We think that this suggestion has substantial merit.

Notes:

- §1.1 – The possibility of establishing a separate Physics & Astronomy Department should be seriously considered for both UTSC and UTM.
- §1.2 – Some thought might be given as to how the space occupied by the Library might be better utilized to foster collegial exchanges within the stimulating environment of a reading room.
- §3 – We therefore urge the FAS to implement an exit survey of final-year undergraduates and to follow their (academic) trajectories. This will allow, among other things, a more objective determination of the strength of the program.
- §4.1 – [We note that the graduate students] feel that their support level, all factors considered, is relatively low. If this becomes a widespread impression, it could seriously affect the recruitment of new graduate students.
- §4.1 – [It] would seem that a more strategic approach to graduate recruitment would be worthwhile.
- §4.1 – The DAA must continue to monitor and explore ways of enhancing the quality intake to its graduate program.
- §4.2 – We concur with the proposed restructuring of the oral exam.
- §4.2 – A second and more general solution [to a broader education in astrophysics] is to strengthen the advisory committee structure to ensure that students receive sound advice on improving their general background knowledge.
- §4.2 – It is unlikely that all teaching demands can be met without some increase in the faculty complement, which would allow for a rebalancing between teaching at the undergraduate and graduate levels.
- §4.2 – We would urge the FAS to address the financial stress under which the DAA is operating, which, we believe, would help remove the small blemishes on the Department’s reputation arising in the area of graduate teaching.