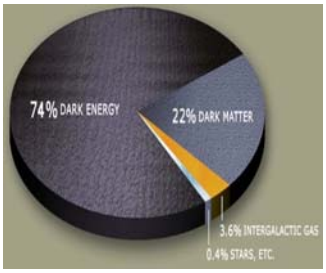
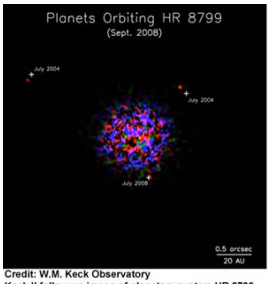
1. WHY ENGAGE IN ASTRONOMY AND ASTROPHYSICS?

Vision: A global society aware of its infinitesimal place in the universe yet confident in its aspirations and shared potential.

We live in stimulating times. Just 400 years after Galileo's phenomenal observations of the solar system bolstered the Copernican Revolution, we have pushed beyond resolving the Milky Way into stars to the observable edge of the universe. Recent discoveries of dark energy and dark matter indicate that stars, the traditional realm of astronomy, comprise a mere 0.4% sliver in the energy/matter budget of the universe. The Sun, one such star and supporter of life as we know it, will go out in a finite time. From observations that the universe is expanding we are led to ponder the dawn of time, the epoch of inflation and creation of matter; and equally staggering, the evidence for accelerating expansion suggests a feeble end to it all.





Credit: W.M. Keck Observatory
Keck II follow-up image of planetary system HR 8799 showing all three planets.

In the last decade we have discovered for the first time hundreds of planets orbiting other stars, confirming that exoplanets are a natural phenomenon accompanying star formation. As we set plans to find terrestrial planets in the "habitable zone" of their parent star and search for signatures of life, and in parallel seek evidence for life elsewhere in the solar system, we are on the cusp of an intellectual revolution, a mind-expanding change in perspective, a profoundly new "world view."

An alien visiting Earth might remark judgmentally "what wonders/monstrosities hath man wrought" or disinterestedly "oh well, there are lots of other planets," but can we afford to be detached?

Mission: Making sense of the complex universe through leading astrophysical research, providing a scientific context for contemplating life in the cosmos and a fertile ground on which to develop wisdom concerning the human condition.

Modus operandi. Astronomy thrives on fundamental intellectual challenges of stupendous sweep. Charged with the origin, evolution, and fate of the universe and how it works at scales ranging from galaxy clusters to stars, from planets to elementary particles, it is the ultimate environmental study. By unlocking the mysteries of the universe, we aspire to go beyond myth to deliver insight. We aim for rigorous physical and mathematical models, at times increasingly complex and then by turns grandly unified and simplified. We continually challenge and even disrupt our models by new observational data, whether acquired deliberately or serendipitously. In contemplating the rise in complexity, there is plenty of scope for curiosity-driven research and opportunity to marvel at the subtleties.

Research on the fundamentals is the *sine qua non*, but is for naught if not connected to teaching and outreach. Sharing the insight, indeed the beauty, is central to our mission.

We marvel at the astronomical images produced with advanced telescopes working across the electromagnetic spectrum. This is a wonderful modern manifestation of the sense of awe experienced by humans through the ages, alone outdoors in the dark, face up to the firmament. But our mission would be incomplete if we stopped there, failing to move beyond passive appreciation to intellectual engagement.

Aboard a tightly interconnected but hugely diverse and finite Earth, humanity faces tough questions, crises, with moral imperatives, such as lack of clean water, hunger, uneven distribution of wealth, uneven effects of global warming. In blundering along, humanity might at times seem like the fanatical and hapless Wile E. Coyote; yet the profound difference is made clear by the overarching astronomical perspective: we are not in some protective cocoon and immune to outside forces. Actions have consequences. There is no cosmic birthright. Nothing is forever. Contemplating the cosmos is exhilarating and uplifting, but it is also sobering to acknowledge that within the Earth's microcosm society might not be up to handling the pressing problems, suffering the ultimate "ingenuity gap." This obviously goes well beyond astronomy and astrophysics alone. But we can aim to develop the scientific context in which to discuss, perhaps even understand, life in the universe and how the particular instance that includes humans on Earth fits in. What would Spinoza think today?

Collateral benefit: science literacy. There is a broad and age-old thirst for astronomy. In the UN Declaration of the International Year of Astronomy 2009 the "*Assembly encouraged all Member States, the United Nations system and all other actors to take advantage of the Year to promote action at all levels to increase public awareness of the importance of astronomical sciences and promote widespread access to new knowledge and experiences of astronomical observation.*" Inspired citizens such as Gruber, Kavli, and Shaw, their imaginations captured, have established awards to recognize advances in the field. The new Bhaumik Prize places great value on helping "*society at large to better understand the mysteries of the Universe and reassess our place in it.*" In addressing this thirst, exposure to the big ideas of astronomy and the way they are investigated contributes more generally to scientific literacy and the public good. This is an excellent outcome, though not the prime motivation for engagement.

Relationship to technology. Advances in astronomy are intimately dependent on cutting-edge technology, whether the ever-more-capable instrumentation for giant telescopes and observatories or the high performance computers increasingly implicated in data acquisition, reduction, modeling, and simulation. It can even be documented that the exacting requirements of astronomical observations drive technology development with (usually unanticipated) lucrative spin-offs feeding back into the economy. But it would be a mistake, especially in an academic plan, to argue for support for astronomy based on a narrow inventions-to-market agenda. Astronomy is about ideas, not material things.

The flapping of a butterfly's wings might have unimagined effects, but the whole point of strategic planning is for deliberate actions to have predictable outcomes. Astronomy and astrophysics matter. The University of Toronto should continue to be engaged at the very forefront. The Department, working closely with CITA and the new Dunlap Institute, can deliver.

2. KEY STRENGTHS

In terms of FTE (9.5), the Department of Astronomy and Astrophysics (DAA) is the second smallest in the Faculty of Arts and Science (FAS). Nevertheless, it has a pre-eminent national and international role in research, and in outreach it provides one of the more prominent modes of contact between the University of Toronto and the public. This couples seamlessly with a long tradition of commitment to teaching at all levels. In undergraduate studies there is strength spanning specialist programs to breadth courses. With top professors engaged in the classroom DAA's reach has blossomed to the second highest FCE/FTE ratio (B1=157) among the Science departments in FAS. Despite the stresses of this success, and diminishing resources, we are continuing to innovate to bring the latest research to the classroom, to inspire research opportunities, and to provide hands-on, experiential learning to each undergraduate. Graduate students, many international, are high performers as well and very successful in their subsequent careers. The demand is high and the enrolment is still expanding, standing at 37 pursuing the PhD degree. DAA currently hosts eight world-class postdoctoral fellows.

Within Canada, the University of Toronto is in a unique and enviable position of leadership, thanks to the century-long programs of the DAA and the outstanding success of the Canadian Institute for Theoretical Astrophysics (CITA, 1984). Altogether Toronto holds 20% of the value of the national astronomy annual grants under NSERC GSC 17 (the next universities are under 10%). Nevertheless, these other universities are developing strong programs and we cannot be complacent. The stimulus provided by the endowment and establishment of the Dunlap Institute for Astronomy and Astrophysics (DI), combined with the continued unique strengths of DAA and CITA, will consolidate and enhance the University's work in astronomy and astrophysics within the top tier internationally and deepen our commitment and contributions to research, teaching, and public outreach.

The excellence and high performance of Canadian astronomy and astrophysics are well documented through the ISI country and discipline rankings, which show we are leaders in the G20 and the highest impact science in Canada. To a great extent, our continued success depends on the development and implementation of national Long Range Plans for the discipline through which hundreds of millions of dollars are invested for the Canadian university community through the Canadian Space Agency (CSA), CFI, NRC, and NSERC, mostly in international ventures. DAA recently completed an 80-page Self Study. The priorities of DAA are in synergy with this national and international effort, and with a deliberately world outlook we are making the most of these opportunities.

a) What distinguishes/differentiates DAA from its peers in Canada and abroad. The key has been to recruit, nurture, and retain high quality personnel, bringing together unique talents in observation, theory, instrumentation, and computation to address the far-reaching questions, and in doing so earn the essential support required from the University and the funding agencies, inspire the next generation of students and researchers, and give back to the community through our extensive outreach programs.

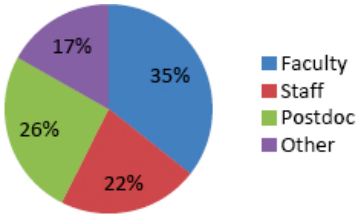
DAA recruits its top faculty from all over the world, the six most recent being from Canada, China, Korea, the Netherlands, Sri Lanka, and USA (Netherlands, UK, and USA PhDs). We make the best hires. Winning three Steacie Fellowships in the past four annual competitions across all of science and engineering in Canada must be unprecedented for any department. As expected, all FAS performance indicators are very competitive (D1=0.4, D2=0.9, D4=$400K). D3B dipped only because we optimistically put CLTAs forward at a time when changed policy/practice funded none in GSC17 across Canada. Faculty members enjoy success with CSA contracts and grants as well.

(i) Research and scholarship. DAA is distinguished by its high publication/citation ranking (see (b) (i) below) and the rare ability to engage and combine across the broad spectrum from observation to theory (wonderfully enhanced by CITA and DI). We have a vibrant international connectivity through our leadership in research and thanks to endowments enrich this through a weekly colloquium series, distinguished visitorships, and memorial lectures.

(ii) Graduate education. Our ability to recruit top students is crucial. Our domestic students are outstandingly competitive (C5=0.5), including Vanier and CGS. We attract top international students too. This can be judged from six Connaught awards of a possible eight in the last four competitions, an amazing fraction of the ~80 awards across all disciplines. Of these three were recruited in the face of fierce international competition, a success made possible by the tremendous opportunities here and the high satisfaction rating of the program (C6=0.8). Our excellence in research attracts brilliant students, which leads to high impact research – a winning formula.

The culture in our discipline is for close supervision and collaboration with the students, and even so C1=2.8 is near the median in FAS. These are all PhD students and so the graduation rate C2=0.8 is relatively much higher and increasing (see (b) (ii)). The MSc has little relevance in this discipline and C3 is low because of our pioneering direct entry program. Compared to our competitors, and across FAS, the mean time to completion (C4=5.7) is already favorable, and decreasing.

A hallmark of our direct entry program is that students are immediately immersed in research, the first call on their time. Over the course of the first year they complete two distinct MSc level projects mentored by different professors (a heavy load of supervision not reflected in the indicators). Students gain close knowledge of developing fields, a keen sense of how to do independent research, and begin to build their publication record. The formal courses also offered are well received, rating 5.8 on the scale of B3.



Our alumni do well. Of 101 PhD graduates over 1979-2009, 36 (13 in Canada) hold faculty positions, 22 (9) hold professional astronomer staff positions in government labs, observatories, and universities, 26 (7) are postdocs (recent grads early in their careers), and 17 are working outside the field (industry, financial sector, software, writing, secondary school, civil service, 3 unknown).

(iii) Undergraduate education. DAA offers a wide variety of instruction to undergraduates with diverse backgrounds and interests. One outside perspective from the Self Study was that *"UofT's astronomy course offerings greatly exceed those offered by other universities in number and quality. UofT offers a real astronomy undergraduate program, as opposed to the usual physics program with some astronomy electives. That's rare and worth emphasizing."* The courses are also well received by the students themselves (B3=5.7). The burgeoning enrolment has resulted in a large student/faculty ratio (B1=157). Nevertheless, we take care to provide many small-group learning opportunities (B5=0.5, B4=0.4 and growing – see (b) (ii)). We also offer the same number of First-Year Seminars (199 courses) as much larger departments.

Our undergraduate specialists are in demand at the top graduate schools. Their training includes hands-on practice in excellent undergraduate observatories. Additional research opportunities include the senior research project and summer employment (B7=0.6 and many more funded by grants). A computer lab, well equipped in astronomical software packages, is used in conjunction with research work and upper-level practical astronomy.

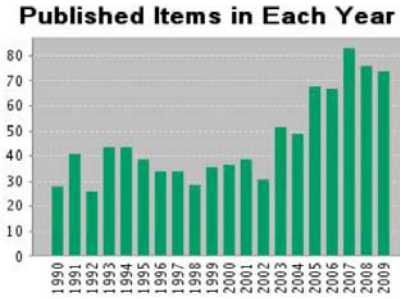
Our large courses for non-specialists, including breadth courses, are particularly noteworthy, aligned with our mission to contribute to common knowledge on the great intellectual issues raised by considering the cosmos.

Actual instruction is given high priority (B1=0.9, all professors). We place our top researchers in the large courses providing award-winning teaching (B2=0.1, continuing the legacy of professors like Hogg, Garrison, and Percy (UTM)). Our culture embraces an Education Discussion Group, an effective forum through which many innovative ideas have been floated, debated, and piloted.

(iv) Outreach. In its many aspects, outreach is another area that DAA does exceptionally well, systematically and on a much larger scale relative to others in the Faculty. Several of our faculty members have created, organized, and/or delivered innovative outreach programs that have captured international attention. We regularly mount major public lectures of our own and with the outstanding and energetic student Astronomy and Space Exploration Society (ASX). We also work closely with the Royal Astronomical Society of Canada and other local astronomy clubs and through the Education and Public Outreach Committee of the Canadian Astronomical Society. We participate in judging science fairs and special programs at the Ontario Science Centre. This has been a particularly busy year with the International Year of Astronomy (IYA). Our recent King's College Circle Heritage Society Event had record attendance and resulted in new donations.

b) What DAA has done over the past five years to enhance these strengths

(i) Research and scholarship. DAA has made one faculty hire to enhance the nascent astronomical instrumentation program (a holdover from Raising our Sights), adding to the outstanding new faculty already mentioned. With the faculty renewal, the growing number of postdoctoral fellows, and the expanding graduate program, DAA research



output measured in refereed publications has greatly increased in the Stepping UP period, to double the annual rate compared to the previous decade, according to ISI Web of Science. Citations are showing a parallel rise and should exceed 4,000 per annum this year for the first time. Diverse research highlights include the first microwave background measurements showing that the Universe was geometrically flat, the discovery that big galaxies had already formed when the universe was still relatively young, the first good evidence that the so-called dark-energy is well described by a cosmological constant, and the first image of a planetary mass object near a young solar analog. DAA faculty members have done well in grants and contracts and their stature has been recognized in many ways (FRSC, Steacie Fellowships, Steacie Prize, Herzberg Medal, Top 40 under 40, Beals Award, Bappu Gold Medal, ERA, CRC, and fellows of CIFAR).

Collective international recognition. The Association of Universities for Research in Astronomy – which runs the Space Telescope Science Institute (Hubble and the successor James Webb Space Telescope (JWST)), three leading national suites of ground-based telescopes for the US national community, and the US Gemini effort, all under contract with NSF – invited DAA to apply for International Affiliate status. Our application, supported by the Dean and President, was endorsed "unanimously and enthusiastically" in 2004 and renewed in 2007. International Affiliates are a select few, DAA being the only one from Canada. Others include Cambridge and Leiden.

(ii) Graduate education. We have consolidated and refined our direct entry PhD program. With targeted graduate expansion we have been able to recruit an even higher fraction of scholarship holders, building a strong cohort. Effective PhD committees have helped students complete in a more timely fashion. The rate of PhD graduates is therefore increasing, on the scale of indicator C2 (=0.8) from 0.7 in 2000-4 to 1.1 in 2005-9.

With the present split of DAA across three sites, we have adopted a policy of room assignments to place students close to relevant research groups, even moving them between the first two projects, to ensure close-knit dynamic learning communities.

With recent innovations in our undergraduate program, we are providing our graduate students, in their role as TAs, more rewarding opportunities creating content and leading small group labs and tutorials, rather than simply marking.

(iii) Undergraduate education. For the undergraduates this new thrust on labs/tutorials adds the benefits of bringing more research to the classroom and greatly enhanced small group learning. This is essential because of burgeoning enrolment. Uniquely among the six physical and mathematical sciences departments (where the comparison has been made), DAA's FCE has seen steady growth throughout the decade, with no post-double-cohort decline. Top teachers working with the Education Discussion Group have made the courses inspiring and oversubscribed. We had been held back on improving the learning experience by inadequate TA funding. With the new FAS formula this year, we have been able to introduce tutorials/labs in our large Convocation Hall courses. This

together with exciting new innovations like the proposed (to CRIF) teaching planetarium will make the enrolment pressure stronger still. If caps were lifted across all courses, enrolment could grow by a further 50%.

In the specialist/majors program we have responded to student input by increasing the Practical Astronomy course to one FCE (AST 326Y) and creating a capstone course for fourth year (AST425Y), building on the former very successful senior thesis half course.

(iv) Outreach. Our graduate students have developed and run a successful public night program once a month. Thanks to both advertising and word-of-mouth, these now routinely draw capacity crowds into a 200-seat lecture hall in McLennan after which they visit the telescopes at the campus observatories and on the balcony. The above-mentioned planetarium will also be a major new facility for public outreach. A new program for lectures and demonstrations in area high schools begins in January 2010.

c) Effective use of resources to enhance these strengths. A stimulating project with major promise has been to work with the Dunlap family to realize the renewal of the Dunlap legacy started with the David Dunlap Observatory in 1935. See the Dunlap Institute planning pages below.

Graduate expansion has been enabled by increased research grants and two new graduate scholarships (Martin and Shelley). With top quality graduate students we have excellent, motivated, and creative tutors and lab demonstrators.

Top researchers are in the classroom working flat out with good effect (note that nobody is required to take any of our courses!). By contrast to the increased enrolment, FTE available to teach these students has declined over the decade, with no professors beyond their normal retirement date (NRD), no bridged positions, and the sole Stepping UP position delayed then cut. With small total FTE and other factors like sabbaticals, this is beginning to reduce and constrain flexibility to provide opportunities for our professors to teach at all levels.

Beyond the classroom, we have nurtured and mentored the ASX that has grown to probably the largest student society (1,800 members). Their many ambitious programs provide superb extracurricular cross-disciplinary learning as well as providing challenging leadership opportunities, like organizing the annual symposium in Convocation Hall (see you on 29 January). We have helped pioneer the “Backpack to Briefcase” program bringing alumni insight to current undergraduates, something also accomplished by our regular alumni events through the AstroGradNetwork.

3. PRIORITIES

a) Taking advantage of our breadth. “*Recent years have seen a resurgence of interest in the concept of liberal education.*” Both our vision and mission resonate with this FAS goal. Operationally we place high priority on our breadth courses, with top professors in the classroom complemented by top research-active TAs providing small group learning.

"*Other avenues, such as mounting new, multi-disciplinary 'big ideas' courses in first year, are still in the early stages of discussion and development, but merit serious attention.*" DAA is ready to contribute to the discussion, in particular from experience with AST210 Great Moments in Astronomy, AST251 Life on Other Worlds, and our SCI199 courses, to ensure that science becomes an integral part of the cultural core for all students.

b) Rebuilding the student experience: intensifying our efforts. We will continue the roll-out of the new labs/tutorials to reach all 3,000 of our undergraduates in 2010-11. The proposed teaching planetarium will be put into action this summer (2010) and we will build collaborative use with other disciplines thereafter. We will increase hands-on use of telescopes in all courses.

Many students are eager for additional research opportunities beyond the many we provide in the summer, and so along with DI we will create more ROP experiences by tapping into the creative talents and research focus of our postdoctoral fellows.

As a variant of the "Socrates project," in DAA we will engage graduate students and postdocs, as well as senior undergraduates, with the beginning undergraduates in the specialist/majors program, offering attractive mutual benefits.

c) Graduate education and research excellence: leveraging our advantage. A top priority is to capitalize on our research expertise to provide our graduate students access to leading international telescopes (CFHT, Gemini, and JCMT, and TMT in the future) and to engage them in research consortia and key projects. The latter has been achieved for example in connection with the ESA cornerstone missions Herschel and Planck and we are poised to accomplish the same with the James Webb Space Telescope (JWST). We create opportunities through innovative instrumentation too, e.g., F2T2 on Gemini, WIFIS on the GTC, SPIDER stratospheric telescope, and first-light facility for TMT. Planned collaborative programs in instrumentation and emerging fields like astrobiology would combine our expertise with the broader University community. See the DI plan, pages 11-12.

d) The Colleges: capitalizing more fully on unique assets (see DI plan, page 12)

e) Engaging the broader community – globally and locally. To expand the international opportunities for our undergraduate specialists we have proposed a program making use of our 24-inch telescope in Argentina, possibly as an intersession course. Other non-science students could join to learn some astronomy and facilitate an enhanced cultural exchange. This requires new (private) funding. (Our graduate students already travel internationally to observatories and meetings.)

"*We should not lose sight of the valuable experiential and service learning opportunities that abound right here on our own doorstep*." Aligned with this FAS goal, we are in discussions with Outward Bound Canada to add an astronomy element to their new program for at-risk youth at the Evergreen Brick Works in the Don Valley starting 2010.

4. PLANS FOR ACHIEVING PRIORITIES

a) Strategies for achieving priorities with the current level of resources. We are successfully refocusing existing resources to promote undergraduate small group learning experiences and direct interactions with researchers, by greatly extending and enhancing the tutorials/labs and telescope sessions for all students especially in our large classes.

The largest threat is layoffs, temporarily delayed by outside funding (prestigious awards to faculty), to address the accumulated $120K structural annual shortfall from base budget cuts. Inevitably this would further impact the administrative staff (a full-time computing assistant was already eliminated), disrupting a lean, re-organized, and streamlined team providing essential support to the academic programs. At 1.6, indicator A2 is already high, and with two of six positions eliminated, both A2 and A3, already the highest among physical and life sciences, would skyrocket to 2.4 and 373, respectively.

b) Strategies given a base budget increase of $100K. For an experimental science department with the need for teaching "laboratories" (undergraduate telescopes, laboratories, computer lab, planetarium), DAA has a very high FCE/staff ratio (A3=249). This has historically impacted our ability to mount small class learning experiences, but using new OTO funding we have hired a TA coordinator/observatory demonstrator (this position is already in the denominator). Ideally, to realize opportunities with the planetarium, outreach, and web presence, we would have two technical staff (in part recovered from planetarium shows and DI?). But the first priority would be to offset the coming crushing effects of the budget shortfall.

c) Strategies re complement. DAA lost its only Stepping UP position, thus not benefiting from the 72 FTE increase in FAS from a low in 2006 (707) to 2009 (779); none of the 75 beyond NRD are in DAA. The indicators, most obviously the blossoming DAA undergraduate and graduate enrolments, show that the need for this position has actually increased, whereas complement is decreasing, by a further 0.5 with the return of the present chair to CITA. We have accumulated bridging funds from CIFAR to permit an immediate hire. By advertising broadly we have had great success in maximizing faculty excellence and would follow the same strategy in close coordination with DI and CITA. We are excited by coupling efforts in instrumentation and computational astrophysics to create novel opportunities in observational astronomy. Among exciting studies exploiting the major new international facilities ALMA and JWST, and the flagship TMT whose development we lead within Canada, would be planet and star formation. Such hires would propel the new initiatives in exoplanets and astrobiology in the graduate and undergraduate programs. Though visible minorities are well represented in DAA (~50%), we need to address the low fraction of female faculty members.

In the next seven years, seven members of the tri-campus graduate faculty will reach their NRD. If there were attrition (as threatened presently at both UTM and UTSC, seemingly beyond our control), then our outstanding programs, especially graduate, would be compromised. The University must not be complacent and allow our carefully developed preeminence to be squandered.

DUNLAP INSTITUTE FOR ASTRONOMY AND ASTROPHYSICS

1. VISION

As a renewal of the memorial that founded the David Dunlap Observatory, creation of the Dunlap Institute for Astronomy and Astrophysics (DI) presents a unique opportunity to ensure that the Dunlap name continues to be recognized internationally, in perpetuity, closely associated with excellence in astronomy and astrophysics. DI's mission builds upon the principle of bringing strong research leaders together with top students and postdoctoral researchers and forefront facilities. DI intends to become a major player on the world scene and, through its research programs, outreach, and its alumni, to have a lasting impact stretching beyond astronomy and astrophysics in the profound way that has come to be associated with the Dunlap name.

2. KEY STRENGTHS

a) What distinguishes DI from its peers in Canada and abroad. As an independent endowed academic unit, DI has no obvious peers. The University of Toronto is already excellent in astronomy and astrophysics based on its investments in DAA, hosting CITA, leadership in the Cosmology and Gravity Program of the Canadian Institute for Advance Research, and creation of a cluster of four chairs under the Canada Research Chair program. This top research-intensive university environment makes DI even more distinctive and informs the strategy for its development. While DI is independent, it is essential that it complement DAA and CITA so that the stimulus provided by the endowment enhances the University's leadership non-linearly. Collaborations with DAA and CITA will have most impact through synergy, by "*promoting fruitful interaction between astronomers engaged in observations, experimentation, simulation, and theory*."

Among the many objectives in the DI founding document that passed through governance, the External Review highlighted the unique and timely opportunities of two: instrumentation ("*explore and exploit the use of new technologies in advancing research in astronomy and astrophysics*") and outreach ("*provide a primary means for channeling information on astronomy and astrophysics to the general public*"). For both, what sets DI apart is the ability not only to think outside the box, but also to follow through. For example, DI can seed the development of novel instrumental approaches, so that applications for external funding are made from a position of strength. Likewise, DI enables unique outreach initiatives, as already accomplished (see below).

b) What DI has done over the past five years to enhance these strengths. DI started only in summer 2008. Two accomplished postdocs (from Caltech and Leiden) were hired in the winter competition and arrived in September 2009 to initiate searches for planets around low-mass stars using novel techniques and to study the formation and evolution of galaxies by exploiting data uniquely acquired with integral field spectrographs. We have advertised for two more postdocs to start September 2010. A world-wide search for the first Director has gone through short-listing and interviews and an offer is pending to a

remarkable candidate. Further complement planning for DI (an EDU B) will be done collaboratively with DAA.

Outreach. Already there have been two novel initiatives enhancing the celebration of the International Year of Astronomy 2009. Our Journalist in Residence Ivan Semeniuk, former North American bureau chief for New Scientist, is having an international impact through his blog, professional podcasts, video productions, and television appearances. To kick off IYA, we placed over 3,000 inspiring banner ads (5 originals) in every transit vehicle in Toronto and Mississauga for a month, with enriched support through our new CoolCosmos website. A campaign in French followed in Montreal and one ad was featured in a Universal Pictures movie.

3. PRIORITIES (a work in progress pending appointment of the first director)

Amplified research output. The overarching priority is to ensure that not only does DI become as productive to CITA and DAA, but also that it complements them such that there is non-linear gain and much larger impact. Already, independent Thomson ISI data (2003-7) would rank University of Toronto astronomy and astrophysics (DAA plus CITA) 17 among 71 North American universities (AAU and G13) in publications, where for comparison Caltech, UC Berkeley, and Arizona stood at 1, 2, 3 and Harvard 25. For the public universities, Toronto was 10 of 45. For citations, the rankings were 18 and 11, respectively, with Caltech, UC Berkeley, and Princeton the top 3. Thus, Toronto is already very competitive and it is reasonable to aim to boost these rankings to beyond 5, 3, 10, and 5, respectively.

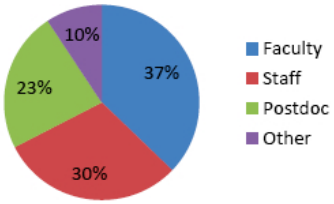
a) Taking advantage of our breadth. Astrobiology. Advances in the discovery and characterization of exoplanets have driven research in allied fields on the development of life in the universe. This is a "hot" field still being defined where DI could provide the focus for a collaborative graduate program, bringing together expertise of researchers from several departments across FAS. In the Planetary Science specialist program, DI could complement the efforts by DAA, Geology, Physics, and UTSC/DPES.

b) Rebuilding the student experience: intensifying our efforts. To complement DAA activities, individual interactions with students through ROP seem an ideal target.

c) Graduate education and research excellence: leveraging our advantage.
Instrumentation. DI will participate in dedicated experiments and the design, fabrication, and implementation of scientific instrumentation for well-defined and strategically-chosen research projects on world-class ground and space-based observatories. It is essential for our graduate students to be trained in the development of first rank hardware for the next generation of international and world observatories. Canada's current

decadal Long Range Plan (LRP) for astronomy and astrophysics gives as its highest priority for universities *the creation of laboratories for experimental astrophysics*, pointing to the *disappearance of university instrumentation laboratories as a potential point of critical failure in Canadian astronomy.* With its bold response, DI will dominate the field. To kick-start the graduate education we are exploring a Collaborative Masters in Instrumentation with the Faculty of Applied Science as well as players in FAS.

Postdoctoral training. We anticipate a high quality program based on DAA success. Of their 42 postdocs in the last three decades, 16 (7 in Canada) hold faculty positions, 13 (1) hold professional positions in government laboratories, 10 (2) are in further postdoctoral positions, and 4 are working outside the field (industry, federal civil service, and secondary education; 1 unknown).



d) The Colleges: capitalizing more fully on unique assets. Along with DAA and Physics, we are in discussion with Vic on creating a new physical sciences stream within the successful Vic One program. This might be resourced in part as an alternative to First-Year Seminars or independently. It would also introduce more scientists into the important college "*space for scholarly and social interaction between faculty from across the wide range of FAS*" with benefits for liberal education and courses on "big ideas."

e) Engaging the broader community – globally and locally. We will continue to look for "outside the box" initiatives where by targeting resources we can make an unique impact. Presently, with the Vice-President and the Vice-Dean International Relations, we are contemplating a bid to host the new "Office of Astronomy Development" highlighted in the new Strategic Plan of the International Astronomical Union. This would provide tremendous reach and new opportunities for faculty, staff, and students.

4. PLANS FOR ACHIEVING PRIORITIES

a) Strategies for achieving priorities with the current level of resources. A high dependence on endowment income is risky, but fortunately in the startup phase this has not had a serious effect. Planning for such emergencies will have to be built into DI's long-term budget strategy in order not to jeopardize programs.

b) A new building for astronomy and astrophysics. In its startup phase, DI is sharing space in the Astronomy Building (AB), a building that already does not have the capacity to house all of DAA. The lack of elevators makes access generally, and to labs specifically, problematic. DI cannot hope to flourish in the available space. Part of DAA occupies offices on half of the 12th floor of McLennan and a major research group has its primary home in the Stratospheric Telescope Integration Facility further along Russell St. CITA occupies the 13th and 14th floors of McLennan and the separation from DAA and DI is a major impediment to intended joint efforts. The much-anticipated redevelopment on the AB site will accommodate all of astrophysics (DAA, DI, CITA). This will require a major effort in advancement and with granting agencies like CFI, beyond the scope of the SPC, but it is important that the current high priority be endorsed.