

UNIVERSITY OF TORONTO

Brief for the Periodic Appraisal
of the
MSc. and PhD Programs
in the Department of
ASTRONOMY AND ASTROPHYSICS

Submitted to the
Ontario Council on Graduate Studies
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VOLUME I: The Program

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1. INTRODUCTION

1.1 Brief listing of programs

The Department of Astronomy and Astrophysics offers programs leading to the degrees of Master of Science (MSc) and Doctor of Philosophy (PhD).

The first PhDs were awarded in the early 1950s. Over the ensuing years, graduates have played an important role in the development of astronomy in Canada and indeed worldwide. Although there are now many other graduate programs in Canada, U of T's is the only one in an independent Department of Astronomy and Astrophysics. The Graduate Department draws its strength from faculty on three campuses and the Canadian Institute for Theoretical Astrophysics. It is the largest and leading program in Canada, with international recognition. Our graduates have been very successful in their further careers, most going on to post-doctoral positions and then to professional positions as faculty or staff members in astronomy observatories and institutes. Given the present strength and the anticipated growth of the discipline in Canada and internationally, the program has been authorized to grow by up to 50% over the coming planning period.

1.2 Objectives of the programs

Master's program:

The objective of the program is to prepare students more deeply in fundamental Astrophysics and to introduce them to independent research.

PhD program:

The objective of the program is to prepare candidates for a career in teaching and research. Graduates are expected to have acquired autonomy in conducting research, and preparing scholarly publications. The program is designed to provide both a broad knowledge of astronomy and astrophysics and training in basic research.

This document describes the Graduate Programs of the Department of Astronomy and Astrophysics as approved by the graduate faculty in 2001 after wide-ranging and extensive discussions in the department involving both students and faculty.

There are several motivations underlying the latest revision of the graduate curriculum. These include: offering students an opportunity to enter directly into PhD studies combining both coursework and intensive research while retaining the ability to provide a well-rounded one-year MSc degree; providing flexibility to students who enter into the program with a wide range of background and interests in astronomy and astrophysics; encouraging research as a major component in the education process; and ensuring that the department can offer a dynamic, competitive, and attractive degree program in comparison with other Canadian and international universities.

Candidates are accepted after specialist undergraduate preparation in physics and mathematics and sometimes (depending on the university) astronomy and astrophysics. The program leading to the PhD is intended to be completed in four years following a one-year MSc. Since 2000, most candidates are accepted directly into the PhD program and these “direct entry” students are to complete their programs in five years (15 sessions). Students are immediately engaged in original research through two required research courses, with different supervisors. The core of the program is a thesis embodying the results of original research which must be submitted for external appraisal. As a first step, a candidate is required to prepare a written PhD thesis proposal and defend it at a qualifying examination, the assessment being based on the candidate's graduate record to date, including graduate lecture courses and research performed, together with the presentation and defense of the proposed PhD thesis.

1.3 Method used for the self-study as well as the preparation of the brief, including faculty and student input and involvement

This past academic year, faculty and graduate students provided input concerning the University's “Stepping-Up” planning process. Faculty and graduate students also participated in the external review process which took place in January 2005. The department schedules monthly faculty meetings, for core and cross-appointed faculty as well as representatives from the Graduate Astronomy Students Association (GASA). This brief reflects those discussions.

1.4 Fields in the programs

There are two program fields: Stellar and Galactic Astronomy, and Galaxies and Cosmology. There has been no change in fields since the last appraisal.

1.5 Concerns expressed in previous appraisal and actions taken

Concern 1: the adequacy of graduate student space and facilities, especially in light of enrolment growth projections.

Action taken: In the interim the Department has acquired temporary space in the Greenhouse Tower and in the coming year will acquire major new space dedicated to astronomy and astrophysics in the former Nursing Building.

Concern 2: the future of the David Dunlap Observatory

Action taken: There are well advanced plans to transform the legacy of the David Dunlap Observatory (DDO) into a new Dunlap Institute of Astronomy and Astrophysics which will be housed on the St. George Campus in the former Nursing Building.

Concern 3: faculty renewal, and its relationship to the imbalance among fields, and the teaching load of junior faculty.

Action taken: Many new hires have been made in the department since 1999. These have been in both program fields, but have focussed on renewing the Stellar and Galactic Astronomy field in which there have been many retirements.

Hires in Galaxy and Cosmology are: R. Abraham, D. Moon, B. Netterfield.

Hires in Stellar and Galactic Astronomy were: C. Matzner, M. van Kerkwijk and Y. Wu. In addition, CITA has hired C. Thompson and R. Rafikov. There have also been new cross-appointments to the graduate program in the field: Pawel Artymowicz hired through UTSC, and G. Srinivasan, Geology.

1.6 Special matters and innovative features

The department became an international affiliate of AURA in May, 2004.

The graduate units of Astronomy and Astrophysics, Physics, and the Canadian Institute for Theoretical Astrophysics participate in the Collaborative MSc Program in Astrophysics at the University of Toronto. This program is intended to foster graduate education in Astrophysics, particularly in those areas of study that overlap traditional departmental boundaries.

Historically, a major advance came in 1984 with the establishment of the Canadian Institute for Theoretical Astrophysics (CITA) and its location adjacent to the Department. The cross-appointments of CITA's permanent U of T faculty members as professors in the program enhanced graduate teaching and supervision and the synergy between CITA and the Department of Astronomy and Astrophysics (DAA) has been very rewarding.

Faculty and students enjoy access to the Magellan 6.5-m telescopes and the Dupont 2.5-m telescope at Las Campanas under an instrumentation development collaboration with the Carnegie Observatories. We have an active experimental program using telescopes on long-duration stratospheric balloons telescopes for cosmological and Galactic research and have built a new Stratospheric Telescope Integration Facility (STIF) to support this program.

We also use the major optical, radio, and satellite observing facilities of the world. Of particular importance are the national facilities: the Canada-France-Hawaii optical telescope, the James Clerk Maxwell radio telescope, and the Gemini telescopes located at the world's finest observing sites.

An endowment fund supports student travel for observations and conferences.

The program enjoys funding for two Canada Research Chairs in the Department of Astronomy and Astrophysics (C. Matzner, H. Yee) and two in CITA (N. Murray, R. Rafikov).

Several faculty members are active in the CIAR Cosmology and Gravitational program (J. R. Bond, R. Carlberg, L. Kofman, C. B Netterfield, U-L. Pen).

2. THE FACULTY

2.1 List of faculty by field

The graduate department, including the professors appointed at UTM, UTSC, and CITA comprises 21.64 active research faculty covering the broad range of areas – observation, theory, computational simulations and instrumentation – through which our discipline advances. We have great strength in the first two, need to consolidate computation, and give top priority to renewing instrumentation. DAA is actively engaged in a wide range of research on the cosmic microwave background, large scale structure, the early universe, galaxy formation and galactic structure, the formation of stars and planets, stellar structure and evolution, and high energy astrophysics, often through large surveys and international collaborations.

There are 15.64 core professors.

This represents an increase of 1.49 since the last appraisal. P. Artymowicz and C. Dyer are paid from UTSC budget. J. Lester and J. Percy are paid from UTM budget. J. R. Bond, L. Kofman, N. Murray, U.L. Pen, R. Rafikov, C. Thompson are paid from CITA budget and cross-appointed to the graduate program in Astronomy and Astrophysics. G. Srinivasan is a member of the Geology Department and cross-appointed to the graduate program in Astronomy and Astrophysics.

There is currently one vacant position that is expected to be filled in the Stepping-Up plan. Two professors will retire within the next few years and their appointments have been bridged.

In addition, there are three research-active emeritus professors.

Graduate Faculty Appointment Guidelines

Effective March 1996, chairs and directors of graduate units were granted the final authority to make appointments to the graduate faculty for their units. Appointments may be made in one of three categories: full member, associate member, or member emeritus.

Full members may act as the sole or major supervisor of a doctoral or master's thesis, and as a member of thesis committees; serve as chair or voting member of a final oral examination committee, where such examinations are required by SGS, and perform all associated duties; assume responsibility for the setting and marking of comprehensive (general) examinations; teach, set, and mark examinations for a graduate course and give such other graduate direction as may be required.

Associate members shall be permitted to undertake all the duties of a full member but shall not serve as a sole or major supervisor, whether formally or otherwise, of a doctoral student nor act as the chair of a final doctoral oral examination. The graduate chair or director may place further limitations on the graduate activities of an associate member.

Members emeriti shall be permitted to chair a final oral examination and to carry out one or more of the following: serve as a member of a thesis committee and as a voting member of a final oral examination; teach, set, and mark examinations for a graduate course; assume responsibility for setting and marking comprehensive (general) examinations; continue to act as a sole or major supervisor of a doctoral or master's thesis; take on new master's or doctoral supervision with the approval of the graduate chair or director.

The chair or director shall remove from the graduate faculty the names of those who, through death, retirement, resignation, or for any other reason, are no longer eligible for the graduate faculty.

Table 1 lists the faculty members involved in the graduate program, identifies their field affiliation and indicates gender, and any agreed retirements in the next seven years. (Note: there is now no mandatory retirement at U of T).

TABLE 1

Faculty Members by Field						
Faculty Name & Rank	M/F	Ret. Date	Home Unit	Supervisory Privileges	Stellar and Galactic	Galaxies and Cosmology
Category 1: CORE Faculty - Tenured or Tenure-Track						
R. G. Abraham Associate Professor	M		Astronomy and Astrophysics	Full		X
P. Artymowicz Professor	M		DPES ¹ UTSC ²	Full	X	
C. T. Bolton Professor	M		Astronomy and Astrophysics	Full	X	
J. R. Bond Professor	M		CITA ³	Full		X
R. G. Carlberg Professor	M		Astronomy and Astrophysics	Full		X
C. C. Dyer Professor	M		DPES UTSC	Full		X
R. Jayawardhana Associate Professor	M		Astronomy and Astrophysics	Full	X	
L. Kofman Professor	M		CITA	Full		X
J. B. Lester Professor	M		UTM ⁴	Full	X	
S. J. Lilly Professor (resigned Oct./02, supervised student to 2004)	M		Astronomy and Astrophysics	Full		X
P. G. Martin Professor (.50 appointment)	M		CITA; Astronomy and Astrophysics	Full	X	
C. Matzner Assistant Professor	M		Astronomy and Astrophysics	Full		X

¹ Department of Physical Environmental Sciences at Scarborough

² University of Toronto at Scarborough

³ Canadian Institute for Theoretical Astrophysics

Faculty Members by Field						
Faculty Name & Rank	M/F	Ret. Date	Home Unit	Supervisory Privileges	Stellar and Galactic	Galaxies and Cosmology
S. W. Mochnecki Associate Professor	M		Astronomy and Astrophysics	Full	X	
D. S. Moon Associate Professor	M		Astronomy and Astrophysics	Full		X
N. Murray Professor	M		CITA	Full		X
C. B. Netterfield Associate Professor (.50 appointment)	M		Physics; Astronomy and Astrophysics	Full		X
U. L. Pen Associate Professor	M		CITA	Full		X
J. R. Percy Professor	M		UTM	Full	X	
R. Rafikov Assistant Professor	M		CITA	Full	X	
C. Thompson Associate Professor	M		CITA	Full	X	
M. van Kerkwijk Professor	M		Astronomy and Astrophysics	Full	X	
Y. Wu Assistant Professor	F		Astronomy and Astrophysics	Full		X
H. K. C. Yee Professor	M		Astronomy and Astrophysics	Full		X
Category 2: CORE Faculty - Non-tenure Track						
W. H. Clarke Assistant Professor (.64 appointment)	M	2008	Astronomy and Astrophysics	Full	X	
C. M. Clement Associate Professor (CLTA ⁴ to 2005)	F	2005	Astronomy and Astrophysics	Full	X	X

⁴ CLTA Contractually Limited Term Appointment

Faculty Members by Field						
Faculty Name & Rank	M/F	Ret. Date	Home Unit	Supervisory Privileges	Stellar and Galactic	Galaxies and Cosmology
J. J. Dubinski Assistant Professor (CLTA to 2006)	M		Astronomy and Astrophysics	Assoc.		X
S. Rucinski Professor (CLTA to 2009)	M	2009	Astronomy and Astrophysics	Full	X	
Category 3: Tenured or Tenure-Track Core Faculty Members in Other Graduate Program(s)						
G. Srinivasan Assistant Professor	M		Geology ⁵	Full		X
Category 5: Emeritus Professors						
M. J. Clement Professor Emeritus	M	2003	Astronomy and Astrophysics	Full	X	
R. G. Garrison Professor Emeritus	M	2001	Astronomy and Astrophysics	Full	X	
E. R. Seaquist Professor Emeritus	M	2004	Astronomy and Astrophysics	Full		X

1. DPES: Department of Physical and Environmental Studies
2. UTSC: University of Toronto at Scarborough
3. Canadian Institute for Theoretical Astrophysics
4. University of Toronto at Mississauga
5. Cross-appointed

2.2 External operating research funding

Table 2 presents the external research funding received by the program by source and by year for the past seven years. This represents funding to support faculty research and potentially available to support graduate students and their research.

⁵ Cross appointment to Department of Astronomy and Astrophysics. Home graduate unit is Department of Geology.

TABLE 2

Operating Research Funding by Source and Year

	Granting Councils	Other Peer Adjudicated	Contracts	Others
1998/99	653,600	24,068		20,000
1999/00	972,504	24,300		343,000
2000/01	1,149,995	113,050		233,000
2001/02	1,187,932	35,306		
2002/03	1,451,467	413,306	87,479	261,500
2003/04	1,597,050	95,000	184,780	220,000
2004/05	1,433,550	45,000	286,798	345,000
Totals	8,446,098	750,031	559,057	1,422,500

Over the period under consideration, there has been a steady increase in funding from all sources. This can be attributed both to the appointment of new faculty with active research careers and to ongoing research success of senior faculty. Most of the Granting Council support is in the form of NSERC Discovery grants. Other peer-adjudicated grants are from a variety of sources, largely Ontario Premier's Research Excellence Awards and the Sloan Foundation. Contracts, from CSA, relate to research done for forthcoming missions like Planck and BRITE, but do not include major contracts for the hardware (see below). The remaining source ("other") is largely university start-up funding and matching contributions (cash into the PI accounts) as required for several of the preceding sources of research funding.

As in Table 2, Table 2a presents the external research funding received by the program, but by source and by field, summed over the past seven years. The field “G & C” presently enjoys more funding than “S & G”. The former is a pillar of the research program developed over the past two decades, while the latter is in a healthy process of renewal.

TABLE 2a

Total External Operating Research Funding (7 years) by Field

	Granting Councils	Other Adjudicated	Peer Contracts	Others
G & C	6,023,803	455,531	529,031	706,000
S & G	2,422,295	294,500	30,026	716,500

Neither Table 2 nor 2a reports funding for equipment and infrastructure. There have been substantial investments of this nature, as summarized in Table 2b, which have a very positive effect on the research program.

TABLE 2b

Major Infrastructure and Equipment Funding (7 years)

Project	NSERC	CSA	CFI	OIT	University	Project cost
Magellan Telescope Instrumentation Collaboration				1,321,400	1,982,100	3,303,500
Stratospheric Telescope Integration Facility			640,800	640,800	320,400	1,602,000
Cosmochemistry Laboratory			260,000	260,000	130,000	650,000
Parallel Computing			200,000	200,000		400,000
Boomerang			200,000	200,000	100,000	500,000
Boomerang and BLAST		1,040,938				1,040,938
Equipment/Instrumentation	394,004					394,004
Totals	394,004	1,040,938	1,300,800	2,622,200	2,532,500	7,890,442

Table 2b does not capture other sources of funding which have an impact, if less direct.

Chief among those of national scope are the NSERC Institute grant for CITA (about \$940,000 per annum), \$1,000,000 from CFI/OIT for the McKenzie high performance computing cluster, and the \$25,000,000 funding (CFI, federal, and provincial) devoted to the detailed design phase of the Large Optical Telescope (30-metre Telescope collaboration).

Our researchers are also important co-investigators on numerous grants with US PIs, through HST, NASA LTSA, PG&G, etc. This includes a variety of large projects such as \$3,200,000 from NASA toward BLAST and \$230,000 from NSF/NASA toward the Nstars program. Although this funding does not cross the border, our researchers are engaged in attracting this funding because of its importance to the development and conduct of their research programs.

Four Canada Research Chairs (two tier 1 and two tier 2) are funded at a total of \$600,000 per annum

2.3 Graduate supervision - Completed, and current, supervision of master's, doctoral, and post-doctoral students, by faculty member. There are no faculty supervising students in other departments.

TABLE 3

Completed and Current Numbers of Thesis Supervisions by Faculty Member						
	Completed			Current		
Member	Master's	PhD	PDF	Master's	PhD	PDF
Category 1: Core faculty - Tenured or Tenure-Track						
R. G. Abraham Associate Professor	1	3	0	0	2	1
P. Artymowicz ¹ Professor UTSC	0	0	0	0	0	0
C. T. Bolton ² Professor	13	8	5	0	0	0
J. R. Bond Professor	1	0	14	0	2	2
R. G. Carlberg Professor	0	6	11	0	1	7
C. M. Clement Associate Professor	0	0	0	0	0	0
C. C. Dyer Professor (UTSC)	24	12	3	0	3	0
R. Jayawardhana ³	0	0	0	0	1	2

Completed and Current Numbers of Thesis Supervisions by Faculty Member						
	Completed			Current		
Member	Master's	PhD	PDF	Master's	PhD	PDF
Associate Professor						
L. Kofman Professor	4	5	6	0	2	3
J. B. Lester Professor	4	6	1	0	1	0
S. J. Lilly ⁴ Professor	0	4	0	0	0	0
P. G. Martin Professor	10	14	19	0	2	3
C. Matzner Assistant Professor	5	0	0	0	0	1
S. W. Mochnacki Associate Professor	4	1	0	0	0	0
D. S. Moon Assistant Professor	0	0	0	0	0	0
N. Murray Professor	3	0	19	0	2	0
C. B. Netterfield Associate Professor	3	0	0	0	6	1
U. L. Pen Associate Professor	2	2	0	1	1	1
J. R. Percy Professor	0	7	16	0	0	0
R. Rafikov Assistant Professor	0	0	0	0	0	0
C. Thompson Associate Professor	1	0	0	0	0	0
M. H. van Kerkwijk Professor	0	0	0	0	1	2
Y. Wu Assistant Professor	0	0	0	0	1	1
H. K. C. Yee	11	10	5	0	4	1

Completed and Current Numbers of Thesis Supervisions by Faculty Member						
	Completed			Current		
Member	Master's	PhD	PDF	Master's	PhD	PDF
Professor						
Category 2: CORE Faculty - Non-tenure Track						
W. H. Clarke Assistant Professor	0	0	0	0	0	0
C. M. Clement Associate Professor	0	0	0	0	0	0
J. J. Dubinski Assistant Professor	1	0	0	2	0	0
S. Rucinski Professor	0	1	1	0	0	0
Category 3: Tenured or Tenure-Track Core Faculty Members in Other Graduate Program(s)						
G. Srinivasan Assistant Professor	0	0	0	1	0	0
Category 5: Emeritus Professors						
M. J. Clement Professor Emeritus	6	3	0	0	0	0
R. G. Garrison Professor Emeritus	0	0	0	0	0	0
E. R. Seaquist Professor Emeritus	12	15	10	0	2	1

1. Hired Mar. 14/05
2. On Long term disability leave
3. Hired Sept. 1/04
4. Resigned Oct./02, supervised student to 2004

As previously indicated, the majority of students in the program under review have chosen the direct entry program and are thus shown as PhD students currently. With the exception of the students and single PDF supervised by Prof. Seaquist, all are supervised by Core faculty.

It is anticipated that the number of students supervised will grow by 30-50% over the period covered by the Stepping Up plan. This will be a natural result of the ability of new faculty to accept additional students. (A normal supervisory load would be on the order of 3-4 students.)

2.4 Current teaching assignments - (graduate and undergraduate), showing the number of courses taught by each faculty member

TABLE 4a

Teaching Assignments for 2002/03				
Faculty Member	Rank	Undergraduate	Graduate	Comments
Category 1: CORE Faculty - Tenured or Tenure-Track				
R. G. Abraham	Associate Professor	AST 121S 2 hrs/wk	AST 2040F 2 hrs/wk	
P. Artymowicz	Professor	0	0	Hired March 2005
C. T. Bolton	Professor	0	0	Long Term Disability
J. R. Bond	Professor	0	0	Director, CITA
R. G. Carlberg	Professor	AST 420F 2 hrs/wk	0	CIAR ¹ Fellow
C. M. Clement	Associate Professor	AST101F 2hrs/wk AST 101S 2hrs/wk	0	Undergraduate Coordinator
C. C. Dyer	Professor		AST 2060F 2 hrs/wk AST 2070S 2 hrs/wk	UTSC
R. Jayawardhana	Associate Professor	0	0	Hired September 1, 2004
L. Kofman	Professor	0	0	CITA
J. B. Lester	Professor	AST 110F-UTM 2 hrs/wk AST 201S-UTM 2 hrs/wk AST 425H – St. George 2 hrs/wk	AST 2000L 2 hrs/wk	UTM
S. J. Lilly	Professor	0	0	Resigned Oct./02, supervised student to 2004
P. G. Martin	Professor	0	0	Chair Appointed .50 DAA; .50 CITA
C. Matzner	Assistant Professor	0	AST 2030F 2 hrs/wk	Hired July 1, 2002
S. W. Mochnacki	Associate Professor	AST 221F 2 hrs/wk AST 325H	AST 2050S 2 hrs/wk	

Teaching Assignments for 2002/03				
Faculty Member	Rank	Undergraduate	Graduate	Comments
		2 hrs/wk		
D. S. Moon	Assistant Professor	0	0	Hire date to be effective July 1/06
N. Murray	Professor	0	0	Associate Director, CITA
C. B. Netterfield	Associate Professor	PHY 280F 2 hrs/wk	0	Appointed .50 DAA, .50 Physics CIAR Fellow
U. L. Pen	Associate Professor	0	0	
J. R. Percy	Professor	AST 101F-UTM 2 hrs/wk SCI 398Y-UTM 2 hrs/wk SCI 499H-UTM 2 hrs/wk	0	UTM
R. Rafikov	Assistant Professor	0	0	CITA Hire date to be effective Sept. 1/05
C. Thompson	Associate Professor	0	0	CITA
M. H. van Kerkwijk	Professor	0	0	Hired Jan. 1/03
Y. Wu	Assistant Professor	0	0	Hired April 1, 2003
H. K. C. Yee	Professor	AST 222S 2 hrs/wk	AST 1501Y 2 hrs/wk AST 1500Y	CRC ² Chair Tier 1
Category 2: CORE Faculty - Non-tenure Track				
W. H. Clarke	Assistant Professor	AST 199Y-2 2 hrs/wk	0	Associate Chair and Graduate Coordinator
J. J. Dubinski	Assistant Professor	0	0	CLTA to 2006 Research and study leave 2002/03
S. Rucinski	Professor	0	0	CLTA retires 2009. Associate Director, DDO. Transferred to faculty position July 1/04.
Category 3: Tenured or Tenure-Track Core Faculty Members in Other Graduate Program(s)				
G. Srinivasan	Assistant Professor	0	0	Geology Cross-appointed to DAA March/2005

Teaching Assignments for 2002/03				
Faculty Member	Rank	Undergraduate	Graduate	Comments
Category 5: Emeritus Professors				
M. Clement	Professor Emeritus	0	0	Retired June 30/02
R. G. Garrison	Professor Emeritus	0	0	Retired June 30/01
E. Seaquist	Professor Emeritus	AST 199Y-2 2 hrs/wk	AST 1440S 2 hrs/wk	Retired June 30/04

1. CIAR : Canadian Institute for Advanced Research
2. CRC: Canada Research Chair

TABLE 4b

Teaching Assignments for 2003/04				
Faculty Member	Rank	Undergraduate	Graduate	Comments
Category 1: CORE Faculty - Tenured or Tenure-Track				
R. G. Abraham	Associate Professor	AST 101F 2 hrs/wk AST 121S 2 hrs/wk AST 201S 2 hrs/wk	0	
P. Artymowicz	Professor	0	0	Hired March 2005 UTSC
C. T. Bolton	Professor	199Y-2 2 hrs/wk	0	Long Term Disability
J. R. Bond	Professor	0	0	Director, CITA
R. G. Carlberg	Professor	AST 420F 2 hrs/wk	AST 3100Y 2 hrs/wk	CIAR Fellow
C. M. Clement	Associate Professor	0	0	Undergraduate Coordinator Research and study leave 2003/04
C. C. Dyer	Professor	0	AST 2060F 2 hrs/wk AST 2070S 2 hrs/wk	UTSC
R. Jayawardhana	Associate Professor	0	0	Hired September 1, 2004
L. Kofman	Professor	0	0	CITA
J. B. Lester	Professor	AST110S-UTM 2 hrs/wk AST 201S-UTM 2 hrs/wk	0	UTM
S. J. Lilly	Professor	0	0	Resigned Oct./02
P. G. Martin	Professor	0	0	Chair Appointed .50 DAA ; .50 CITA
C. Matzner	Assistant Professor	AST 251F/S 2 hrs/wk	AST 2030F 2 hrs/wk	CRC Chair Tier 2
S. W. Mochnacki	Associate Professor	AST 325H 2 hrs/wk	0	
D. S. Moon	Assistant	0	0	Hire to be effective

Teaching Assignments for 2003/04				
Faculty Member	Rank	Undergraduate	Graduate	Comments
	Professor			July 1, 2006
N. Murray	Professor	0		Associate Director, CITA
C. B. Netterfield	Associate Professor	AST 101F 2hrs/wk AST 201S 2hrs/wk	0	Appointed .50 DAA, .50 Physics CIAR Fellow
U. L Pen	Associate Professor	0	AST 3100H 2 hrs/wk	CITA
J. R. Percy	Professor		0	UTM
R. Rafikov	Assistant Professor	0	0	Hire to be effective Sept./05
C. Thompson	Associate Professor	0	0	CITA
M. H. van Kerkwijk	Professor	AST 101F 2 hrs/wk AST 201S 2 hrs/wk	0	Hired Jan. 1/03
Y. Wu	Assistant Professor	AST 221F 2 hrs/wk	AST 1501Y 2 hrs/wk	Hired April 1, 2003
H. K. C. Yee	Professor	0	AST 1430F 2 hrs/wk	CRC Chair Tier 1
Category 2: CORE Faculty - Non-tenure Track				
W. H. Clarke	Assistant Professor	AST 210F 2 hrs/wk AST 210S 2 hrs/wk	0	Associate Chair and Graduate Coordinator
J. J. Dubinski	Assistant Professor	AST 222S 2 hrs/wk	AST 1420F 2 hrs/wk	CLTA to 2006
S. Rucinski	Professor	0	0	CLTA ends 2009. Associate Director, DDO. Transferred to faculty position July 1/04
Category 3: Tenured or Tenure-Track Core Faculty Members in Other Graduate Program(s)				
G. Srinivasan	Assistant Professor	0	0	Geology; cross-appointed DAA March 2005
Category 5 : Emeritus Professors				
M. J. Clement	Professor Emeritus	0	0	Retired June 30/02
R. G. Garrison	Professor Emeritus	0	0	Retired June 30/01
E. Seaquist	Professor	AST 199Y-1	AST 1440S	

Teaching Assignments for 2003/04				
Faculty Member	Rank	Undergraduate	Graduate	Comments
	Emeritus	2 hrs/wk	2 hrs/wk	Retired June 30/04

TABLE 4c

Teaching Assignments for 2004/05				
Faculty Member	Rank	Undergraduate	Graduate	Comments
Category 1: CORE Faculty - Tenured or Tenure-Track				
R. G. Abraham	Associate Professor	AST 101F 2 hrs/wk AST 201S 2 hrs/wk	AST 2040F 2 hrs/wk	
P. Artymowicz	Professor	0	0	UTSC hired March 2005
C. T. Bolton	Professor	0	0	LTD
J. R. Bond	Professor	0	0	Director, CITA
R. G. Carlberg	Professor	0	AST 3100Y 2 hrs/wk	CIAR Fellow
C. M. Clement	Associate Professor	AST 210F 2 hrs/wk AST 210S 2 hrs/wk	0	Undergraduate Coordinator
C. C. Dyer	Professor	0	AST 2070S 2 hrs/wk	UTSC
R. Jayawardhana	Associate Professor	AST 251S 2 hrs/wk	0	Hired September 1, 2004
L. Kofman	Professor	0	0	CITA
J. B. Lester	Professor	AST 101F 2 hrs/wk AST 110S 2 hrs/wk	AST 1440S 2 hrs/wk	UTM
S. J. Lilly	Professor	0	0	Resigned Oct/02, supervised student to 2004
P. G. Martin	Professor	0	0	Chair Appointed .50 DAA ; .50 CITA
C. Matzner	Assistant Professor	AST 251F 2 hrs/wk	AST 2030F 2 hrs/wk	CRC Chair Tier 2 Parental leave 10 weeks Jan-Mar/05

Teaching Assignments for 2004/05				
Faculty Member	Rank	Undergraduate	Graduate	Comments
S. W. Mochnacki	Associate Professor	AST 325H 2 hrs/wk AST 326Y 2 hrs/wk	AST 2050S 2 hrs/wk	
D. S. Moon	Assistant Professor	0	0	Hire to be effective July 2006
N. Murray	Professor	0	0	Associate Director, CITA
C. B. Netterfield	Associate Professor	AST 101F 2 hrs/wk AST 201S 2 hrs/wk	0	Appointed .50 DAA, .50 Physics CIAR Fellow
U. L. Pen	Associate Professor	0	0	CITA
J. R. Percy	Professor	0	0	UTM
R. Rafikov	Assistant Professor	0	0	Hire to be effective Sept/05
C. Thompson	Associate Professor	0	0	CITA
M. H. van Kerkwijk	Professor	AST 101F 2 hrs/wk AST 201S 2 hrs/wk AST 320S 2 hrs/wk	0	Colloquium 2 hrs/wk
Y. Wu	Assistant Professor	AST 221F 2 hrs/wk	0	MLOA1 – Aug/04; parental leave 10 weeks Jan-Mar/05
H. K. C. Yee	Professor	AST 121S 2 hrs/wk	AST 1501Y 2 hrs/wk AST 1500Y 2 hrs/wk	CRC Chair Tier 1
Category 2: CORE Faculty - Non-tenure Track				
W. H. Clarke	Assistant Professor	199Y-1 2 hrs/wk 199Y-2 2 hrs/wk	0	Associate Chair and Graduate Coordinator
J. J. Dubinski	Assistant Professor	AST 222S 2hrs/wk AST 425H 2 hrs/wk		CLTA to 2006
S. Rucinski	Professor	AST 420F 2 hrs/wk	AST 2000L Seminar 2 hrs/wk	CLTA ends 2009. Associate Director, DDO. Transferred to

Teaching Assignments for 2004/05				
Faculty Member	Rank	Undergraduate	Graduate	Comments
				faculty position July 1/04
Category 3: Tenured or Tenure-Track Core Faculty Members in Other Graduate Program(s)				
G. Srinivasan	Assistant Professor	0	0	Geology ; cross-appointed to DAA March 2005
Category 5 : Emeritus Professors				
M. J. Clement	Professor Emeritus	0	0	Retired June 30/02
R. G. Garrison	Professor Emeritus	0	0	Retired June 30/01
E. Seaquist	Professor Emeritus	0	0	Retired June 30/04

A normal full teaching load consists of three “half-courses”, usually two undergraduate and one graduate. Some teaching relief is provided for those with administrative duties, major fellowships, etc. CITA faculty members do not contribute to the undergraduate program except through research supervision, and that is their primary role in the graduate program too. In addition, faculty and research associates offer “mini courses” (equivalent to approximately 1/3 of a half course) on specialized topics of interest. There is no formal counting of these courses in the teaching assignments, though they do figure in the annual performance evaluations. Likewise, there is no formula to account for graduate supervision; all are expected to contribute.

2.5 Commitment of faculty members from other graduate programs and/or from other institutions:

Cross-appointments have the approval of home Chair, are made for finite terms, and are subject to review for renewal. There are currently no cross-appointments from other institutions. Cross-appointed faculty members have two roles in the graduate program: They provide enriched opportunities for supervision of student research, and they can offer specialized graduate courses, including mini-courses.

3. PHYSICAL AND FINANCIAL RESOURCES

3.1 Library⁶

The programs of the Department are well serviced by the University of Toronto Library in both the Astronomy and Astrophysics Library and the Central Library collections which support research in the full range of the discipline. The Department of Astronomy and Astrophysics houses the best astronomy collection in Canada - indeed it is one of the best in North America. It is consulted by and provides loans to astronomers across the country.

The Gerstein Information Centre, the Engineering and Computer Science Library, the Mathematics Library and the Physics Library also provide collections that round out the information needs of researchers, especially for interdisciplinary subjects. Access to the collections is provided by an online catalogue of University of Toronto records, searched by author, title, subject, or keyword.

Monographs

The University of Toronto Library is ranked fourth over-all in holdings for North American libraries⁷. In the QB (Astronomy) Library of Congress Classification we rank first in over-all holdings for monographs. It is the policy of the Central Library to acquire a single copy of all science books published in English that are considered of research value. These include proceedings of conferences and symposia, professional society publications, review literature, technical handbooks and reference books in addition to research

⁶ The following material is extracted from a report (January 3, 2005) prepared by: Joyce Chyrski, Science Book Selector, Robarts Library; Lee Robbins, Astronomy Librarian Carole Moore, Chief Librarian, University of Toronto Library

⁷ North American title count: titles: classified by Library of Congress and National Library of Medicine Classifications, 2001. Chicago: Association for Library Collections and Technical Services, American Library Association, 2001

monographs. The libraries have resources in the forms of handbooks, encyclopedias, dictionaries and biographies and technical reports. The number of books held in the Astronomy Library is 37,994 with 212 books added in 2003/2004. The Astronomy Library also houses 272 microform collections, 43 CD-ROMs, 5,663 Graphic Materials, 2 Sound Recordings and 33 Films and Videos.⁸

Serials

The Library has extensive journal holdings in the Central and Departmental libraries. However, like all North American libraries is experiencing great difficulty in keeping up with the rising cost of serial subscriptions. This situation has improved significantly during the past several years due to the Central Library's extensive holdings of electronic journals. Several approaches to improve access to periodical articles have been utilized such as direct Web-based subscriptions and local loading of journals in the Ontario Scholars Portal. Electronic indexing and publishing in all fields has been thoroughly integrated into the University programs.

A search of the periodical titles from ISI Journal Citation Reports for the subject "Astronomy" shows the Library holding print or full text electronic versions of 41 of the 42 top-ranked journals.⁹

Reference Resources

Electronic information services at the University of Toronto Library have been evolving since 1987, when the first online catalogue was mounted, and the Library is now a world leader in this field. At the present time a total of 36,482 electronic journals, 483 electronic journal indexes, 514 electronic reference sources, 30,401 e-books, and 596 electronic news services are available to students and staff at the university. Many of these are available as full text.¹⁰

ADS, the Astrophysics Data System, is a NASA-funded project which maintains four bibliographic databases containing more than 4.1 million records: Astronomy and Astrophysics, Instrumentation, Physics and Geophysics, and Preprints in Astronomy. In addition to its databases, ADS provides access and pointers to a wealth of external resources, including electronic articles, data catalogs and archives. ADS is self-serve and free.

The University of Toronto is one of a few locations holding the Palomar Sky Survey. The Astronomy and Astrophysics Library has a collection of

⁸ University of Toronto Libraries. "Annual Statistics", May 1, 2002 – April 30, 2003.
www.library.utoronto.ca/aboutlibraries/index.html

⁹ ISI Journal Citation Reports, 2002. Philadelphia : Institute for Scientific Information, 2003.
<http://jcr6.isiknowledge.com/JCR>

¹⁰ <http://link.library.utoronto.ca/eir> (November 26, 2004)

astronomical catalogues on CD-ROM including the Space Telescope Institute Digitized Sky Service (102 CDs) and acquires any such catalogues as needed. A small collection of commercial astronomical software and multimedia as well as the U.S. Naval Observatory's Astronomical Almanac on diskette are also available.

The physical collection of the Library of the Department of Astronomy and Astrophysics includes monographs, theses, conference proceedings, sky atlases & catalogues in both print and electronic media, scholarly journals, newsletters and publication series from observatories and astronomical institutions worldwide. The collection is primarily devoted to astronomy and astrophysics material however it also includes physics, mathematics and computer science materials of interest to astronomers and astrophysicists.

The Astronomy and Astrophysics Library continues to publish Astronomy Book and Software Reviews, a quarterly publication that provides citations for reviews of books on subjects related to astronomy and astrophysics. Coverage is complete from 1987 to the present, and the Reviews are also published in ADS.

Staff and special services

The staff consists of one full-time professional librarian and one half-time library technician. In 2004, a Library Advisory Committee (LAC) was established to promote the Library's role in supporting the academic and professional charges of the Department of Astronomy and Astrophysics at the University of Toronto. The LAC members include graduate students, post-docs, and faculty members from the Department of Astronomy and Astrophysics and CITA (Canadian Institute for Theoretical Astrophysics). There is also a faculty advisor for book acquisitions.

The Central Library participates in a "direct borrowing" program through the Ontario Council of University Libraries; this permits graduate students from any Ontario University to borrow from other Ontario universities. Beyond this, the Interlibrary Loan and Document Delivery service will obtain material worldwide.

The most important supporting collection in Astronomy is CISTI (Canada Institute for Scientific and Technical Information), Canada's national science library in Ottawa. It is now possible to handle transactions electronically from CISTI, thereby decreasing the time required to fill requests. A book delivery service between the Gerstein Science Information Centre and the Astronomy and Astrophysics Library is provided in a timely manner.

Budget and Long-term Commitments

The strength of the Library's financial commitment to purchasing material over the next five to seven years depends upon University policy and government funding. To date it has been the University of Toronto's stated policy to protect, as far as possible, the Library's acquisition budget from

rising costs and maintain this protected status. This present financial policy allows the Library to maintain its current purchasing levels for publications relevant to astronomy and astrophysics ensures continued support for the program.

3.2 Laboratory facilities

We enjoy access to the Magellan 6.5-m telescopes and the Dupont 2.5-m at Las Campanas under an instrumentation development collaboration with the Carnegie Observatories.

We also use the major optical, radio, and satellite observing facilities of the world, including the national facilities CFHT, JCMT, DRAO, and the Gemini telescopes located at the world's finest observing sites.

We have an active experimental program using telescopes on long-duration stratospheric balloons telescopes for cosmological and Galactic research and for this have just opened a specialized Stratospheric Telescope Integration Facility (STIF). The first occupant (April 2004) was BLAST (Balloon-borne Large Aperture Submillimetre Telescope; Canadian PI Barth Netterfield).

In support of the growing thrust in astronomical instrumentation (including the hire of D.-S. Moon), new laboratories and workshops are being established on the St. George campus in the former Nursing Building and above STIF. This effort will include cooperative development and management of advanced Physical Sciences Workshops (with Physics and Chemistry).

DDO houses a 1.88-m telescope, the largest in Canada, which is equipped with an efficient CCD grating spectrograph. DDO also provides shops for electronic and mechanical work.

The Helen Sawyer Hogg Telescope (HSHT, formerly located at the University of Toronto Southern Observatory on Cerro Las Campanas in Chile) is now located in Argentina on Cerro Burek at the Observatorio El Leoncito. This 60-cm telescope is on permanent loan to the Argentine observatory, in return for which DAA has 25% of the observing time (remote observing from DAA being the goal).

3.3 Computer facilities

DAA and CITA are recognized centres in the numerical study of dynamical systems ranging from hydrogen molecules, to comets in the solar system, to star clusters, to spiral waves in galaxies, to colliding galaxies, to the large scale clustering of galaxies. Various workers have developed some of the most powerful numerical techniques in use today. DAA and CITA researchers have installed a series of competitive machines, most recently a novel parallel computer (over 500 processors), at the time the fastest computer in Canada (38th in the world). This facility has been used to carry

out some of the largest, most accurate N-body and magneto-hydrodynamic simulations done to date. Aggressive computation is also required for processing and analysing the enormous amounts of data acquired in modern observing campaigns. Other major computing systems are in place to support the Canada-France-Hawaii Legacy Survey (CFHLS) and the EXPLORE search for planets via transits. We are now helping to lay the groundwork for new facilities as a part of SciNet, for modeling, simulations, and data analysis.

All faculty and graduate students are provided with an account on the department's server. This account gives them access to electronic mail facilities, internet, colour printers, and various software packages, e.g., Maple, IDL, scientific graphics, computer language compilers, e.g., Fortran and C, a rich mathematical software library, etc. There are over 200 microcomputers currently available to the faculty and students. Computing is largely Linux based on PCs, although the program is starting to support the Macintosh operating system. There is central DAA support for high-speed switching, and in the near future, wireless networking will also be made available in our various sites.

3.4 Space

The Department of Astronomy and Astrophysics is presently spread over four sites: a main locus in the McLennan Physical Labs building, on the 13th through 16th floors (1130 m²); the nearby four storey "Stratospheric Telescope Integration Facility" including the "High Bay" where BLAST presently is housed together with related laboratories (230 m²); the second floor in the adjacent "Greenhouse Tower", for the Canada France Hawaii Legacy Survey (90 m²); and the David Dunlap Observatory (1260 m², including 520 m² for the 4 telescope domes). Together, these locations provide a total of 2710 m² for research and research support activities, including faculty and graduate student offices, and workshops and laboratories. Note that this does not include space of relevance to the graduate program in CITA, the main computer machine room, cognate departments, and on the campuses at Scarborough and Mississauga.

Core Faculty members have private offices. Other faculty members, postdoctoral fellows, graduate students, and visitors have shared offices. All graduate students have their office space in close proximity to their Faculty Supervisors. All offices have the usual office furniture, telephone, and computers connected to the internet.

In the near future, the department will consolidate many of its activities in space in an adjacent building being vacated by the Faculty of Nursing. This will provide for more on-campus labs and workshops, growth of the graduate program, better co-location of research groups, and development of the Dunlap Institute.

3.5 Financial support of graduate students

Students are supported under the terms of the University funding guarantee. Support is provided for 1 year for students pursuing a Master's degree or for 5 years if they choose the direct entry program. The department supplements the basic guaranteed support at a level, currently, of \$3000 per annum. Finally, those students who obtain external awards receive a further bonus of 50% of the value of the award to a maximum of \$2000.

In addition to internal or external fellowship support, the guarantee includes a component from TA and RA employment which may be held cocurrently.

TABLE 5

Financial Support for Master's Students								
	\$ Amount of Support From						Students Funded	
Year	External Scholarship \$(#)	Univ Scholarship \$(#)	TAs \$(#)	RAs (#)	Other* (#)	Total \$	# (%) ¹	Av \$ ²
1998/99	\$19,300 (1)	\$29,600 (3)	(0)	(0)	(0)	\$48,900	3/100%	\$16,300
1999/00	34,600 (2)	68,140 (6)	(0)	(0)	(0)	102,740	5/100%	17,123
2000/01	15,000 (0)	79,206 (7)	(0)	(0)	(0)	94,206	7/100%	13,458
2001/02	(0)	16,551 (1)	4,049 (1)	(0)	(0)	20,600	1/100%	20,600
2002/03	(0)	(0)	(0)	(0)	(0)	0	0	0
2003/04	(0)	(0)	(0)	(0)	(0)	0	0	0
2004/05	(0)	24,128 (1)	4,373 (1)	(0)	(0)	28,501	1/100%	28,501

¹ Funding is provided under the guarantee program to all students

² average funding per funded student

TABLE 5a

Financial Support for Doctoral Students								
	\$ Amount of Support From						Students Funded	
Year	External Scholarship \$(#)	Univ Scholarship \$(#)	TAs \$(#)	RAs \$(#)	Other (#)	Total \$	# (%) ¹	Av \$ ²
1998/99	\$124,372 (9)	\$96,954 (17)	\$88,983 (18)	\$55,246 (11)	0	\$276,572	17 (81%)	\$16,269
1999/00	126,359 (7)	95,859 (15)	106,685 (20)	40,237 (8)	0	262,455	15 (88%)	17,497
2000/01	151,700 (9)	136,484 (19)	106,685 (21)	43,652 (9)	0	331,836	20 (100%)	16,592
2001/02	194,900 (12)	177,312 (22)	103,664 (24)	74,936 (16)	0	550,812	24 (92%)	22,951
2002/03	201,000 (13)	214,237 (26)	137,859 (22)	63,816 (9)	0	616,912	26 (96%)	23,727
2003/04	208,000 (12)	201,224 (23)	124,395 (22)	74,340 (12)	0	607,959	25 (83%)	24,318
2004/05	153,600 (8)	227,450 (26)	116,230 (21)	108,515 (13)	0	605,795	26 (96%)	23,300

¹ Funding is provided under the guarantee program to all students in the first 5 years of the program. Thereafter, funding is provided at the discretion of the supervisor.

² average funding per funded student

4. PROGRAM REGULATIONS AND COURSES

4.1 The intellectual development and the educational experience of the student.

In 2001, the Department introduced a “direct entry” option to the PhD program. The intent was to allow for immediate participation research, to increase the variety of research projects undertaking by a student before completion of the degree, and to build student experience in preparing papers for peer review. At the same time, the course work normally expected of a graduate student was spread over two years rather than being concentrated in the one-year Master’s program as previously.

As set out in section 4.5 of this brief, the Department continued to support the Collaborative Program in Astrophysics in conjunction with CITA and the Department of Physics in order to offer a course-intensive option for those students (particularly those aiming towards theory) who preferred that approach.

Finally, the department continued to offer an MSc to those students who completed all the course requirements for the PhD but who decided to terminate their studies at that point.

The direct entry program has worked well. Students are required to do research with at least two faculty in two different areas at a level which generally leads to publication and to presentation at conferences. At the same time, they are encouraged to select courses which give them the necessary breadth of background to permit them to work effectively outside their particular area of focus. In addition to “core” courses, the department offers advanced courses and “mini” courses (typically equivalent to 1/3 of a normal half-year course) in topics which they have expressed an interest.

Working in more than one research area during the first two years of study provides considerable opportunity for students to work with a variety of faculty and with their student colleagues. They also have, through the G2000 weekly student colloquia, opportunities to present their research and develop their skills in this area.

The Department maintains a very active program of colloquia throughout the year. In any given week, it is possible to attend both a Departmental colloquium and a CITA colloquium (and frequently Physics colloquia as well). The students are also provided with funding to host an informal dinner with invited speakers.

Through endowment funds, the department is able to subsidize student travel to obtain observations, meet with researchers in their area of thesis research, and to present the results of their research (both thesis and otherwise) at meetings in Canada and internationally. By the time they graduate, our students will have established themselves in the networks of researchers in

their field and frequently are already involved in collaborations with other institutions.

4.2 Program regulations.

Admission

Master's Programs

An appropriate four-year bachelor's degree with a final year average of at least mid-B from the University of Toronto, or its equivalent from another recognized university.

Doctoral Programs

An appropriate University of Toronto master's degree, or its equivalent, with an average of at least B+, or demonstrated comparable research competence.

The department admits directly to the doctoral program from a bachelor's degree or exceptional students with a minimum final-year average of A-.

Degree requirements – Master's

Students who have completed the course requirements (including research courses) for the PhD (see below) and who wish to terminate their studies at that point may apply for the MSc degree.

Students who have successfully completed the requirements of the Collaborative Program in Astrophysics (see Section 4.5 below) may also apply for the MSc degree.

Degree requirements – PhD

Candidates are accepted under the general regulations of the School of Graduate Studies. Applicants who were educated outside Canada should pay particular attention to the English language competency requirements.

Because many universities do not offer extensive undergraduate training in astronomy and astrophysics, preparation in physics and mathematics is an acceptable background for candidates.

Candidates are strongly advised to take the verbal, quantitative, and advanced physics tests of the Graduate Record Examination administered by the Educational Testing Service, Princeton.

The program for the degree is intended to be completed in five years (15 semesters) Candidates are normally expected to be on campus full time for the duration of their program.

Candidates are immediately engaged in original research through two required research courses, AST 1501Y and AST 1500Y, with different supervisors. An oral exam by committee is held for each. Schedule: AST

1501Y is normally completed during the fall/winter of the first year, and AST 1500Y is completed in the following summer.

In addition to the research courses, candidates follow an approved program of study including a minimum of four half-courses, at least two of which are from among the AST Elective or Specialized Courses, subject to the approval of the instructor, the candidate's PhD. program committee and the Department. More courses may be taken for credit or audited as appropriate. The required half-courses are normally taken on average one per semester in the fall/winter semesters during the first two years of the program.

The core of the program is a thesis embodying the results of original research which must be submitted for appraisal in accordance with the regulations of the School of Graduate Studies. As a first step, a candidate is required to prepare a written PhD. thesis proposal (possibly on a theme growing out of one of the first two research courses, but not necessarily) and defend it in an oral examination conducted by a panel of faculty members. The intention of this “qualifying examination” is to assess the candidate's ability and readiness to carry forward and complete successfully independent PhD.-level research. This assessment is based on the candidate's graduate record to date, including graduate lecture courses and research performed, together with the presentation and defence of the proposed PhD. thesis.

The qualifying examination is taken after four and within five semesters of beginning the program.

Candidates are expected to participate in the Department's weekly seminar series and to attend astronomy and astrophysics seminars and colloquia arranged by the Department, CITA, and Physics (no academic credit or marks are given).

Progress reports

Beginning in the second year, candidates register each year in the research course AST 400*Y (where the * indicates the year of study: 2, 3, ...). While this “course” has no formal requirements, it provides for a formal assessment of the student's progress in their thesis research. A grade is assigned by the student's supervisory committee based on research reports submitted and interviews with the student. Unsatisfactory performance may lead to termination of the program.

Thesis evaluation procedures

Extracts from the regulations of the School of Graduate Studies for the evaluation of theses and the conduct of the Final Examination are set out in Appendix 2.

4.3 Part-time studies

The program is not offered on a part-time basis.

4.4 Total graduate courses listed and level

Table 7 lists the graduate courses offered during each of the past three years with the enrolments. We do not allow undergraduate students to enroll in graduate courses.

Table 7

Courses Offered to Graduate Students in the Past Three Years				
Course	Faculty member(s) responsible	2002/03	2003/04	2004/05
AST 1410S - Stars	J. Dubinski		4/G	
AST 1420F - Dynamics	H. Yee		7/G	
AST 1430F - Cosmology	H. Yee		7/G	
AST 1440S - Radiation	E. Seaquist	5/G	7/G	
AST 1440S - Radiation	J. Lester			3/G
AST 2030F - ISM	C. Matzner	5/G		3/G
AST 2040F - Extragalactic	R. Abraham	4/G		6/G
AST 2050S - Techniques	J. Lester			1/G
AST 2060F - GR I	C. Dyer	1/G	2/G	
AST 2060F - GR I	A. Peet			2/G
AST 2070S - GR II	C. Dyer	2/G		
AST 2010S - Stellar Astronomy	J. Lester			1/G
AST 1501Y - Research I	H. Yee	4/G		5/G
AST 1501Y - Research I	Y. Wu		4/G	
AST 1500Y - Research II	B. Clarke	4/G	4/G	
AST 1500Y - Research II	H. Yee			5/G
AST 3100Y - Mini Courses:				
Weak Gravitational	H. Hoekstra/U. Pen	1/G		

Courses Offered to Graduate Students in the Past Three Years				
Course	Faculty member(s) responsible	2002/03	2003/04	2004/05
Lensing				
Intro to Physical Cosmology	L. Kofman	1/G		
Magnetars	C. Thompson	1/G		
Stellar Winds II	T. Bolton		1/G	
Planetary Dynamics	Y. Wu		1/G	
Binary Stars	S. Mochnacki		3/G	
Parallel Computational Astrophysics	J. Dubinski		4/G	
Dark Matter, Dark Energy, Dark Ages	U. Pen		4/G	
Gamma Ray Bursts	C. Thompson		1/G	
Star and Planet Formation	M. van Kerkwijk			3/G
MK process and stellar classification	R. Garrison			4/G

4.5 Collateral and supporting departments

Since 1998, the graduate units of Astronomy and Astrophysics, and Physics, and the Canadian Institute of Theoretical Astrophysics have participated in the Collaborative MSc. Program in Astrophysics. This program is intended to foster graduate education in Astrophysics, particularly in those areas of study that overlap traditional departmental boundaries. There is a heavier reliance on formal course work, which provides useful foundations especially for theoretical work. Thus the program requires the equivalent of ten half courses as follows: three half courses from Astronomy and Astrophysics; three half courses from Physics; two further half courses in astronomy, physics, or from a cognate department (e.g., chemistry, math, computer science); a supervised research project in the field of astrophysics, equivalent to two half courses. The program is normally completed in one year (three sessions).

Graduate students in the Collaborative MSc. Program register in the School of Graduate Studies through their home graduate unit, this being either Astronomy or Physics. The student must meet all respective degree

requirements of the School of Graduate Studies and the home department. This will normally require the equivalent of 10 half courses as follows:

3 half courses from Astronomy

3 half courses from Physics

2 further half courses in astronomy, physics, or from a cognate department (e.g., chemistry, math, computer science)

a supervised research project in the field of astrophysics, equivalent to 2 half courses

The supervised research project and associated report will be completed under the regulations of AST 1500L for students whose home department is Astronomy and under the regulations of PHY 3400L for students whose home department is Physics.

In addition the student must attend the seminar program of the Canadian Institute of Theoretical Astrophysics, and prepare a report on a selection of these seminars, to be submitted to the Director. Program requirements are expected to be completed within twelve months of entry to the program.

Application for admission to the Collaborative MSc. Program in Astrophysics should be made through one of the two participating home departments. In addition, the student must submit a supplementary brief application form to the Collaborative Program Director (available from either home department or the Collaborative Program office). Normal deadlines for application to the School of Graduate Studies apply. Students who have already been admitted to one of the two home departments may apply to the Collaborative Program until October 1.

5. OUTCOMES

5.1 Enrolment and graduations

Enrolment and graduation data for the past seven years are given separately for the MSc and PhD degree programs in Tables 8 through 13. All students in both programs are full-time.

5.1.1 Master's program

Table 8: Cohort data

New Enrolments, Withdrawals and Graduations in the Master's Program by Year of Admission									
Year ¹	New ²	within 6 terms ¹¹				within 9 terms ¹¹			
		Trans PhD ³	Withd ⁴	Compl ⁵	IP ⁶	Trans PhD ⁷	Withd ⁸	Compl ⁹	IP ¹⁰
1998/99	2	0	0	2	0	0	0	2	0
1999/00	6	0	1	5	0	0	1	5	0

2000/01	7	0	0	6	1	0	0	6	1
2001/02	1	0	0	1	0	0	0	1	0
2002/03	0	0	0	0	0	0	0	0	0
2003/04	0	0	0	0	0	0	0	0	0
2004/05	1	0	0	0	1	0	0	0	1

- 1 Academic year starting September 1 with three entry points: (Sept, Jan. and May).
- 2 Sum of intake for each entry point of a given academic year.
- 3 All students from that cohort who transferred to the PhD within six terms of entry point.
- 4 All students from that cohort who had withdrawn within six terms of entry point.
- 5 All students from that cohort who had completed the program within six terms of entry point.
- 6 All students from that cohort who were still in program or on approved leave after six terms of entry point
- 7 All students from that cohort who transferred to the PhD within nine terms of entry point.
- 8 All students from that cohort who had withdrawn within nine terms of entry point.
- 9 All students from that cohort who had completed the program within nine terms of entry point.
- 10 All students from that cohort who were still in program or on approved leave after nine terms from entry point.
- 11 If 6 (or 9) terms have not elapsed for that cohort, results to date are given.

Starting in 2001, virtually all incoming students chose the Direct Entry program. Hence the enrolment in the Master's program dropped significantly from earlier projections.

Table 9: Flow-Through Data

Master's Total Enrolments, Transfers, Withdrawals and Graduations by Year (Flow-Through Data)							
Year¹	Total Enrol²	# female (%)³	# visa (%)⁴	Total Transfers⁵	Total Withdrawals⁶	Total Graduations⁷	Total Continuing⁸
1998/99	9	1 (10%)	1 (10%)	0	1 (10%)	5 (56%)	3 (33%)
1999/00	9	1 (10%)	1 (10%)	0	1 (10%)	3 (33%)	5 (56%)
2000/01	12	4 (33%)	0	0	1 (8%)	5 (42%)	6 (50%)
2001/02	7	2 (29%)	0	0	0	6 (86%)	1 (14%)
2002/03	1	0	0	0	0	1 (100%)	0
2003/04	2	1 (50%)	0	0	0	1 (50%)	1 (50%)
2004/05	2	0	1 (50%)	0	0	1 (50%)	1 (50%)

- 1 Academic year starting September 1 with three entry points: (Sept, Jan. and May).
- 2 All students registered in the program in that academic year continuing and new (continuing in this context includes students graduating in November 1 who were not required to register in September).

- ³ Number of female students and (%).
⁴ Number of visa students and (%).
⁵ All students who transferred to the PhD within that year with (%).
⁶ All students who withdrew within that year with (%).
⁷ All students who completed the program within that year with (%).
⁸ All students who continued in program in the subsequent year with (%).

Mean and median times to completion

Table 10

Mean (range) and Median Times-to-Completion of Master's program		
# Students	Mean (range)	Median
22	1.26(1-3) years	1 year

5.1.2 Doctoral program

Table 11: Cohort Data

New PhD Enrolments, Withdrawals and Graduations by Year of Admission										
Year ¹	New ²	Within 12 terms ¹²			Within 18 terms ¹²			Within 21 terms ¹²		
		Withd ³	Compl ⁴	IP ⁵	Withd ⁶	Compl ⁷	IP ⁸	Withd ⁹	Compl ¹⁰	IP ¹¹
1995-6	5	1	0	4	1	2	2	1	3	1
1996-7	3	0	1	2	0	1	2	0	2	1
1997-8	5	1	0	4	1	2	2	1	2	2
1998-9	5	0	2	3	0	4	1	0	4	1
1999-0	2	1	0	1	1	0	1	1	0	1
2000-1	6	0	2	4	0	2	n/a	0	n/a	n/a
2001-2	9	2	0	n/a	2	n/a	n/a	2	n/a	n/a
2002-3	6	0	0	n/a	0	n/a	n/a	0	n/a	n/a
2003-4	4	1	0	n/a	1	n/a	n/a	1	n/a	n/a
2004-5	6	0	0	n/a	0	n/a	n/a	0	n/a	n/a

¹ Academic year starting September 1 with three entry points: (Sept, Jan. and May).

² Sum of intake for each entry point of a given academic year (to include students who transferred from the master's degree).

- 3 All students from that cohort who had withdrawn within twelve terms of entry point.
 4 All students from that cohort who had completed the program within twelve terms of entry point.
 5 All students from that cohort who were still in program or on approved leave after twelve terms from entry point.
 6 All students from that cohort who had withdrawn within eighteen terms of entry point.
 7 All students from that cohort who had completed the program within eighteen terms of entry point.
 8 All students from that cohort who were still in program or on approved leave after eighteen terms from entry point.
 9 All students from that cohort who had withdrawn within twenty-one terms of entry point.
 10 All students from that cohort who had completed the program within twenty-one terms of entry point.
 11 All students from that cohort who were still in program or on approved leave after twenty-one terms from entry point.
 12 If 12 (or 18, or 21) terms have not elapsed for that cohort, results to date are given.

Table 12: Flow-Through Data

PhD Total Enrolments, Withdrawals and Graduations by Year (Flow-Through Data)						
Year¹	Total Enrolments ²	# female (%)³	# (visa (%)⁴	Total Withdrawals⁵	Total Graduations⁶	Total Continuing ⁷
1998/99	23	6 (26%)	6 (26%)	1 (4%)	3 (12%)	19(83%)
1999/00	21	7 (33%)	7 (33%)	1 T (5%)	5 (25%)	16(76%)
2000/01	22	5 (23%)	5 (23%)	1 (5%)	2 (9%)	19(86%)
2001/02	28	10 (36%)	6 (21%)	0	1 (4%)	27(96%)
2002/03	33	12 (36%)	9 (27%)	1 T (3%)	5 (15%)	28(85%)
2003/04	32	10 (31%)	8 (25%)	5 P(16%) 1 T	3 (9%)	24(75%)
2004/05	30	11 (37%)	10 (33%)	5 P(17%) 1T	2 (7%)	23(77%)

- 1 Academic year starting September 1 with three entry points: (Sept, Jan. and May).
 2 All students registered in the program in that academic year continuing and new.
 3 Number of female students and (%).
 4 Number of visa students and (%).
 5 All students who withdrew within that year with (%).
 6 All students who completed the program within that year and (%).
 7 All students who continued in the program in the following year and (%).
 8 Permanent (P), Temporary (T) indicating students who subsequently rejoined the program.

Two of the students who withdrew (2003/04 and 2004/05) successfully applied to transfer to the MSc program and graduated with that degree. They are included in Table 9.

Table 13: Mean and median times to completion

Mean (range) and Median Times-to-Completion of Doctoral Program(s)		
# Students	Mean (range)	Median
21	5.19 (1.33-8) years	5 years

Time to completion is impacted by the move to a “direct entry” program in 2001. It may also reflect somewhat longer times for those students whose research involves observing programs at large international facilities and who must submit a successful time request proposal in competition.

The Department is convinced, on the other hand, that the overall time to completion as well as the quality of the graduate experience will ultimately be improved as a result of the direct entry program.

5.2 Employment

Initial employment (or status) of students graduating over the past seven years

Table 14 shows the post-graduation (or current where known) status of our doctoral students graduating since 1990. Of the 43 graduates, only 5 have not taken positions based on their experience or research here.

Table 14: Post-graduate employment

NAME	DATE	PRESENT POSITION
Dubinski, John Joseph	1991	F (temporary), U Toronto
Harper, John Francis	1991	S, Toronto (computing)
Hill, Robert James	1991	S, NASA GSFC
Ortiz, Patricio F.	1992	S, Leicester University
Rouleau, Francois	1993	P, Leiden, MPI Jena
Ip, Peter Shun Sang	1994	S, U Toronto (computing)
Li, Gang	1994	medical imaging, Sunnybrook Hospital
Hudon, James Daniel	1995	freelance writer, teacher
Kim, Sang-Hee	1995	P, Korea NO; now patent expert in Seoul
Landry, Sylvie	1995	P, Laval University
Marleau, Francine R.	1995	S, Spitzer Science Center (F, St. Mary’s)
Short, Christopher Ian	1995	F, St. Mary’s University
Sigut, T. A. Aaron	1995	F, University of Western Ontario
Shelton, Ian K.	1995	S, David Dunlap Observatory
Wiegert, Paul A.	1996	F, University of Western Ontario
Brown, James Patrick	1997	P, Oxford
Hendry, Paul A.	1996	industry

NAME	DATE	PRESENT POSITION
Huang, Siqin	1997	unknown
Lopez-Cruz, Omar	1997	F, INAOE-Tonantzintla, Mexico
Gravel, Pierre	1998	unknown
Kroeker, Teresa Lynn	1998	computing
Papadopoulos, Padelis Peter	1998	P, Leiden
Wadsley, James	1998	F, McMaster University
Allen, Michael L.	1999	F, Washington State
Barrientos, Luis Felipe	1999	F, Catolica
Sawicki, Marcin	1999	S, HIA Victoria
Clarke, Tracy E.	2000	P, Virginia (was Jansky Fellow)
Kerton, Charles Robert	2000	F, Iowa State
Mallen-Ornelas, Gabriela	2000	P, CfA
Verner, Ekaterina	2000	P, NASA GSFC
Hamilton, Devon	2001	S, Ontario Science Centre, Toronto
Zhu, Ming	2001	S, JCMT
Burns, Christopher, R.	2002	F (visiting), Swarthmore
Gladders, Michael David	2002	P, Carnegie Fellow (OCIW)
Karr, Jennifer	2002	P, Spitzer Science Center
Shepherd, Charles	2002	F (temporary), U Toronto Scarborough
Webb, Tracy M. A.	2002	P, Leiden University
Barkhouse, Wayne Alan	2003	P, CfA
Reid, Robert	2003	P, DRAO
Zhang, Pengjie	2003	F, Beijing
Brodwin, Mark	2004	P, JPL
Trac, Hi	2004	P, Princeton
Tycner, Chris	2004	P, USNO

F=faculty, S=professional staff, and for recent graduates, P=postdoctoral fellow

5.3 Publications

All students at the doctoral level are involved in research-based study and all have at least one paper in a refereed journal such as the Astrophysical Journal, the Monthly notices of the Royal Astronomical Society, the Astronomical Journal, Astronomy & Astrophysics and the Publications of the Astronomical society of the Pacific.

5.4 Projected graduate intake and enrolments

Table 14 shows the projected intake of doctoral stream students for the next seven years. These targets have been arrived at in conjunction with the planning exercise conducted as part of the “Stepping Up” review. They are based on best estimates of our supervisory capacity and a continuing program of recruitment. Current application levels (approximately 50 per year) provide a pool of good to excellent students from which to choose, but we must seek to expand our recruitment efforts in the face of tough competition.

The direct-entry PhD. has proven very popular and is where DAA will continue to head. But the MSc. is still a desirable program for students wishing to gain experience at more than one institution; no special resources are needed to mount it since it relies on graduate courses given for the direct-entry PhD. and Collaborative MSc.

TABLE 15

PROJECTED INTAKE AND ENROLMENTS Master's (M) and Doctoral (D) Programs				
YEAR	FULL-TIME			
	Intake		Enrolments	
	M	D	M	D
2005/06	1	8	1	33
2006/07	2	9	2	37
2007/08	2	9	2	39
2008/09	2	10	2	42
2009/10	2	10	2	44
2010/11	2	11	2	45
2011/12	2	11	2	46

APPENDIX I

SCHOOL OF GRADUATE STUDIES UNIVERSITY OF TORONTO

STATEMENT ON DOCTORAL STREAM FINANCIAL SUPPORT AND UNIVERSITY OF TORONTO GRADUATE AWARDS POLICY JULY 2003

Financial support for our graduate student is important to the University of Toronto and its School of Graduate Studies. This is why in the year 2000 the University took a major step towards a commitment of funding of at least \$12,000 plus tuition and fees to eligible doctoral-stream students.

The University of Toronto is the first Canadian University to offer a guaranteed level of financial support for graduate students pursuing doctoral degrees. In accordance with the University of Toronto Graduate Awards Policy, attached, the funding will be available for up to five years of study and will help put eligible graduate students at the University of Toronto on a more equal footing with their counterparts in the United States.

This objective is to be realized for all graduate units by 2004. However, in many faculties and units this goal has already been met.

APPENDIX 2

SCHOOL OF GRADUATE STUDIES UNIVERSITY OF TORONTO

Final Oral Examination

1 The candidate shall defend the thesis at a final oral examination organized by the graduate unit with the cooperation of SGS. ...

3 The thesis will be sent to an appraiser external to the University of Toronto, appointed by SGS on the recommendation of the graduate unit. (The Supervisor of the thesis will propose a list of three or more names of possible external appraisers to the graduate coordinator or Chair, who will choose one and send the recommendation to SGS for approval. The graduate unit will certify that the external appraiser has an arm's-length relationship to the candidate and Supervisor.) The external appraiser should be a recognized expert on the subject of the thesis and should be external to the University as well as to its affiliated teaching hospitals and research institute. Such an individual must be an associate or full professor at the home institution or, if the individual comes from outside the academic sector, must possess the qualifications to be appointed to an academic position at this level. Arrangements with external appraisers are the responsibility of the graduate unit. In particular, the graduate unit must allow the external appraiser sufficient time to act. The graduate unit must have a copy of the thesis delivered to the appraiser at least six weeks, and preferably longer, in advance of the examination date. Appraisals must be submitted to SGS at least two weeks in advance of the examination date; if they are not, the examination may have to be rescheduled. The graduate unit must also ensure that copies of the thesis are made available to all other voting members of the Examination Committee at least four weeks in advance of the examination date.

4 An Examination Committee, appointed by SGS on the recommendation of the graduate unit, will conduct the Final Oral Examination. The Examination Committee must include at least four, but no more than six, voting members: one to three of the voting members will have served on the candidate's Supervisory Committee, and at least one voting member will not have been closely involved in the supervision of the thesis. Eligible for inclusion in the latter group are the external appraiser (in person or by audio or video connection), members of the graduate faculty of the candidate's graduate unit, and members of the graduate faculty of other departments, centres, or institutes of the University. The Examination Committee may include, in addition, up to two non-voting members, who will be members of the graduate faculty of the candidate's graduate unit or members of the graduate faculty of another graduate unit of the University. A quorum is four voting members. Graduate units must ascertain in advance the willingness of the persons named to act.

The Associate Dean may modify the composition of the Examination Committee to fit exceptional circumstances.

5 SGS will appoint a non-voting Chair to the Examination Committee. The Chair will be a full member or member emeritus of the graduate faculty, holding no appointment to the graduate faculty of the candidate's graduate unit.

...

7 The graduate unit must submit to SGS a Certificate of Completion together with the nomination form confirming completion of all other academic requirements, such as language and field requirements; an abstract of the thesis not longer than 350 words; and a copy of the Examination Program.

8 The graduate unit will send a copy of the external appraisal of the thesis to SGS as soon as it is received. The graduate unit is responsible for the distribution of copies of the external appraisal to the candidate (two weeks before the examination) and members of the Examination Committee. To avoid prejudicing the result of the examination, the external appraisal is not to be discussed with the candidate by members of the Examination Committee until the examination takes place, nor should it be distributed beyond that group and the relevant administrative officers.

9 Members of the graduate faculty are entitled to attend the examination, and with the permission of the Chair, they may ask questions of the candidate, but they must withdraw before the Committee's discussion and vote. A qualified observer may attend, subject to the same restrictions, if the graduate unit has received approval for such attendance in writing beforehand from the Associate Dean. Otherwise the examination is closed to the public. The vote at the examination takes into account both the thesis and the oral defence itself.

10 The Examination Committee represents the Council of the School of Graduate Studies and through it the University. It is therefore responsible for the standard of the Ph.D. degree in this University. Graduate unit examinations held immediately in advance of the final oral must not therefore interfere with attendance at, or thoroughness of, the final examination.

The Committee must evaluate the external appraisal of the thesis, which is to be considered only as an individual opinion to be employed as the committee sees fit. It must examine the candidate on the content and implications of the thesis. Where someone other than the candidate is a co-author of any portion of the thesis, the Examination Committee must be satisfied that the candidate's personal contribution to the thesis is sufficient to fulfil the requirements of the Ph.D. degree. In addition to determining the adequacy of the thesis, the committee must satisfy itself that the thesis document meets the proper standards of scholarship.

The committee possesses the full authority of the School with respect to the examination.

11 A quorum for the final examination is four voting members, plus the Examination Committee Chair who has no vote. Voting shall be by signed ballot, and the names of the examiners and their respective votes shall be read to the Examination Committee by the Chair. If a quorum is not present the Chair may delay the examination to obtain a quorum or may postpone the examination to another date.

12 The candidate passes on the first examination:

if the decision is unanimous, OR

if there is not more than one negative vote or abstention.

If there is more than one negative vote or abstention, adjournment is mandatory.

In the event of adjournment, the Examination Committee must provide the candidate, as soon as possible, with a written statement that indicates the reasons for adjournment and the committee's requirements for the reconvened oral examination. In addition, the Examination Committee must decide the approximate date of the reconvened examination. The time between the adjourned examination and the reconvened examination should be as short as circumstances will permit and in no case shall exceed one year.

At the reconvened examination, no new committee members shall be added, except for necessary replacements. It is the obligation of the examiners to attend the reconvened examination.

The candidate passes on the reconvened examination:

if the decision is unanimous, OR

if there is not more than one negative vote or abstention.

No further adjournment will be allowed.

If a candidate is not recommended for the degree by the committee in charge of the second examination, the candidate is ineligible for further Ph.D. candidacy at the University. The Examination Committee must provide the candidate, as soon as possible, with a written statement that explains clearly and directly why the examiners found the candidate's performance unsatisfactory on the written and/or oral components of the examination, as may be relevant.

13 If minor corrections in style are a condition of acceptance of the thesis, the candidate must complete the corrections within one month of the date of the examination, and the supervisor will inform the candidate of the necessary corrections. The supervisor must notify the School of Graduate Studies directly in writing that the required corrections

have been made by the candidate, with a copy of the correspondence sent to the graduate coordinator of the graduate unit, before the candidate is recommended for the degree.

14 If minor modifications are a condition of acceptance of the thesis, the Chair of the Examination Committee will appoint a Subcommittee of the Examination Committee (to be approved by the Examination Committee) to supervise the proposed modifications. One member of the Subcommittee is designated by the Chair, with the approval of the Examination Committee, as the Convenor. The Convenor will be responsible for the preparation of a statement detailing the modifications required. Modifications must be completed within three months of the date of the oral examination. The members of the Subcommittee will report on the acceptability of the completed modifications to the Convenor. If all members of the Subcommittee approve the completed modification, the candidate will be passed without the necessity of reconvening the Examination Committee. The Convenor of the Subcommittee must certify in writing to the School of Graduate Studies, within three months of the original examination, that the modifications have or have not been satisfactorily completed. If one or more members of the Subcommittee do not approve the completed modifications, the final oral examination must be reconvened within a year of the date of the original examination.

The Examination Committee must decide the nature of minor modifications, but it is intended that minor modifications should be more than corrections in style and less than major changes in the thesis. A typical example of minor modifications might be clarification of textual material or qualification of research findings and conclusions. The option of acceptance with minor modifications does not apply to the reconvened examination.

If major changes are required, the examination must be adjourned and the Committee reconvened after the changes have been made.

...

16 The School requires that every Ph.D. thesis be published substantially as it is accepted

...

It is the intention of the University of Toronto that there be **no restriction** on the distribution and publication of theses. However, in exceptional cases, the author, in consultation with the thesis supervisor and with the approval of the chair of the graduate unit, shall have the right to postpone distribution and publication by microfilm for a period up to two years from the date of acceptance of the thesis. In exceptional circumstances and on written petition to the Dean of the School of Graduate Studies, the period might be extended, but in no case for more than five years from the date of acceptance of the thesis unless approved by the Council of the School of Graduate Studies. ...