GRADUATE STUDENT HANDBOOK

2018-2019

Department of Physics
University of Toronto

DEPARTMENT OF PHYSICS, UNIVERSITY OF TORONTO, 60 ST. GEORGE STREET, TORONTO, ONTARIO, CANADA M5S 1A7

September 2018

WELCOME MESSAGE

Welcome to the Department of Physics at the University of Toronto. This handbook provides most of the information needed by new graduate students so that they can rapidly orient themselves to the departmental environment. It will also be useful as a reference document as you pursue your graduate studies here.

We would appreciate your comments about the usefulness of this booklet and how it can be improved in the future. We would also like to thank everyone who has contributed to this handbook so far.

Best wishes for a productive and enjoyable journey through your studies here!

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SEP. 19	**Completed applications for NSERC CGSD and PGSD due**
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OCT. 29	**Final date to withdraw from a fall-term half course without academic penalty**
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I. SUMMARY OF RESEARCH ACTIVITIES

Historical Background
The first Ph.D. in physics in Canada was given in 1900 to J.C. McLennan, who later made the Department a major force in the development of physics worldwide. The pioneering work in superfluid ^{4}He and superconductors (McLennan) and the construction of North America's first electron microscope (Hillier and Prebus) in the 1930s established the Department's international reputation. In the 1950s, the Department was pre-eminent in the field of Raman molecular spectroscopy (Welsh). Its faculty now continue this tradition in most of the important fields of physics. Over five hundred men and women with doctorates in physics from the University of Toronto are working in government, in industry and in education within Canada and around the world. Two of them have been awarded the Nobel Prize in Physics: A.L. Schawlow (1949) was a co-winner in 1981, and B.N. Brockhouse (1950) was a co-winner in 1994.

Degrees
Master of Science
Doctor of Philosophy

Areas of study
Experimental and theoretical research opportunities are offered in the following areas:
Biological Physics, Condensed Matter Physics, Earth, Atmospheric and Planetary Physics, Experimental High Energy Physics, Theoretical High Energy Physics and Quantum Optics.

Research
Research activities in the Department range from macroscopic modelling of global geophysical characteristics to the microscopic study of the quark and gluon substructure of hadronic matter. The research activities are both basic and applied, with theoretical and experimental faculty members providing mutual support. Every week leading physicists from around the world visit, giving seminars and sharing their results and ideas. Not only is the scope of the research exceptionally broad, but as well the quality is exceptionally high. Research productivity is equal to that of the best universities: proof is provided by the number of research publications originating with faculty and graduate students and the number of prizes and research grants awarded to the faculty.

Faculty
Our faculty members and their individual research interests are listed below. Telephone numbers are listed as University of Toronto extensions, e.g. 8-xxxx = 416-978-xxxx and 6-xxxx = 416-946-xxxx. All partial e-mail addresses are within ".utoronto.ca", e.g. *username@physics.utoronto.ca*

D.C. Bailey	dbailey@physics	MP919	8-4993
	Measurement uncertainty and scientific reproducibility		
V. Barzda	virgis.barzda@utoronto	UTM SB4047	905-828-3821
	Advanced imaging and nano-spectroscopy in biological systems		
J. R. Bond	bond@cita	MP1419	8-6874
	Cosmology and particle astrophysics		
D. Curtin	dcurtin@physics	MP1113	8-4784
	Theoretical Particle Physics, Beyond Standard Model theories and signatures, collider physics, Higgs Physics, interface between cosmology and particle physics.		
A. Dhirani	adhirani@chem	LM254	6-5789
	Charge transport in nanoengineered materials (quantized charging, quantum coherence , metal-insulator phase transition , e-e correlations , magnetotransport); micro fabricated devices and bioanalytical devices (development, fabrication and applications)		
D.J. Donaldson	jdonalds@chem	LM 316	8-3603

	Physical chemistry, atmospheric chemistry, heterogeneous chemistry		
C. Dyer	dyer@astro	NU209	6-3044
	General relativity, cosmology, gravitational lensing		
R. Ghent	ghentr@es	22 Russell St	8-0597
	planetary scientist who focuses on geological processes on the terrestrial planets at a number of spatial scales		
S. Goyal	goyal@physics	MP504	6-0672
	Evolutionary dynamics and biophysics		
C. Gradinaru	claudiu.gradinaru@utoronto	DV4043	905-828-3833
	Expertise: single-molecule spectroscopy, protein folding and recognition, small-molecule cancer drugs		
N. Grisouard	nicolas.grisouard@physics	MP703	8-6824
	Geophysical fluid dynamics		
A. Hilfinger	andreas.hilfinger@utoronto	DV4050, MP516C	905 569-4582
	Biological physics, theoretical systems biology, uncertainty bounds for cellular processes.		
B. Holdom	bob.holdom@utoronto	MP1111	8-4753
	Origin of quark and lepton masses in gauge theories, beyond the standard model		
D.F.V. James	dfvj@physics	MP1014	6-3736
	Theoretical quantum optics, quantum information technology		
S. John	john@physics	MP1002	8-3459
	Theoretical condensed matter physics and quantum optics, disordered systems, quantum many-body problem, photon localization, high-T superconductivity		
D.B.A. Jones	dbj@atmosp.physics	MP707B	8-4992
	Atmospheric physics, effects of anthropogenic pollution on the composition of the global atmosphere		
S.R. Julian	sjulian@physics	MP323 MP086	8-5205 8-8188
	Experimental condensed matter physics, strongly-correlated electron systems, unconventional quantum materials, high pressure materials science		
H-Y. Kee	hykee@physics	MP1009	8-5196
	Theoretical condensed matter theories, highly-correlated materials, unconventional superconductivity, topological phases, frustrated systems		
Y.B. Kim	ybkim@physics	MP1016	8-5193
	Theoretical condensed matter physics		
Y.-J. Kim	Associate Chair for Graduate Studies	MP314	8-2931
	yjkim@physics	MP1001	8-7868
	Experimental condensed matter physics, neutron and x-ray scattering, quantum materials		
P. Krieger	krieger@physics	MP801	8-2950
	Experimental particle physics, electron-positron and hadron collisions, OPAL and ATLAS experiments, searches for physics beyond the Standard Model		
P.J. Kushner	paul.kushner@utoronto	MP716	6-3683
	Theoretical atmospheric physics, models of the atmosphere, land atmosphere interactions		

C. Lee	clee@atmosp.physics	MP1214	8-4251
	Planetary atmospheres		
Q. Liu	liuqy@physics	MP504A	8-5434
	Geophysics, seismology		
H.-K. Lo	hklo@physics	BA7108	6-5525
		MP1103A	8-0354
	Quantum information, quantum cryptography		
J. Lowman	lowman@utsc	MP421	8-3912
	Computational fluid dynamics, heating modes and cooling processes in terrestrial planets, feedback between mantle convection and surface motion		
M. Luke	Chair	MP323	8-5205
	luke@physics	MP1116	8-2985
	Theoretical particle physics, heavy quarks, QCD, weak interactions		
R.S. Marjoribanks	marj@physics	MP1104C	8-6769
	Atomic physics & spectroscopy at high-energy densities, laser-plasma interactions, atoms in ultra-intense light fields		
D. McMillen	david.mcmillen@utoronto	UTM DV4056	905-828-5353
	Biological physics, systems biology, synthetic biology, principles of cellular behaviour, cellular dynamics		
B. Milkereit	bm@physics	MP504	8-2466
	Exploration geophysics, crustal geophysics, 3D seismology		
R.J.D. Miller	dmiller@lphys.chem	MP1103A	8-0354
		LM245	8-1528
	Femtosecond electron diffraction, coherent control of complex systems, multidimensional coherent spectroscopy of liquids and biological/molecular systems, solid state laser development		
J.N. Milstein	milstein@physics	UTM SB4053	905-569-4598
		MP313	
	Single-molecule and single-cell techniques to study fundamental questions of nature of life		
G.W.K. Moore	moore@atmosp.physics	MP614	8-4686
		UTM SB4037	905-828-5368
	Geophysical fluid dynamics, baroclinic instability, mesoscale dynamics		
S.W. Morris	smorris@physics	MP505B	8-6810
	Experimental nonlinear physics, liquid crystals, convection, fracture, geophysical pattern formation		
N.W. Murray	murray@cita	MP1402	8-1778
	Non-linear dynamics, solar physics, active galactic nuclei, planet, star and galaxy formation		
B. Netterfield	netterfield@astro	ES1450	6-0946
	Balloon-borne astrophysics		
K.H. Norwich	k.norwich@utoronto	MB322E	8-6698
	Physics of sensation, biokinetic processes		

R.S. Orr	orr@physics	MP818A	8-6029
Experimental particle physics, pp collisions at the ATLAS experiment. Superconducting radio frequency for particle accelerators			
A. Paramekanti	arunp@physics	MP1006	8-8633
Condensed Matter Theory – superconductivity, graphene, ultracold atoms, topological insulators			
A. W. Peet	awpeet@physics	MP1118	8-3911
Interface between String/M theory and Quantum Black Hole physics			
W.R. Peltier	peltier@atmosp.physics	MP702	8-2938
Geophysical fluid dynamics, planetary interiors, nonlinear atmospheric waves and wave, mean- flow interaction, hydrodynamic stability, ice-age paleoclimate, global change, ocean circulation and the carbon cycle			
U-L. Pen	pen@cita	MP1317	8-6477
Astrophysics, cosmology			
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Numerical relativity; black holes; neutron stars; gravitational waves			
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Physics beyond the standard model. Nonperturbative gauge theory dynamics			
R. Pysklywec	russ@es.utoronto	ESS	8-3021
deformation of the solid Earth			
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Planet formation, stochastic processes, celestial mechanics, high performance computing			
S. Rauscher	sarah.rauscher@utoronto	DV4055, MP516C	905-828-3805
Molecular simulations, molecular biophysics, protiein physics, intrinsically disordered proteins, protein folding.			
J. Repka	repka@math	BA6193	8-4692
Group represe ntations, automorphic forms			
W. Ryu	wryu@physics	MP508	8-4285
Experimental biological physics			
P. Savard	savard@physics	MP803	8-0764
Higgs boson and physics beyond the Standard Model			
P.K. Sinervo	pekka@physics	MP814A	8-5270
Experimental particle physics, hadron collisions, CDF and ATLAS experiments			
J.E. Sipe	sipe@physics	MP1013	8-4517
Theoretical physics of nonlinear optics, solitons, optical properties of semiconductors, the quantum/classical interface			
A.M. Steinberg	steinberg@physics	MP1103	8-0713
Experimental quantum optics: ultracold atoms, quantum measurement and quantum information			

K. Strong strong@atmosp.physics MP710A 6-3217
Experimental atmospheric physics, ground-based and satellite remote sounding of the atmosphere

H. Tanaka htanaka@physics MP801A 8-7132
Experimental particle physics, neutrino physics (T2K, Super-Kamiokande, Hyper-Kamiokande), and dark matter (SuperCDMS).

R.J. Teuscher teuscher@physics MP802 8-1543
Experimental particle physics, ATLAS experiment at CERN, searches for physics beyond the Standard Model

C. Thompson thompson@cita MP1316 8-8784
High-energy astrophysics

J.H. Thywissen jht@physics MP1109A 8-2941
Cold quantum gases, Bose Einstein condensation, superfluid transition in trapped Fermi gases

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Experimental particle physics, ATLAS experiment at CERN and SRF accelerator development

D. Valencia diana.valencia@utoronto MP309 6-7290
Super-earths and sub-neptunes

K. Vanderlinde vanderlinde@di.utoronto AB126 6-5436
Long wavelength (radio, microwave) instrumentation and cosmology

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Precision measurements using atoms and molecules, atomic clocks.

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Experimental atmospheric physics, satellite and ground-based remote sounding of the atmosphere, development of new satellite missions, spectroscopy

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Unconventional superconductivity, exotic electron pairing states, topological insulators, complex oxide & intermetallic materials, cryomagnetic scanning tunneling microscopy, Andreev point contact spectroscopy, epitaxial thin films & heterostructures

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Environmental fluid dynamics; Influence of Coriolis forces on geophysical flows; lake and ocean circulation

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Atmospheric physics, satellite and ground based remote sensing of the atmosphere, studies of the global and urban carbon cycle

L. Yang lyang@physics MP1004 416-978-3821
Experimental condensed matter physics, ultrafast optical spectroscopy, quantum materials.

A. Zilman	zilman@physics	MP503	416-978-4946
	Interface between physics, biology and bio-engineering, quantitative understanding of biological phenomena on multiple levels, from molecular biophysics to systems biology		
M. Diamond	mdiamond@slac.stanford.edu	TBA arriving in January 2019	

Departmental Associations

Although faculty in the Department are involved in many collaborative efforts and institutes worldwide, nine have a particular impact on our students. Not only are they concerned with interdisciplinary work, but they are based, in whole or in part, at the University of Toronto and provide novel research opportunities for our students at their "home base". They include: CGCS (The Centre for Global Change Science), CIFAR (The Canadian Institute for Advanced Research), CITA (The Canadian Institute for Theoretical Astrophysics), CQIQC (The Center for Quantum Information and Quantum Control), CQM (Centre for Quantum Materials). The Fields Institute for Research in Mathematical Sciences, IBBME (The Institute of Biomaterials and Biomedical Engineering), IOS (The Institute for Optical Sciences), and PRO (Photonics Research Ontario).

The Department of Physics participates in Collaborative Graduate Programs in: Astrophysics, Biomedical Engineering, Environmental Sciences, Earth Sciences, and Optics. Please consult with the Associate Chair of Graduate Studies for details.

II. GRADUATE DEGREE PROGRAMS

Introduction

The Department of Physics offers M.Sc. and Ph.D. graduate programs that are directed primarily to qualified students seeking a career in scientific research, with an emphasis on doctoral-stream studies. The M.Sc. can be taken both with and without a thesis, the latter being the norm. Highly qualified students may be offered "direct entry" into the Ph.D. straight from their B.Sc.

It is the policy of the Department to ensure that all students making satisfactory progress are supported at or above the prevailing minimum rate (see section V of this handbook) for up to five years of graduate study (one year of M.Sc. and four years of Ph.D., or five years for direct-entry Ph.D.). In accepting a student, the supervisor accepts the responsibility for ensuring and arranging this financial support which may come from any combination of external or internal sources, teaching assistantship, and research grants.

For convenience in this document, the year is divided into three four-month terms; Fall (September to December), Spring (January to April) and Summer (May to August). The booklet also assumes that students start at the beginning of the Fall Term (September). Here, a full course means two one-term (i.e. half) courses.

All items in *italics* are defined later in this section.

The M.Sc. Degree

The M.Sc. degree may be completed either with or without a thesis. The M.Sc. (without thesis) is the normal route for students, whereas the M.Sc. (with thesis) is an option for those students who specifically require a thesis for a professional designation. However, the Department only provides financial support for 1 year of the M.Sc., so you should consult your supervisor and the Associate Chair for Graduate Studies before considering this option.

The M.Sc. (without thesis) is generally intended to provide preparatory background prior to the commencement of Ph.D.-level research; it is intended that this degree be completed within one year (i.e., three terms). The requirements of this program can be met in one of two ways:

Option I. Three (full) *graduate lecture courses* and an *M.Sc. Report (Option I)*. Students pursuing Option I enroll in three graduate lecture courses, in the 6000-series *research course* appropriate to their field of specialisation, and in the 'Report' course PHY3400Y, which is entitled 'Selected Topics in Physics'. The supervisor provides the grade for the 6000-series research course. The grade for PHY3400Y is provided by an independent faculty assessor assigned by the department on the basis of the written *Option I M.Sc. Report*. Option I students need to identify a supervisor by January 15.

Option II. Two (full) *graduate lecture courses* and an *M.Sc. Research Project (Option II)*. Students pursuing Option II enroll in two graduate lecture courses, the 'Report' course PHY3400Y ('Selected Topics in Physics'), the 6000-series *research course* appropriate to their field of specialization, and the appropriate 7000-series s*eminar course*. The supervisor provides the grade for the 6000-series research course. Grades for PHY3400Y and the seminar course are provided by two independent faculty assessors assigned by the department to conduct a *M.Sc. Oral Examination* on the Research project. Option II students need to identify a supervisor by the first week of October and will be expected to prepare a 1-page progress report (signed by supervisor and student) by the end of January, unless they take three graduate lecture courses in their Fall term. In the latter case, the supervisor needs to be identified by the end of the Fall term and the 1-page progress report is due by April 15.

The two options involve equivalent amounts of work. All requirements, including examination and grading, must be completed within three terms of initial registration in order that the full assessment of the M.Sc. work be complete in time for Ph.D. registration and enrolment. That means that if you enroll in September, we expect you to complete your M.Sc. by September of next year at the latest.

The M.Sc. (with thesis) is intended to provide training in research at the Master's level for a professional designation. Students who take this option normally do not go on to a Ph.D. degree. The requirements of this program are:

Option III. Two (full) *graduate lecture courses* and an *M.Sc. Research Thesis (Option III)*. Students pursuing Option III enroll in the 'Thesis' course, THS9999Y, and must satisfactorily complete two graduate lecture courses. In addition each candidate enrolls each year in the appropriate 6000-series *research courses* in sequence of the last digit and in the second year, in the appropriate 7000-series *seminar course* and PHY3400Y Report Course. Grades for these last two courses will be assigned by two independent faculty assessors after the *M.Sc. Oral Examination*. Candidates will be expected to find a supervisor by the first week of October and will be expected to prepare a 1-page progress report (signed by supervisor and student) by the end of January. Candidates are expected to complete all requirements, taken in any order, within six terms of initial registration. The Department only provides financial support for 1 year of the M.Sc., so you should consult with your supervisor and the Associate Chair for Graduate Studies before considering this option.

The Ph.D. Degree

Candidates for the Ph.D. degree are normally admitted by the *Admissions Committee* after satisfactory completion of the M.Sc. degree or its equivalent elsewhere. Candidates who do not complete the M.Sc. within three terms will normally not be admitted to the Ph.D. program. Excellent candidates who do not wish to complete the M.Sc. degree may apply for direct transfer into the Ph.D. program. Such students are not subsequently permitted to re-register in the M.Sc. program.

Outstanding candidates may be offered direct entry into the Ph.D. program from their undergraduate studies. A student who commences a direct-entry Ph.D. will normally not be permitted to re-register in the M.Sc. program. In their first year of graduate studies, direct-entry Ph.D. students are required to pass a minimum of two full graduate lecture courses, enroll in the 6000-series *research course* appropriate to their field of specialization (with the grade given by their supervisor at the end of the summer), and submit a brief progress report at the end of the summer (which will not be graded) to the Associate Chair for Graduate Studies. The time by which students must choose a supervisor depends on their lecture course load, consistently with the requirements for M.Sc. students. In order to continue in the Ph.D. program beyond the first year, direct-entry students must obtain at least a B+ average and have a willing supervisor.

The key requirement of the Ph.D. degree is the presentation and acceptance of a *Ph.D. thesis* describing an original and significant research contribution made to a field of physics by the candidate. A subsidiary requirement is the satisfactory completion of three full approved *graduate lecture courses* approved by the supervisor and the Associate Chair for Graduate Studies. Credit will be given for all graduate lecture courses completed in the M.Sc. in this Department. Candidates with a relevant M.Sc. from elsewhere will receive credit for a maximum of two (full) lecture courses.

At the time of initial enrolment in the Ph.D. program, the candidate must be associated with a qualified supervisor who will provide academic and financial support. In addition, two other Faculty members must be named to constitute, with the supervisor, the candidate's *supervisory committee*. In the case of direct-entry Ph.D., the timing of supervisor identification is as discussed above, and the supervisory committee must be identified at the beginning of the second year of graduate studies.

Benchmarks of Progress during the Ph.D. Program

End of Year 1 (Year 2 for direct-entry Ph.D.). All Ph.D. candidates must pass the *Ph.D. Oral Qualifying Examination*. The Examination must be taken within two terms of the candidate’s initial enrolment in the Ph.D. program (five terms for direct-entry Ph.D.). The exams occur before the end of April.

During subsequent years, the *supervisory committee* must meet with the student at least once a year to assess the student's progress in the program, and to provide advice on future work. This should normally occur sometime in the Fall term. The committee submits a report detailing its observations of the student's progress and its recommendations; the student may append a response if desired. Copies of the report are given to the student and filed with the Department. At least one week prior to the meeting, the student should give an outline of their thesis problem and progress made to date to the supervisor and the two other committee members; the outline is often brief, sometimes as short as one page, but should be more detailed if desired by either the committee or the student. If progress is deemed to be unsatisfactory then the committee will request another meeting within a specified time period, typically within a few months.

End of year 4 (year 5 for direct-entry Ph.D.). Meetings of the supervisory committee after this point are generally held more frequently, and can be convened by the Associate Chair for Graduate Studies or a member of the *Standards and Evaluations Committee*. For these meetings the student is typically asked to prepare a five page scientific report outlining the thesis project and the progress made, along with a statement explaining the reasons for the delay in completion and the extra time required.

At the completion of the Ph.D. degree the candidate will normally present a thesis with the consent of their supervisor and supervisory committee. This Ph.D. thesis will be examined first by a *Departmental*

Ph.D. Oral Examination and, if successful, by a *Ph.D. Final Oral Examination of the School of Graduate Studies.*

It is expected that the Ph.D. degree will be completed within four years (twelve terms) of full time postgraduate study (five years, or fifteen terms, for direct-entry Ph.D.). In no case will financial support be guaranteed by the Department beyond this time, nor will departmental scholarships be made available.

Typically the Associate Chair for Graduate Studies will meet near the start of each academic year with students who have not completed their Ph.D. program within the normally expected time, and discuss the student's plan for finishing the program as well as a schedule for future meetings of the supervisory committee. The Department's main concern at this point is to ensure that any problem which has occurred can be resolved quickly and that the student be treated in as fair and reasonable a manner as possible.

Summary

This is a summary of the requirements for each option for a student who starts in September 2018. Please note that courses are to be taken in the first two years of the program.

	Direct-entry Ph.D.	**OPTION I**	**OPTION II**	**OPTION III**
September 2018	Select at least 2 full courses	Select 3 full courses	Select 2 full courses	Select 2 full courses
October 2018	Choose Supervisor[a]		Choose Supervisor[a]	Choose Supervisor
January 2019	Choose Supervisor[b]	Choose Supervisor	Choose Supervisor[b] 1-page report	1-page report
April 2019			1-page report[b]	
August 2019	Present brief progress report	Present M.Sc. Report	Present M.Sc. Research Report	
August 2019			M.Sc. Oral Examination	
August 2019	Confirm Ph.D. Supervisor, choose Ph.D. Supervisory Committee			
September 2019	Select remaining courses (total of 3)		Select 1 full course	
April 2020	Ph.D. Oral Qualifying Examination 5-6 page outline one week in advance			
June 2020				Submit M.Sc. Thesis
August 2020				M.Sc. Oral Examination
Fall 2020-22	Supervisory Committee Meeting Progress Report (short) one week in advance			
May 2023	Submit Ph.D. Thesis (there may be a supervisory committee meeting)			

June 2023	Departmental Ph.D. Oral	
August 2023	Final Ph.D. Oral	

[a] Unless the student is taking three lecture half-courses that term

[b] Unless the requirement has already been completed

In addition to these requirements, students must register as necessary with the University and must also apply for any external graduate scholarships for which they are eligible, e.g. NSERC PGS and Ontario Graduate Scholarships.

Committees

Admissions Committee. This committee consists of faculty members whose expertise jointly spans the research areas of the Department, chaired by the Associate Chair. The Admissions Committee evaluates candidates' academic and research potential and preparation for the proposed program of study and decides on whether or not to recommend that the School of Graduate Studies issue an offer of admission at either the M.Sc. or Ph.D. level. The offer will usually be contingent upon satisfactory completion within a designated time interval of some program which is in progress. Candidates who fail to complete the M.Sc. within one year (three terms) will not normally be admitted to the Ph.D. program.

Ph.D. Supervisory Committee. A supervisory committee will be appointed for each Ph.D. candidate immediately upon his or her acceptance into the Ph.D. program (or by the end of the first year, for direct-entry Ph.D.). This committee will consist of the supervisor and two other Faculty members of the Graduate Department of Physics who are appointed upon the recommendation of the supervisor, in consultation with the student, and with the approval of the Associate Chair. It is recommended that the committee consist of one experimentalist and one theorist, and that, as far as possible, one should be in the same research field and the other in a related field. The supervisory committee is intended to monitor the student's progress and be available to provide guidance and assistance to the student. Informal meetings between the student and individual members of the committee are encouraged. However, both student and supervisor have the right to call a formal meeting at any time. The Associate Chair for Graduate Studies, or a faculty member whom he or she appoints, may attend any formal meeting of the supervisory committee. The first formal meeting of the supervisory committee will normally be at the Ph.D. Qualifying Examination.

Standards and Evaluations Committee. This committee consists of faculty members and is chaired by the Associate Chair. The committee provides a ranking of students for external graduate scholarships (NSERC, OGS, etc.). Members of this committee convene all Ph.D. Qualifying Examinations.

Courses

Graduate Lecture Course. A full year graduate course (indicator Y) carries one full academic credit. A half year graduate course (with indicators F, S, or H) carries one half academic credit.

Course Requirements. For the purposes of fulfilling the lecture course requirements for the M.Sc. or Ph.D., the Department recognizes any relevant lecture course listed in the current School of Graduate Studies calendar (please consult with the Associate Chair concerning courses in other departments), or in the Department's current Graduate Course Listings. However PHY 1600Y, "Effective Communication for Physicists", and the modular course (PHY2109H) will not count towards course requirements for M.Sc. or first-year direct-entry Ph.D. students, although they will count towards the course requirements for the Ph.D. Students will not be given credit for any courses taken during their time as undergraduates; nor may they take for graduate credit any courses they have already taken as undergraduates (e.g. courses cross-

listed in the Faculty of Arts and Science). Students require the approval of their supervisor and of the Associate Chair before registering in graduate lecture courses. It is normally expected that at least 50% of the courses taken by students toward satisfying the requirements for the M.Sc. or Ph.D. will have a PHY indicator, and that no more than 30% will be graduate courses that are cross-listed as undergraduate courses in the Faculty of Arts and Science. The course requirement specifies only the minimum number of courses which are to be included in the graduate programs; however, it is expected that all students will audit additional graduate lecture courses and attend seminars in their area of specialization throughout the period of their graduate education as well as the weekly departmental colloquium. Additional requirements may also be imposed by a student's supervisory committee.

Research Courses. M.Sc. and first-year direct-entry Ph.D. candidates register in these courses, and M.Sc. (with thesis) students register also in their second year, in sequence of the last digit (i.e. in PHY60x1Y in their first year of graduate study, in PHY60x2Y in their second year of graduate study.) Grades for these courses are provided by the supervisor, based on the supervisor's evaluation of the ability and progress of the student in performing research as evidenced in interactions with the student throughout the year. The available Research courses are:

PHY6011Y - Research in Atmospheric Physics
PHY6021Y - Research in Biophysics
PHY6031Y - Research in Condensed Matter Physics
PHY6041Y - Research in Geophysics
PHY6051Y - Research in Quantum Optics
PHY6071Y - Research in Subatomic Physics and Astrophysics

Seminar Courses. All M.Sc. (Option II) students enroll in the seminar course appropriate to their area of research. The grade for this course is provided by a Faculty assessor on the basis of the student's ability to orally present and defend the results of the Research Project at the M.Sc. Oral Examination. The L designator for these courses means that although students enroll in these courses upon entry to the M.Sc. program, the grade needs to be reported to the School of Graduate Studies only after the M.Sc. oral examination. The available Seminar courses are:
PHY7001L - Atmospheric Physics Seminar
PHY7002L - Biophysics Seminar
PHY7003L - Condensed Matter Physics Seminar
PHY7004L - Geophysics Seminar
PHY7005L - Quantum Optics Seminar
PHY7007L – Subatomic Physics and Astrophysics Seminar

Courses from other Departments. Physics graduate students often find courses offered by other departments useful in their programs. In this respect, the available resources include the School of Graduate Studies Calendar and up to date information available at other departments, often through handbooks similar to ours. In the recent past, our graduate students have taken courses from the Departments of Astronomy and Astrophysics, Chemistry, Electrical and Computer Engineering, and Mathematics, to name a few. Normally no more than 50% of a student's courses can be from another department, and not all courses are appropriate. Consult your research supervisor and the Associate Chair for advice.

Grading of Graduate Courses.

Guidelines 1 through 7 summaries the 'Grading Practices Policy' of the School of Graduate Studies: guidelines 8 through 11 are specific to the Department of Physics.

Points 1 through 5 below refer to all graduate courses:

1. Letter grades are to be used in all final reporting. The equivalence of these letter grades with numerical grades is given below for information.

Letter Meaning	Grade Meaning	Numerical Grade	Letter Meaning	Grade Meaning	Numerical Meaning
A+		90-100%	B+		77-79%
A	Excellent	85-89%	B	Good	73-76%
A-		80-84%	B-		70-72%
			Fz	Inadequate	0-69%

2. Whereas a minimum passing grade for an undergraduate in a course is 'D'(=marginal=50%), a minimum passing grade for a graduate student is 'B-'(=good=70%). However it is not intended that marks should be awarded more liberally to graduate students. On the contrary, it is intended that graduates should perform at a higher level to achieve a passing grade. In particular, where graduate courses are cross-listed in the Faculty of Arts & Science, graduates should be marked to the same standard as undergraduates. Instructors in other graduate courses might take these cross-listed courses as providing useful reference levels.

3. A mark in a course is not final until it has been submitted to the Graduate Office and reviewed by the Graduate Chair for anomalies.

4. Should a dispute over a grade not be resolved in discussion with the examiner(s) and the Graduate Chair, the student may make an appeal to the Associate Dean of Division III of SGS: further appeal mechanisms are available should a solution not be reached.

5. Course grades are due in the Graduate Office as follows:

F courses	10 January
S and Y courses	10 May
L courses	10 September

Points 6 and 7 below refer to graduate lecture courses:

6. It is recommended that the grading scheme be based on more than one component: research has shown that the validity and reliability of grades show strong positive correlation with the number of contributing components. In the event that a significant fraction of the grade is based on a seminar or

an oral examination, it is strongly recommended that the seminar be accompanied by a report written by the examiner and signed by the student. These reports need not be formal or comprehensive.

7. As early as possible in each course and no later than the last date to enrol in course, the instructor will make available to the class the methods by which student performance will be evaluated and the relative weights of these methods. After the methods of evaluation have been made known, the instructor may not change them or their relative weight without the consent of at least a simple majority of the students enrolled in the course. Commentary, appropriate in the instructor's judgement, on assessed work and time for discussion of it must be made available to the student.

Point 8 refers to the Report Course:

8. The Report Course (PHY 3400Y) is taken by students in the M.Sc. (without thesis -- options I and II) programme, and consists of a written report of research performed in the M.Sc. year. It need not meet archival standards, being a document internal to the Department of Physics. The grade for the report will be assigned on the basis of the following criteria: clarity and correctness of language, organisations of the material, the thoroughness of the investigation, careful attention to biases and error analysis (where appropriate), evidence of the candidate's independent contribution and maturity of scientific judgement.

   For many students the report course would be the first serious research experience. The supervisor should guide the student first and foremost in the scientific research aspects and also help in organising structure and linguistic aspects of the report at the initial draft stage.

   For Option I students the report is to be a written account of an agreed minor research topic of literature survey carried out with the advice of a research supervisor. It is not expected to involve extensive calculations or the building of any new experimental equipment. It should be completed within three terms of full time graduate study where two courses are being taken simultaneously, and be brought to a point where the quality of the research is demonstrable and the candidate's ability to carry out independent research can be evaluated. The Research Project is considered to constitute the same workload as three full lecture courses. The supervisor provides the grade for the Research course, and the grades for the Seminar course (which consists of the oral presentation and defence of the report) and for PHY 3400Y are given by the M.Sc. Oral Examination Committee which consists of the supervisor and two Faculty assessors appointed by the Department.

Point 9 refers to the Research courses:

9. Research Courses. M.Sc. and Ph.D. direct entry candidates register in these courses in their first year of graduate study, in PHY60x2Y in their second year of graduate study, and so on). Grades for these courses are due by 10 May (for MSc Option II) and 10 September (for MSc Option I and PhD direct entry). Grades for the Research Courses will be based on an evaluation of the student's ability to perform research and to produce effective results appropriate to the stage of postgraduate studies reached. Included in this evaluation are such things as the student's common-sense, technical competence, industry and maturity of judgement, the organisations and quality of the research design, care in data-taking procedures, measurement and calculations, careful attention to the estimation of errors and biases, the ability to work independently and to take initiative, evidence of creativity and imagination, and, especially in the senior postgraduate years, evidence of originality. The grade is provided by the supervisor based on the observation of the student's work.

Point 10 refers to the Seminar Courses:

10. Seminar Courses. M.Sc. (Option II) students enrol in the seminar course appropriate to their area of research. The grade for this course is provided by Faculty assessors on the basis of the student's ability

to orally present and defend the results of the Research Project at the M.Sc. Oral Examination. The L designator for these courses means that although students enrol in these courses upon entry to the M.Sc. programme, the grade need be reported to the School of Graduate Studies only after the M.Sc. oral examination, which should usually take place in August of the first year of graduate studies.

The Seminar Course will be graded on the basis of the candidate's ability to give a clear, concise, and well organized oral presentation of the research performed, and to answer promptly and correctly questions posed by the examination committee on points raised or related to the presentation and the written report.

Point 11 refers to the Reading Courses:

11. Every year a number of graduate students request permission to fulfil some of their graduate course requirements (besides the M.Sc. Report course PHY 3400L) by taking a reading course. It is clear that there are considerable misunderstandings of the Departmental and Graduate School policies in this matter and this point is intended to correct that situation.

    Please note that:

    a) There are no reading courses per se in the graduate Calendar.
    b) It is not intended that students should restrict their graduate coursework to the direct area of their research work. Thus the argument that there are insufficient course offerings in a student's research area does not normally constitute an acceptable case for a reading course.
    c) It is not intended that taking a listed course as a reading course should be an easy option.

    d) Students inevitably study many areas of physics in the course of their research. But such studies are not a substitute for formal courses which should expose the participants to topics they might not otherwise encounter. The interaction with other students in a course is an essential part of the graduate education process and the course requirements provide for a minimum of such interaction and formalized study.
    e) It is also important that graduate students enrol in courses with other students to permit comparisons.

    In the light of these observations the Committee on Graduate Studies, Standards and Evaluations has recommend the adoption of the following policy:

> "A course can be offered as a reading course only if it is currently listed in the graduate calendar and if there is a staff member willing to offer the course and to make it available to any graduate student wishing to take it. The course must have a well-defined syllabus and grading scheme and be approved by the Associate Chair for inclusion among the regular course offerings of the department for the academic year in question."

Examinations

M.Sc. Oral Examination. (Option II and III). Within three terms of their initial enrolment, candidates for Option II of the M.Sc. (without thesis) will be given an oral examination on the Research Project which they have been pursuing. The Examination Committee will consist of the supervisor and two Faculty assessors appointed by the Department, in consultation with the supervisor. The two Faculty assessors will provide two grades, one based on the written report of the Research Project (PHY3400Y), and the other on the oral presentation and defence of the Research Project (the 7000-series Seminar course). For Option III students, this examination will be held within 6 terms of initial enrolment.

Ph.D. Oral Qualifying Examination. Ph.D. candidates must present themselves for examination within two terms of enrolment in the Ph.D. program (five terms for direct entry students). The intention of the Qualifying Examination is to assess the candidate's ability and readiness to promptly carry forward and successfully complete independent Ph.D.-level research. This assessment will be based on the candidate's graduate record to date, including three graduate lecture courses and the research performed, together with the presentation and defence of a research plan for the Ph.D. thesis. The examination committee will normally consist of the supervisory committee and a Convenor, who is a member of the Standards and Evaluations Committee who is not a member of the candidate's proposed supervisory committee. One of the Convenor's important duties is to ensure that departmental standards are maintained across the wide spectrum of disciplines in the Department. Committee members should have received a 5-6 page outline of the proposed thesis project at least a week before the exam. As a full member of the examining committee the Convenor will lead a discussion on the candidate's academic and research performance to date, as determined by the grades obtained in three graduate lecture courses, the 6000-series Research course, and the M.Sc. 'Report' course (if taken); members of the supervisory committee will comment on their perception of the candidate's ability to perform independent research at the Ph.D. level and on the quality of the research carried out by the candidate. The candidate will then be asked to present, in approximately 20 minutes, a research plan that will lead to a Ph.D. thesis. The examining committee will then question the candidate, who will be asked to explain and defend this research plan. Finally, the Convenor will lead a discussion to obtain a consensus on whether or not the candidate has presented a sufficiently realistic and well-conceived program of research and has sufficiently demonstrated the academic ability, the required background preparation, the potential for independent research, and the scientific judgement to be permitted to continue in the Ph.D. program. The examination committee may permit or deny confirmation of the candidate in the Ph.D. program. The committee may recommend one or more conditions (e.g. additional course requirements) that the candidate must fulfill before being allowed to continue. In the event of a denial, the candidate may be re-examined within four months of the date of the first examination. Upon a second unsuccessful result, Ph.D. enrolment will be terminated.

N.B. For candidates who start their Ph.D. studies in September, the Ph.D. Qualifying Examination must be taken before the end of the April of the same academic year (following year for direct-entry Ph.D.).

Departmental Ph.D. Oral Examination. Each candidate for the Ph.D. and their thesis will be examined at a Departmental Ph.D. Oral Examination upon receipt of a copy of the thesis. The examination committee normally consists of the supervisory committee, convened by the Associate Chair for Graduate Studies. As a full member of the examining committee, the Convenor will ensure that the candidate presents a lucid discussion of the thesis contribution in the time allocated (normally 20 minutes). The Convenor will, through questioning and by observing the response to questions from other committee members, confirm that the candidate can defend the work being presented and that the student has a sufficient mastery of the subject area and research area in general to reasonably expect the candidate to be successful at the Final Oral Examination. At the same time, the Convenor will ensure that the examination is conducted in a manner that is completely fair to the candidate. After the examination the Convenor will lead the discussion to obtain a consensus of the Committee as to whether or not the candidate may go forward to the Final Oral Examination of the School of Graduate Studies.

Ph.D. Final Oral Examination of the School of Graduate Studies. This examination is run under the auspices of the School of Graduate Studies by a committee which includes, besides members from the Department of Physics, one member from outside the University of Toronto, who provides an external appraisal of the thesis. The Final Oral Examination will be scheduled not sooner than eight weeks after the Department Ph.D. Oral Examination. This time cannot be reduced due to the time required to organize the meeting and the time required for the committee and the examiner to read the thesis. Students are strongly advised to allow for this time when planning their completion exercises. The Graduate Office

has further information on the timeline and at the appropriate time, you should get the latest information from them.

Reports and Theses

Archival. An archival document is departmental approved and made available in the University's digital library repository where it becomes a matter of public record. Accordingly it must be written in a clear and comprehensible manner in acceptable scientific language, free of both major and minor errors, well organized, and professionally bound and presented. It should provide a complete and accurate record of the research which has been performed. All references and sources must be carefully and comprehensively listed, and full details of calculations, experimental procedures, and equipment should normally be included (often in appendices). Theses are generally archival documents, reports are not.

M.Sc. Report. (Option I). The written account of an independent examination by candidates for Option I of an agreed minor research topic or literature survey carried out with the advice of a research supervisor. It is not expected to involve extensive calculations or the building of any new experimental equipment. It should be completed within three terms of full time graduate study in which three full lecture courses are also being taken. The report need not meet archival standards. It is considered to constitute the same workload as two full courses, with one full-course grade being given by the supervisor for the supporting research as the research course grade, and one full-course grade being given by an independent Faculty assessor for the M.Sc. report, which is listed as PHY3400Y on the candidate's transcript. The format and length of the report are given below.

N.B. For candidates who start their M.Sc. studies in September, the M.Sc. Report must be submitted to the Graduate Office before the end of the third week of the following August.

M.Sc. Research Report. (Option II). Research carried out by candidates for Option II under the supervision of a faculty member resulting in a written report. The research should attack a significant scientific question, but need not involve extensive calculation or the construction of any new piece of experimental equipment. It should be capable of completion within three terms of full time graduate study where two courses are being taken simultaneously, and be brought to a point where the potential of the research is demonstrated and the candidate's ability to carry out independent research can be evaluated. The written report is not expected to meet archival standards. The format and length of the report are given below. The Research Project is considered to constitute the same workload as three full lecture courses. The grade for the Research course is given by the supervisor based on the student's work during the first two terms. Then, upon completion of the written report, the candidate will be given an oral examination by a committee consisting of the supervisor and two Faculty assessors appointed by the Department. The Faculty assessors will provide the remaining two grades at this examination: one based on the quality of the oral presentation and defence by the student of the Research Project (the appropriate 'Seminar' course) and the other based on the quality of the written report (PHY3400Y).

N.B. For candidates who start their M.Sc. studies in September, the written report must be submitted electronically to the Graduate Office before the end of the third week of the following August, and the oral examination must be taken before the end of the second week in September.

M.Sc. Research Thesis. (Option III). The written report of research carried out by candidates for Option III under the supervision of a faculty member. The thesis is to be of archival quality and should attack a scientific question of publishable significance. The investigation undertaken should be much less extensive than for a Ph.D. and need not be carried out in such an independent manner. It should be capable of completion within six terms of full time graduate study while two lecture courses are also being taken. It is considered to constitute the same work load as four full lecture courses. The format and length of the thesis are given below. The thesis will be assessed by the supervisor and two independent

Faculty assessors assigned by the Department; the thesis may be accepted, accepted with minor changes, or rejected (see also M.Sc. Oral Examination). The Research thesis is indicated on the student's transcript by the indicator THS9999Y; no grade is assigned.

Ph.D. Thesis. The written report of original research carried out by the candidate in an independent manner, but under supervision as to quality and correctness. The research should result in one or more contributions to the scientific field of sufficient importance to be publishable in the scientific literature. The written thesis is to be of archival quality, and must represent the candidate's own work. The format and length of the thesis are given below. The thesis and the candidate will be examined at a Departmental Ph.D. Oral Examination, by a committee that will normally consist of the supervisory committee, convened by the Associate Chair for Graduate Studies. This committee will recommend whether or not the candidate should proceed to the Final Oral Examination.

Report and Thesis Formats:

Technical Requirements. Good-quality white bond paper, thick enough to be opaque, should be used (20 lb. base is acceptable). The size of the pages should be 8 1/2" x 11" (21.5 cm x 28 cm), the text reading across the 8 1/2" (21.5 cm) dimension. The left-hand margin should be at least 1 1/4" (32 mm), and the remaining three margins should be at least 3/4" (20 mm) to the main text. "Times New Roman" or "Helvetica" or similar typeface is preferred. Font size must be a minimum 10 points and 1015 characters per inch. (Note: Font size of 12 points is recommended.) You may use a smaller font size for graphs, formulas, and appendices (avoid italics). The spacing of the printed lines must be at least one-and-a-half spaces, on one side of the paper only. Single spacing may be used for long quoted passages and footnotes. Decisions as to the form and location of footnotes and the presentation of references and bibliography are to be made by the student and the supervisor at an early stage in the writing of the report or thesis. The preferred location for footnotes is either at the bottom of the page or at the end of the chapters to which they refer.

Size Limits. In all cases size limits refer to the main body of the document, excluding prefaces, references, indexes, diagrams, tables, appendices and the like. However the document shall be examinable without reference to text other than that contained in the main body of the document. The current limits are as follows:

M.Sc. report – Option I	6,000 words
M.Sc. report – Option II	12,000 words
M.Sc. thesis − Option III	25,000 words
Ph.D. thesis	45,000 words

Reports or theses which exceed the limits above will not normally be accepted for examination. Explicit evidence of compliance with size limits will not normally be required, but will be requested by the Graduate Office as necessary.

Format. Check that all pages are present, in sequence, and correctly numbered. There shall be an integrated reference list and/or bibliography for the entire report or thesis. Diagrams and tables shall be integrated with the text in an appropriate manner.

For Ph.D. students, please see http://www.sgs.utoronto.ca/currentstudents/Pages/Producing-Your-Thesis.aspx regarding formatting and submitting your thesis to the School of Graduate Studies.

III. CHOOSING YOUR RESEARCH SUPERVISOR

No single decision you make in your graduate studies is as important as your choice of research supervisor. Not only will this choice affect what you do and who you work with over the next several years, but it will also have a profound impact on the direction of your career. The right choice can make your graduate studies an enjoyable and very rewarding experience, but a poor choice can be devastating. It is the intent of this section to give you guidance in making this crucial decision by relaying some of the knowledge (and mistakes) of older students. It is particularly relevant to incoming M.Sc. and direct-entry Ph.D. students who are about to begin the selection process for their supervisor.

Perhaps the most important advice, which almost every graduate student at Toronto agrees with, is that you should *not* rush into making such an important decision as this one. If you feel you have been 'pushed' to choose a supervisor before you arrive, you have been misled. Many students do, but there is absolutely no benefit to doing so. All the preliminary things that you do before and when you arrive (register, get a computer account, etc.) can be done completely through the department. This is not to say that you should not come down to Toronto before September and talk to all the professors you wish. Just remember that most students here believe that you should not rush into a decision before you arrive at school.

So what should you do before you arrive? Check the Research Section on our website where all professors are listed. Make a list of the professors whose research sounds even remotely interesting. If you wish to study in a specific field, this list may be quite short. Many new students, however, are not sure what field they wish to work in, and this list may seem very long. Don't worry! It's better to start with a large number of choices and narrow it down than to start narrow and not find what you want. Next, you should go online and look up selected publications of the professors on your list. Read them over, but don't get bogged down in the details (and don't be surprised if you don't understand much of them). Try to get an idea of what they are doing and whether or not it appeals to you. At this point, you may wish to strike some names from your list or mark some as being 'particularly interesting', but try not to use their publications to cut down the list too much; in many cases the professor's current research is very different. The idea of reading is to have some background for when you interview prospective supervisors.

Interviewing should be your next step. You can come to the department before September if you wish, but there will be plenty of time when you arrive to talk to all the professors you would like (and they are much more likely to be around in September once classes have started). Make an appointment to talk to every professor on your list, even if there are a lot of them. Professors enjoy talking to prospective students about their research, and this process is an excellent opportunity to meet the faculty and to discover their current research interests. Before you talk to each one, read their selected publications again and think of the questions you would like to ask them. Some important questions you should ask everyone you interview are:

- Is the professor taking on new students?
- Would I work on my own project, or on the professor's?
- How many students are currently working for the professor?
- How many students have graduated under the professor in the last few years? Where are they now?
- How many students left before graduation? Why did they leave? Where are they now?

- How long does it typically take for a student to graduate under the professor's supervision? What is the funding policy in the group, especially after year five?

- What conferences would I have the opportunity to attend? Which of your students have recently attended conferences?

- Would I have the opportunity to publish papers? Who is typically first author?

- What does the professor expect for a Ph.D. in terms of publications?

- What is the source of the professor's funding? How stable is it? Are the resources sufficient and available for the work I want to do, especially if it is a new project? How are resources shared in the research group?

- Is the professor retiring soon, or leaving for an extended period?

- Would I be required to travel abroad? How often and for how long?

- What prospects would I have in this line of research after I graduate?

Remember, at this stage you are interviewing the professor, and not the other way around. Find out everything you want to know, and don't be embarrassed to ask probing questions.

Along with interviewing the professors on your list, you should also talk to their graduate students. It is from these students that you will find out what it is really like to work for this person. While the professors will likely talk about the research, the students will talk about what it is like to do the research. Take their opinions seriously, but also with a grain of salt. Not every graduate student has the same interests and goals as you do, so don't be swayed too much by a single glowing recommendation or bitter comment. However, if all the students in a group agree on a certain opinion, they are likely to be correct. Another good idea might be to talk to students in other groups about your potential supervisor's group as they might be able to provide more impartial insight. As always in physics, you can never ask too many questions!

You should try and do all of your interviews in September, before your course work gets hectic. After you have completed this process, think for a while about all that you have heard. If you have been wise and spent a lot of time researching and interviewing, don't jump to a decision. It is likely that one or two professors have stood out as being particularly interesting. Talk to them again if you wish; you cannot have too much information. After a month or so of being in the department, most entering students are confident enough to select a supervisor. If you are still unsure after all your interviewing, talk to the Associate Chair for Graduate Studies about your difficulties.

Once again, it should be stressed how important choosing the right supervisor is. Do not rush into it; take your time to be confident of your decision. Remember, those of you in the 3-course option will be too busy with courses for the first eight months to begin the M.Sc. research project. The other important observation is that your first-year supervisor need not be the same as your ultimate Ph.D. supervisor. All of you should use your first year to learn about the department and the faculty, so that when you do make your final decision about your Ph.D. supervisor, it is done with confidence and enthusiasm.

Good luck!

IV. COMMON PRACTICES

Different research groups in the department go about their activities in very different ways. Some of these differences result from the types of research being done. The dichotomies of theory *vs.* experiment, in-house research *vs.* research done at international facilities, laboratory research *vs.* field research, and highly independent work *vs.* collaborative work are just four that are present in our Department. As well, the personalities of the supervisor and the graduate students inevitably help set the pattern for how research is done. Constraints that follow from the research funding a group receives also play a role. So it is impossible to identify any set of "universal policies" that describe how all the research groups in the Department function. Nonetheless, there are certain common practices that many, if not all, research groups follow. While in any given case there may be deviations from these with good reason, students can at least take them as a starting point for what they can expect during their time in the Department.

An important issue for all students is their level of **financial support**. The Department has guidelines for graduate student financial support, during the period of guaranteed support, which all faculty members must follow. These are listed in the Student Handbook and can be accessed from the Department's web site; any questions about them can be addressed to the Associate Chair for Graduate Studies or the Graduate Administrator. While the guidelines specify annual levels of support, graduate students are paid at different rates during the year depending on how much of their income is earned from teaching assistantships, awarded in scholarships, and provided from their supervisor's research grant. Because the funding comes from different sources, it is reported to the student separately and it is the student's responsibility to keep track of their income streams and tuition obligations. With respect to research grant support, students and supervisors should discuss when this support is to be paid. From the student's point of view, it may be preferable to have this funding in a lump sum at the start of the year to help, for example, cover first- and last-month's rent. From the supervisor's point of view, it may only be possible to pay this support at a certain time due to the availability of funding. Beyond the period of guaranteed support, all funding normally comes from teaching assistantships and the supervisor's research grant. Supervisors are encouraged to maintain their students at the level of the guidelines (provided program is satisfactory) and most do, but often different arrangements are made depending on the particular circumstances. Most supervisors discuss funding issues with each of their students at least once a year, just to "touch base" and make sure there are no misunderstandings. But students should certainly feel free to bring this issue up for discussion with their supervisor if their funding level and schedule is not clear. In case of difficulties, they should talk with the Associate Chair.

Students are generally provided with **computing facilities** and email resources through their research group. In most cases, students have a PC, workstation, or terminal at their desks. In some groups these facilities are maintained by Physics Computing Services, in others by computer technicians hired by the group, and in others by a graduate student or postdoctoral fellow who is paid from the supervisor's research grant for the time such maintenance requires. Most supervisors provide their students with access cards for photocopying and for checking out supplies from the Departmental Stores, and supervisors are responsible for authorizing the issue of keys to graduate students as well. Office arrangements, and the accessibility of filing cabinets, bookshelves, and the like are usually addressed when a student joins a research group. But students often raise concerns about these matters with their supervisor in the course of their research program, as their needs and patterns of work change.

A crucial part of a physicist's professional life is the **presentation of research results**. Attendance at conferences is important not only for students to have a chance to discuss their research results with the larger physics community, but also for them to have the opportunity to meet other researchers in their field and hear first-hand about the latest developments. Patterns vary across the Department, but most graduate students find themselves attending conferences during the course of their Ph.D. work, with their travel, housing, and registration costs covered by their supervisor's research grant. Some supervisors follow a general rule that their students can attend such a conference at least once a year if they have

results to present. Publications in the scientific literature are also important for both the promulgation of research results and the career development of the student. Often students publish results as their work progresses; these papers form the basis for the student's Ph.D. thesis. Another common pattern is that the thesis is completed first and manuscripts are constructed from the thesis shortly after the student passes the Departmental exam.

Monitoring the pace of work and ensuring that the research is progressing at a reasonable rate are important **responsibilities of the supervisor**. While by definition the outcome of any research project is unknown, short-term goals, and even mid-term milestones, can be set. Students have the responsibility to try and meet these, as supervisors have the responsibility to return drafts of manuscripts and other written material in a timely manner with comments and suggestions for changes. Professors who supervise more than a couple of students often have group meetings once a week where administrative matters can be discussed, and students can present recent progress or problems for informal discussion within the group, or present an overview of an interesting recent publication. These group meetings are also a good opportunity for students to make appointments to see their supervisor one-on-one to talk about recent results or research difficulties. In the kind of collaborative work between student and supervisor that is common in the Department, weekly or biweekly one-on-one meetings between students and supervisors are common.

The **Ph.D. program** of any student is necessarily a mix of intense research on a particular project and the continuation of a general education in a subfield of physics and, indeed, in physics as a whole. The balance of these components is often one of the most difficult issues that students and supervisors must confront. A student and supervisor can hold quite different views on what this balance should be and, although they may be meeting regularly to talk about research progress, these and other differences can remain hidden until the student and supervisor find themselves at loggerheads. To avoid this, some supervisors set up particular opportunities for addressing possible areas of disagreement, such as a lunch meeting with each student once a year specifically to discuss the general progress of the Ph.D. program. As the student moves towards the completion of the degree, such a meeting also gives the supervisor and student the opportunity to talk about the student's career plans and prospects. The yearly meeting of a student's supervisory Ph.D. committee, involving two faculty members in addition to the supervisor, provides another opportunity to review research progress, and to consider general concerns involving the direction of the thesis, the nature of the research and the research program, and the student's career plans. Sometimes differences between student and supervisor can arise in the expectations of what is required for the Ph.D. These expectations should be made clear in the written report of the annual supervisory committee meeting, especially towards the end of the program. A student may choose to exceed what is required for an acceptable Ph.D., especially if they intend to pursue an academic career. However that choice rests with the student, not the supervisor.

There is a booklet entitled "GRADUATE SUPERVISION: Guidelines for Students, Faculty, and Administrators" produced by the School of Graduate Studies that contains much useful information and advice. It is available in paper form from the Graduate Office and on the web at http://www.sgs.utoronto.ca/Documents/Supervision+Guidelines.pdf.

V. GRADUATE STUDENT FINANCIAL SUPPORT FOR 2018-2019

The following guidelines for levels of graduate student support in the Department of Physics are in effect as of **September 1, 2018**. It is intended that these guidelines should apply for 1 year of a M.Sc. and the first 4 years of the Ph.D. or in case of Ph.D. direct entry students for the first five years of the Ph.D. program. Scholarship support is limited to 5 years in total.

LEVEL 1: NSERC SCHOLARSHIP HOLDERS	**CGSM**	**PGSD**
T.A. (100 hours)*	$ 4,621	$ 4,621
NSERC/FRQNT B1, B2 Scholarship	$ 17,500	$ 21,000
Scholarship/Research Assistantship	$ 10,379	$ 8,879
Total	$ 32,500	$ 34,500

PLEASE NOTE: NSERC CGSD and Vanier recipients will NOT receive a topup but are eligible for T.A. assignment.

LEVEL 2: OGS/QEII-GSST/ SCHOLARSHIP HOLDERS

T.A. (120 hours)*	$ 5,546
OGS/QEII-GSST	$ 15,000
Research Assistantship	$ 11,554
Total	$ 32,100

LEVEL 3: ADMISSION AWARD HOLDERS

T.A. (140 hours)*	$ 6,470
Admission Award	$ 3,000
Scholarship/Research Assistantship	$ 25,250
Total	$ 34,720

LEVEL 4: NON-SCHOLARSHIP HOLDERS

T.A. (140 hours)*	$ 6,470
Scholarship/Research Assistantship	$ 25,250
Total	$ 31,720

Notes:
- NSERC Scholarships are currently worth: CGSM-$17,500, PGSD-$21,000, CGSD-$35,000, Vanier - $50,000. The OGS is $10,000 plus $5,000 university matching. The QEII-GSST is $15,000.
- **Level 4 support is $23,230 + tuition fees. Example above shows domestic STG campus fee of $8,490.** International PhD students without other sources of funding receive an additional fee differential of $624 and M.Sc. students an additional $15,740. UofT and departmental fellowships are worth $12,500 for continuing students ($6,500 for those in the last year of the funded cohort) and $19,500 for new students.
- Students are responsible for payment of tuition fees. More information is posted at www.fees.utoronto.ca
- Students must inform Graduate Office in writing if they are awarded any external scholarships.

*This is a guaranteed minimum of TA hours. More hours may be available on request and will be assigned on application.

VI. TEACHING ASSISTANTSHIPS

During their pursuit of an M.Sc. or Ph.D. degree, most graduate students choose to accept a Teaching Assistantship in connection with an undergraduate or graduate course offered by the Department of Physics (or, much less frequently, by a cognate Department). Teaching assistantship positions can take the form of Tutor (tutorial), Demo (laboratory), Practical Leader (special activities in some undergraduate service courses), or Marker. Details of these positions including responsibilities and teaching tips are covered in "The Teaching Assistants' Handbook"; information may also be obtained from the Undergraduate Office in room MP301. Candidates normally apply each year via a personal on-line account created for them when they join the Department. The Physics Teaching Assistant Coordinator offers them one or more positions, based on qualifications of the applicant, suitability for the position, preferences expressed in their on-line TA account, as well as the needs of the Department. Employment under conditions covered by the Teaching Assistants' Union of the University of Toronto is guaranteed to students without major external scholarships for 140 hours (see Section V). More hours may be available based on enrolment and qualifications. The website of CUPE 3902 is /www.cupe3902.org/.

Teaching Assistantships offer several benefits for graduate students and develop teaching and interpersonal skills that will serve well in almost any career that is undertaken in the future. Also, a Teaching Assistantship provides income for work performed in an area directly related to one's interests, namely Physics!

VII. SAFETY

We intend that you should have a safe time in the Department of Physics. Our safety procedures take a number of forms some of which are legal requirements and all of which are designed for your protection. It is your right to have a safe workplace. It is your duty to ensure that you follow the required procedures and do what you can to ensure your safety and that of and your friends' and colleagues'. The Physics Health & Safety committee members meet 4 times a year to deal with any safety concerns within the McLennan laboratories and the department H&S website is at http://www.physics.utoronto.ca/physics-at-uoft/services/health-and-safety/?searchterm=safety.

General

All accidents must be reported immediately to the Safety Officer, Peter Hurley or to the McLennan Health & Safety Office at 8-2231. In the event of any life-threatening emergency on campus, call 9-911 for ambulance, fire, or Metro Police services and then notify the local campus Police (St. George campus 8-2222) All injuries must be recorded on http://ehs.utoronto.ca/report-an-incident. Thefts have occurred, so we strongly recommend you keep your door locked whenever you leave the office, even for a few minutes.
Many graduate students here in the Department of Physics work in their office or lab late into the evening, on weekends and statutory holidays. During these quiet hours you could easily be the only person on your floor or in your laboratory, and your personal safety could be at risk. The Campus Community Police at the University of Toronto have thus initiated the Working Alone Program to augment the personal safety of anyone working late here at the St. George Campus. To register for the Work Alone Program, come by the University of Toronto Campus Police Office. For more information contact the University of Toronto Campus Police at 416-978-2323.

Immediately below is the link to the Campus Community Police's web site. Take particular note of the range of Community Service Programs available at the University including Travelsafer (416-978-7233), a service where building patrol or constables from Campus Police will walk you to any location on the St. George Campus and surrounding TTC stations.
http://www.campuspolice.utoronto.ca/

Laboratory Safety

Safe operating procedures are mandatory in the laboratory environment. Potential hazards such as high power laser beams, magnetic fields, compressed gases and toxic chemicals all require specific training procedures. Supervisors have an obligation to ensure that employees work in a safe manner and with the protective devices and procedures required by the Occupational Health & Safety Act and its regulations. The Safety committee has information posted on the departmental H&S website about laboratory safety procedures. There is also a machine shop training course for students who need to use the technical facilities. We also conduct annual workplace inspection of the entire building. The university Office of Environmental H&S at the following website, http://www.ehs.utoronto.ca, offers safety programs such as WHMIS training, Laser Safety training, Radiation Protection, Fire Safety and Emergency procedures as well as providing resource material such as MSDS data, Emergency/Accident Reporting policies and service personnel.

Laser Safety

The university Laser Safety Committee oversees a laser safety program that applies to all Class 3b and Class 4 lasers and laser systems in controlled areas (indoors) and to all those identified as principal investigators, laser supervisors and laser workers. It is responsible for the registration of all Class 3b & 4 laser and laser systems, requirements for inspection and worker training and education on potential laser hazards and links to other additional resources. It controls the reporting of related accident/incident, administrative and procedural guidelines, provision of medical surveillance, requirements for personal protective equipment and engineering controls. If you are going to use such laser systems, consult your supervisor to arrange appropriate training.

Personal Safety

Students with personal safety concerns may wish to contact the Community Safety Office. For more information check the website: **http://www.communitysafety.utoronto.ca** They should be aware that graduate student office location and phone numbers are normally available in the departmental directory on the physics web pages (www.physics.utoronto.ca). Students who wish to restrict access to this information should contact Krystyna Biel, in Office MP315. Teaching assistants with safety concerns should notify Dr. Jason Harlow, Associate Chair for Undergraduate Studies.

Traveling Safety

Students who have to travel outside the province or country to do field research or even attend a conference must follow the requirements for “Reasonable Care”. The Safety in Field Research website: http://www.ehs.utoronto.ca/field-research-safety is available to assist in assessing risks, and documenting the precautions that should be taken. It also contains information on topics such as Health Insurance Coverage, continuance of University and Workplace Safety and Insurance Board Benefits as well as Requirements for Reasonable Care.

In addition, the Safety Abroad Office (SAO) offers information on logistics, safety and cultural issues for the student’s time away. To register for a mandatory pre-departure information session and join the Safety Abroad database, visit www.studentlife.utoronto.ca/cie/safety-abroad at least one month before departure.

VIII. WHO TO SEE ABOUT WHAT

Question About?	Name	Office	Telephone
Network connection, computer advice and accounts	**Steve Butterworth** **Greg Wu**	**MP805** **MP805A**	**8-2746** **8-6452**
General administration, services, space, furniture	**Peter Hurley**	**MP327**	**8-0627**
Expense Reports **Purchase requisitions**	**Aloma Namasivayam**	**MP320**	**8-2937**
Health and Safety	**Peter Hurley**	**MP327**	**8-1726**
Keys (office and building)	**Liz Glover**	**Main Office MP302**	**8-2231**
Student Affairs	**Krystyna Biel**	**MP315**	**8-2945**
Teaching Assistantships **TA Payments**	**Teresa Baptista**	**MP301**	**8-7057**
Telephone, Building Repairs	**Sheela Manek**	**MP328A**	**8-3307**

WHO'S WHO IN THE DEPARTMENT

Name and Position	Office	Telephone	Responsibilities
Michael Luke *Acting Chair*	MP323	8-5205	General department policy
Young-June Kim *(Associate Chair)*	MP314	8-2931	Graduate programs; scholarships
Jason Harlow *(Associate Chair)*	MP328	8-6674	Undergraduate programs; teaching assistantships; departmental services; laboratory and office space
Peter Hurley *(Administrative Officer)*	MP327	8-1726	Non-academic affairs; policy and procedures; personnel; facilities management; communications. Support services: technical, computing, cryogenics, stores-receiving and shipping
Ilda Cunha *(Administrative Assistant, Finance)*	MP322	8-5223	Departmental finances/academic affairs and policy; administration of payroll for academic/non-academic staf post-doctoral fellows and research associates; research grants administration
Christopher McGugan *(Administrative Assistant to the Chair)*	MP324	8-3944	Chair's and Administrative Officer's Assistant, assisting Chair and AO with administrative duties and appointments
Krystyna Biel *(Administrative Assistant, Graduate Program)*	MP315	8-2945	Graduate administration; scholarships; conflict resolution and counselling

Beata Kuszewska *(Graduate Program Assistant)*	MP316	8-2945	Secretarial services for graduate office; graduate student registration
Teresa Baptista *(Administrative Assistant, Undergraduate Program)*	MP301	8-7057	Undergraduate programs; undergraduate enquiries; registration; course office bookings; teaching assistants' payroll, lecture/tutorial offices
April Seeley *(Secretary, Undergraduate Program; First Year Undergraduate Office)*	MP129	6-0531	Secretarial services for undergraduate office; First Year Undergraduate Office
Lisa Jefferson *(Administrative Assistant, Accounting)*	MP318	8-2951	Accounting policy and procedures, grant reconciliation; accounts receivable; cost recovery units
Aloma Namasivayam *(Administrative Assistant, Purchasing)*	MP320	8-2937	Purchase requisitions; purchase orders; personal expense reimbursements; receiving reports; Physics Computing Services accounting; purchasing policy; payment of invoices; accounts payable
Sheela Manek *(Facilities and Special Projects Coordinator)*	MP328A	8-3307	Main Office administration; facilities and services assistance; building maintenance and repairs (lights, power, floods, etc.)
Liz Glover *(Departmental Receptionist)*	MP302	8-2231	Key issue; bulletin boards; Booking conference rooms, office, and lounge; assists with administrative functions
Steve Butterworth *(Manager, Physics Computing Services)*	MP805	8-2746	Computing services for research, teaching and administration. Network management, system administration, internet services and application development
Phil Scolieri *(Safety Officer)*	MP128	8-2957	Departmental and university safety policies and procedures
David Rogerson *(Director Physics Learning Research Services)*	MP070	8-0626	1st-4th year undergraduate laboratories and lecture Office support. Technical support services
Dylanne Dearborn *(Librarian)*	MP211C	8-5188	Department of Physics library
Alex Cui *(Stockroom Operations Coordinator)*	MP060/062	8-5232	Stores; shipping/receiving; chemical disposal

Group Offices

Research Area	**Office**	**Telephone**	**Contact**
Theoretical Physics, Quantum Optics and Condensed Matter Physics	MP1109	8-7135	**Helen Iyer**

Experimental Physics, Quantum Optics and Condensed Matter Physics	MP1109	6-7640	**Joanafel Magnaye**
High Energy Physics and Geophysics	MP804	8-1543	**Crystal Liao**
Earth, Atmospheric & Planetary Physics-Atmospheric	MP716A	8-2933	**Ana Sousa**

IX DEPARTMENTAL SERVICES

Our department is large and may appear complex. A wide variety of services is offered in aid of teaching and research. This section summarizes and gives you an introduction to their use. In almost all cases, there is a charge (subsidized by the department) for the use of these services which is usually debited to your supervisor's research account. For further information, please visit the Physics Services website at http://www.physics.utoronto.ca/physics-at-uoft/services.

Physics Library

Contact: Dylanne Dearborn (Librarian)
Office: MP 211C • Tel: 8-5188
http://www.physics.utoronto.ca/physics-at-uoft/library
dearborn@physics.utoronto.ca or library@physics.utoronto.ca.

Collection

The Physics Library is one of several departmental libraries at the University. Our collection of books and journals reflects the Department's teaching and research interests. A complete collection of the Department of Physics theses/dissertations forms an integral part of the library holdings. Links to electronic resources commonly used in Physics can be found on the Physics Library website (http://www.physics.utoronto.ca/physics-at-uoft/library). Searchable records for our collection appear in the Library Catalogue through the University of Toronto Libraries website (www.library.utoronto.ca).

Circulation Policies

To borrow materials from the library, you must present a valid TCard. After hours, books can be signed out manually by filling out a card at the desk. If a book is already checked out, a hold can be placed by clicking on 'request' while viewing the book record in the Library Catalogue. An email notice will be sent to you when the book becomes available. Course Reserves/Short Term Loan books are due back by 10 a.m. the following morning. Journals and other periodical publications do not circulate and are for in-library use only.

If a book or article is not available through the UofT library system, it can be ordered through RACER (available on the Library website).

We encourage you to pay any overdue fines at the Physics Library, as you may be exempt from fines for Physics material. For fines that are charged, the money will go to new material for the library that receives the payments. Be sure to register your UofT email address with us in order to receive any due date reminders, fine/overdue or on-hold notices.

Library Services

Printing is available in the library using your TCard. Note that you cannot add value to your TCard in the Physics Library. Reference services are available – to book a consultation, email dearborn@physics.utoronto.ca.

Please refer to the Physics Library website for detailed information. We are your home library and we act as your liaison with all libraries at the University of Toronto. If you require assistance with any library matters or have any book recommendations, please speak to our library staff.

Physics Computing Services (PCS)

Contact: Steve Butterworth, PCS Manager
Office: MP 805 • Tel: 8-2746
bworth@physics.utoronto.ca

Physics Computing Services (PCS) provides a variety of IT services to Physics Department faculty, staff, and graduate students, and supports undergraduate computing needs in conjunction with the Physics Learning Services group. Core PCS services include email, web services and application development, secure remote sessions, central file storage, hardware consulting, operating system installation and support, and general network infrastructure management.

World-class high performance computing (HPC) resources are available through the *SciNet Consortium for High Performance Computation* (http://www.scinethpc.ca/).

Support requests and problem reports related to system and network problems should be directed to our general support address: pcs@physics.utoronto.ca.

Undergraduate Learning Services

Contact: Larry Avramidis, Senior Learning Services Specialist, Physics Learning Resources Centre
Office: MP 128 • Tel: 8-2957
avramidi @physics.utoronto.ca

Undergraduate Learning Services staff members provide technical support to faculty, teaching assistants, and students in the Department's undergraduate learning laboratories. Classroom support is provided by assisting with physics demonstration experiments and with audio-visual, multimedia, and specialized learning technologies installed in lecture rooms. Staff are involved in the ongoing development and implementation of new experiments, demonstrations, and learning technologies, and welcome requests and suggestions.

Staff:

Supervisor	Phil Scolieri	MP128	8-2957	scolieri@physics.utoronto.ca
Advanced Labs	Larry Avramidis	MP229	8-1992	avramidi @physics.utoronto.ca
2nd year labs	Larry Avramidis	MP229	8-1992	avramidi@physics.utoronto.ca
1st year labs	Lilian Leung	MP128	8-2961	lfan@physics.utoronto.ca
Demos	Pius Santiago	MP128	8-2961	santiago@physics.utoronto.ca

Support:

Physics Lecture Demonstrations	MP128	8-2961	demo@physics.utoronto.ca
1st Year Lab Support	MP128	8-2961	first.year.labs@physics.utoronto.ca
2nd Year Lab Support	MP229 MP250	8-1992 8-0669	second.year.labs@physics.utoronto.ca
Advanced Physics Lab (3rd & 4th year) Support	MP250	8-0669	avramidi@physics.utoronto.ca
Electronics and Computer labs	MP128	8-2957	elect.comp.labs@physics.utoronto.ca

Stores/Shipping and Receiving/Mail/Couriers

Contact: Alex Cui
Office: MP 060/062 • Tel: 8-5232
stores@physics.utoronto.ca

A wide variety of supplies and materials for teaching, research, and administrative use are available. For the items and materials that are among the inventory items, special orders can be made. The commonly used items may be procured through the use of a billing card (which is obtainable from the Physics stores) or by debit and credit card. Out-going mail and shipping/receiving services are also provided. A supervisor's name must be indicated on out-going mail and an appropriation number is needed for courier services.

Incoming Mail/Keys/Physics Directory

Contact: Liz GloverOffice:
Main Office MP 302 Tel: 8-2231
reception@physics.utoronto.ca

Mail is sorted and distributed every morning to various group, alphabetic, or personal mail boxes located in the mailroom, MP 306. Remember to check for your mail frequently. As the Physics Directory and Mail Recipients list are maintained by the receptionist, please ensure that she is kept informed of any changes in locations, additions, or departures. Keys and Authorization Forms (to be signed by your Supervisor) to various Offices within McLennan Physical Labs are available in the Main Office. Please note that restrictions may apply to certain keys. A cash deposit is required ($25 for room/lab keys and $50 for the building key). You will be reimbursed when the keys are returned. The reimbursement is via cheque (in Canadian funds) issued by the University's Financial Services and is mailed to the address you provide.

Photocopiers are located as follows: basement lounge MP053; mailroom MP306; Geophysics office MP402, QOCMP and Theoretical Physics and Nuclear Physics offices MP1109; High Energy Physics office MP804; Atmospheric Physics office MP716A. Photocopiers are accessed through an assigned code available from the group secretary. Copy units are charged against faculty grants or departmental accounts, cash is not accepted. Please see your group administrative assistant if you need access to photocopying services.

Cryogenics

Contact: Robert Henderson
Office: MP 063B • Tel: 8-8510
hender@physics.utoronto.ca

A cryogenics facility is located in Office MP 063. Liquid nitrogen is available to all members of the University community. Liquid Helium is also available for use within Physics. The facility can also provide advice on such matters as dewar selection, gas recovery and the safe use of cryogenic equipment and products.

Leak Detection Service

Contact: Gurmit Besla
Office: MP067 • Tel: 8-3533
gbesla@physics.utoronto.ca

See Gurmit to borrow leak detector.

McLennan Joint Health & Safety Committee

Contact: Peter Hurley, Co-Chair (Management)
Office: MP 129 • Tel: 6-0531
Phil. Scolieri, Co-Chair (worker)

The Joint Health and Safety Committee consist of representatives from the departments and organizations within the building including Physics, Astronomy, CITA, and the Impact Centre. The committee serves graduate students, technical/laboratory and office staff and faculty, with staff holding a majority on the committee. Under the Occupational H&S Act, the H&S Committee is responsible for implementing legislative and University safety policies as well as identifying and addressing departmental health and safety concerns. Research and teaching laboratories and technical facilities represent significant challenges in ensuring a safe working environment, and demand close attention to risks and awareness of responsibilities. Each September new graduate students are expected to take the Health and Safety training seminar which takes place during orientation week. They must subsequently pass a Health and Safety quiz recorded by the McLennan Health and Safety Committee. Contact reception@physics.utoronto.ca regarding H&S meetings or any safety information requirements.

Physics Technical Services Central Office

For all technical Services

Contact: David Rogerson
Office: MP 070 (Basement, north wing) • Tel: 8-0626
rogerson@physics.utoronto.ca

The central office provides general support to the Department's learning activities and research projects. This includes assistance and advice about budget estimation, scheduling, purchasing and other management-related activities. The office provides similar management services to all PTS groups, and will usually be involved in all medium and large projects done by any of the PTS groups. The PTS manager can also provide advice and design support in most aspects of PTS activities and can provide assistance in locating and obtaining materials or instruments that you require. The PTS manager will also assist with expediting the repair of instruments that must be sent out.

Precision Fabrication Services

Main Shop/Student Shop Contact: Gurmit Besla, email: gbesla@physics.utoronto.ca
Office: MP 067E (Basement, north wing) • Tel: 8-3533

The main task of the Mechanical Workshop is to fabricate, modify, and repair experimental apparatus. A wide variety of equipment is available for this purpose, and the staff is experienced in meeting the often exotic demands of physics researchers. The staff is comprised of Gurmit Besla (Supervisor), Masahiro (Mark) Aoshima and Rolyn Benedicto. If you have work for the shop, or need advice of a mechanical nature, please contact Gurmit. There is also a mechanical workshop for students connected to the main shop.

The Department maintains a machine shop specifically for use by students. It is equipped with a band saw, drill presses, lathes and milling machines. Machinists from the main shop will help students deal with the mechanical problems that arise in the course of their research, and assist students who choose to use the student shop to manufacture and modify equipment for themselves. The Student Workshop Supervisor, Paul Woitalla, can help students with their projects. Before using the shop, students must take a course, and demonstrate that they can work safely. The course is offered in the spring, to accommodate summer students, and in the fall. It may also be provided at other times, with sufficient demand. To take the course, or to use the shop, please contact Paul at woitalla@physics.utoronto.ca or 416-978-3533. Safety rules must be followed at all times or shop privileges will be withdrawn.

Electronics Support Services

Contact: Robert Morley rmorley@physics.utoronto.ca or Shuqing Li li@physics.utoronto.ca
Office: MP 072 (Basement, north wing) • Tel: 8-2969

Electronics is a rapidly changing field that has become an essential element in most experimental work. The PERC staff (Shuqing Li and Robert Morley) make every effort to provide state-of-the-art solutions to the problems that are brought to them. Their expertise covers a broad range of technologies including digital, analogue, and interface circuitry. They will also make every effort to repair commercial instruments where support from the original manufacturer is not available. PERC maintains the Departmental site license for Labview, and can provide assistance with Labview applications. To access PERC services or to get further information, please contact Robert Morley or Shuqing Li.

Graphics Support Services

Contact: Raul Cunha
Office: MP 070 (Basement, north wing) • Tel: 8-2960
raulc@physics.utoronto.ca

Raul Cunha provides scientific visualization services to the Department. This includes the use of CorelDraw and other computer-aided tools to produce presentation quality slides, posters, etc. Raul can also help in the development of graphical content for web pages. The facility has a variety of hardcopy devices, including large format colour poster printers, a high quality colour inkjet printer, and a high resolution tabloid size laser printer. Raul has a digital camera which he uses for basic photographic services; the camera is also available for loan. More advanced still or portrait photography services are available from the Earth Sciences Photographer and can be arranged by Raul. For assistance in any of these areas, please call Raul Cunha.

Caretaking Services Office: MP 116 Tel.: 8-2962

Caretaking and Lost and Found.

X. MANY-BODY INTERACTIONS

One of the great things about being part of a large Physics Department is the variety of people that you can meet who share your enthusiasm for Physics – and other things. Here are a few of the ways in which you can participate in the broader aspects of the life of the Physics Department.

Physics Colloquium

Every Thursday during the academic year at 4:10pm, the Physics Colloquium is held in MP 102. These colloquia offer an outstanding roster of well-known speakers who provide an expert view of research advances in the various fields of Physics. The lecturers are requested to aim their presentation to Physics graduate students and senior undergraduate students. Regular attendance at these colloquia is strongly recommended as part of all students' education, and even the faculty can benefit! Coffee and cookies are served in the Physics lounge before the colloquium from 3:45pm onwards. (If, in the course of your activities, you hear someone and think "they would be really good as a colloquium speaker", then let the Colloquium Committee know so that they can invite them.)

Group Seminars

Many of the research groups in the department organize their own seminar series, with outside speakers and/or internal speakers.

Graduate Student, Faculty and Staff Lounge

MP 110 on the 1st floor (behind the elevators) is the Department's lounge available to graduate students. The lounge has a kitchenette with a refrigerator and a microwave. A place to relax, it is also used for various events such as the start-of-year and end-of-year parties.

Physics Graduate Students Association (PGSA)

The PGSA organizes a coffee hour which is also frequented by some of the Faculty members, every day after lunch (1:10pm) in the Physics lounge. Bring your own mug and come along and get to know some of the other students from outside (or even inside) your research group.
OTHER ITEMS OF INTEREST TO GRADUATE STUDENTS Physics Graduate Students Association (PGSA)

The Physics Graduate Students Association aims to foster a sense of community within the Physics graduate student body through the organization of social events and opportunities for student interaction. The PGSA also works closely with other committees, representatives and the department administration to maintain a high quality of academic experience for graduate students within the Physics Department. The PGSA Executive is made up of four people: the president, a vice president, a secretary and a treasurer. During the year the PGSA organizes various activities such as: movie nights, pub nights, the annual Physics Formal, and various BBQ/picnic events. It also runs daily coffee hours in the Physics lounge. Elections are held at the end of the summer and everybody is encouraged to run. For 2017-2018, PGSA President is Aris Spourdalakis, VP Internal is John Ladan, VP External is Sophie McGibbon-Gardner, Secretary is Jeremy Rothschild, Minister of Justice is Peihang Xu, Treasurer is Eli Bourassa and Director of Communications is Doris (Xiaoqing) Zhong.
Email address is pgsa@physics.utoronto.ca

For 2018- 2019 the new PGSA members are:

President - Aris Spourdalakis
VP External - Robert Fajber
VP Internal - Ilan Tzitrin
Treasurer - Eli Bourassa
Secretary - Panagiotis Stavropoulos
Minister of Justice - Nazim Boudjada
Communications - Daniel Baker

Graduate Liaison Committee (GLC)

The Physics Graduate Liaison Committee is comprised of the Associate Chair of Graduate Studies and graduate students in all years of enrollment from each subsection of the department (QOCMP, Subatomic Physics, and Planetary Physics). Its function is to provide the department with feedback on departmental issues of relevance to graduate students and to voice student concerns about issues such as funding, committee meetings and graduation timelines. The student members of the GLC meet independently and, approximately, a few times each year with the Associate Chair of Graduate Studies. Please contact the Associate Chair of Graduate Studies if you would like to get involved. For this year's committee members:
Kirsten Tempest
Sheetal Jain
Laura Saunders
David Wandler
as well as Ilan Tzitrin from the PGS

Exit Interviews

As a student finishes the Ph.D. (or the M.Sc., if not proceeding to the Ph.D.) the Chair (or Associate Chair for Graduate Studies, if the Chair is the student's supervisor) requests an interview with the student. The interview is an opportunity for students to share their views on all aspects of the graduate student experience. It is completely confidential, and any notes taken by the Chair remain in his or her possession and are not placed in Departmental files. For more information, consult the Chair or the Associate Chair for Graduate Studies.
A.

Course Evaluations

Course evaluations are conducted each year for all of the graduate courses offered in the physics department. If you are interested in the results, see the Graduate Secretary in MP 316 for the full course evaluations report.

PHYSU (Physics Students Union)

The office for this association of Physics undergraduate students is located at MP 217. There is also a mailbox in MP 306.

University of Toronto Student Services

The Office of Student Services offers all U of T students support and counselling in the areas of career development, housing, learning skills, health, personal/emotional development, family concerns and support for Aboriginal and international students. For further information, please visit https://www.studentlife.utoronto.ca. Some services and resources of interest to graduate students are highlighted below:

Career Centre

The Career Centre at 214 College Street provides services and resources to assist Masters and Ph.D. students in planning, developing and managing their careers. It also administers the Graduate Dossier Service (GDS), a confidential depository of letters of reference, transcripts and a C.V. for U of T doctoral students seeking advertised academic positions. The Career Centre operates a summer, part-time and temporary employment service for students enrolled at the University of Toronto. For further information, call 416-978-8000 or visit the Career Centre website at http://www.careers.utoronto.ca/.

Student Housing Service

The Student Housing Service at 214 College Street provides information on U of T and independent residences, maintains a registry of off-campus housing, offers information on landlord and tenant rights as well as emergency housing referrals, and functions as the admissions office for Student Family Housing on the St. George Campus. (The term "family" refers to students residing with their dependent children and to childless couples in a permanent relationship for a minimum of twelve months.) For further information, call 416-978-8045 or visit the Student Housing website at http://link.library.utoronto.ca/StudentHousing/.

Health and Wellness Centre

The Health and Wellness Centre at 214 College Street offers a wide range of services for U of T students and their partners. Physician services include comprehensive medical care, counselling and referrals.

Nurses provide health-related information and a range of services including dressing care, immunizations and travel education. Diagnostic lab services are also available. Most services are free of charge provided you have an OHIP (Ontario Health Insurance Plan) number or UHIP (University Health Insurance Plan) coverage. For further information, call 416-978-8030 or visit the Health and Wellness Centre website at http://www.studentlife.utoronto.ca/hwc

Accessibility Services – St. George

For those eligible, Accessibility Services provides advocacy and support for students with hidden or obvious disabilities and works to facilitate the inclusion of students with disabilities into all aspects of university life. Services include assessment for a learning disability, alternative test and exam arrangements, note taking, on-campus transportation, adaptive equipment and assistive devices, information and resource materials, and liaison within the University and with off-campus agencies. For further information, call 416-978-8060 (TDD: 416-978-1902) or visit the AS website at http://www.studentlife.utoronto.ca/as

Athletics and Recreation

The Athletic Centre, Goldring Centre, Varsity Centre and Hart House offer a wide range of athletic activities throughout the year. Hart House also organizes a variety of social and cultural events, including concerts, shows and art exhibitions. For more information on the multitude of programs, classes, facilities and services available to U of T students, contact any of the facilities:

Athletic Centre at 416-978-5845
(http://www.physical.utoronto.ca/FacilitiesAndMemberships/Athletic_Centre.aspx)

Hart House at 416-978-2452 (http://www.harthouse.utoronto.ca/)

Goldring Centre at 416-946-0400 (http://physical.utoronto.ca/FacilitiesAndMemberships/goldring-centre-for-high-performance-sport.aspx)

Varsity Centre: (http://physical.utoronto.ca/FacilitiesAndMemberships/Varsity_Centre.aspx) Ice Skating, Soccer, Volleyball, Basketball. Ultimate Frisbee is in Back Campus East Field.

There are Physics teams in various intramural leagues on campus, including winter ice hockey, summer soccer, volleyball, basketball and autumn ultimate Frisbee.

The Graduate Student Union (GSU) gymnasium is also available for bookings by any graduate student for one hour periods. For further information, please visit http://www.utgsu.ca/athletics.

Graduate Professional Skills (GPS) Program

The Graduate Professional Skills Program (GPS) is a program of workshops, social events and online resources designed to enhance the graduate student experience. The program teaches the skills necessary for a wide range of careers, both within and outside of academia. Workshops and seminars address: choosing academic vs. non-academic careers, learning entrepreneurial skills, thesis and grant writing, managing the supervisory relationship, balancing school and life, dealing with stress, settling into a new city, writing literature reviews and more. For further information, visit the GPS website at https://www.sgs.utoronto.ca/international/Pages/Graduate-Professional-Skills.aspx

Student Web Service (ACORN)

Graduate students are able to access the Student Web Service (SWS) to change personal information (addresses and telephone numbers), view their academic and current courses, enrol in, request or drop courses, and order transcripts. The SWS can be accessed via ACORN website at http://www.acorn.utoronto.ca/
Instructions are located there.

Graduate Students' Union

Every graduate student at the University of Toronto is automatically enrolled as a member of the Graduate Students' Union (GSU) at 16 Bancroft Avenue. The GSU (Member Local 19 of the Canadian Federation of Students) represents your interests during your time as a graduate student at U of T and provides services such as health insurance, confidential advice, and a voice for the graduate student body on the various committees of the University. In conjunction with the Office of Student Affairs, GSU also operates Grad Escapes: a program of social, cultural and recreational events designed for busy graduate students. For further information, consult the GSU Handbook/Dayplanner you received at orientation, phone the Main Office at 416-978-2391/6233, or visit the GSU website at http://www.gsu.utoronto.ca/.

Physics Bicycle Facility

The Department of Physics has a secure Bicycle Facility/Lock-Up (in the parking garage of the McLennan Physical Labs). Physics Department (Faculty, staff and student) who opt to bike to the Department will now be able to use the Lock-Up free of charge. A $25 refundable deposit for the facility key is required. The facility can accommodate up to twenty bicycles. Spaces will be allotted on a "first come, first served" basis. A "wait list" will be maintained and periodically updated. Note that users of the Bicycle Facility have to provide their own bike lock to secure their bike in the cage. If you are interested in this opportunity please go to the Physics Main Office/Reception across from the elevators on the third floor, MP302.

"End Game" – The Process for Approval of a Ph.D. Thesis in the Department of Physics of the University of Toronto

After a number of years of research – it is finally done! You have a Ph.D. thesis to be examined. This is the timetable to be followed for the approval of your thesis at the Final Oral Examination (FOE). It takes at least 8 weeks and usually more like 10 weeks from possession of a "final" copy of the thesis to completion of the examination process. These times are non-negotiable. They cannot be shortened because a number of necessary steps have to be followed carefully in order that the procedure be fair to all and be seen to be fair to all. If you have a specific date by which you must have completed the FOE, then it is your responsibility to ensure that the other parties can meet their timetables as well.

When	What	Who
At least 8 weeks before the FOE	Submits a hardcopy of the thesis to each of his/her PhD committee members and to the Graduate Office for the Departmental Oral Exam Chair - usually the Associate Chair for Graduate Studies - and requests the Departmental Oral Exam at the Graduate Office	Student
	Schedules the departmental exam, notifies committee members and student in writing. It is reasonable to expect that this will take about two weeks to schedule - longer at holiday times.	Grad Office
At least 6 weeks before the FO	Departmental Oral Exam	
Departmental Oral Exam	Suggests two additional FOE Committee members: a member of the Physics or related department and recommends an External Examiner	Committee

	States preference for a closed vs open final PhD oral exam	Student
	Confirms willingness and availability of the External Examiner to participate in the FOE and informs the Graduate Office (If it takes time to identify an external examiner, the six weeks will be lengthened by the time it takes to identify the external. The FOE cannot be finally scheduled until the external examiner has been agreed to by the School of Graduate Studies)	Supervisor
	Schedules FOE, books room and AV equipment, notifies in writing SGS PhD Oral Office, the student, all FOE committee members and requests thesis appraisal from the External Appraiser	Grad Office
At least 5 weeks before the FOE	Sends the hardcopy of the corrected thesis to all committee members including the External Examiner. (External Examiner's copy of the thesis should be sent by overnight courier!) Submits the thesis abstract (no more than 350 words) to the Grad Office In case of an open exam, submits to the Graduate Office a summary of a talk and a picture for advertising on the department website	Student
At least 2 weeks before the FOE	Receives the External Appraisal. Sends External Appraisal and the FOE program to the SGS PhD Oral Office, the student, and all committee members including the Chair	Grad Office
Final Oral Exam	Brings a spare copy of the thesis for the Chair (Note: Some chairs have been known to request a copy of the thesis in advance. This is at their discretion.)	Student
Immediately after the FOE	Reports to SGS PhD Oral Office to complete Post Examination forms	Student
Within 1 month of the FOE (minor corrections)	Informs SGS PhD Oral Office in writing that all minor corrections have been completed satisfactorily	Supervisor
	Submits the thesis electronically to T-Space according to SGS instructions and one bound copy to Grad Office. It is considered courteous to consult with your supervisor about requirements for additional copies for other colleagues.	Student

Thesis Format:
Full instructions about the thesis format are available on the SGS website and the regulations specific to the Physics Department are in the Graduate Handbook. Read the instructions carefully and in particular make sure you have permission from the publisher to include any previously published material.

External Appraiser:
The External Appraiser should be a recognized expert on the subject of the thesis and should be external to the University and to its affiliated research institutes. Such an individual must be an Associate or Full Professor at his/her institution or, if he/she comes from outside of the academic sector, must possess the qualifications to be appointed to an academic position at this level. (A cv of the External Examiner will be necessary for review by the School of Graduate Studies.) The External Appraiser should not be a close collaborator of either the candidate or the supervisor and should not have more than an academic interest in the result of the examination. If there is some

ambiguity in this area, please consult the Associate Chair, Graduate Studies, as soon as possible. The External Examiner usually attends the FOE in person but a teleconference is acceptable.

Expenses of the External Appraiser
The School of Graduate Studies pays an honorarium to an External Appraiser and provides up to $500 for the associated travel expenses. The remaining costs of the visit should be covered by the supervisor.

External Appraisal
The external appraisal is the comments of the external examiner on the thesis. It will hopefully be constructive and will recommend acceptance, perhaps with some conditions and will almost certainly have some quite specific questions and comments about the thesis. It may say that some of these queries need to be answered before the thesis is acceptable. These questions and comments will certainly provide part of the discussion at the FOE. You and all members of the FOE should receive a copy of the external appraisal two weeks before the FOE to ensure that you have time to respond to the comments and queries at the FOE.

It is an SGS regulation that the contents of the External Appraisal cannot be discussed with the External Examiner prior to the FOE.

Membership of the FOE Committee
The Chair, who is not a member of the Physics Department, but is usually from the sciences and is appointed by the School of Graduate Studies.
Two members of the supervisory committee of the candidate.
Two other members from the Physics or related Department.
External Examiner
A quorum for the examination is four voting members and at least two of whom were not members of the student's Ph.D. supervisory committee.

Conduct of Examination
The conduct of the FOE is broadly the same as for all other oral examinations: After a short recess for the committee to examine the file and organize itself, the candidate is invited to give a 20-minute summary of the main results of the thesis after which he/she is examined on the thesis and the oral presentation. There are usually several rounds of questions and the questions may vary from particular questions about points in the thesis to general questions about the context of the research, the subject area and the research area in general. Both the thesis and the oral defense must be judged acceptable in order for the candidate to pass the examination. It is our general observation that candidates are very well informed about their research, but less forthcoming about the more general areas of questioning. You have been warned!
In case of an open defense, the candidate gives a public 45-minute research seminar in lieu of a 20-minute thesis summary and subsequently fields questions from general audience but not from examination committee members. After that, the candidate and examination committee move on to a different location for questioning, as above. Examination Chair is not required to attend the public seminar.

Results of the Examination
There are broadly four results that can come out of the examination:

1) Pass as is
2) Minor corrections – corrections of typographical and similar errors. Before the thesis is acceptable, the supervisor writes a letter to the School of Graduate Studies with a copy to the Graduate Office, that the corrections have been made
3) Minor modifications – larger corrections. These have to be examined and regulated by a committee chosen (usually) from the FOE committee and reported back when the corrections have been made
4) Fail

In the event of minor corrections or minor modifications, it is the responsibility of the candidate to "get a move on" with getting the corrections done!

Further details on all of these can be found in the School of Graduate Studies Graduate Calendar and if that is not enough, then come to the Graduate Office and we will try and answer any other questions you might have.

Forms

School of Graduate Studies

Please go to http://www.sgs.utoronto.ca/currentstudents/Pages/Student-Forms-and-Letters.aspx for forms relating to:

- Awards and loans
- Change in Program Status
- Confirmation Letters
- Exchanges and Agreements
- Master's and Doctoral Thesis and Doctoral Forms
- Registration and Enrolment
- Supervision

UNIVERSITY OF TORONTO – DEPARTMENT OF PHYSICS

Annual meeting report of the Ph.D. Committee Meeting

Date: _____

Student: _____

Supervisor: _____

Ph.D. Committee Members: _____ and _____

Ph.D. first enrolment date: _____

Course work completed: ☐ yes ☐ no

- Is there a viable thesis topic and research plan?

- What is the timeline for the thesis?

- Are the necessary resources (including financial support) available?

- What concrete progress has been made in the last year?

- What is the research plan for the coming year?

- Are there any known risks or impediments to the completion of this plan?

- Is the candidate making satisfactory progress towards a Ph.D.?

- Has the candidate done enough research to begin writing up?

PLEASE TURN OVER -->

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After meeting with the student and assessing his/her progress in the research, we recommend that:

☐ The student continue his/her Ph.D. programme, with the next committee meeting to be held on _____

☐ The student proceed with his/her present programme, but that the following conditions should be met by _____ (date), at which time another Ph.D. Committee meeting should be held.

Conditions:

☐ That the student not proceeed in his/her present programme.
Reasons:

_____ _____ _____
Supervisor's signature Committee Members' signatures

_____
Student's signature

TO BE COMPLETED BY THE GRADUATE OFFICE: ☐ The Student has been sent a copy of this report

Guidelines for Annual Ph.D. Supervisory Committee Meetings, Department of Physics

The Ph.D. supervisory committee must meet with the student at least once a year to assess the student's progress in the program, and to provide advice on future work. At least one week prior to the meeting, the student should distribute a written report, typically about 5 pages long, which gives an update on their thesis problem, the progress made to date, and future plans. At the meeting the student will present a 20-minute overview of the status of their research, with an emphasis on where the major problems and challenges lie. The committee will then help the student assess the nature of the problems encountered and suggest ways ahead. It will also assess the overall appropriateness of the research scope of the thesis. The committee submits a report detailing its observations of the student's progress and its recommendations; the student may append a response if desired. If any member of the committee is unsatisfied with the situation then the consensus view should reflect this. In the case of unsatisfactory progress, details must be provided and another supervisory meeting scheduled. Copies of the report are given to the student and filed with the Department.
Questions that should be addressed by the supervisory committee include:

- Is there a viable thesis topic and research plan?
- What is the timeline for the thesis?
- Are the necessary resources available?
- What concrete progress has been made in the last year?
- What is the research plan for the coming year?
- Are there any known risks or impediments to the completion of this plan?
- Is the candidate making satisfactory progress towards a Ph.D.?
- Has the candidate done enough research to begin writing up?

Meetings of the supervisory committee once the student is outside the funded cohort (after 4 years for regular students, after 5 years for direct-entry students) are generally held more frequently, and can be convened by the Associate Chair for Graduate Studies or a member of the Standards and Evaluations Committee. For these meetings the student is typically asked to prepare a statement explaining the reasons for the delay in completion and the extra time required, in addition to the usual report.

If you have any questions about the Graduate Student Handbook, please feel free to drop by the Graduate Office in MP 315/316.