

# **Astronomy Graduate Student Handbook**

## **Astronomy M.Sc. and Ph.D. programs**

**Department of Astronomy and Physics, Saint Mary's University**

Current rules, procedures, etc. are published by the University in the Graduate Calendar, the ultimate source for graduate school information. Our program and its procedures and the University's procedures are changing every year. Always refer to the Graduate Calendar in the years of your schooling for definitive information.

**Original: September 2005, Ian Short**  
**Revised: August 2007, 2008, 2010, 2014 David Guenther**  
**October 2019, February, September 2020, 2023 Luigi Gallo**

## Table of Contents

<b>Welcome .....</b>	<b>3</b>
<b>The special role of graduate students .....</b>	<b>3</b>
<b>Before you arrive.....</b>	<b>4</b>
<b>Newly-arrived students .....</b>	<b>4</b>
Your office .....	4
Computer account.....	5
Bank account .....	5
Fellowship and tuition .....	5
Payroll.....	5
Graduate Student Society.....	6
International students .....	6
<b>People .....</b>	<b>6</b>
<b>Faculty of Graduate Studies and Research (FGSR) .....</b>	<b>7</b>
<b>Graduate Coordinator.....</b>	<b>7</b>
<b>Gotcha's and other tidbits .....</b>	<b>7</b>
<b>Social life .....</b>	<b>8</b>
<b>Registration and enrollment .....</b>	<b>8</b>
Transfer Credits .....	10
Summer .....	10
Residency and post-residency enrollment .....	10
Maximum program length, Extensions, and Leaves of absence .....	11
<b>Choosing a supervisor.....</b>	<b>11</b>
<b>Financial support .....</b>	<b>11</b>
<b>Teaching Assistantship (TA) .....</b>	<b>12</b>
<b>Library Services .....</b>	<b>12</b>
<b>Writing Centre &amp; Academic Communication .....</b>	<b>12</b>
<b>Counselling Services .....</b>	<b>13</b>
<b>Institute for Computational Astrophysics (ICA) .....</b>	<b>13</b>
<b>ACEnet .....</b>	<b>13</b>
<b>Burke Gaffney Observatory (BGO) Public Tour Program.....</b>	<b>13</b>
<b>Courses.....</b>	<b>14</b>
Special courses .....	14
<b>Graduate Seminar (“Journal Club”) – ASTR 5900, 6900.....</b>	<b>14</b>
Evaluation.....	15
<b>Supervisory committee.....</b>	<b>15</b>
<b>Thesis and no-thesis options.....</b>	<b>15</b>
<b>Thesis defense .....</b>	<b>15</b>
Possible outcomes.....	16
<b>Ph.D. track students .....</b>	<b>16</b>
M.Sc. to Ph.D. transition.....	16
Courses .....	17
<b>Admission Requirements.....</b>	<b>17</b>

<b>Goals .....</b>	<b>17</b>
<b>Courses.....</b>	<b>17</b>
Dissertation courses .....	18
Journal club .....	18
<b>Supervisory committee.....</b>	<b>18</b>
<b>Qualifying requirements .....</b>	<b>18</b>
<b>Ph.D. Qualifying Exam .....</b>	<b>18</b>
Overview .....	18
Purpose.....	19
Qualifications to be met .....	19
Preparation.....	19
Dissertation proposal .....	20
<b>Dissertation .....</b>	<b>20</b>
Defense.....	20
<b>SUMMARY OF PROGRAM REQUIREMENTS .....</b>	<b>21</b>
<b>Credit Requirements.....</b>	<b>21</b>
<b>Grade Requirements.....</b>	<b>21</b>
<b>Thesis Option Courses .....</b>	<b>21</b>
<b>No-Thesis Option Courses.....</b>	<b>21</b>
<b>Thesis Option Supervision .....</b>	<b>22</b>
<b>Admission Requirements.....</b>	<b>22</b>
<b>Comprehensive Exam and Dissertation Proposal Defense.....</b>	<b>22</b>
<b>Dissertation .....</b>	<b>22</b>
<b>Credit Requirements.....</b>	<b>23</b>
<b>Grade Requirements.....</b>	<b>23</b>
<b>Course Requirements .....</b>	<b>23</b>
<b>Withdrawal .....</b>	<b>23</b>
<b>Core Courses .....</b>	<b>23</b>
<b>Lecture Courses .....</b>	<b>23</b>
<b>Research, Thesis, Seminar Courses .....</b>	<b>24</b>

## Welcome

Welcome to the Department of Astronomy and Physics at Saint Mary’s. We look forward to having a mutually rewarding relationship with you over the next few years, whether you are arriving to begin a Masters or a Doctoral program.

### *The special role of graduate students*

Grad students are no longer entirely “pupils,” but have reached the level where they are to a significant extent researchers and educators within academia. Much more so than undergrads, grads are part of the daily social and intellectual life of the department, and their participation is expected to extend well beyond attending classes and discharging obligations. Indeed, we view our graduate students as a vital group within our community who add a unique vibrancy and zest to our departmental culture. To that end, each grad

has their own assigned personal space within the department, equipped with a desk and a computer, which they are strongly encouraged to use as the base of their activity.

As graduate students, you are now at a level where you can expect to have a collegial relationship with the faculty. You should view the faculty as your partners in the scientific and academic enterprise, and feel free to engage any of them about any matters of interest or concern.

As graduate students develop within our programs, we look forward to seeing them take up increasingly enriching leadership roles as they transform from students into independent research scientists.

## **General**

### ***Before you arrive***

Students should bring enough money to pay rent (including deposit) and food for at least a month since financial support does not begin immediately upon your arrival. See below. You should bring all your documentation with you. This is especially important for foreign students since this material may be used when issuing you a visa.

You should be prepared for harsh winters. Don't be fooled by the mild Winter temperatures in December. Temperatures drop to well below 0 C from January to March, with (on average) two to five winter storms a month during this period.

You will have access to Department computers for e-mail, course work, and research, and will be issued an "ap" email address in addition to the University email. All our computers run a version of Linux so we recommend that you familiarize yourself with this operating system.

### ***Newly-arrived students***

The department is located on the third floor of the Atrium, which is located between the Science Building and the Library.

Fall semester usually begins a few days after Labour Day, and graduate courses begin when the semester begins. *There are several things to do to get yourself established, so it is best to check in with the department a week or so before the first day of class.* To be sure of finding someone who can meet you on the day you arrive, e-mail your expected date and time of arrival to the Graduate Coordinator beforehand (see *People* Section below). When you arrive, look for the Graduate Coordinator or the Departmental Secretary in AT 319.

### **Your office**

The Graduate Coordinator will take you to the graduate student offices and help you to pick out a desk. Desks are assigned on a "first come, first served" basis. Opportunities to change desks occur infrequently, so choose well! You will also need to fill out requisition paperwork to get a swipe card to the graduate office. See our Departmental Secretary (AT 319) for details.

## **Computer account**

The Department provides a Macintosh/Windows/Linux computing environment. The computer support technician will create a local computer account for you. This will give you access to local high performance computing on a variety of machines and all applications for which we have site licenses, as well as an email account and personal WWW page in the smu.ca domain. *Note:* Be sure to change your initial password after the first time you log onto the system. Your local email address in the @ap.smu.ca domain is the one that the department will use to communicate with you, you are responsible for checking it regularly or have it forward to your preferred email address.

## **Bank account**

If you do not already have one you need to get a Canadian Bank Account as soon as you arrive in Halifax. The University payroll service will only pay you by direct deposit into your bank. You will need picture identification (e.g., passport, driver's license) to get an account.

As soon as you get your account bring a VOID check from your banking account to the Faculty of Graduate Studies.

## **Fellowship and tuition**

Graduate students who have been awarded Saint Mary's administered fellowships and scholarships, will receive their funds (less tuition and associated fees) in three installments at the beginning of each semester, provided they have registered early. Students who have registered in early August may collect their first installment (34% of scholarship less fees) in early September. Students who have registered by early December, may collect their second installment (33% of scholarship less fees) in January. Students who have registered by April, may collect their third installment (33% of scholarship less fees) in May (the exact dates can be found in the FGSR Graduate Student Handbook). It is up to the student to request that the funds be issued to them.

Because the fall fellowship cheques are not available until just after semester begins, plan to arrive in Halifax with access to enough money to open a bank account (needed by SMU payroll), pay the deposit on rental accommodation and utilities, and other miscellaneous expenses. Note that your fellowship is most of your annual income, and the next fellowship installment will not be paid until early January, so it is necessary to budget your cash flow for sporadic income.

## **Payroll**

Remuneration from your Teaching Assistantship (see TA Section below) is paid biweekly by direct deposit to a chequing account. To enable these payments, arrange with the departmental secretary to complete payroll paperwork. You will need to provide banking information and a voided cheque for your bank account. TA payments normally do not begin until late September, and continue until the end of April (there are no TA

jobs in the summer). Note that TA remuneration is normally only a small fraction of your income.

## Graduate Student Society

The Saint Mary's Student Society (<https://www.smusa.ca>) is an association that advocates the interests of students as well as providing occasional social activities (see *People* Section below).

## International students

The Saint Mary's International Student Centre (<https://smu.ca/international/international-students.html>) can assist newly arrived international students (see the *People* section below) and may even provide free airport pickup when you arrive. If you do not already have a Canadian Social Insurance Number (SIN), you must apply to the Canadian government for one as soon as you arrive before you can be paid for your Teaching Assistantship. Forms can be obtained from the departmental secretary.

## People

Graduate students are encouraged to interact with everyone, but there are a few people who play a special role. The individuals who hold these offices change with time, but are currently listed.

### Department of Astronomy and Physics

Graduate Coordinator	Luigi Gallo	AT 319C	420-5637	luigi.gallo@smu.ca
Chair	Ian Short	AT 324	496-8194	ian.short@smu.ca
Secretary	Shannon Rhode	AT 319	420-5828	s.rhode@smu.ca
Graduate student office		AT 302	496-8769	
Undergrad office		AT 325	420-5149	
Computer and Observatory support	Tiffany Fields	AT 312	420-5633	tiffany.fields@smu.ca
Laboratory and Computer support	Michael Dunlavy	AT 317	420-5833	michael.dunlavy@smu.ca
Fax		AT 319	496-8218	

### Institute for Computational Astrophysics (ICA)

Director	Marcin Sawicki	AT 319D	420-5144	Marcin.sawicki@smu.ca
Secretary	Shannon Rhode	AT 319	420-5828	icaadmin@smu.ca

### Faculty of Graduate Studies and Research (FGSR)

Dean	Adam Sarty	AT 210B	496-8169	adam.sarty@smu.ca
Graduate Studies Officer	Heather Taylor	AT 210D	420-5069	heather.taylor@smu.ca
Secretary		AT 210	420-5089	fgsr@smu.ca

### Faculty of Science

Dean (acting)	Lori Francis	Science 223	420-5494	dean.science@smu.ca
Secretary	Courtney Miriam	Science 221	420-5494	adminassist@smu.ca

**Burke-Gaffney Obs**

Loyola 24<sup>th</sup> 420-5896

**Students Society (SMUSA)**

Student Centre 500 496-8700 <http://www.smusa.ca/>

**Counselling Centre**

Student Centre 406 420-5615 [counselling@smu.ca](mailto:counselling@smu.ca)

**International Centre**

Student Centre 300 420-5525 [international.center@smu.ca](mailto:international.center@smu.ca)

## ***Faculty of Graduate Studies and Research (FGSR)***

The Faculty of Graduate Studies and Research (FGSR) formally administers all aspects of a graduate student's status at Saint Mary's, from admission until graduation, including fellowship and scholarship money. The team that handles graduate student issues consists of the Dean, the Graduate Studies Officer, and the Secretary. The FGSR office is located on the second floor of the Atrium (AT 210). Phone: 902-420-5089; email: [fgsr@smu.ca](mailto:fgsr@smu.ca). Their WWW site is <http://fgsr.smu.ca/>. Often the best way to resolve problems with, or obtain information from, FGSR is through the Graduate Coordinator (see next item below). See the addendum with definitions and elaboration of FGSR terms.

## ***Graduate Coordinator***

The Graduate Coordinator (or "Program Coordinator") is the faculty member in the Astronomy and Physics department who is responsible for departmental aspects of graduate studies. You should feel free to view the Coordinator as the first resource person whom you can approach if you have a question or an issue regarding any aspect of your program or your status at Saint Mary's. Often the Coordinator can get answers and address issues within FGSR more easily than a student could on their own.

## ***Gotcha's and other tidbits***

There are many *unusual* procedures and circumstances that sometimes catch students and faculty by surprise. Here is a list of some of them:

- You register once only in ASTR 6900 (Master's Thesis) or ASTR 8999 (Doctoral Dissertation) in the first semester that you begin your thesis research. Your transcript will show IP for *in progress* until you complete your thesis.
- Every term you are not registered in a class (including Spring/Summer), you should register in the course FGSR 9000 (you can register every semester to make it a habit). This is a place holder course that keeps your status as a full-time student. If you find your scholarship money is taxed or missing, see the graduate coordinator immediately to straighten this out.
- All students attend and participate in the Graduate Seminar courses but only students enrolled in the Master's program register for the Graduate Seminar I and II (ASTR 5900/6900) courses.
- Entering students must take both Research Methods I and II (ASTR 5990 and 5991) in their second semester.
- The astronomy and physics department runs its own mail server and has its own IP subnet addresses separate from the University.

- If you feel that the course work or teaching assistantship workload is too heavy, then you should first talk/complain to the lecturer in charge, then you should go to the graduate coordinator or department chair. It is reasonable to expect an average (over the entire term) of 10 hours of homework per course per week. The TA workload should also be approximately 10 hours per week. That said you should not be surprised if the workload varies from week to week.

## ***Social life***

Throughout the academic year, weekly colloquia are either preceded or followed by a social time at which refreshments are served. These events are particularly valuable because most colloquia are given by visiting scientists from other institutions, and they provide students with the opportunity to meet and interact with such visitors. Frequently, when a colloquium is given by a visitor, a few graduate students are invited to join the speaker and one or two faculty members for dinner that evening. These opportunities are an invaluable part of our students' broader education. In addition, the department, the Faculty of Science, FGSR, and the University, all traditionally have several social events throughout the year (that are well catered with refreshments!).

## ***Registration and enrollment***

Saint Mary's University makes use of the *Banner Self-Service* system ([https://ssb-nlive.smu.ca/pls/sNLIVE/twbkwbis.P\\_GenMenu?name=homepage](https://ssb-nlive.smu.ca/pls/sNLIVE/twbkwbis.P_GenMenu?name=homepage)). This system allows students to register for programs, enroll in courses, and check their financial account with Saint Mary's electronically from anywhere on-line. Banner User ID's and initial passwords are provided by FGSR upon acceptance of an offer of admission.

Note that students must register for each academic year that they are in the program until they have completed all the requirements or have withdrawn. Annual re-registration normally must be done by the beginning of each new academic year in early September. Note *especially* that timely release of fellowship payments is contingent upon registering before the deadline.

## ***Which courses to take?***

We advise you to register in all core courses as they appear. All core courses are offered once every two years. Other courses may appear less frequently. A minimum of five courses will be offered each year. Ph.D. students should not take the Research courses unless advised to do so. Ph.D. students do not take the Graduate Seminar courses (but do attend and participate in the course). M.Sc. students must take the Graduate Seminar courses. M.Sc. students are required to take, under normal circumstances, two Research Project courses in their first year, during the second semester. Worksheets are provided below, that outline the course flow in both programs.



**MSc. in ASTROPHYSICS**  
**Program Requirements**

**2023-24**  
**Calendar**

Grad Seminar 6 credit hr	Research Project 6 credit hr	*Core Courses 12 credit hr	**Electives 6 credit hr	Thesis 6 credit hr
ASTR 5900 (1XX, 2YY)	ASTR 5980			ASTR 6990 (1XX)
ASTR 6900 (1XX, 2YY)	ASTR 5981			ASTR 6990 (2YY)

**NOTES:**

★ Core Courses include: ASTR 5500; ASTR 5510; ASTR 5600; ASTR 5610; ASTR 5617; ASTR 5620 or courses approved by the Graduate Coordinator.

★★ Electives include ASTR courses number 5000 or above, but excluding those already required for graduation.

*NB: An overall GPA > 3.0 is required in the combined Electives and Core Courses. In addition, no grade below B- can be used toward graduation.*

1XX and 2YY correspond to Fall and Winter semester, respectively. Students must register in both semesters.

Students should register in FGSR 9000 any semester in which they are not registered in any other course (e.g. summers).

LIGHT GRAY = suggested schedule for Year1

DARK GRAY = suggested schedule for Year2

**PhD. in ASTROPHYSICS**  
**Program Requirements**

**2023-24**  
**Calendar**

*Core Courses 18 credit hr	**Electives 6 credit hr	Thesis 6 credit hr
		ASTR 8990 (1XX)
		ASTR 8990 (2YY)

**NOTES:**

★ Core Courses include: ASTR 5500; ASTR 5510; ASTR 5600; ASTR 5610; ASTR 5617; ASTR 5620 or courses approved by the Graduate Coordinator

★★ Electives include ASTR courses number 5000 or above, but exclude Research Project, Graduate Seminar, and Thesis.

*NB: An overall GPA > 3.0 is required in the combined Electives and Core Courses. In addition, no grade below B- can be used toward graduation.*

1XX and 2YY correspond to Fall and Winter semester, respectively. Students must register in both semesters.

Students should register in ASTR 8990 after they have defended their dissertation proposal.

Students should register in FGSR 9000 any semester in which they are not registered in any other course (e.g. summers).

## Transfer Credits

Students entering the Ph.D. program may receive transfer credits for courses completed during their M.Sc. program. Upon agreement between the student and the graduate coordinator some courses the student has taken will be matched to courses in our graduate program. If the student has been given transfer credits for a course than the student cannot take that course for credit, although, the student can sit in on the course to refresh their knowledge in that subject area and help prepare themselves for the comprehensive exams. Transfer credits will be worked out before the term starts but the credits will not be transferred until after the first term begins.

## Summer

Graduate students are engaged in academic activity year-round, and should plan to spend most of the summer on campus conducting their thesis or dissertation research. Therefore, students are enrolled, and paid, for Fall, Winter, and Spring/Summer semesters. This also has tax implications because you are a student for 12 months of the year, not eight.

See sections on *Courses* and *Thesis* under the M.Sc. and Ph.D. sections below for information about special courses that you should enroll in at times of the year.

Students need to notify their supervisor and the graduate coordinator if they plan to take more than two weeks summer vacation.

## Residency and post-residency enrollment

FGSR refers to the first phase of a graduate program that lasts until the nominal time limit of the program as the *residency* phase. During the residency phase the student enrolls with normal status, must pay full tuition, and is normally guaranteed full financial support providing they continue to satisfactorily meet all program requirements. It is during this phase that students normally complete, at the very least, all course work and preliminary degree requirements. In the Sciences, students depend heavily on departmental and campus resources to conduct their research. Therefore, the norm in Science programs, including Saint Mary's graduate Astronomy, is for students to complete *all* program requirements, *including* their thesis or dissertation, within the residency period. For *full-time* students, our residency periods are:

M.Sc. – 2 years,

Ph.D. – 4 years.

All graduation requirements must be satisfied by August 31 of the final year (assuming the student started September 1). This means that the *final* thesis, with committee signatures, must be submitted to FGSR by that date. You should plan to have your thesis defence a few weeks prior to August 31 to ensure you have time to address comments. A final copy of the thesis must also be submitted to the Library for achieving (<https://smu.ca/academics/archives/theses.html>).

Students who have completed the residency phase of their program, but have not yet met all the program requirements, should continue to register each year and enroll in “Program Continuation” until they have completed all the requirements, even if they have relocated outside Halifax. *There is a significant fee for this so it is encouraged that students do their best to graduate on-time. Moreover, students do not receive University funding when in continuation.* If a student who has not yet completed all program requirements, does not act to remain registered each year, then FGSR and the Registrar may deem the student to have abandoned their program.

### **Maximum program length, Extensions, and Leaves of absence**

Regulations regarding maximum program length, extensions, and leaves of absence, are set by FGSR. The maximum length of time that a student may spend in the M.Sc. and Ph.D. programs is five years and eight years, respectively. An extension is a prolongation of the length of a degree program, and must be applied for to the Graduate Coordinator. Each extension is normally no longer than a year. A student may apply for more than one extension, but should expect that the justification will need to be more compelling with each application. A leave of absence ([https://smu.ca/webfiles/FORMleaveofabsenceNEW\\_web.pdf](https://smu.ca/webfiles/FORMleaveofabsenceNEW_web.pdf)) is a suspension of the program during which record of time spent in the program is frozen. Leaves of absence are normally granted for no more than one year, and normally no more than once during a student’s program. Financial support is not available to a student during a leave of absence. Students should apply to the Graduate Coordinator for a leave. A leave is normally only granted in the case of extraordinary circumstances, and requires departmental deliberation before being granted. Students returning from leave must apply to FGSR to reactivate their program.

### ***Choosing a supervisor***

New graduate students should select a supervisor from among the Astronomy and Physics faculty by mutual agreement with a faculty member by the end of their first semester in the program. Students are invited and, indeed, strongly encouraged, to meet with all faculty members during the first semester to discuss potential areas of research before selecting a supervisor.

### ***Financial support***

Full time graduate students who continue to satisfactorily meet all the program requirements in a timely manner are guaranteed financial support sufficient to meet the cost of living for one person in Halifax during the residency period of their program (2 years for the M.Sc., 4 years for the Ph.D.). Full financial support is normally contingent upon taking up a Teaching Assistantship (TA) assignment.

Note that timely release of Fellowship money is contingent upon registering by the deadline each academic year (see Section on *Registration and Enrollment* above). Note also that your fellowship will normally be the largest portion of your annual stipend, and it is paid out to you in three large lump sums four months apart in early September, January, and May. It falls to you to budget your cash flow such that you can meet your

obligations until the next payment. The bi-weekly Teaching Assistantship remuneration is at most a few hundred dollars.

### ***Teaching Assistantship (TA)***

Students without external financial support (e.g. an NSERC post-graduate award) must normally take up a Teaching Assistantship (TA) to guarantee an annual stipend that is sufficient to meet minimal costs of living. TA assignments for Graduate Students typically involve grading for one senior level undergraduate course and demonstrating and grading for one undergraduate laboratory course each semester. The total work load should on average not exceed eight hours per week.

### ***Library Services***

Graduate Students can look to the library for a variety of services:

- **Research by Appointment** – book a one on one session with a Librarian where they can help with in depth research & information gathering as well as citation help  
Email [research@smu.ca](mailto:research@smu.ca) or call 902-420-5544
- **Inter-Library Loan/Document Delivery** – the library can help you locate and request materials from other institutions.  
<https://smu.ca/academics/borrow-from-other-libraries.html>  
Email: [ill@smu.ca](mailto:ill@smu.ca) or call 902-420-5542
- **Research Data Management** – Librarians can help with navigating the requirements for Data Management including planning, depositing, and storage.
- **Research Toolkit** – Librarians provide sessions specifically for Graduate Students & Teaching Assistants at specific dates in the year  
- <https://libguides.smu.ca/researchtoolkit>
- **Copyright Office** – The Copyright Librarian and Copyright Assistant can help you navigate copyright for course material, authorship, and your thesis.  
Email [copyright@smu.ca](mailto:copyright@smu.ca)

### ***Writing Centre & Academic Communication***

The Writing Centre offers a wealth of support and resources for students preparing their dissertations and term papers. There are writing guides, tutorials, workshops and English language support for graduate students. Their contact information and list of available tutorials are found on their website: <https://studio.smu.ca/wc-home>

They also offer individual academic support for graduate students by appointment: <https://studio.smu.ca/graduate-academic-support>

## ***Counselling Services***

The Counselling Centre (Student Centre 4<sup>th</sup> floor; 420-5615) is available to all SMU students. The centre offers all kinds of support for students in crisis, but also for students that may be having trouble focusing or are feeling overwhelmed. This is important information for your own well-being, but also for students you may encounter in your classes in your capacity as a teaching assistant. The centre also offers a series of *Mental Health* workshops that you are encouraged to attend. Their website contains resources contact/appointment information, and workshop information:

<https://smu.ca/campus-life/the-counselling-centre.html>

## ***Institute for Computational Astrophysics (ICA)***

The Institute for Computational Astrophysics (ICA) resides within the Department of Astronomy and Physics. The ICA office is in AT 319, and the secretary is the Department secretary.

## ***ACEnet***

ACEnet is a consortium of Atlantic Canadian universities that has received funding from the federal and provincial governments and private industry to create a network of high performance computing (HPC) and data visualizations infrastructures in Atlantic Canada. Students carrying out computational research here can expect to have access to rapidly increasing computer and data visualization capabilities during their program. ACEnet will also sponsor series of meetings and special events at which students can present research results and interact with computational scientists at other institutions.

## ***Burke Gaffney Observatory (BGO) Public Tour Program***

The department runs very popular public tours at the Burke Gaffney Observatory (BGO) throughout the year on one or two weekends each month. Graduate students are asked to participate regularly in the program as tour guides. Participation is regarded as part of your broader education. The program is promoted and coordinated by Observatory Director Tiffany Fields. Training sessions for new guides are held each fall. A student can expect to be on duty no more frequently than one weekend every two months during the fall and winter semesters, and one weekend a month during the spring and summer. There are also opportunities for interested graduate students to be paid tour leads and telescope operators - if interested, contact Tiffany Fields.

## M.Sc. students

### Courses

The complete set of Astronomy graduate courses is described in the *Saint Mary's University Academic Calendar Graduate Program* (or just *Graduate Calendar* for short). Courses are classified as either core or elective, and this classification has a bearing on whether and how a course meets degree requirements.

Note that no graduate course, including core courses, is ever offered more frequently than once every two years, so careful planning is required to complete a program on time. In rare situations where it is deemed to be of significant benefit to a student, with special permission of the supervisor and Department, a student may take select graduate courses from other Departments within Saint Mary's or from other Universities.

### Performance Standards

Note that a grade of B or better is considered a pass at the M.Sc. level.

### Special courses

Some of the required courses that students must register for to meet their program requirements are not typical lecture courses, but represent other academic activities. Furthermore, which course a student must register for to cover these other activities depends on which year of the program a student is in. Below is a guide to which special courses a student should normally register in for each year of the program. Note that these are in *addition* to the required load of core and elective *lecture* courses.

#### Year 1:

ASTR 5900 Graduate Seminar I

ASTR 5980 Research Project I

ASTR 5981 Research Project II

#### Year 2:

ASTR 6900 Graduate Seminar II

ASTR 6990 M.Sc. Thesis

Also, see note on *Post-residency enrollment* under *Registration and enrollment* in the *General* section above.

### **Graduate Seminar (“Journal Club”) – ASTR 5900, 6900**

The Graduate Seminar I and II courses (ASTR 5900, 6900), known commonly in the department as “Journal Club”, consist of weekly oral presentations and discussion based on the astronomical and astrophysical research literature. The purpose is to broaden the students' educational experience with exposure to the research literature, and to develop the students' presentation skills. The format varies somewhat from semester to semester, but, typically, each week one or two graduate students either make an oral presentation

of, or lead a discussion of, a research paper chosen in advance by them in consultation with the course Instructor. Students can typically expect to make *at least* two presentations per semester. The room used for presentations is equipped with a data projector, and students should plan to use data projection for the audio-visual component of their presentation. First year M.Sc. students should work closely with the course coordinator to select suitable papers for presentation.

## **Evaluation**

Students' performance in this course is currently evaluated with a letter grade, and, as with all graduate courses, a grade of B or higher is considered a 'Pass'. Students are evaluated based on their participation every week as audience members (*i.e.* attendance and participation in question periods and discussion) as well as on the quality of their presentations.

## **Supervisory committee**

Both, MSc and PhD students are expected to meet with a supervisory committee two-times per year. The supervisory committee consists of the student's supervisor and two full-time faculty selected by the supervisor and student. This need not be, but often is, the thesis examination committee. The role of the supervisory committee is to track the student's progress through the program and ensure that objectives are clear and the student will graduate on time.

## **Thesis and no-thesis options**

M.Sc. students have the option of completing the degree requirements with or without completing a thesis. No-thesis students must take a larger load of lecture courses than thesis students. The detailed requirements of the two programs are described in the *Graduate Calendar*. *Note that no-thesis students are not guaranteed full financial support, and we normally expect students to pursue the thesis option.*

## **Thesis defense**

At least one month before the date of the defense, the Supervisor, in consultation with the student and the Graduate Coordinator, will select an examining committee. The committee normally consists of the supervisor and two other faculty members, at least one of whom should be from the Astronomy and Physics Department. If deemed helpful, the supervisor may also select an external examiner from outside Saint Mary's who may, but need not, attend the defense. At that time the student should submit a draft that both the supervisor and student regard as final to the committee for evaluation.

The defense consists of a 20-minute oral presentation to the department and any interested members of the public, followed by a brief public question period. The audience is then excused and the committee examines the student orally on the contents of the thesis until satisfied. This phase normally takes no longer than an hour.

At this point committee members may submit a written list of corrections to the student and supervisor.

## **Possible outcomes**

**Pass** – The student has passed and need take no further action. This outcome would only occur in the event of an exceptional thesis.

**Pass with minor modifications** – The student is deemed to have passed, but is asked to make modifications that pertain to clarity and presentation. The committee may ask to see the modified thesis, or may elect to be satisfied with the supervisor’s judgment as to when the modifications have been satisfactorily made.

**Major modifications required** – Major modifications must be made to the thesis before it can be adequately judged. This outcome would arise if significant scientific research must be performed, or re-performed, to salvage the thesis. For this outcome, a second exam is normally required.

**Fail** – The thesis is deemed to be unacceptable and unsalvageable. The student would normally be asked to leave the program without having completed the degree requirements.

Be sure to work closely with your supervisor to ensure that the latter two outcomes do not occur!

## **Ph.D. track students**

There are several special considerations for M.Sc. students who intend to pursue a Ph.D. in Astronomy at Saint Mary’s.

### **M.Sc. to Ph.D. transition**

There are two ways in which a student in our M.Sc. program who wishes to pursue a Ph.D. in Astronomy at Saint Mary’s may make the transition between the two programs. There are important differences in the implications and consequences between these two ways, and such students are encouraged to make their decision about which way they should proceed in consultation with their supervisor and the Graduate Coordinator. Students who wish to graduate from Saint Mary’s with an M.Sc. degree and continue into the Ph.D. program must apply to FGSR for acceptance into the Ph.D. program following the same procedure as an applicant from another University, including obtaining letters of reference and paying the full application fee. The student’s application is then considered in competition with those for the Ph.D. program received from external applicants. Students who are deemed to have made satisfactory progress in their M.Sc. have the option of requesting transfer to the Ph.D. program, with the transfer occurring at the end of their first year. Students who are granted such a transfer become re-classified as Ph.D. students without need to make formal application to FGSR. *However*, students who so transfer are considered by FGSR to have *not* completed the M.Sc. program, and will *not* receive an M.Sc. degree from Saint Mary’s. Students who wish to be considered for such a transfer should indicate their intent in writing to the Graduate Coordinator during their first year in the M.Sc. program.



## **Courses**

Students who enter the M.Sc. program who believe that they will pursue a Ph.D. at Saint Mary's are encouraged to take as many of the eight lecture courses required for the Ph.D. program as they feasibly can during their M.Sc., even though only six lecture courses are required for the thesis option. Credit for any Saint Mary's graduate Astronomy course can be transferred from the M.Sc. to the Ph.D. program and applied toward meeting the Ph.D. requirement, so the more courses taken at the M.Sc. stage, the fewer need be taken at the Ph.D. stage. Students should consult with their supervisor when deciding how many of the offered courses they can feasibly take in each semester.

## **Ph.D. students**

### ***Admission Requirements***

Students must have received their M.Sc. degree or equivalent before they begin the Ph.D. program. Do ensure that a copy of your M.Sc. degree certificate is sent to FGSR before you arrive. Fellowship money will be withheld if we do not have proof of your M.Sc. degree.

Students who are finishing up their M.Sc. theses when they arrive should see the graduate coordinator immediately. Because you will not receive any fellowship money until your M.Sc. degree is completed it is important that you have a clear plan to obtain your M.Sc. degree within a month (preferable) or two of the start of the Ph.D. program.

This also applies to students in the Saint Mary's University M.Sc. program transferring into the Ph.D. program. If you have not completed your M.Sc. requirements you will be classified as a program continuation student. You must pay a program continuation fee for each term until you do graduate.

### ***Goals***

The Ph.D. is unique in the hierarchy of academic degrees in that by the time a student graduates, they are expected to have developed to the point where they are, in fact, no longer students of astronomy and astrophysics. Rather, they are now independent research scientists and international experts in their fields, capable of directing their own research programs, propagating knowledge authoritatively, guiding their own students, securing their own research funding in a competitive environment, and creating significant new knowledge motivated by their own interest and guided by their own judgment.

### ***Courses***

Students must complete eight lecture courses to meet the Ph.D. requirements. However, it is expected that most, if not all, of these courses will have already been completed at the M.Sc. level, either at Saint Mary's or elsewhere, and credit transferred toward the Ph.D.

program. Students who completed an M.Sc. elsewhere should contact the Graduate Coordinator to determine how many of the required courses they may waive by transfer of credit.

### **Dissertation courses**

In the first *or* second year of the program *only*, students should enroll in ASTR 8990 (Ph.D. Dissertation). Students should not enroll in this course more than once. As always, students should enroll in FGSR 9000 every term that they are at Saint Mary's University.

### **Journal club**

Note that ASTR 5900 and 6900 (Graduate Seminar I and II) are M.Sc. courses only, and Ph.D. students may not enroll in them. Rather, regular participation in *Journal Club*, both as a regular presenter and as an active audience member, is considered a degree requirement. Senior Ph.D. students are expected to take a leadership role in organizing Journal Club.

### **Supervisory committee**

The supervisory committee consists of the student's supervisor and two full-time faculty selected by the supervisor and student. With compelling justification, one of the three additional faculty may be from a department other than *Astronomy and Physics*. The role of the supervisory committee is to consider and evaluate the *Dissertation Proposal*, and to meet thereafter with the candidate as frequently as the committee deems worthwhile, but no less frequently than annually, for the duration of the student's candidacy. The objective of these meetings is to review progress, provide oversight, and to establish milestones and timetables. Note that the supervisory committee is formally not the same as the *thesis defense committee*, although the two committees will have members in common.

### **Qualifying requirements**

A new Ph.D. qualifying exam has been proposed March 24, 2014. It is described below. The previous guidelines, retained here, will be no longer apply for any student entering on or after September 1, 2014. Students enrolled in the program prior to September 1, 2014 may choose the form of their qualifying exam.

### **Ph.D. Qualifying Exam**

#### **Overview**

To be allowed to continue in the Ph.D. program, by the end of their 2nd year all Ph.D. students are required to take and pass *a comprehensive defense of their Ph.D. thesis proposal*. The oral exam is two-hours and twenty-minutes and is administered by the student's Ph.D. qualifying exam committee. During the first twenty minutes, the student presents their proposed Ph.D. dissertation research plan. In the remaining two hours, the

student defends the scientific merit of the proposal and their ability to accomplish the proposed research. In addition, they should be able to explain how their proposed thesis research fits in with current astronomical research and how it compares to related research. In other words, the student must demonstrate a thorough working knowledge of their proposed field of research *and* of related fields.

A document describing Ph.D. Qualifying Exam Guidelines for students and professors can be obtained through the graduate coordinator or online via the Department's graduate student page ([https://smu.ca/webfiles/PhDQualifierGuidelines\\_2014\\_rev06.pdf](https://smu.ca/webfiles/PhDQualifierGuidelines_2014_rev06.pdf)).

## **Purpose**

The purpose of the qualifying exam is to determine if the student is *qualified* to commence the dissertation phase of their Ph.D. program.

## **Qualifications to be met**

- The student must present and successfully defend a credible proposal for original research.
- The student must demonstrate a competent (graduate) level of knowledge and understanding of astronomy in the area of research by successfully answering questions in the field of research.
- The student must demonstrate a basic (undergraduate) level of knowledge and understanding in related fields of astronomy by successfully answering questions in fields of astronomy relevant to the research. The fields to be covered will be set by the examining committee at least three months in advance of the exam.
- The student must demonstrate that they are familiar with the current literature in the field of their proposed research.

## **Preparation**

- At least three months before the date of the exam, the supervisor, the student, and graduate coordinator select an examining committee consisting of the supervisor, and two full-time faculty.
- At least three months in advance of the exam the examining committee specifies the areas of astronomy open to examination. That is, they define the research field and related fields of the exam. This will be communicated to the graduate student and the graduate coordinator.
- In consultation with the student and the committee, the supervisor sets the date for the exam, reserves a room, and notifies the graduate coordinator.
- At least *three* weeks before the exam, the student distributes a written thesis proposal to the committee members. Note, the thesis proposal should be up to approximately 10 double-space pages in length plus additional figures, tables, and bibliography.

## **Dissertation proposal**

The dissertation proposal consists of two components: a written submission and an oral presentation. Both components should address all the following:

- Definition of the research problem to be investigated and statement of goals
- Background and broader context
- Overview of the current state of the field
- Proposed research program and its relation to the goals
- Description of methods to be used and data to be obtained
- Description of resources needed and assessment of availability
- Tentative milestones and timetable for at least the first year
- A bibliography of papers sorted into those that are a) examples of current research (last two years), b) seminal in the field, c) review articles.

Addressing the first three items will necessarily involve a literature review, and such a review is regarded as an important component. Item 8 is expected to list the literature that was most useful for researching the first three items.

The written proposal should be about 10 pages in length, and be double-spaced. It should be structured with clearly labeled sections addressing the above items. It is to be submitted to the *supervisory committee* at least two weeks prior to the oral presentation.

## ***Dissertation***

The dissertation is the most important component of the Ph.D. program. Research and writing carried out to the end of producing the dissertation is expected to occupy most of the student's time in the program. A passable dissertation must contain a significant body of *individual* research that would meet the standards of the academic research community for *originality* and *importance*. As a guide, it is expected that a passable dissertation would contain material sufficient for no fewer than three research papers acceptable for publication in a peer-reviewed professional research journal such as *The Astrophysical Journal* or *Astronomy and Astrophysics*. Indeed, students are strongly encouraged to prepare major sections of their dissertation research for submission to such journals while in the program. The student and the supervisor, in consultation with the supervisory committee, decide at their discretion when the dissertation is ready for submission for evaluation.

## **Defense**

The dissertation defense is an FGSR procedure and detailed guidelines can be found in the *Graduate Calendar*. At least three months before the expected date of the defense, the supervisor, in consultation with the student and Graduate Coordinator, will have selected the defense committee. The committee should consist of three or four examiners from the Saint Mary's faculty, including the Supervisor, all but one of whom must be from the Astronomy & Physics Department, and one examiner who is external to the University who must be a faculty member, or equivalent thereof, at a suitable institution of higher

education or research. Normally, the external examiner should agree to being present at the defense as well as to evaluating the dissertation. At least one month before the date of the defense, the student should submit a draft of the dissertation that both the student and supervisor regard as final to the members of the defense committee.

Possible outcomes of the defense reflect the need for both the written dissertation and the oral defense to separately pass scrutiny. A detailed description of possible outcomes can be found in the guide to FGSR procedures in the *Graduate Calendar* (<https://smu.ca/academics/calendar/>).

## **SUMMARY OF PROGRAM REQUIREMENTS**

### **M.Sc. Requirements (2-year program)**

#### ***Credit Requirements***

- 36 credit hours of courses over two years
- 18 credit hours/year for full-time students

#### ***Grade Requirements***

- grade  $\geq$  B- (2.67 GPA) each course
- GPA  $\geq$  3.0 after first year to enter second year
- GPA  $\geq$  3.0 to graduate

#### ***Thesis Option Courses***

- ASTR 5900 Graduate Seminar I (3 hours)
- ASTR 6900 Graduate Seminar II (3 hours)
- ASTR 5980 Research Project I (3 hours)
- ASTR 5981 Research Project II (3 hours)
- $\geq$  4 of 6 core courses ( $\geq$  12 hours)
- 2 ASTR courses (excluding Research Project and MSc Thesis) or graduate courses in related disciplines (subject to approval of supervisor) (6 hours)
- ASTR 6990 MSc Thesis (6 hours)
- Original work
- Defend thesis before Thesis Defense Committee (end of second year)

#### ***No-Thesis Option Courses***

- ASTR 5900 Graduate Seminar I (3 hours)
- ASTR 6900 Graduate Seminar II (3 hours)
- ASTR 5980 Research Project I (3 hours)
- ASTR 5981 Research Project II (3 hours)
- 6 core courses (18 hours)
- $\geq$ 4 ASTR courses (excluding MSc Thesis) or graduate courses in related disciplines

- (subject to approval of supervisor) ( $\geq 12$  hours)
- ASTR 5980 Research Project I and/or ASTR 5981 Research Project II may be taken subject to approval by supervisor

### ***Thesis Option Supervision***

- Select faculty supervisor during first semester
- With supervisor and graduate coordinator select Thesis Defense Committee beginning of third semester
- Faculty supervisor,  $\geq 2$  Department faculty, optionally 1 external reader (need not be present at defense)

## **Ph.D. Requirements (4-year program)**

### ***Admission Requirements***

- Normally, an M.Sc. or equivalent in Astronomy, Physics or related field.
- SMU M.Sc. graduated students must formally apply to FGSR for admission to Ph.D. program during second year of M.Sc. program.
- SMU M.Sc. students transferring without completing degree must obtain Departmental approval, notify graduate coordinator six months prior to intended transfer, and do not apply to FGSR for admission to Ph.D. program.

### ***Comprehensive Exam and Dissertation Proposal Defense***

- Normally, taken near end of second year
- Two attempts are allowed. Second failure requires withdraw from Ph.D. program

### ***Dissertation***

- Select supervisor during first semester.
- With supervisor and graduate coordinator select Supervisory Committee beginning of second semester.
- Faculty supervisor,  $\geq 2$  Department faculty
- Meet with student  $\geq 1$  a year
- Purpose to assess progress
- Submit written dissertation proposal ( $\leq 10$  pages) to Supervisory Committee during first year of program.
- With supervisor and graduate coordinator select Dissertation Defense Committee  $\geq 3$  months before anticipated defense date.
- Faculty supervisor,  $\geq 2$  Department faculty, 1 external to SMU reader.
- Submit draft dissertation to Dissertation Defense Committee  $\geq 3$  months before anticipated defense date.

## ***Credit Requirements***

- 24 credit hours of courses • all lecture courses taken by SMU M.Sc. Astronomy students count (this excludes thesis, research projects, and graduate seminars).
- subject to University regulations on transfer credits and supervisor approval, courses taken elsewhere may be counted.
- More than 24 credit hour courses require supervisor approval.

## ***Grade Requirements***

- grade  $\geq$  B- (2.67 GPA) each course
- GPA  $\geq$  3.0 after first year to enter second year
- GPA  $\geq$  3.0 to graduate

## ***Course Requirements***

- 6 core courses (18 hours)
- 2 ASTR courses (excludes thesis, research projects, and graduate seminars) or graduate courses in related disciplines (subject to approval of supervisor) (6 hours)
- ASTR 8990 Doctoral Dissertation taken in first year after approval of dissertation proposal
- FGSR 9000 in every year after taking ASTR 8990.
- Participate in Journal Club (ASTR 5900 and 6900) every year. Non-credit.

## ***Withdrawal***

- Progress to date may be applied towards an M.Sc. degree.
- If insufficient credits, then student can apply to transfer to M.Sc. program to complete requirements.
- Must notify graduate coordinator in writing.
- Must obtain approval by Department and FGSR

## **List of Courses**

### ***Core Courses***

ASTR 5500.1(.2) Galactic Astronomy  
ASTR 5510.1(.2) Extragalactic Astronomy  
ASTR 5600.1(.2) Cosmology  
ASTR 5610.1(.2) High-energy Astrophysics  
ASTR 5617.1(.2) Stellar Astrophysics  
ASTR 5620.1(.2) Astrophysics Data Analytics

### ***Lecture Courses***

ASTR 5200.1(.2) Astronomical Instruments and Techniques

ASTR 5210.1(.2) Computational Methods in Astrophysics  
ASTR 5410.1(.2) Stellar Atmospheres and Spectra  
ASTR 5420.1(.2) The Interstellar Medium  
ASTR 5430.1(.2) Binary and Variable Stars  
ASTR 5600.1(.2) Clusters of Galaxies  
ASTR 5700.1(.2) Magnetohydrodynamics  
ASTR 5710.1(.2) Astrophysical Dynamics  
ASTR 6400.1(.2) Stellar Astrophysics II  
ASTR 6800.1(.2) Selected Topics in Astronomy and Astrophysics  
ASTR 6810.1(.2) Directed Readings Current Literature

***Research, Thesis, Seminar Courses***

ASTR 5900.1(.2) Graduate Seminar I  
ASTR 5980.1(.2) Research Project I  
ASTR 5981.1(.2) Research Project II  
ASTR 6900.1(.2) Graduate Seminar II  
ASTR 6990.0 Master's Thesis  
ASTR 8990.0 Doctoral Dissertation