PHYS 590: Research Thesis Course

"Investigation of a contemporary research topic in physics or astronomy under the supervision of a faculty member, and leading to a written thesis and both oral and poster presentations of the results."

2023-24 PHYS 590 Coordinator:
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https://www.queensu.ca/academia/wright/

See https://www.queensu.ca/academia/wright/teaching/phys-590-info/phys-590-2023-2024 for course information, syllabus, etc

Goals of PHYS 590

- Carry out original research using the methods of experimental physics, data analysis and modeling, theoretical and computational physics, and/or observational astronomy
  - Delve into a subfield of physics under the guidance of a member of the faculty
  - PHYS 590 students often interact with the graduate students, postdoctoral fellows, and collaborators of their supervisor.
  - Some projects may lead to an academic publication
- Develop the communication skills of a physicist
  - Present your results and progress in written reports and both poster and oral presentations
- More than any other course, PHYS 590 is the closest approximation you'll have to what is expected of a research MSc thesis.
- For those thinking of graduate school, a strong letter from a thesis supervisor is often the key to a successful application.

*The following are peer-reviewed articles published by **PHYS 590 students** and their supervisors:*

Judith Irwin, **Jacqueline Dyer**, Leonardo Drake, Q Daniel Wang, Jeroen Stil, Yelena Stein, Jayanne English, Theresa Wiegert CHANG-ES – XXVII. A radio/X-ray catalogue of compact sources in and around edge-on galaxies
Monthly Notices of the Royal Astronomical Society 512, 4 (2022).

Axelrod, S., Kamandar Dezfouli, M., Wong, H.M.K., Helmy, A.S., and Hughes, S.
Hyperbolic metamaterial nanoresonators make poor single-photon sources
Phys. Rev. B 95, 155424 (2017).

Wong, H.M.K., Kamandar Dezfouli, M., **Axelrod, S.**, Hughes, S., Helmy, A.S.
Theory of hyperbolic stratified nanostructures for surface enhanced Raman scattering
Phys. Rev. B 96, 205112 (2017).

Wesch, N. L., **Burlock, L. J.**, Gooding, R. J.
Critical telomerase activity for uncontrolled cell growth.
Physical Biology 13 (4), 046005 (2016).

Shan, Y., McDonald, M., & Courteau, S.
Revised Mass-to-Light Ratios for Nearby Galaxy Groups and Clusters.
Astrophysical Journal, 800, 122 (2015).

Hills, S., von Hippel, T., Courteau, S., Geller, A.M.
Bayesian Investigation of Isochrone Consistency Using the Old Open Cluster NGC 188.
Astronomical Journal, 149, 94 (2015).

Lawrence M. Widrow and **Gage Bonner**.
Vertical Oscillations of Fluid and Stellar Discs.
Monthly Notices of the Royal Astronomical Society, 450, 266 (2015).

Lawrence M. Widrow, **Jarrett Barber**, Matthew H. Chequers and Edward Cheng.
Bending and breathing modes of the Galactic disk.
Monthly Notices of the Royal Astronomical Society, 440, 1971 (2014).

Course Learning Outcomes

- Present a significant personal contribution to cutting-edge scientific research.
- Carry out cutting-edge scientific research with increasing confidence, technical skill, and autonomy.
- Prepare manuscripts describing research results in the style expected by scientific journals.
- Prepare and present scientific posters that describe research results in the style expected at scientific conferences.
- Prepare and deliver oral presentations describing scientific research results in the style expected at scientific conferences.

Time Commitment and Time Management

- Expect a significant time commitment for your research. The "learning time" expectation in a typical course is ~10 hours/week. You should expect to spend at least that much time on PHYS 590.
- It can be challenging to keep the project on track in spite of nearer-term deadlines from other courses. Time management is important. Weeks go by quickly!
- You are responsible for making and keeping to a reasonable schedule. Don't underestimate "ramp up time." This is not something that can be left to "catch up on later."
- In planning your work, I strongly recommend discussing the scope of your topic carefully with your supervisor and put together a rough timeline for your work. Your supervisor will be able to give feedback about how much effort is involved in different aspects of the work. It is important to be realistic!

PHYS 590 Deliverables

The main 590 deliverables are:

Project Proposal: 2%

Midyear report draft: 1%

Midyear report: 18% written, 9% oral

Final report draft: 1%

Final Report: 46% written, 23% poster

Your major deliverables are evaluated by a committee of two faculty research experts from the Department and your supervisor.

Three Elements of a Successful PHYS 590 Thesis

- **Quality Research**
  - Dedication, initiative, time management, and engaging closely with your advisor are keys to ensuring that you make good progress.
- **Good Understanding**
  - Demonstrate understanding of how your project fits in with current research. Part of success in PHYS 590 involves a careful literature review. Work with your supervisor on this!
- **Quality Presentations**
  - Clear and concise reports, free of grammatical errors, and following appropriate style. Good use of figures and tables. Proper referencing. Resources and information on report preparation will be made available later in the semester.

Timeline & Deliverables

- **September 22nd: Project Proposal**
  - The project proposal should be 1 page in length and describe the aim of your research project and briefly discuss the proposed methodology. You may wish to include one or two key references. Students who are working with their summer research supervisors should provide an additional description of the relation between their summer work and the work they plan to do in PHYS 590. The proposal should be submitted in electronic form, by email, to the course coordinator. The project proposals help me to ensure that everyones' projects are a good fit with PHYS 590 course expectations

Timeline & Deliverables

- **November 9th: Midyear Report Draft**
  - Report drafts are meant to be an opportunity for us to provide you with constructive feedback. The drafts should include at a minimum a properly formatted skeleton of the paper with section headings, an image, and a point form outline of what you plan to say in each section – this will help you get started with your thinking about the draft contents and ensure you have the formatting tools in place. The more complete the draft the more useful our feedback can be. The draft, in pdf form, should be sent electronically to your supervisor and the course coordinator. This is intended to be helpful, and will be graded as either 0 or 1/1. Should you receive 0 the mark will be dropped and the weighting assigned to this component in your overall mark will be added to the corresponding written report.

Timeline & Deliverables

- **November 23rd: Midyear Report**
  - Midyear reports should be no more than 10 pages in length (including figures and tables). Reports should be formatted in the style of a journal publication, with single line spacing and 12 pt font. Reports should be prepared using a word-processing package that is capable of handling equations, tables, and figures, as necessary (use of LaTeX is recommended; I can provide an introduction if requested). The reports should include an introduction, a literature review, a discussion of methodology, a report of progress to date, and a clear statement of the goals for the coming semester. Students should include (as an appendix and not counted toward the page limit) a timeline for their remaining 590 work. PDF versions of the report should be emailed to me and your supervisor. Further information regarding the report format and assessment, including the grading rubric, will be provided.
- **Week of December 4th: Midyear Oral Presentation**
  - An oral presentation of your results to your assessment committee. The presentations should be 12 minutes in length, and will be followed by questions from the committee.

I will schedule a course meeting in November to provide more information/guidance on the reports and oral presentations.

Timeline & Deliverables

- **March 14th: Final Report Draft**
- **March 28th: Final Report**
  - Similar format to midyear report, but 20 page limit
- **Week of April 8th: Final Poster Presentation**
  - A scientific poster describing your research and results will be will produced and presented. The poster will be presented "socially" to members of the Department of Physics, Engineering Physics, and Astronomy through a joint poster session with ENPH 455 students, followed by scheduled presentations to your committee members. Further guidance on poster production and presentation, including the marking rubrics, will be provided.

I will schedule a class meeting in February to discuss the final deliverables.

Supervisor's Role

- Suggest an appropriate topic (level of required background, amount of work required for acceptable progress, etc)
- Provide starting material and access to necessary resources (e.g. existing code, laboratory space & equipment)
- Provide guidance throughout the academic year.
  - Note that PHYS 590 is mostly self-directed: expect your advisor to guide you, not tell you what to do.
- The nature of the supervisor-student relationship will be different for each supervisor-student pair. It is up to you and your supervisor to establish a working relationship.
  - It is your responsibility to remain in good contact with your advisor (e.g. scheduled meetings)

PHYS 590 Coordinator's Role

- Manage the "mechanics" of the course (managing deliverables, setting up committees, scheduling presentations)
- Help to ensure that projects undertaken have a reasonable chance of success and provide intervention if things seem not to be heading in a good direction.
- Act as a resource for students
  - Help students find supervisors when necessary
  - Handle any difficulties that may arise during the course
- **I'm available to both students and supervisors throughout the year. Please don't hesitate to contact me with any questions or concerns.**

Questions?