



# Physics Senior Thesis

November 12, 2019

<https://physics.oregonstate.edu/wic-thesis-course-information>

# Physics Major Timeline



- Junior Year
  - Paradigms
  - Computational Physics
  - Electronics Lab
  - Research
- Senior Year
  - Capstones (EM, QM, Thermo, Optics)
  - Senior Thesis
  - Electives
  - Research
- Job / Grad School

# Senior Thesis



- OSU Baccalaureate Core
- Writing Intensive Course (WIC)
  - Major specific
  - Physics majors: PH 403 (3) thesis
- New option
  - PH 317X Experimental Physics / PH 403 hybrid

# Senior Thesis Requirements



- Physics Research - 3 units PH 401 (Jr/Sr)
- Writing Intensive Course (WIC)
  - PH 403 Thesis
  - 1 unit Fall term of Senior year
  - 1 unit Winter term of Senior year
  - 1 unit Spring term of Senior year
- THESIS
- ORAL Presentation at end of Spring

# OSU WIC Guidelines



- <http://wic.oregonstate.edu/wic-thesis-option>
- The thesis must be written in the student's major, or in the case of a student with an interdisciplinary major, in a subject area relevant to the major.
- Students in a major who are writing a thesis will meet together regularly in a group, with faculty leadership, to discuss and demonstrate understanding of issues related to writing in the discipline; to discuss and demonstrate familiarity with a variety of types of writing used by those working in the field (for example, writing done for various audiences); and to participate in peer review of ongoing drafts of writing projects in the major.
- The person leading the thesis writing group will be a faculty member in the discipline rather than a graduate teaching assistant.
- Students writing a thesis will gain experience in the steps involved in the process of writing a large document over time. Documents in the process might include: thesis proposal or project description, update memos to the committee or faculty mentor, literature review, drafts of required thesis sections on which the student received feedback, a whole draft with feedback, and a final polished version.

# OSU WIC Guidelines (contd)



- Thesis writers will receive instruction in revising their writing and will perform significant revision of their writing.
- Thesis writers will have opportunities (perhaps in the thesis writing group) to use informal, minimally graded or ungraded writing as a mode of learning and understanding content.
- Thesis writers will write at least 2000 words of polished writing that has gone through revision in response to feedback, and a total of 5000 words including drafts. Graphics are not included in the word count. Drafts to prepare for an oral presentation can also be counted in the 5000 words.
- Thesis writers will demonstrate in their thesis the ability to integrate and document information from outside sources.
- Students receiving WIC credit in a thesis option will take a minimum of three hours of thesis/research credit.
- It is recommended that at least one person in a department offering a WIC thesis experience have taken the WIC Seminar in order to be familiar with current research and pedagogies for helping students become better writers.

# Research Options



- OSU Physics Faculty
- OSU Faculty in other depts
  - Engineering
  - Oceanography
  - Chemistry
  - Ag
  - .....
- REU (need OSU co-advisor)
- Internships (need OSU co-advisor)

# OSU Physics Faculty



- Prof. Liz Gire Physics Education Research
- Prof. Matt Graham Experimental Condensed Matter Physics
- Prof. Henri Jansen Theoretical Condensed Matter Physics
- Prof. David Lazzati Theoretical Astrophysics
- Prof. Yun-Shik Lee Experimental Atomic & Optical Physics
- Prof. Corinne Manogue Physics Education Research
- Prof. David McIntyre Experimental Atomic & Optical Physics
- Prof. Ethan Minot Experimental Condensed Matter Physics
- Prof. Oksana Ostroverkhova Experimental Atomic & Optical Physics
- Prof. Weihong Qiu Experimental Biophysics
- Prof. David Roundy Theoretical Condensed Matter Physics
- Prof. Heidi Schellman Particle Physics
- Prof. Guenter Schneider Theoretical Condensed Matter Physics
- Prof. Xavier Siemens Astrophysics
- Prof. Bo Sun Experimental Biophysics
- Prof. Janet Tate Experimental Condensed Matter Physics

<https://physics.oregonstate.edu/senior-thesis-projects-20202021>



# OSU Physics Faculty (contd)



- Dr. Kathy Hadley                      Theoretical Astrophysics
- Dr. K.C. Walsh                        Physics Education Research
- Prof. Pavel Kornilovich (HP)        Theoretical Condensed Matter Physics
- Prof. David Craig                      Theoretical Quantum Physics

<https://physics.oregonstate.edu/senior-thesis-projects-20202021>

# OSU Physics Research



- Learn about OSU Research at talks:
- Colloquium: Monday 4:00 Weniger 116
  - Coffee/Tea/Cookies at 3:30 in Weniger 379
  - <http://physics.oregonstate.edu/events-colloquia>
- Seminar: Wednesday 4:00 Weniger 304
  - <http://physics.oregonstate.edu/events-SSO>
- Talk to students in groups
- Web
  - <https://physics.oregonstate.edu/research-department-physics>
  - <https://physics.oregonstate.edu/senior-thesis-projects-20202021>

# REU



- Research Experience for Undergraduates

- 8-10 weeks

- NSF

- <http://www.nsf.gov/crssprgm/reu/>

- [http://www.nsf.gov/crssprgm/reu/list\\_result.cfm?unitid=69](http://www.nsf.gov/crssprgm/reu/list_result.cfm?unitid=69)

- Stipend + Expenses (housing, travel)

- OSU URSA Engage \$\$\$

- <https://apli.oregonstate.edu/research/programs/ursa-engage>

- <https://apli.oregonstate.edu/research>

- Summer Undergraduate Research

- Experience: SURE \$\$\$

- <https://www.science.oregonstate.edu/SUREscience>

# Internships



- <http://www.science.oregonstate.edu/node/111>
- <https://www.nrel.gov/careers/suli.html>
- <http://science.energy.gov/wdts/suli/>
- <https://www.energy.gov/student-programs-and-internships>
- <http://godefense.cpms.osd.mil/internships.aspx>
- <http://www.nasa.gov/audience/forstudents/index.html>

# PH 403 Activities



PH403 (Thesis) concerns the writing aspect of the research, and students enroll in 1 unit of PH403 in each of Fall, Winter and Spring of the senior year. You will need permission from the Physics office to register. These three total credits satisfy the OSU Writing Intensive Course (WIC) requirement of the OSU Baccalaureate Core requirement. Students meet weekly as a group to write, critique, and revise their writing. They also discuss and write about issues relating to ethics, types of science writing, and logical presentation of ideas. In Winter and Spring, activities focus on the thesis itself, including significant time devoted to the writing and revision of the thesis. Steady progress and continual peer and advisor review are expected throughout. A typical thesis is about fifteen to twenty pages, or about 3,000 to 5,000 words. The goal is to have the thesis ready by week 6 of Spring term. This means that research should be substantially complete by the end of Winter term of the senior year.

After the written thesis is complete, class time is devoted to preparing 10-minute oral presentations, the standard at physics conferences. In the final week of Spring term, there is a mini-conference where students give oral presentations on their projects to the department.

# Senior Thesis Outline



- 1 Title, abstract, PACS.
- 2 Introduction: Why is topic important? How does it relate to the real world? How does it add to our knowledge base?
- 3 Previous work: survey of what has been done before.
- 4 Methods: description of theory, equipment, computational tools, etc.
- 5 Results
- 6 Discussion: What do the results mean? How do they relate to previous work?
- 7 Conclusion: What have we learned? What should be done next?
- 8 Bibliography

# Recent OSU Physics Theses



- Computing Wavefunctions of Silicon Donor Qubits with Density Functional Theory
- Theoretical and Experimental Analysis of the Length of Actin Filaments in Cancer Cells
- Analysis of Upper Ocean Surface Wave Structure in the Bay of Bengal using  $\Xi$ -SOLO Floats
- Correlating Boxsand.org Web Engagement with Increased Student Performance
- Project BoxSand: Impact of Course Website Interactions on Exam Performance in a Flipped Classroom Environment
- Using an Optical Trap to Measure Brownian Motion on 3  $\mu\text{m}$  Polystyrene Microspheres
- Econophysics: Evolving Boltzmann-Gibbs Income Distributions
- Synchronized Cellular Mechanosensing due to External Periodic Driving
- The Effect of Annealing Parameters on the Electrical Properties of Fluorine Doped Tin Oxide

# Timeline, Action Items



- JR year Fall term: Gather info, Seek project
- JR year Winter term: Seek project
  - Apply for summer REU
  - Contact OSU profs
  - other ...
- JR year Spring term: Start: PH 401
- JR-SR Summer: DO RESEARCH, PH 401
- SR year Fall term: PH 403, PH 401
- SR year Winter term: PH 403, PH 401
- SR year Spring term: PH 403



# PH 317X



- Experimental Physics Course
- Winter Term – 3 credit lab course & writing
- Times MWF 2-4 ???, Limited space
- Research-type experience focused on 2 experiments only: X-ray crystallography, Brownian motion
- Learn troubleshooting, statistics and uncertainty, work in teams, open-ended extensions of experiments include research-grade equipment or/and student-generated questions to further investigate the topics, writing reports, probably oral presentations
- Hybrid with PH 403 for senior thesis

# How do I secure a project?



- Learn about the research from talking to seniors and grads, the WIC projects page, the WIC thesis page (previous projects and advisors)
  - <https://physics.oregonstate.edu/wic-thesis-course-information>
  - <https://physics.oregonstate.edu/senior-thesis-projects-20202021>
- Go to the professor's office and ask for an appointment (maybe even a lab tour by a grad or UG). Email may work, but often gets lost
- Go to at least three people and express interest, have a copy of your resume
- You need time to decide; faculty need to gauge the needs of the entire class, so the decision will take time
- Department will host a meeting to match advisors to projects and/or PH 317 if you have not found a project by late winter.

# Contacts



- Head Advisor: David McIntyre, Weniger 311
- PH 403 Instructors: Ethan Minot, Weniger 417  
Janet Tate, Weniger 485
- PH 317 Instructors: Janet Tate, Weniger 485
- Dept. Chair: Heidi Schellman, Weniger 301

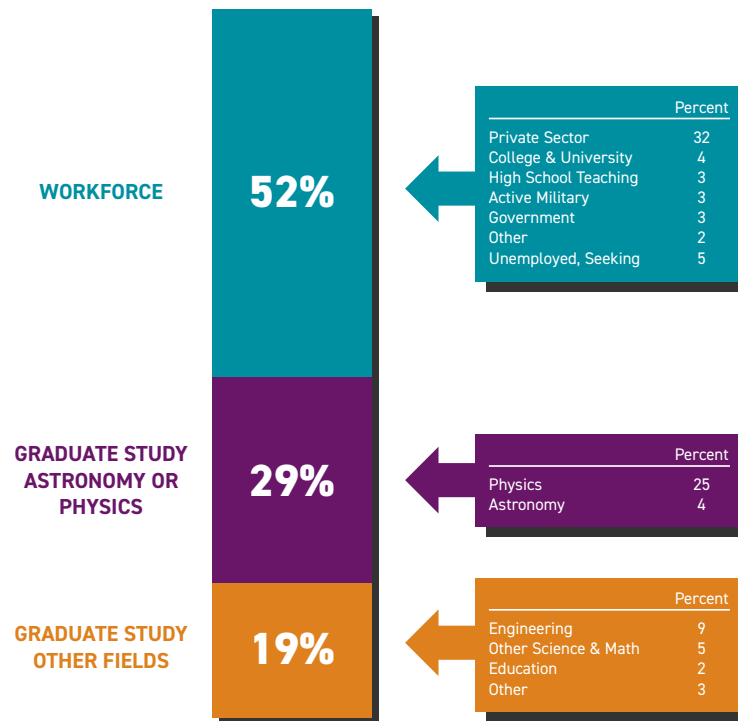
# Jobs



- Oregon: HP, Intel, InFocus, ESI, Solar World...
- Washington: Boeing, Microsoft, Yahoo, ...
- California: Silicon Valley, LA Aerospace, ...
  
- Career Fair: <https://career.oregonstate.edu>
  - October 23-24, 2019                      CH2M Hill Alumni Center
  - February 19, 2020                      CH2M Hill Alumni Center
  - April 22, 2020                      CH2M Hill Alumni Center
- UO MS Intern Pizza event Nov 19
- Physics career info:     <http://www.aps.org/careers/>  
   <https://www.aip.org/career-resources>

# Jobs

## Physics Bachelors 1 Year Later 8,800 Recent Degree Recipients



Note: Data in this figure are from the AIP Statistical Research Center's annual Bachelors Follow-up Survey, classes of 2017 and 2018 combined. The 8,800 degree recipients represent the average of these two classes. Two percent of respondents to the survey indicated that they had left the US to pursue employment or graduate study and are not included in the figure.

# Graduate School



- Physics, Applied Physics, Engineering, ...
- M.S. , Ph.D.
- Research Experience as UG
- Letters of Recommendation (3+)
- GRE
  - General: Computer based, anytime
  - Physics: paper-based: September, October, April
  - GRE seminar: PH 407(1) Spring term
- Finance: TA/RA, Fellowship (NSF, DOE, etc)

# Graduate School Info



- GRE: [www.ets.org/gre](http://www.ets.org/gre)
- AIP info: [www.gradschoolshopper.com](http://www.gradschoolshopper.com)
- GradSchools.com [www.gradschools.com](http://www.gradschools.com)
- [www.princetonreview.com](http://www.princetonreview.com)
- [www.petersons.com](http://www.petersons.com)

# Graduate School Timeline



- GRE
  - General: Computer based, anytime
  - Physics: paper-based: **September, October, April**
- Applications due: Jan 1 approx
- Letters of Recommendation (3+, 4 weeks notice)
- Fellowship apps
- Acceptance date: Feb, March approx
- Visit campuses: March, April
- Decision date: 15 April
  - <https://cgsnet.org/april-15-resolution>