PHYS-3119/3129 Syllabus

Connect with the Instructors

Dr. Daniel Fischer

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Joel Peacher

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Jason Summers

Meeting time/room

Tue/Thu 12:30pm-15:15pm
Fuller room (208 Physics)

Prerequisites

Physics 2129

Goals

The Advanced Lab consists of two semesters of independent, team-based, research projects, typically taken in the Junior or Senior years. The overall goal of this course is to give you the experience of doing an experimental research project, which includes finding an interesting

scientific question to be investigated, designing an experiment that is suited to answer the scientific question, setting up and performing the actual experiment, analyzing the experimental data and deriving quantitative results, and both presenting the results in oral and written form. These are all critical elements in the research world for either applied or fundamental researchers and help you to develop and deepen the understanding of scientific methodology.

Major components of the course

1. Short written research proposal

The objective of this proposal is to convince your instructor that your experimental physics project idea is interesting and feasible with the given resources. It should include the following:

- Project title and names of investigators
- Scientific question of the research project, background, and hypothesis
- experimental realization, layout of the planned setup and detectors, measured experimental observables
- cost estimate (if applicable)
- References to other published scientific works

2. Experimental work, set-up, measurement, and documentation (Individual notebooks)

All research must be documented. This is one of the most critical skills a researcher must have. Without proper documentation it is impossible to write a paper about the research that has been done. In this class, your **individual** notebook is the proof that you participated in the research.

3. Midterm presentation

This presentation is the first of two talks which will give you practice speaking to a group of peers. The objective is to give an introduction in your research project, present the scientific question and any preliminary results you have, describe the work you hope to accomplish in the rest of semester, and try to convince a friendly yet skeptical group of people that you know what you are talking about.

4. Final report

This report should be written as if you were going to submit a paper to a scientific journal. It should contain the following elements:

- Abstract: highlights key points of your study concisely and effectively
- Introduction: includes background/hypothesis/predictions
- Methods: give enough detail to allow for replication

- Results: A careful analysis of the experimental data is extremely important. There should be a quantitative result which includes an analysis of statistical and systematic experimental errors. Include tables or graphs of measured quantities.
- Discussion: relate results to hypothesis & predictions/discuss outcome

Moreover, the report should be technically sound (grammar, spelling conciseness, etc.) and contain proper citations where required.

In writing this document you will rely on your notebooks, which will contain all the details of your work. The best is to be working on the final report throughout the semester.

5. Peer review

Referees play a crucial role in evaluating manuscripts submitted to journals. They help the journals' editors (who are not necessarily experts in the field) assessing the quality of a submitted paper. The editors (in the A-Lab, the editor is your course instructor) have established criteria for the suitability of publications in their journals. These criteria vary and generally depend on the nature of the journal's readership. The role of the referee is to provide an opinion as to whether the paper satisfies the stated criteria of the journal for publication.

In the A-Lab, each student is required to read the final report of another group and assess its quality specifically with respect to the following questions:

- Is the work well executed and technically correct?
- Are the models or approximations used sufficiently justified?
- Are the main conclusions or claims well supported?
- Are the title and abstract informative, concise, and clear?
- Is the manuscript well organized and clearly written?
- Is the description of the technical content sufficiently comprehensive?
- Are the references to the literature appropriate and adequate?
- Please be specific as to how and where the manuscript could be expanded or shortened.
- Are the figures and tables clear, useful, and suitably summarized in the captions?

6. Final presentation

In this talk you will present the work you accomplished in this course. Like the final report, it should contain the following elements:

- Introduction: establish motivation/hypothesis/prediction
- Methods: explain in detail
- Results: present measured data and describe analysis
- Discussion: Discuss outcome/respond to Q & A

This talk should be presented with organized slides and effectively using visuals, diagrams, or tables. Being able to clearly explain your research to others is an imperative skill for all scientists.

7. Teamwork

All experimental research projects rely on the effective cooperation of several individuals. The advanced lab is ideal environment to train your teamwork skills. Therefore, research projects should typically be done in groups of 2 to 3 students which are formed at the beginning of the semester. Even though a clear assignment of tasks in the team is effective and desirable, it is important that all the students of one group contribute equally to developing the research idea, writing the lab report and doing the midterm and final presentations.

Grades

Your grade will be based on the sum of the components listed above. It will **NOT** directly be based on the success of your research project. However, your grade will depend on you being able to prove that you were an active participant in the research project and showing an understanding of the scientific methodology.

Course points:

Proposal	150 P
midterm presentation	150 P
final presentation	150 P
final report	360 P
peer review	40 P
overall experimental work	150 P
SUM	1000 P

Grades:

A	≥ 900 points
B	≥ 800 points
C	≥ 700 points
D	≥ 600 points
F	< 600 points

Due dates

02/06/2025	Proposals
03/06/2025	Midterm presentation
05/06/2025	Final presentation
05/06/2025	Final report
05/09/2025	Peer review

"Large Language Models" course policy

In this course, the use of large language models (LLMs, such as ChatGPT, Gemini, etc.) as research tools or for drafting text is generally permitted, with the exception of their use in the peer review. However, the following guidelines must be strictly adhered to:

1. **Disclosure**: Clearly disclose any use of AI-generated content in your assignments. Cite the specific LLM used and explain how it contributed to your work.
2. **Critical Evaluation**: Critically assess the AI-generated output to ensure that your final submission accurately reflects your own understanding, analysis, and original thought.
3. **Academic Integrity**: Submitting AI-generated content without proper attribution will be treated as plagiarism and may result in academic misconduct proceedings.

By adhering to these guidelines, you can responsibly integrate AI tools into your academic work while maintaining the integrity of your submissions.

Safety

Safety is everyone's responsibility. The instructors and staff do their utmost to ensure a safe learning environment, but in the end, it is your skin. Students should always consider any potential risks involved in an experiment, e.g., those associated with the use of high voltages, chemicals, radioactive sources, lasers, ultraviolet light, cryogenic fluids, heating elements, heavy equipment, heavy metals, cutting edges, particulate dust, intense sound, high pressure gas, or vacuum. Any technical instrumentation may only be operated after approval of the instructors or staff. Lasers, chemicals, radioactive sources, liquid nitrogen, etc., may only be handled after the corresponding safety training. **Food and drinks are not allowed in the laboratory**. All safety related incidents, including close calls, must be reported to the instructors.

Disability support service

It is the university's goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please contact your lab instructor and the Student Disability Services at (573) 341-6655, sdsmst@mst.edu , visit http://dss.mst.edu/.for information, or go to mineraccess.mst.edu to initiate the accommodation process.

Academic dishonesty

You should behave as responsible scholars and scientists. Academic dishonesty such as plagiarism, cheating, or sabotage is unethical and unacceptable. For more detail see the Student Academic Regulations which are available at http://registrar.mst.edu/academicregs/index.html. and the Honor Code developed and endorsed by the Missouri S&T Student Council at http://stuco.mst.edu/honor-code/.

Title IX

Missouri University of Science and Technology is committed to the safety and well-being of all members of its community. US Federal Law Title IX states that no member of the university community shall, on the basis of sex, be excluded from participation in, or be denied benefits of, or be subjected to discrimination under any education program or activity. Furthermore, in accordance with Title IX guidelines from the US Office of Civil Rights, Missouri S&T requires that all faculty and staff members report, to the Missouri S&T Title IX Coordinator, any notice of sexual harassment, abuse, and/or violence (including personal relational abuse, relational/domestic violence, and stalking) disclosed through communication including but not limited to direct conversation, email, social media, classroom papers and homework exercises.

To learn more about Title IX resources and reporting options (confidential and non-confidential) available to Missouri S&T students, staff, and faculty, please visit https://equity.mst.edu/.

Emergency exits

Please familiarize yourself with the classroom emergency exists shown on the egress maps posted on-line at: http://designconstruction.mst.edu/floorplan/.

Complaints

It is hoped that any problems can be resolved through discussions between student and instructor. If there are any complaints that cannot be resolved they can be taken to Dr. Vojta (102 Physics, vojtat@mst.edu).