



Physics 121: Experimental Techniques

Course Introduction

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Course Goals

- Bestow upon you the skills you will use in practical lab settings
- Let's say you want to participate in physics research at UCSD...
- You will be asked: what can you do?
 - program?
 - electronics?
 - mechanical design?
 - optical design?
 - vacuum systems
- What will your answer be?

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Course Content

- Mechanical Design
 - designing/machining parts, mechanical flexure
- Thermal Design
 - understanding heat flow
- Optics
 - geometrical optics/raytracing
- Vacuum and Cryogenics
 - requirements and techniques
- Analog Electronics
 - power supplies, op-amps, LEDs
- Computer Interface
 - serial, parallel ports; D/A converter, mag-swipe; C-programming

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Why should you work hard in this class?

- You can get shortchanged by going to a research university
 - professors are primarily interested in research
- How to offset: **participate in research!**
- But there's a barrier: **experience**
- This class **can** provide some of this needed experience
 - but only an initial exposure
 - realistically, a one-quarter course can't do it all
- So you win big if you put a lot in
- And aside from research, mastering these skills makes you an asset to employers

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My Background

- Why is this relevant?
 - it influences the type of exposure I can offer in this course
- Amateur Astronomer (high school, mainly)
 - built telescope, did astrophotography
- Co-op student at Naval Research Lab
 - worked on lasers, optics, interfacing equipment, telescopes
 - learned to machine, use a theodolite, many optical tools
- Grad student in physics/infrared astronomy
 - built infrared spectrograph for Palomar 200-inch telescope
 - tons of machining
 - some cryogenic exposure
- Postdoc at UW
 - began building lunar laser ranging apparatus
 - diversity of optics, mechanics, electronics, thermal

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Failure mode

- The downside is that I'm trying to cram stuff I learned over years into a single quarter
- For me, learning all this stuff was a lot of fun
 - no substitute for pursuing on your own
- Within class structure, it is unlikely to be as fun for you as it was for me
 - hard to formulate a class without "cookbook" flavor
 - but this is partly up to the individual
 - and we'll try to be careful about this
- At least you'll get an intro to things that you can learn more thoroughly on your own in the future
 - and hopefully the intro will make the eventual process easier

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Invitation to Explore

- The labs/projects will not be as "cookbook" as many you have experienced
 - partly because real experimentation is not cookbook
 - partly because the best learning comes when *you* write the recipe
- Allow your natural curiosity to guide you
 - if the lab inspires a question, think of ways to answer the question
 - what could you measure?; how would you measure it?
 - little side-projects may be more valuable to your learning than the "main" task at hand
 - seek help on how to explore further
- Please offer **feedback**: we want you to **learn!**

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Grading Scheme

- What's important is how much you learn: how much you understand; how much you can **do**
 - this is more important than the grade (really!)
- Grades based 80% on labs/projects:
 - completion, success, demonstrated verbal understanding
 - some supporting calculations accompany each project
 - write-up describing the point, the critical concepts, data/results, and what you learned from the experience
 - less structured than cookbook lab reports
 - but **clear communication** is *very* important: do a good job!
- 20% in final exam (exam is academic requirement)
- So: must stay plugged in throughout course
 - late labs (up to a week) only count **HALF** credit

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Resources

- Professor:
 - Tom Murphy; SERF 336; 534-1844;
tmurphy@physics.ucsd.edu
 - Office hours Monday 4–5 PM, or by appointment
- Teaching Assistant:
 - Travis Wong;
tjw006@ucsd.edu
 - Office hours Mon. 10–11 AM AND Tue. 3:30–4:30 PM
- Lab Partner:
 - work cooperatively on lab portion
 - discuss write-up, but must be **your own words/effort**
 - copying text/sections will result in **grading penalty**
- The Lab (MHA 3544/3574):
 - available throughout quarter with ID card access

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Lab Access

- The lab hours are officially 2–6 PM Wed.
 - Travis and I will be present during these times
 - Useful Intro, tips, etc. at beginning of each session
 - Previous week's lab also due by **2PM sharp**
- But you may spend as much time as you like/need to get the job done
 - please coordinate with partner, otherwise problems
- Will borrow ID cards in first lab session to establish access
- Please do not remove equipment from the lab
 - tempting as it is!
 - accidental damage/loss could cause problems

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Website

- The course website is at:
 - <http://physics.ucsd.edu/~tmurphy/phys121/>
- The website resources contain:
 - course syllabus and related course info
 - lectures (PowerPoint and PDF), typically prior to class time
 - information on labs (procedures, write-ups, requirements)
 - supplemental info like datasheets, etc.

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Text

- Building Scientific Apparatus, 3rd or 4th edition
 - by Moore, Davis, Coplan
 - I will specify reading assignments in both editions
- As good a match as one might hope for this class
 - but not perfect overlap, of course
- Decent resource for physics experimentation
 - a wide range of topics, and good pointers to additional resources
- Questions???

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