

The In's and Out's of Graduate School

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Why should I get a PhD?

- I am moved by “external leisure or internal pressures toward learning and research.”¹
- I want to realize the “human need to discover and create, to explore and evaluate and come to understand, to refine and exercise [my] talents, to contemplate, to make [my] own individual contribution to contemporary culture, to analyze and criticize and transform this culture and the social structure in which it is rooted.”²

¹ Wilhelm von Humboldt, “On the Inner and Outer Organization of the Higher Institutions of Learning in Berlin,” parts translated in Marianne Cowan, ed., *Humanist without Portfolio*.

² Noam Chomsky, “The Function of the University in a Time of Crisis,” in the *Great Ideas Today Nineteen Sixty-nine* eds. Rober M. Hutchins and Mortimer J. Adler (Chicago: Encyclopedia Britannica, 1969).

Why should I get a PhD?

- I want to take courses in which “it doesn't matter what we cover, but what we discover.”³
- I want “to come up with new ideas, to question and often undermine what [I] read and [am] taught, and to somehow pick up, by experience and cooperative inquiry, the trick (which no one begins to comprehend) of discerning important problems and possible solutions to them.”⁴

³ Enrico Fermi, private communication.

⁴ Noam Chomsky, “Rationality/Science,” Z Papers Special Issue, 1995.

How do I get in?

- Develop your abilities in physical science:
 - Summer Research Experiences for Undergraduates (REU's)
 - Join a research group as an undergrad!
- What are graduate schools looking for?
- Typical financial package

How do I get out?

Required Courses	Electricity & Magnetism (Jackson) Quantum Mechanics (Sakurai) Statistical Mechanics	Done within first 1 to 2 years of entering
Preliminary Exam	Same topics and level as physics GRE Oral and written parts	Done within first 1 to 2 years
Elective courses	Often involve individual, competitive projects and exams Do not have to be physics courses!	Done within first 1 to 3 years
“Oh that my grief were thoroughly weighed, and my calamity laid in the balances together!” <i>Job 6:2</i>		

How do I get out?

- Find an advisor and join the research group:
 - A mysterious process
 - Done within year or so of preliminary exam
- Qualifying Exam:
 - Mainly oral, may include write-up.
 - Discuss ideas for dissertation.
 - Done within first year or two after joining the research group.
- Dissertation:
 - “Original, individual and complete contribution to knowledge.”
 - Done within one to three years after qualifying exam.

“For now it would be heavier than the sand of the sea: therefore my words are swallowed up.” *Job 6:3*

How do I pay my bills?



■ Funding Options:

- Teaching Assistant (TA) 👍
- Research Assistant (RA) 👍
- Fellowship 👍👍

■ Teaching

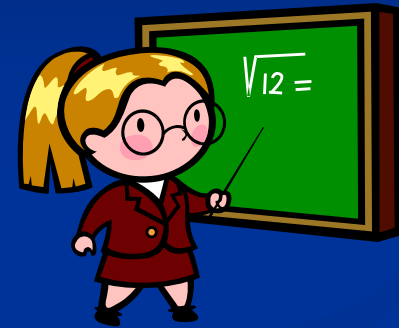
- + Can learn a lot
- + Good Job training
- Takes time
- Repetitive (grading)
- What do you want to do after you graduate?

- Apply for Fellowships! (You always have the option of teaching, but you don't have to)

Teaching

■ Opportunities to develop as a teacher

- TA for a variety of classes
- Curriculum development
- Outreach to local high school



■ Resources

- AAPT (<http://www.aapt.org/>)
- Preparing Future Physics Faculty (pfpf) at UCSD
 - <http://www.ctd.ucsd.edu/programs/pfpf/index.htm>
- Physics Education Research Groups
 - U. Washington, UC, Boulder, U. Maryland, Kansas State University

Becoming a Researcher

■ Research:

- Become familiar with what's been done
- Identify interesting and unanswered questions
- Devise a way to answer the question and carry it out
- Communicate findings



■ Typical Daily Activities:

- Read: Journal Articles. Books.
- Discussions with advisor or other graduate students
- Seminars, Colloquia, Conferences
- Performing calculations, writing code, running simulations
- Taking measurements, maintaining equipment



“The people who lock themselves in a room/lab for 5 years and just do their work are missing out on some of the best parts of grad school (and some of the most important lessons). ... I sometimes learned a lot more by having discussions and tackling problems with my research group-mates (or other grad students/post docs/profs) than I ever would have learned on my own.”

Choosing an Advisor



- Graduate school experiences vary greatly. Your advisor is a key element.
- Choosing an advisor
 - What am I looking for?
 - Talk to potential advisors
 - **Talk to current graduate student**
- Issues to consider (USC Advisor Survey)
 - Expectations (Working hours? Meetings? Hands on/off?)
 - Accessibility (On campus? Communication?)
 - Funding (RAships? Travel? Conferences?)
 - Professional Development (Writing papers? Grants?)
 - Personality

“...one of the most important things is to pick your advisor carefully, this could make or break your experience”

Working with your advisor

- Some tips:
 - Develop short and long term goals
 - Communicate regularly with your advisor
 - Be pro-active
 - Clarify expectations
 - Have multiple mentors (older graduate students, postdocs, other faculty)
- What if it's not working out?
 - Talk to your advisor
 - University Resources - Graduate Student in Residence
 - You can switch!

How Steve spent his time with Gene, 1972-1978*

Topic	Time spent on project	Letter grade
Theory of protostar formation	~ 3 months	Incomplete
Violation of $\Delta v \Delta t > 1$	~ 1 week	Success, but not for credit
Beta decay asymmetry	~ 1 year	Incomplete
Lamb Shift of High-Z ions	~ 1 year	Incomplete
Parity violation in atomic transitions	2.5 years + 2 years postdoc	C -

*Steven Chu, “A Random Walk in Science,” in *Art and Symmetry in Experimental Physics*, ed. D. Budker et.al. (2001).

Why Graduate School in Physics?

- Reasons not to go to graduate school in physics
 - I can't think of anything else to do
 - Aunt M. wants me to
 - My primary goal in life is to be rich
 - I want to work on problems with straightforward solutions
- Reasons to go to graduate school in physics
 - Work with interesting people from all over the world
 - You get paid (not a lot) to learn
 - Flexibility
 - Work is challenging, interesting, varied
 - Advance frontiers of our understanding of physical world

Some Final Thoughts

“Don’t just do it because it seems like the next step. You should think carefully about your choice and be deliberate in your career and choices. Seek out mentors, learn everything you can, take challenging classes (in a variety of topics within your field), but also take time to enjoy the process and being in academia. ...get the most out of it that you can.”

-former graduate student