



FORMALITIES

Eric Prebys, UC Davis



E. Prebys, USPAS, June 4-15, 2018

Accelerator Fundamentals: Formalities 2



Goals of this course

- I hope this course will provide you with...
 - a rigorous foundation of the underlying physics of particle accelerators,
 - Fairly sophisticated understanding of their operations.
 - The background to pursue more advanced studies on your own (or in further classes).
 - a quantitative overview of the state of the art, as well as current and future challenges.
 - familiarity with enabling and related technologies:
 - Magnets
 - RF
 - Instrumentation
 - etc.

 E. Prebys, USPAS, June 4-15, 2018 Accelerator Fundamentals: Formalities  3

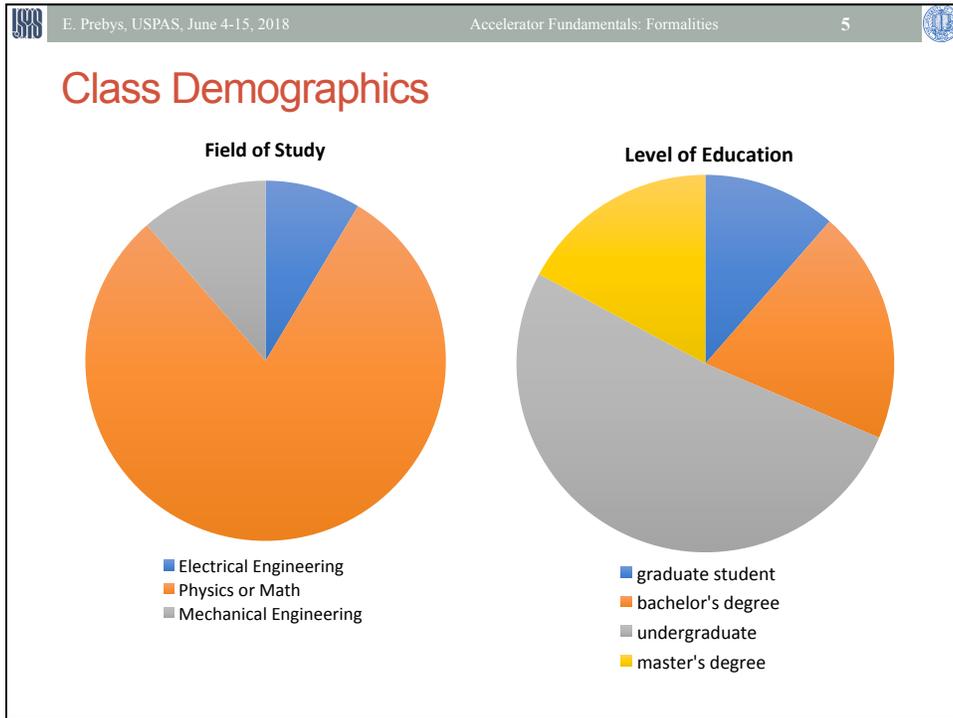
Course Personnel

- Instructor:
 - Eric Prebys, UC Davis, eprebys@ucdavis.edu, 630-336-1893
- Lab Instructors:
 - Elvin Harms, FNAL, harms@fnal.gov
 - Amber Johnson, University of Maryland, ajohns37@umd.edu
- TA:
 - Nicole Neveu, Illinois Institute of Technology, nneveu@hawk.itt.edu
- Graders
 - Laura Boon, lauraeroon@gmail.com
 - Robert Hipple, Michigan State University, hipple@msu.edu
- Course Website (everything gets posted here!):
http://home.fnal.gov/~prebys/misc/uspas_2018/

 E. Prebys, USPAS, June 4-15, 2018 Accelerator Fundamentals: Formalities  4

Some warnings right up front

- This course is intended to cover in two very intense weeks the material that would be in a *full semester* university course
 - That's the mandate; there's nothing I can do about it
- Students have a pretty broad range of backgrounds, so some will struggle more than others, particularly in the beginning.
- If you get behind, you will never catch up!
 - Ask questions
 - Attend help sessions
 - Work together



E. Prebys, USPAS, June 4-15, 2018 Accelerator Fundamentals: Formalities 6

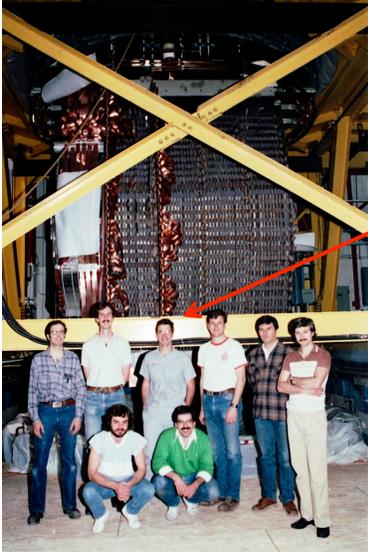
My Background

- 1984: BS in Engineering Physics, University of Arizona
 - Got a job in an HEP group after being fired from a gas station.
- 1984-1990: Grad Student, University of Rochester
 - PhD topic: Direct Photon Production in Hadronic Interactions
- 1990-1992: CERN Fellow, CERN
 - Studied e+e- reactions on the OPAL Experiment at LEP
- 1992-2001: Postdoc and Assistant Professor, Princeton U.
 - GEM Experiment at the Superconducting Super Collider 😞
 - Belle CP Violation Experiment at KEK, Japan
 - Nonlinear QED in E-144 Experiment at SLAC
- 2001-2017: Scientist, Fermilab
 - MiniBooNE short baseline neutrino oscillation experiment
 - Proton Source Department Head
 - Director of LHC Accelerator Research Program (LARP)
 - Mu2e rare muon conversion experiment
 - Created Lee Teng Internship and ran it for 10 years
- 2017-present, Professor, UC Davis
 - Mu2e
 - Director, Crocker Nuclear Laboratory (cyclotron)

Experimental HEP

Accelerator or Physics (mostly)

E. Prebys, USPAS, June 4-15, 2018 Accelerator Fundamentals: Formalities 7




Me

"Buck's River Road Exxon"

Fermilab E-706 Rochester Group
~1987

E. Prebys, USPAS, June 4-15, 2018 Accelerator Fundamentals: Formalities 8

General Plan

- I'm going to spend today on the basics, as well as a fairly qualitative overview of everything we're *going* to learn
 - This will hopefully level the playing field in terms of previous experience and exposure to the concepts
- I'm planning to give an in depth treatment of
 - Transverse motion
 - Strong focusing
 - Lattice functions
 - Longitudinal motion
 - Acceleration
 - Synchrotron motion
- More qualitative treatment of general topics in the field
 - Will mix up the two, to give your brains a rest.

 E. Prebys, USPAS, June 4-15, 2018 Accelerator Fundamentals: Formalities 9 

A note on text

- I chose Edwards and Syphers “An Introduction to the Physics of High Energy Accelerators” as the primary course text because
 - It’s the book I learned from
 - I find the mathematical level appropriate to a broad range of students.
 - It was written by Fermilab people, so it uses conventions that I’m familiar with.
 - It’s the same book I use for the graduate course, but we’ll cover much less of it, and at a less rigorous level.
 - I won’t stick to the order of the book. In particular, like most people who use it, I’ll switch the order of Chapter 2 (longitudinal motion) and 3 (transverse motion)

 E. Prebys, USPAS, June 4-15, 2018 Accelerator Fundamentals: Formalities 10 

Other references

- Edmund Wilson, “Particle Accelerators”
 - A bit lower level than E&S. Often used for this course.
 - Concise reference on a number of major topics
 - Available in paperback (important if you are paying)
- Klaus Wille “The Physics of Particle Accelerators”
 - Same comments
- Wilmut Wiedemann, “Particle Accelerator Physics”
 - Probably the most complete and thorough book around (originally two volumes)
 - Scope very large and mathematical level very high, even for the graduate course.
- Fermilab “Accelerator Concepts” (“Rookie Book”)
 - <http://tinyurl.com/FNAL-concepts>
 - Particularly chapters II-IV

E. Prebys, USPAS, June 4-15, 2018 Accelerator Fundamentals: Formalities 11

Tentative Schedule

- Lecture: 9-12
 - Will lecture in the afternoon a bit today.
- Lunch: 12-1:30
- Labs: 1:30-5:00
- Problem sessions: 7-??
- Homework every day except Friday and next Thursday, to be turned in the next day.
 - Students are encouraged to work together on homework
- In-class exam next Friday.
- As lectures, homework, and other material are ready, they will be put at:
 - http://home.fnal.gov/~prebys/misc/uspas_2018/

E. Prebys, USPAS, June 4-15, 2018 Accelerator Fundamentals: Formalities 12

Course Schedule (very approximate)

Time	Day				
	Mon. (6/4)	Tues. (6/5)	Wed. (6/6)	Thu. (6/7)	Fri. (6/8)
9:00 AM	Lecture: - Formalities - Introduction - Basics	Lecture: - Transverse Motion 1	Lecture - Transverse Motion 2	Lecture: - Longitudinal Motion	Guest Lecture: Nicole Neveu - Linacs
10:00 AM					
11:00 AM					
12:00 AM	Lunch	Lunch	Lunch	Lunch	Lunch
1:00 PM	Lecture (cont'd)	Lab	Lab	Lab	Lab
2:00 PM					
3:00 PM					
4:00 PM					

Time	Day				
	Mon. (6/11)	Tues. (6/12)	Wed. (6/13)	Thu. (6/14)	Fri. (6/15)
9:00 AM	Lecture - Lattice - Imperfections - Insertions	Guest Lecture: Nicole Neveu - Cavity Development - Sources	Lecture - Collective effects - Instability - Colliders and Luminosity	Lecture - Special topics - Requests	In-class final exam
10:00 AM					
11:00 AM					
12:00 AM	Lunch	Lunch	Lunch	Lunch	End
1:00 PM	Lab	Lab	Lab	Lab	
2:00 PM					
3:00 PM					
4:00 PM					



Lecture Style

- All the details of my lectures will be in my PowerPoint slides, which I will copy and hand out (they'll also be available online).
 - There will probably be some mistakes in the slides, which I'll correct in the online version if and when we catch them.
- I will often write on the board simply as a way to pace myself (otherwise, I find I go way too fast). Sometimes this will involve simply copying what's on the slides.
- I'll also work through a lot of problems and examples that aren't in the slides, so that's where you'll want to take notes. I'll copy and distribute any I think are particularly valuable, but don't count on it.
- I used to think that if people didn't ask questions, it's because they understood everything I was saying. Now I know the opposite is true, so if I don't get any questions, I'll keep slowing down until I do.