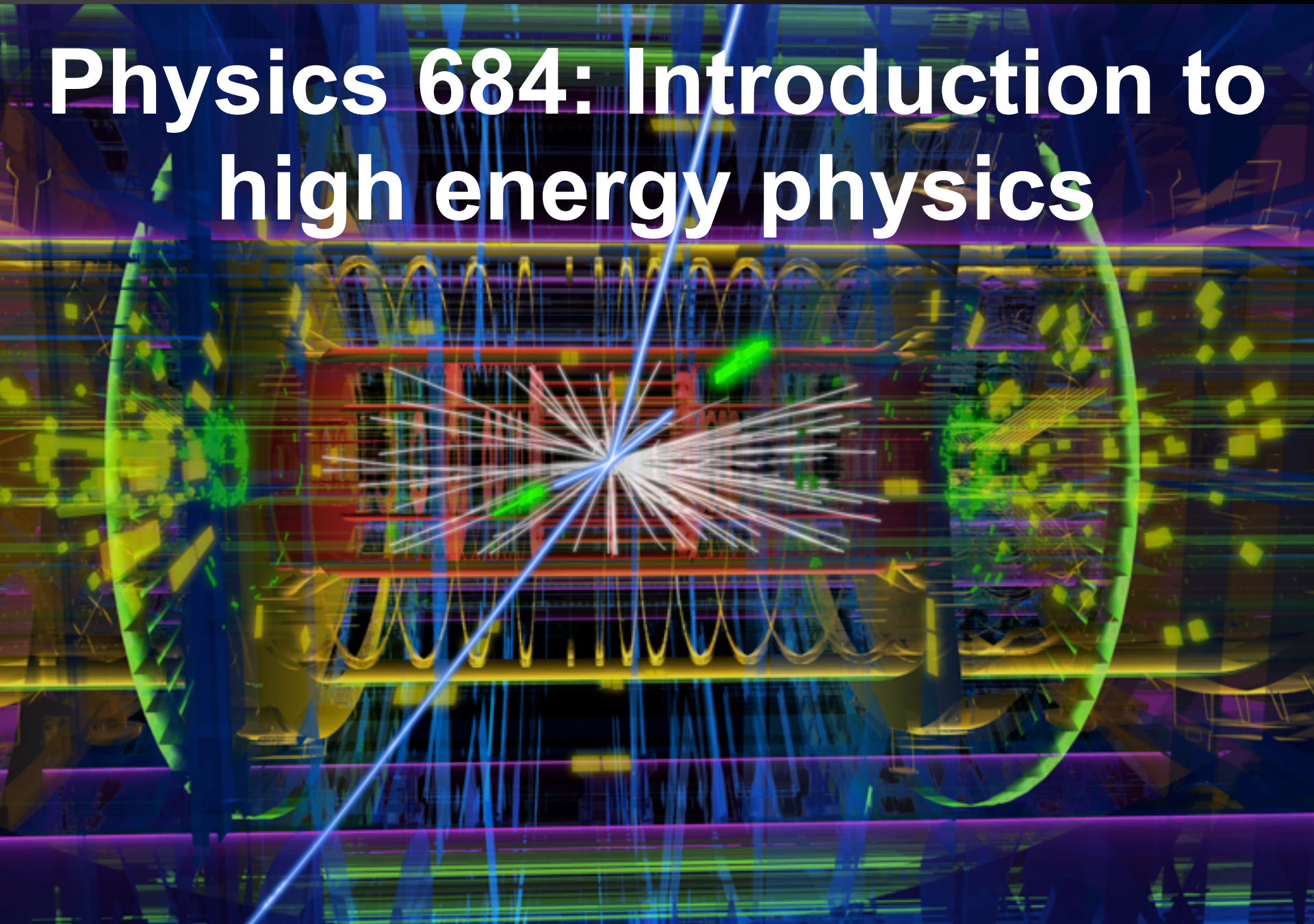
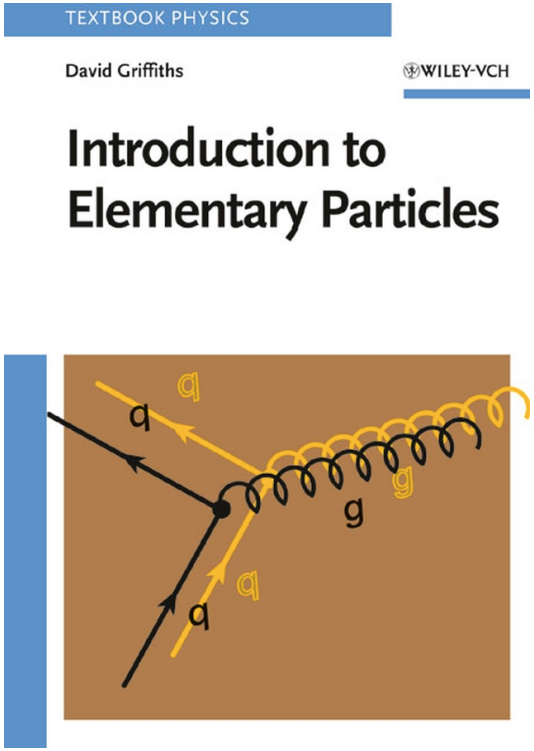
Physics 684: Introduction to high energy physics



Some practical information

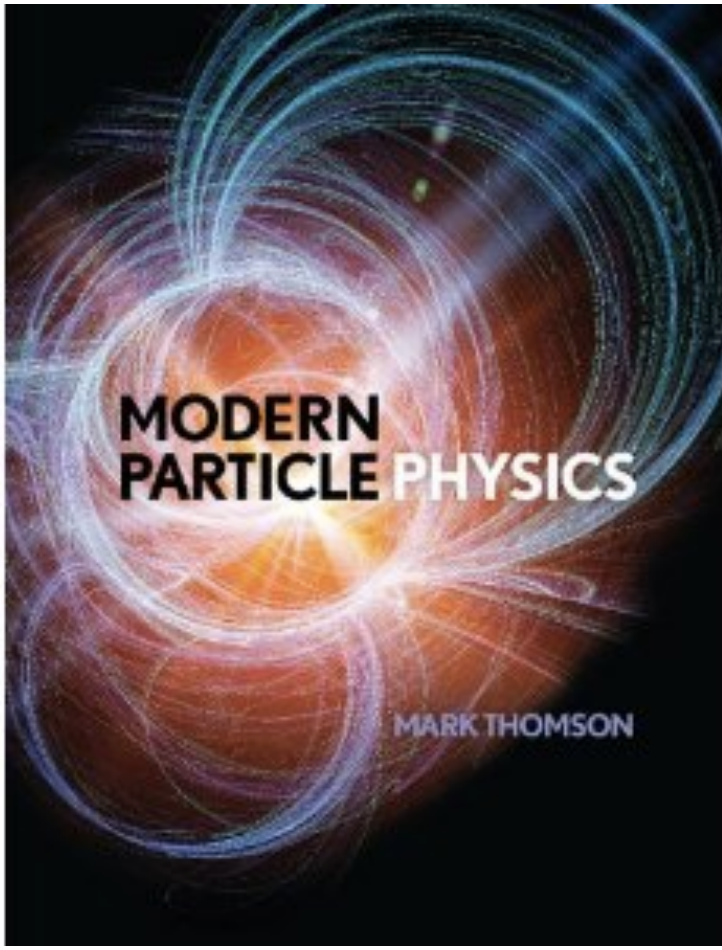
- Monday/Wednesday, 12:30-1:45 pm in Faraday 238 (aka here)
- Griffiths Introduction to Elementary Particles is the required text
  - Expect a good, basic knowledge of quantum mechanics, though we'll hopefully cover everything you need to know
  - Plan on following the book quite closely, with some important exceptions (see next slides)
- Useful formulas and equations and information in appendix at back of book cover



When I will diverge from Griffiths

- In terms of material, it is very well explained, but we'll go a bit more in depth on certain topics (and skip others), and fill in the gaps in between equations
- I'll use slightly different notation (natural units!)
- Will cover detectors a bit
- We'll end with some discussion of "real" LHC analyses

Will also be mined for some extra material



What we will cover (partially following Griffiths)

1. Some history of particle physics
2. Particle dynamics and a Standard Model (SM) overview
3. How do particle detectors work? Modern particle physics experiments
4. Relativistic kinematics
5. On symmetries
6. Bound states
7. Feynman rules
8. Quantum electron dynamics, QED
9. Quantum chromo dynamics, QCD (short version)
10. Weak interactions
11. Gauge theories and the Higgs mechanism
12. "Real" particle physics @ the LHC!

We may have to skip the last 1-2 topics, or if all goes well, we'll add some extra material on neutrino oscillations

With roughly 1 problem set per 1-2 topics above

Grading

- Problem sets every 1-2 weeks, each with the same weight: combined total, 70% of grade
  - All to be due 1 week after they are given, in class, after assignment
  - To be distributed after we finish 1-2 chapters/topics
  - Start the HW early! If you get stuck and need help, please come by during office hours
  - Please ask for help if you don't understand solutions after they are posted (we'll briefly go over them in class, but not over everything)
- Final presentation: 30% of grade
- Late homework/exams NOT accepted without valid note or excuse (for sure not if you don't talk to me as soon as possible)

Final exam

- Final will be a bit different than the usual exam, and will be focused more on “real” particle physics
  - Based on presentations in class (your presentation, and the questions you ask of others during their presentations)
- Dates and schedule TBD

30% of total grade

Grading

- After weighting problem sets and final presentation, the grades will be:
  - A: 93-100%
  - A-: 87-93%
  - B+: 82-87%
  - B: 74-82%
  - B-: 67-74%
  - C+: 60-67%
  - C: 55-60%
  - D: 50-55%
  - F: 50% or less

I reserve the right to shift this scale, but only in the direction that helps you

On homework

- I don’t want to keep you from working with others, but any work that you hand in must be your own
  - Solutions found on the web are a form of plagiarism
    - **THESE EXIST AND HAVE TYPOS THAT I CAN RECOGNIZE!**
  - “Can I copy your solutions?” are also plagiarism
  - And “Tell me the Answer” is academically dishonest, as well
    - You will anyway not get credit for answers without showing your work
  - I do want you to help your classmates, however... and don’t forget that office hours are there for those who need assistance, too

Office hours

- Office hours (Faraday 219): Monday 10:00-10:45 am, Friday 12:00-2:00 pm, or by appointment
  - I'm happy to chat after class, too, of course
  - I may spend time at CERN or Argonne (or be traveling or working from elsewhere), so if you want to meet at any time other than during the set office hours please e-mail me (jahred.adelman@niu.edu) to set up an appointment
    - You can always try and stop by, but you will have better luck if you set up an appointment

The class

- Roughly once a week, I will try and post previous slides on the class website for you
  - http://nicadd.niu.edu/~jahreda/phys684_spring2020/
  - Should not be considered a substitute for attendance, but can hopefully help you in preparations for homework
  - Goal: You should not be worried about copying down every formula, but rather instead be focused on paying attention
  - **Syllabus located on course website**
- We may also work out some problems together in presentations here or on blackboard/whiteboard
  - So you can see that I can also get stuck :)

Write this down now :)

Attendance

- Please come to class (shouldn't need to ask this of you, but I state it anyway)
  - You can't hand in homework without being here
  - The problems that we go over will be important to follow and understand
  - I am not taking attendance - but this course should be fun, and you will not learn as much if you don't come to class

The classroom

- Please avoid loud food in the classroom
  - I know it's lunchtime, but the goal should be to avoid distracting others
  - Again, it's not Physics 101 so I hope it's not a problem. If you do eat something and it's not distracting, I won't say anything
- Cell phones need to stay in your pocket and be turned off
  - If your phone rings, we will know it was you (this class is that small)
  - If you have family or others personal issues - keep your phone on vibrate if possible, and if you need to take a phone call, step out of the classroom quietly

Seems silly, but mostly - be respectful!

About me … and you

- I am indeed a particle physicist working on measurements of and searches for new physics with Higgs bosons using the ATLAS experiment at the LHC (at CERN)
  - I'll try and point out my research during the class, as appropriate

NIU@CERN! (Your professor wasn't at CERN for that photoshoot)

About me ... and you

- I'll try to update my teaching style as the semester goes on, based on my experience, observations and your feedback
  - If I am going too fast... or too slow, or if my style (or hand-writing) is incomprehensible, please speak up

One last topic

We are small enough - time to introduce yourselves (and apologies in advance when I forget your name)