Supplementary Reading Suggestions

General remarks

The official textbook for the course is Griffiths' "Introduction to Elementary Particles", but I won't be following it at all closely. I've indicated, in the following topics breakdown, which parts of Griffiths are most relevant. I also suggested Cheng and Li's "Gauge Theory of Elementary Particle Physics". It is more advanced and theoretical, but well grounded and suitable for selective reading (that is, you can put off the hardest parts until you're ready for them, or indefinitely). It also comes with a nice problem book.

My goal in the lectures will be to give you a conceptual framework and overview of the subject. I will not go into technical derivations in quantum field theory, though I'll review some key recipes, especially simple Feynman rules and Dirac algebra, in a formally self-contained way. To really become fluent in this material, there's no substitute for practice. You'll get some of that in working through the "Studies", but you should also do some exercises in Griffiths and/or Cheng and Li. I'll be happy to help you with questions that arise.

There's much more to becoming a practicing particle physicist than listening passively to lectures (or even seminars). You should also explore the literature. I've made a few special suggestions below for the early topics, and I'll update with more as we proceed. Two general sources deserve special mention.

The Particle Data Book, and especially the reviews you can access from pdg.lbl.gov/2013/reviews/contents_sports.html (yes it really does say "sports", I have no idea why!), are a goldmine of up-to-date information, presented concisely by experts and lavishly referenced. See especially the mini-reviews under the heading "Standard Model and Related Topics". I won't reference those again separately below, but you should definitely consult the corresponding ones as we proceed (e.g. "QCD" when we discuss the strong interaction, "Quark Model", etc.). You'll also find that the bits on oscillations and on structure functions are most relevant to the first two studies.

Wikipedia has many good articles that introduce most major concepts in and around the Standard Model. Of course it doesn't aspire to maximal completeness or depth, but usually you'll also find links appended, which can lead you to more expansive sources.

Note: This file will be updated regularly, as we approach the presentation of the different topics.

History of Particle Physics

Consult Griffiths chapter 1

The two-volume text and reprint collection "World of the Atom" by Henry Boorse and Lloyd Motz are two of my very favorite physics books, or just plain books for that matter. They present a very broad perspective on the development of scientific understanding of matter up to about 1960, with substantial selections from original sources and intelligent commentary. I've gone back to them many times. If you have any interest at all in the history of science or the nature of matter you will love these books. (And if you don't, God bless you.)

Steven Weinberg's "The Discovery of Elementary Particles" has a much narrower focus, but does what it does very well.

Richard Rhodes' "The Making of the Atomic Bomb" is a truly great book. Besides narrating a epochal historic episode, it contains a lot of good, clearly presented nuclear physics! I won't be discussing that material in the course, but every physicist, and for that matter any cultured human being, should read Rhodes' book as a young adult.

I also recommend my introduction to Rutherford's "Radioactive Transformations": bit.ly/17ejkwO and this piece on the Dirac equation: bit.ly/17EFdnY.

Units and Magnitudes

This is usually not treated as a separate subject. The Particle Data Book has useful tables. Mathematica also has handy functions for doing conversions.

For the philosophy of unit systems and its connection with the notion of fundamental constants, see especially my paper arxiv.org/pdf/0708.4361v1.pdf

Survey of Particles and Conservation Laws

Consult Griffiths chapters 2, 4

Wigner's fundamental paper on representations of Poincare symmetry: Wigner, E. P. (1939), "On unitary representations of the inhomogeneous Lorentz group", Annals of Mathematics 40 (1): 149204. (Profound, but not an easy read.)

Survey of Strong Interactions and QCD

Consult Griffiths chapter 8

My Nobel lecture: www.nobelprize.org/nobel_prizes/physics/laureates/2004/wilczek-lecture.html (contains both video and the write-up)

Survey of Weak Interactions and Electroweak Theory

Consult Griffiths chapter 9

Survey of Flavor Physics

There is surprisingly little about this in Griffiths. Chapter 11 discusses an important, representative subtopic (neutrino oscillations). Consult also the scattered bits you get by following the index entries "CKM matrix", "Flavor", and "Flavor Dynamics".

Feynman graph recipes

Consult Griffiths chapters 3 (relativistic kinematics), 6, and 7, and Appendices B. I will be presenting this material rather schematically and basically as as recipes, illustrating their use in worked examples. You'll get much more out of it if you do significant reading beforehand!

Quark Model

Consult Griffiths chapter 5.

Study 1: Deep Inelastic Scattering

Consult Griffiths chapter 8

Study 2: Oscillations: K Mesons and Neutrinos

Consult Griffiths 4.4 and 11.

Gauge Theory: Principles

Consult Griffiths chapter 10

Gauge Symmetry: SU(3)xSU(2)xU(1)

Survey of Dimension Counting and Renormalizability

The Grand Normalization Theorem

Consequences of the GNT for Flavor and Neutrino Physics

Study 3: Higgs Particle - Higgs Sector?

Consult Griffiths 12.1

Broad, non-mathematical perspective on Higgs discovery: bit.ly/16yt8A2