

**Fall Semester 2009 Particle Physics Directed Reading  
Syllabus**

**Textbook** - Introduction to Elementary Particles - Griffiths

**Other Texts** - Modern Particle Physics - Halzen and Martin

**Boccio Notes on Website:**

[http://chaos.swarthmore.edu/courses/Physics093\\_2009/index.html](http://chaos.swarthmore.edu/courses/Physics093_2009/index.html)

**Week 1: Quick History - Chapter 1**

The Actors in this Drama  
Eightfolds and Quarks  
November Revolution  
W's and Z's  
Standard Model

**Elementary Particle Dynamics - Chapter 2**

Four Forces  
Q(uantum)E(lectro)D(ynamics)  
Q(uantum)C(hromo)D(ynamics)  
ElectroWeak  
Decays and Conservation Laws  
Unification Attempts

**Lecture on Second Quantization**

**Weeks 2: Relativistic Stuff - Chapter 3**

Four Vectors  
Energy and Momentum  
Collisions and Reactions

**Lecture on Second Quantization(continued)**

**Lecture on Relativistic Electrodynamics**

**Weeks 3-4: Symmetries - Chapter 4**

Group Theory  
Angular Momentum  
Flavor  
C(harge)P(arity)T(ime reversal)

**Lectures on Group Theory**

**Week 5: Bound States - Chapter 5**

Hydrogen, Positronium and Quarkonium  
Quark and Baryon Masses

**Lectures on Relativistic Wave Equations and  
Absorption and Emission of Photons**

**Week 6: Lectures on Relativistic Wave Equations and  
Absorption and Emission of Photons**

**Weeks 7-13: QED of Electrons and Photons - Chapters 6 & 7**

Feynman Diagrams and Calculus  
Decays and Scattering; Decay Rules  
Golden Rules, Lifetimes and Cross Sections  
Two-particle Decays  
Feynman Rules, Diagrams and Calculus  
Calculations in a Toy Theory  
Higher-order Diagrams  
Dirac Relativistic Equation for Electron  
Solutions and Properties  
The Photon  
Feynman Rules for QED  
Examples  
Calculation Tricks  
Some Real Calculations  
Fixing it all up via Renormalization

**Lectures on Quantum Electrodynamics**

Our goal will be to gain an understanding of what is going on in this most exciting of fields of physics.

We will not be able to prove many things since some of the mathematics is at too high a level, but we will be able to understand the ideas and how it all fits together and what it all means.

We will do some calculations, but our goal will not be to become experts at nitty-gritty calculating.

**Bocchio lectures will cover:**

- (1) Special Relativity and Relativistic Electrodynamics
- (2) 2nd Quantization
- (3) Relativistic Wave equations

Electromagnetic Radiation and Matter

- (4) Interacting Fields and Feynman Diagrams - The Concepts
- (5) Quantum Field Theory 1
- (6) Quantum Field Theory 2
- (7) Quantum Field Theory 3
- (8) Quantum Field Theory 4
- (9) Quantum Field Theory 5

You will have a few problems each week along with readings.