

Physics 152A/252A: Introduction to Particle Physics (I)

Winter 2009

Course Time & NEW Location: Mon. + Wed., 4:15pm–5:30pm, Building 240, Room 110

Instructor: Lance Dixon

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course web page: <http://www.slac.stanford.edu/~lance/phys152A/>

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office hours / discussion session: TBD

This course is part I of a two-quarter series. The second part will be taught by Helen Quinn in the Spring. The main goal is to give you a familiarity with the Standard Model of elementary particles and their interactions, as well as some of the experimental methods and results that have led to this framework. Open questions and missing pieces may be discussed as well.

Textbook:

Introduction to Elementary Particle Physics, by Alessandro Bettini.

This book covers some experimental methods and historical development as well as developing the Standard Model. The book should be available at the Stanford Bookstore by about Wed., Jan. 7. (There was a miscommunication in ordering it.) For a more theoretically rigorous approach, see Griffiths.

Other References:

- *Introduction to Elementary Particles*, by David Griffiths.
The first edition is widely available; the second edition just came out in 2008.
- *The Experimental Foundations of Particle Physics*, by Robert Cahn and Gerson Goldhaber. This book contains a collection of experimental papers, as well as text commenting on them. The first edition has been out for many years. The second edition is not quite out yet, but

I have permission from the authors to distribute the text to students (provided that we notify them of any errors!).

Some topics to be covered in part I:

- Overview of the elementary constituents of matter (quarks and leptons) and the fundamental forces between them (electromagnetic, weak and strong)
- Relativistic kinematics and collisions; cross sections and decay rates
- Interaction of particles with matter; particle acceleration and detection techniques
- Symmetries and conservation laws
- Hadrons as bound states of quarks
- Feynman diagrams
- Introduction to Feynman integrals
- The Dirac equation
- Feynman rules for quantum electrodynamics and for chromodynamics
- Deep inelastic scattering
- Asymptotic freedom and confinement
- Properties of quantum chromodynamics at high energies: jets

Grading plan:

- 50% homework (1 problem set approx. every week)
- 20% class project (discuss a paper from the literature)
- 30% final exam.