SPECIAL TOPICS IN ELEMENTARY PARTICLE PHYSICS

Beyond the Standard Model

Physics 481

KPTC 105 9:00 – 10:20 a.m. [1]

Tuesdays and Thursdays – Fall Quarter 2007

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Within the past forty years remarkable success has been achieved in describing a wide range of elementary particle phenomena using the color SU(3) and electroweak SU(2) $\times$ U(1) gauge groups. This course will survey some key suggestions for physics beyond this so-called "Standard Model." One seeks to answer such remaining questions as the origin of fermion masses (including tiny neutrino masses) and mixings, the mechanism of electroweak symmetry breaking, the possibility of electroweak–strong unification, and the origin of the dark matter that pervades the Universe.

The course will rely heavily on student presentations based on literature sources which will be indicated ahead of time. Students may express preferences for presenting specific topics listed below. The grade for the course will be based on class presentations (25%), problem sets (50%), and a final project (25%). Suggestions for the final project will be given during October.

Week	Dates	Subject
1	9/25, 9/27	Introduction; standard electroweak model
2	10/2, 10/4	Quark mixing; neutrino oscillations
3	10/9, 10/11	Neutrino oscillations: atmospheric; solar
4	10/16, 10/18	High mass scales: neutrinos; parity restoration
5	10/23, 10/25	Extended grand unified theories: Extra Zs and fermions
6	10/30, 11/1	Electroweak symmetry breaking: Technicolor; compositeness
7	11/6, 11/9	Higgsless models; extra dimensions
8	11/13, 11/15	Supersymmetry in theory and practice
9	11/20 (1)	Dark matter
10	11/27, 11/29	Experiments for the next decade

(1) No lecture on 11/22 (Thanksgiving).

[1] First meeting: 9:00 a.m., Tuesday, Sept. 25.

READING LIST

1. Available on the Web: J. Rosner, "The Standard Model,"
   `http://hep.uchicago.edu/~rosner/lects.pdf`

2. Useful for students with a theoretical background: *An Introduction to Quantum Field Theory*, by Michael E. Peskin and Daniel V. Schroeder, Addison-Wesley, 1995, ISBN: 0-201-50397-2.

3. Useful for students with an experimental background: *Quantum Field Theory*, by F. Mandl and G. Shaw, Wiley-Interscience, 1984, ISBN: 0 471 90650 6 (paper).

4. Useful supplementary text: *Gauge Theories of the Strong, Weak, and Electromagnetic Interactions*, by Chris Quigg, Benjamin/Cummings, 1983, ISBN 0-8053-6020-4 (also available in paperback).

5. Useful supplementary text: *Journeys Beyond the Standard Model*, by Pierre Ramond, Perseus Books, 1999, ISBN 0-7382-0116-2.

6. Useful supplementary text: *Heavy Flavour Physics*, Proc. 55th Scottish Universities Summer School, St. Andrews, 7–23 Aug 2001, edited by C. T. H. Davies and S. M. Playfer, Institute of Physics, 2002, ISBN 0-7503-0867-2 (paper).