Syllabus - PHYS 592

1. Electroweak neon; Spontaneous Symmetry breaking
2. Renormalization Group
3. Strong Interactions
4. Grand used theories and Theories Beyond the Standard Model.

Physics 592 will explore in depth the held theoretic basis of the Standard Model of particle physics and some of its most important extensions.

The course will bed with the concepts of global and local (gauge) symmetries in field theory processing into a detailed treatment of general Yang Mills theories.

The fundamentals of the theory of compact

Lie Groups and their representations will be presented

This will be followed by a discussion of quantization of gauge theories including gauge fixing, ghosts, Ward identities and unitarity.

The Higgs mechanism will be explored, first in the context of the Abelian Higgs model, then in the context of Yang Mills theories.

All these concepts did be applied to the construction of the Lagrangian for the standard SU(2)xU(1) model of electroweak interactions.

Phenomena to be covered include quark mixing, flavor changing neutral currents and CP violation.

The second part of the course will deal with renormalization and regularization. The ideas of running couplings and masses will be emphasized.
Radiative corrections to quantities will be explored as tests of the Standard Model.

The third section will deal with the theory of strong interactions.
The basics of the quark model and chiral symmetry be explored, including soft pion theorems and chiral symmetry breaking. The QCD Lagrangian and its symmetries will be discussed, and renormalization group techniques

applied to understanding scaling laws and their violation. The basics of perturbative QCD will be presented. The section will conclude with a discussion of instantons the U(1) problem, the strong CP problem, and the Peccei-Quinn mechanism.

Finally, the course will move beyond the standard model to Grand Unified Theories in particular SU(5) and S0(10).
New phenomena such as baryon number violation, proton decay and monopoles did be emphasized. The Gauge Hierarchy Problem will be used to lead into a discussion of Supersymmertry, including superfields, superpotentials and Supersymmetry breaking.
The phenomenology of the Minimal Supersymmetric Standard Model (MSSM) will be developed, including tests of low-energy supersymmetry. Time permitting, there will be a brief introduction to dynamical symmetry breaking and the ideas of technicolor.
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