

Lecture 2

Master Particle Physics I

Marcel Merk

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Standard Model for particles

Fermions (Spin 1/2 particles) :The basic constituents of matter

Quarks:

$$\begin{pmatrix} \text{u} & \text{u} & \text{u} \\ \text{d} & \text{d} & \text{d} \end{pmatrix} \begin{pmatrix} \text{c} & \text{c} & \text{c} \\ \text{s} & \text{s} & \text{s} \end{pmatrix} \begin{pmatrix} \text{t} & \text{t} & \text{t} \\ \text{b} & \text{b} & \text{b} \end{pmatrix}$$

Quarks only occur in colour neutral objects: “Hadrons”

Baryons: qqq

Mesons: $q\bar{q}$

⇒ Hadron particles occur in multiplets

Leptons:

$$\begin{pmatrix} \nu_e \\ e^- \end{pmatrix} \quad \begin{pmatrix} \nu_\mu \\ \mu^- \end{pmatrix} \quad \begin{pmatrix} \nu_\tau \\ \tau^- \end{pmatrix}$$

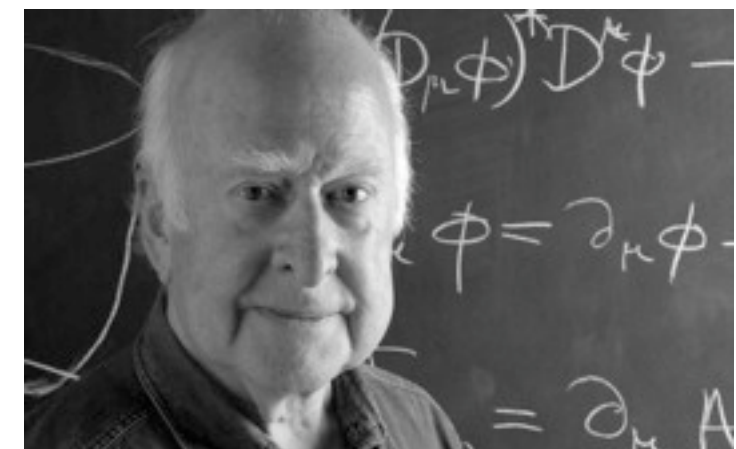
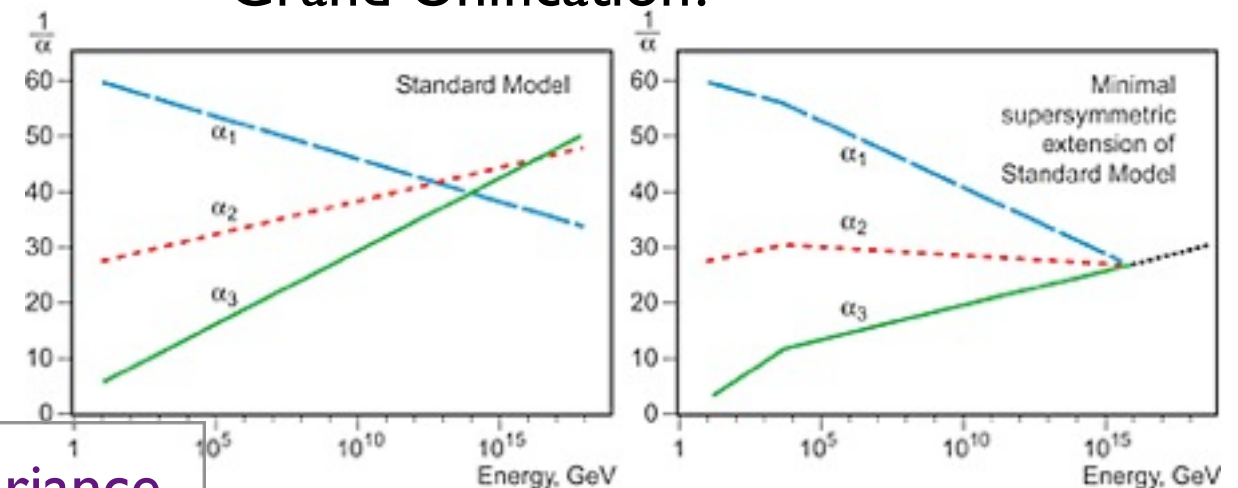
Only 3 generations of fundamental particles are known

Vector Bosons (Spin 1 particles). force carriers

Strong interaction	8 gluons
Weak interaction	W^+ W^- Z^0
Electromagnetic interaction	γ
Gravity	g

⇒ Forces originate from principle of local gauge invariance

Grand Unification?



Scalar Boson (Spin=0 particle).

Generates fermion masses via the Higgs mechanism

Lectures PP I

L0 : Introduction

L1 : Particles and Fields (historical overview)
L2 : Wave Equations and Antiparticles
L3 : The Electromagnetic Field
L4 : Perturbation Theory and Fermi's Golden Rule
L5 : Electromagnetic Scattering of Spinless Particles

QED of Spinless Particles:
Scattering Theory and
Cross Sections

L6 : The Dirac Equation
L7 : Solutions of the Dirac Equation
L8 : Spin 1/2 Electrodynamics

QED for
Fundamental Fermions

L9 : The Weak Interaction
(Fermi 4-point scattering: an analogy with QED)
L10: Local Gauge Invariance
(the role of symmetries in interactions)
L11: Electroweak Theory
L12: The Process: $e^+e^- \rightarrow \gamma, Z \rightarrow \mu^+\mu^-$

The Standard Model for
massless particles
 $SU(2)_L \times U(1)_Y$