

- UNDER STAND GeV GeV/c etc.

$$e^2 = \frac{hc}{137} \leftarrow 197.3 \text{ MeV. fm.}$$

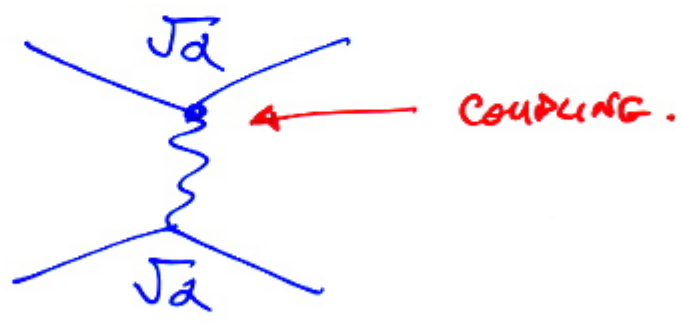
- 4-VECTOR CALCULATIONS

CM \leftrightarrow LAB

INVARIANT MASS

- DECAY $N = N_0 e^{-t/\tau} \quad (e^{-x/\lambda})$

- FEYNMAN DIAGRAMS



$$\text{AMPLITUDE} = \sum \text{PATHS}$$

• ANTI PARTICLES

• QM + SPECIAL RELATIVITY



• ACCELERATORS

• LINAC

• REUSE VOLTAGE — CIRCULAR

• CYCLOTRON
+ VARIANTS

• SYNCHROTRON

• ELECTRONS ↔ HADRONS
(PROTONS)

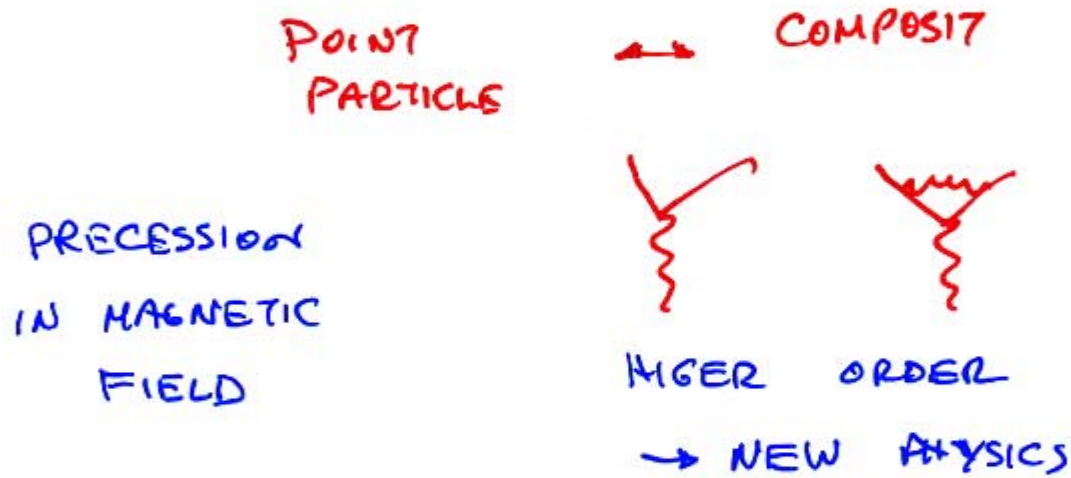
BREMSSTRAHLUNG.

~~R~~ RADIUS $\sim \frac{p}{B}$

• ANGULAR MOMENTUM & SPIN

- QUANTIZATION
- COMBINATION
- INTRINSIC ANGULAR MOMENTUM

• MAGNETIC MOMENTS



• PARTICLE CLASSIFICATION

- SPIN
- MASS
- LEPTON FLAVOUR

QUARKS, LEPTONS, MESONS, BARYONS
GAUGE BOSONS

DECAYS

- DECAY LAW

$$N = N_0 e^{-t/\tau}$$
- BREIT-WIGNER
- RESONANCE
- INVARIANT MASS

$$\Delta M \cdot \Delta E \sim \hbar$$

HADRONIC STRUCTURE

- MAGNETIC MOMENT
- FORM FACTOR $F(q^2)$
- STRUCTURE FUNCTIONS $F_1(x) F_2(x)$
- QUARK / PARTON MODEL

$$\sigma \sim \sum_i (q_i)^2$$

\leftarrow FLAVOURS OF QUARKS

• CROSS SECTION CALC

$$N_S = FN\sigma_{TOT}$$

$N = a \cdot nd$

$$n = \frac{NA \cdot \rho}{A}$$

• WHY ARE QUANTUM NOS CONSERVED

SYMMETRIES, INVARIANCE

- CONTINUOUS XFORMS

LOCAL

• U(1) GAUGE INVARIANCE

↑ EM FORCE

• ADDITIVE QUANTUM NOS

eg ELECTRIC CHARGE

↑ GLOBAL GAUGE INVARIANCE

• DISCRETE SYMMETRIES

P, C, T

• WHAT THESE DO

• EXPERIMENTS

• PARITY VIOLATION

• $\gamma \bar{\nu}$

• CP

CP EIGENSTATES

$K_1^0, K_2^0, K_L^0, K_S^0$

• STRANGENESS OSCILLATIONS / MASSES

• FLAVOR MIXING

$$\begin{pmatrix} u \\ d \end{pmatrix}_{\text{WEAK}} \neq \begin{pmatrix} u \\ d \end{pmatrix}_{\text{MASS = STRONG}}$$

$$\begin{pmatrix} u \\ d \cos\theta + s s \sin\theta \end{pmatrix}_{\text{WEAK}} \quad \begin{pmatrix} u \\ d \end{pmatrix}_{\text{MASS}} + \begin{pmatrix} c \\ s \end{pmatrix}$$

$$\begin{pmatrix} d \\ s \end{pmatrix}_{\text{WK}} = \begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix} \begin{pmatrix} d \\ s \end{pmatrix}_{\text{MASS}}$$

3 GENERATIONS

$$\begin{pmatrix} d \\ s \\ b \end{pmatrix}_{\text{WK}} = V_{\text{CKM}} \begin{pmatrix} d \\ s \\ b \end{pmatrix}_{\text{MASS}}$$

3 GENERATIONS CP PHASE

2 GENERATIONS NO CP PHASE