

Outline

■ Relativistic Kinematics

- ▶ (4-momentum)² invariance, invariant mass
- ▶ Hypothesis testing, production thresholds
- ▶ Cross-sections, flux and luminosity, accelerators
- ▶ Particle lifetime, decay length, width

Today

■ Classification of particles

- ▶ Fermions and bosons
- ▶ Leptons, hadrons, quarks
- ▶ Mesons, baryons

- [Lecture 13 \(4 slides/page\)](#) - Quark flavour conservation, CKM matrix
 - Griffiths, pp. 74-77, 324-329.
 - Williams not the best for this topic

■ Quark Model

- ▶ Meson and baryon multiplets
- ▶ Isospin, strangeness, c, b, t quarks

■ Particle Interactions

- ▶ Colour charge, QCD, gluons, fragmentation, running couplings
- ▶ Strong and weak decays, conservation rules
- ▶ Virtual particles and range of forces
- ▶ Parity, charge conjugation, CP
- ▶ **Weak decays of quarks**
- ▶ Charmonium and upsilon systems

Previous
lecture

■ Electroweak Interactions

- ▶ Charged and neutral currents
- ▶ W, Z, LEP experiments
- ▶ Higgs and the future

- [Lecture 12 \(4 slides/page\)](#) - Strong and weak decays, conservation rules
 - Griffiths, pp. 66-71, 79-82, 84-85.

■ LHC Experiments

■ Future - introduction to accelerator physics

Strange Particle Production

- Properties of **SI**, **WI** important in **production/decay** of strange and heavier quarks
- **Production** requires **strong** (or EM) to give large cross-section. Requires **ss** production to conserve strangeness
 - ▶ Strange hadrons created in pairs - so-called "associated production"
- SI decay 13 orders magnitude faster than WI, so WI decays only observed when SI/EM forbidden by (e.g.) flavour conservation rules.
- Heavier strange hadrons (i.e. excited states) decay to lighter strange hadrons by SI
 - ▶ Conserves flavour and other quantum numbers
 - ▶ Typical lifetime of strong decays $\sim 10^{-22}$ - 10^{-23} s, called resonances
- Process continues until arrive at **lightest** strange hadrons (kaons), which are **stable** under SI because of **strangeness conservation**