Outline

- Relativistic Kinematics
  - (4-momentum)2 invariance, invariant mass
  - Hypothesis testing, production thresholds
  - Cross-sections, flux and luminosity
  - Particle lifetime, decay length, width
- Classification of particles
  - Fermions and bosons
  - Leptons, hadron
  - Mesons, baryon
- Quark Model
  - Meson and baryon multiplets
  - Isospin, strangeness, c, b, t quarks
- Particle Interactions
  - Virtual particles and range of forces
  - Strong and weak decays, conservation rules
  - Parity, charge conjugation, CP
  - Weak decays of quarks
  - Colour charge, QCD, gluons
  - Charmonium and upsilon systems
- Electroweak Interactions
  - Charged and neutral currents
  - W, Z, LEP experiments
  - Higgs and the future
- LHC Experiments
- Future – introduction to accelerator physics

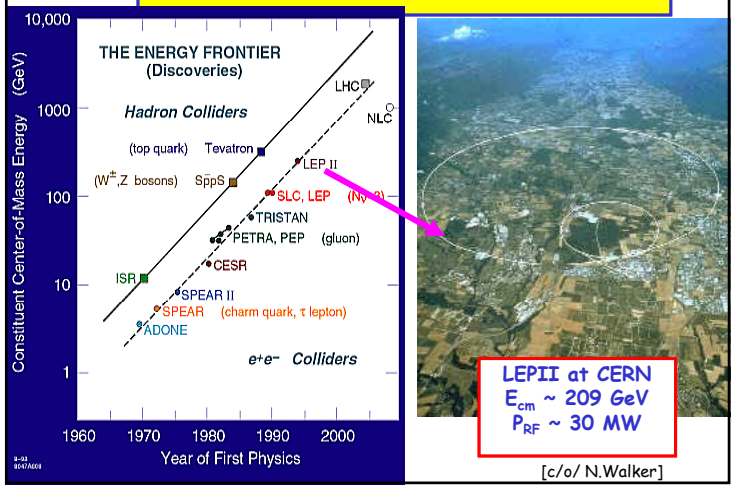
Today

- Lecture 3 (4 slides/page) - Particle decays and hypothesis testing
  - Bubble Chamber web (CERN/G.T.Jones)
  - Kinematics from PDG, J. Beringer et al. (Particle Data Group), Phys. Rev. D86, 010001 (2012)

Previous lecture

- Lecture 2 (4 slides/page) - Relativistic kinematics and four momenta
  - Griffiths, pages 89-103
  - Williams, page 159
  - Handout on kinematics and units
  - Units: see also Perkins (3rd edition), pg.25.

"Energy Frontier" Accelerators



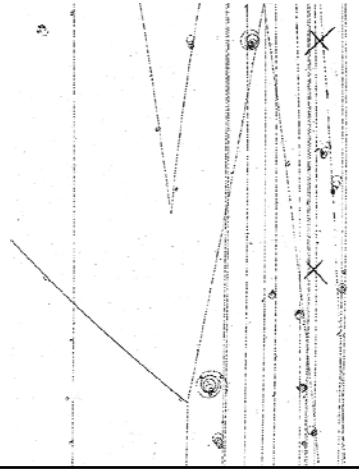
LEPII at CERN
E_{cm} ~ 209 GeV
P_{RF} ~ 30 MW

[c/o/ N.Walker]

Bubble chambers

- Liquid (e.g. H_2) at high pressure, ~several atm.
- Pressure reduced as beam arrives (superheated)
- Ionisation along charged particles' trajectories causes boiling
- Bubbles form for ~ms
- Flash photographs, multiple angles, 3d-reconstruction
- Increase pressure and repeat
- Slow to accumulate data
- Iconic, full angular coverage for detection

Decays in bubble chamber



- Deduce momenta of charged particles by curvature in known and uniform magnetic field
- Reconstruction of neutrals from charged decay products
- Many detailed examples from course web page, incl. interactive demos.
- Worth a visit.