PHYSICS 198-620B

Experimental Techniques in Sub-Atomic Physics

CALORIMETRY

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DAY 1

1. Introduction
   - Principle
   - Particle detection
   - Properties
2. Electromagnetic showers
   - Energy losses e and attenuation γ
   - Critical energy E_c
   - Radiation length X_0
   - Shower examples and models
   - Data vs Simulations: logitudinal and lateral distributions
   - Energy measurements
3. Electromagnetic calorimeters
   - Energy resolution vs different types
   - Fully active calorimeters
     - Examples, shower leakage
     - Properties and performances
   - Sampling calorimeters
     - Ionization techniques
     - Intrinsic sampling fluctuations
     - Performances
     - Scintillation techniques
     - Wavelength shifter readout
     - Trigger signals
     - Time response

DAY 2

4. Hadronic showers
   - Strong interaction and elementary processes
   - Longitudinal distributions
   - Shower model
   - Distributions from induced radioactivity
   - Lateral distributions
   - Shower components, examples
   - Intrinsic e/h ratio: compensation, energy resolution
5. Hadronic calorimetry
   - Dissipation of energy
   - Hadronic shower processes
   - mip, e/mip, γ/mip, p/mip
   - Binding energy loss
   - Neutron cross section
   - Signal amplification
6. Hadronic calorimeters
   - Compensation
     - Methods, saturation effects
     - Neutron response, n/mip
     - e/h ratio vs calorimeter type
   - Hadronic energy resolution
     - n and γ resolutions
     - Binding energy loss
     - Resolution vs calorimeter type
   - Shower containment
   - Radiation damage
7. Particle identification
   - Detection
   - Longitudinal information
     - Additional Si-diode sampling
   - Lateral information

EXAMPLES

8. Review of calorimeters
   - DØ, H1, GEM, ATLAS, SLD, RD1, SDC, CDF
9. ZEUS calorimeters
   - Physics at HERA
   - Deep inelastic scattering
   - AFS → HELIOS → ZEUS
   - Barrel, forward and rear calorimeters
   - Longitudinal and lateral segmentations
   - Optical chain: scintillator, wavelength shifter
10. ZEUS calorimeter performances
    - Prototype
    - Energy distributions
    - Inter-calibration
    - Linearity
    - e/h ratio
    - Energy resolution
    - Non-uniformities
    - Calibrations: UNO signals, ^{60}Co source, muons
    - Magnetic field dependence
    - Time information
    - DIS events
11. Towards the new generation of detectors
    - Performance goals
    - Energy Flow techniques
12. The CALICE approaches to ILC
    - The CALICE collaboration
    - Analog calorimeters
    - Digital calorimeters
    - Designs and performances
    - Test beam results