ECOLE Joliot-Curie - 2015

Detection techniques in hadronic physics.

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The lecture will cover the main detection techniques in use in hadronic physics.

Introduction

Hadronic physics address the understanding of QCD essentially in the non perturbative regime, via the study of the nucleon structure and nucleon spin structure. The main physics processes used will be presented, in particular the deep inelastic scattering, the Drell-Yan process, the hard exclusive reactions and p p collisions, since they determine the structure of the experimental setup. A specificity of the domain is the use of polarized beams and targets.

Beams and targets

An overview of the beams currently used will be presented. This includes polarized lepton and proton or anti-proton beams. Energies vary from a few GeV to several hundreds of GeV. The beam polarization is obtained by various means and is controlled by specific measurements.

An example of polarized fixed target will be presented. It uses a 2m long super-conducting solenoid with a field of 2.5T. The target material (solid ammonia to obtain polarized protons) is polarized by the method of DNP (dynamic nuclear polarization) to about 90% at a temperature of a few tens of mK.

Experimental setups

Two examples of experimental setups will be shown, one adapted to collider experiments, the other to fixed target ones. They have in common the use of a variety of detector types, for the spectrometer part, where the tracking is used to reconstruct the kinematics of the reaction, as well as for the particle identification part.

The detectors which see beam particles must stand very high particle rates; position resolutions of a few tens of microns and time resolutions down to a few 100ps are reached. Then micro pattern detectors, with medium sizes (typically a fraction of square meter) are used in the hot environment close to the beam. And finally large size detectors like drift chambers or straw tubes cover the larger areas (several square meters) where the density of particles is lower.

The particle identification is done using several types of detectors: electromagnetic calorimeters for photons and neutral pions, muon filters, and detectors based of the Cerenkov effect for the identification of pion, kaon and protons. The RICH (Ring Imaging Cherenkov) detectors are now mandatory for the study of the strange quark sector, that is addressed via the identification of kaons .

Finally the technics used for the measurement of spin asymmetries and related systematic studies will be shown.