Study of Anti-Quark Distributions in Nucleon by Drell-Yan Experiment SeaQuest at FNAL

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The proton and neutron contain a substantial number of antiquarks which arise from dynamical interactions of gluons such as gluon dissociation. The SeaQuest experiment investigates anti-quark distributions in the nucleon using the Drell-Yan process studied at Fermi National Accelerator Laboratory (FNAL). The Drell-Yan process takes place in hadron-hadron collision when a quark of one hadron and an antiquark of the other hadron annihilate into a virtual photon which then decays to a lepton pair. SeaQuest detects a muon pair produced in this reaction: \( q + \bar{q} \rightarrow \gamma^* \rightarrow \mu^+ + \mu^- \). The asymmetry between the \( \bar{d} \) -quark distribution and the \( \bar{u} \) -quark distribution in the proton will be extracted. We can get \( \bar{u} \) and \( \bar{d} \) distributions separately by comparing the Drell-Yan production in hydrogen and deuterium targets. The modification of the asymmetry in nuclei will also be studied. In particular, we focus on the asymmetry at large Bjorken-\( x \), where Bjorken-\( x \) is the fraction of the target nucleon momentum carried by the antiquark.

The SeaQuest spectrometer consists of four tracking stations made of hodoscope planes and drift chambers or drift tubes as shown in Figure 1. It has also a spectrometer magnet (KTeV magnet in Figure 1) to measure the momenta of the muons.

In spring 2012, a two-month commissioning run of the SeaQuest spectrometer was successfully done using a 120 GeV proton beam extracted from the FNAL main injector. A two-year physics run will start in summer 2013. The status of the commissioning run and the plan for the physics run will be reported in this presentation.

Figure 1. The SeaQuest spectrometer