Construction of Drift Chambers for Drell-Yan Measurement at FNAL SeaQuest

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The internal structure of the proton is one of the most vital topic in the present hadron physics. The proton in low-energy (static) condition can be expressed with three valence quarks, namely two up quarks and one down quark. But the proton in high-energy condition consists of a large number of quarks (q), anti-quarks ($\bar{q}$) and gluons (g), where gluons and anti-quarks are dynamically created via $q \rightarrow q + g$ and $g \rightarrow q + \bar{q}$, respectively. The dynamics of the proton structure is being investigated in both experiment and theory.

The Drell-Yan process in proton+proton collisions is the reaction in which a quark in one proton and an anti-quark in the other proton annihilate into a virtual photon and then create a muon pair, $q + \bar{q} \rightarrow \gamma^* \rightarrow \mu^+ + \mu^-$, as shown in Fig. 1. This process is suited to study the anti-quarks in the proton, since an anti-quark is always involved in the reaction.

SeaQuest is a Drell-Yan experiment running at Fermi National Accelerator Lab (FNAL) in USA. The primary goal of this experiment is to precisely measure the light-quark flavor asymmetry in the proton, namely the difference in the amount of $\bar{u}$ and $\bar{d}$ quarks. The SeaQuest experiment injects a 120-GeV proton beam into a liquid-hydrogen or liquid-deuterium target. Muon pairs from Drell-Yan process are detected with a magnetic spectrometer shown in Fig. 2. The third group (called "station") of detectors includes two drift chambers, each of which covers the top or bottom half of the spectrometer. They measure the hit position of muons to reconstruct their trajectory and to determine the momentum with a help of other stations and an analyzing magnet.

A commissioning run using the proton beam was performed in March and April of 2012, and a physics run will start in spring of 2013. Toward the physics run, we are now constructing a new chamber for the bottom of Station 3, in order to have the acceptance symmetric to the one which we have already built for the top of Station 3 before. The outer dimensions of one chamber are 3.6 m in width, 1.9 m in height and 0.3 m in depth. Wires are stretched in vertical direction, and form six sense planes with a 2-cm interval between sense wires. The effective size of the acceptance of the drift chamber is 2.3 m in width and 1.7 m in height.

The status of the construction of the new chamber as well as the performance of other chambers will be reported.

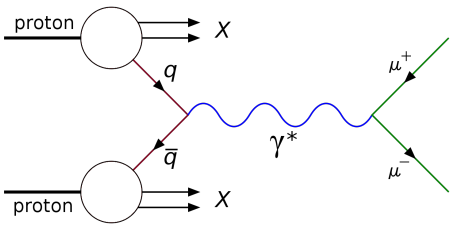

Figure 1: Drell-Yan Process.

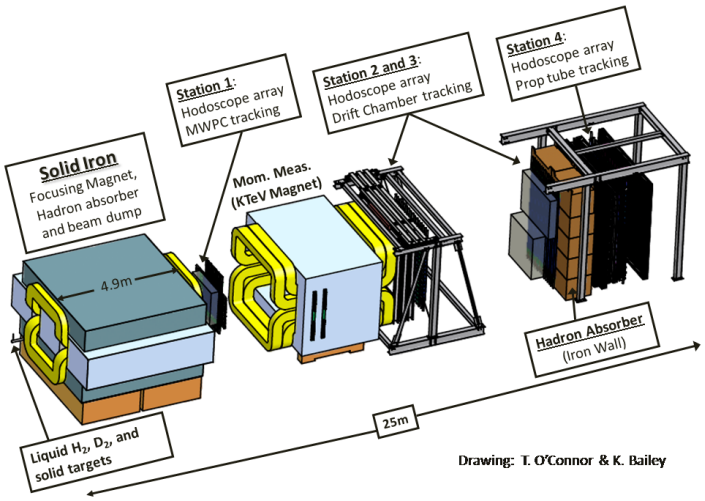

Figure 2: FNAL-SeaQuest Spectrometer.