

Abstract

The strange quark content of the nucleon is one of the most important questions in medium energy physics. Recent calculations show that some of the double polarization observables in the photoproduction and electroproduction of a ϕ meson from a proton target are extremely sensitive to the strange quark content of the proton. We propose to measure the polarization of the recoil proton from electroproduction of the ϕ mesons with a longitudinally polarized electron beam and a liquid hydrogen target. The scattered electrons and recoil protons will be detected in coincidence and ϕ mesons will be identified by missing mass reconstruction. We propose to make measurement on the $p(\vec{e}, e'\vec{p})\phi$ at a fixed invariant mass of 2.15 GeV and at $|Q^2| = 0.135 \text{ (GeV/c)}^2$. The time requested for this experiment is 15 days.

I. INTRODUCTION

In the naive constituent quark model, which has been quite successful in its description of the low lying states of the baryon [1], the nucleon ground state is composed of three valence quarks, two with flavor up and one with flavor down in the proton, and *vice-versa* in the neutron.

However, in a more realistic description of the nucleon, the three valence quarks are surrounded by quark-antiquark pairs which fluctuate out of the vacuum, the so-called “sea” quarks. The sea is often assumed to be symmetric in the three light quark flavors. However, because the s quark is heavier, this symmetry may be broken. Since the up and down quarks are the lightest and, hence, have the longest fluctuation lifetimes, most of the sea is likely to consist of $u\bar{u}$ and $d\bar{d}$ pairs. Nevertheless, although strange quarks are heavier and thus $s\bar{s}$ pairs would have a lower probability of being in the sea at a given time, they are expected to be there at some level.

This picture of $s\bar{s}$ pairs in the quark sea has been used to explain a number of experimental observations. These include (1) an anomalous value for the σ term observed in πN scattering, (2) deviations of the nucleon spin structure functions integrated over Bjorken x from theoretical predictions, as observed in the deep inelastic scattering (DIS) of polarized leptons from polarized nucleons, (3) a larger than expected value of the proton axial-vector form factor observed in νp scattering, and (4) a much larger than expected cross section ratio $p\bar{p} \rightarrow \phi\pi^+\pi^-/p\bar{p} \rightarrow \omega\pi^+\pi^-$.

Low energy theorems relate the isospin even π - N scattering amplitude $\Sigma = F_\pi^2 \bar{D}^+(2m_\pi^2)$, which is determined by extrapolating πN scattering to the unphysical pion pole [2], to the σ term $\sigma = \langle p|(m_u + m_d)(u\bar{u} + d\bar{d})|p\rangle/4M_N$. Naive estimates based on the baryon mass spectrum give $\sigma \approx 25 \text{ MeV}$. However, analysis of the πN scattering experiments gives $\Sigma \approx 60 \text{ MeV}$ (Koch gives a value of $64 \pm 8 \text{ MeV}$ [3]). This discrepancy and its possible interpretation in terms of strange quarks in the nucleon was first addressed by Cheng and Dashen [4]. Subsequently, the results have been analyzed and interpreted as evidence for $s\bar{s}$ in the nucleon quark sea. Gasser *et al.* extract a value [5]: