Abstract

We will measure the cross section for the reactions $\gamma p \rightarrow K^+\Lambda$ and $\gamma p \rightarrow K^+\Sigma$ at photon energies between 1.6 GeV and 4 GeV. These energies span the "gap" between existing data, which are qualitatively different from each other. In particular, the lower energy data is consistent with a fundamental kaon/hyperon amplitudes description (and has been used to derive the kaon/hyperon couplings), while the data at higher energies suggests the onset of quarklike degrees of freedom. There is evidence that the cross section in this gap contains contributions from undiscovered baryons as intermediate states in the s-channel. We will use a bremsstrahlung beam and the SOS spectrometer in Hall C to detect the K^+. We require only the initial complement of experimental equipment in Hall C.

1 Introduction

The simple reaction $\gamma p \rightarrow meson + baryon$ is prototypical of the interface between "particle" and "nuclear" physics. At lower energies, less than $\approx$1 GeV, the data is usually described in terms of s- (or $u-$) channel baryon exchange, as well as some t-channel meson interaction. On the other hand, the limited high energy, high momentum transfer data [1], where $E_\gamma \geq$4 GeV, has been used to support the notion that perturbative Quantum Chromodynamics (QCD) is a valid treatment [2, 3]. This predicts that the cross section $d\sigma/dt$ should fall like s^{-7}, for $s = E_{CM}^2 \rightarrow \infty$, and this is indeed borne out by the high energy data over a wide range of center of mass angles θ_{CM}. Figure 1 shows a "quark line" diagram of this reaction, indicating the various ways in which the interactions can be modeled. Each model should give the same result when all intermediate states are included, but in practice truncation of the basis yields very different phenomenological results.

The example for which we have the most data is $\gamma N \rightarrow \pi N$, in particular $\gamma p \rightarrow \pi^+ n$ and $\gamma p \rightarrow \pi^0 p$ [4, 5]. Figure 2 shows the differential cross sections $d\sigma/dt$ for these reactions, at $\theta_{CM} = 90°$, multiplied by s^7. This is plotted as a function of $\sqrt{s} = \sqrt{2E_\gamma M + M^2}$ (where M is the proton mass), and is expected to approach a constant value for large s according to perturbative QCD. The data support this prediction, although as discussed by Isgur and Llewellyn-Smith [6], it is hard to understand how perturbative QCD can predict the correct *normalization* of the cross section in a self consistent fashion.

Figure 2 is curious nevertheless. The factor of s^7 takes out an overall scale that allows the cross section to be plotted on a linear vertical axis despite the fact it is falling by several orders of magnitude. The resulting structure clearly indicates the dominance of $s - channel$ baryon excitation (Fig.1(a)) with peaks at well known baryon masses such