# Measurement of $R_\Sigma$ at large $W$

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The $(e, e'K^+)$ reaction on deuterium produces $\Lambda$, $\Sigma^0$, and $\Sigma^-$ hyperons. In a quasifree picture, the $\Lambda$ and $\Sigma^0$ are produced of the proton, and the $\Sigma^-$ is produced of the neutron. Isopsin conservation at the hadronic vertices predicts for the ratio total $\Sigma$ production of deuterium $(\Sigma^0 + \Sigma^-)$ to $\Sigma^0$ production of hydrogen,

$$R_\Sigma = \frac{\frac{d\sigma}{d\Omega}(\gamma d \to K^+\Sigma)}{\frac{d\sigma}{d\Omega}(\gamma p \to K^+\Sigma^0)} \ , \tag{1}$$

values of $R_\Sigma = 3$ for $t$-channel and $R_\Sigma = 1.5$ for $s$-channel. Photoproduction experiments performed in the 70s measured values of $R_\Sigma = 2.37 \pm 0.11 \pm 0.12$ [1] and $R_\Sigma = 2.73 \pm 0.18$ [2] for $W = 4.6$ GeV and $W = 5.6$ GeV, respectively. Jefferson Lab experiment E91-016 measured $R_\Sigma = 1.6$ for $W = 1.9$ GeV. The only earlier electroproduction experiment averages at $R_\Sigma = 1.89$ for $W = 2.4$ GeV , but, suffers from large errors. All the results are summarized in Fig. 1. An almost linear increase of $R_\Sigma$ with $W$ is observed. Therefore, $R_\Sigma$ could be a measure of the evolution of the reaction mechanism from primarily $s$-channel at low $W$ to primarily $t$-channel at high $W$. The existing data, however, don't cover the transition region. The goal of this proposal is to measure $R_\Sigma$ from close to threshold to the maximum $W$ accessible with the proposed Hall C equipment. With 11 GeV beam energy, a maximum of $W = 3.6$ GeV is reached for $Q^2 = 1.4$ GeV$^2$. At somewhat lower $W$ L/T separations are kinematically accessible. This should also be explored. A measurement of $R_\Sigma$ up to the maximum possible $W$ combined with an L/T separation at lower $W$ could determine the kinematic ranger over which longitudinal components dominate the reaction mechanism. This could guide experiments which strongly depend on the assumption of longitudinal mechanisms, like meson form factor measurements.

## References

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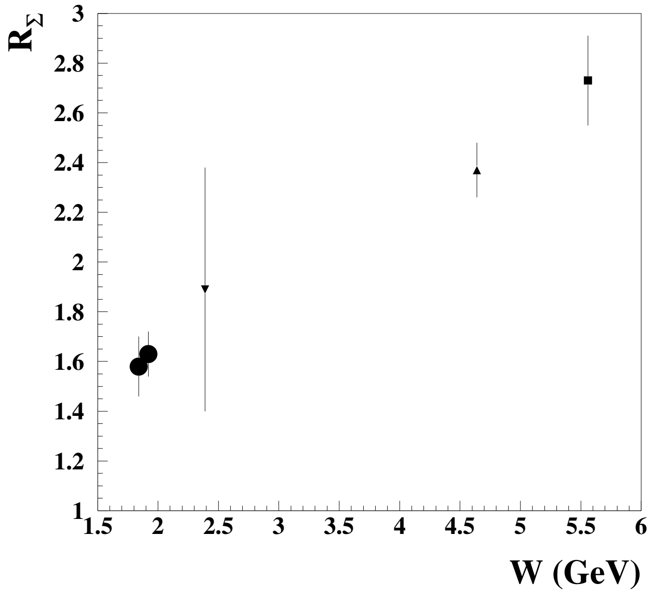


Figure 1: Ratio of sigma production off deuterium and hydrogen, $R_\Sigma$, averaged over $t$ as a function of center-of mass energy, $W$, in the photon-nucleon system. The points at 4.6 and 5.6 GeV are the photoproduction data from Boyarski *et al.* [1] and Quinn *et al.* [2]. The point at 2.4 GeV has been extracted from the electroproduction data from Bebek *et al.* [3]. The two points around $W = 1.9$ GeV are the E91-016 data.