Hyperon Beams in Modern Baryon Spectroscopy

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The use of multiple diverse incident particle probes is vital for our understanding of baryon spectroscopy. For this purpose, we commonly use primary beams such as protons and electrons, or secondary beams produced from these, such as photons, pions, and kaons. Quantitative measurements such as cross sections require good knowledge of both the beam flux and the effective target thickness. The primary beam flux is typically measured by the accelerator, while the geometric length of the target can be easily measured; secondary beam flux can be measured by the experimenter. Short-lived beam particles, such as the Λ or K_S, provide additional information that cannot be obtained in any other way, but it must be shown that both the beam flux and the effective target thickness can be adequately determined; bubble chamber experiments measured these quantities directly. In modern large-acceptance detectors, the beam particle is not detected, but is inferred via missing mass using the final-state particles. With significantly higher data rates, they can overcome this deficiency relative to bubble chambers. An initial publication from CLAS used a preliminary version of this technique to measure the cross section for $\Lambda p \rightarrow \Lambda p$. The scattered Λ was inferred via its decay to $\pi^- p$, and events were selected in which the missing mass m_X in the process $Xp \rightarrow \Lambda p$ was consistent with m_Λ. To improve our understanding of the beam Λ, it was required to come from the process $\gamma p \rightarrow K^+ \Lambda$, and detection of the K^+ was required. The number of events in this measurement was far greater than any previous measurement for this process. The use of inclusively produced beams, such as in $\gamma p \rightarrow \Lambda X$, can increase greatly both the overall flux and the momentum range of the beam Λ. The CSUDH Hadronic Structure Laboratory is in the process of testing this technique using the process $pp \rightarrow pp$, where the beam proton is produced in the process $\gamma p \rightarrow pX$. In parallel, we are revisiting the process $\Lambda p \rightarrow \Lambda p$ using a different CLAS dataset, as well as the process $K^0 p \rightarrow K_S p$. This talk will present the motivations for the development of short-lived beams, the present status of this project with the CLAS Collaboration, and place it in context with other, similar projects.