Photproduction of the very strange baryons on a proton target in CLAS12

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Abstract

Almost half a century after the prediction and discovery of the Ω^- baryon, many properties of the $S = -2$ and -3 hyperon resonances remain unknown. In particular, quark-model predictions suggest there are many more Cascade states than have been seen in experiments. Recent theoretical modeling indicates photo-production is useful to provide access to these states and their observables. The CLAS detector, part of JLAB's 6 GeV program, has provided a unique lens into photo-production of the lowest mass Cascade states, however the energy and luminosity reached was not sufficient to study the heavier Ξ^*'s or the Ω^-. With the increased energy and better acceptance promised with CLAS12, we propose to study the production of $S = -2, -3$ baryons with high precision and statistics in exclusive photo-nuclear reactions.

The production mechanism of these states is of particular interest: the change of the baryon strangeness from the initial state to the final state is large, there is no current precision measurement of the differential cross section for the Ω^- and there is no polarization measurement of the cascades in photoproduction. The spin-parity of the few relatively well-established cascade states, such as $\Xi(1690)$ and $\Xi(1820)$, may be confirmed via the double moments analysis technique using the combined decay angular distributions. The improved CLAS12 detector acceptance for the few-particle final states, which is necessary for the detection of these baryons, makes it possible to access their production mechanisms.

The proposed experiment would be run in parallel with the approved CLAS12 meson spectroscopy experiment using the forward

tagger currently under construction. This experiment is expected to yield the statistics necessary to perform the cross section measurements for the Ω^- baryon. In addition, the proposed experiment is expected to yield high statistics for Cascade baryons, corresponding to the world's largest sample for the Ξ ground state in photoproduction and allowing the possibility of discoveries of new excited Ξ-states, and the determination of their quantum numbers.