Spin transfer in quasifree pion single charge exchange

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At a beam momentum of 750 MeV/c π^--proton charge shows a rapid change with lab angle in the fraction of the differential cross section due to spin transfer, being zero at 0 and 180 degrees, but also with a strong minimum at mid-angles [1]. We have measured this charge exchange on protons in complex nuclei in quasifree kinematics, with q from 400 to 1000 MeV/c, across a large range of reaction angles, using the Crystal Ball detector for exclusive pion single charge exchange (SCX). The responses do not display a uniform pattern with changing angle when free pion SCX differential cross sections are used to define the responses. A plot of the magnitude of the measured responses against the ratio of spin ΔS=1 to ΔS=0 cross sections, as determined from SAID [1], shows a linear dependence, much as is revealed by the Rosenbluth decomposition for electron scattering. The slope of this plot for C, Al and Cu shows in-medium ΔS=1 SCX cross sections to be quenched below those for ΔS=0 found from the intercepts where the ΔS=1 cross section vanishes, using free SCX as the standard. To restore the scaling of responses as seen in electron scattering [2], in-medium ΔS=1 SCX differential cross sections must be quenched, and ΔS=0 cross sections must be enhanced, relative to free-space values. Only small differences from the expectations of free scattering are seen with SCX on the deuteron. This spin-analysis was successful and sensitive for the 750 MeV/c beam momentum because of the unusual spin sensitivity of the SCX cross sections with angle at this momentum and large angular acceptance of the Crystal Ball detector.

[1] R. A. Arndt et al., Phys. Rev. C56, 3005 (1997); http://gwdac.phys.gwu.edu

[2] T. W. Donnelly and I. Sick, Phys. Rev. C60, 065502 (1999)

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