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# np ELASTIC-SCATTERING EXPERIMENTS WITH POLARIZED NEUTRON BEAMS†

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Measurements of the spin transfer parameters, $K_{NN}$ and $K_{LL}$, at 500, 650, and 800 MeV are presented for the reaction $\vec{p}d \rightarrow \vec{n}pp$ at 0°. The data are useful input to the NN data base and indicate that the quasi-free charge exchange (CEX) reaction is a useful mechanism for producing neutrons with at least 40% polarization at energies as low as 500 MeV. Measurements of np elastic scattering observables $C_{LL}$ and $C_{SL}$ covering 35° to 172° are performed using a polarized neutron beam at 500, 650, and 800 MeV. Preliminary results are presented.



Our recent nucleon-nucleon scattering experiments at LAMPF energy were reported here. We have measured the spin transfer parameters, $K_{NN}$ and $K_{LL}$ at 500, 650 and 800 MeV for the reaction $\vec{p}d \rightarrow \vec{n}pp$ at 0°[1] and, np spin correlation parameters $C_{LL}(=A_{LL})$ and $C_{SL}(=A_{SL})$ for free np elastic scattering. These NN scattering experiments were expected to provide significant input for the np data base because of the wide angular range ($35° < \theta_{c.m.} < 172°$) that the experiment covered and because of the scarcity of np data.[2]

The layout of the $K_{NN}$ and $K_{LL}$ experiment is shown in Fig. 1. The polarization of the neutron beam produced by the reaction $\vec{p}d \rightarrow \vec{n}pp$ was measured using two spin precession magnets and a liquid hydrogen polarimeter. The incident proton polarization was measured by a beam line polarimeter. The results are shown in Fig. 2. They show that a 40% polarized neutron beam is obtainable at energies as low as 500 MeV, by the charge exchange mechanism (CEX). The momentum spectra[3] at 650 and 800 MeV are shown in Fig. 3. It is noted that the signs of both $K_{LL}$ and $K_{NN}$ are negative, which means neutrons emerging from an LD2 target prefer spins opposite to that of protons and the magnitude of $K_{LL}$ increases slightly as the incident proton kinetic energy increases, whereas that of $K_{NN}$ seems to show no significant change.

The spin correlation parameters for free elastic np scattering were measured using the polarized neutron beam obtained by the CEX mechanism mentioned above. The measurement of $C_{LL}$ and $C_{SL}$ utilized a polarized target with a typical polarization of ~ 75%. The elastic events are accumulated in four separate missing mass histograms corresponding to the four possible initial spin states after the recoil protons are momentum analyzed in our spectrometer.

The preliminary results for 80° to 120° are shown in comparison with phase shift predictions in Fig. 5 and Fig. 6. It should be remembered that the results shown

represent only about half of our data. The results show that the agreement with the phase shift predictions are generally good for $C_{LL}$ but are somewhat poor for $C_{SL}$.

## REFERENCES


1) J. S. Chalmers, et al., Phys. Lett. 153B, 235 (1985).
2) R. A. Arndt et al., Phys. Rev. D28, 97 (1983).
3) C. Bjork et al., Phys. Lett. 63B, 31 (1976).



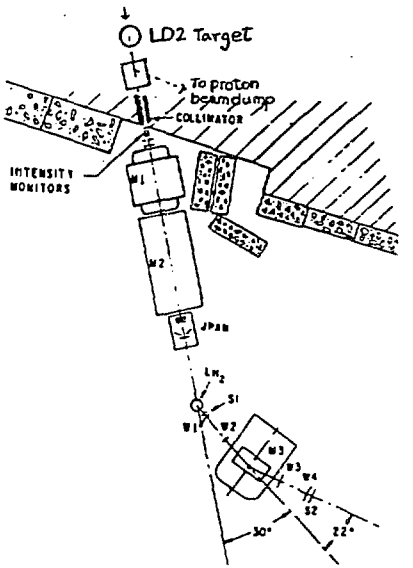




Fig. 1. Layout of the $K_{LL}$ and $K_{NN}$ experiment.

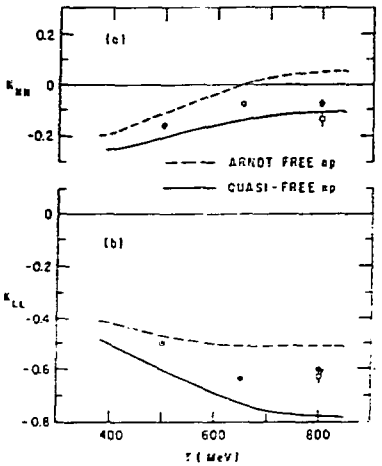



Fig. 2. $K_{NN}$ and $K_{LL}$ for the reaction $\vec{p}\vec{d} \rightarrow \vec{n}pp$ at 0°.

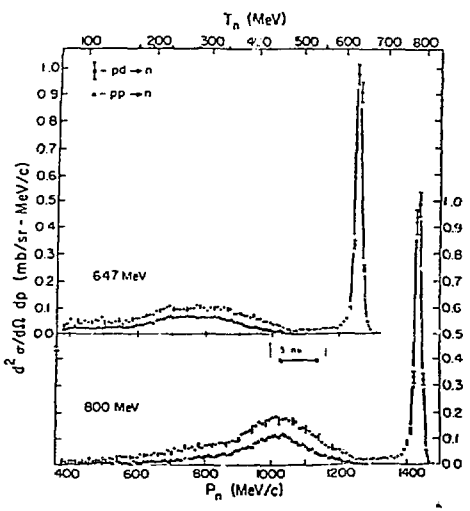



Fig. 3. Neutron spectra.[3]

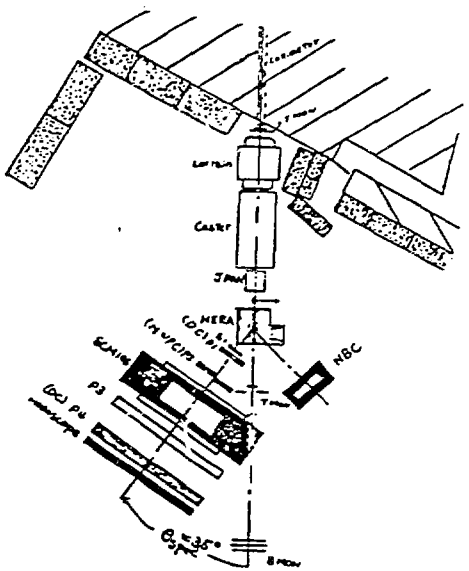
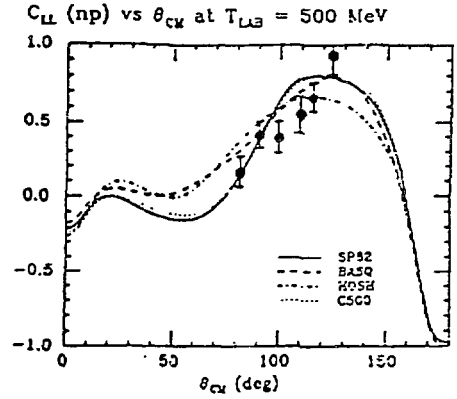
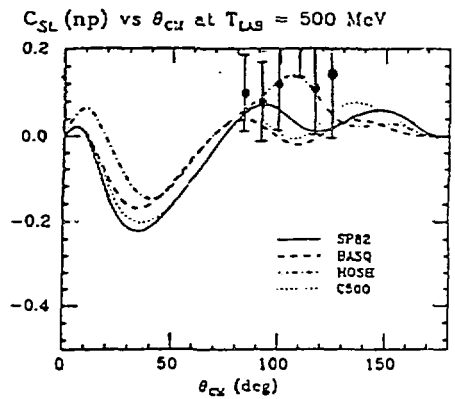
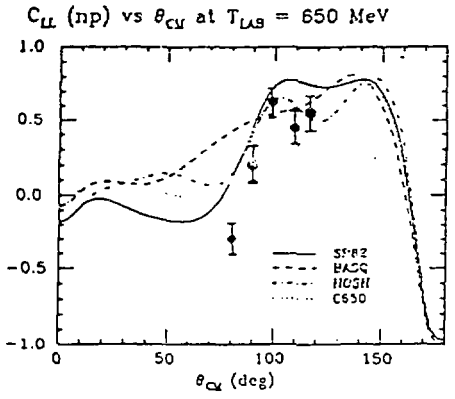
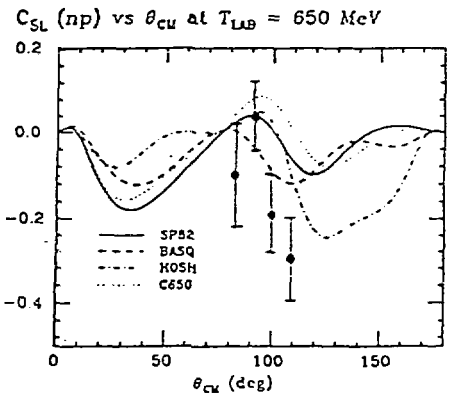


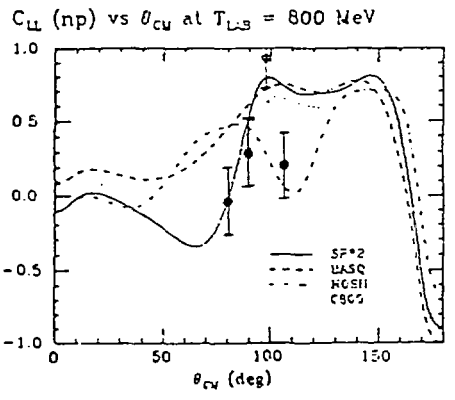

Fig. 4. Layout of the $C_{LL}$ and $C_{SL}$ experiment.



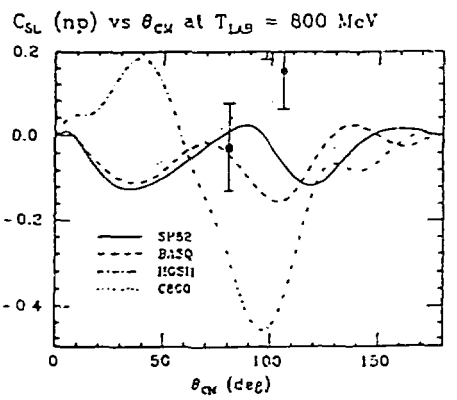




Fig. 5. $C_{LL}$ in np elastic scattering. Phase shift predictions of Arndt (SP82 and C800), Basque (BASQ) and Hoshizaki (HOSH) are shown.

Fig. 6. $C_{SL}$ in np elastic scattering phase shift predictions of Arndt (SP82 and C800), Basque (BASQ), and Hoshizaki (HOSh) are shown.

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