IN-PLANE POLARIZATION TRANSFER IN ^{10}B(p,p')^{10}B INELASTIC SCATTERING

S. Chang, A.D. Bacher, S. Bowyer, W. Franklin,
J. Lisantti, J. Liu, E.J. Stephenson, S. Wells, and S.W. Wissink
Indiana University Cyclotron Facility, Bloomington, Indiana 47408

H. Baghaei, V. Gladyshev, and R.A. Lindgren
University of Virginia, Charlottesville, Virginia 22901

The purpose of E368 is to measure the in-plane polarization transfer coefficients for the $^{10}\mathrm{B}(\vec{\mathrm{p}},\vec{\mathrm{p}}')^{10}\mathrm{B}$, $3^+ \rightarrow 0^+$, $\Delta T = 1$, $E_x = 1.74$ MeV transition. For $(\vec{\mathrm{p}},\vec{\mathrm{p}}')$ experiments, eight observables (cross section σ, analyzing power A, polarization P, and five polarization transfer coefficients $D_{NN'}$, $D_{SS'}$, $D_{SL'}$, $D_{LS'}$, and $D_{LL'}$) are possible when parity is conserved. Different linear combinations of polarization transfer observables yield different pieces of information on the effective nucleon-nucleon interaction.[1] A study of $^{10}\mathrm{B}(\vec{\mathrm{p}},\vec{\mathrm{p}}')^{10}\mathrm{B}$ will allow us to learn to what extent nuclear medium modifications are needed to the effective interaction, which is designed to reproduce free NN scattering.

In E338, measurements were made of σ, A, P, and $D_{NN'}$ at angles between 7.5° and 80° (Ref. 2). These ^{10}B $D_{NN'}$ data and similar work on ^{16}O and ^{28}Si showed that free nucleon-nucleon interaction calculations were not consistant with experimental data. Stephenson and Tostevin[3] made modifications to the tensor (t_τ^T) and spin-dependent central ($t_{\sigma\tau}^C$) terms for ^{16}O to improve the fit to the polarization transfer data. Similar changes are needed for the ^{10}B and ^{28}Si $D_{NN'}$ data.[2,4] A comparison of the phenomenologically-adjusted medium-modified interaction and the free nucleon-nucleon interaction[5] show that the size of the modification tends to increase as the momentum transfer increases, in a manner consistent with a smaller ρ-meson mass. In $^{10}\mathrm{B}(\vec{\mathrm{p}},\vec{\mathrm{p}}')^{10}\mathrm{B}$, the $3^+ \rightarrow 0^+$ transition represents a "stretched" $0\hbar\omega$ excitation that proceeds via spin recoupling within the $1p_{3/2}$ shell (a $1p_{3/2} \rightarrow 1p_{3/2}$ transition). Unlike ^{16}O and ^{28}Si, the ^{10}B transition is a clearly separated state at low excitation energy, making possible measurements that are essentially free of background. So a thicker target can be used to allow coverage of a larger momentum-transfer range, with the idea of testing the momentum-transfer dependence seen for ^{16}O. In addition, (e,e') magnetic formfactor measurements are available over a large momentum-transfer range (from 100 to 800 MeV/c) as well and serve to constrain the $3^+ \rightarrow 0^+$ transition density.

New data on the in-plane polarization transfer coefficients were taken in February, 1993. The BL3 and BL5 superconducting spin procession solenoids were used to achieve the desired polarization orientations on target. Three in-plane polarization orientations approximately 60° apart were used for each scattering angle. While only two orienta-

tions will, in principle, provide information on both longitudinal and sideways polarization transfer, the third orientation acts as a check on the internal consistency of the data. Polarization at the BL2 low-energy polarimeter was measured every other day. In BL3 and BL5, two p + d high-energy polarimeters (HEPs) were used to continuously monitor the normal and sideways components of the beam polarization in order to calculate the polarization on target. Concrete shielding was built around the external beam dump to reduce room background. A veto scintillator was installed to remove ^{10}B elastic scattering events. This increased the computer live-time and made higher beam currents possible. Since ^{10}B is a light nucleus, at large scattering angles the K600 kinematic coil could not provide currents high enough to correct the kinematic energy spread. So the focal plane wire chamber detectors were put 10 cm further downstream. The polarization of the outgoing protons was measured by the focal plane polarimeter at scattering angles of 20°, 31°, 40°, 48° and 60°. Since the measurements were carried out at one spin procession angle as the scattered protons pass through K600 magnetic spectrometer, only the linear combinations of spin transfer observables, $D_\sigma = D_{SS'}\cos\alpha + D_{LS'}\sin\alpha$ and $D_\lambda = D_{SL'}\cos\alpha + D_{LL'}\sin\alpha$, where α is the spin procession angle, were obtained. In the medium dispersion mode, α is about 230°.

Online results for D_σ and D_λ are shown in Fig. 1. The solid lines are calculated by using the impulse approximation program DW86 (Ref. 6) with the 210-MeV Love-Franey interaction. The dashed lines presents the fixed-density modification made to reproduce the ^{16}O, $4^-, T = 1$ data[3] ($m^*_\rho/m_\rho = 0.93$, where m_ρ is the free ρ-meson mass). The optical potential is from Lewis.[7] The results show that the Love-Franey interaction, rather than

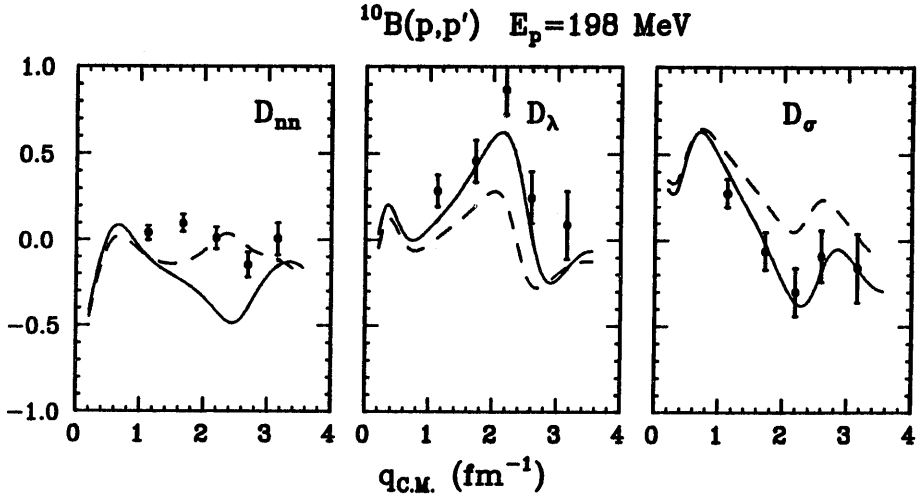

Figure 1. Measurements of $D_{NN'}$, D_λ, and D_σ as a function of momentum transfer q for the $3^+ \rightarrow 0^+$, $\Delta T = 1$ transition in ^{10}B(p,p')^{10}B. The impulse approximation program DW86 was used for all calculations. The solid curves present the free nucleon-nucleon Love-Franey interaction and the dashed curves present the modified interaction.

the medium-modified interaction, is in better agreement with the experimental D_σ and D_λ data. This is different from $D_{NN'}$ in ^{10}B and from the ^{16}O and ^{28}Si cases, where a modification is necessary to make the calculations fit experimental data. More detailed work is underway to understand these new results.

1. E. Bleszynski, M. Bleszynski, and C.A. Whitten, Jr., Phys. Rev. C **26**, 2063 (1982).
2. H. Baghaei, *et al.*, Phys. Rev. Lett. **69**, 2054 (1992).
3. E.J. Stephenson and J.A. Tostevin, in *Spin and Isospin in Nuclear Interaction*, eds. S.W. Wissink *et al.*, (Plenum, New York, 1991) p. 281.
4. J. Liu, *et al.*, Bull. Am. Phys. Soc. **37**, 1319 (1992).
5. See E368 Proposal by E.J. Stephenson and R.A. Lindgren, *et al.*
6. R. Schaeffer and J. Raynal, program DWBA70, as modified by S.M. Austin, W.G. Love, J.R. Comfort, and C. Olmer, unpublished.
7. P.R. Lewis, Ph.D. thesis, University of Melbourne, May, 1990.