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ABSTRACT

As a result of recent measurements at LAMPF the nucleon-nucleon amplitudes (both $I=0$ and 1) are now well determined near 800 MeV.

INTRODUCTION

The first goal of the nucleon-nucleon groups at LAMPF (Los Alamos, Argonne Nat. Lab., Univ. of Texas, and Texas A and M University) is the complete determination of the isospin 0 and 1 elastic scattering amplitudes to 5% from 500 to 800 MeV. When previous data¹ are combined with the recent data reported here, these amplitudes become well determined² near 500 and 800 MeV. Measurements scheduled for 1991 should complete the measurements within this energy range.

SPIN TRANSFER MEASUREMENTS FOR NP ELASTIC

We have measured the horizontal spin transfer parameters at 788 MeV, from 47° to 177° with a typical accuracy of 0.03 (fig 1). (The notation is defined in table 1.) This triple-scattering experiment was made possible by the new high-intensity optically pumped ion source (OPPIS)³ at LAMPF. Full details are contained in a forthcoming paper⁴. New phase-shift fits (including these new data) by Arndt⁵, Bugg⁶, Bystricky, Lehar and Leluc⁷ are satisfactory, with χ^2 slightly greater than 1 per degree of freedom. The new fits differ significantly from previous fits.

Arndt estimates an uncertainty in his single-energy fit (800; the change between his preliminary 1991 fit and previous fits is about five of these standard deviations. This change results both from the new data, and from the correction of systematic errors or the correct inclusion of systematic uncertainties in previous data.

One of the more significant systematic errors in previous data concerns the overall normalization. We re-measured the spin transfer parameter for the LAMPF polarized neutron beam (K_{LL} for the $D(p,n)$ reaction) and obtained a new value of -0.720 ± 0.017 , which disagrees with the previous values⁸ of

-0.64 ± 0.04 and -0.604 ± 0.04 . We suspect that the previous results may be incorrect because of an error in the n_p analyzing power⁹ to which both previous measurements were normalized. The new measurement avoided this systematic error by measuring K_{LL}^2 by double scattering⁴.

PROTON PROTON ELASTIC CROSS SECTIONS

We have also measured the pp elastic differential cross section to 1% absolute accuracy from 491 to 791 MeV. This completes our program of pp elastic scattering measurements at LAMPF, and completes the precise determination of the isospin 1 scattering amplitudes¹⁰ at LAMPF energies.

The method involved¹¹ an innovative technique to count individual beam protons at 5 MHz, and contained many detailed cross-checks at every stage of the measurement. Preliminary results are within a few percent of (but typically lower than) Arndt's phase-shift predictions. Results will be reported in detail in a forthcoming paper¹².

CONCLUSION

With sufficient data to over-determine the nucleon-nucleon scattering amplitudes, internal inconsistencies in the extensive data-base become apparent. This has enabled us to pinpoint a large number of previously unsuspected systematic errors in the data-base. Improved treatment of these systematic errors has led to reliable phase shift solutions for the first time near 800 MeV.

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TABLE 1. SIGN CONVENTION AND NOTATION

THIS PAPER	ARNDT	BYSTRICKY
K_{LS}	AT	K_{00k0}
K_{LL}	AT T	(K_{00k0})
K_{SS}	RT	(K_{0000})
K_{SL}	PPT	K_{0k00}

FIGURE CAPTION

FIGURE 1. Spin transfer parameters for np elastic scattering at 788 MeV.

NP Observables at 788 MeV from E876

— Arndt C800
 - - - Bugg 1991
 — Leluc 1991