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3.24 Two-Nucleon Force Model with Δ and Pion Degrees of Freedom: Application to πd<->πd and NN<->πd Processes

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An isospin-triplet two-nucleon force model including Δ-excitation and explicit pionic degrees of freedom is constructed. The coupled channel approach is used; pionic degrees of freedom are introduced by a unitary coupling of the nucleon-Δ system to intermediate two-nucleon-one-pion three-body states, including a dynamical description of the pion-nucleon P_{33} resonance. In the two-nucleon-one-pion (NNπ) three-body system, only the $^3S_1$-$^3D_1$ nucleon-nucleon interaction is included and yields the correct deuteron (d) pole, whereas the two-nucleon system without pion is fully described with all relevant partial waves. The model forms a consistent basis for microscopic nuclear structure and nuclear reactions at low and intermediate energies. In this contribution it is tested in the two-nucleon system above pion threshold.

The model describes the two-nucleon system below and above pion threshold at intermediate energies as well as cross sections and polarization observables for elastic pion-deuteron scattering and the NN<->πd reaction[1]. Selected results for these polarization observables are presented in this contribution (Figs. 1,2).

The πd<->πd vector analyzing power it_{11} and tensor polarization t_{20}^{LAB} are in qualitative agreement with the data of Refs. 2,3. All t_{20}^{LAB} predictions are negative; at 142 MeV, no strong oscillations as suggested by the data of Ref. 4 are found. The NN<->πd analyzing power A_{yo} has the correct order of magnitude, while it_{11} is overestimated at all energies.

The model is being extended by the inclusion of the nonresonant pion-nucleon amplitudes and applied to nuclear structure and nuclear reactions.

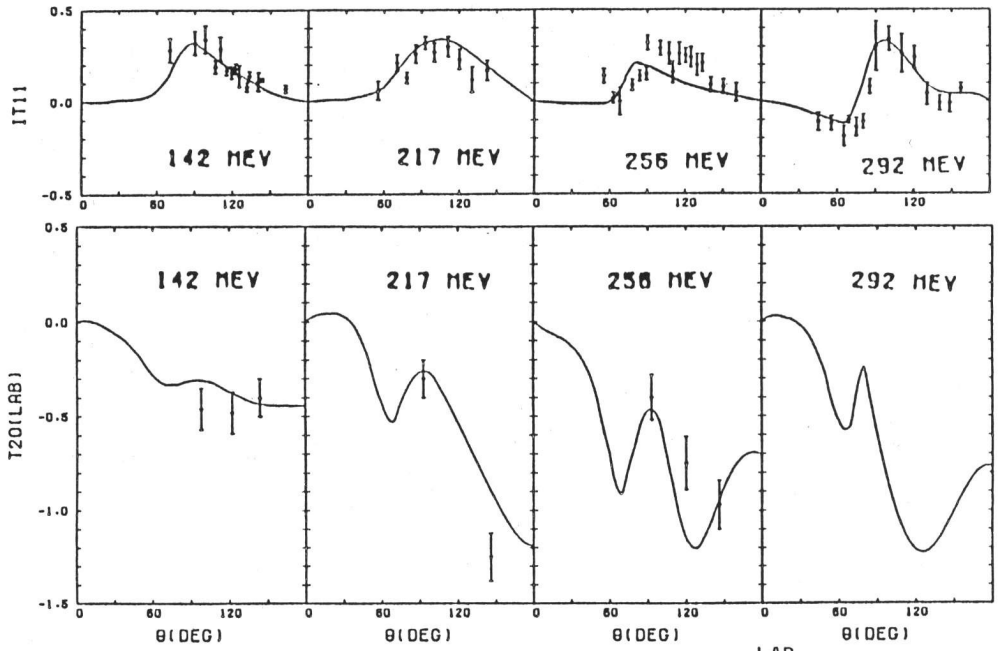

Fig. 1. Vector analyzing power it_{11} and tensor polarization t_{20}^{LAB} for elastic pion-deuteron scattering for four pion lab energies. Data from Refs. 2,3.

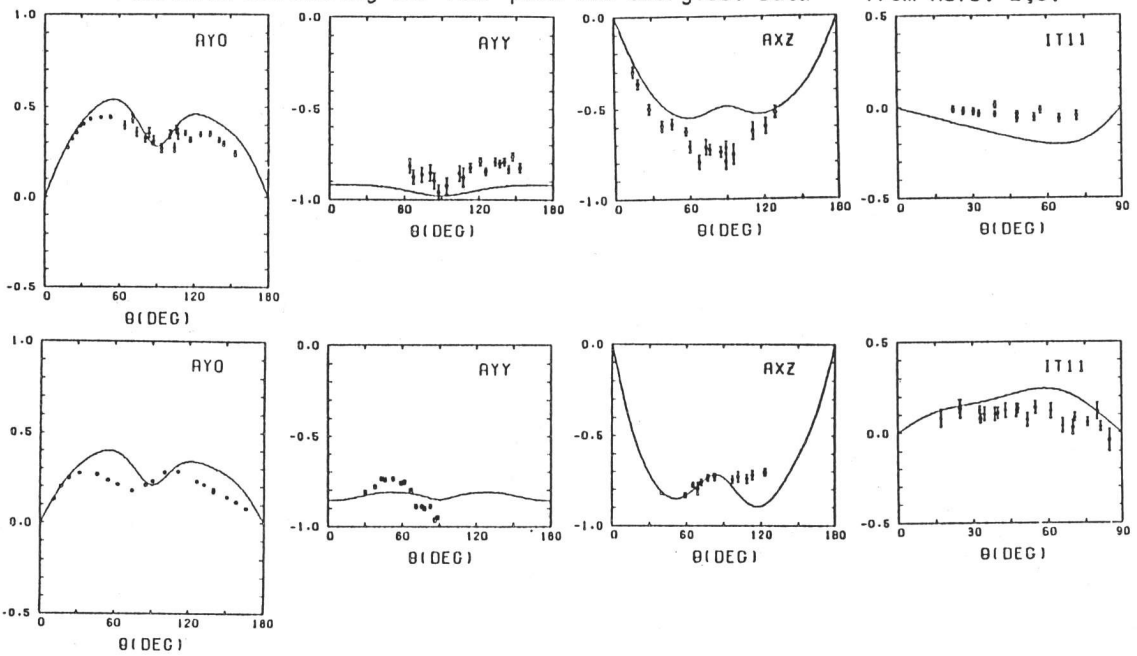

Fig. 2. Polarization observables for the NN<->πd reaction for nucleon lab energies 578 MeV (top) and 800 Mev (bottom).

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