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Intermediate Energy

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Contributions in the areas of polarization transfer, polarized deuteron scattering, and $(p,\pi^{\pm})$ reactions are summarized.

1. Introduction

The number of contributions in this section is rather small due to the division of intermediate-energy physics into three separate areas. Because of this and due to an overlap of themes found in Section 1, I have taken the liberty of lowering the threshold for intermediate energy to 80 MeV. This results in the inclusion of two very interesting papers from RCNP, Osaka University in this section (1.33, 1.36).

The organization of this review is based on three categories which contain most of the contributions. They are: polarization transfer, polarized deuteron scattering, and polarized $(p,\pi^{\pm})$ reactions.

2. Polarization Transfer

The application of final-state polarization analysis in nucleon-nucleus scattering had just begun at the time of the previous Polarization Symposium in 1980 in Santa Fe. In this review I will concentrate on polarization transfer (PT) in inelastic scattering and charge-exchange since most of the contributions deal with this subject.

At present there are very active groups employing PT techniques to the study of (p,p') and (p,n) reactions at RCNP, LAMPF, IUCF and TRIUMF. The papers at this symposium testify to the breadth of physics issues addressed in this research.

Papers 1.33, 4.7, and 4.8 examine PT in inelastic scattering to discrete nuclear levels. Of particular interest here is the excitation of states which proceed via spin transfer. Transitions whose density matrix elements are "calibrated" from other data offer an excellent testing ground for models of effective N-N interactions. As we have seen in the invited talks of Carey, Love, and Taddeucci, combinations of PT observables may be exploited to focus on particular components of the effective interaction. The data of Olmer et al. (4.7) at E_p = 200 MeV, and Hosono et al. at 80 MeV are compared to a number of prescriptions for the N-N effective interaction -- including both nonrelativistic and relativistic models. It is too early to make definitive statements about the validity or lack thereof of any of the models. There are, however, clear differences among the calculations, and it is very likely in the near future that these types of experiments will put severe constraints on models of N-nucleus scattering. Particularly crucial in these tests will be experimental evidence which favors either models based on the Schroedinger Equation or the Dirac equation.

Investigations of PT observables in the giant resonance and continuum regions have also received much attention at this conference (talks of Love and Taddeucci). Papers 1.36, 4.11, and 4.13 examine S_{NN} in the region of the M1 and Gamow-Teller giant resonances. It is clear that these papers as well as similar work reported in invited talks has already contributed a great deal to our understanding of the giant resonance region particularly in connection with the question of how much "hidden" Gamow-Teller strength lies in the continuum above the resonance. Paper 4.10 takes a different look at the continuum excited in the (p,p') reaction. A complete set of PT observables was measured for 500 MeV protons scattered from ^{2}H, ^{40}Ca and Pb at a rather large momentum transfer ($q = 1.75\ fm^{-1}$). These authors used combinations of the PT observables which isolate longitudinal (pionic) coupling of nucleons to make a very sensitive search for pionic collectivity in the heavy targets. No differences were seen in the appropriate observables between ^{2}H (where pionic collectivity is absent) and either of the heavy targets. The authors use this observation to cast doubt on the validity of models of the European Muon Collaboration (EMC) effect which attributes this effect to pions.

3. Polarization in Deuteron Elastic Scattering

Paper 4.16 presents some very beautiful measurements of cross section, A_y, and A_{yy} in the elastic scattering of vector and tensor polarized deuterons from ^{16}O at 200, 400, and 700 MeV. There were also three theoretical models of medium-energy deuteron elastic scattering. These may be roughly described as: (a) a relativistic model based on a Dirac-like equation for spin 1 particles (Santos et al., 4.14), (b) a folding model which starts with both Schroedinger and Dirac equation descriptions of N-nucleus scattering (Yahiro et al., 4.15), and (c) a Glauber theory approach (Yanlin and Van Sen, 4.17). We note an interesting statement in the paper of Yahiro et al. which may give some hint about the future direction of these analyses -- "it is interesting to note that the analysis described above seems to indicate that the deuteron-nucleus scattering can be a better tool for probing the nucleon optical potential than the nucleon-nucleus scattering itself."

Polarized elastic deuteron scattering is clearly only the beginning of a potentially broad subfield. As an example of other possible studies we mention the suggestion of Bugg and Wilkin[1] to use polarization transfer in the (^2H,^2He) reaction as a means of investigating giant spin-flip excitations. The Saturne Facility obviously has this field to itself for the near-term future.

4. Polarization in ($p,\pi^{\pm}$) Reactions

Although there were only two papers, one theoretical (4.3) and one experimental (4.2), in this area, we should emphasize that polarization studies in (p,π) reactions have been extremely successful in elucidating the mechanism of this process near threshold. The references of Paper 4.2 should be consulted for details of this interesting story.

We would like to emphasize the importance of polarization in (p,π^+) reaction as illustrated in Fig. 1 of Paper 4.2. The authors have constructed a composite of spin up and down spectra in which most of the peaks seen in this reaction disappear. The reason for this is that the analyzing powers are nearly identical for all (p,π^+) reactions. In the composite spectrum at least two peaks are seen prominently. This observation and the authors' confidence in the underlying two nucleon mechanism for the $^{13}C(p,\pi^+)^{12}C$ reaction lead them to conclude that there is new physics in these excitations. Speculation about the origin of these differences includes the possibility that they are T = 2 states in ^{12}C and thus cannot be populated by the "normal" $pp \to (n,p)_{T=0}\pi^+$ mechanism of this reaction. Other spectroscopic application of ($\vec{p},\pi^+$) reactions are also considered in this paper.

References

1) C. Wilkin and D. V. Bugg, preprint.