SUMMARY OF SPIN PHYSICS SESSIONS

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INTRODUCTION

The list of topics included in the many talks given during the Spin Physics sessions is nearly as long as the one of this conference:

P and T Violation
NN Interaction
πp and πd Elastic Scattering
Nuclear Matter Spin Effects
High Energy Spin Effects
Muon (g - 2)
Polarized Proton Beams
Polarized Gas Targets

This points to the almost trivial fact that spin is fundamental to our understanding of nuclear and particle physics. I will discuss in some detail only four of these topics. Needless to say this choice is very much personally biased and I apologize to all the speakers whose excellent contributions I did not include.

P AND T VIOLATION

According to the 'standard' picture parity non-conserving (PNC) NN interaction is dominated at low energy by meson exchange with one weak meson nucleon vertex. Each of the six possible vertices are characterized by a weak meason nucleon coupling constant:

$$f_\pi^1, h_\rho^0, h_\rho^1, h_\rho^2, h_\omega^0, h_\omega^1$$

In a by now almost classical paper Desplanques, Donoghue, and Holstein (DDH)[1] calculated these coupling constants from QCD renormalized Weinberg-Salam operators using SU(6) wave functions.

M. Simonius described in detail how to analyze the PNC observable A_z of pp scattering in terms of these coupling constants. Using the two combinations:

$$h_\rho^{pp} = h_\rho^0 + h_\rho^1 + h_\rho^2/\sqrt{6}; h_\omega^{pp} = h_\omega^0 + h_\omega^1$$

he finds:

$$A_z(45MeV) = \alpha_1(h_\rho^{pp} + h_\omega^{pp}) = (-1.50 \pm .22) \times 10^{-7} \approx -2 \times 10^{-7}(DDH)$$

$$A_z(230MeV) = \alpha_2 h_\rho^{pp}$$

The proportionality constant in front of the coupling constants depends on strong scattering phase shifts and the geometry of the experiments.

Clearly a measurement at 230 MeV would allow the determination of h_ρ^{pp} and h_ω^{pp}. J. Birchall presented a proposal to measure A_z (230 MeV) at TRIUMF to an accuracy of 0.2 x 10^{-7}. It will be very interesting to hear their result.

Although the agreement between the measurement of A_z (45 MeV) and the prediction of DDH is very good, M. Simonius argued that there is an inconsistency at short range between the PNC potential and the strong interaction models used for the second meson nucleon vertex and for the scattering wave functions.

V. Zeps presented the result of a recent measurement of A_z at the 0^+ resonance in ^{13}C($\vec{p}$, p) where mixing with the nearby 0^- level of ^{14}N creates considerable enhancement of the PNC effect. The measured value (86 $\pm$ 59) x 10^{-7} does not agree with the DDH prediction (-224 x 10^{-7}). However, rather than pointing to a problem in the DDH calculation, this measurement presents a test for the shell model wave functions used in the analysis.

Even larger enhancement factors were found in p-wave resonance scattering of thermal neutrons from ^{139}La[2]. Although this will not add much to the understanding of the PNC NN interaction, it was suggested that this is a unique place to look for T violation in weak NN interaction. D. Bowman and

A. Masaike reported on such efforts underway at Los Alamos and KEK, respectively. In preparation for this experiment A. Masaike measured A_z to be $10.5 \pm 0.6\%$, somewhat bigger than the value of Reference 2.

POLARIZED GAS TARGETS

Recently increased effort has gone into the development of polarized gas targets as a new tool to study spin effects. Unlike solid polarized targets, gas targets are clean in the sense that they consist only of the polarized target atoms. Used as an internal target luminosities greater than 10^{31} cm $^{-2}$ s^{-1} seem possible.

At very low temperatures electron spin polarized atomic hydrogen can be trapped in a high magnetic field and accumulated to high densities. R.S. Raymond described efforts to form an ultra-cold jet of polarized atomic hydrogen by using microwave to extract the atoms from the trap. A target thickness of 10^{14} cm^{-2} could be reached. This would allow to study one and two spin effects in high $p_\perp$ processes.

An alternative scheme that was proposed by W. Haeberli[3] involves a storage cell to accumulate the polarized atoms from a standard atomic beam source. The circulating beam would pass through low conductance openings of the cell. R. Millner presented a proposal to use such a target, as well as a cell filled with optically pumped metastable ^{3}He to measure neutron and proton spin dependent structure functions at the HERA electron storage ring. He anticipates target thicknesses between 10^{14} and 10^{15} cm^{-2}.

A thickness greater than 10^{20} cm^{-2} was achieved by T. Chupp with his high pressure ^{3}He gas target. He polarized the ^{3}He by spin exchange with optically pumped rubidium. The rather long polarizing time precludes it from being used in an open, Haeberli-type cell. However, T. Chupp is proposing to use it as an external target at Bates to measure G_e^n. Another interesting application would be to study spin effects in proton neutron scattering[4].

HIGH ENERGY SPIN EFFECTS

Large spin effects found several years ago in high energy processes are still not understood. We had two reports of experiments using the polarized proton beam at Brookhaven, that continued a systematic study of two areas of unexplained spin effects. With no theoretical explanation at hand, such new data is urgently needed to provide clues for a future understanding.

D.G. Crabb reported on the first systematic measurement of A and A_{NN} in pp-elastic scattering at 18.5 GeV/c covering a $p_\perp^2$-range from 1.4 to 3.2 $(\mathrm{GeV/c})^2$. Both A and A_{NN} show pronounced dips in this kinematic range that are not reflected in the spin averaged cross-section. It is planned to extend these measurements to higher momentum transfer where, at lower energy, unexplained large values for A_{NN} were previously observed at Argonne.

The large polarizations measured in inclusive hyperon production is still not explained. However, in a simple fragmentation picture all the polarization data can be parameterized successfully. This model predicts that no polarization should be transferred from the proton to a lambda hyperon, but $\sim$ 70% should be transferred in the case of a sigma hyperon. F. Nessi-Tedaldi described a measurement of polarization transfer in hyperon production. The prediction for the lambda was confirmed, but the result for the sigma (38 $\pm$ 18%) is in disagreement with the fragmentation picture.

THE FERMILAB POLARIZED PROTON BEAM

We heard from D. Underwood of the recent success at Fermilab to form a polarized proton beam from the weak decay of lambdas. 10^7 polarized protons were produced every 20 second spill with an average momentum of 185 GeV/c. The polarization of the protons depends on the angle between their direction and the direction of the lambdas, which results in a polarization distribution that extends from $^-$60% to $^+$60%. A Primakoff polarimeter with an analyzing power of $\sim$ 57% was used and good agreement with the prediction was found. This new facility will soon allow us a first look at two spin effects at very high energies.

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