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3.8 Measurement of n-p and p-p Asymmetry with Accelerated Polarized Deuteron Beam from 725 to 1000 MeV/Nucleon

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The polarized deuteron beam of SATURNE II was used to measure the analyzing power of n-p elastic scattering. The method is based on the fact that the polarizations of protons and neutrons in the deuteron are equal. It avoids the problems of determining the energy, intensity and polarization of the neutrons in a conventional neutron beam. The asymmetries for n-p and for p-p elastic scattering of quasifree beam nucleons on free protons in CH_2 are measured simultaneously in the same apparatus. The results for $A_{oono}(n\text{-}p)$ are given by

$$A_{oono}(n\text{-}p) = (\varepsilon^d_{np}/\varepsilon^d_{pp})\, A_{oono}(p\text{-}p)$$

and depend only on the measured ratio of the left-right asymmetries $\varepsilon^d_{np}/\varepsilon^d_{pp}$ and on the known analyzing power for p-p elastic scattering.

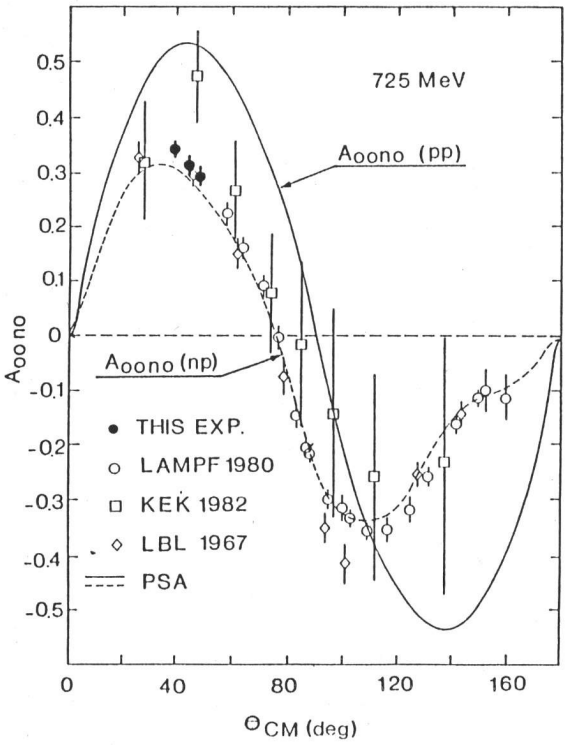

Fig.1 - Results for the analyzing power of 725 MeV/nucl elastic n-p scattering.

The method however assumes that in the kinematic range of the experiment the ratio between n-p and p-p analyzing powers for elastic scattering of quasifree polarized nucleons in deuterons is the same as for free polarized neutrons and protons. This condition is trivially satisfied if there is no difference in analyzing power for scattering of free nucleons or quasifree nucleons in deuterons. This is in fact found to be the case for p-p scattering within error bars since dividing the asymmetry ε^d_{pp}, measured with incident deuterons of 725 MeV/nucl. by the known analyzing power for scattering of free protons we obtain a proton polarization in the polarized deuterons of $P_B = 0.577 \pm 0.002$ which agrees with the value of $P_B = 0.589 \pm 0.027$ deduced from a direct measurement of the deuteron vector polarization [1]. Similarly, comparison of our data with those of another recent Saclay experiment [2] using a pola-

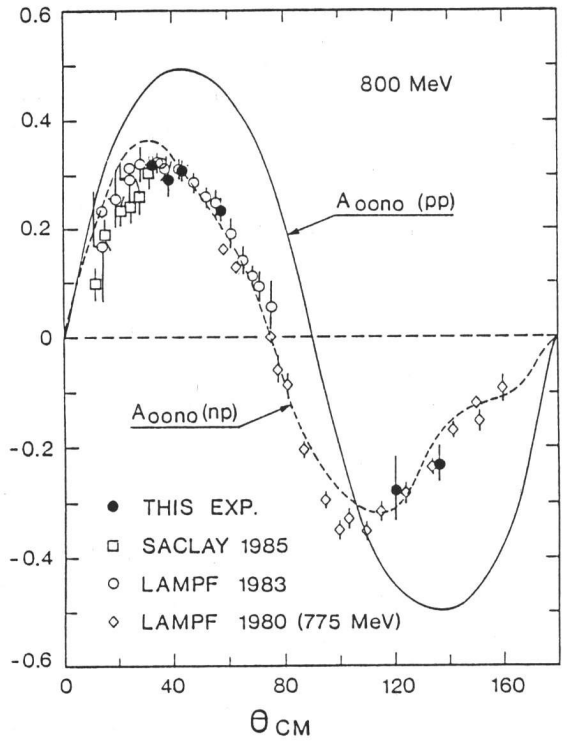

Fig.2 - Results for the analyzing power of 800 MeV/nucl elastic n-p scattering.

rized neutron beam shows no evidence, within the errors , for a difference in n-p analyzing power between free neutron scattering and scattering of quasifree neutrons.

The deuteron beam was extracted at five energies ranging from 1.45 to 2.0 GeV.

We use the polarimeter [3] of the NN beam line. The beam polarization, which is vertical, is reversed for successive cycles of the accelerator. Particles are scattered in CH_2 and carbon targets of the same size (5mm thick, 2mm wide and 15mm high). Four neutron counters are positioned closely behind the rear proton counters of the polarimeter. The beam intensity is monitored by two telescopes counting scatterings from the same target in the up and down direction and by a wire chamber integrating the ionization produced by the beam at each burst. Both monitors are independent of the beam polarization.

Our results for A_{oono}(n-p) are shown in Figs 1 to 3 together with previously published data in the same energy range [2,4, 5,6,7,8]. The curves in Figs 1 and 2 are predictions of the phase shift analysis (PSA) [9] which includes the data [4,5].

Comparing the results of the present experiment with those of the Saclay polarized neutron beam experiment [2](Figs 2 and 3) we observe no evidence for any systematic difference larger than the quoted errors between the analyzing powers for scattering of free polarized neutrons or of polarized neutrons in deuterons.

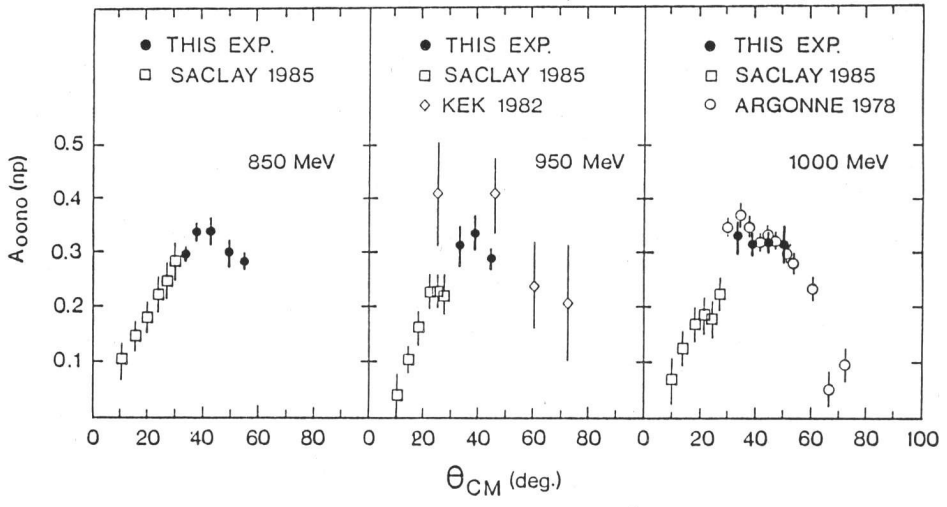

Fig. 3 - Results for the analyzing power A_{oono}(n-p) of elastic neutron-proton scattering at 850, 950 and 1000 MeV/nucl.

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