PROPOSAL OF POLARIZED SPIN EXPERIMENTS OF ELASTIC np SCATTERING AT T_L=1.2∼3.6 GeV

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A rich amount of the spin unpolarized and polarized data for elastic pp and np scattering has been recently accumulated at the incident energy of nucleon T_L=1.2∼2.7 GeV[1]. The EDDA(COSY) experiment provided the precised data on $d\sigma/d\Omega$ at T_L= 0.5∼2.5 GeV. SATURNE II measured The observables of D_{ij}, A_{ij}, K_{ij}, H_{ijk} and the mixed one of them were measured at Saclay for elastic pp scattering at T_L=0.8∼2.7 GeV and np scattering up to 1.1 GeV. The data on $\Delta\sigma_L$ for np scattering were measured at JINR above 1 GeV[2]. As a result of these advances, we have the possibility of carrying out the phase-shift analyses (PSA) of elastic NN scattering at multi-GeV region. Using these data we perform the PSA of elastic pp (Table I) [3] and np scattering[4].

(I) PSA of elastic pp scattering at T_L=1.2-3.6 GeV

It is found that our solution obtained by the present PSAs are consistent with the one of our previous PSA at higher energies. The difference between our solutions and those of other groups becomes clear above 2 GeV. Our previous PSAs of pp elastic scattering at higher energies show a strong energy dependence of the spin-orbit phase-shift of p-wave. We suggested the possibility of the phase transition from the hadron phase to the quark-gluon phase. It is interesting to investigate whether the strong energy dependence of spin-dependent forces would be found in elastic np scattering in the same energy region or not.

(II) Amplitudes analyses of elastic np scattering T_L=1.2-3.6 GeV[5]

Since the amplitudes of np scattering consist of I=1 and I=0 parts, we search I=0 amplitudes by PSA of np scattering by fixing the I=1 amplitudes of pp scattering obtained by PSA. The deficiency of the experimental data are supplied by the pseudo-data, which are presented by means of interpolating the experimental data on their energy dependencies with Splin-Function Method(Table II). We obtain the three different solutions at the three energy points. Comparing the χ^2 values of each solutions obtained by PSA, the most favorable one shows that the predicted values of $\Delta\sigma_T$ go to zero with increasing energy(Sol. A(1.2 and 2.5 GeV), Sol. C(3.6 GeV), as seen in Fig. 1). It seems that all of data on the $\Delta\sigma_{L,T}^{pp,np}$ go to zero with increasing energy. It is interesting to perform the measurements of $\Delta\sigma_T^{np}$ in this energy region.

Table 1:The observables and their numbers of experimental data used in the phase-shift analyses of elastic pp scattering. The symbol(*) shows the number of pseudo-data.

T_L (GeV)	1.295	1.596	1.796	2.096	2.396	2.696
Forward Obs.[a)]	7(*3)	7(*3)	7(*3)	7(*3)	7(*3)	7(*3)
$d\sigma/d\Omega$	50(*8)	48(*7)	35	37	83	72
D	13	18	12	25	3	2
D_{LS}	16	17	16	19	7	5
A_{NN}	35	36	40	43	40	40
A_{LL}	60	52	55	81	32	20
A_{SL}	43	38	32	50	27	18
K_{NN}	8	9	6	8	2	2
K_{LS}	7	8	8	9	4	3
$K_{LS}+\alpha K_{SS}$ $+\beta K_{LL}$	8	8	4	9		
$H_{LLN}+\beta K_{LL}$	7	7	10	10	4	3
$H_{NLS}+\alpha K_{SS}$	7	9	8	8	4	3
$H_{LNS}+\alpha H_{SNS}$ $+\beta KLL$	8	9	6	9		
$K_{NN}+\alpha H_{SLN}$ $+\beta K_{SL}+\gamma H_{NLL}$	8	9	10	8	4	3
Total	327	326	319	393	285	228

a) Forward obs.: $\sigma_t, \sigma_r, \Delta\sigma_T, \Delta\sigma_L, \alpha$, Re$F_2$, Re$F_3$

Table 2:The observables and their numbers of the experimental data used in the amplitude analysis of elastic np scattering. The symbol(*) shows the number of pseudo-data.

T_L (GeV)	1.2	2.5	3.6
Forward Obs.[a)]	7(*3)	7(*3)	7(*3)
$d\sigma/d\Omega$	116((*30)	*31	*32
P	114(*34)	*34	*34
Total	385	72	73

In order to obtain the reliable amplitudes of np scattering by PSA, we need more spin observables at T_L= 1.2∼3.6 GeV. If spin-polarized experiments for np scattering are performed at the energy where a rich amount of spin observables for pp scattering were measured, then we could obtain more reliable solution in np scattering by PSA in this energy region.

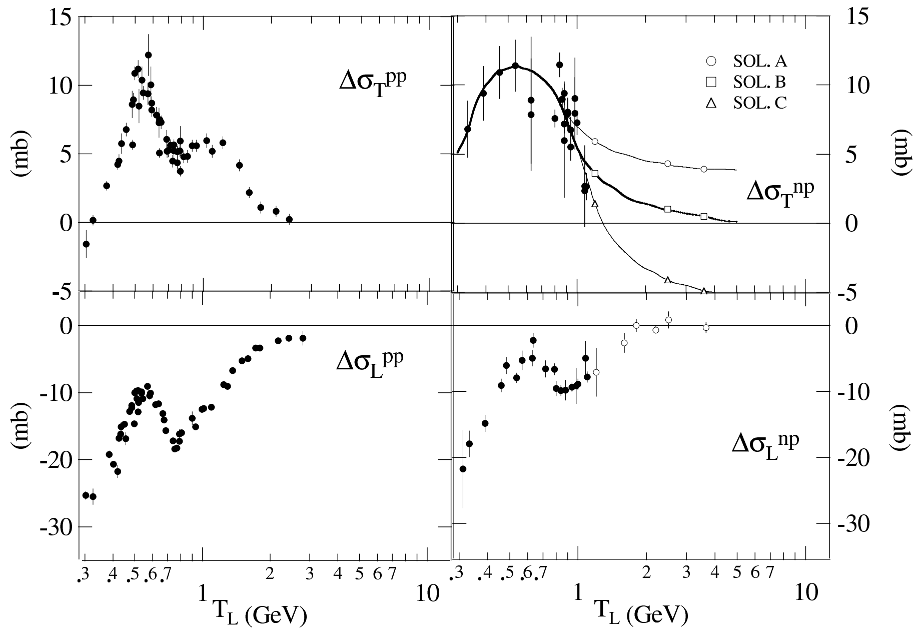

Figure 1: Experimental data on the forward spin observables measured so far. The open circles(∘) are the experimental data measured at JINR recently.

References

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