

Nucleon-Nucleon Scattering at Small Angles, measured at ANKE-COSY

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Since Quantum Chromodynamics (QCD) can not conclusively describe the strong interaction at low energies, description of nucleon-nucleon (NN) interaction requires a detailed phenomenological study of proton-proton (pp) and proton-neutron (pn) scattering. Hence, the partial wave decomposition of fundamental scattering data is a very important issue in physics. The SAID analysis [1] has proved to be truly invaluable tool over many years for researchers working in this area. Such an analysis is based on the measurement of various NN scattering observables at different energies over the full angular range. Many accelerators around the world included the NN study into their research program, however even after many years of studies, there are still many gaps in our knowledge. As one can see on the Fig.1a, even in the data base of the most basic reaction of proton-proton elastic scattering, there has been a significant gap at the small angles ($\theta_{cm} < 30^\circ$) above 1 GeV. The situation is much worse with proton-neutron scattering (Fig. 1b).

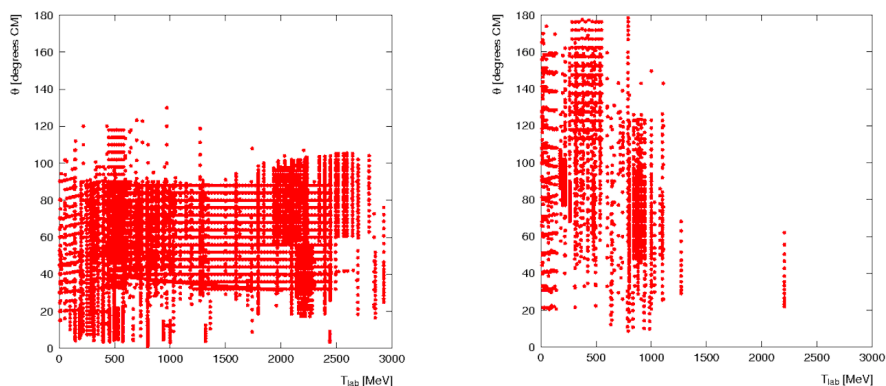


Figure 1: Abundance plot of c.m. scattering angle (θ_{cm}) versus beam energy (T_{lab}) for experiments on the analyzing power for proton proton elastic scattering (a) and proton-neutron scattering (b). Source: <http://nn-online.org>.

Adding to the NN scattering data base is one of the major priorities of the ANKE collaboration. It has been demonstrated that polarized beams

and targets are experimental tools of choice to probe spin effects in NN-scattering experiments. During the experiment performed at COSY-Jülich scattering data was taken at small angles for six beam energies between 0.8 and 2.4 GeV with a polarized proton beam incident on both hydrogen and deuterium unpolarized targets. The new ANKE pp data [2] are markedly different from the last published SAID solution just underlying the need for a full angular coverage.

While pp data from ANKE closes a very important gap at small angles, proton-neutron (pn) data is a crucial contribution to the very incomplete pn data base. The lack of information on spin observables results in large uncertainties in pn phase shifts. Experiments at COSY can lead to significant improvements in the situation through the study of quasi-free reactions on the neutron in the deuteron. The contribution will report on the measurement results of cross section and spin observables, obtained in the earlier ANKE experiments with polarized deuteron beam, and the abovementioned new experiment with polarized proton beam and unpolarized deuterium target.

References

- [1] R.A. Arndt et al. Phys. Rev. C **62** (2000) 034005; R.A. Arndt et al. Phys. Rev. C **76** (2007) 025209; <http://gwdac.phys.gwu.edu>.
- [2] Z. Bagdasarian et al. Physics Letters B **739** (2014) p. 152-156.