LASER STREAMER DETECTOR FOR LOW ENERGY HADRON-PROTON SCATTERING STUDY

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The pion-nucleon sigma-term [1], representing a measure of the chiral symmetry breaking in strong interaction, can be estimated using the pion-nucleon *S*- and *P*-wave isoscalar scattering lengths. One of the best ways to find these pi-p characteristics is to study elastic scattering beginning from the low projectile's energies. The comprehensive review of the situation in pi-p study is given in [2]. The accurate elastic cross section and polarization data have been obtained only at the energies higher than 100 *MeV*. In the range of energies from 30 *MeV* to 100 *MeV* there are discrepancies. Some of the data are in agreement with the phase shift analysis based on the high energy measurements while the other aren't. These discrepancies lead to uncertainty of the value of sigma-term. Any pi-p data at the energy below 20 *MeV* are absent up to now while namely this region can be important for the reliable estimate of the scattering lengths. The difficulties with low energy measurements can be explained by very short ranges of both the scattered pions and, especially, the recoil protons.

This difficulty can be overcome with the laser streamer detector (LSD) designed in our laboratory to study low energy hadron-proton scattering. The layout of the pi-p experiment is shown in figure. Our LSD is based on the hydrogen streamer chamber [3] with a set of the scintillators (C4—C7) built into the lateral walls in order to register both the scattered and recoil particles in coincidence with the incident one. Incident pions have to be identified and counted by RF-referenced TOF to in-beam scintillators C1, C2 and the hole scintillation anticounter C3: $C1 \times C2 \times \overline{C3}$. The triggering signal of useful events is $N = C1 \times C2 \times \overline{C3} \times \overline{C8} \times [C4 \times C6 + C5 \times C7 + C5 \times C6]$.

The main characteristics of our experimental set-up are: time of memory — 1 microsecond, dead time <3 second, spatial resolution — 150 micron, angular resolution — (0.1—0.2) degree. Because of high angular resolution in our laser streamer chamber two-body elastic scattering events can be easy identified. The visual

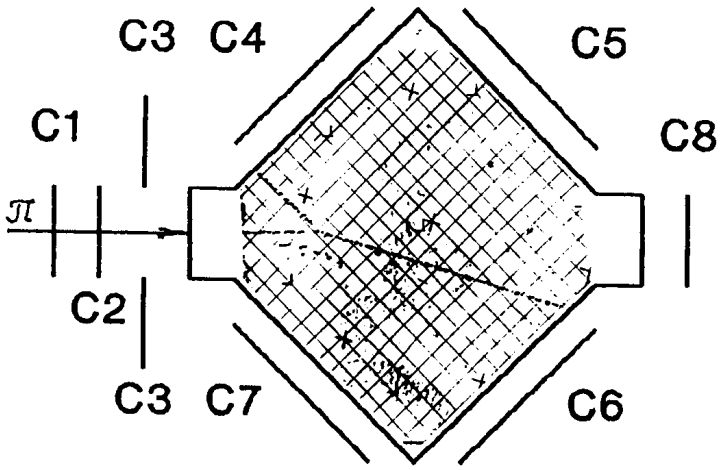

Fig. Experimental set-up. (C1—C8) – scintillation counters. Picture of event is shown in plane of chamber

pictures of the elastic scattering events are recorded by two film cameras with their subsequent analysis on semi-automatic, manually oprated measuring machines. In future we plan to use the CCD technique to record events thus ensuring data processing without manual assistance.

The LSD can operate on the stretched beams with intensity up to 10^6 particles per second allowing to measure cross section of about 1 *mb/sr* at the reasonable counting rate.

Trial run with LSD has been performed at the pion beam of the LNPI synchrosyclotron. As an example, one of the elastic pi-p scattering events at 50 *MeV* is shown in figure 1.

We consider that the LSD represents a unique opportunity to measure low-energy elastic pion-proton scattering in the wide range of energies beginning from 5 *MeV* which can improve the situation with pi-p data and estimating of the sigma-term.

References

1. Gasser J., Sainio M.E., Swarc A. //Nucl.Phys., B307. 1988. 779.
2. Hohler G. //Nucl.Phys., A508. 1990. 550.
3. Bakanov L.V. et al. LNPI Research Report 1988—1989. 1990. P.41.