Preparation of experiments to study light nuclei structure at Nuclotron (JINR)

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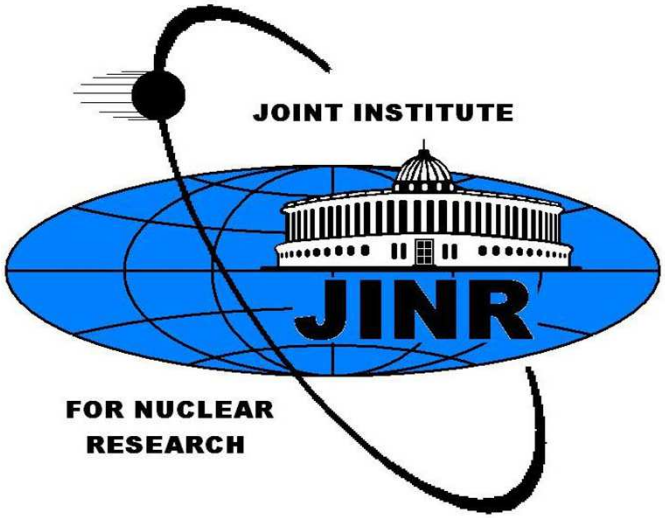


XXI Baldin Seminar,10-15 September 2012

Introduction

The results of preparation of experiments at extracted beam and internal target station at Nuclotron-JINR are reported in this presentation.

First extraction of the 3.42 A·GeV carbon beam and of the 4 A*GeV deuteron beam at Nuclotron and their transportation to the experimental area and the measurements to study dp-elastic scattering, dW- and dAg- quasi-elastic scattering at internal target station at Nuclotron are performed.

BM@N - project

The study of the dense baryonic matter at Nuclotron (BM@N project) is one of the main scientific directions at the LHEP-JINR. The research program of BM@N project will be focused on the production of strange matter in heavy-ion collisions at beam energies between 2 and 6 A*GeV. For these purposes it is proposed to install an experimental setup at the 6V beamline in the fixed-target hall at Nuclotron.

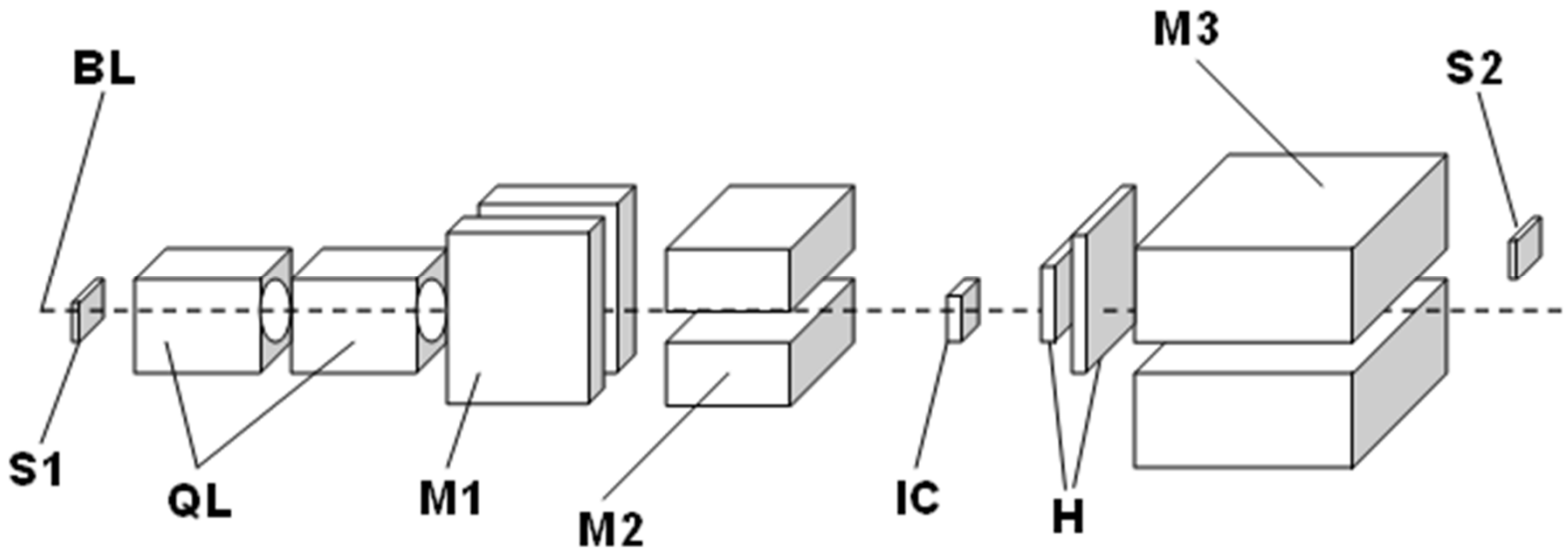
The carbon- and deuteron- beams with energies 3.42 and 4 A*GeV respectively were successfully transported to 6V – area.

DSS - project

The goal of the Deuteron Spin Structure project is systematic study of the polarization observables in hadronic reactions by using polarized deuteron beam and polarized ^{3}He – target at intermediate and high energies. The experiment to measured T_{20} and C_{yy} for ^{3}He(d,p)^{4}He - reaction at 1.0-2.0 GeV deuterons energy is planned. The results this experiment will help to understand short-range deuteron spin structure.

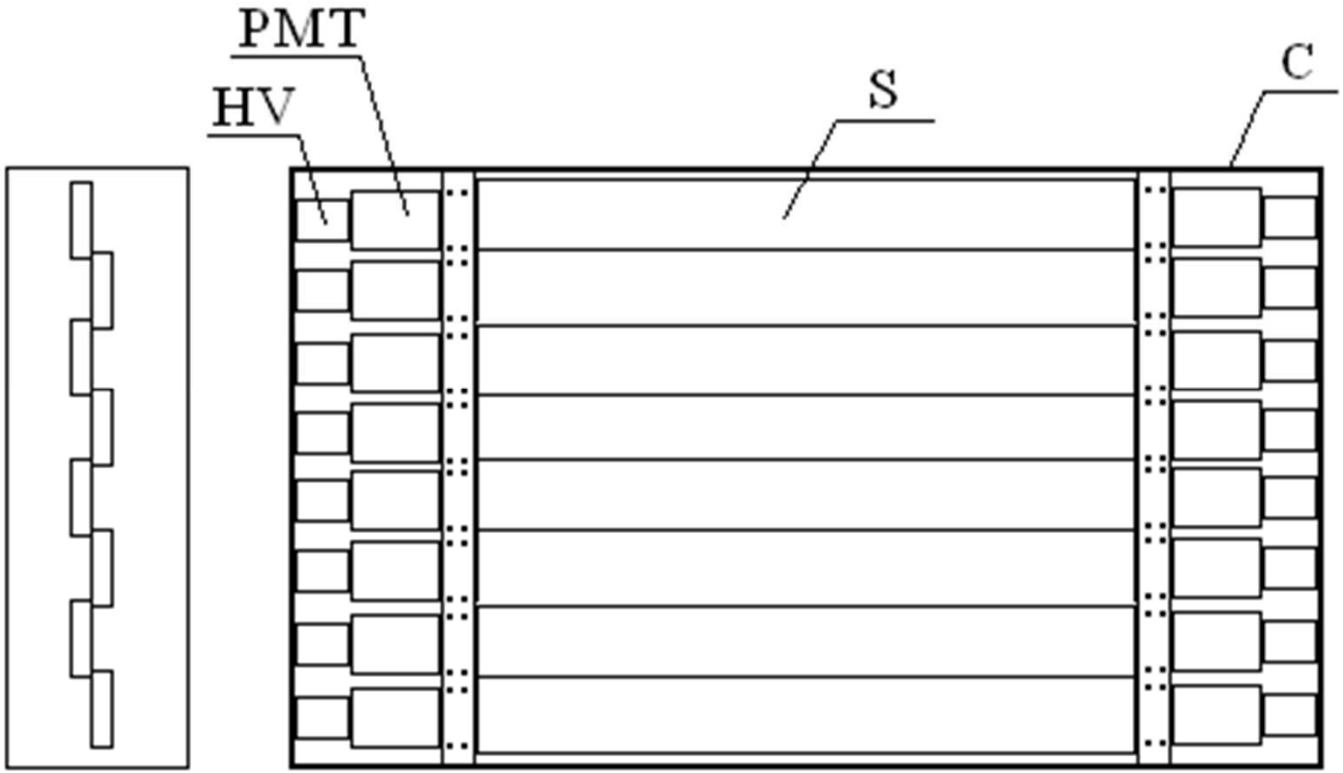
In addition the study of deuterons interaction with protons and nuclei is included in DSS project.

Scheme of the experiment on the extracted beam at Nuclotron



The layout of the experiment. BL is the optical axis of the 6V beam line, QL and M1-M3 are the quadrupole and dipole magnets, respectively. IC is the coordinate ionization chamber, S1 and S2 is the start- and stop- scintillation counter, H are the 2 planes of the scintillation counters hodoscopes.

Hodoscope

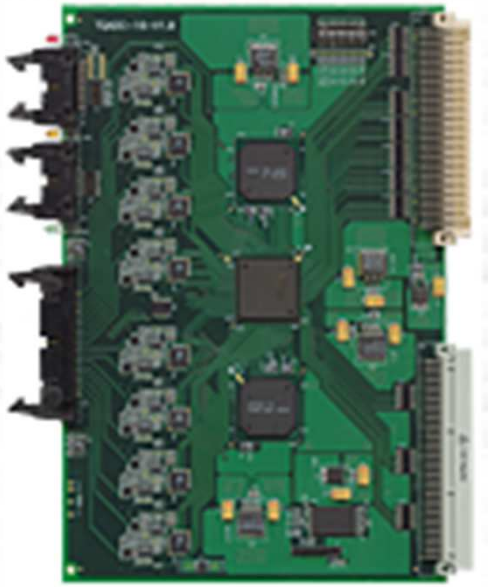


- Left: profile of the hodoscope
- On the right: the layout of the hodoscope. C – case, HV - cells of high-voltage power,PMT - photomultipliers, S – scintillation plates

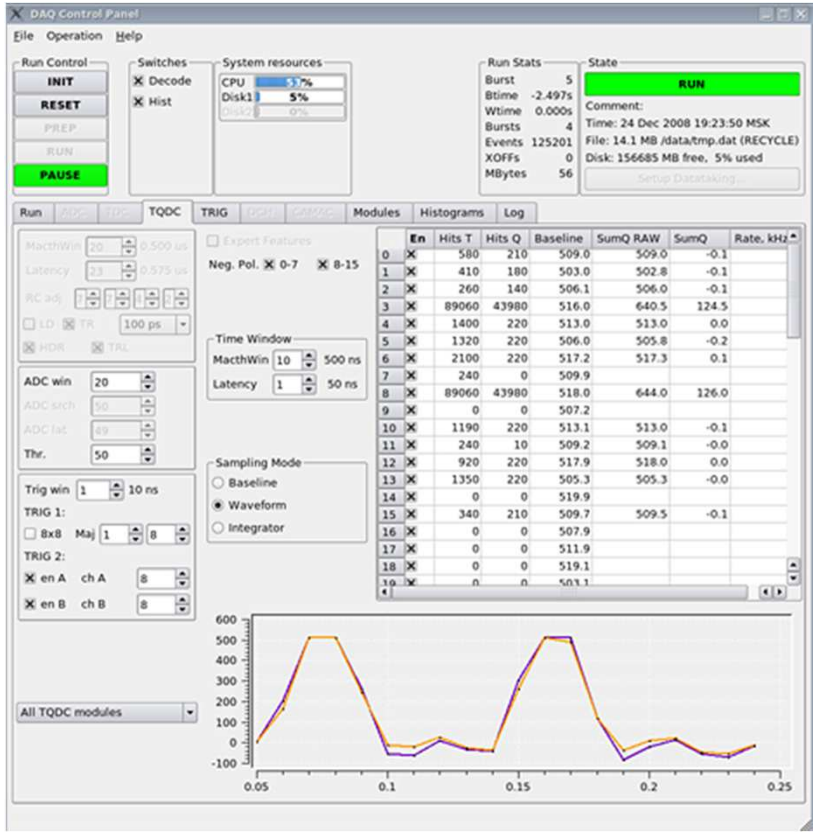
VME Data Acquisition System

The VME based data acquisition system was used for the data taking from scintillation detectors.

TTCM



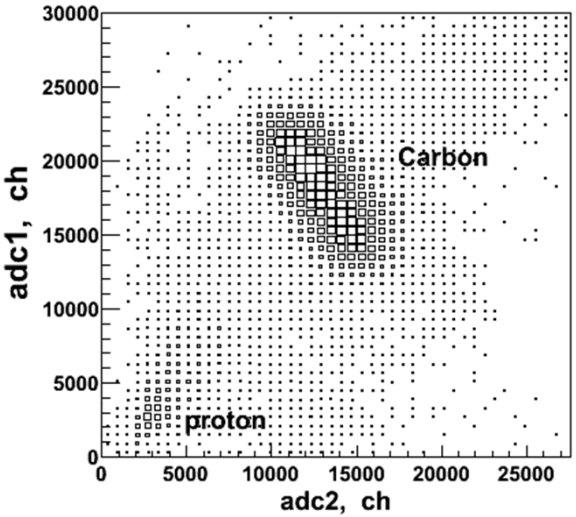
TQDC-16



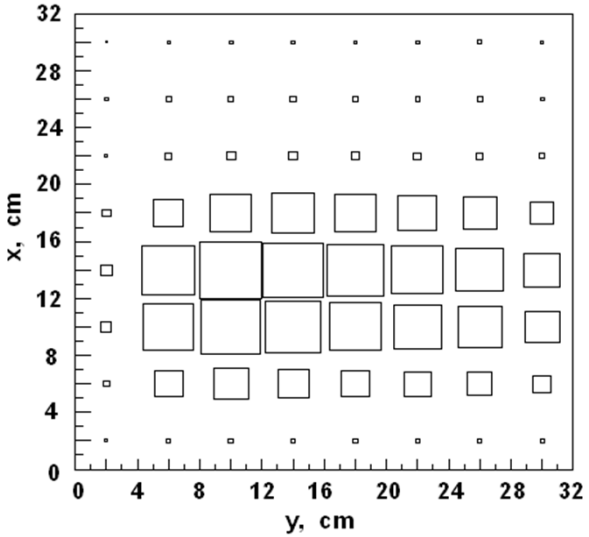
GUI Controls

TQDC-16 – 16 - channel time and charge digitizer

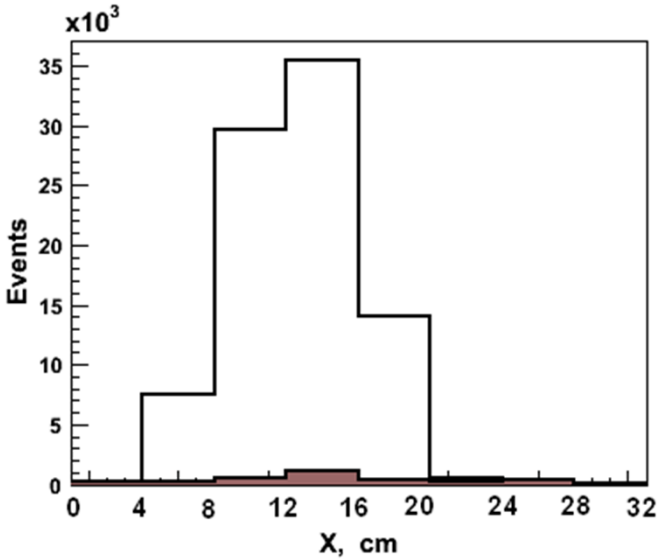
Measurements on the carbon nuclei beam at 3.42 A*GeV



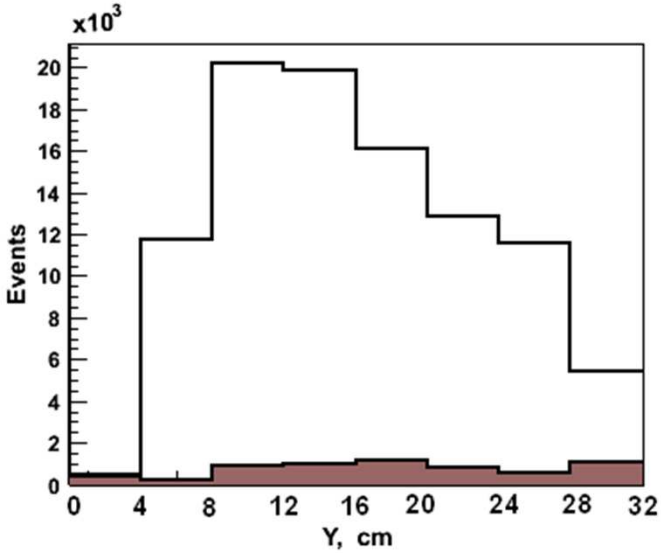
The signal amplitudes correlation for one of the scintillation detector of the hodoscope.



The X-Y coordinates correlation for carbon nuclei.

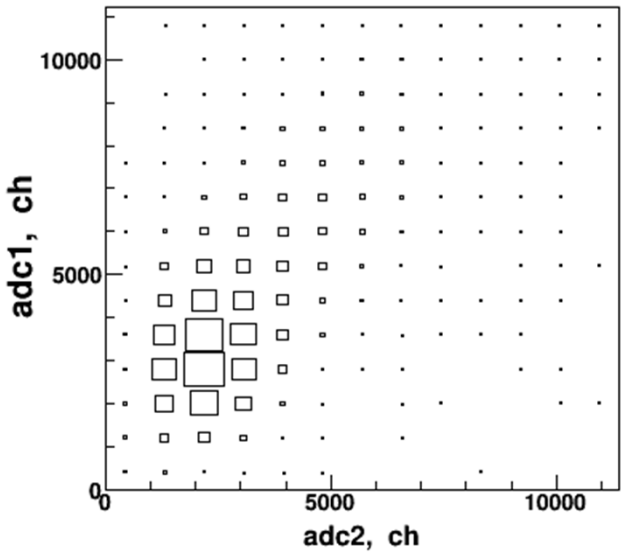


The X-coordinate beam profile measured by scintillation hodoscope.

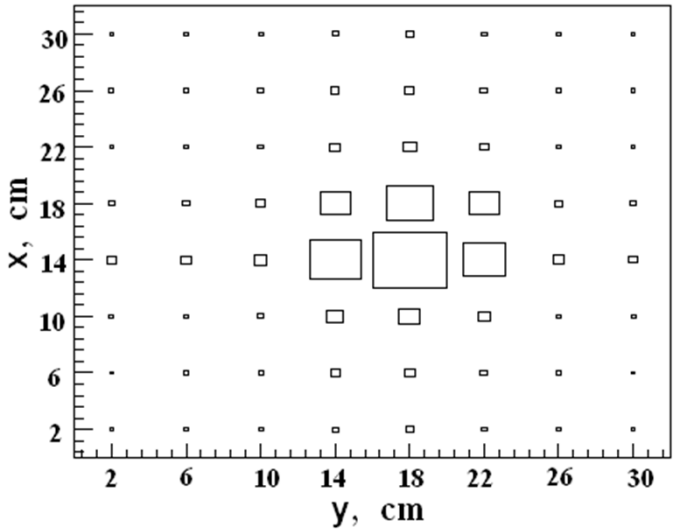


The Y-coordinate beam profile measured by scintillation hodoscope.

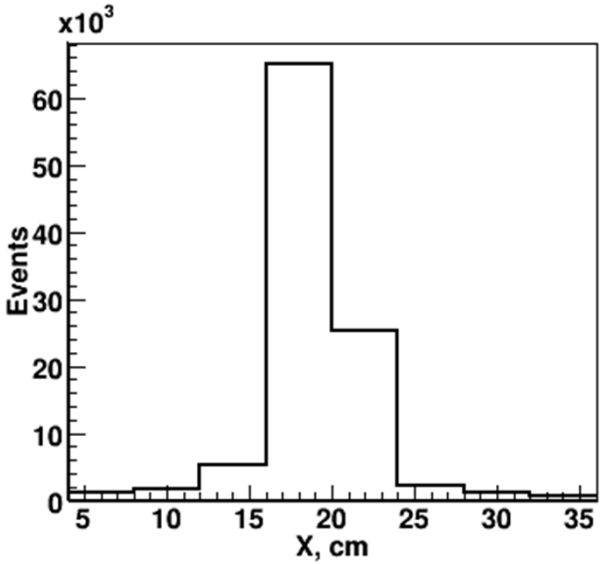
Measurements on the deuteron beam at 4 A*GeV



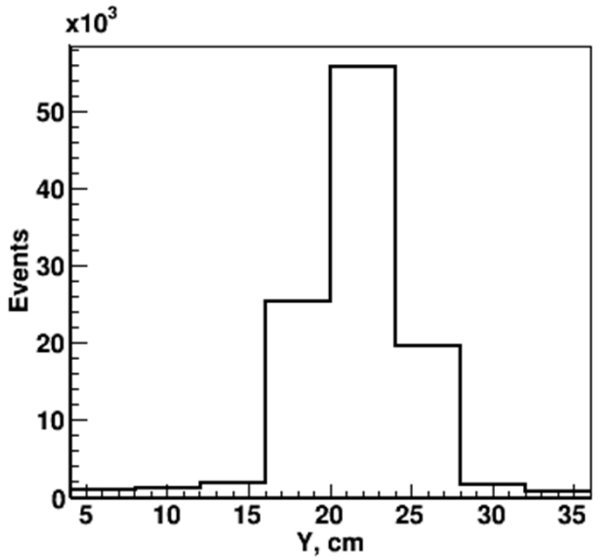
The signal amplitudes correlation for one of the scintillation detector of the hodoscope.



The X-Y coordinates correlation for deutoron beam.

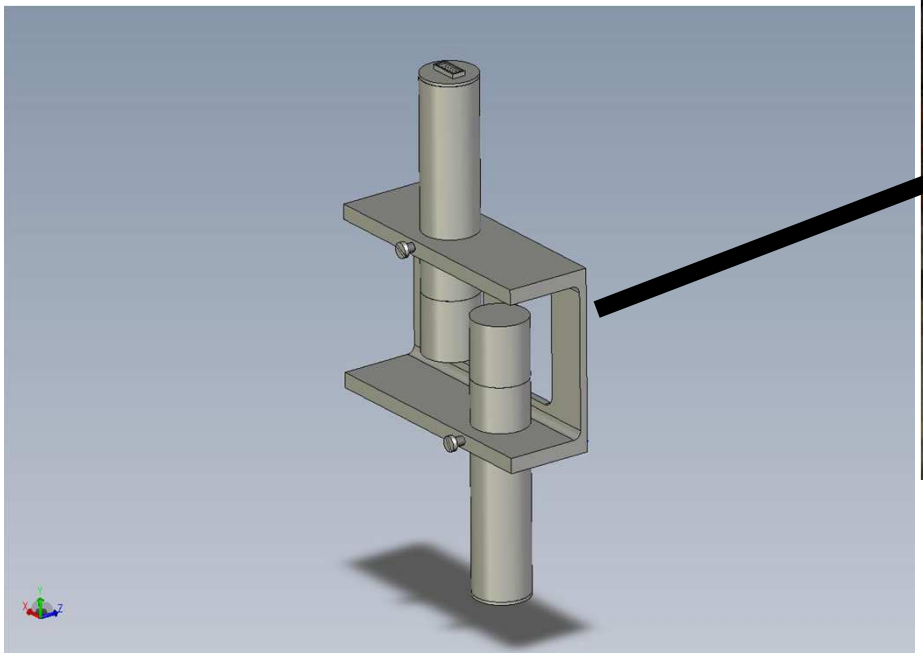


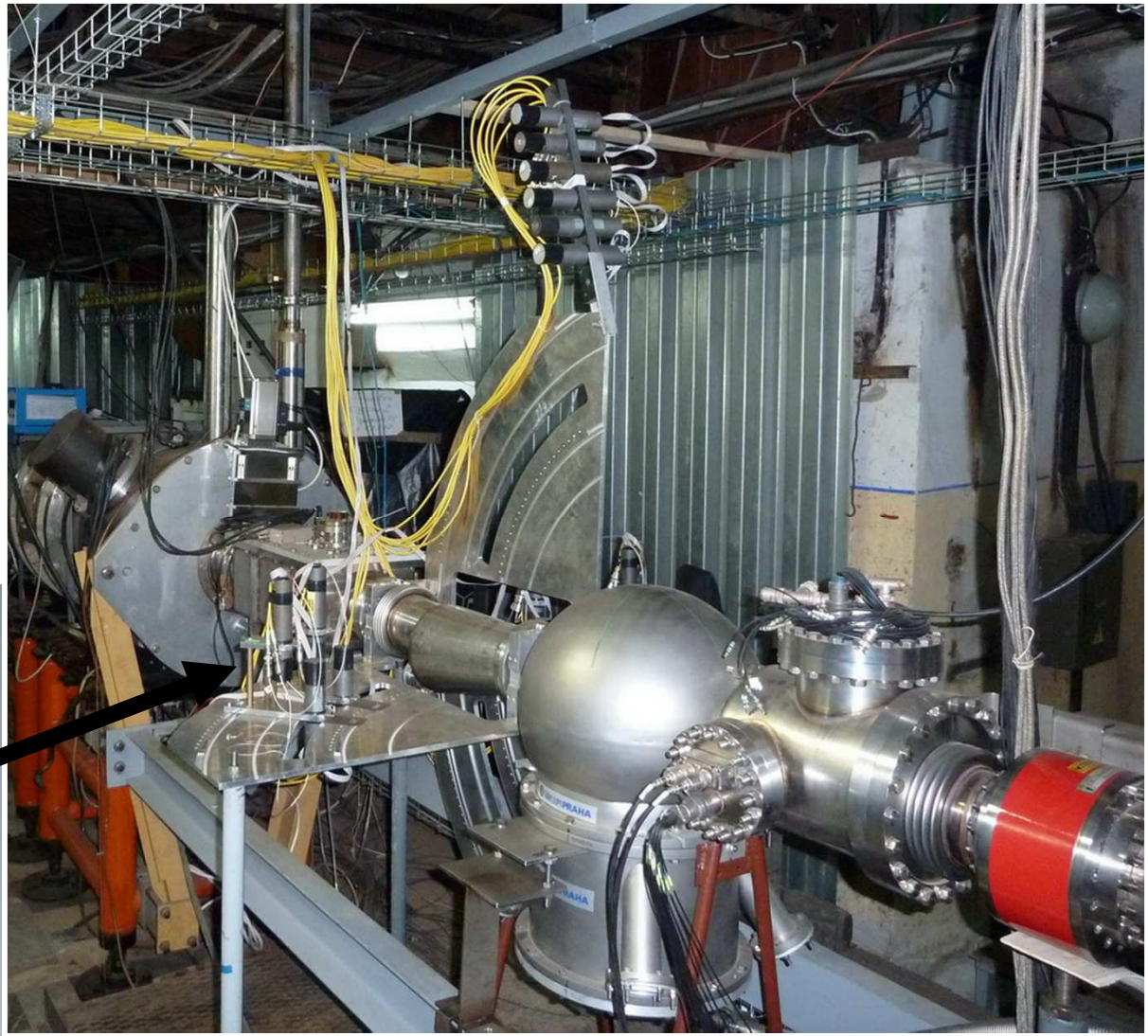
The X-coordinate beam profile measured by scintillation hodoscope.



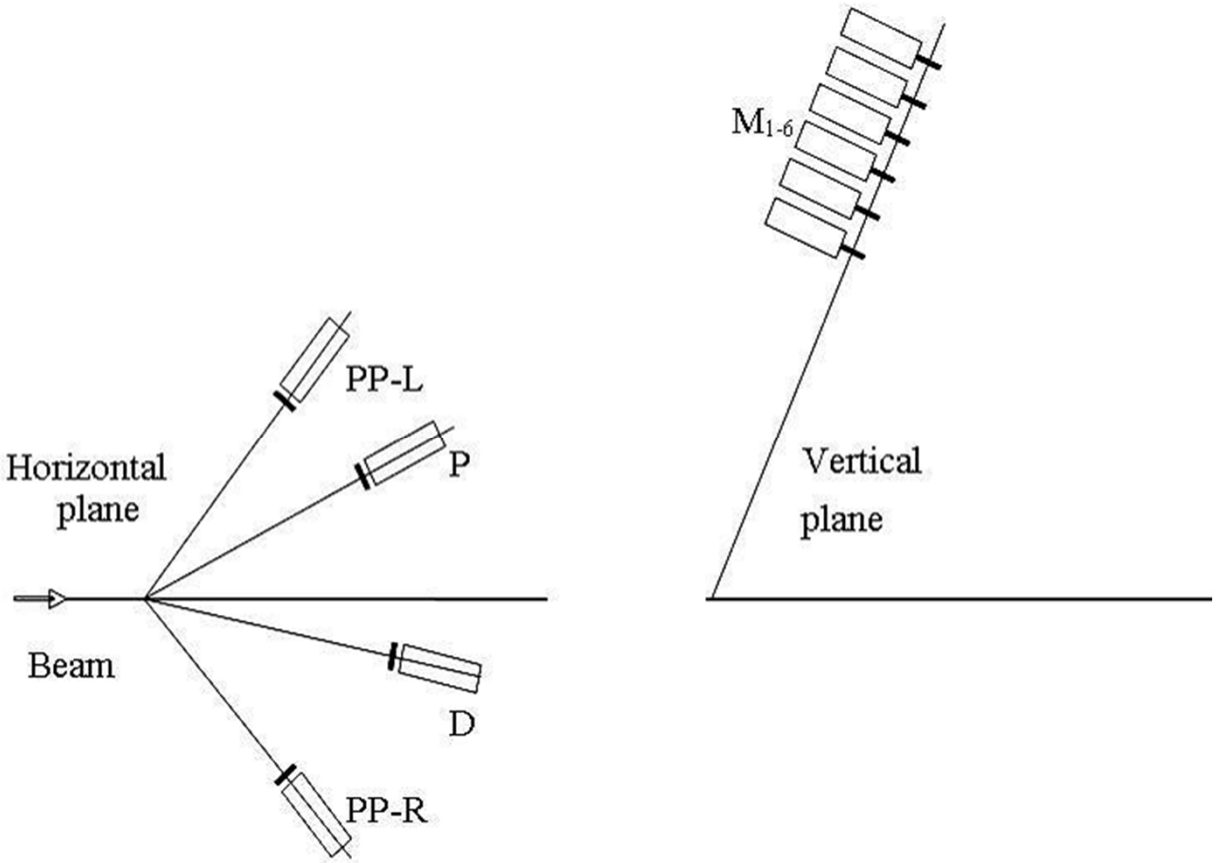
The Y-coordinate beam profile measured by scintillation hodoscope.

Measurements on the Internal target station

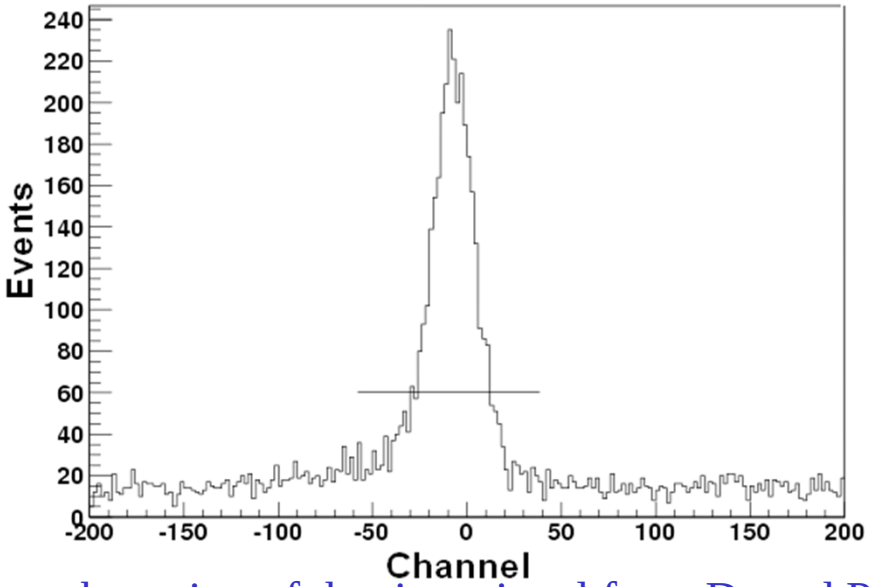




Layout of the counters with respect to the beam diraction



Data for dp-elastic scattering at 1 GeV/n



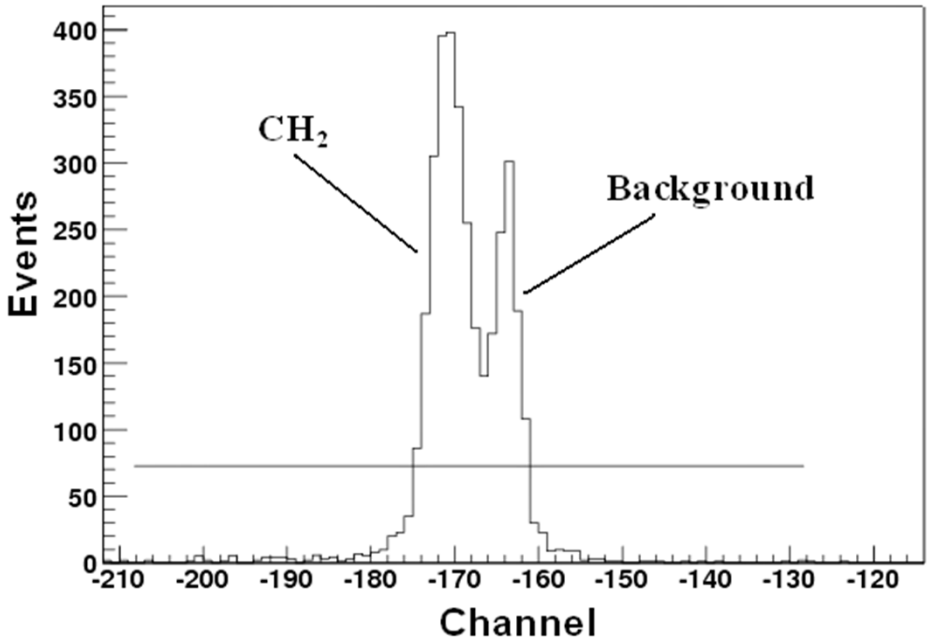
The subtraction of the time signal from D- and P-counters. The data were obtained by using the counters based on the FMP FEU -85.

$\Theta_{dp}=75^{o}$

c.m.s.

$\Theta_{pp}=90^{o}$

The subtraction of the time signal D- and P-counters. The data were obtained by using the japanese counters based on the FMP Hamamatsu H7416MOD.



The anomalous pion yield is observed in same experiment on the interaction of protons with nuclei. The experiment at ITS with DELTON setup on the measurement of the pion yield in the interact of deuterons with W and Ag nuclei was performed in 2011 – 2012 years. During these experiments we measured the energy dependence of the dp- and pp-yield in dW and dAg – interactions.

W-target

$\Theta_D = 22.1^o$
$\Theta_P = 48.4^o$ **l.s.**
$\Theta_{PPL} = \Theta_{PPR} = 42.6^o$

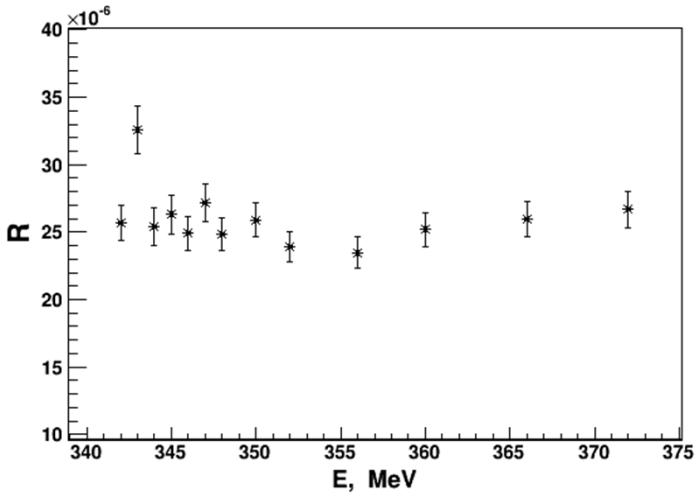
$\Theta_{dp} = 75^o$ **c.m.s.**
$\Theta_{pp} = 90^o$

Ag-target

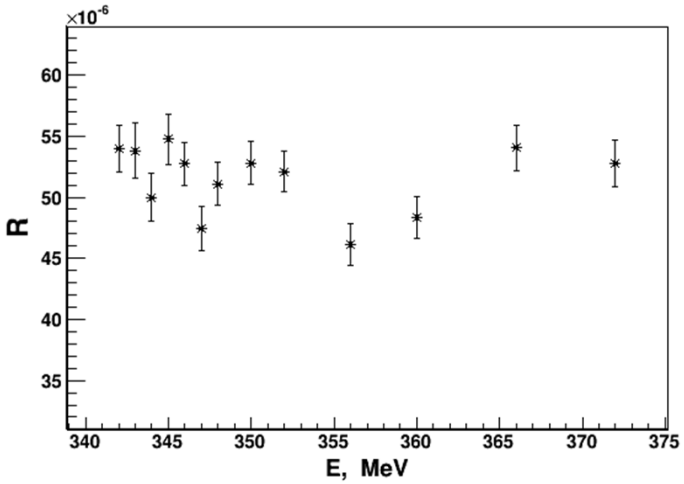
$\Theta_D = 20.5^o$
$\Theta_P = 50.1^o$ **l.s.**
$\Theta_{PPL} = \Theta_{PPR} = 42.6^o$

$\Theta_{dp} = 70^o$ **c.m.s.**
$\Theta_{pp} = 90^o$

d-W - reaction

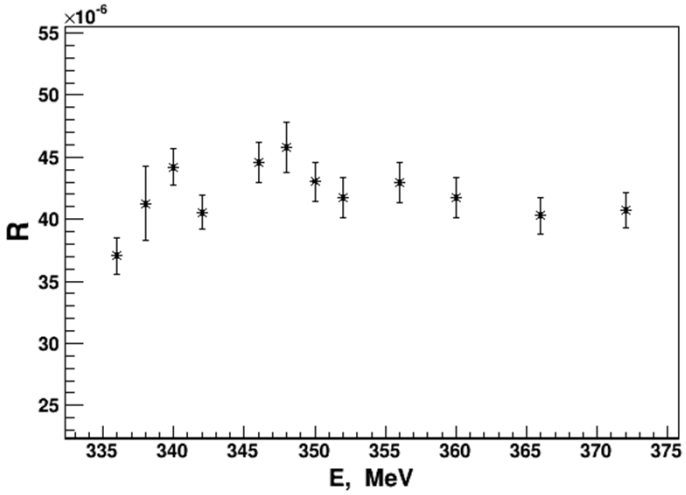


dp

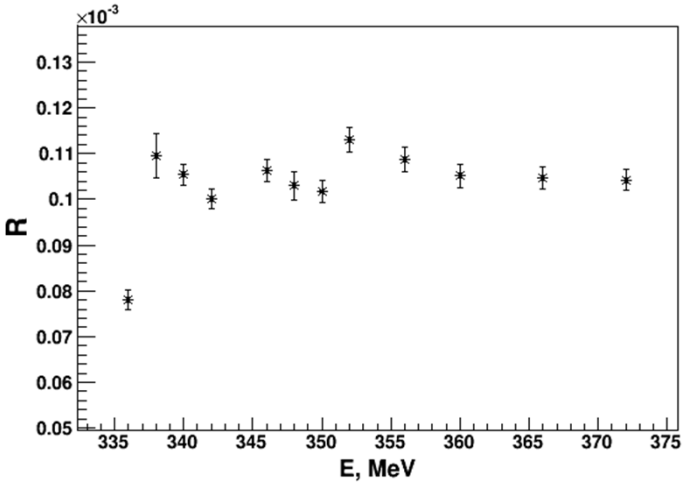


pp

d-Ag - reaction

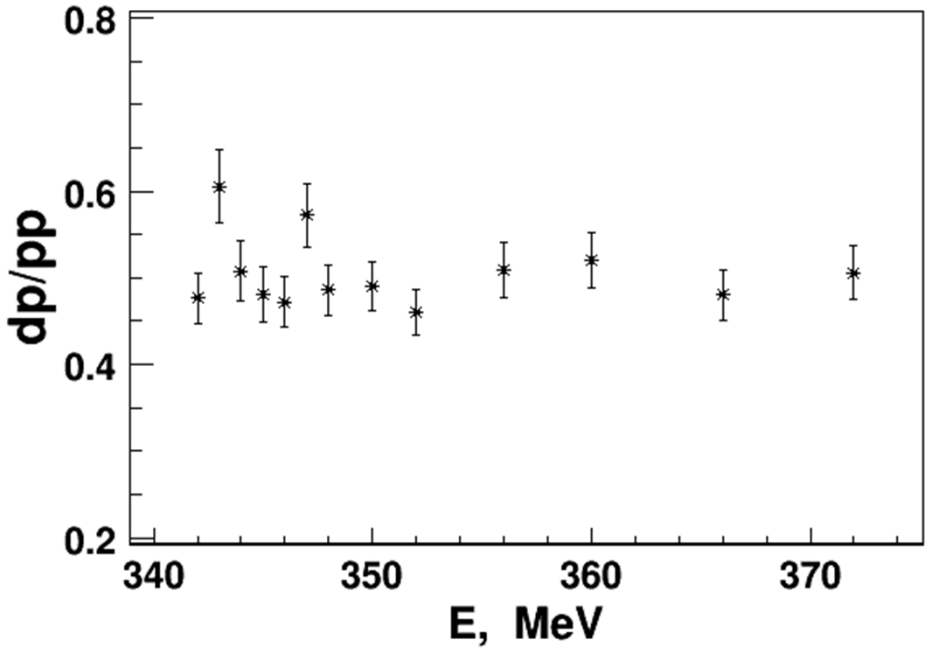


dp

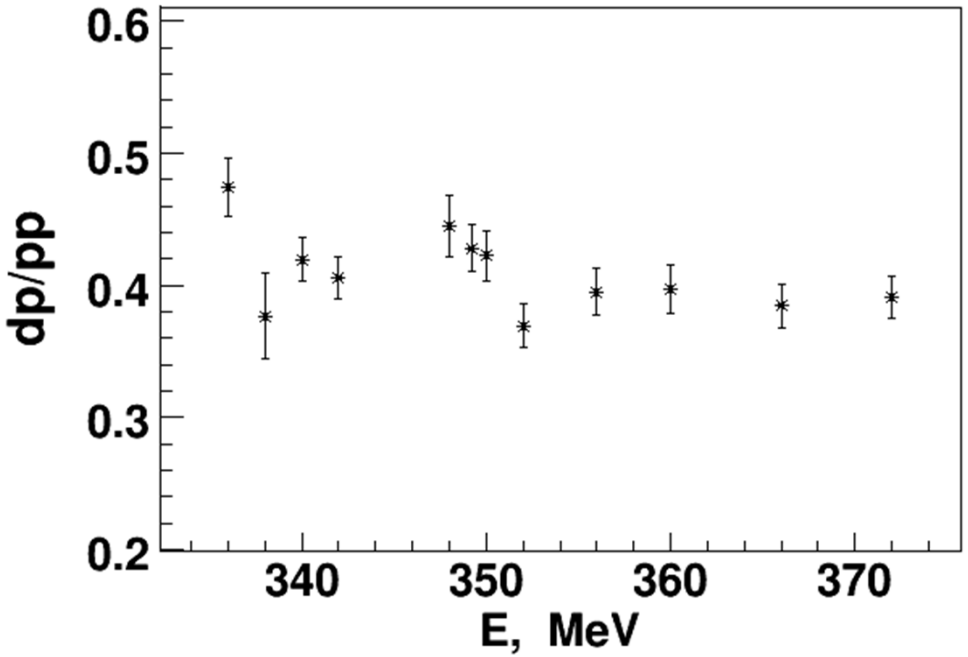


pp

d-W - reaction

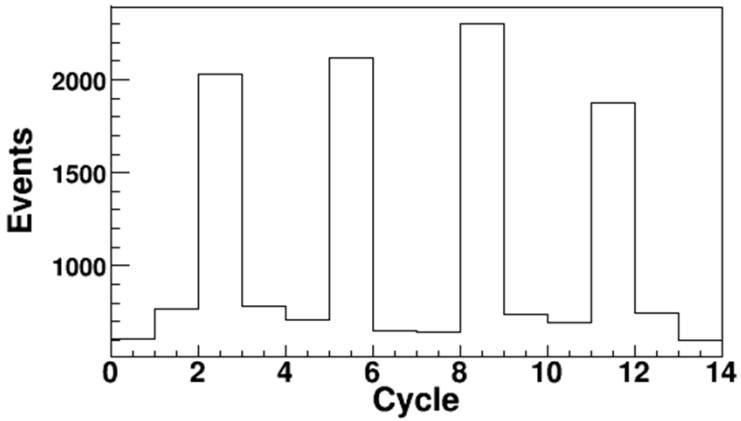


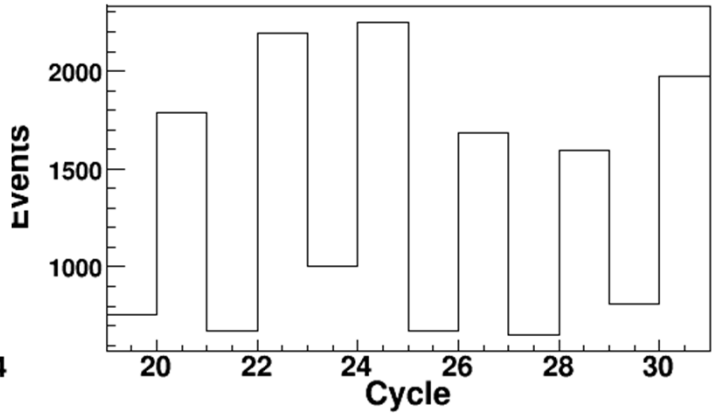
d-Ag - reaction

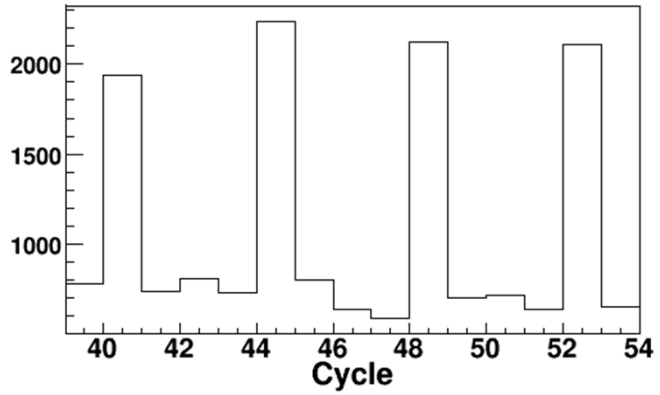


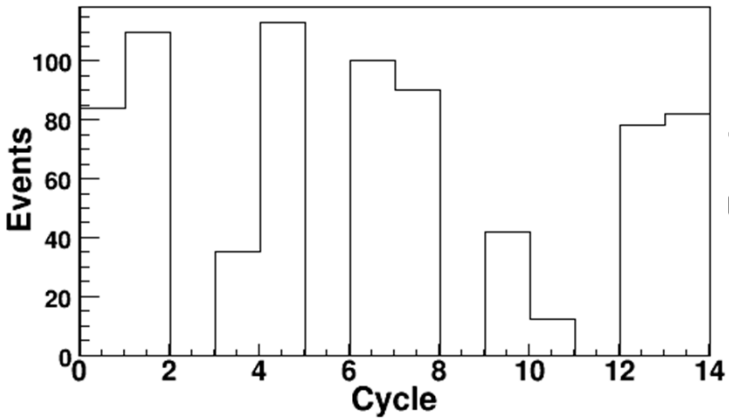
Measurements with the omission of cycles

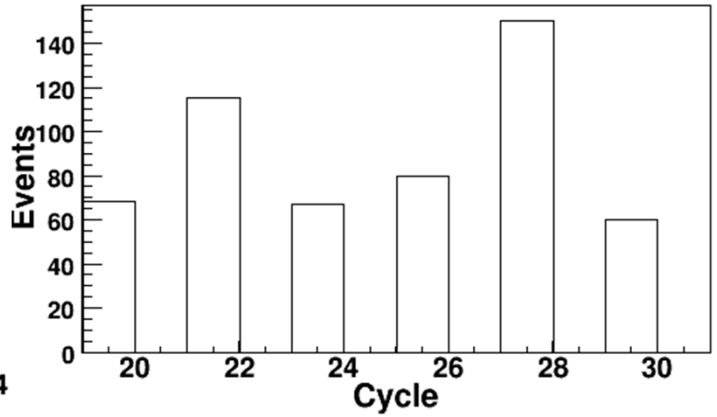
Extracted beam

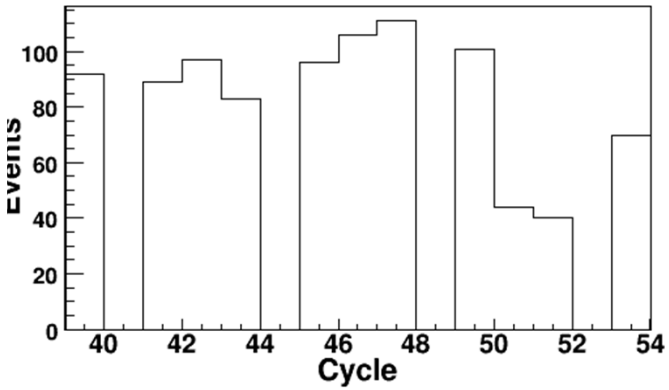












Internal target station

Conclusion

- First extraction of the 3.42 A·GeV carbon beam and 4 A·GeV deuteron beam at Nuclotron and their transportation to the experimental area are performed. Work of magnetic optic elements was demonstrated.
- Measurements of dp-elastic scattering, dW- and dAg- quasi-elastic scattering at internal target station at Nuclotron are performed. Energy dependences of dp-elastic scattering and pp–quasi-elastic scattering was measured. The any anomalous effect isnt observed for these channels.
- The regime of the beam sharing between the experiment at ITS and extracted beam was realized. The simultaneous work of the ITS and extracted beam setup was demonstrated.

Thank you for Attention