

VECTOR POLARIZATION OF THE DEUTERON BEAM ON NUCLOTRON AT THE ENERGIES FROM 200 TO 650 MeV/N

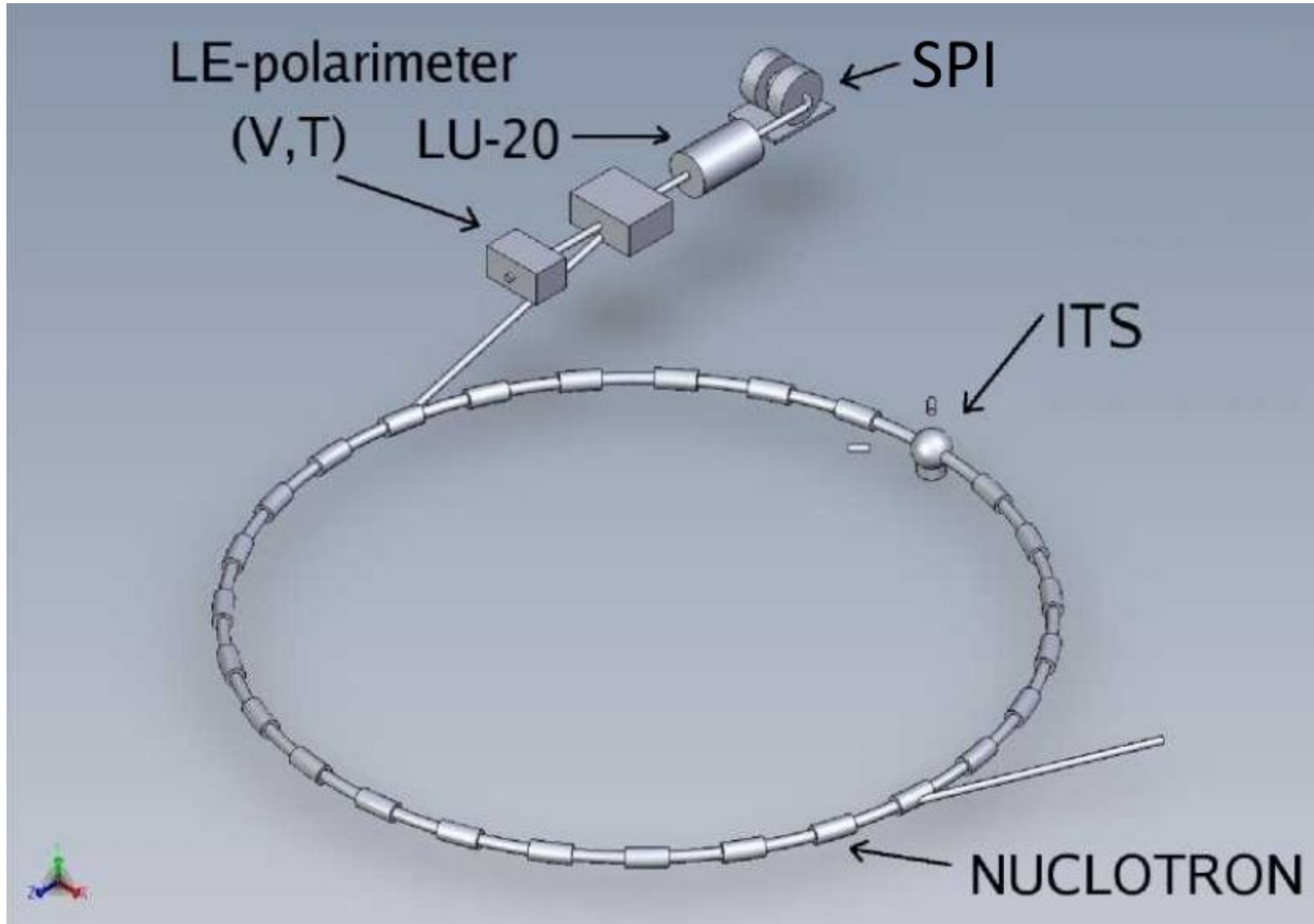
Volkov Ivan

DSS Collaboration, LHEP JINR

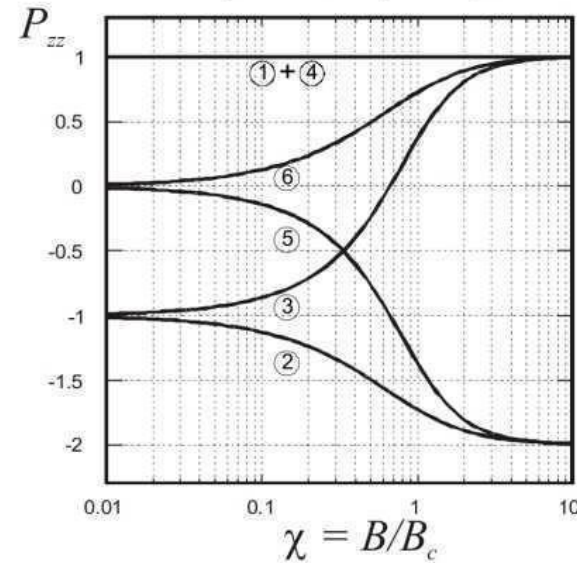
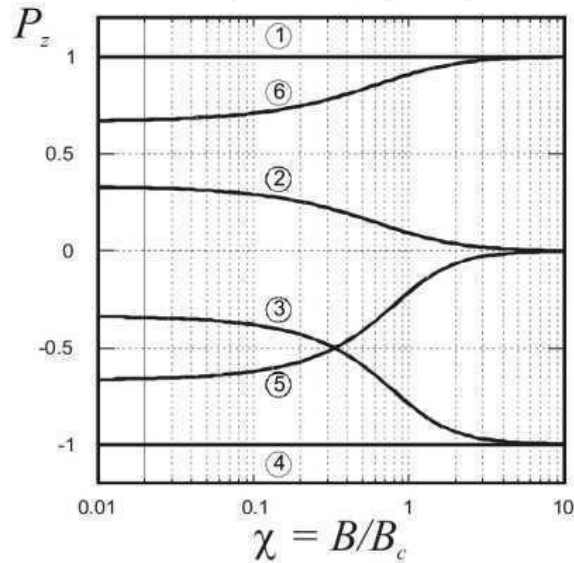
Motivation

1. The measurement of vector polarization of the polarized deuteron beam at energies up to 650 MeV/n using quasi-elastic proton-proton scattering;
2. Preparation of the polarimetry for the run with polarized proton beam.

Scheme of the experiment at NUCLOTRON



Beam polarization



3 modes of the ion source were used:

(P_z, P_{zz})

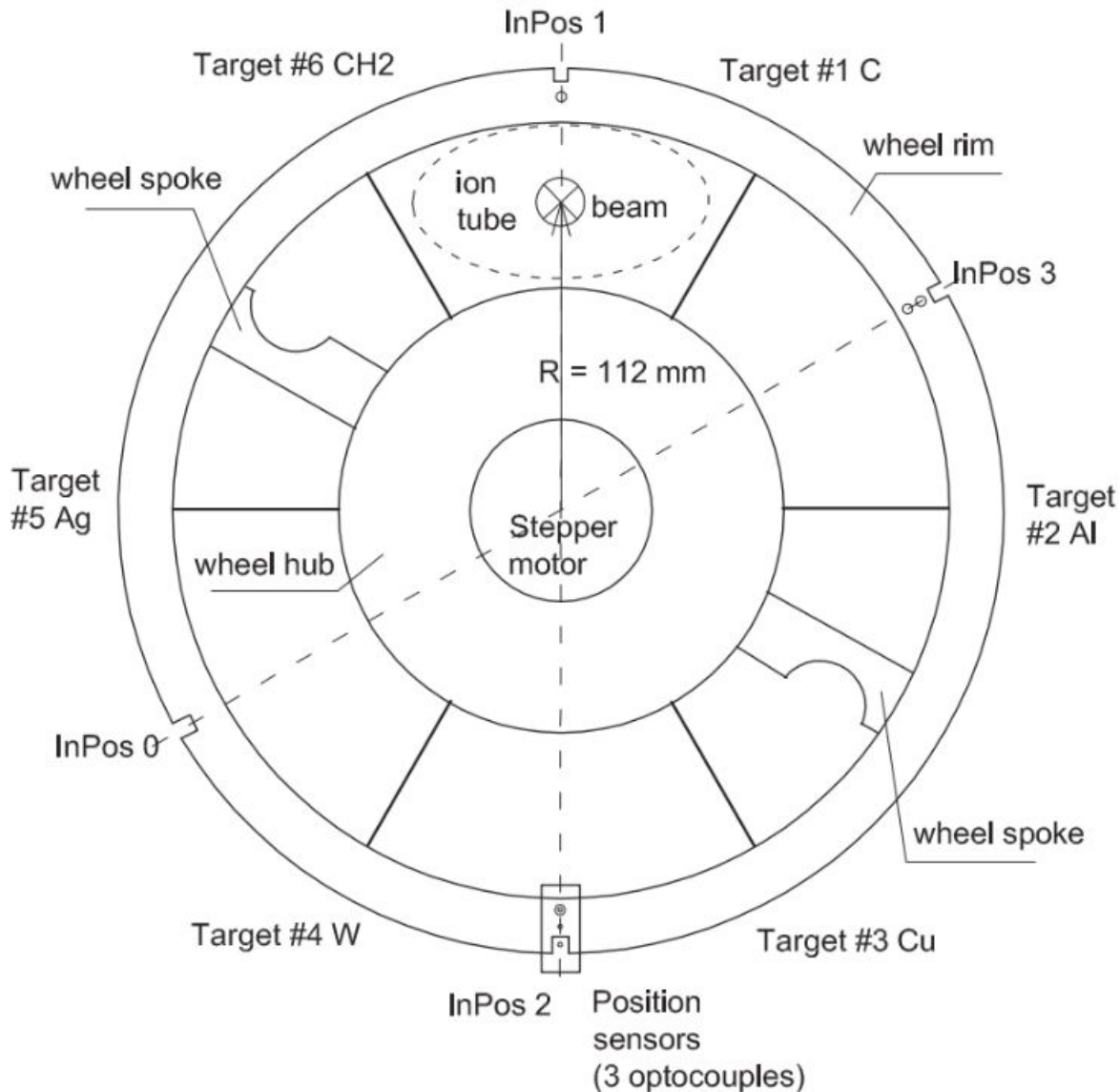
| | | |
|-------------|-----|-------------|
| "2-6" | "+" | $(1/3, +1)$ |
| "3-5" | "-" | $(1/3, -1)$ |
| Unpolarized | "0" | $(0, 0)$ |

Vector polarization values obtained with dp elastic scattering at 135 MeV/n

| | P_z^+ | ΔP_z^+ | P_z^- | ΔP_z^- |
|----------------|---------|----------------|---------|----------------|
| 500, 650 MeV/n | 0.231 | 0.008 | 0.245 | 0.006 |
| 200, 550 MeV/n | 0.211 | 0.007 | 0.239 | 0.005 |

~70% of the ideal values!

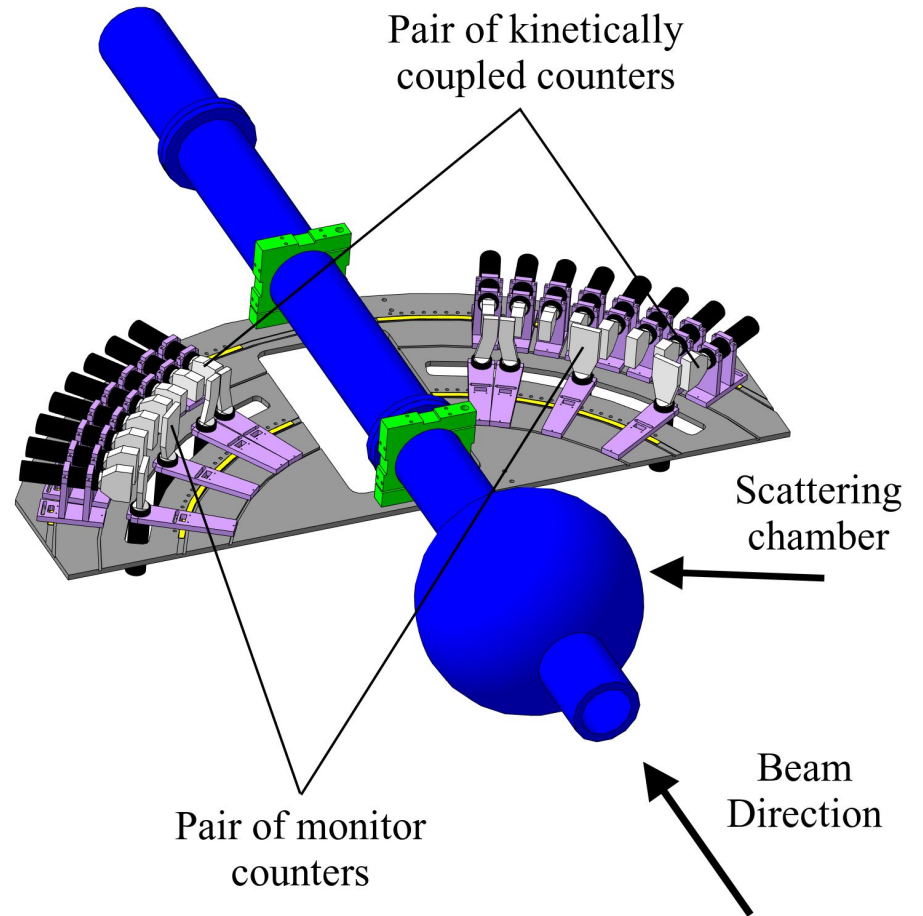
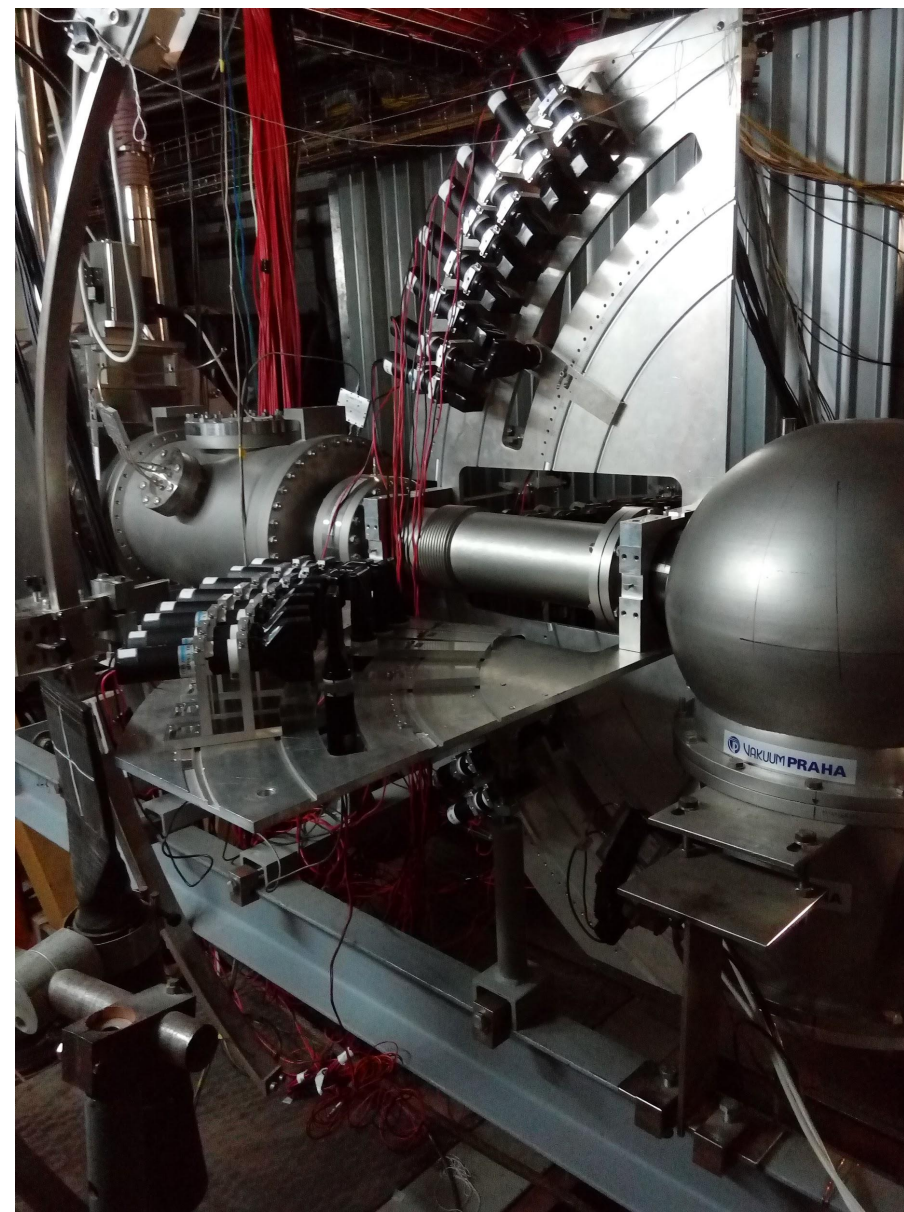
Target Changing System



In the experiment were used:

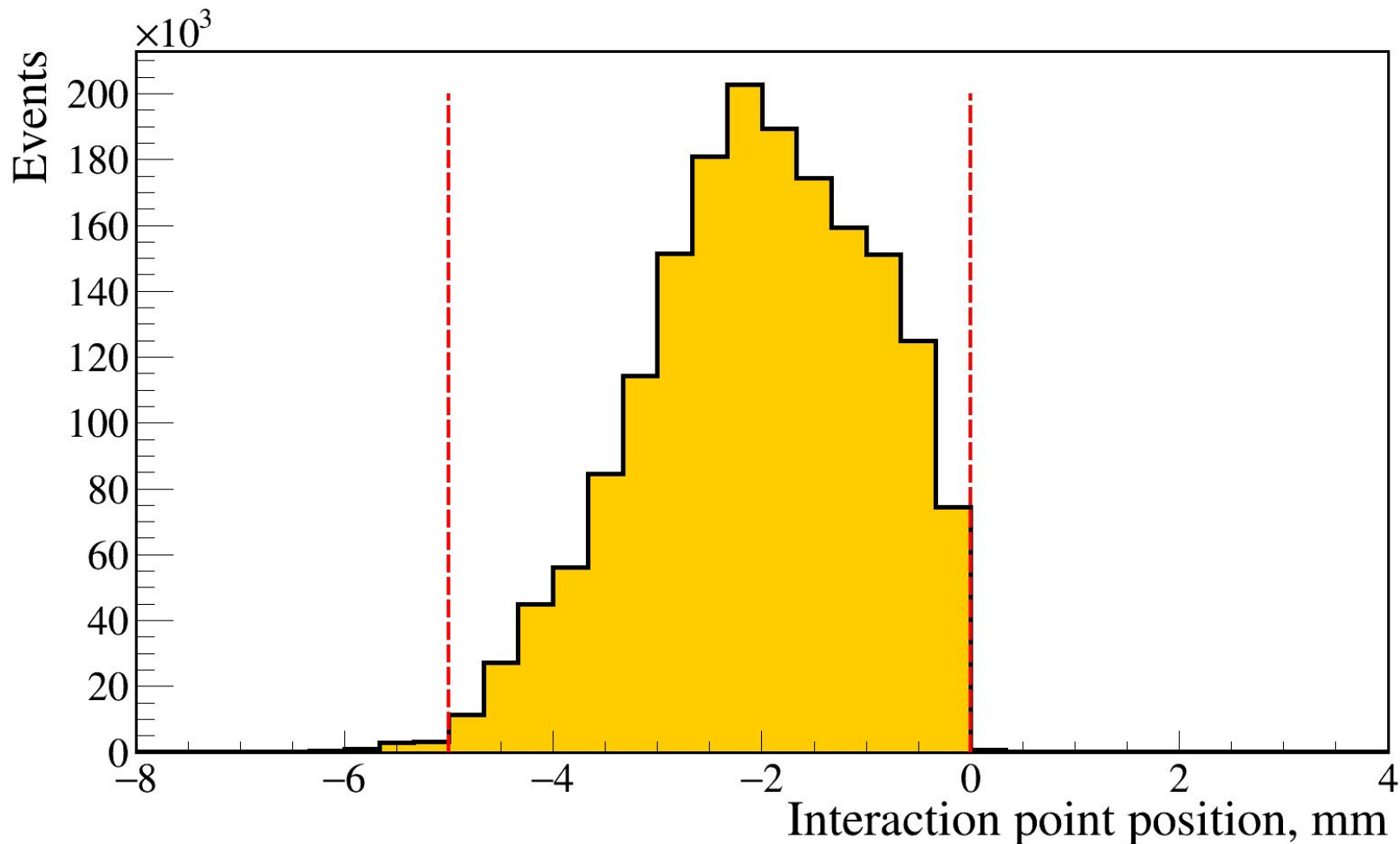
- Target #6 CH₂. Film with $10 \mu\text{m}$ thickness.
- Target #1 C. Filament from 10 threads with each $8 \mu\text{m}$ thickness.

The DSS Setup



- 6 pairs to the left, 6 pairs to the right;
from 55° to 85° in the CM system;
- 1 pair to 90° in CM.

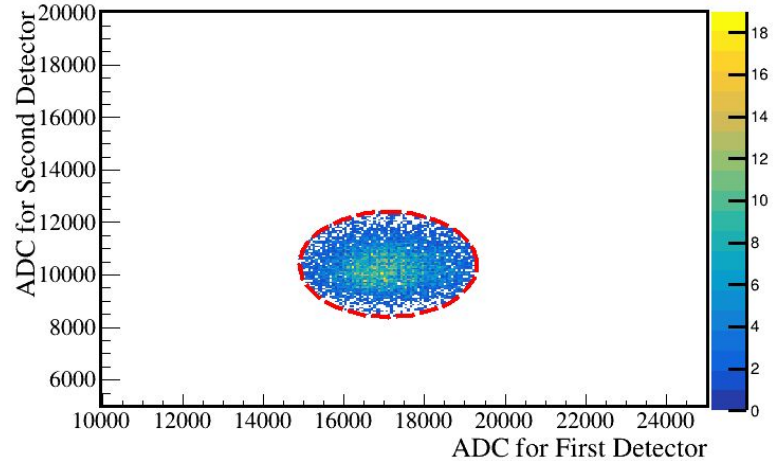
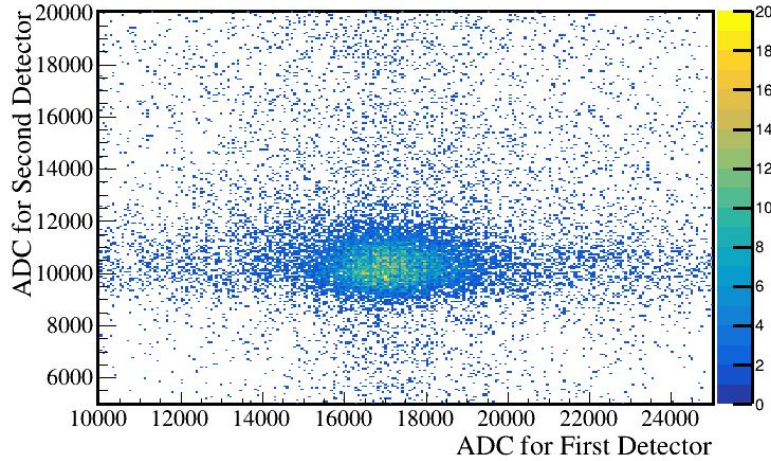
Selection of useful data by the event position of the target inside the ion tube



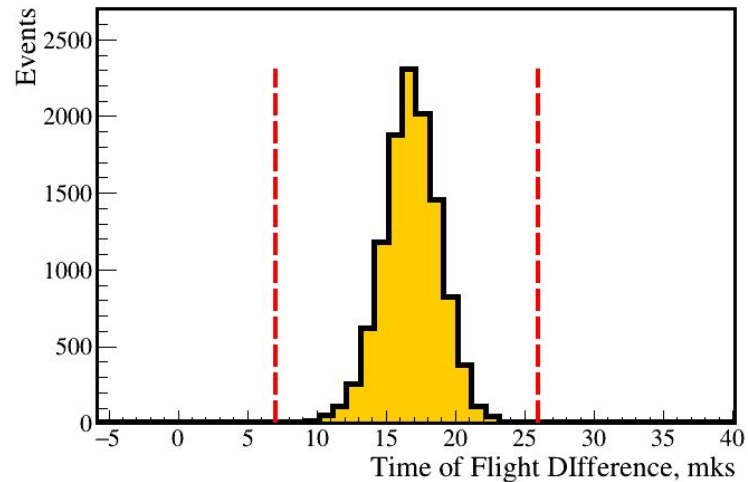
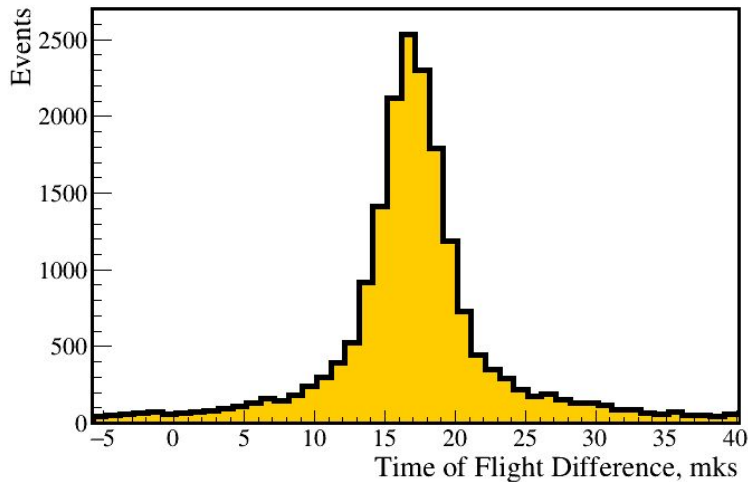
Based on the rotation of the target changing system wheel.
Data from the stepper motor.

Selection of useful data

Ionization loss correlation for the counters pair

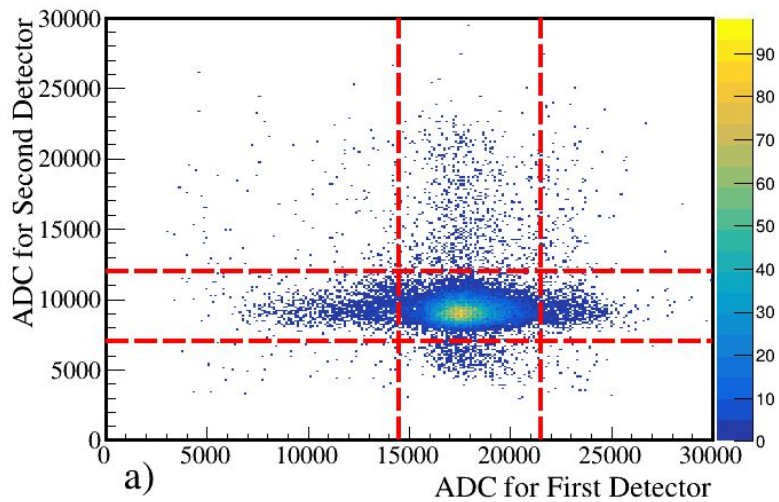


Time-of-flight difference for the pair

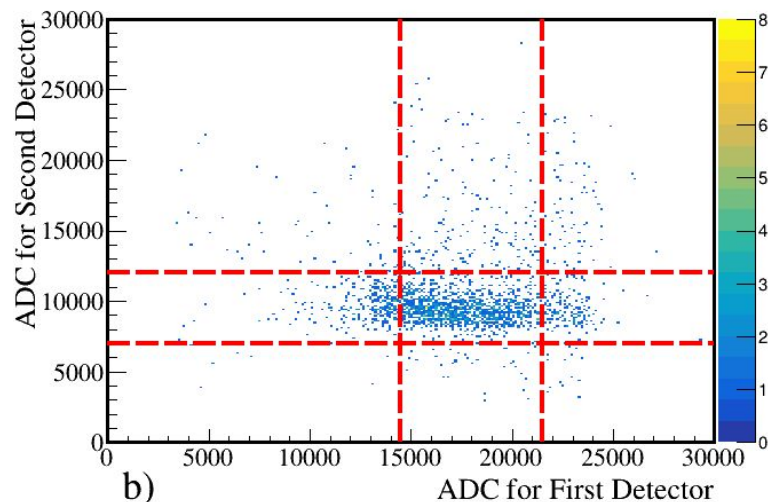


Cuts
applied one
after
the other
for better
result

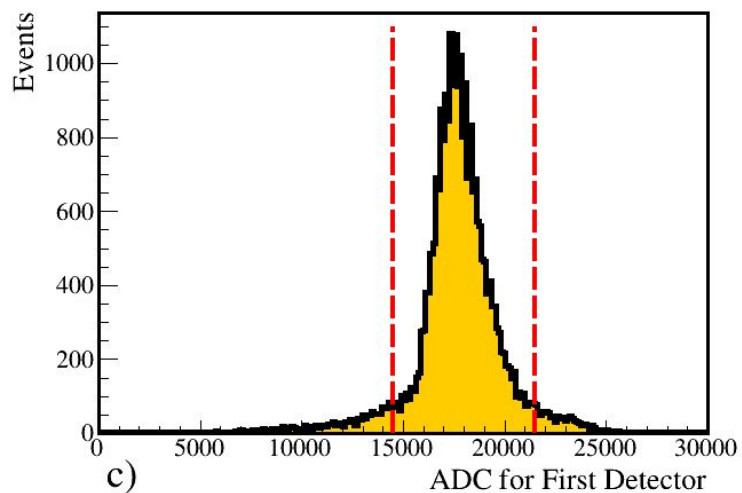
Background subtraction procedure



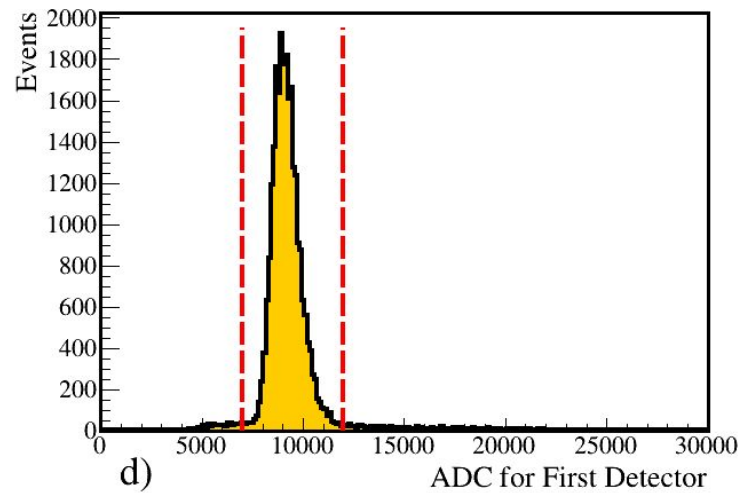
Polyethylene



Carbon

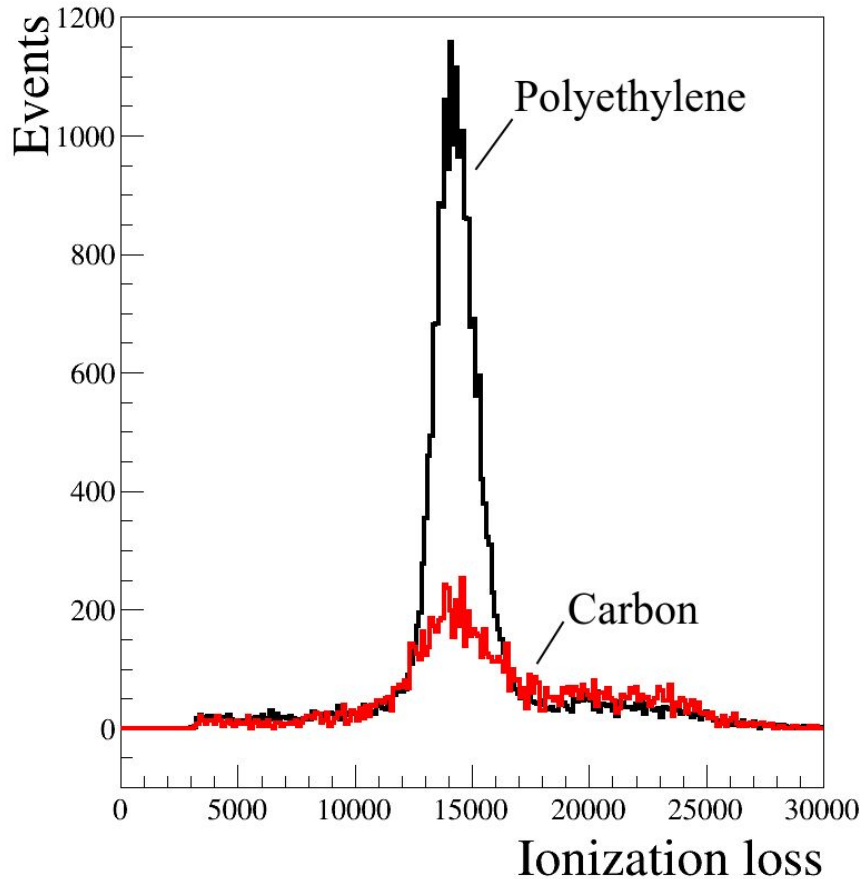


X polyethylene projection

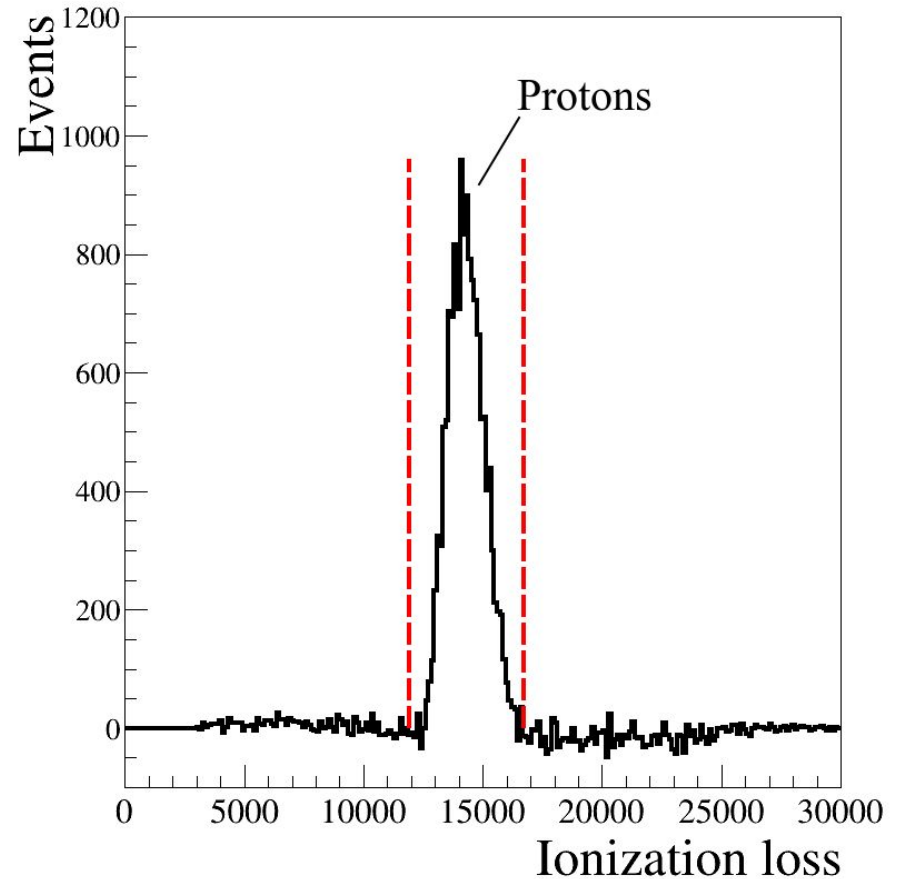


Y polyethylene projection

The result of the background subtraction. For 500 MeV/n, 85° in CM system



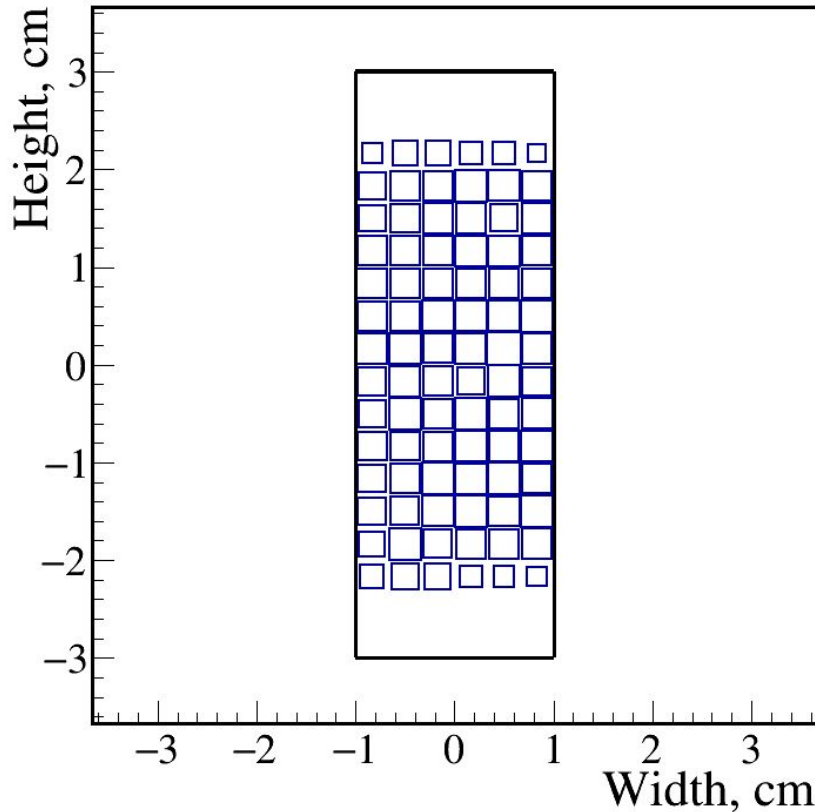
~50% of events is background.



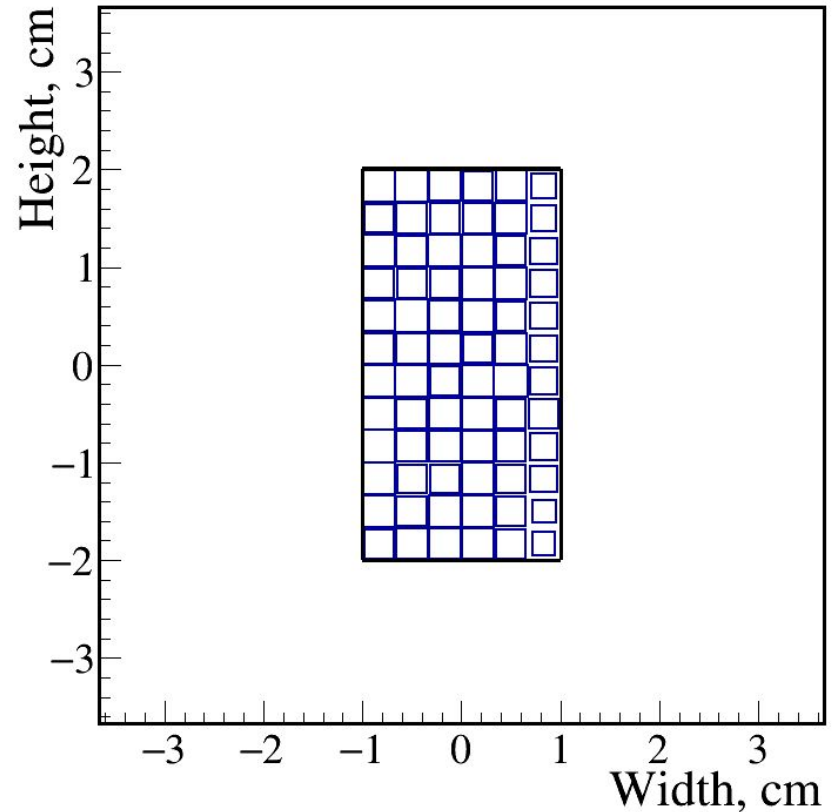
Red lines - cut on ADC.

Hits distribution in the detectors from the simulation.

For 500 MeV/n, 85° in CM system



Left detector

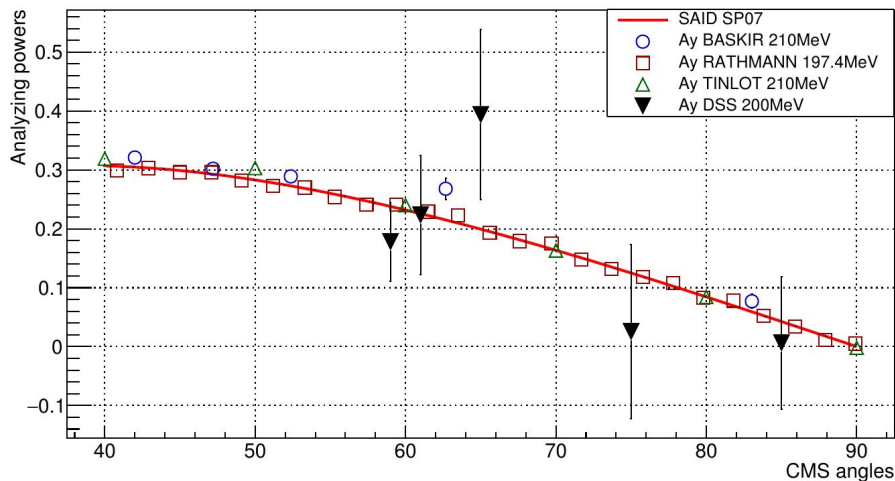


Right detector

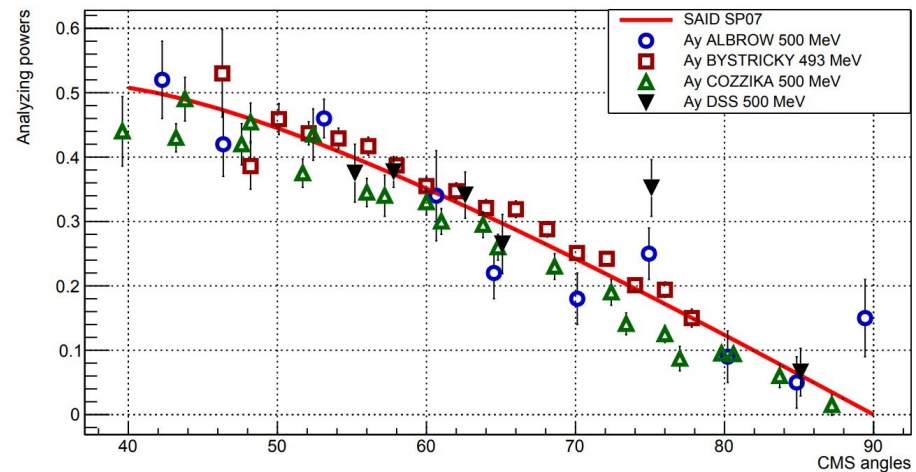
It needs to correct detector angles via the beam shift.
Pluto Generator for ROOT Framework was used.
pp elastic scattering has been simulated.

The vector analyzing power

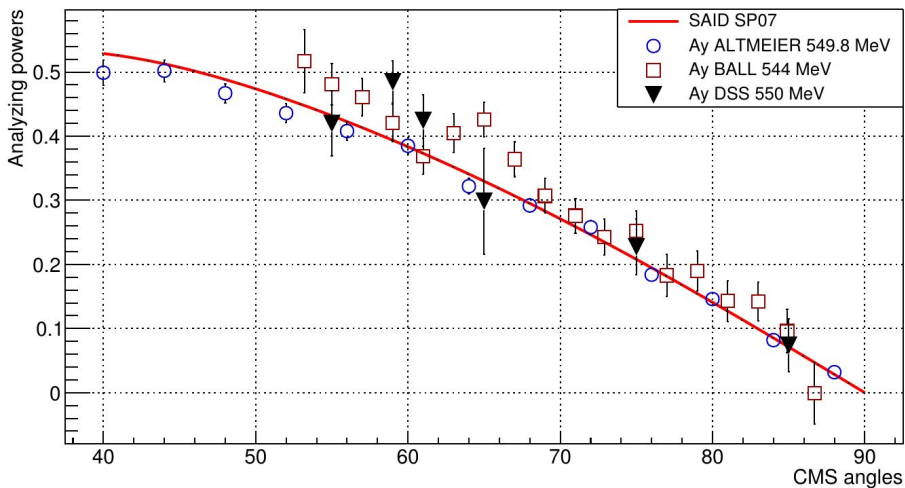
200 MeV/n



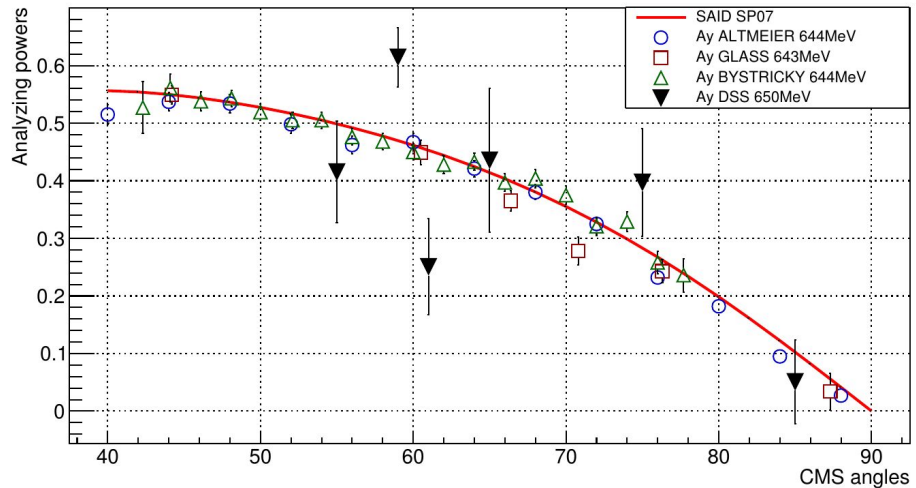
500 MeV/n



550 MeV/n



650 MeV/n



Our data - filled triangles ▼

The vector polarization definition formulas

"2-6"

$$P_y^+ = \frac{\frac{N_L^+ M^0}{N_L^0 M^+} - \frac{N_R^+ M^0}{N_R^0 M^+}}{2A_y},$$

"3-5"

$$P_y^- = \frac{\frac{N_L^- M^0}{N_L^0 M^-} - \frac{N_R^- M^0}{N_R^0 M^-}}{2A_y}$$

P_y^+ and P_y^- - the vector polarization for the SPI mode "2-6" and "3-5".

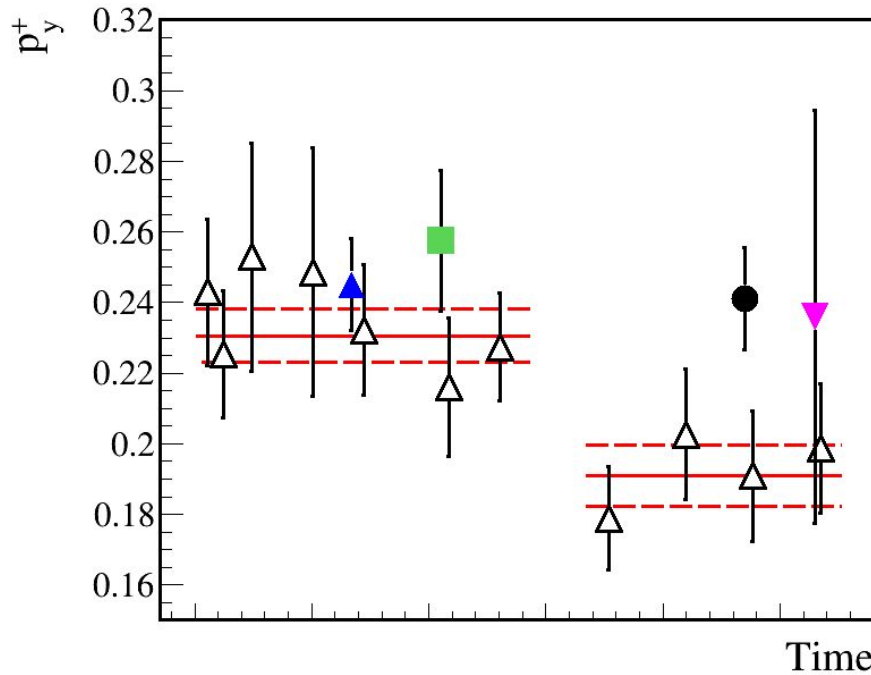
N - number of events for the particular angle. L to the left, R to the right.

M - number of events in the monitor counters.

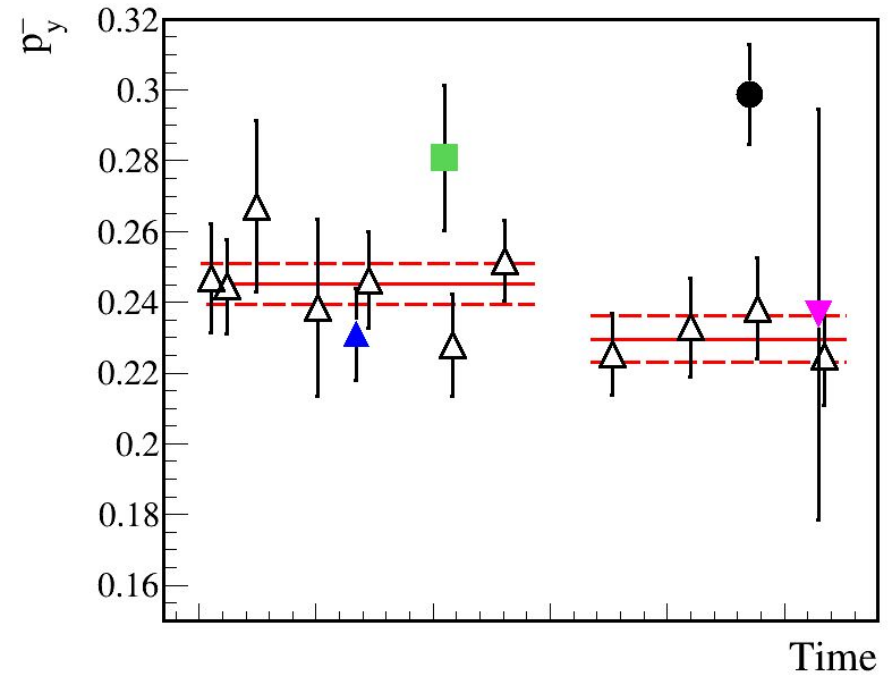
A_y - vector analyzing power for the particular angle.

The beam polarization values

"2-6"



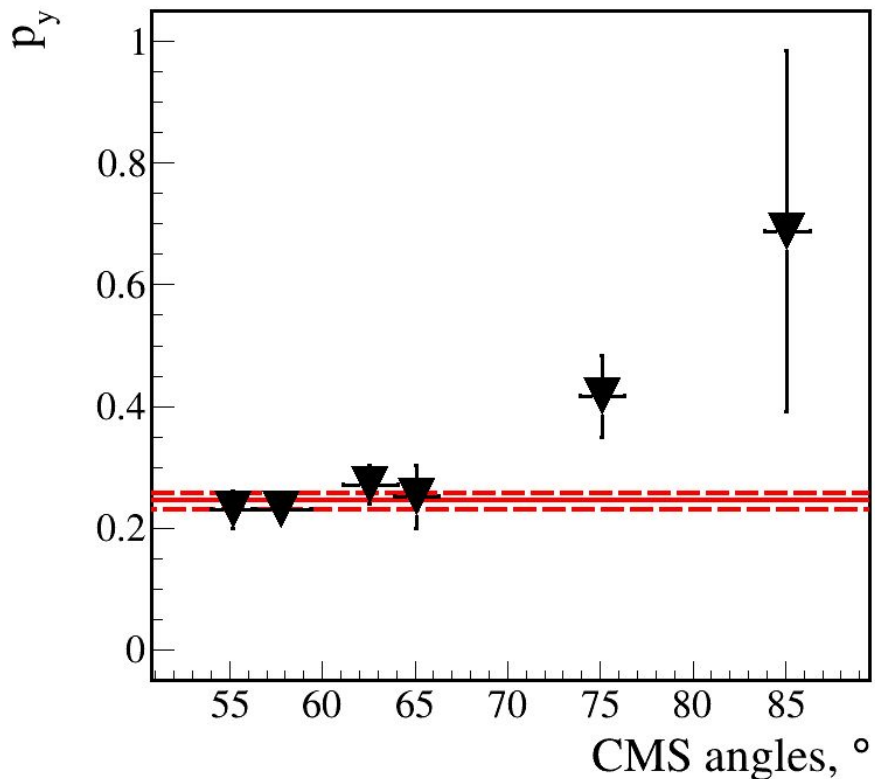
"3-5"



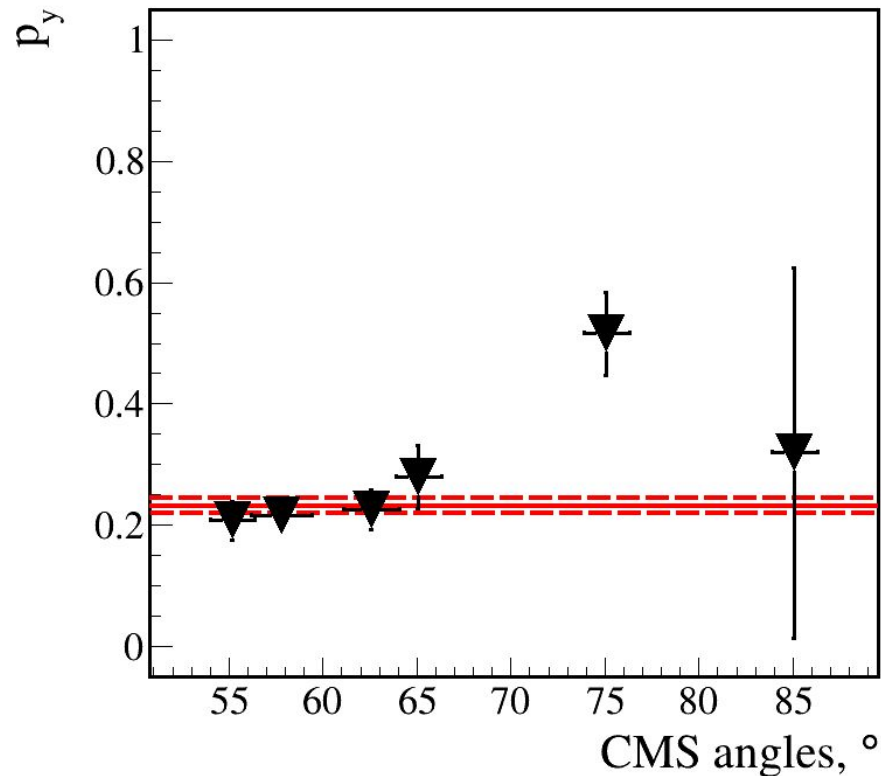
- \triangle - polarization values for dp elastic scattering (135 MeV/n)
- \blacktriangle - polarization values for pp quasi-elastic scattering (500 MeV/n)
- \blacksquare - polarization values for pp quasi-elastic scattering (650 MeV/n)
- \bullet - polarization values for pp quasi-elastic scattering (550 MeV/n)
- \blacktriangledown - polarization values for pp quasi-elastic scattering (200 MeV/n)

The beam polarization values for 500 MeV/n

"2-6"



"3-5"



Values for each angle (detectors pair) in CM system.
Red lines - weighted average.

Conclusion

- The vector polarization values of the deuteron beam were obtained at the beam energies of 200, 500, 550 and 650 MeV/n;
- The vector polarization values are in good agreement with the polarization values that were obtained using dp elastic scattering at the beam energy of 135 MeV/nucleon;
- The vector analyzing power values of the pp-quasielastic scattering reaction were obtained using the same asymmetry. They are in good agreement with the world data and SP07.
- The experimental setup is suitable for the deuteron and proton beam polarimetry.

**Thank you for
your attention!**