

**Analyzing power in  
quasi-elastic proton-proton  
scattering at the beam  
energies of 200-650  
MeV/nucleon**

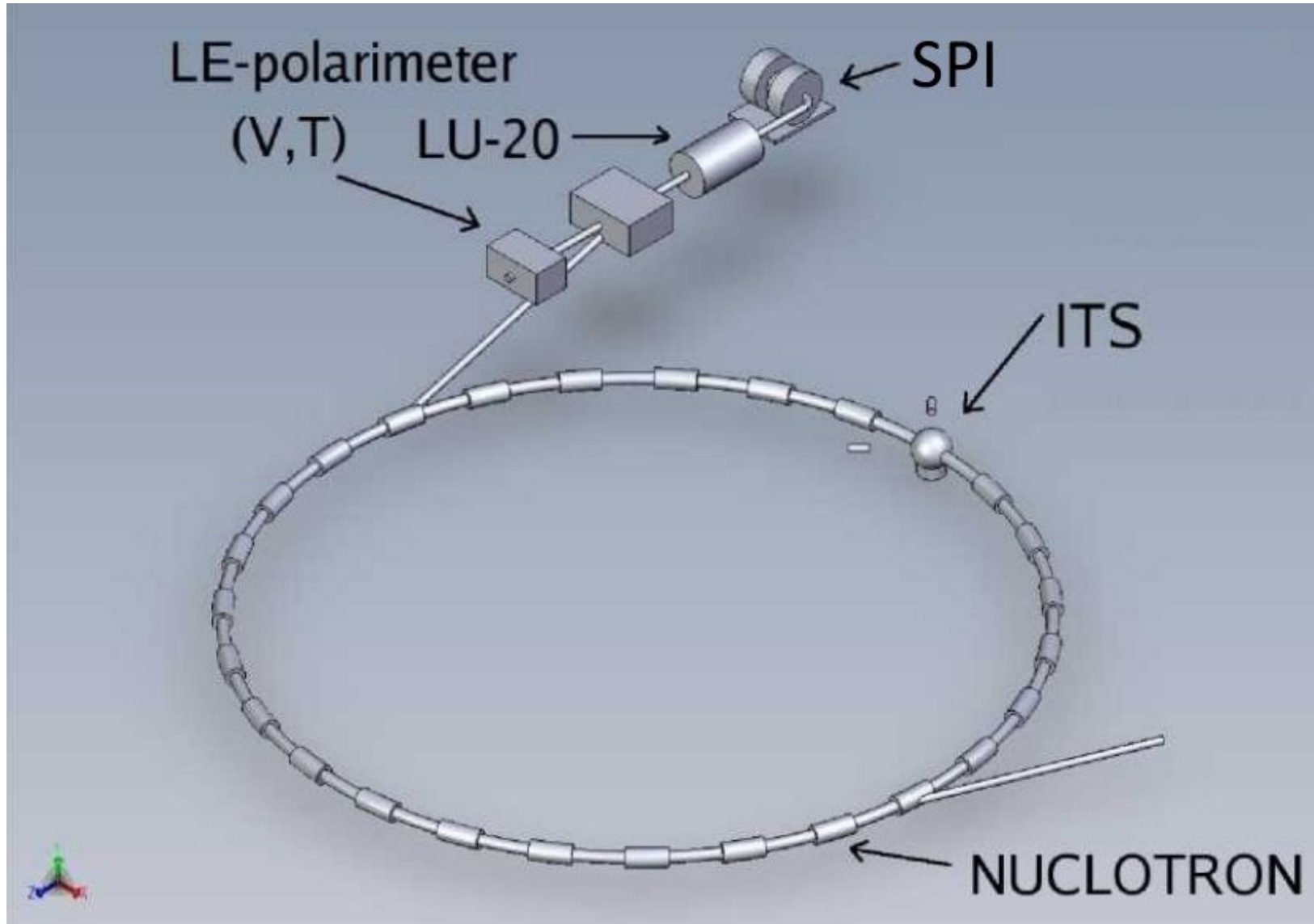
Volkov Ivan Sergeevich

DSS Collaboration, LHEP JINR

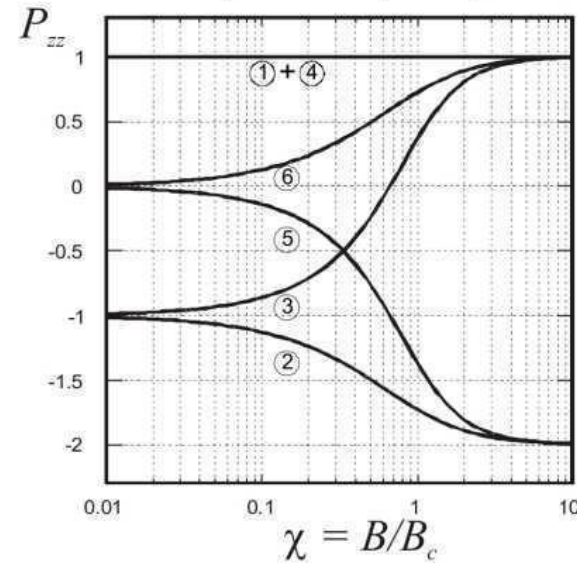
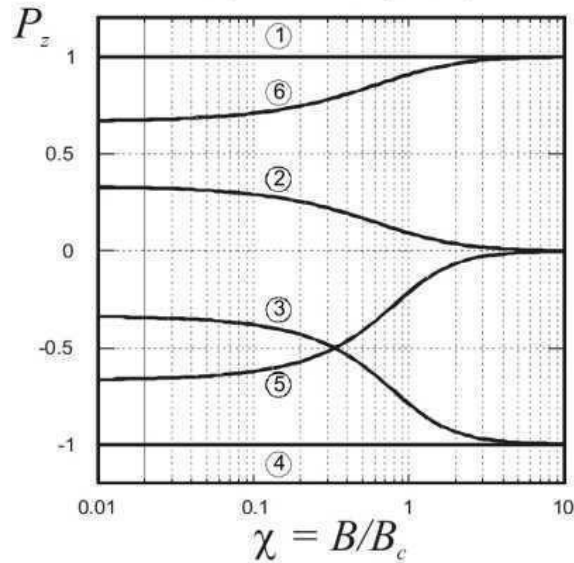
# Motivation

1. Obtaining new data for proton-proton scattering to improve nucleon-nucleon interaction models;
2. Checking the possibility of using quasi-elastic proton-proton scattering to obtain vector polarization values of the polarized deuteron beam at energies up to 1 GeV/n.

# Scheme of the experiment at NUCLOTRON



# Beam polarization



Were used 3 modes of the ion source:

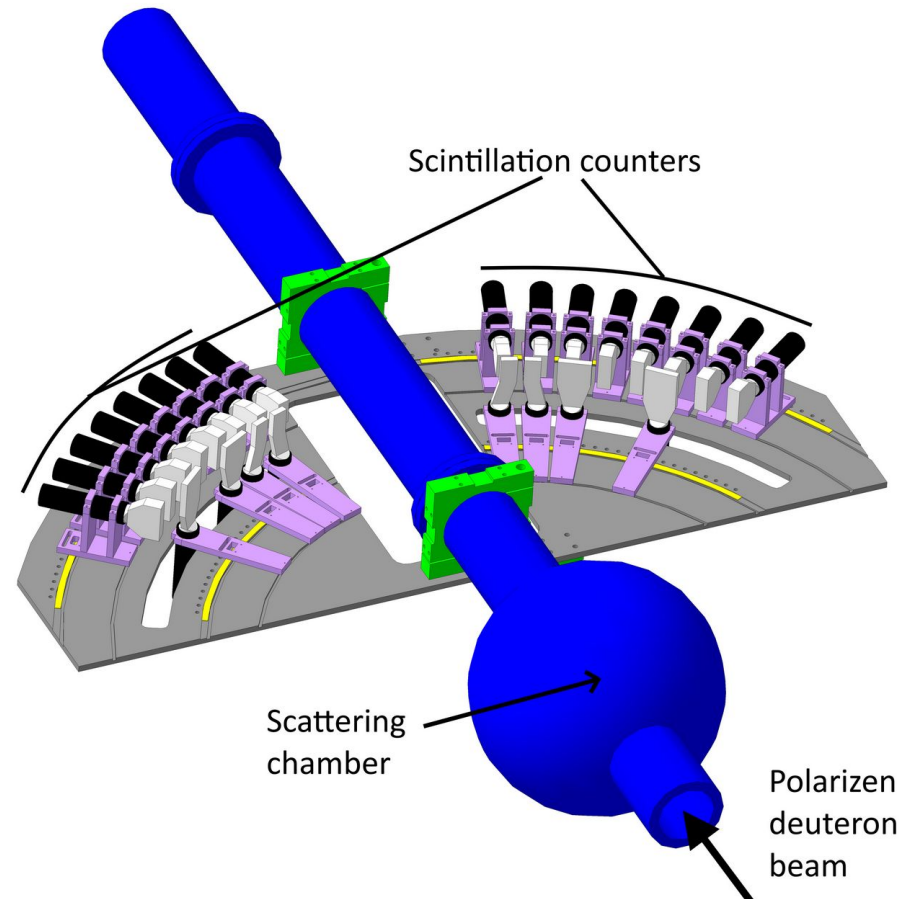
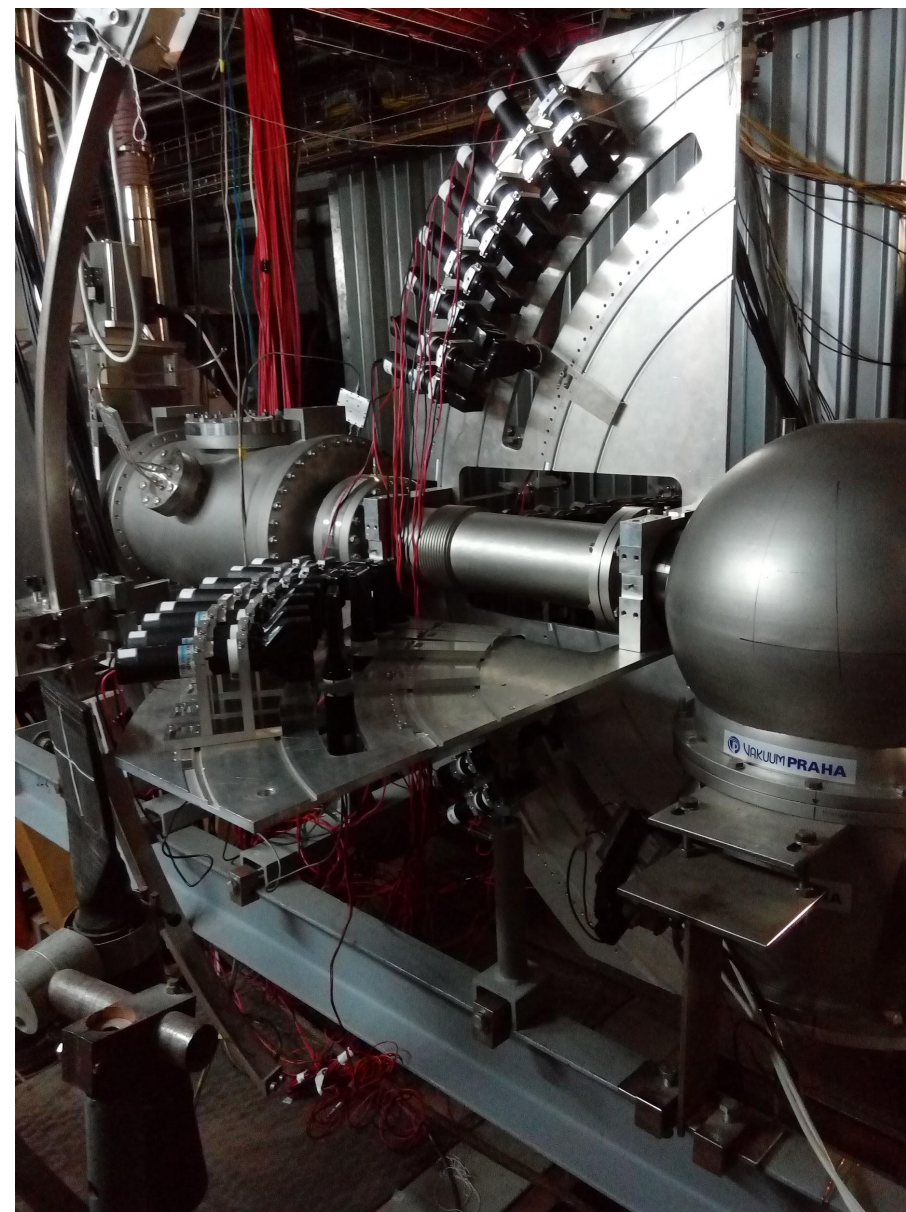
$(P_z, P_{zz})$

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

Vector polarization values

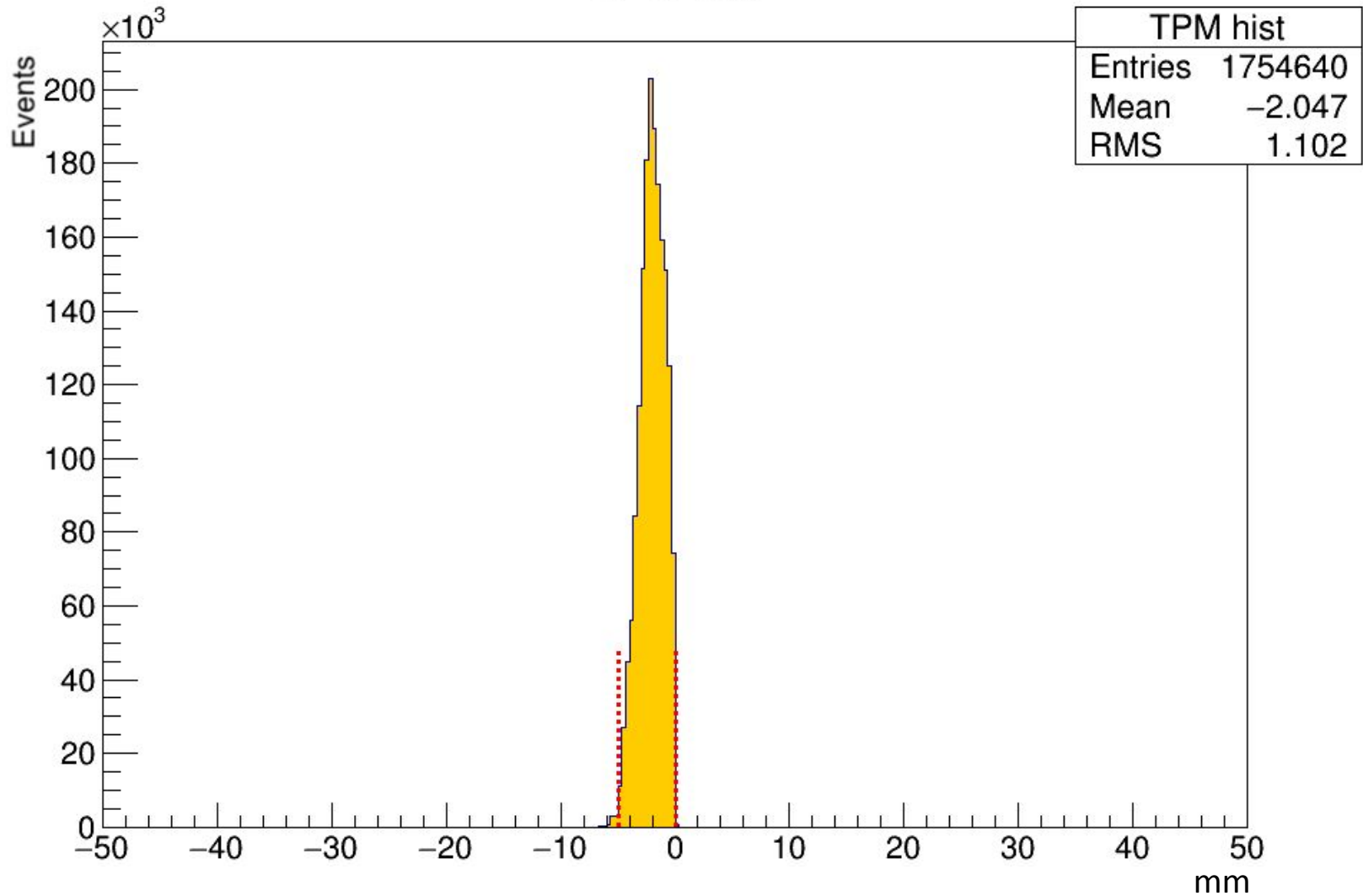
$P_{z+}$	$\Delta P_{z+}$	$P_{z-}$	$\Delta P_{z-}$
0,231	0,008	0,245	0,006

# DSS Setup

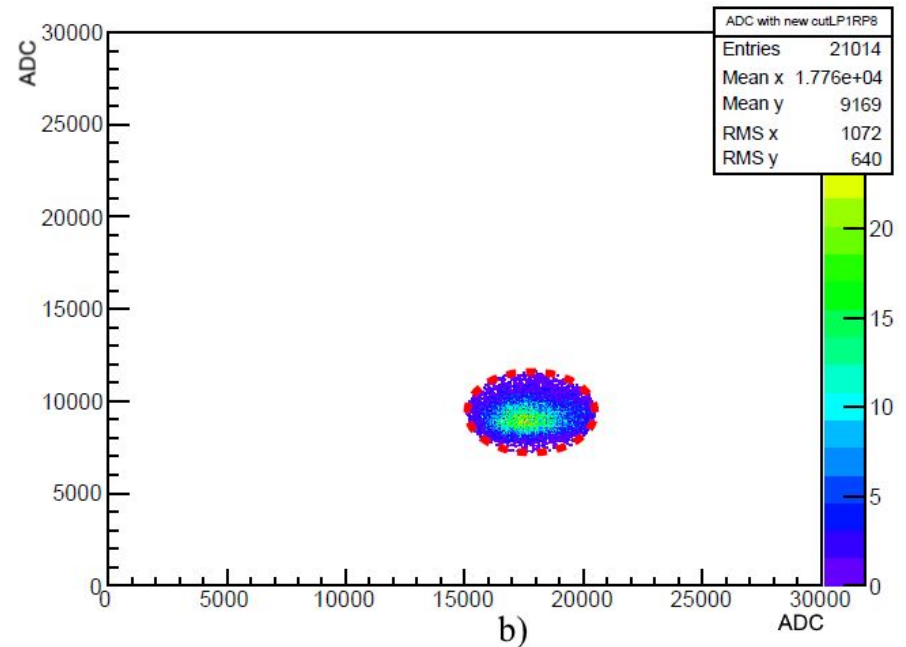
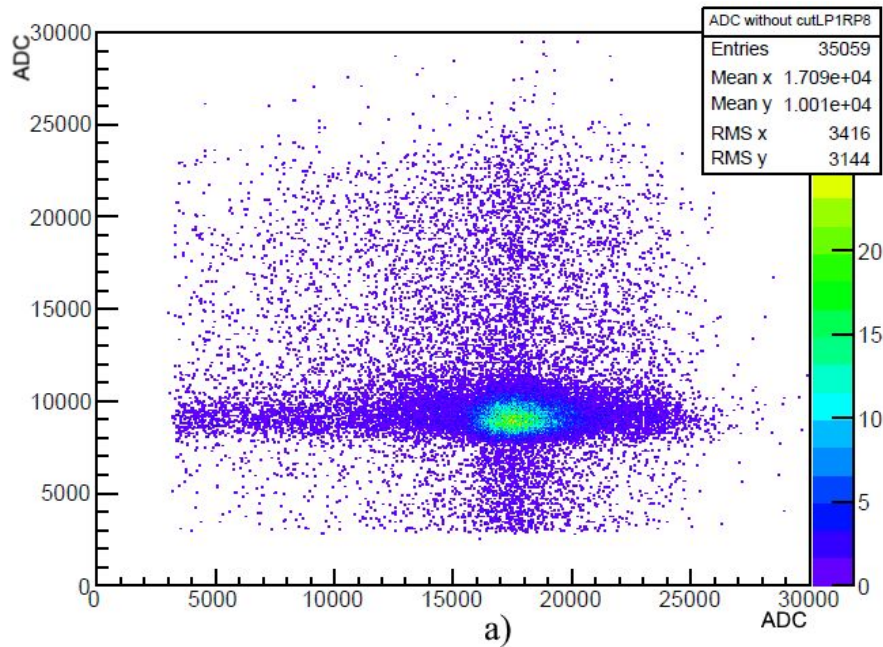


- 6 pairs to the left, 6 pairs to the right;
- from  $55^\circ$  to  $85^\circ$  in the CM system.

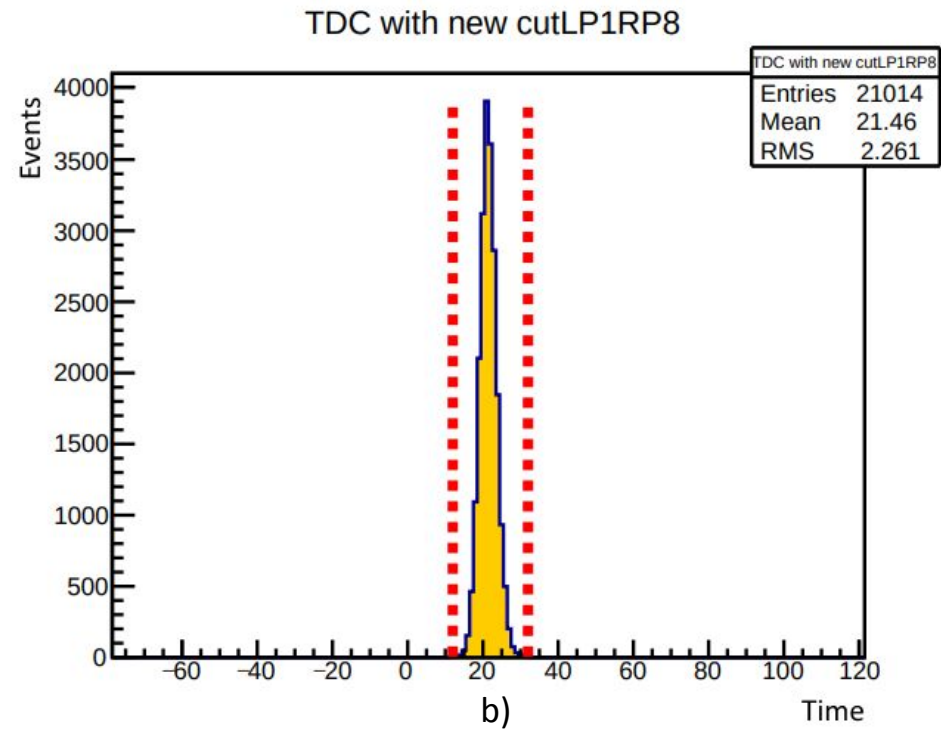
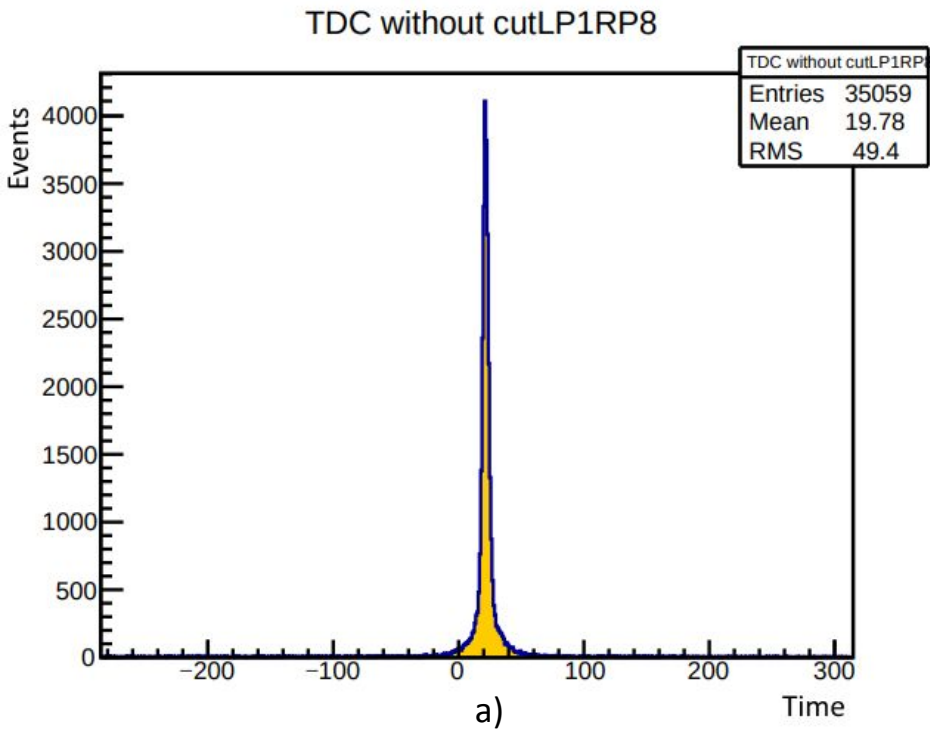
# The dependence of the events yield on the position of the target inside the ion tube



# ADC correlation of the counters pair

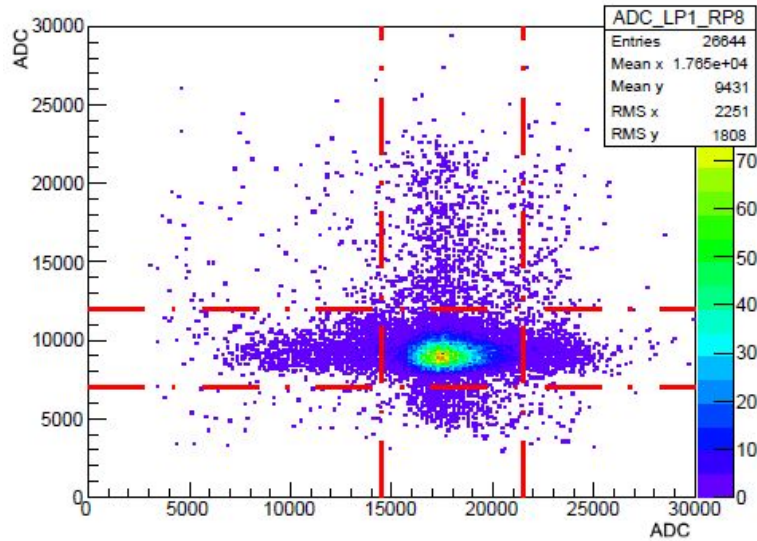


# The time of flight difference

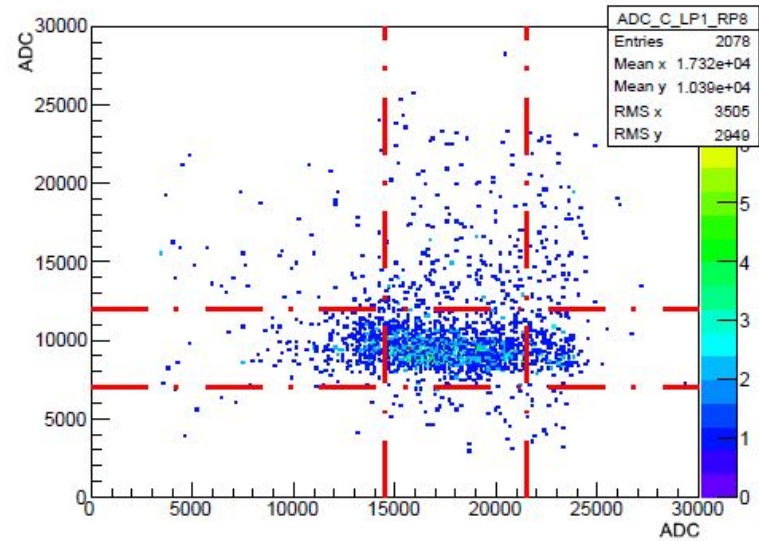




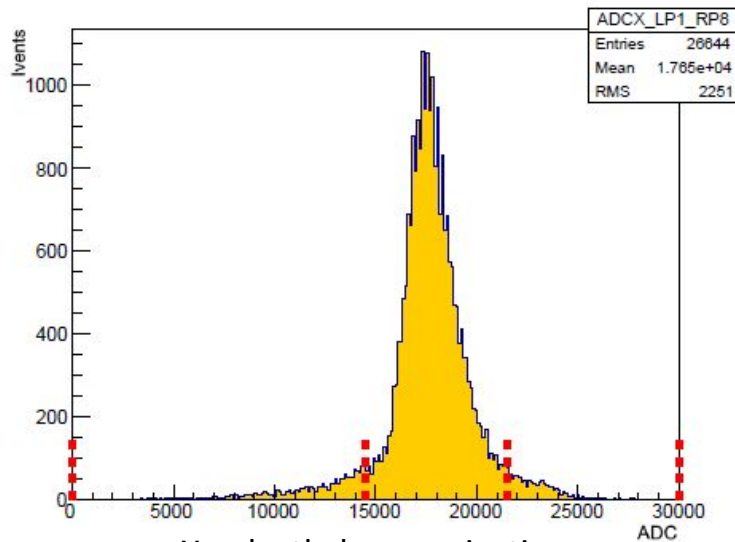
# The process of setting up cuts for the CH<sub>2</sub>-C subtraction procedure



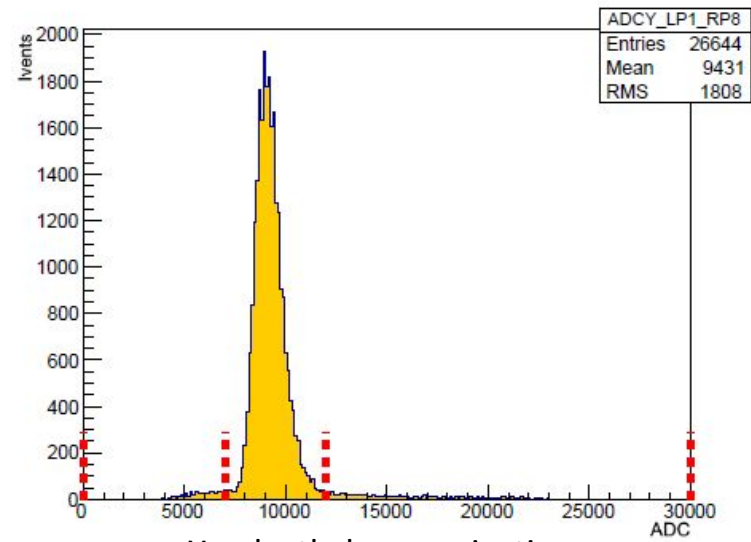
Polyethylene



Carbon



X polyethylene projection



Y polyethylene projection

# Methods of the subtraction coefficient calculations

The integral method

$$n = \frac{\sum_i N_i^{(CH_2)}}{\sum_i N_i^{(C)}}$$

The spectra fitting method

$$f(x) = ae^{\frac{(x-b)^2}{2c^2}}$$

The least squares method

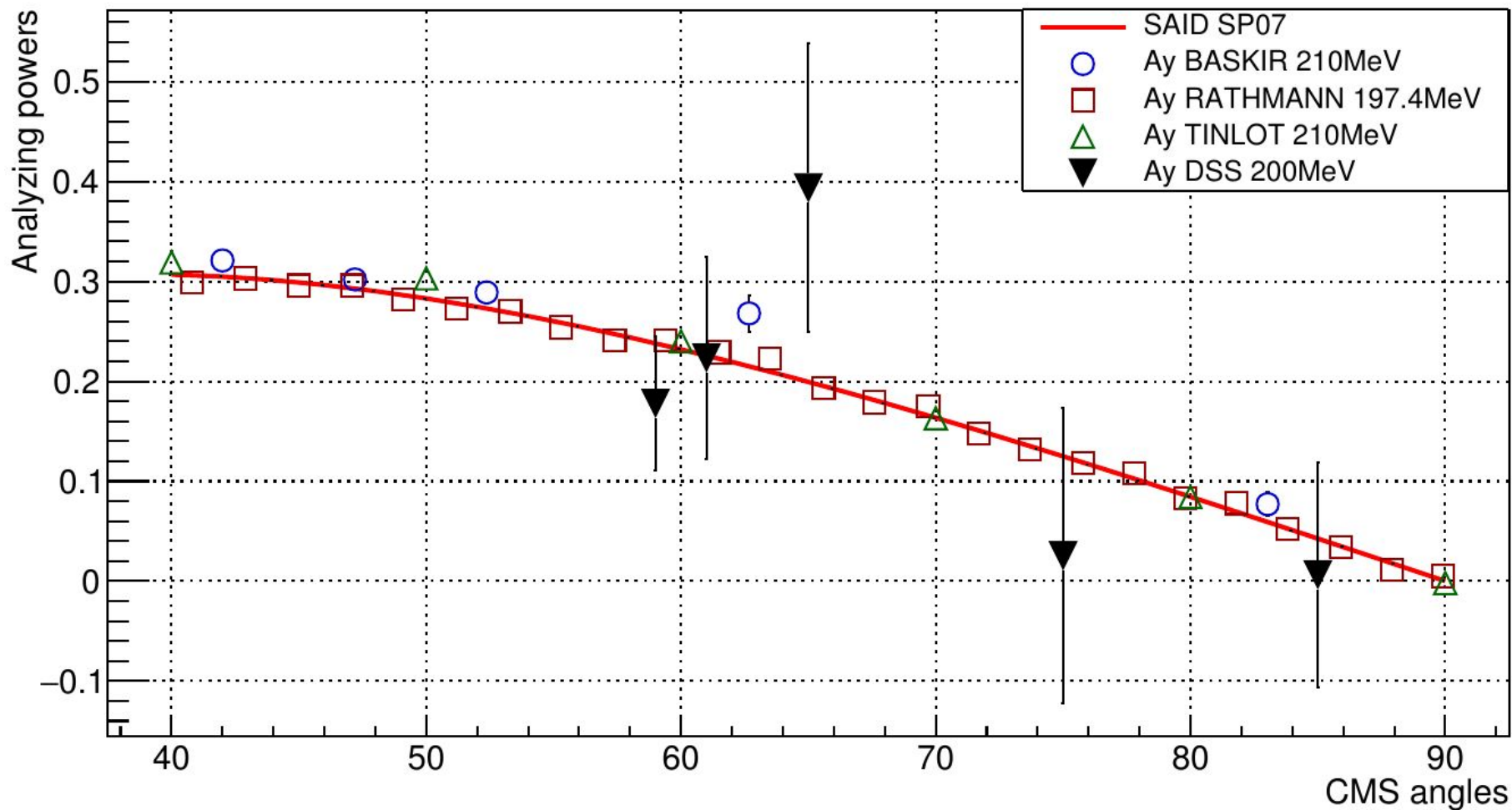
$$f(k) = \sum_i (N_{CH_2} - kN_C)^2$$

# The analyzing powers definition formulas

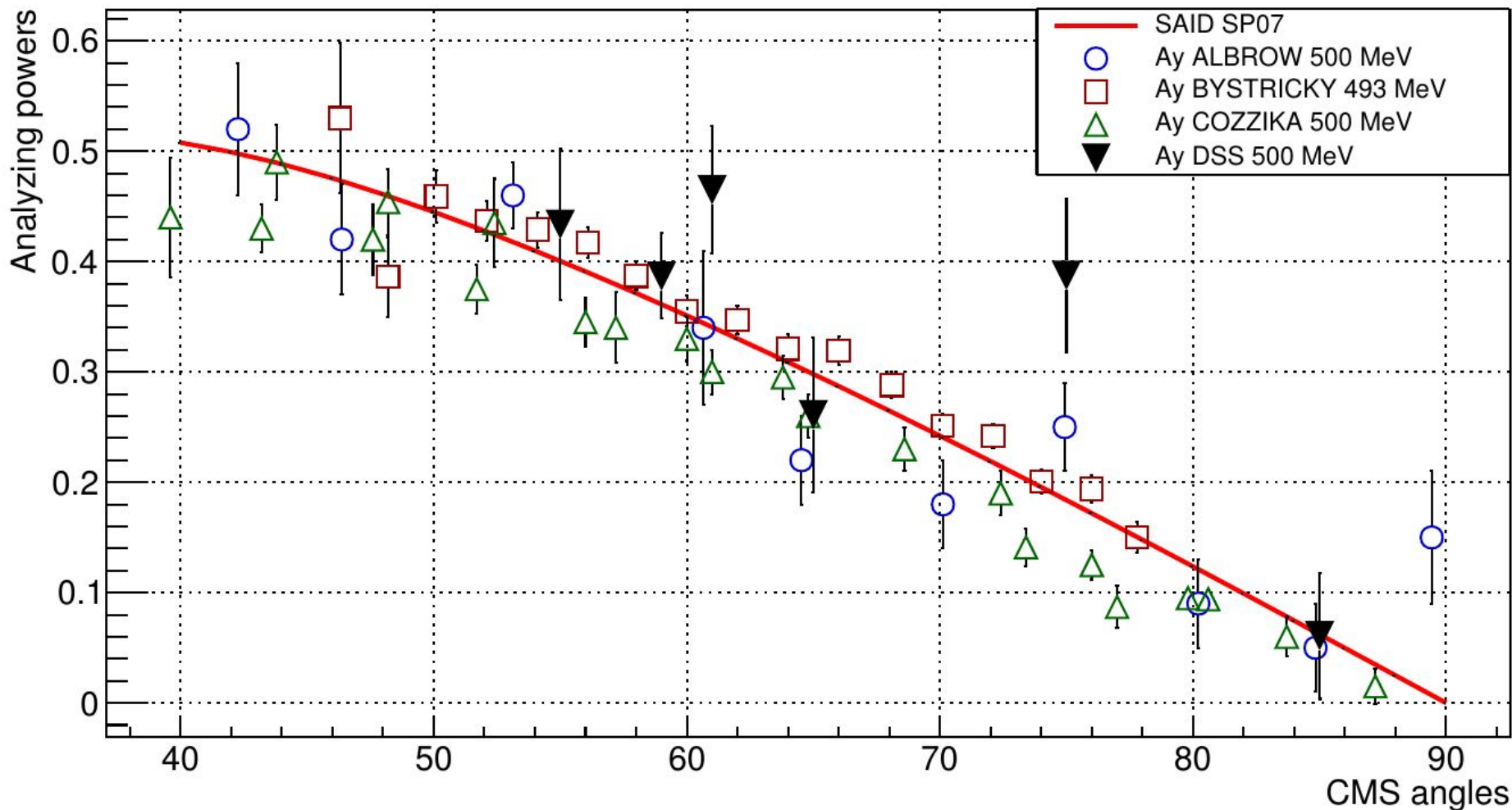
$$A_{yL} = \frac{\frac{N^+ M^0}{N^0 M^+} + \frac{N^- M^0}{N^0 M^-} - 2}{2(P_z^+ + P_z^-)}$$

$$A_{yR} = -A_{yL}$$

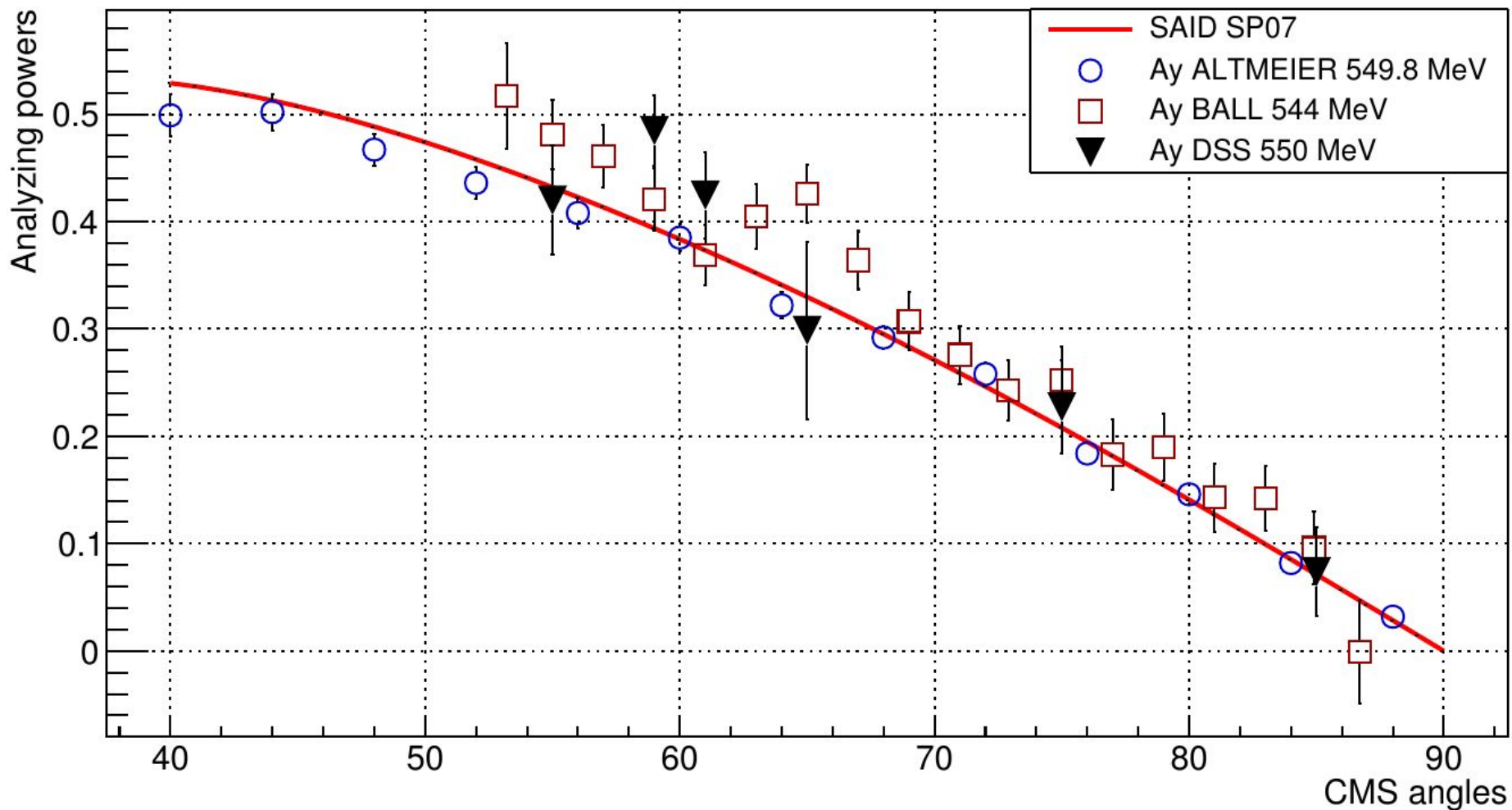
# The vector analyzing power at the beam energy of 200 MeV/nucleon



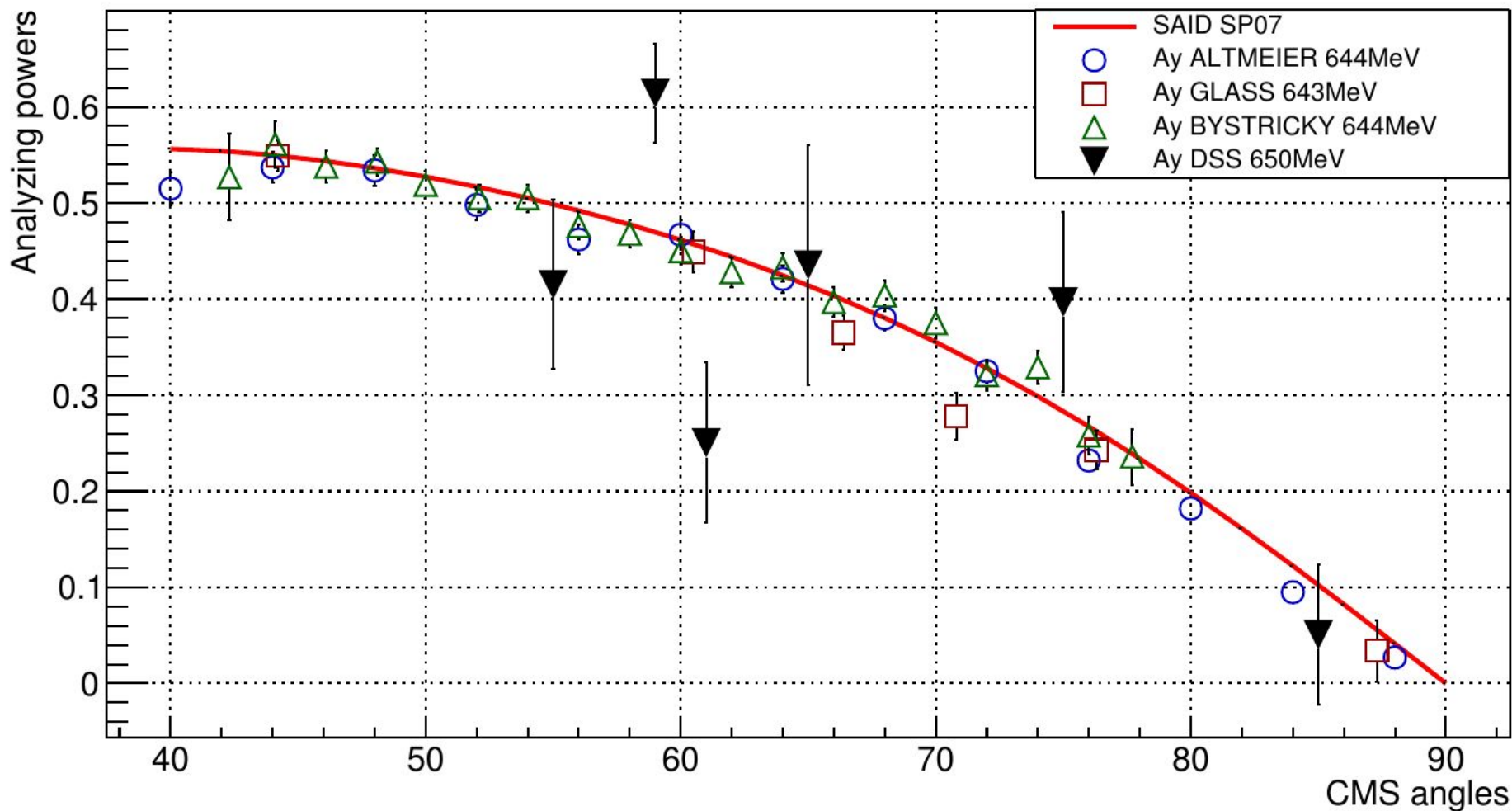
# The vector analyzing power at the beam energy of 500 MeV/nucleon



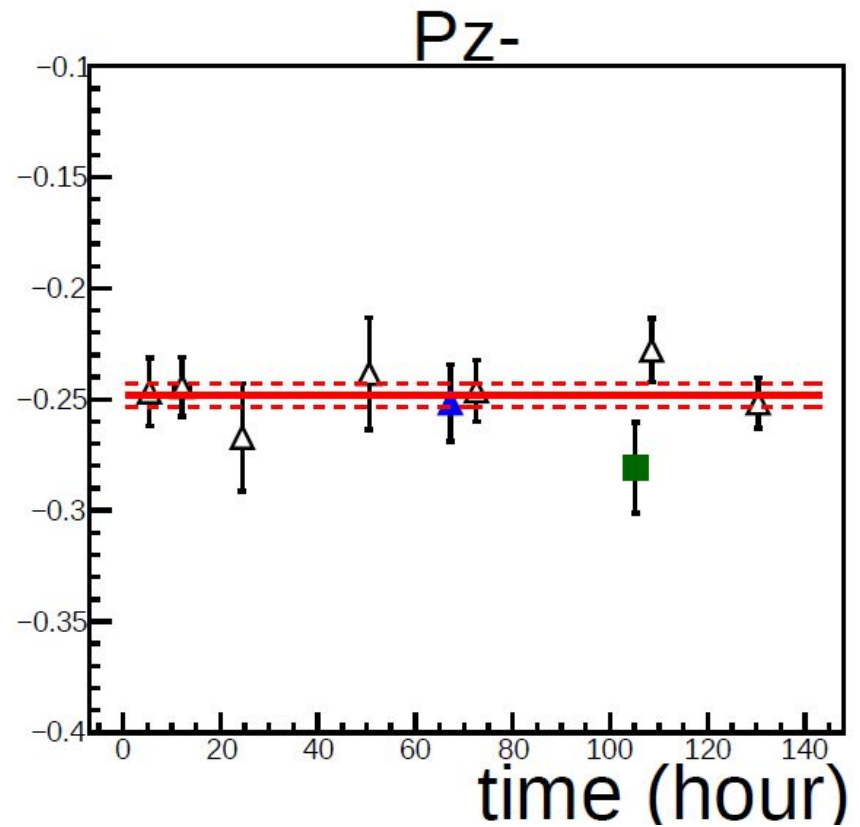
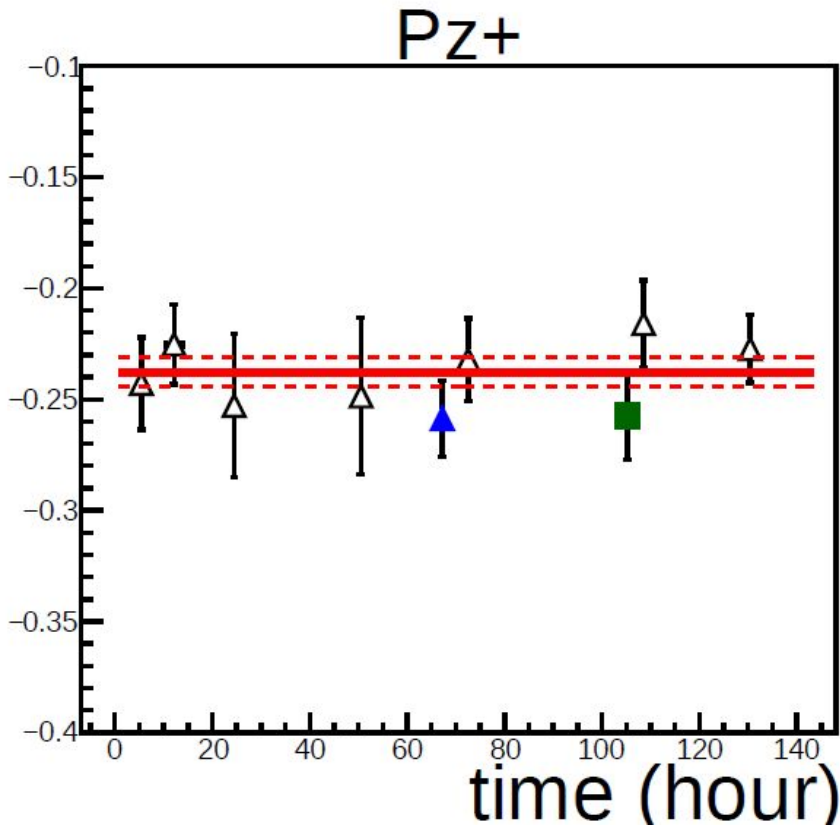
# The vector analyzing power at the beam energy of 550 MeV/nucleon



# The vector analyzing power at the beam energy of 650 MeV/nucleon



# The beam polarization values at the beam energies of 500 and 650 MeV/n



- $\triangle$  - polarization values for dp elastic scattering (270 MeV/n)
- $\blacktriangle$  - polarization values for pp quasi-elastic scattering (500 MeV/n)
- $\blacksquare$  - polarization values for pp quasi-elastic scattering (650 MeV/n)



# Conclusion

- The vector analyzing power values of the pp-quasielastic scattering reaction were obtained at the deuteron beam energies of 200, 500, 550 and 650 MeV/n;
- The analyzing power values are in good agreement with the results of other researches;
- The vector polarization values of the deuteron beam were obtained at the beam energies of 500 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 270 MeV.

**Thank you for  
your attention!**