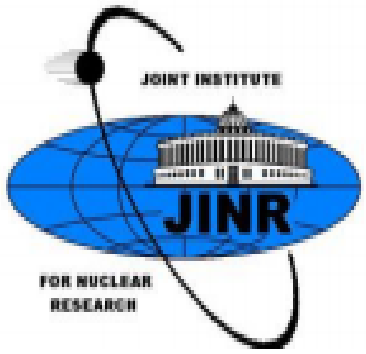



Mezhenska Olena

# Study of the analyzing powers in deuteron-proton elastic scattering at Nuclotron

Supervisor: V. P. Ladygin

1 **Introduction**
*(SRC, DSS project)*

2 **Experimental part**
*(Accelerators complex & ITS)*

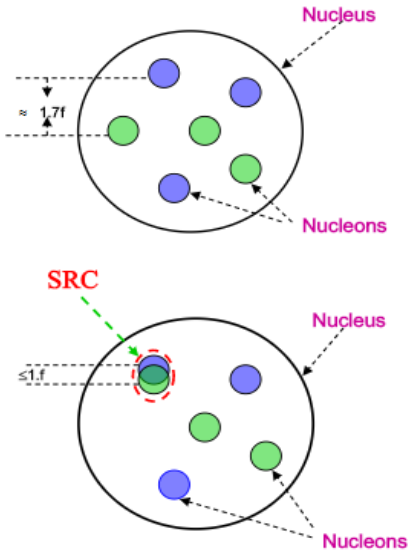
3 **Results**
*(Polarization, events selection, TMP, Ay,Ayy,Axx)*

# Introduction

The main activity in the spin studies at the Laboratory of High Energy Physics of the Joint Institute for Nuclear Research (LHEP-JINR) is related to the short range correlations (SRCs) in nuclei.

SRCs:

- ✓ A typical scale in nuclei is the internucleon distance - $r_0 \approx 1.7$ fermi;
- ✓ At $r \geq r_0$ the nuclear processes can be approximately presented as sums of processes on single nucleons;
- ✓ Due to the quantum fluctuations 2 or more nucleons may overlap at smaller distances creating SRC.



The purpose of the DSS experimental program is to obtain the information about 2NF and 3NF from two processes:

- ✓ dp-elastic scattering at the energies between 300 - 2000 MeV;
- ✓ dp-breakup with registration of two protons at deuteron energies of 300 - 500 MeV

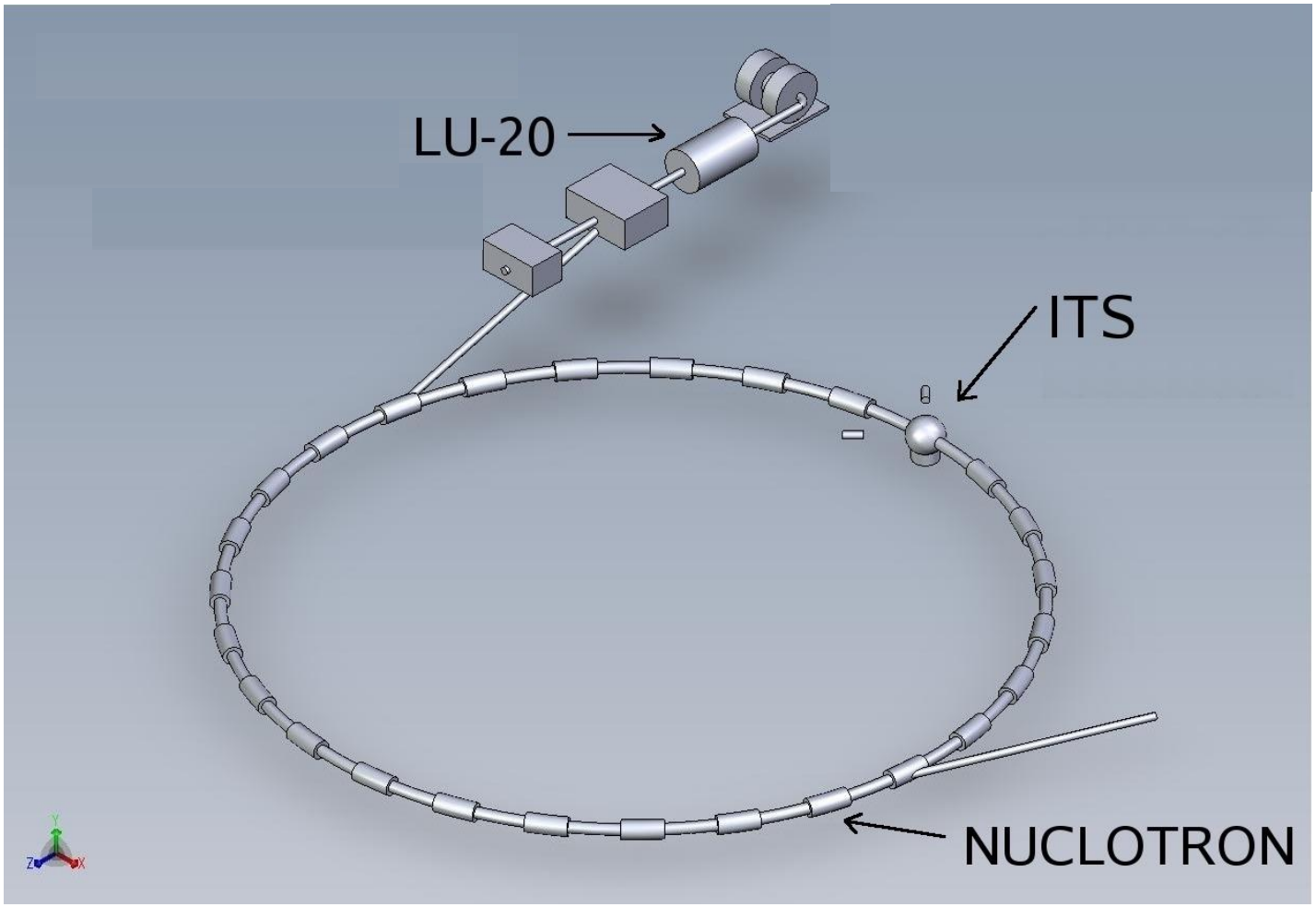
measurement of

- ➢ cross-section,
- ➢ vector Ay analyzing power
- ➢ tensor Ayy & Axx analyzing powers

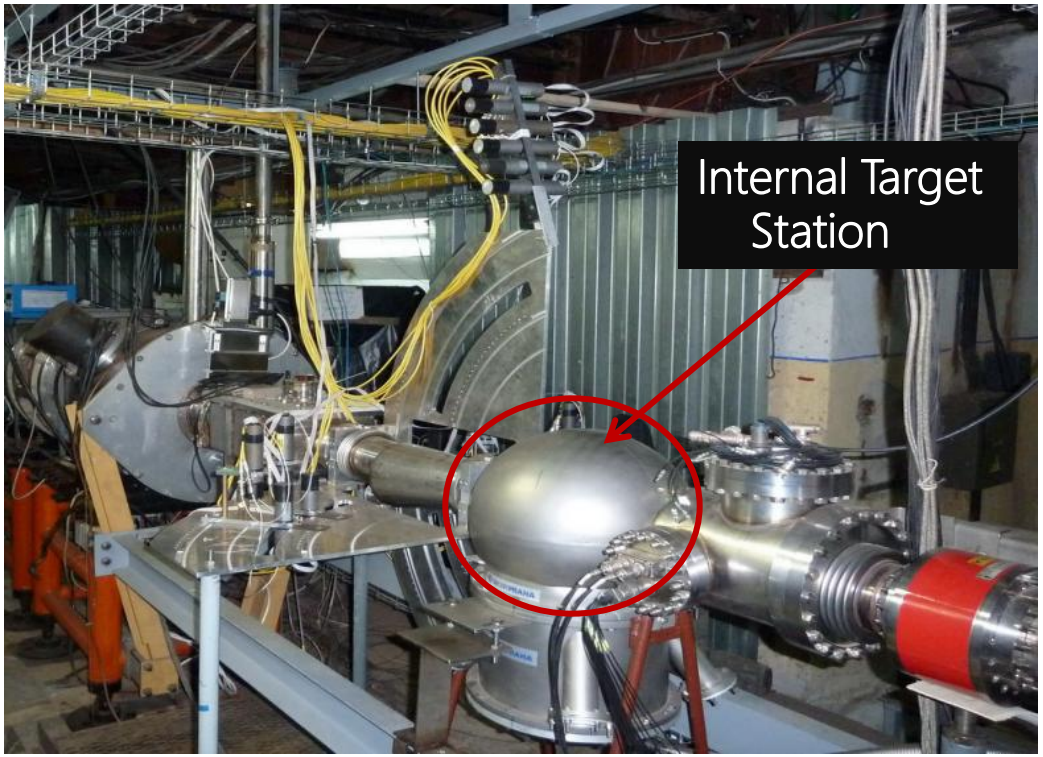
The experimental runs during 2016/2017yy:

- ➢ The energy rage: 400 – 1800 MeV;
- ➢ The angular range: 60˚ - 135˚ in c.m.s.;

# Nuclotron-M accelerator complex



# Experiments at Internal Target Station at Nuclotron



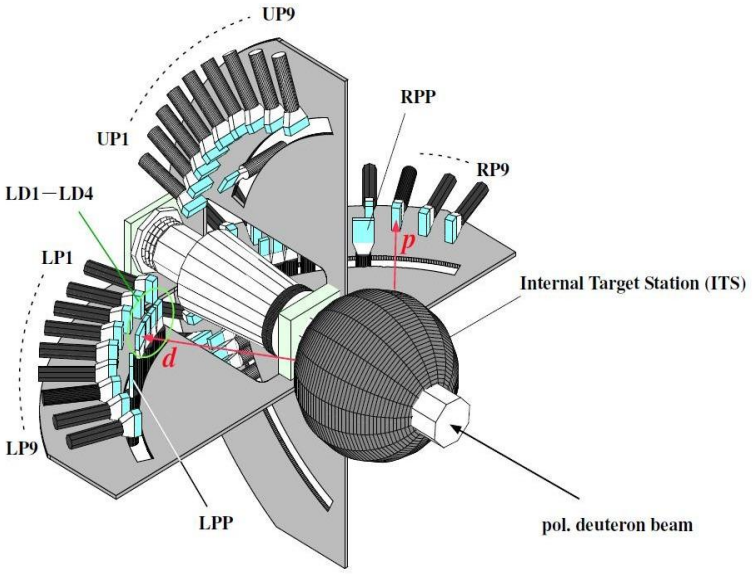

Internal Target Station is very well suited for the measurements of the deuteron- induced reactions observables at large scattering Angles

ITS consist of

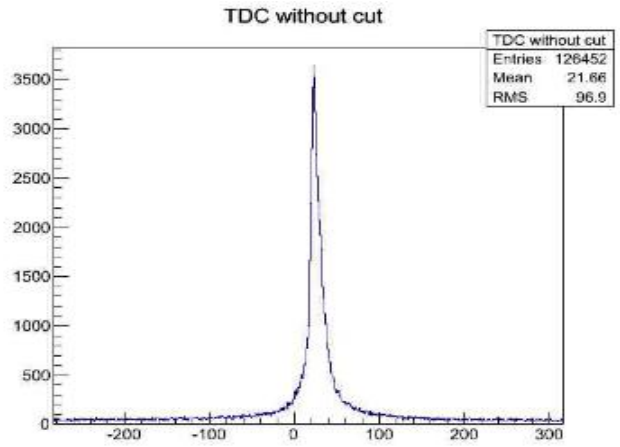
- ✓ Spherical chamber;
- ✓ Target sweeping system.

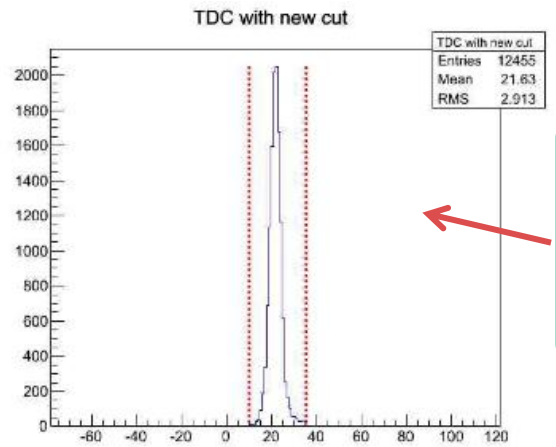
# Experiments at Internal Target Station at Nuclotron

- Deuterons and protons in coincidences using scintillation counters ;
- Internal beam and thin $CH_2$ target (C for background estimation) ;
- Polarization measurement at 270 MeV;
- Analyzing powers measurement at 800 MeV;
- The data were taken for three spin modes of PIS: unpolarized, "2-6" and "3-5" ($p_z$,$p_{zz}$) = (0,0), (-1/3,1) and (-1/3,-1)

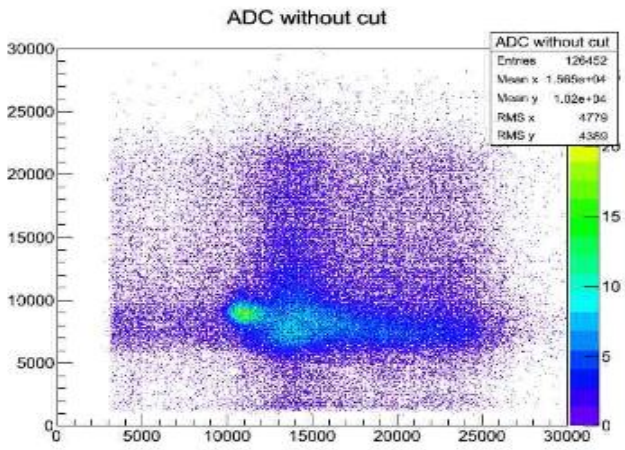


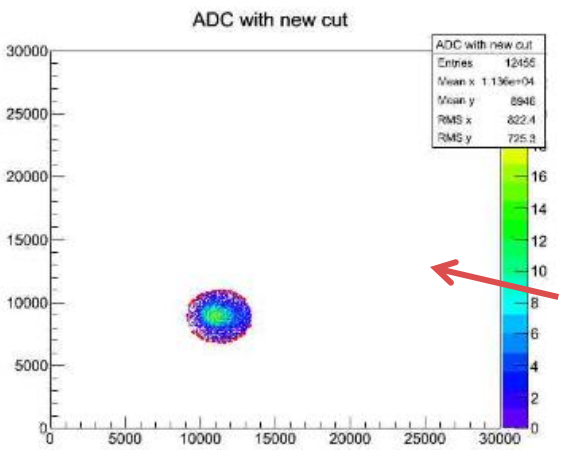
# The dp-elastic scattering events selection



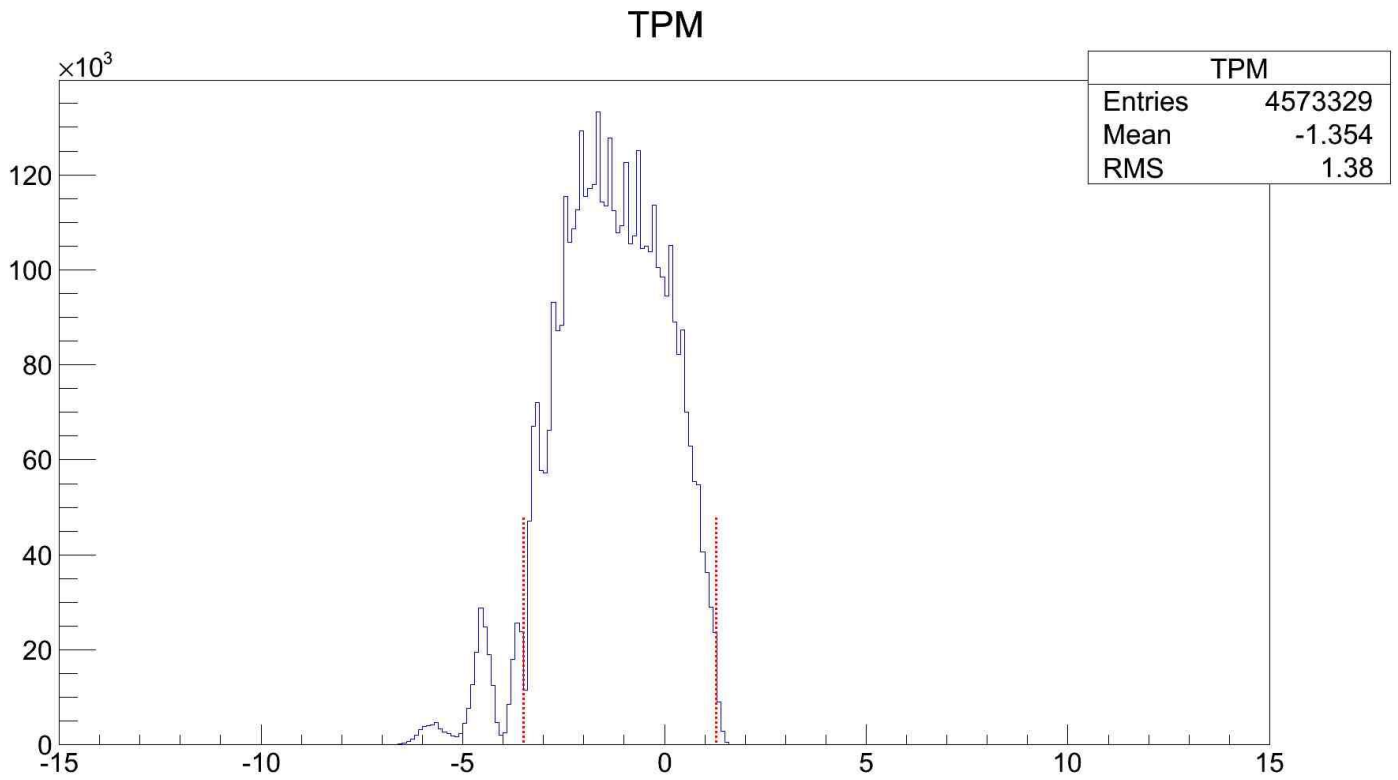

Selection of the dp elastic events by the time difference between the signal appearance from deuteron and proton detectors with the criteria on the amplitude signal correlation.



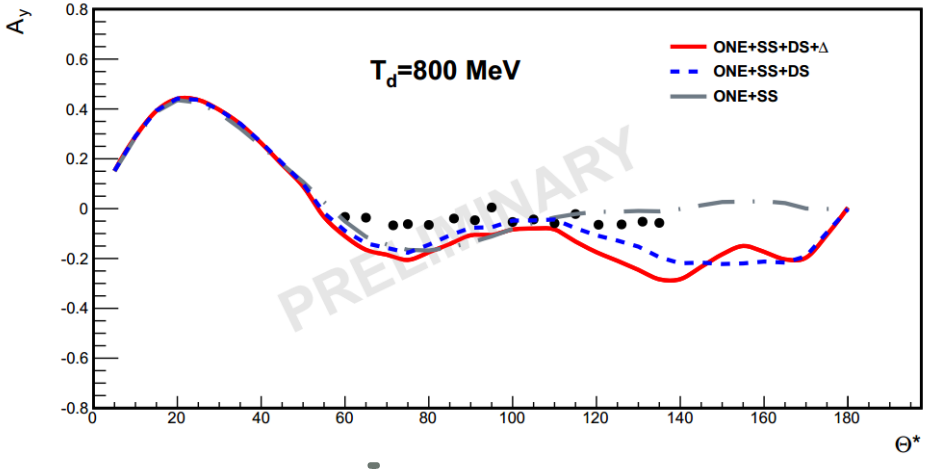

The correlation of the energy-loss signal for a pair of the deuteron and proton detector at 95° in c.m.s. The solid line is a graphical cut for the dp-elastic events candidate selection.

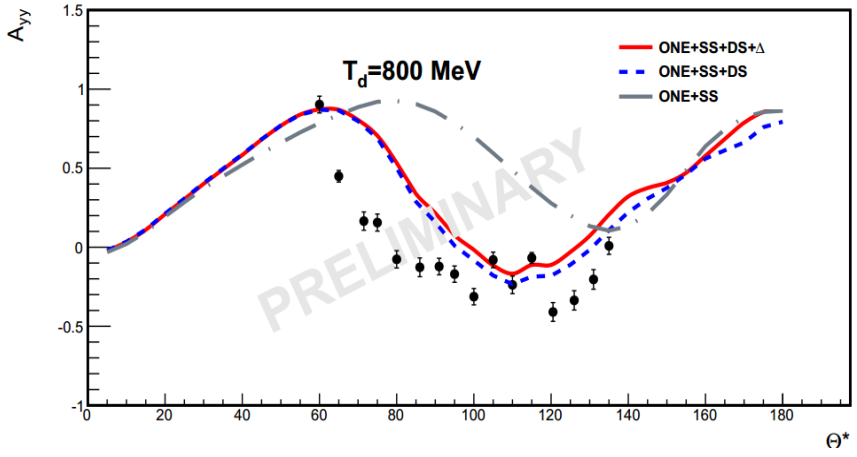
# Interaction point of the beam

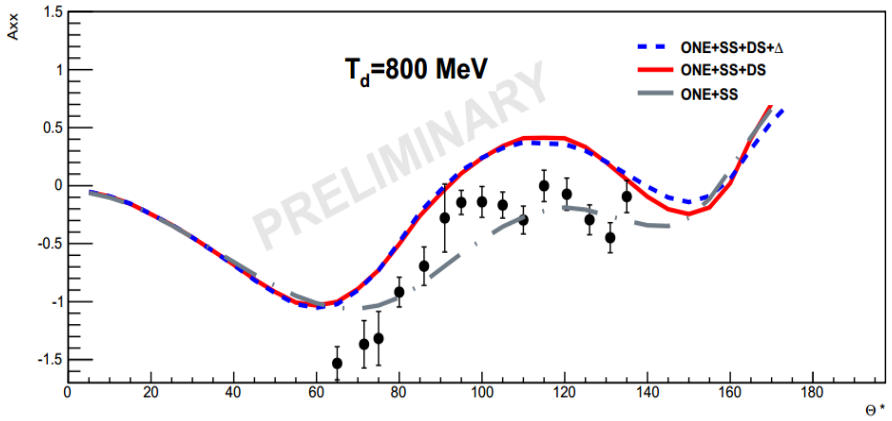



Interaction point of the beam with the target. The solid line is a graphical cut for the selection of dp-elastic scattering events.

# Angular dependences of the Ay, Ayy, Axx in dp-elastic scattering




- ✓ Full symbols are the data obtained at Nuclotron;
- ✓ Lines are the relativistic multiple scattering model calculations

# Conclusions

- The data on the deuteron analyzing powers Ay, Ayy and Axx at the energy of 800MeV covered the angular region of 65–135◦ in the center-of-mass system were obtained at the Internal Target Station at Nuclotron;

- The obtained data are compared with different theoretical predictions. The calculation reproduced the obtained data quite good.

# Thank  for your attention

$$U = 1 + \frac{1}{2} P_{zz} A_{xx} \quad \rightarrow \quad P_{zz} = \frac{2U - 2}{A_{xx}}$$
$$D = 1 + \frac{1}{2} P_{zz} A_{xx} \quad \rightarrow \quad P_{zz} = \frac{2D - 2}{A_{xx}}$$

$$L = 1 + \frac{3}{2} P_z A_y + \frac{1}{2} P_{zz} A_{yy} \quad \rightarrow \quad P_z = \frac{L - R}{3A_y}$$
$$R = 1 - \frac{3}{2} P_z A_y + \frac{1}{2} P_{zz} A_{yy} \quad \rightarrow \quad P_{zz} = \frac{L + R - 2}{A_{yy}}$$

- L,R,U,D - The normalized dp-elastic scattering events to the left (L), right (R), up (U), down (D);
- Ay, Ayy, Axx — analyzing power;
- Pz, Pzz — components of polarization.