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Study of the deuteron **analyzing**
powers in **dp-elastic scattering**
at the energy of **800 MeV**

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(SRC, DSS project)

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(Accelerators complex & ITS)

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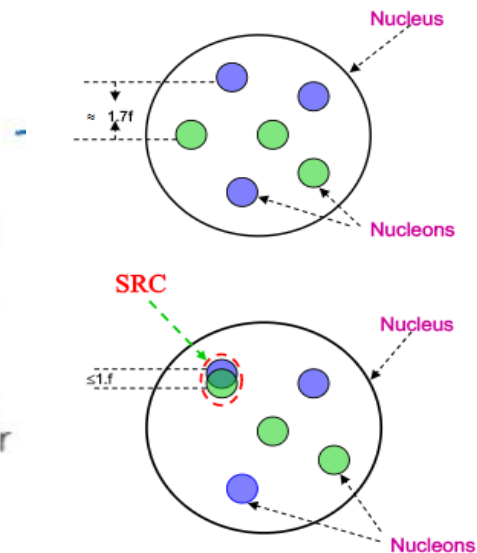
Results
(Polarization, events selection, TMP, A_y, A_{yy}, A_{xx})

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 sum of processes on single nucleons;
- ✓ Due to the quantum fluctuations 2 or more nucleons may **overlap** at smaller distances creating **SRC**.



DSS structure plus deuteron

measurement of

- cross-section,
- vector A_y analyzing power
- tensor A_{yy} & A_{xx} analyzing powers

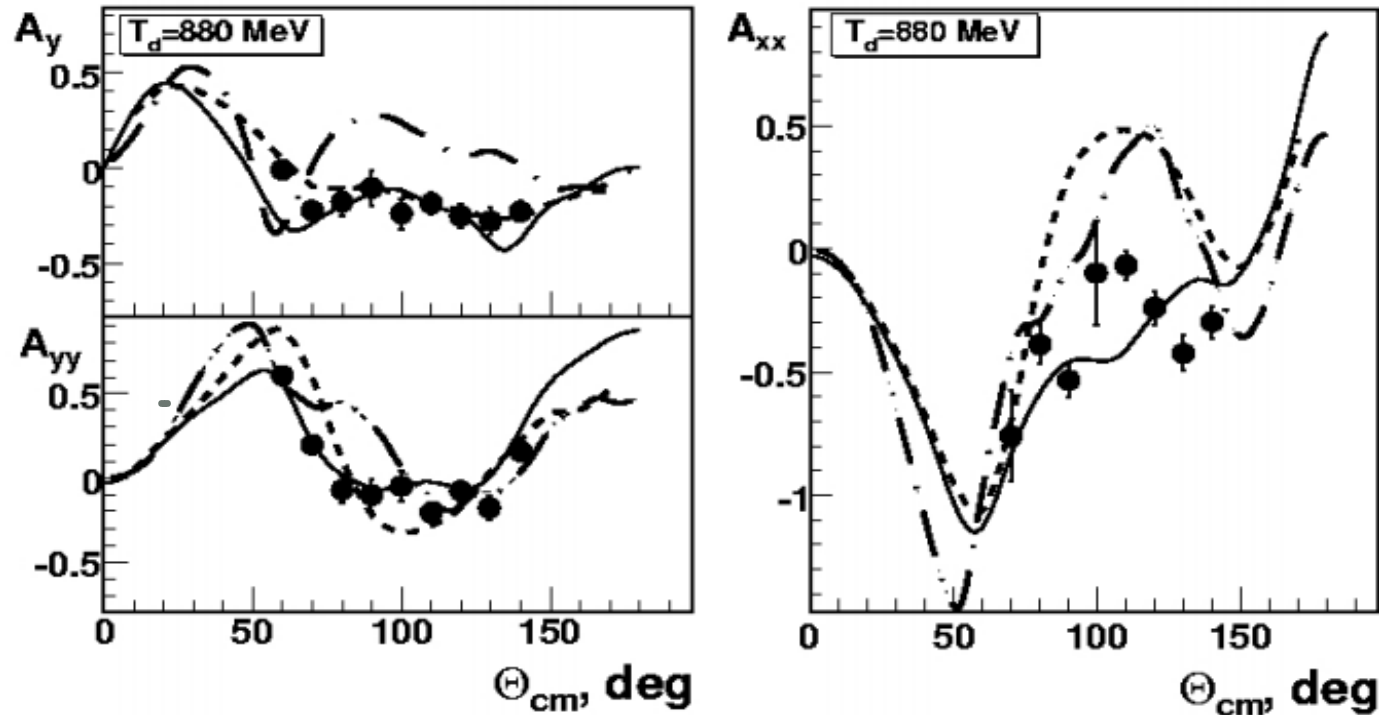
The purpose of the **DSS** experimental program is to obtain the information about **2NF** and **3NF** from two processes:

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

The **experimental runs** during 2016/2017yy:

- The energy range: **400 – 1800 MeV**;
- The angular range: **60° - 135° in c.m.s.**;

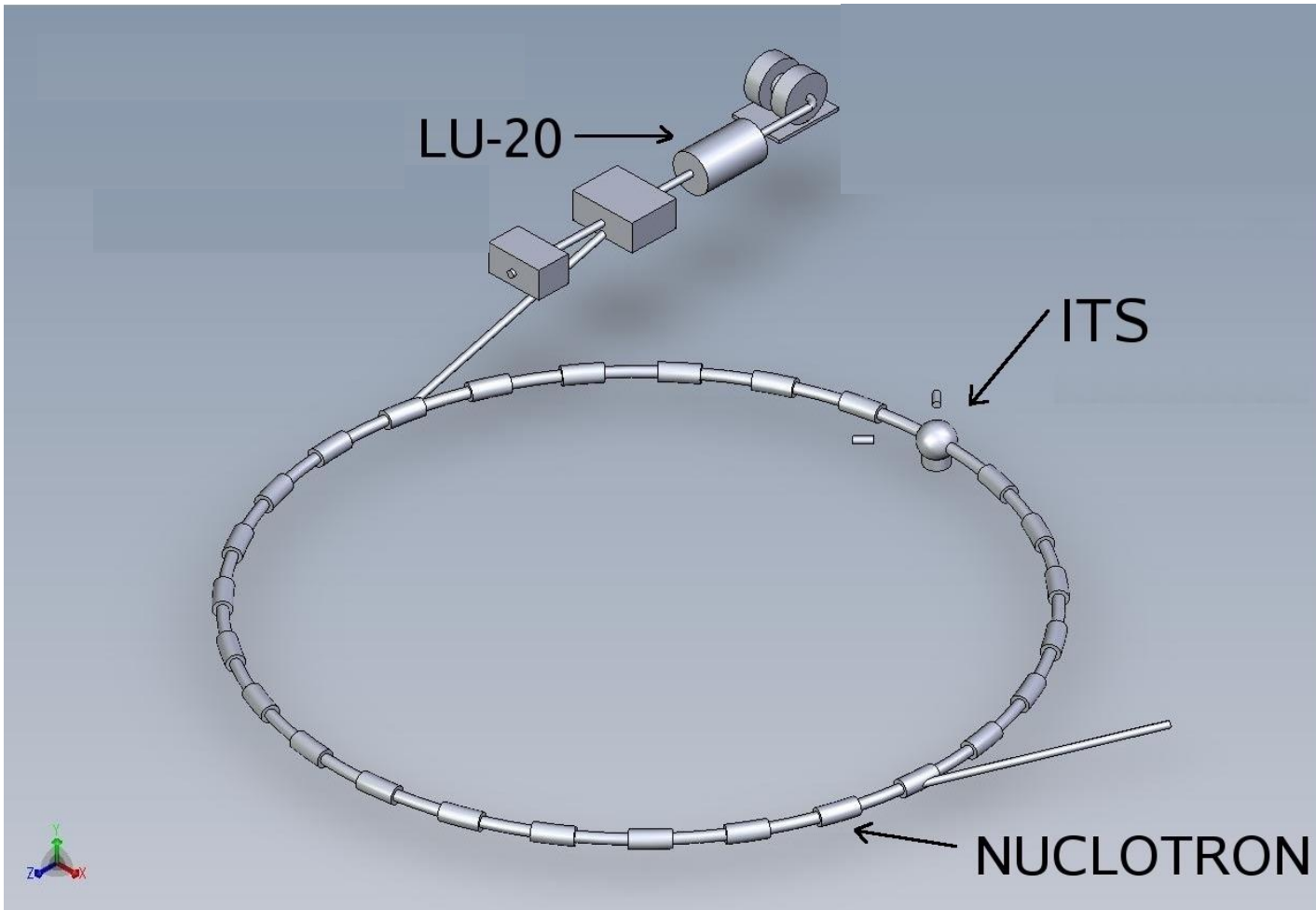
Theory models + experimental results obtained at 880MeV



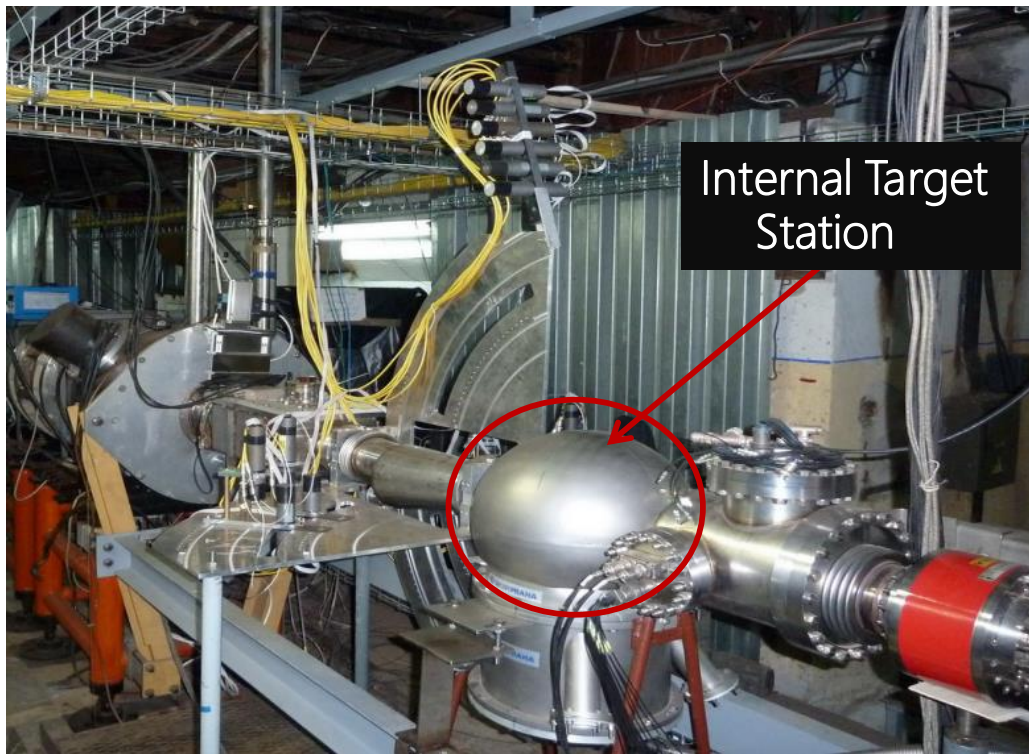
- - experimental results;
- - Faddeev Calculation;
- - - - - relativistic multiple scattering model;
- · - · - · - optical potential calculation.

Published in P.K.Kurilkin et al.,
Phys.Lett.B715 (2012) 61-65

Nuclotron-M accelerator complex



Experiments at Internal Target Station at Nuclotron



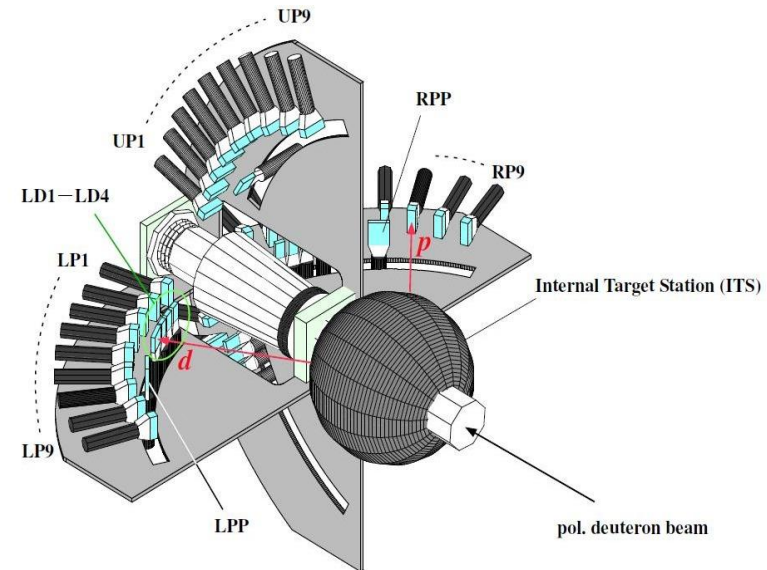
Internal Target Station is very well suited for the measurements of the **deuteron**- induced reactions observables **at large scattering angles**

ITS consists of

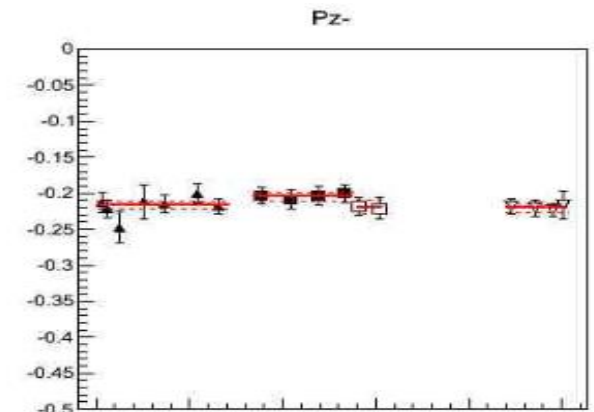
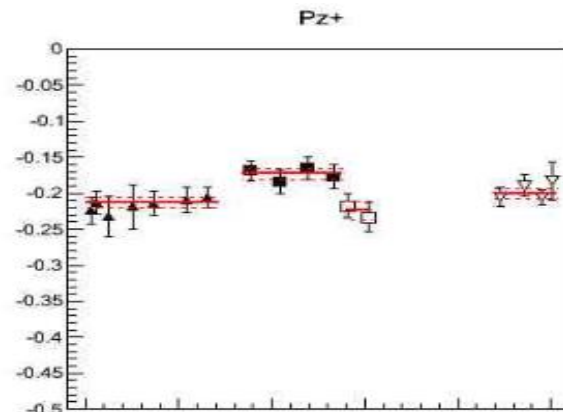
- ✓ Spherical chamber;
- ✓ Target sweeping system.

Experiments at Internal Target Station at Nuclotron

- Deuterons and protons in coincidences using **scintillation counters** ;
- Internal beam and thin **CH₂** 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)

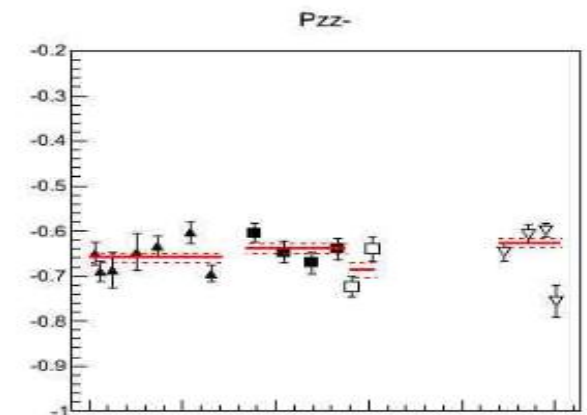
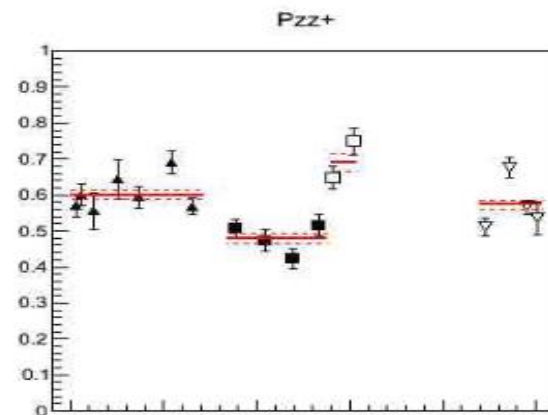


Polarization values using dp- elastic scattering at 270 MeV

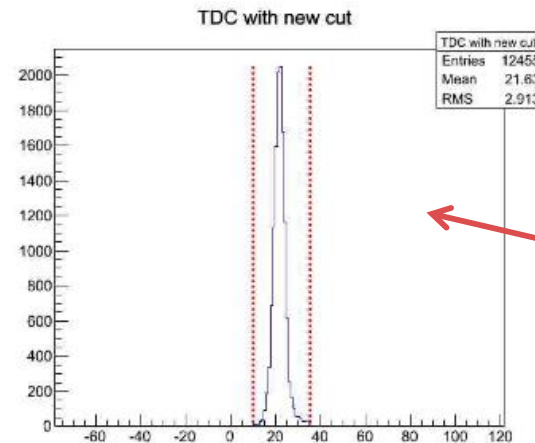
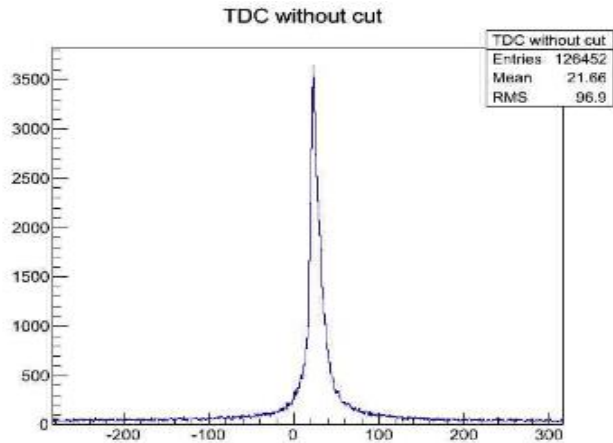


$P_z^+, P_z^-, P_{zz}^+, P_{zz}^-$

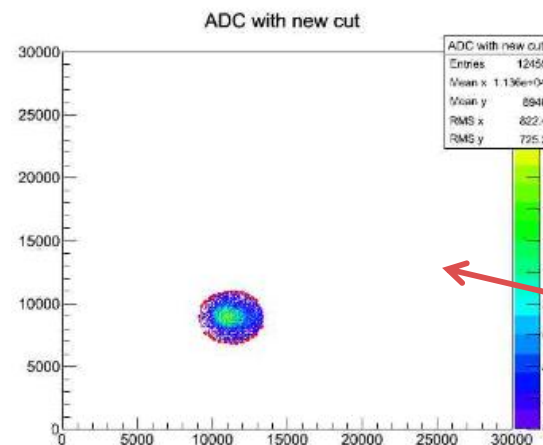
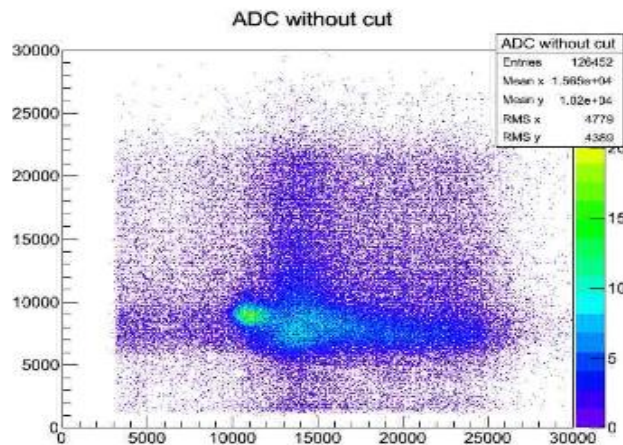
polarization for spin mode:
 $(-1/3, 1), (-1/3, -1)$



The dp-elastic scattering events selection

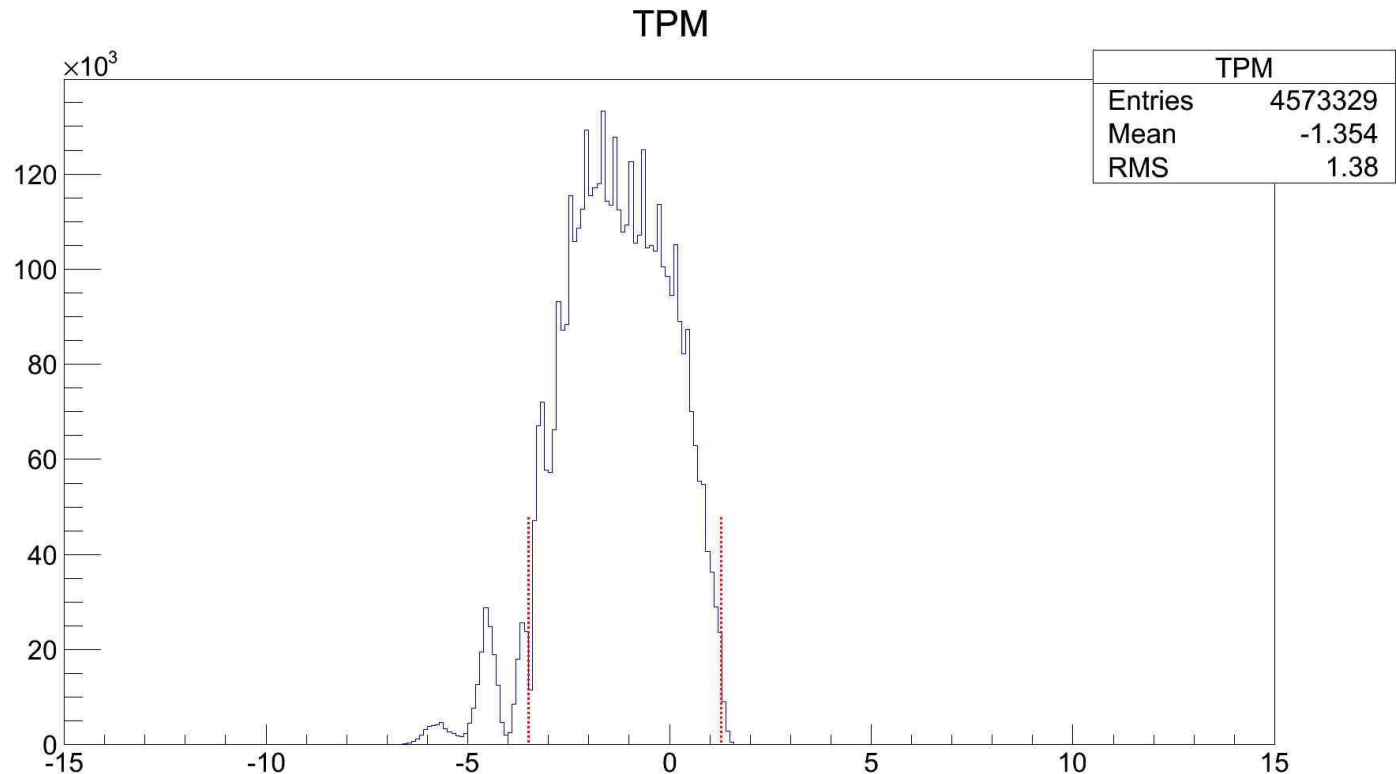


Selection of the dp elastic events by the **time difference** between the signal appearance from **deuteron and proton detectors** with the **criteria** on the **amplitude signal correlation**.



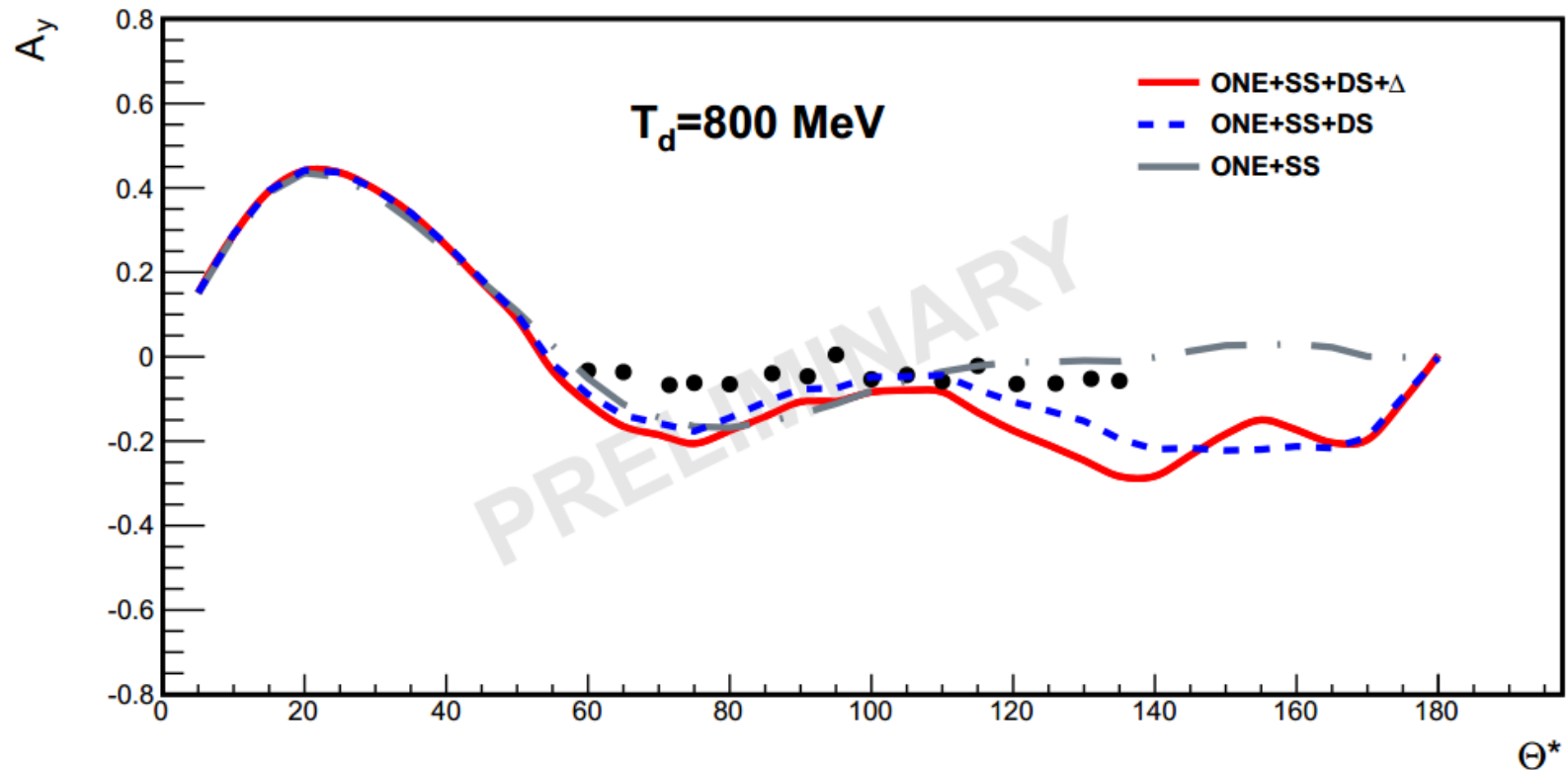
The **correlation of the energy-losses** signal for a pair of the deuteron and proton detector **at 95° in c.m.s.** The **solid line** is a graphical **cut** for the dp-elastic events candidate selection.

Interaction point of the beam



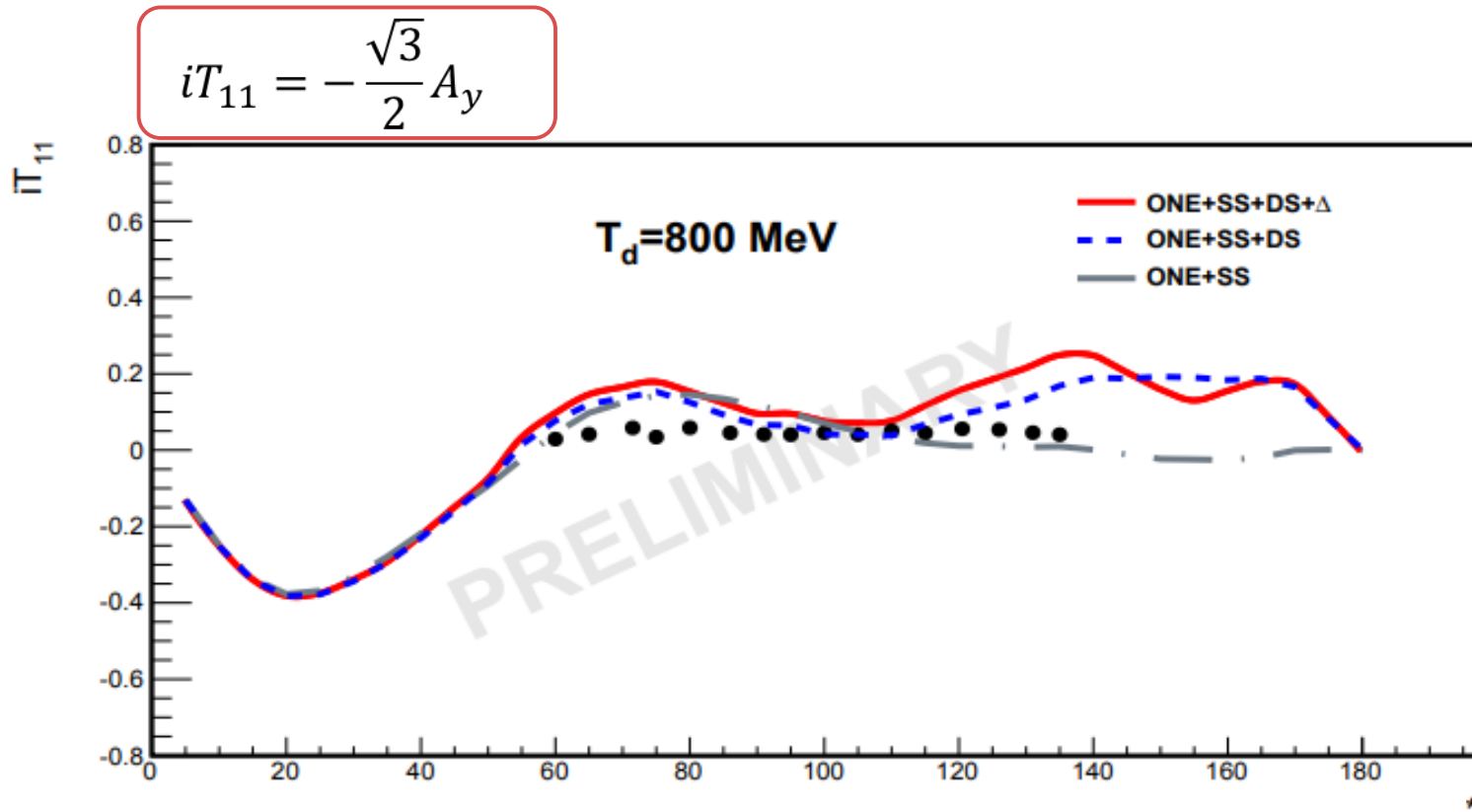
Interaction point of the **beam** with the **target**. The **solid line** is a graphical **cut** for the selection of dp-elastic scattering events.

Angular dependence of the A_y in dp-elastic scattering



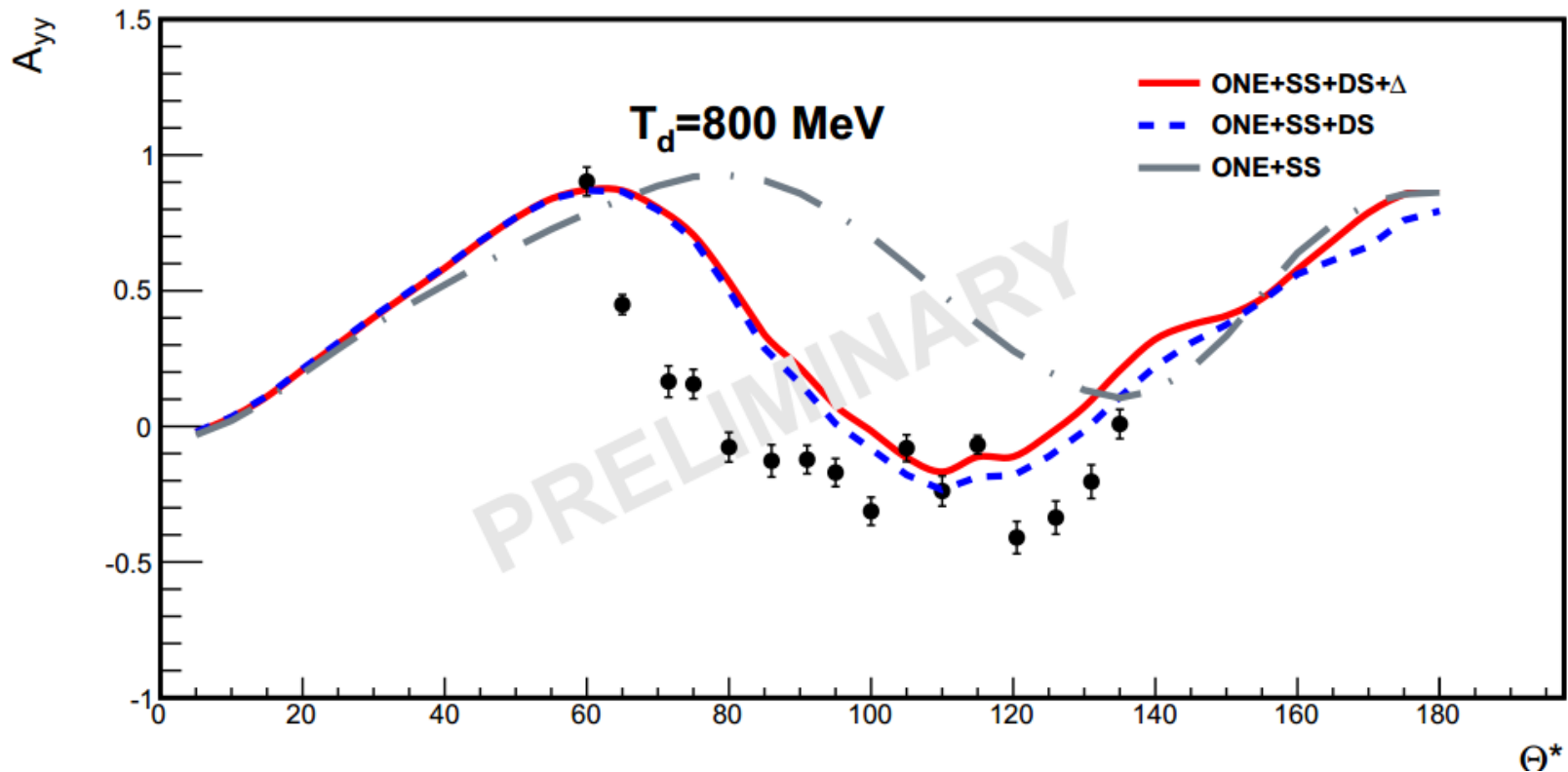
- ✓ Full symbols are the **data** obtained at **Nuclotron**;
- ✓ Lines are the **relativistic multiple scattering model** calculations
 (— - **N.B.Ladygina, Eur.Phys.J, A52 (2016) 199,**
- - - , - . - . - **N.B.Ladygina, Eur.Phys.J, A42 (2009) 91**)

Angular dependence of the T_{11} in dp-elastic scattering



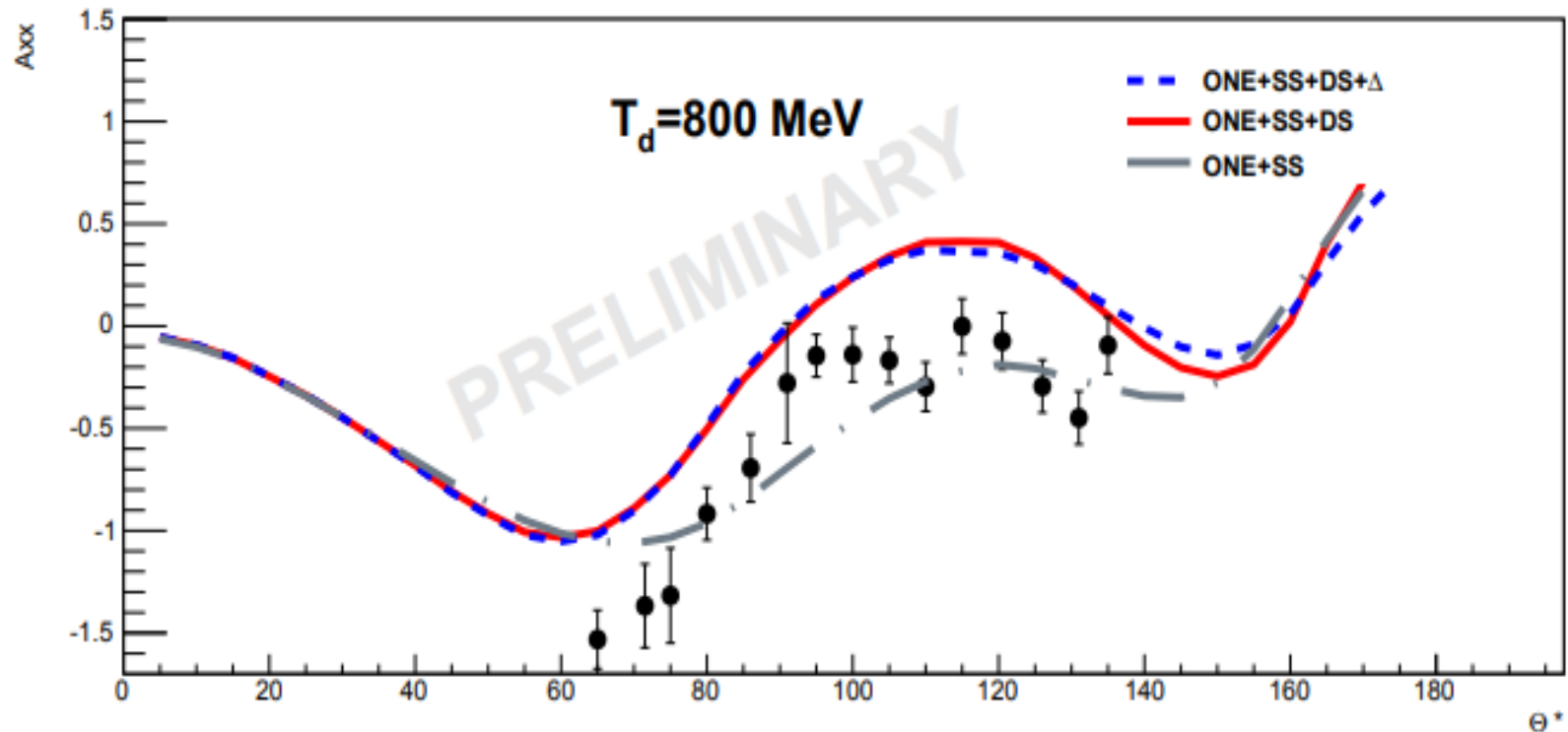
- ✓ Full symbols are the **data** obtained at **Nuclotron**;
- ✓ Lines are the **relativistic multiple scattering model** calculations
 (— - [N.B.Ladygina, Eur.Phys.J, A52 \(2016\) 199,](#)
- - -, - . - . - [N.B.Ladygina, Eur.Phys.J, A42 \(2009\) 91](#))

Angular dependence of the A_{yy} in dp-elastic scattering



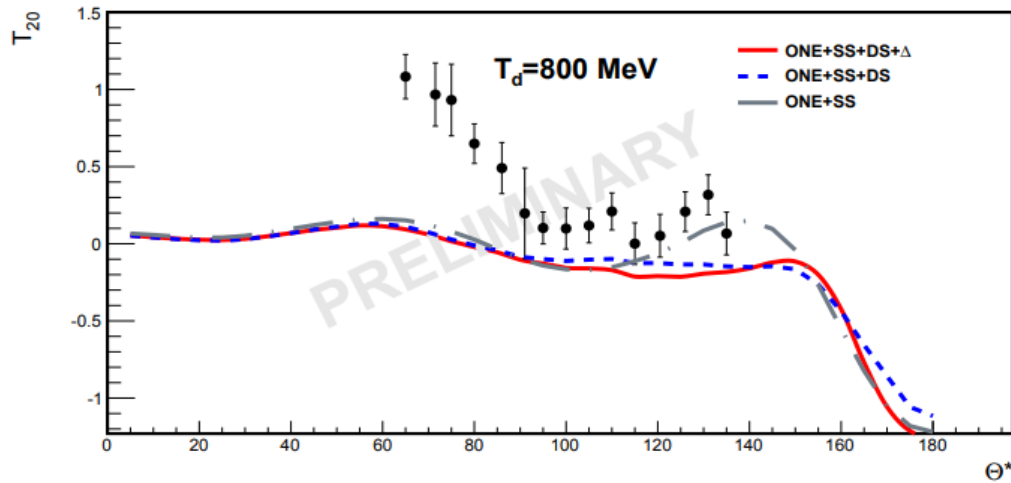
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 (— — — — — **N.B.Ladygina, Eur.Phys.J, A52 (2016) 199,**
 - - - - - **N.B.Ladygina, Eur.Phys.J, A42 (2009) 91**)

Angular dependence of the A_{xx} in dp-elastic scattering



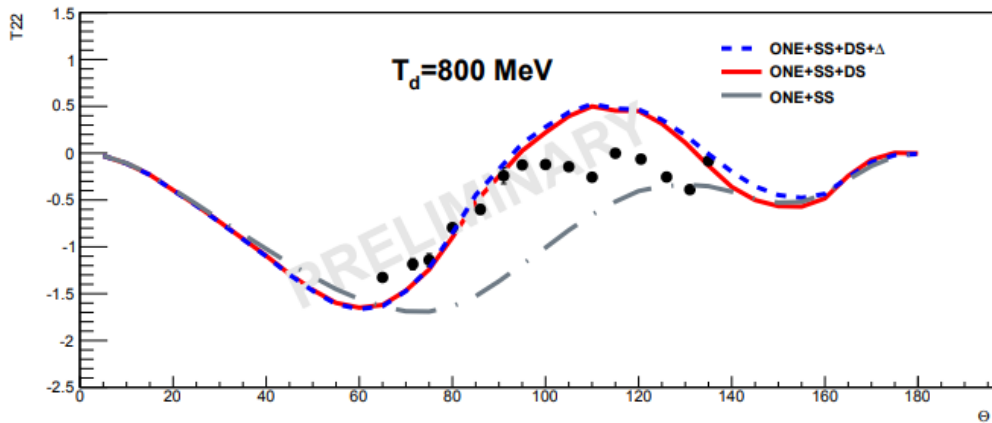
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 - - - - - **N.B.Ladygina, Eur.Phys.J, A42 (2009) 91**)

Angular dependences of the T_{20} & T_{22} in dp-elastic scattering



$$T_{20} = -\frac{1}{\sqrt{2}}(A_{xx} + A_{yy})$$

$$T_{22} = \frac{1}{2\sqrt{3}}(A_{xx} - A_{yy})$$



✓ Full symbols are the **data** obtained at **Nuclotron**;

✓ Lines are the **relativistic multiple scattering model** calculations

(— — — — — [N.B.Ladygina, Eur.Phys.J, A52 \(2016\) 199,](#)
- - - - - [N.B.Ladygina, Eur.Phys.J, A42 \(2009\) 91](#))

Conclusions

- The **data** on the **deuteron analyzing powers** A_y , A_{yy} and A_{xx} at the **energy of 800MeV** covered the angular region of $65\text{--}135^\circ$ **in the center-of-mass system** were obtained **at the Internal Target Station at Nuclotron**;
- The obtained data are **compared** with different **theoretical predictions**.

Thank you for your
attention

