Development of Deuteron Polarimeter at Internal Target Station of Nuclotron

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Collaborators

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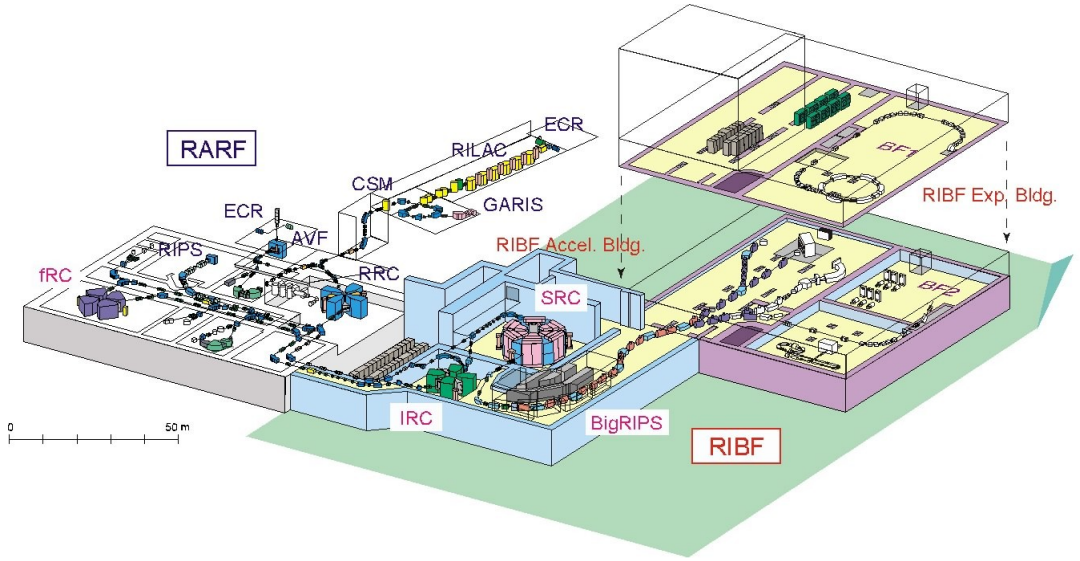
Polarized deuteron beam of ~ 1GeV

Physics programs with medium energy polarized deuterons

- **short-range structure of deuteron**
- **few-body physics**

JINR Nuclotron, Russia **< 12GeV**

RIBF, Japan **< 880MeV**



Deuteron Polarimetry at GeV-region

To obtain polarization observables with sufficient accuracy, an established polarimetry is needed.

deuteron polarimetry at GeV-energies

p-p quasi elastic scattering	**only vector**
deuteron inclusive breakup	**only tensor**
***d*+*p* elastic scattering at forward θ**	**difficult event ID**
***d*+*p* elastic scattering at backward θ**	

large vector and tensor analyzing powers

easy event ID via kinematical coincidence measurement

d+p measurement at JINR

Collaboration program between

Center for Nuclear Study , University of Tokyo

Veksler-Baldin Laboratory of High Energies, JINR

Purpose

Establish a deuteron polarimeter at 500MeV ─2GeV

Status

Construction of a polarimeter setup

at internal target station of Nuclotron

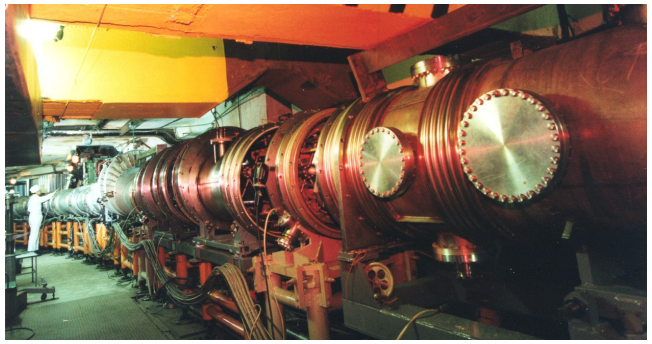
Test experiment with unpolarized beams (March 2005)

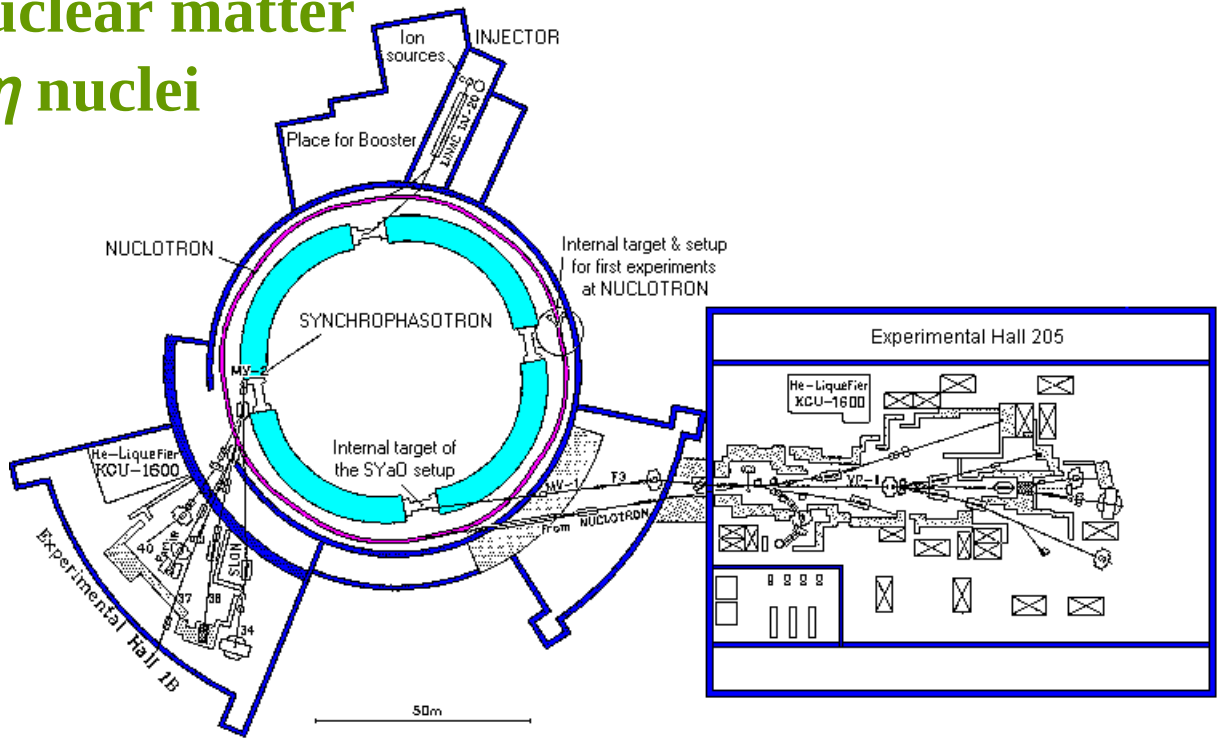
Analyzing power measurement (June 2005)

Nuclotron at JINR

superconducting synchrotron (E/A ~ 6 GeV)

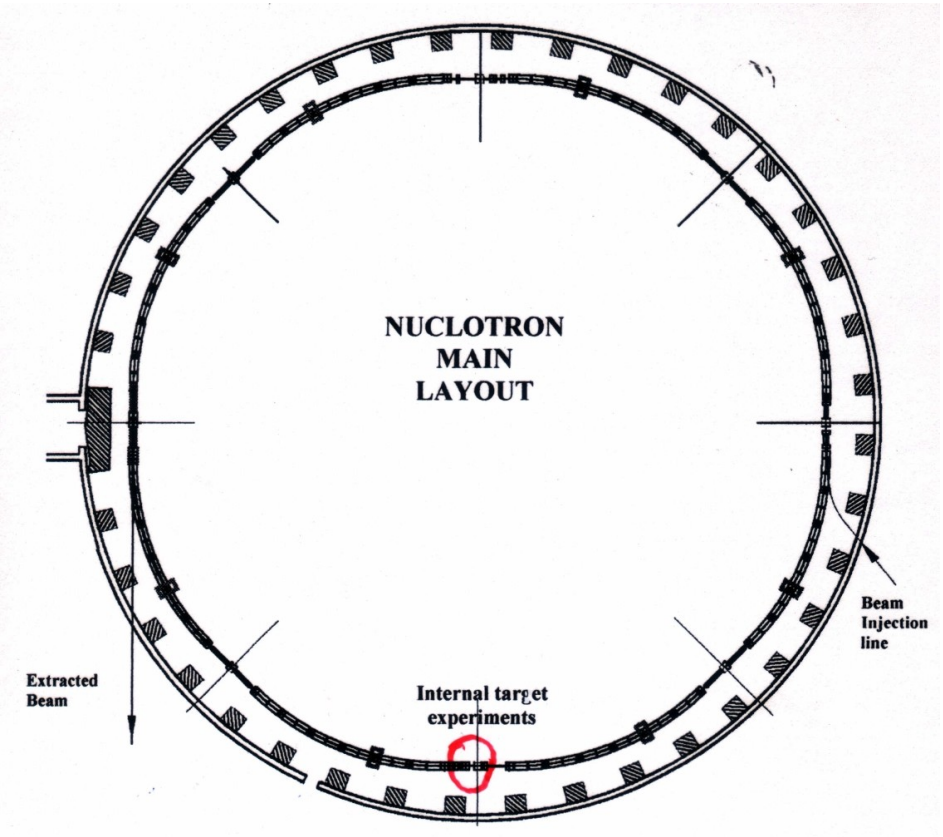
- **Nuclear structure**
- **Medium effects on particle production**
- **Modification of nuclear matter**
- **Hypernuclei and η nuclei**
- **Nucleon structure**

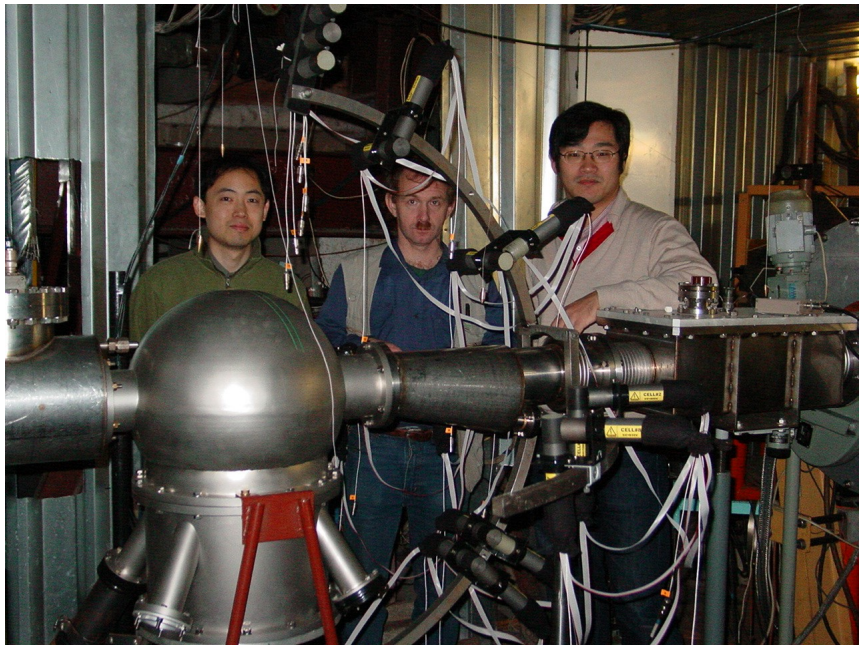




Internal Target Station

A.I.Malakhov et al., NIM A **440** (2000) 320.





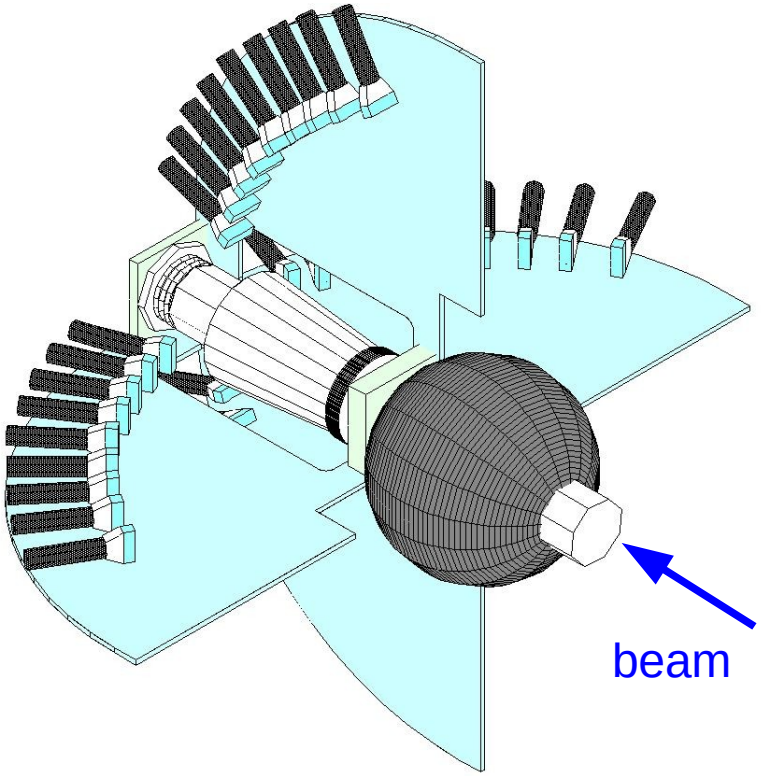
Polarimeter Setup

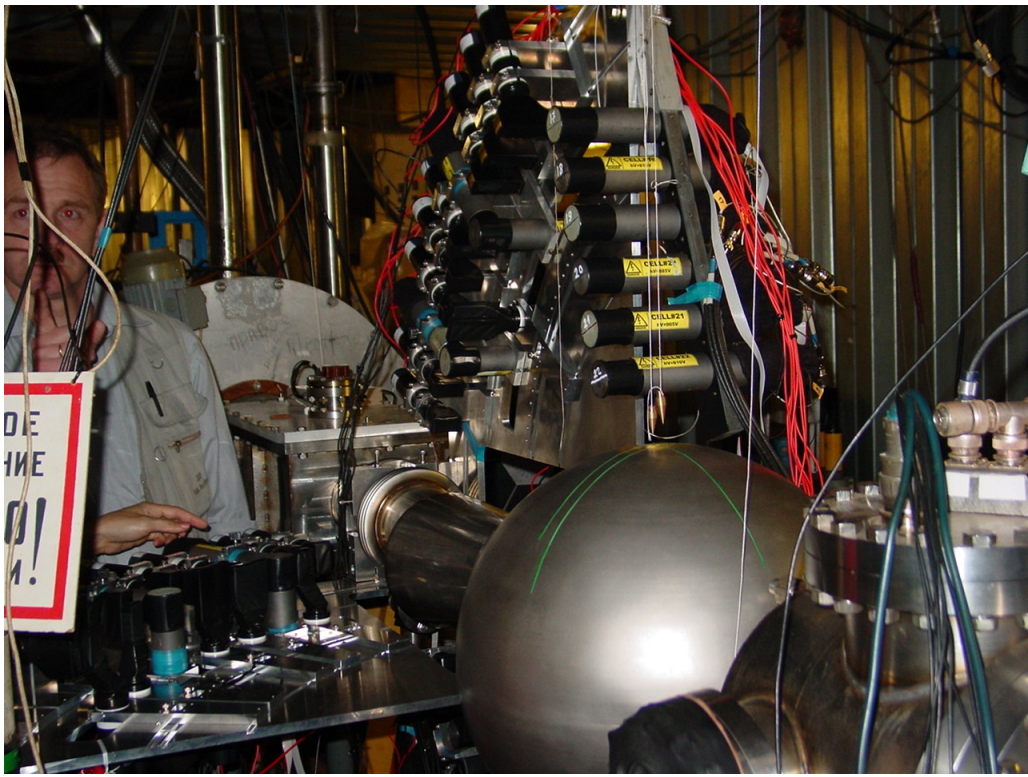
target: 10 μm-thick polyethylene sheet, carbon wire

detectors: 10- or 20-mm thick plastic scintillation detectors

event ID: kinematical coincidence

coincidence timing





Analyzing power Measurement in June 2005

Beam polarized deuteron provided by **POLARIS**

Beam Intensity < 2–3 X10^7 /spill (spill duration 8 sec)

Polarization mode (p_Z, p_{ZZ})=(0, 0), (+1/3, +1), (+1/3, -1)

Beam energy 880 MeV, 2GeV

270 MeV for polarization meas.

Target CH_2 (10 μ m), Carbon

Detectors 30-pairs (total) for *d-p* elastic scattering

in L,R,U,D directions

covered θ cm = 60 – 140 deg

Luminosity monitor

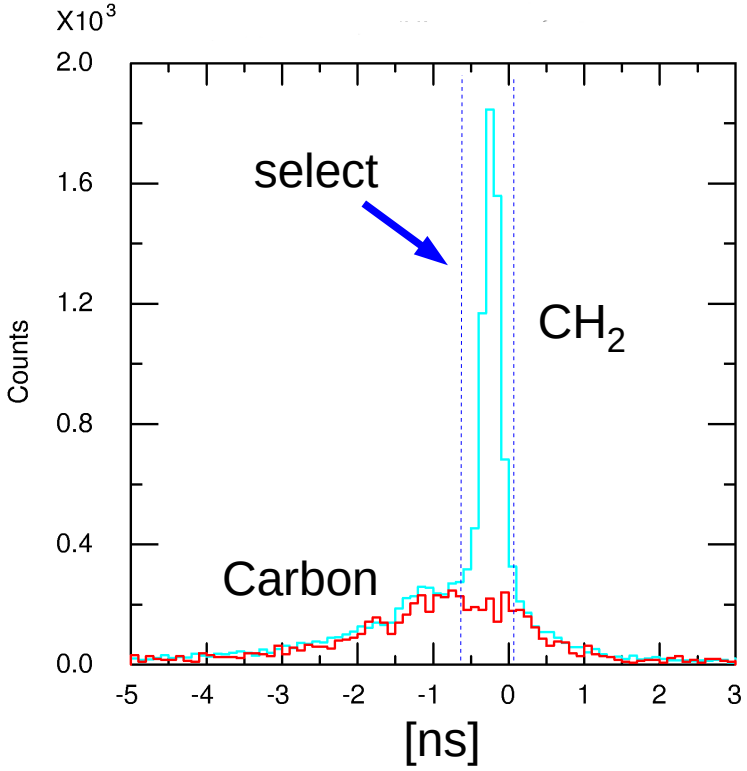
one-pair for *p-p* quasi-elastic scattering

at θ cm = 90 deg (A_y=0)

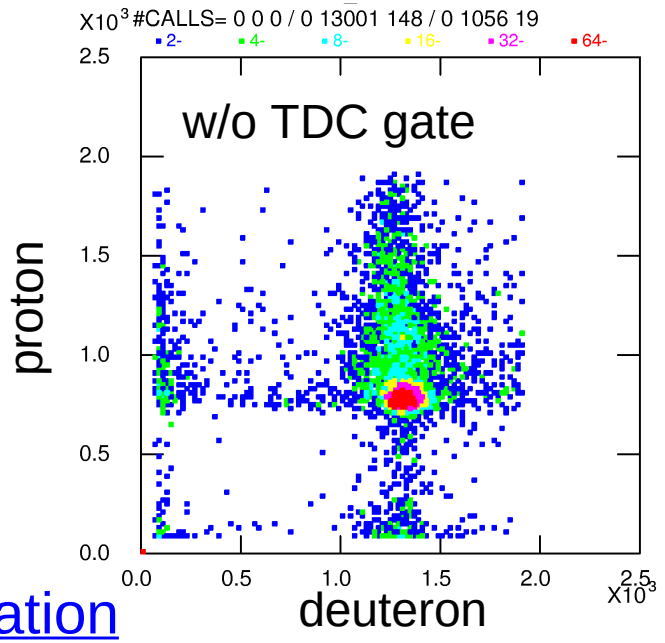
Event identification @880MeV

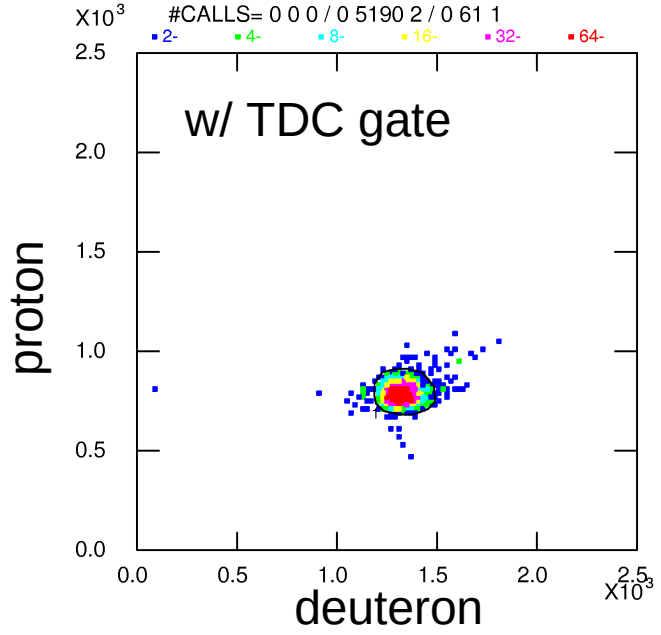
Accidental coincidence is negligible
Carbon contribution should be subtracted

TOF difference



ADC correlation

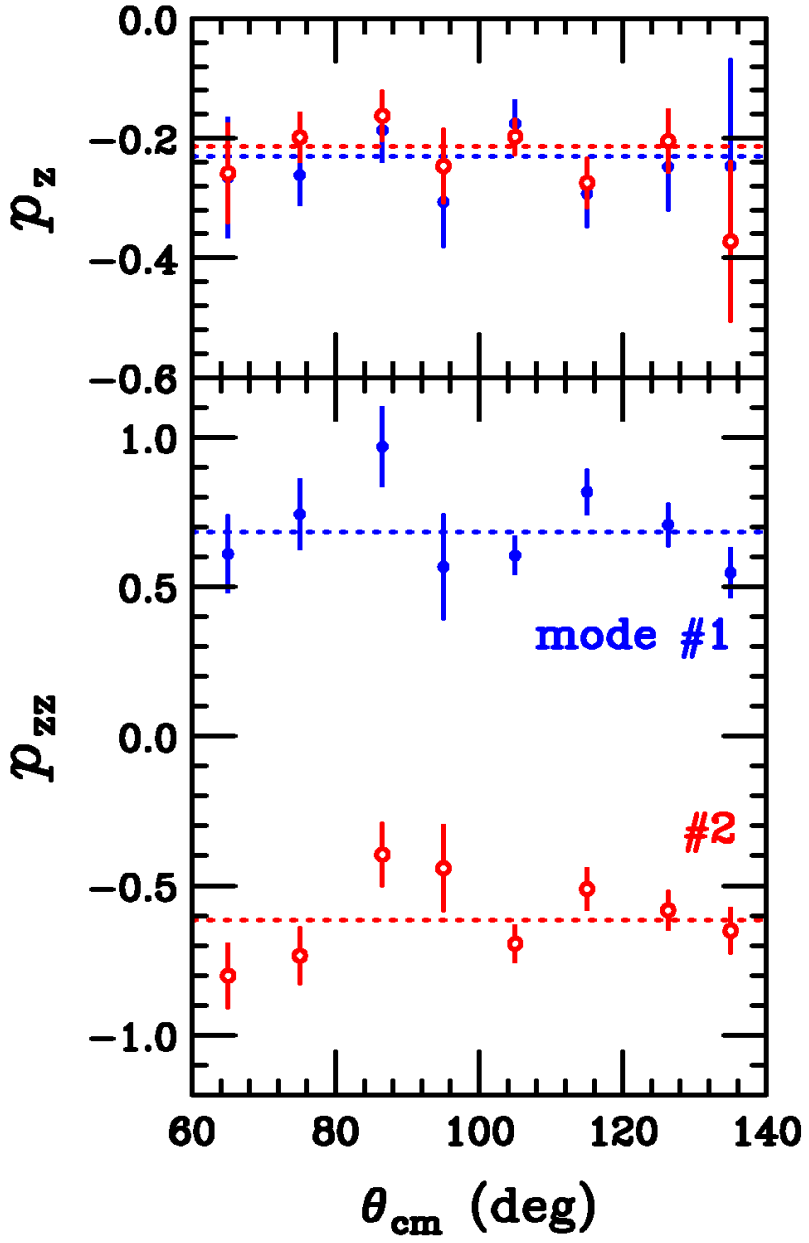




Beam Polarization

- Polarizations are normalized by using RIKEN data at 270 MeV
- averaged for all measured angles

	p_z	p_{zz}
mode 1	-0.231 ± 0.021	0.683 ± 0.031
mode 2	-0.214 ± 0.016	-0.615 ± 0.028



d-p analyzing powers at 880 MeV

A_y ~ – 0.3 ; moderately large

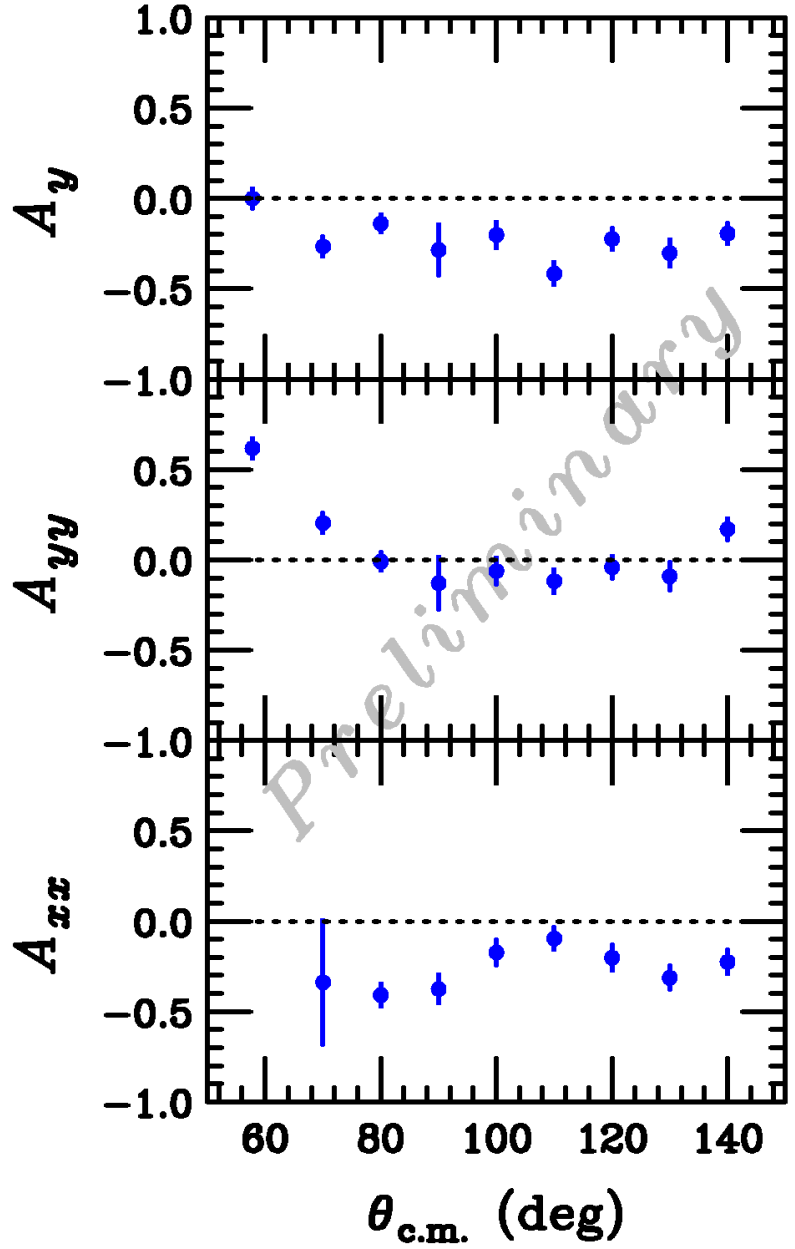
A_{yy} ; large only at $\theta_{cm} <$ 70 deg

vector and tensor polarizations should be measured at two different angles

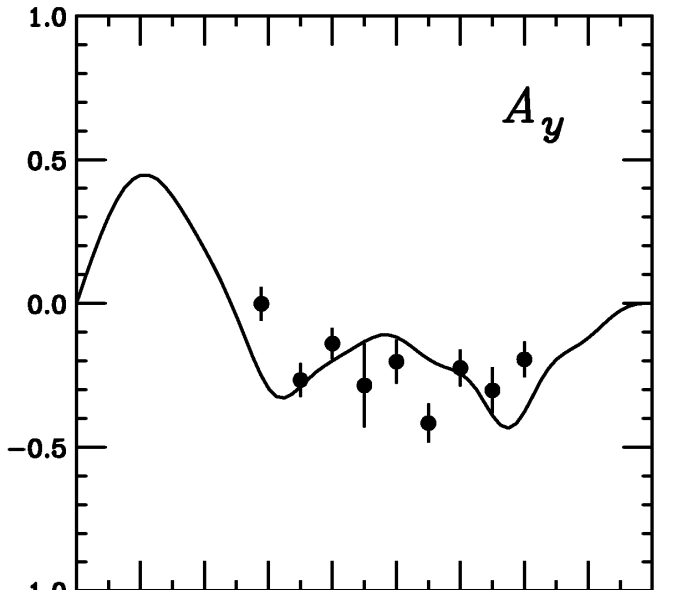
insufficient statistics ($\Delta A \sim 0.07$)

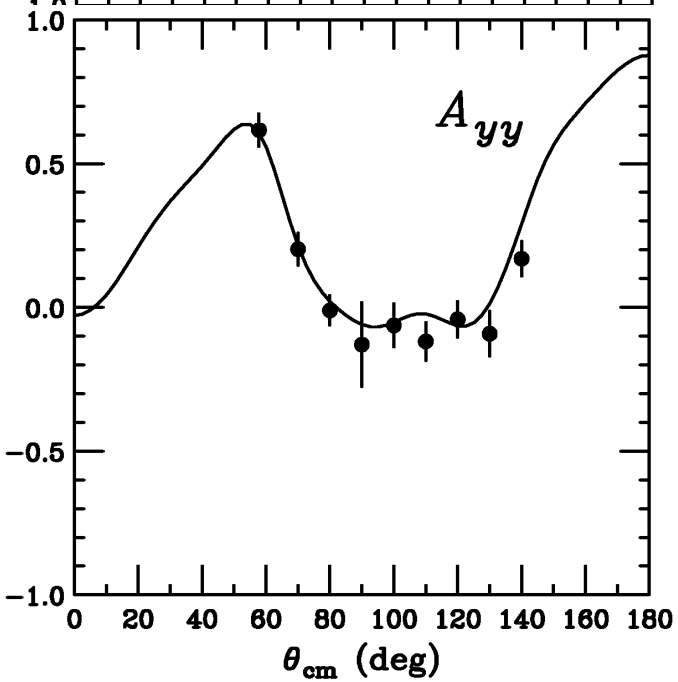
due to low beam intensity

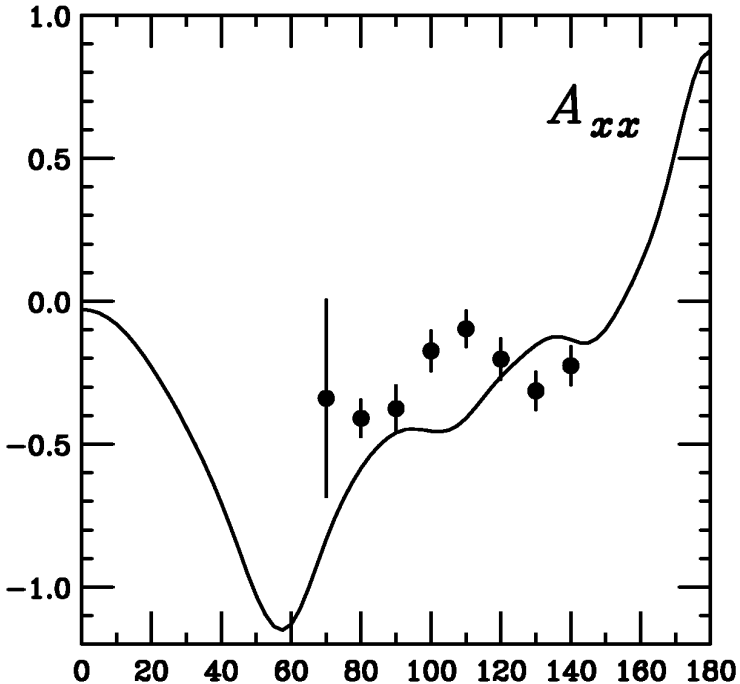
→planning to perform calibration meas. with new ion source CIPIOS



Comparison with Faddeev calculations at 440MeV/A







— CD-Bonn

Calc. By H. Witala (preliminary) private communication

Good agreement at well above pion production threshold.

Summary

- **Construction of a deuteron beamline polarimeter at internal target station of Nuclotron, JINR**

- **Analyzing power measurement of d-p scattering was performed in June 2005 at E_d=880 MeV, 2GeV.**

・**Analyzing power A_y, A_{yy}, and A_{xx} at 880 MeV were obtained at θ cm=60 − 140 deg.**

more precise data is required to establish polarimetry.

planning to take data with new polarized ion source CIPIOS