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Few Nucleon System Dynamics

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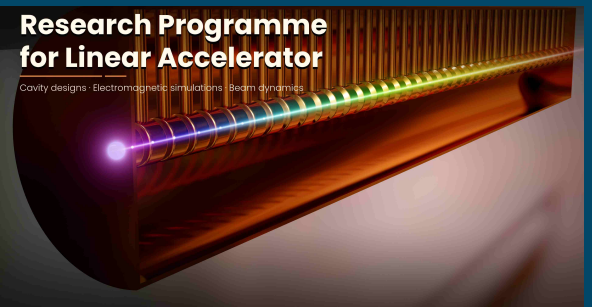
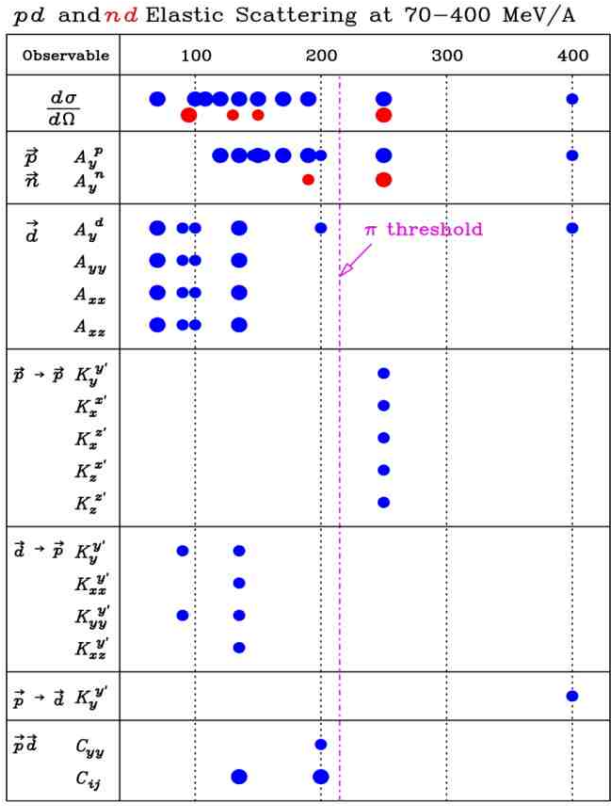


2nd Workshop on Research & Innovation in Poland
IFJ PAN, Krakow, 26-27 May, 2026

Importance of experiments with only few nucleons involved

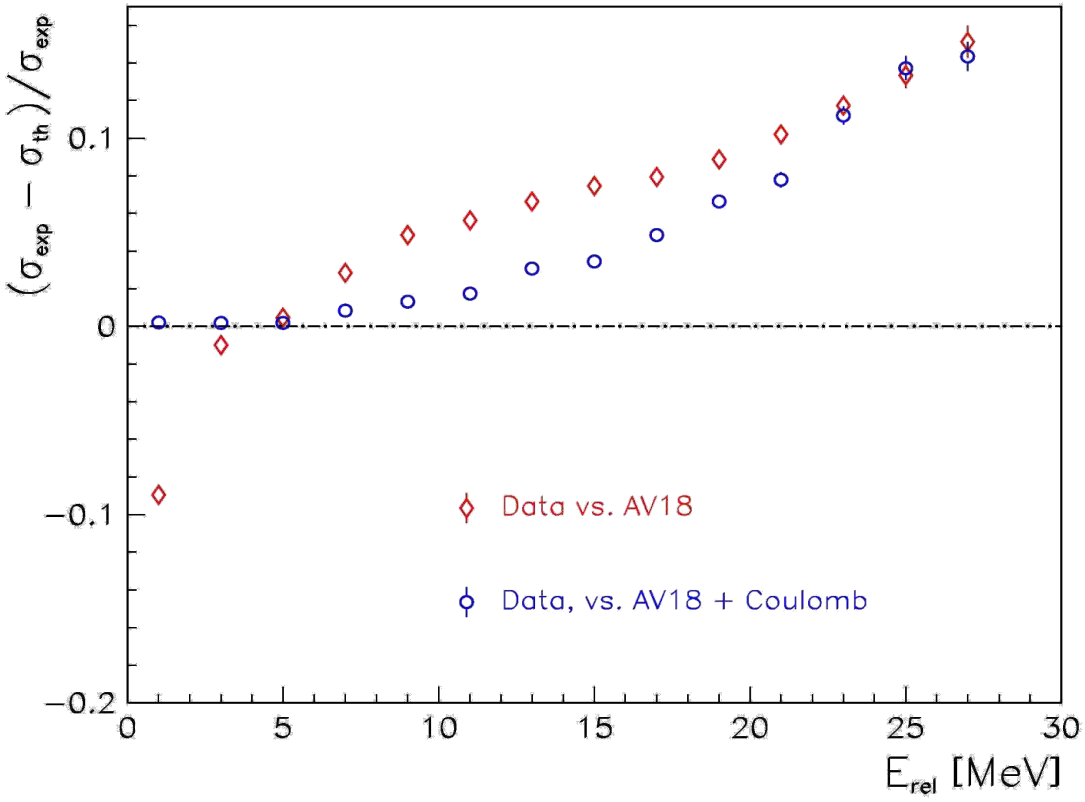
- Set and fine tune values of crucial parameters in models of nuclear interactions
  - CD-Bon, Av 18, Nim I, Nim II, ChPT….
- Decompose nuclear dynamics into basic ingredients:
  - NN- and 3N-interaction
  - Coulomb force
  - Relativistic effects
- Huge set of data already collected for many observables:
  - Elastic scattering
  - Breakup
  - Pd, dp, dd
  - Cross section, polarization sensitive observables...



Courtesy K. Sekiguchi

Picked up from cross section data p(d,pp)n reaction at 130 MeV

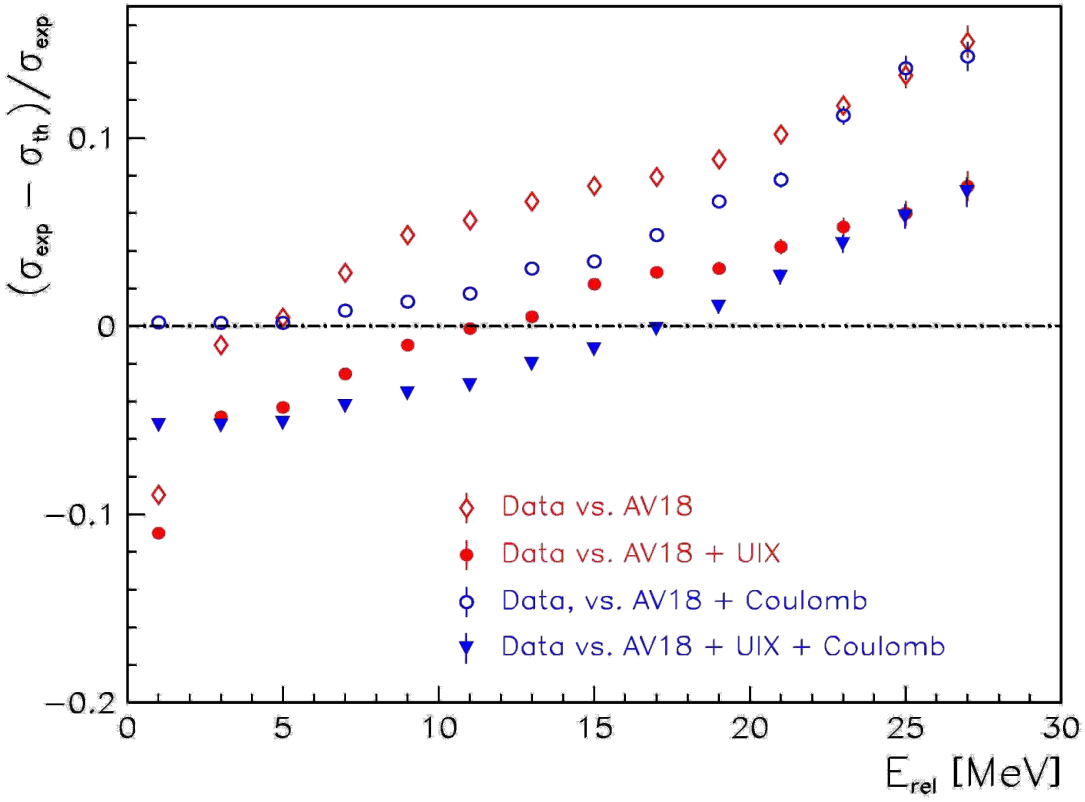
Including Coulomb force effects improves the agreement with the data at low E_{rel} values



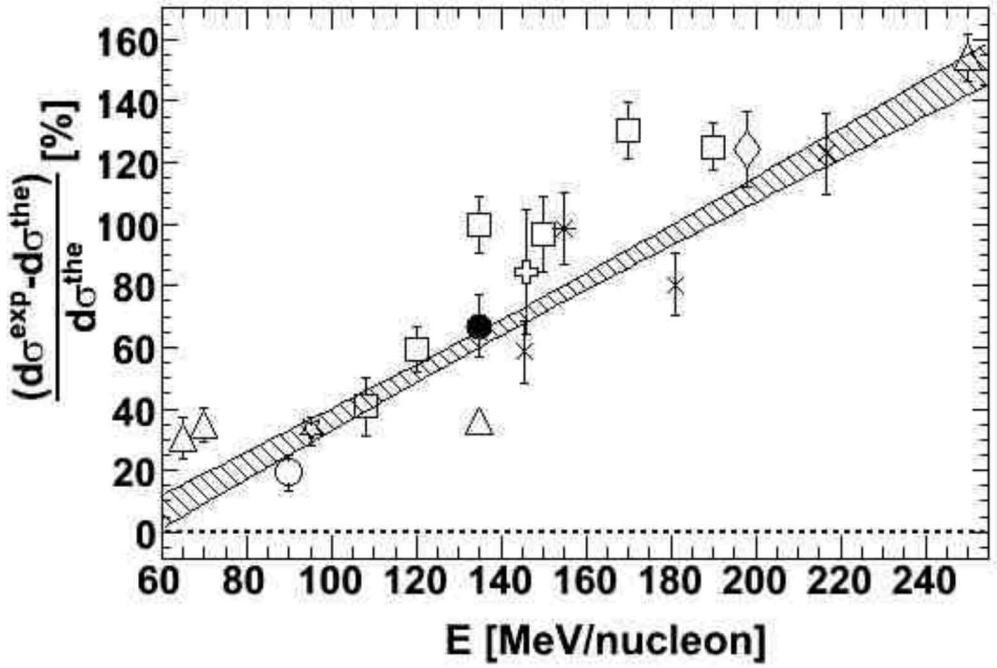
Picked up from cross section data p(d,pp)n reaction at 130 MeV

Including Coulomb force effects improves the agreement with the data at low E_{rel} values

The best agreement is reached when both, the Coulomb force and the 3NF are taken into account !



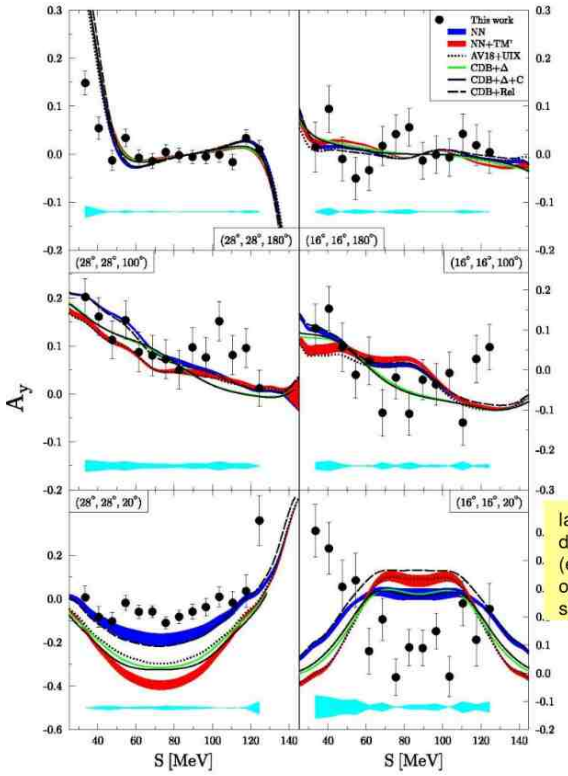
Picked up from cross section data p+d elastic scattering at $\theta_{CM}=140^\circ$

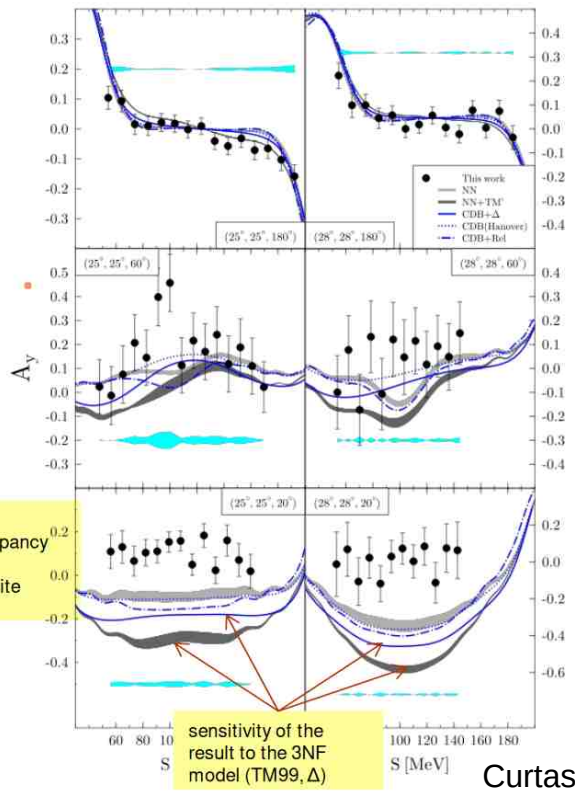


NN

+ 3NF

Central role of polarization sensitive observables



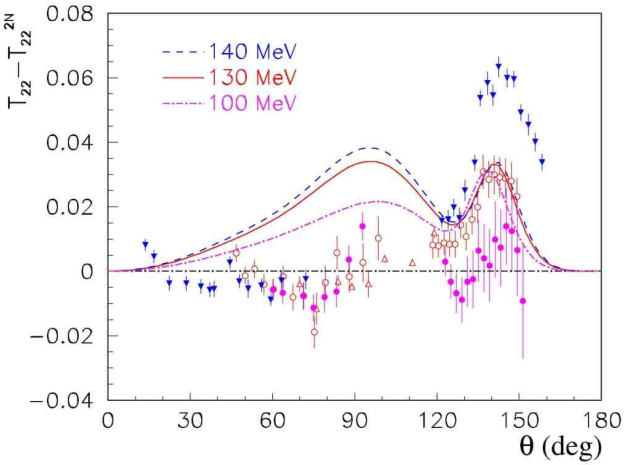


large discrepancy (even opposite signs)

sensitivity of the result to the 3NF model (TM99, Δ)

3NF in pd breakup at 190 MeV

3NF in elastic dp scattering



Curtasy of Ela Stephan, CCB AIC 2025

Section 3
Required beam: particle, energy and properties

Deuterons with variable energy within 100 to190 MeV range, envelope of beam at target ~ 3x3mm^2, beam on target **up to 500 pA**
Energy resolution, around 0.2 MeV, polarization highly demanded.

Inverse kinematics

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^{3}**He** with variable energy within 100 to190 **MeV** range, envelope of beam at target ~ 3x3mm^2, beam on target **up to 500 pA**

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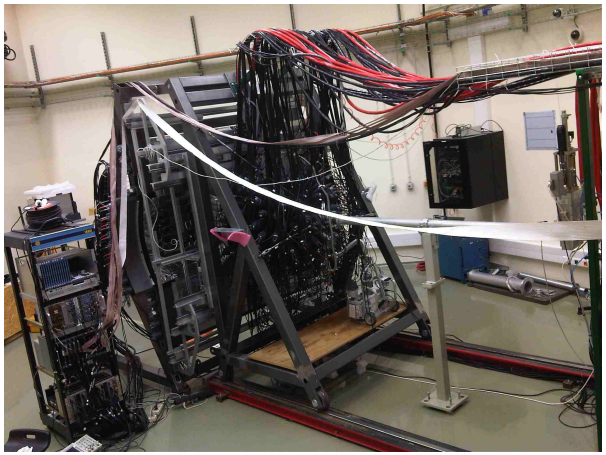
Other requirements (detection system, infrastructure)

- Detection system exists (BINA@CCB) but is getting old and would require renewal or replacement



- Cryogenic target, liquid Hydrogen or Deuterium – Helium compressor needed
- Hyperpolarized Helium-3 target? - only for p beam

SWOT analysis for the project

- S (Strengths)
  - No experimental competition in Europe, only one in the world,
  - strong position of theory group in Krakow, active experimental group
  - Vivid activities of many theory groups in Europe
- W (Weaknesses)
  - Old detector system, substantial investment involved
  - Large delay in delivery of 3N force in next order of CPT
- O (Opportunities)
  - With polarized 3He very interesting and multidysciplinary experiment
- T (Threats)
  - Lack of founding

Conclusions

Crucial for FewBody Physics:

- Precision
- Polarization