Workshop summary

PSTP2011
Scientific sessions

Session 1: Polarized electron sources (chair E. Tsentalovich)

Session 2: Polarimetry (chair: Y. Makdisi)

Session 3: Polarized internal targets, ABS (chair D. Toporkov)

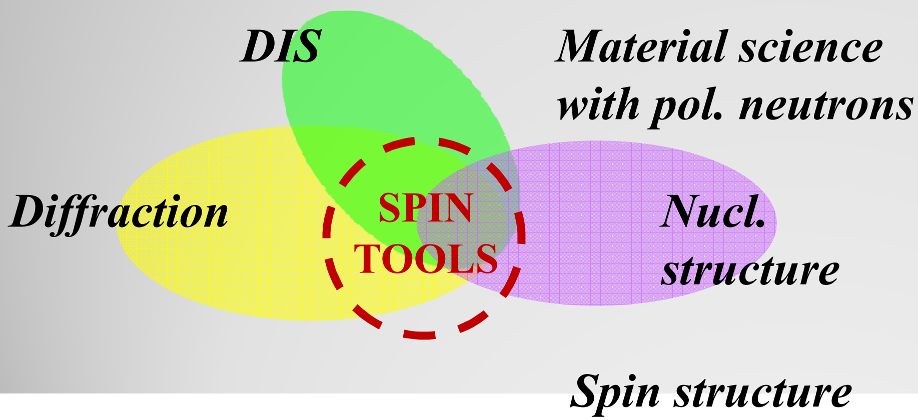
Session 4: Polarized ion sources (chair A. Belov)

Session 5: Prospects of polarized experiments (chair E. Steffens)

Session 6: Polarized solid targets (chair D. Crabb)

Status of Spin Physics and Experiments

Erhard Steffens
University of Erlangen-Nürnberg
Chair, International Committee for Spin Physics Symposia



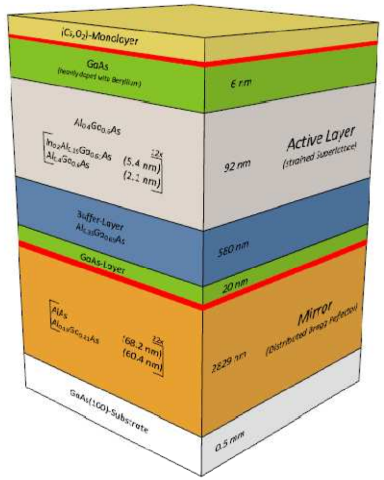
Spin tools are discussed in detail at Workshops (regular or topical)

1.) Polarized electron sources

Determination of photoabsorbtive heating in DBR and nonDBR photocathodes

Eric J. Riehn, BNL

- Photocathodes with a DBR–mirror have an enhanced QY (at same polarization) by the resonator and by the mirror's tails
  - For $\lambda < 700\ nm$ absorption is high and the resonator does not develop
  - For $\lambda > 850\ nm$ absorption is low and the resonator improves only the QY but not the current
  - Within DBR working range, laser power can be increased



Laser systems for a source of polarized electrons at the S-DALINAC

TECHNISCHE UNIVERSITÄT DARMSTADT

Marcus Wagner / Yulia Poltoratsk

- Two laser systems used to get polarised electron beam
- Beam transfer of about 40m
- Stability improvement of the Ti:Sa up to $\sim$ 150 h

Comparison of the lasersystems

TECHNISCHE UNIVERSITÄT DARMSTADT

	Ti:Sa-Lasersystem	ECDL
Wavelength in nm	680 – 1000	780
Power	2 W	50 mW
Pulselength	220 fs	30 ps
Rate of repetition	75 MHz	3 GHz
Stability	Sensitive against external influences	very stable

Status of high intensity polarized electron gun project at MIT-Bates

Evgeni Tsentalovich, MIT

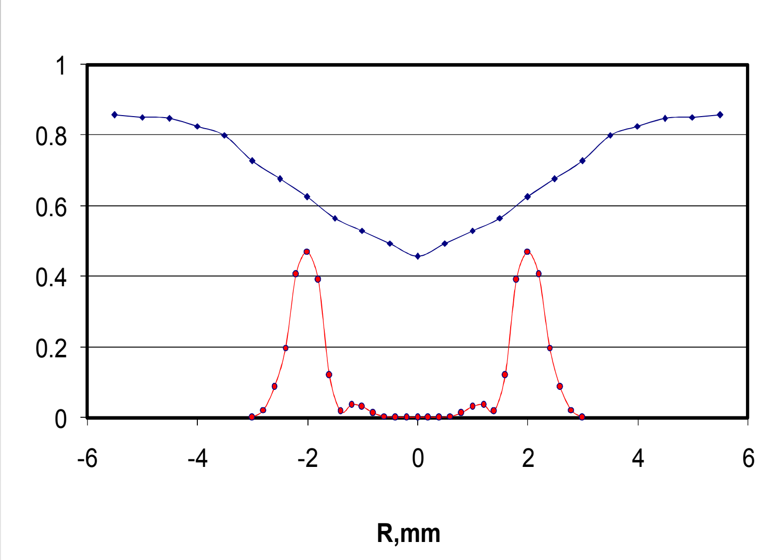
Current status

The gun chamber: built and tested. It was vented 3 weeks ago to install the first dipole followed the gate valve and 2 additional NEGs. Rebaked and HV reprocessed.

The preparation chamber: design is completed, the main chamber has been manufactured, many parts are already ordered.

Load lock – the design is in progress.

Beam line – conceptual design is completed, some parts are designed, the dipole vacuum chambers have been manufactured.



2.) Polarimetry

Polarized beam in RHIC in Run 2011.Polarimetry at RHIC A.Zelenski, BNL

- Faraday rotation polarimeter
- Lamb-shift polarimeter
- 200 MeV - absolute polarimeter
- AGS p-Carbon CNI polarimeter
- RHIC p-Carbon CNI polarimeter
- RHIC - absolute H-jet polarimeter
- Local polarimeters at STAR and PHENIX

H-jet is an ideal polarimeter !

- High (~4.5%) analyzing power in a wide energy range (23-250 GeV).
- High event rate due to high intensity (~100 mA) circulated beam current in the storage ring (~6% statistical accuracy in one 8hrs. long fill

3.) POLARIZED INTERNAL TARGETS and ABS

First experiments with the polarized internal gas target at ANKE/COSY

Maxim Mikirtychyants for the ANKE collaboration FZ Jülich / JCHP and PNPI (Gatchina)

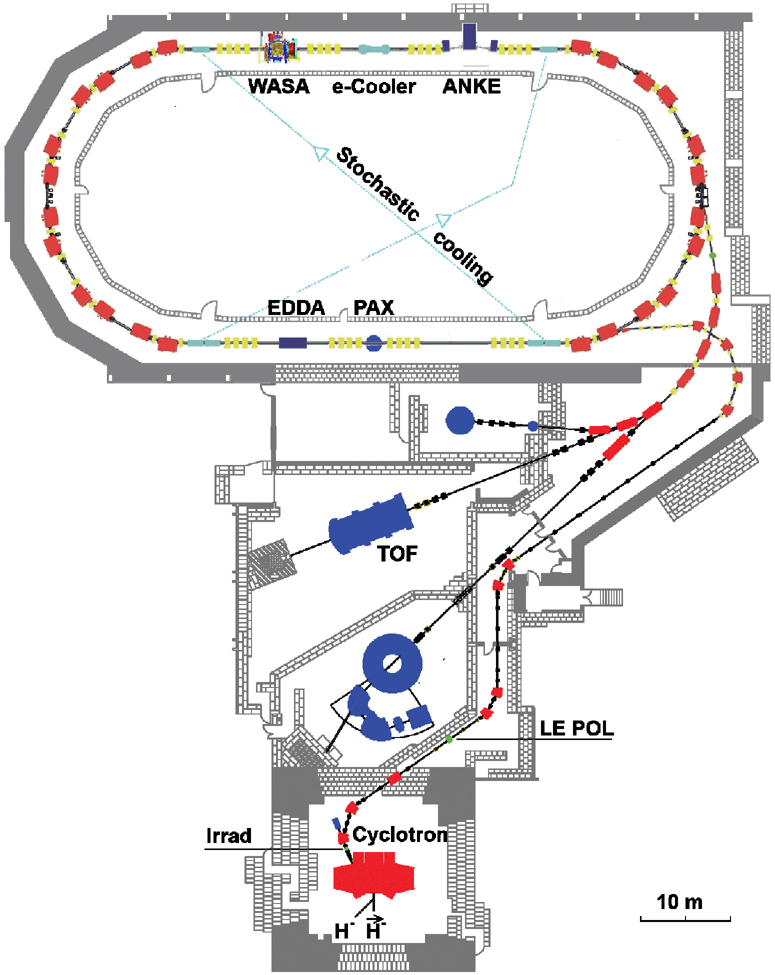
What makes the difference in positive and negative polarization?

Summary

Target performance
- Reliable operation
- High target density
- High polarization

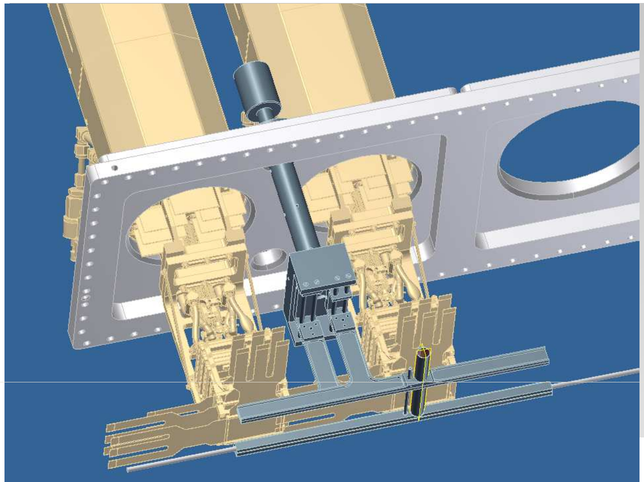
Polarimetry
- Online HFT tuning using the LSP
- Online data analysis procedure

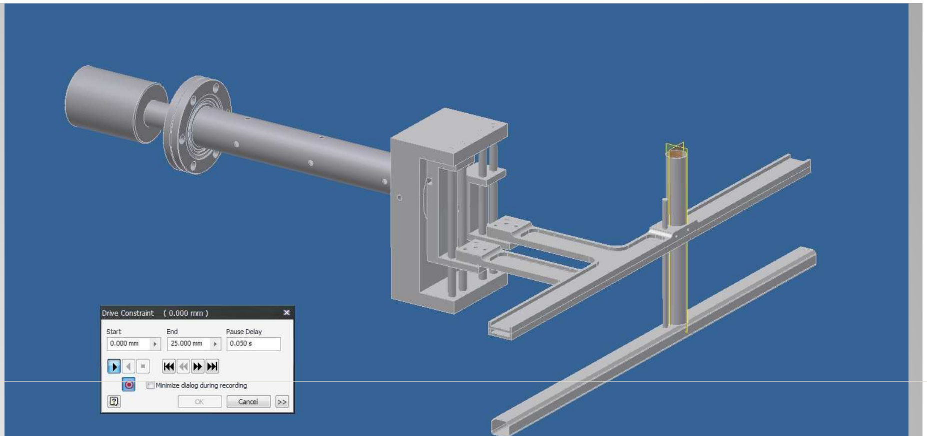
Instruments
- Point-like target (jet)
- Unpolarized Gas Supply System (background measurements)



Storage cells for internal experiments with Atomic Beam Source at the COSY storage ring

Kirill Grigoryev Institut für Kernphysik, Forschungszentrum Jülich, Germany
Petersburg Nuclear Physics Institute, Gatchina, Russia

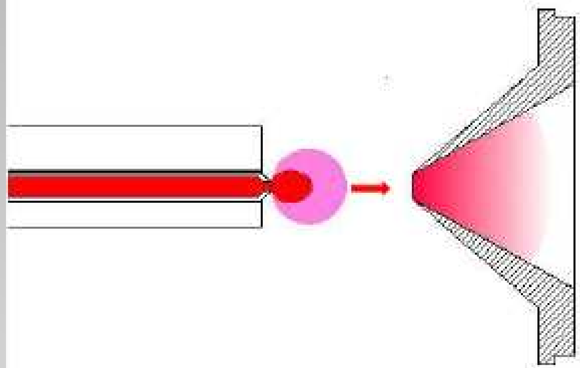




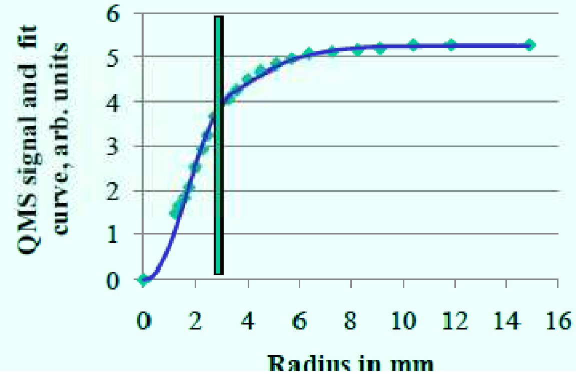
- **dimensions** **15x20x370 (140+230) mm³**
- **material** **25µm Al + 5µm Teflon**
- **Atomic hydrogen target density** **- 1.34 · 10^{13} at/cm²**
- **Openable storage cell configuration:**
- **dimensions** **11x11x390 (190+200) mm³**
- **material** **25µm Al + 5µm Teflon**
- **Fixed storage cell configuration:**
- **Expected atomic hydrogen target** **- 4.7 · 10^{13} at/cm²**

Formation of atomic hydrogen beam and intensity limitations of atomic beam type polarized ion sources and gaseous targets

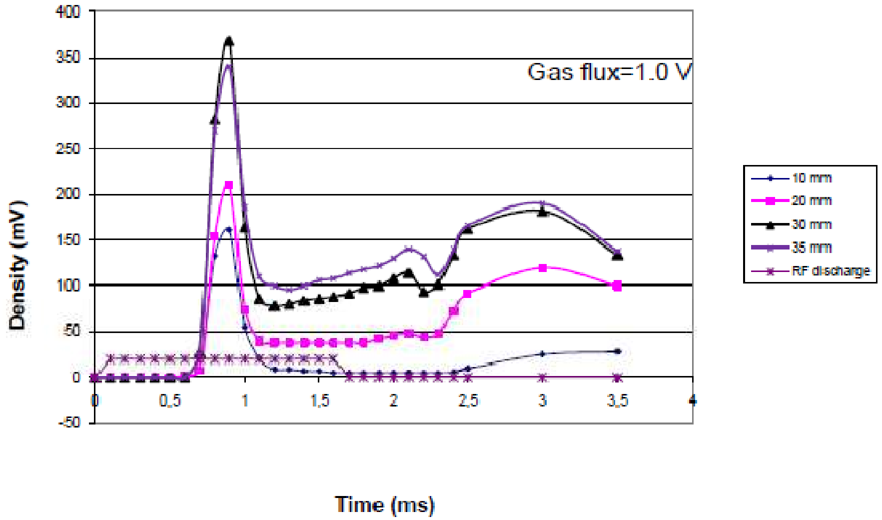
A.Belov, INR RAS



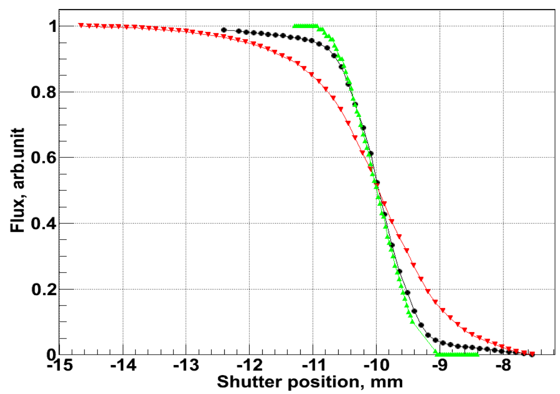
- Characteristic radial size of atomic hydrogen beam source of COSY ABS increases with gas flux from 1.7 mm to 1.9 mm (while nozzle radius was 1.25 mm and skimmer radius – 3 mm).
- Limitation of intensity of a ABS can be connected with scattering of atomic hydrogen beam on a density shock at a skimmer.
- It is important to take into account radial size of atoms source for optimization of ABS apparatus .



- Tails in radial distribution of the atomic hydrogen source density with size larger then skimmer radius appear at high gas flux. This is connected probably with formation of density shock around skimmer orifice and gas cloud inside the skimmer. By this way secondary source of hydrogen atoms arises with radial size larger then the skimmer radius.



R. Engels



Possibility to obtain a polarized hydrogen molecular target

D. Toporkov BINP, Novosibirsk, Russia

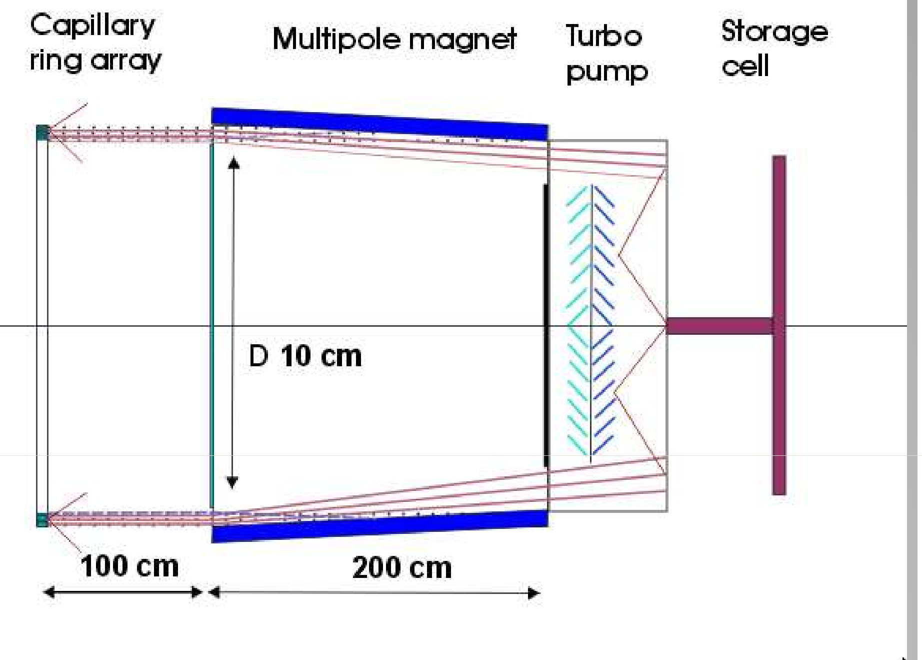
Summary

Intensities of polarized beams from the Atomic Beam sources seems have reached it's limit of about 10^{17} at/sec.

Proposed source of polarized ortho-hydrogen (o-H2) molecules probably will provide intensity by order of magnitude higher.

An opening questions are preservation of polarization of molecules under injection into the storage cell and realization of huge differential pumping system needed to get good vacuum condition.

Suggested source of polarized molecules



4.) POLARIZED ION SOURCES

High-Intensity Polarized H- Beam production in Charge-exchange Collisions

A.Zelenski, BNL

- Atomic H injector produces an order of magnitude higher brightness beam than present ECR source.
- A 5-10 mA polarized H^- ion current (50-100 mA proton current) can be obtained for the smaller (higher brightness) beam.
- The basic limitation on the production of the high-intensity (~300 mA) , high-brightness unpolarized H^- ion beam in charge – exchange collisions will be also studied.

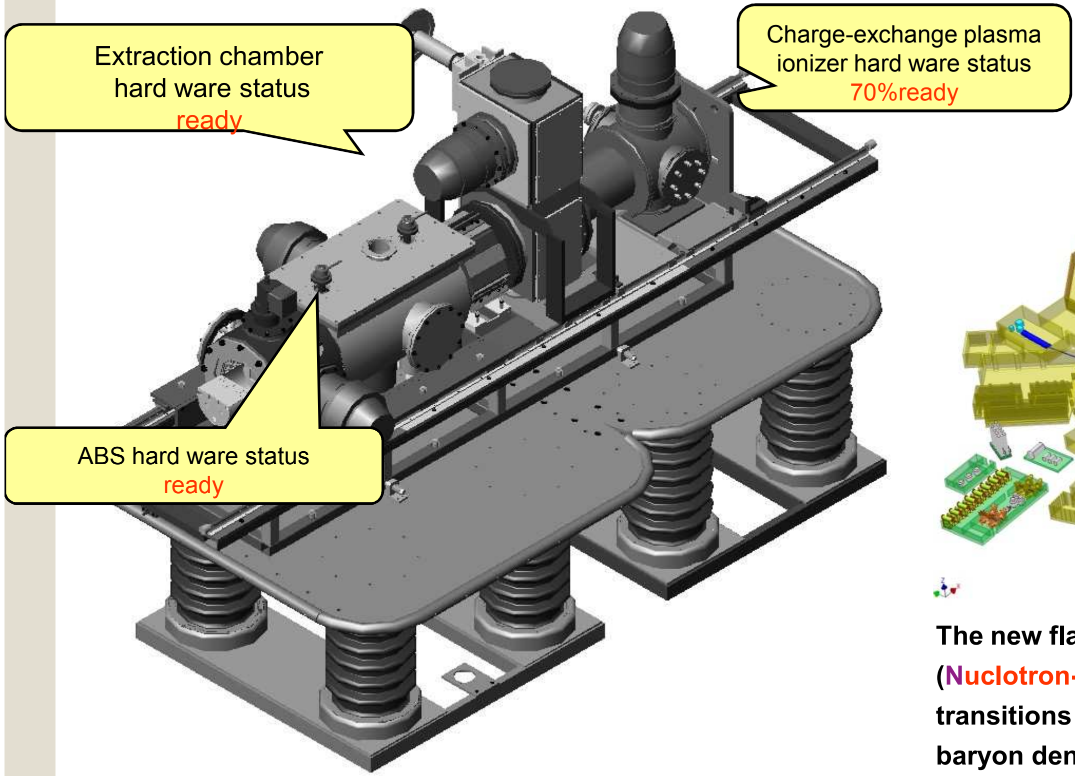
Higher polarization is expected with the fast atomic beam source due to:

a) elimination of neutralization in residual hydrogen;
b) better Sona-transition efficiency for the smaller diameter beam;
c) use of higher ionizer field (up to 3.0 kG), while still keeping the beam emittance below 2.0 π mm·mrad, due to the smaller beam diameter.

All these factors combined will further increase polarization in the pulsed OPPIS to *over 85%.*

5.) Status of the Source of Polarized Ions for the JINR accelerator complex

V.V. Fimushkin *Joint Institute for Nuclear Research, Dubna*



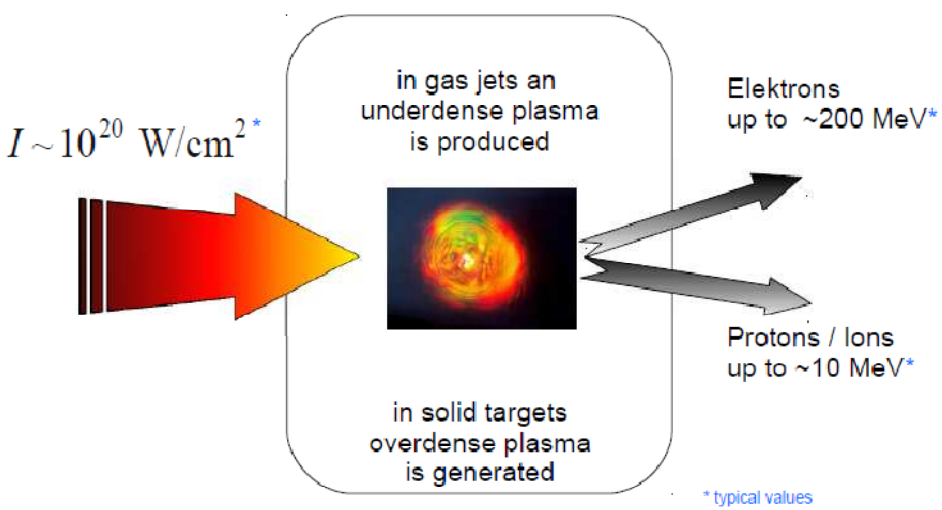
The new flagship JINR project in high energy nuclear physics, NICA (Nuclotron-based Ion Collider fAcility), aimed at the study of phase transitions instrongly interacting nuclear matter at the highest possible baryon density, was put forward in 2006

Intensive work on preparation of the ABS for tests is carried out at INR of RAS (Moscow)
Operating tests of the ABS systems are planned in 2011
The first tests of the SPI charge-exchange ionizer at JINR are planned in 2011 also

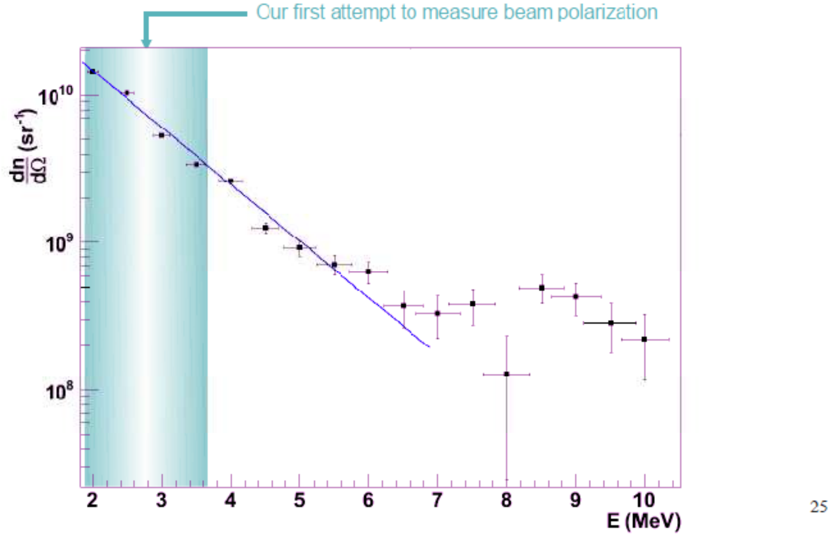
Particle Acceleration in Laser-Induced Relativistic Plasma: A Novel Approach for Polarized Sources?

A.Holler, Jülich

Laser induced acceleration of particles



Proton energy spectrum from foil targets



- Laser-plasma acceleration is an interesting domain for polarization physics
- First steps to measure beam polarizations have been taken
- More data to come soon

6.) Prospects of polarized experiments

Einstein-de Haas Nuclear Analogous Experiment

Yu.Kiselev

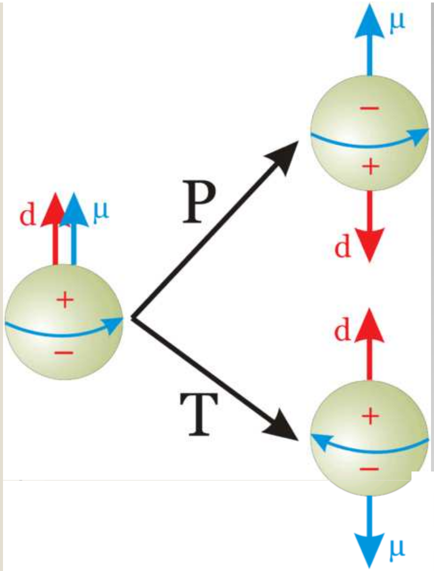
The demagnetization of the polarized target must induce another compensating mechanical angular momentum.

Summary

1. The nuclear magneto-mechanical effect was observed in the irradiated ammonia at superlow temperatures and at negative spin polarizations.
2. Nitrogen spins produce the lattice vibrations when their alignment is being varied at the proton-nitrogen cross-relaxation.
3. Lattice vibrations are transmitted by 3He/4He mixture; they are detected by thermometers and made faster the relaxation of positively polarized protons.
4. Evidence was produced, that a presence of quadruple nuclei in the polarized target materials makes shorter the relaxation time at negative polarization as compared with positive polarizations.
5. By the same reason, the negative polarization could be higher than the positive one due to its faster built-up at superlow temperature.

Precursor experiments to search for permanent electric dipole Moments (EDMs) of protons and deuterons at COSY

Frank Rathmann, Juelich.



A permanent EDM of a fundamental particle violates both parity **(P)** and time reversal symmetry **(T)**.
Assuming **CPT** to hold, the combined symmetry **CP is violated** as well.

PE 1: Use a combination of a snake and RF fields
PE 2: Dual Beam Method (equivalent to g-2 d_μ) for p and d
PE 3: Resonance Method with RF E-fields
PE 4: Resonance Method of EDM Measurements in SR

- Next step:
  - Scrutinize potential of different Principal Experiments
- Systematic error estimates for all PEs require reliable spin tracking tools.

  Top priority to make them available ASAP!
  - Identify PE with best systematic limit on $d_{p,d}$.

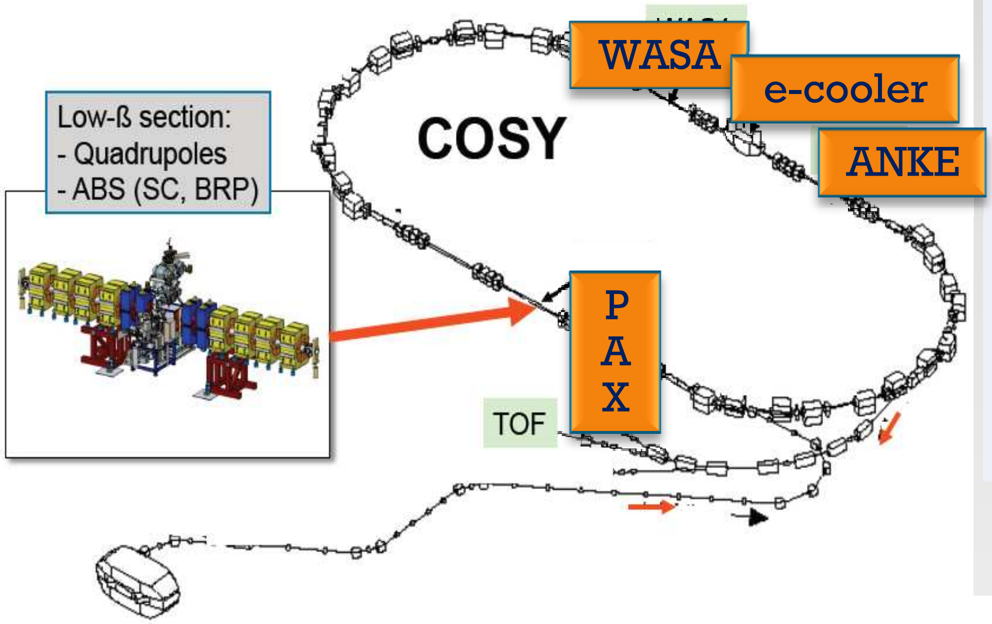
Perspectives for Polarized Antiprotons

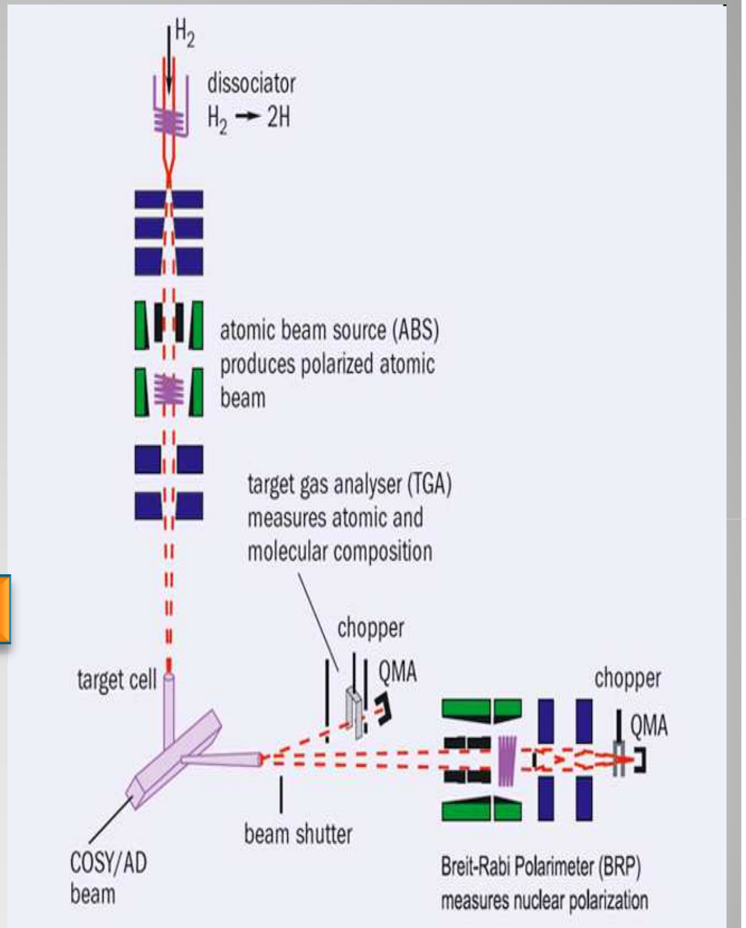
Paolo Lenisa, Università di Ferrara and INFN – ITALY, *on behalf of the PAX-Collaboration*

September 2011 ongoing beamtime:
II Ring polarization studies

I. Measurement of polarization lifetime: $\tau_P > 10^5$ s

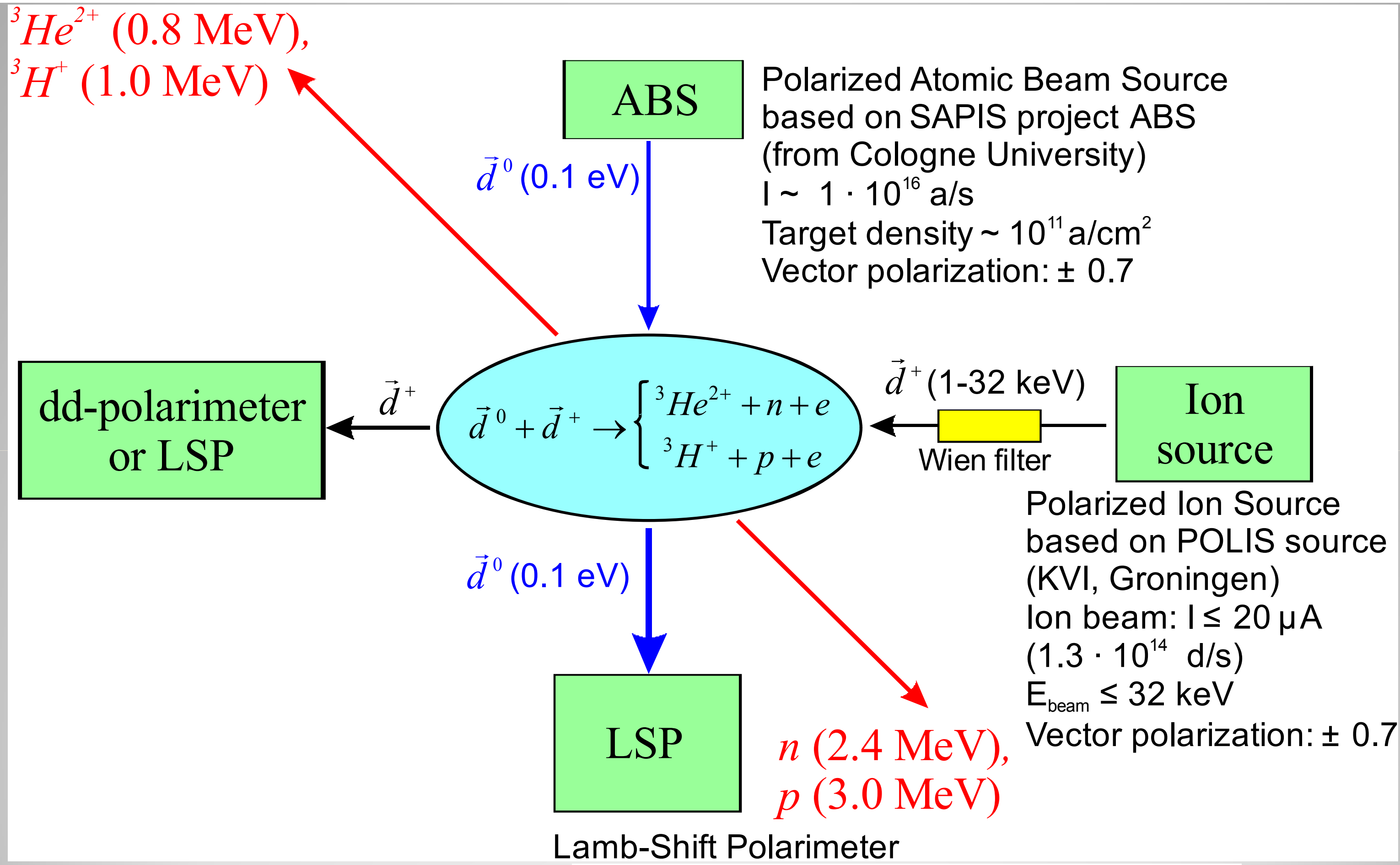
II. Measurement of spin-flip efficiency: $\varepsilon = 0.987$





DOUBLE POLARIZED DD-FUSION

P. Kravtsov, *Petersburg Nuclear Physics Institute, Gatchina, Russia*

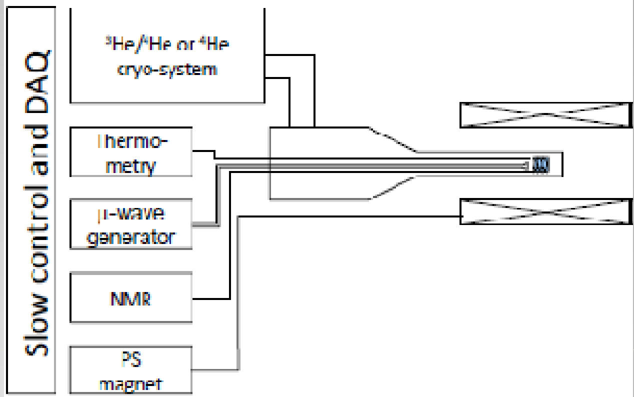


Starting experiment 2012-2013

7.) Polarized solid target

A Continuous Wave NMR System for Detection of the Polarization of Solid Targets

Polarized Target Group Bochum **G.Reicherz**



Summary

- Liverpool Q-meter isn't available any more
- and also some components in the circuit are obsolete

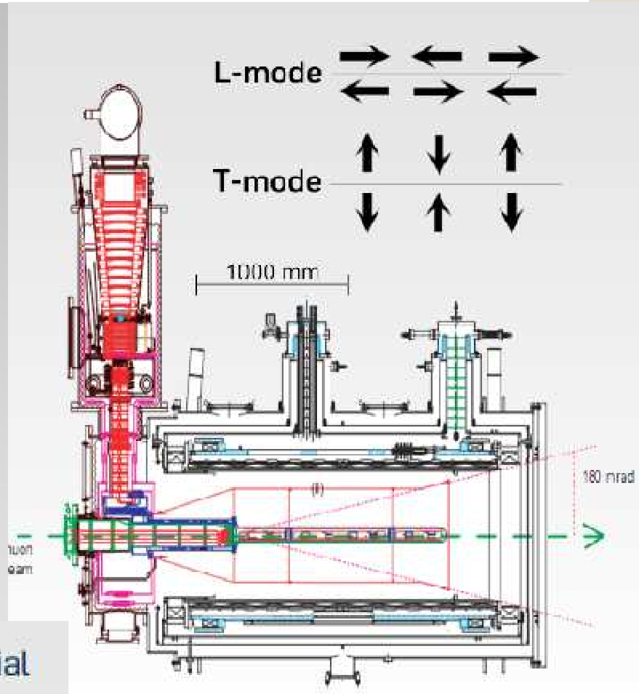
- A new RF and LF part are developed and tested in experiments
- RF-part made of SMA connector amplifiers
- LF is four layer board with diode and phase sensitive detection
- DC-offset compensation board (Bonn style or Yale board)

- more linearity tests are planed in near future

- T : 1K - 50 mK
- B : 2.5 - 5 T
- μ-w. : 70 - 140 GHz
- NMR RF
  - D : 16 - 32 MHz
  - P : 106 - 212 MHz

Production and behavior studies of the new ammonia target for the COMPASS experiment

Alexander Berlin, Ruhr Universitat Bochum



Conclusion

- EPR measurements shows similar spin densities between the new and old material but a different shape of the spectrum
- fast relaxation of the new material at 2.5 T and ~1 K of 1-2 min
- faster build-up and maximum polarization of >90 % * were achieved at COMPASS

beam time is saved for even more interesting physics

Polarized solid 3He target created by the brute force method for medical use

Masayoshi Tanaka, Department of Clinical Technology, Kobe Tokiwa University, Kobe, Japan

To reduce the risk arising from the radiation
This is our motivation to start the "**NSI**" (Nuclear Spin Imaging) - MRI with the Hyperpolarized Nuclei.
Basically, the NSI uses a polarizer and conventional MRI, no need for constructing a new device except for the polarizer itself.

Conclusion

The technical part of the first step, i.e. experimental verification of production of the hyperpolarized 3He is on going.

Future prospect

I. Practical use of hyperpolarized ^{3}He-MRI for medical diagnosis:

1) Basic study on lung, e.g., ventilation Time dependence

2) Medical diagnosis for COPD (Chronic Obstructive Pulmonary Disease) with ADC (Apparent Diffusion Coefficient) etc.

Polarized solid target

PNPI polarized target for pion-nucleon scattering measurements at intermediate energies

D.V. Novinsky ***Petersburg Nuclear Physics Institute, Gatchina, Leningrad district, 188350, Russia***

- method of proton magnetic resonance (PMR),
- polarization pump by the dynamic nuclear orientation method up to absolute value 70–80%
- measurements are based on the calculations of square under the PMR curve: the system containing Q-meter with sequential contour and signal digitalization
- Calibration is based on the equilibrium state at temperature 0.8 – 1.4 K

Successful target work > 20 years
Modernization and new tests are required
New physics tasks

In memory of
A.I. Kovalev (1936-2011)

Final remark

We had an excellent week with inspiring talks and discussions.
Alexander Vasilyev and the organizers did a fantastic job!
Many thanks to the **Local organizing committee:**

Alexander Vasilyev   Mariya Marusina
Eugeniya Brui   Peter Kravtsov   Kirill Grigoryev

Proceedings:

http://lkst.pnpi.nw.ru/pstp2011/proceedings.php

Proc. 14th International Workshop on Polarized Sources, Targets and Polarimetry (PSTP 2011), 12-16 September 2011, St. Petersburg, Russia, eds. K. Grigoryev, P. Kravtsov and A. Vasilyev, ISBN 978-5-86763-282-3, (2011), pp. 11-14.