

STRONG-2020



Annual Meeting

WP 30: JRA12 – Spin for FAIR

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Plan of the presentation

1. Aim of the JRA
2. Highlights of the performed activity
3. Latest progress achieved by Spin for FAIR

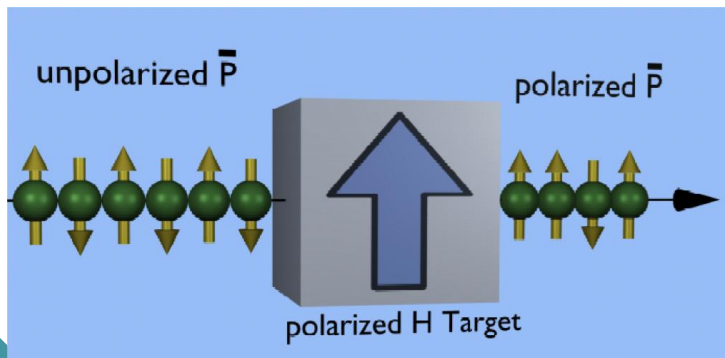
JRA12 – Spin for FAIR: Motivation

Development of an efficient method for polarizing antiproton beams at FAIR

JRA12 – Spin for FAIR: Motivation

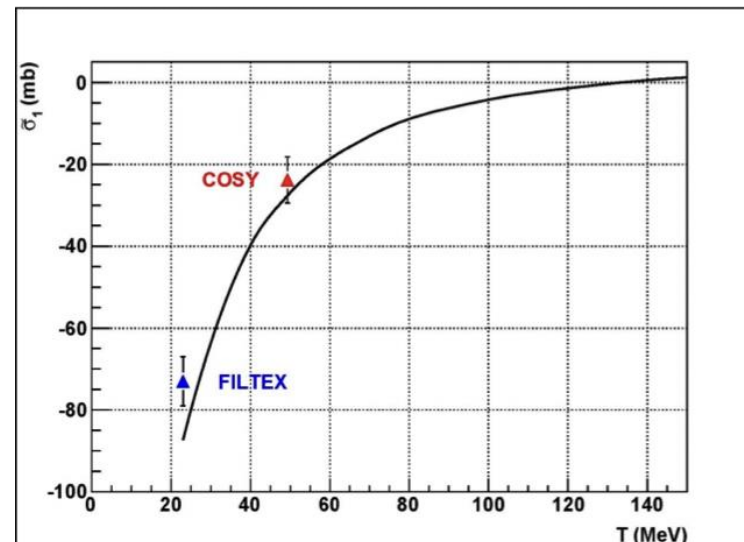
Methodology and previous achievements

- Development of an efficient method for polarizing antiproton beams at FAIR
 - Successful spin filtering of protons with **transverse polarization** performed at COSY



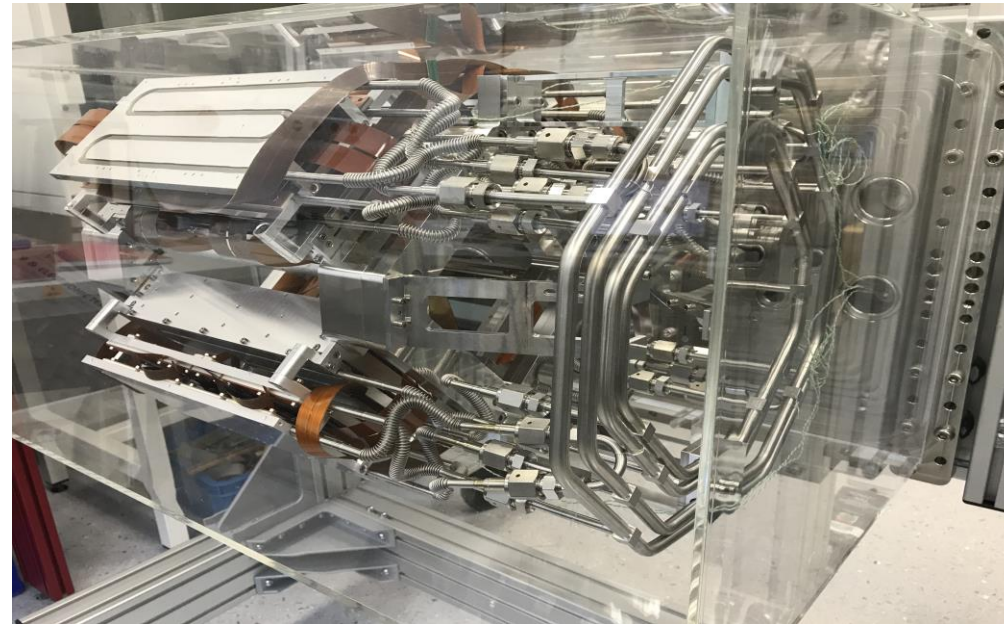
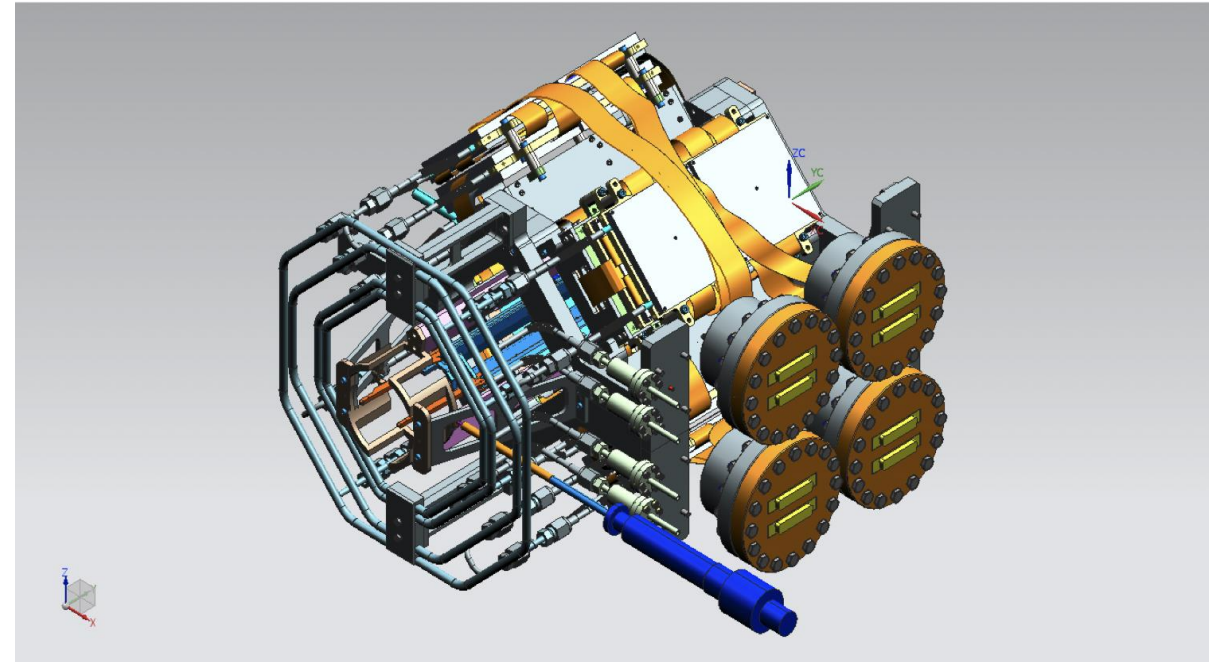
Aims of Spin for FAIR

- Feasibility test with **longitudinal polarization** required to complete the measurement
 - Full determination of the $\bar{p}p$ cross section
 - Future application with antiprotons at HESR at FAIR



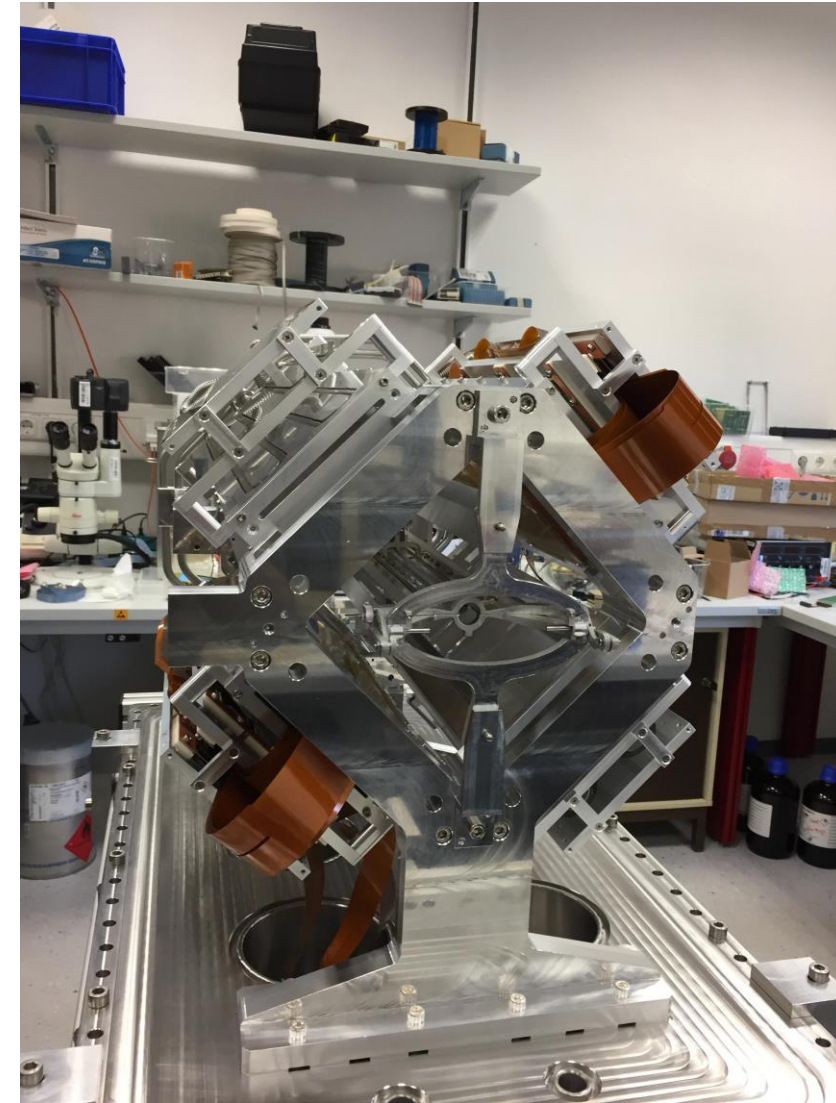
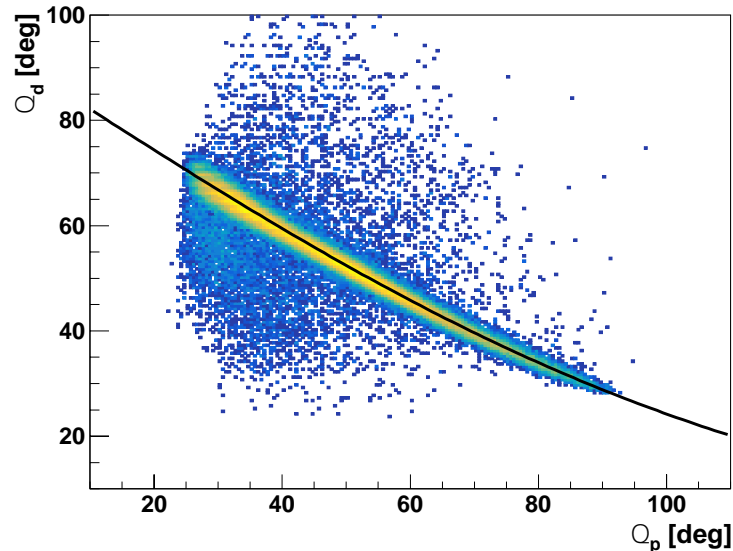
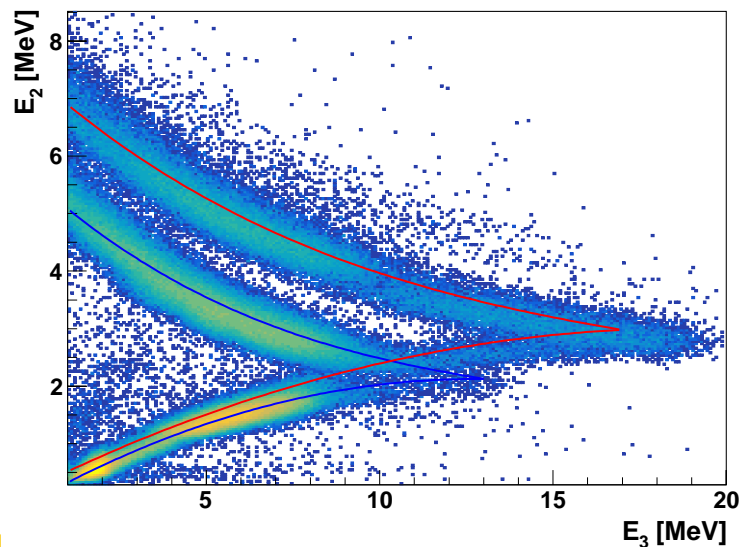
PAX Detector

- Multi-purpose silicon vertex detector installed around the storage cell able to identify:
 - p - p elastic
 - \bar{p} - p elastic
 - p - d elastic
 - Deuteron breakup
- Energy range: 30-200 MeV

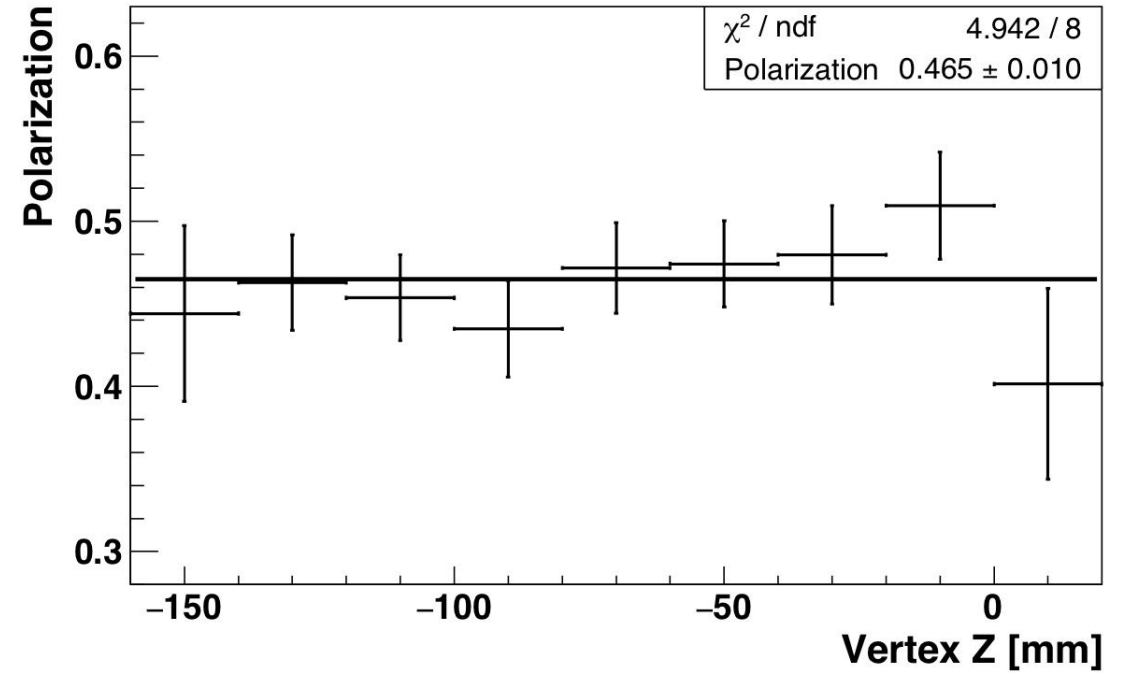
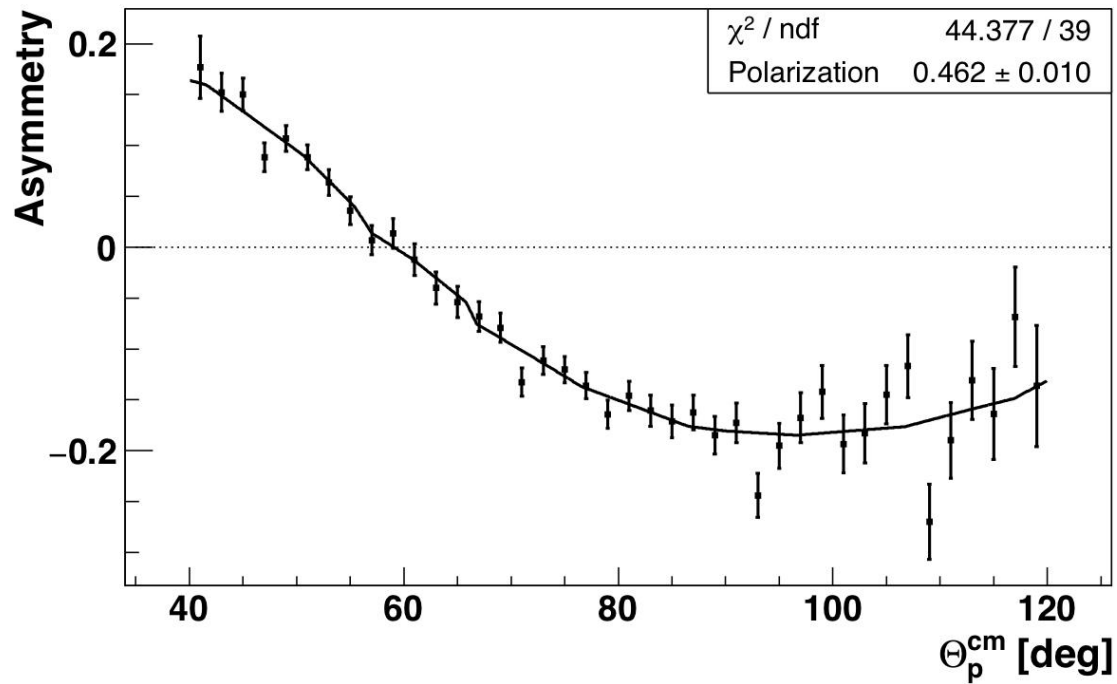


PAX Detector

- Installed at COSY and commissioned with 2 quadrants
- Unpolarized p beam vs. polarized d target
- Identification of p - d elastic events



Target Polarisation

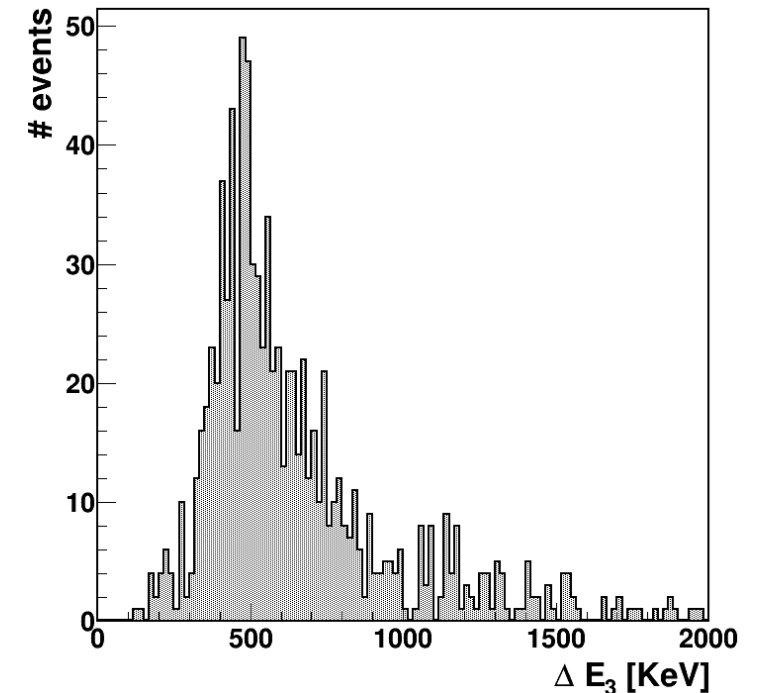
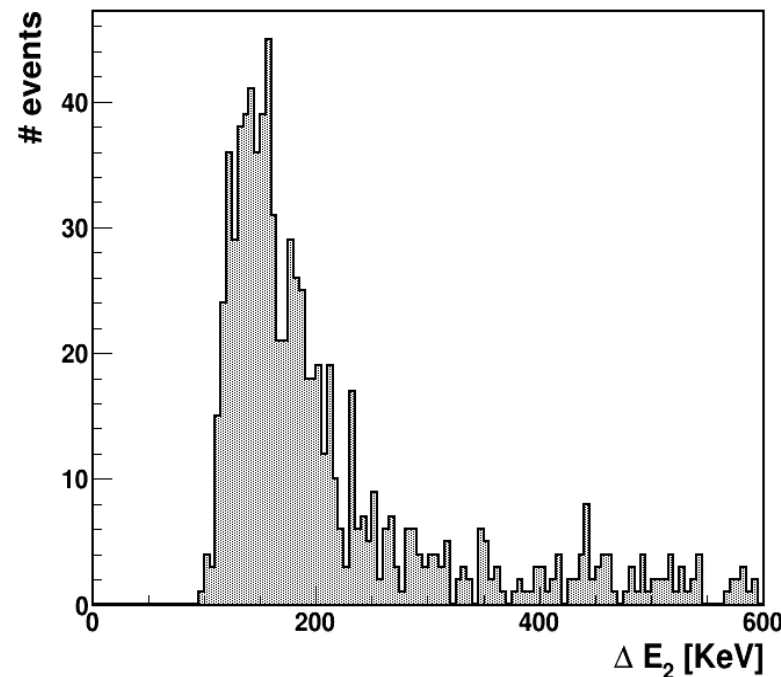
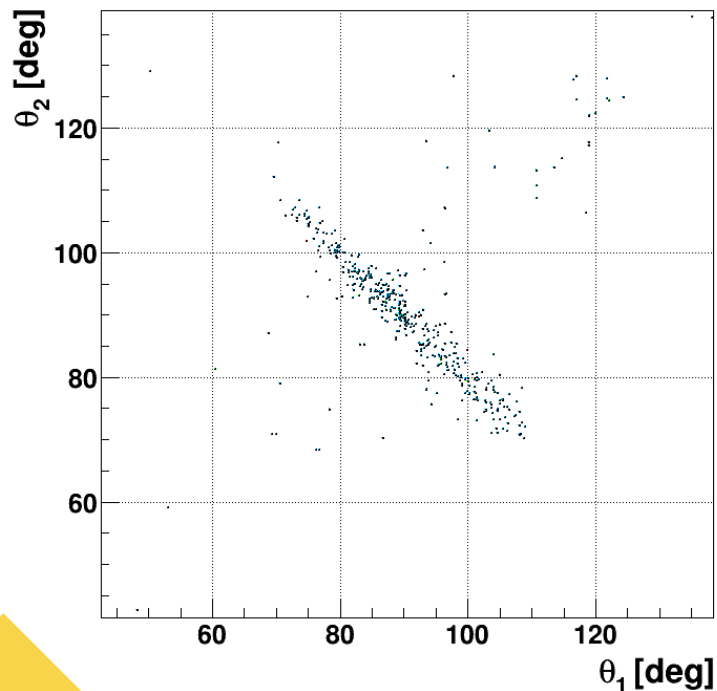


$$\langle Q \rangle = 0.462 \pm 0.010$$

Test of complete detector with cosmic data

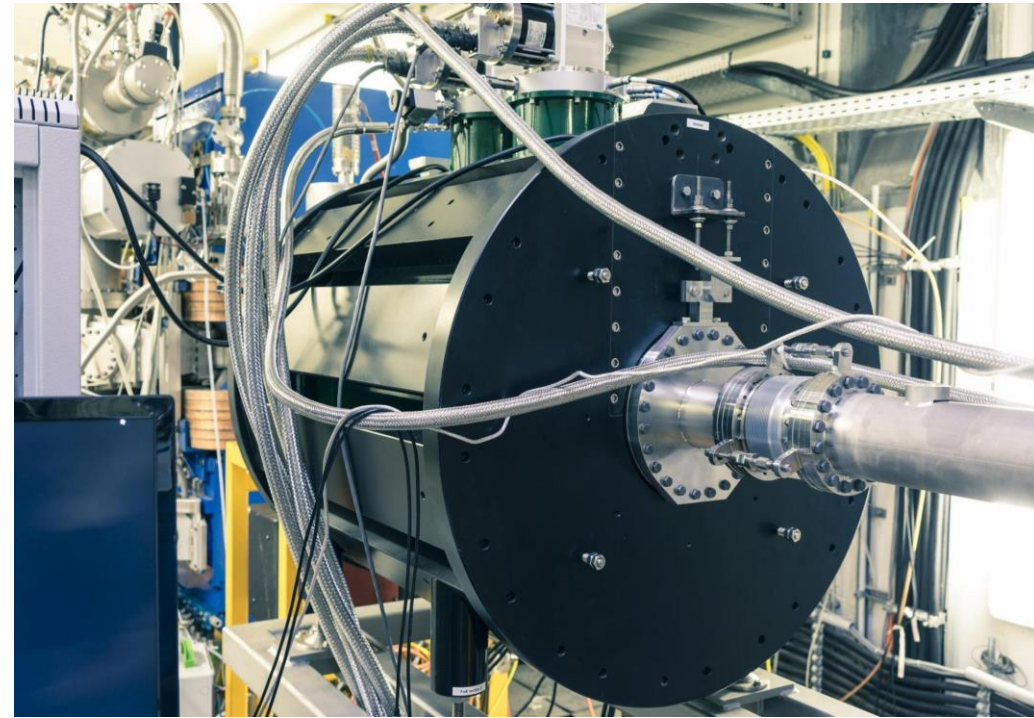
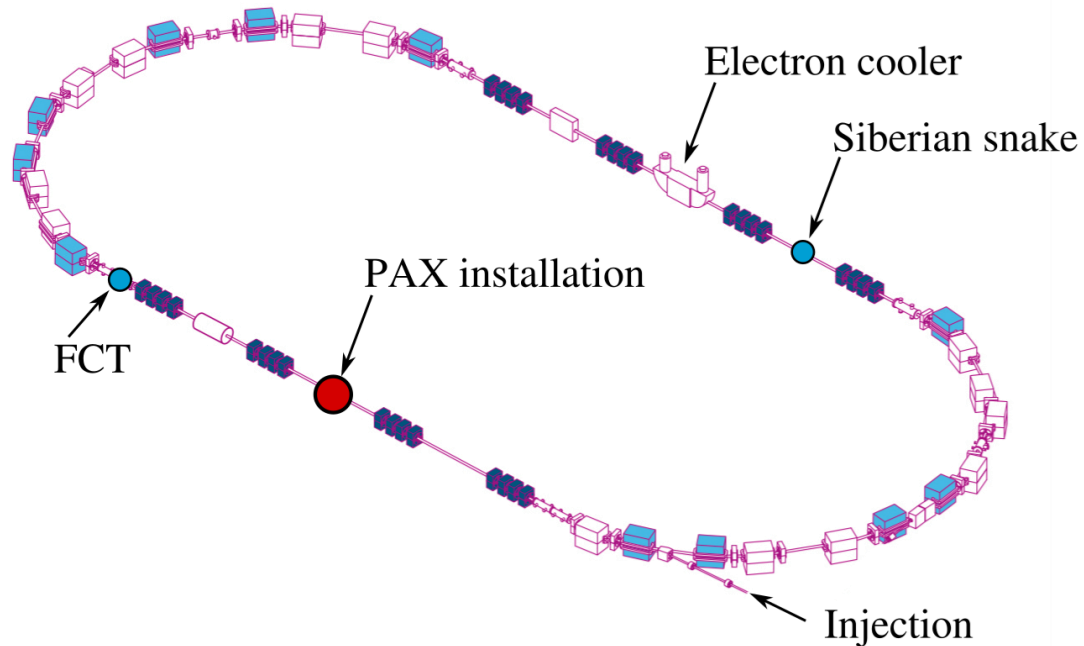
Full commissioning at COSY planned
Problems: budget restrictions + energy crisis

- 4 quadrants assembled!
- Test bench for cosmic data acquisition set up in IKP



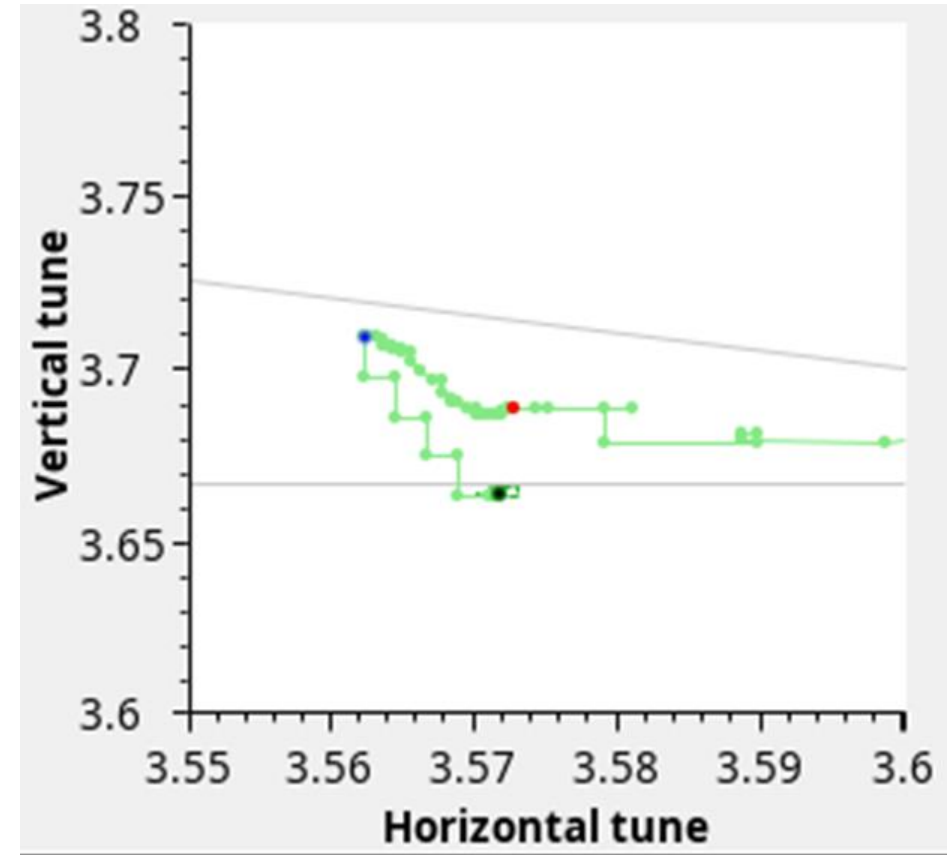
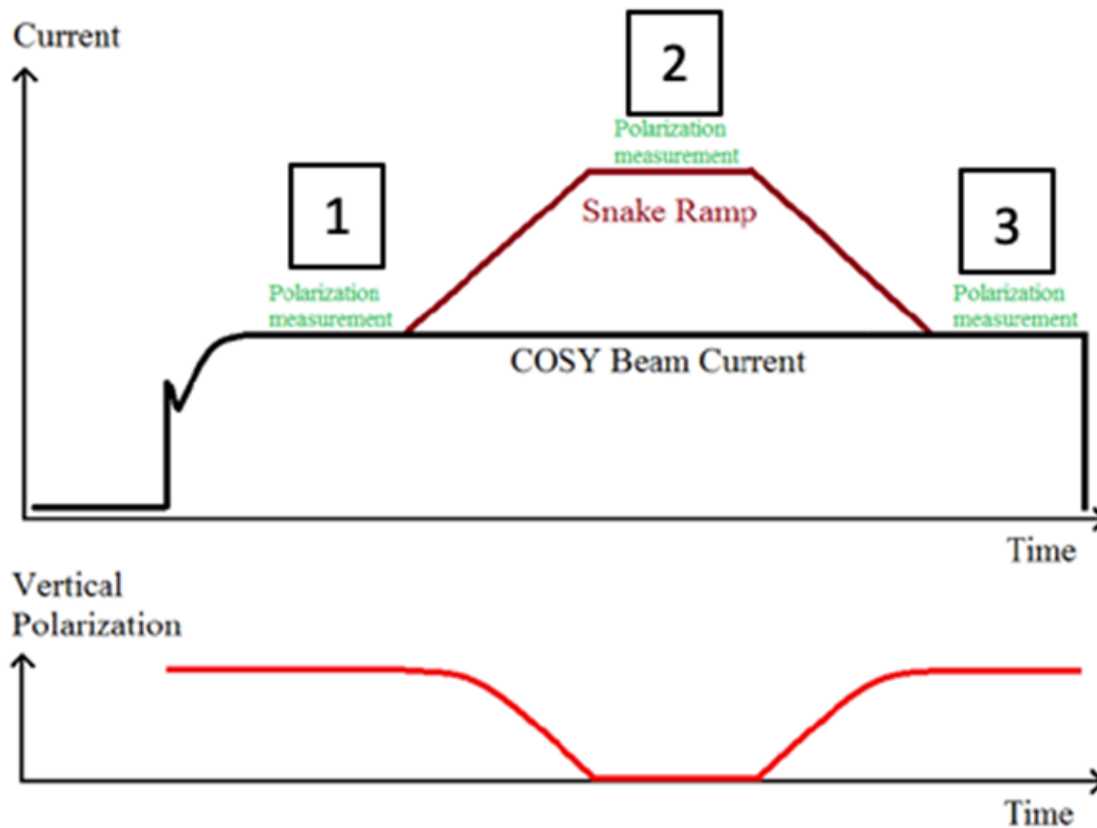
Siberian Snake

- Installed in COSY @ ANKE place
- First commissioning beam time in March 2020
- Able to provide longitudinal polarization at PAX section



Siberian Snake

- Tune shift observed during Snake ramp

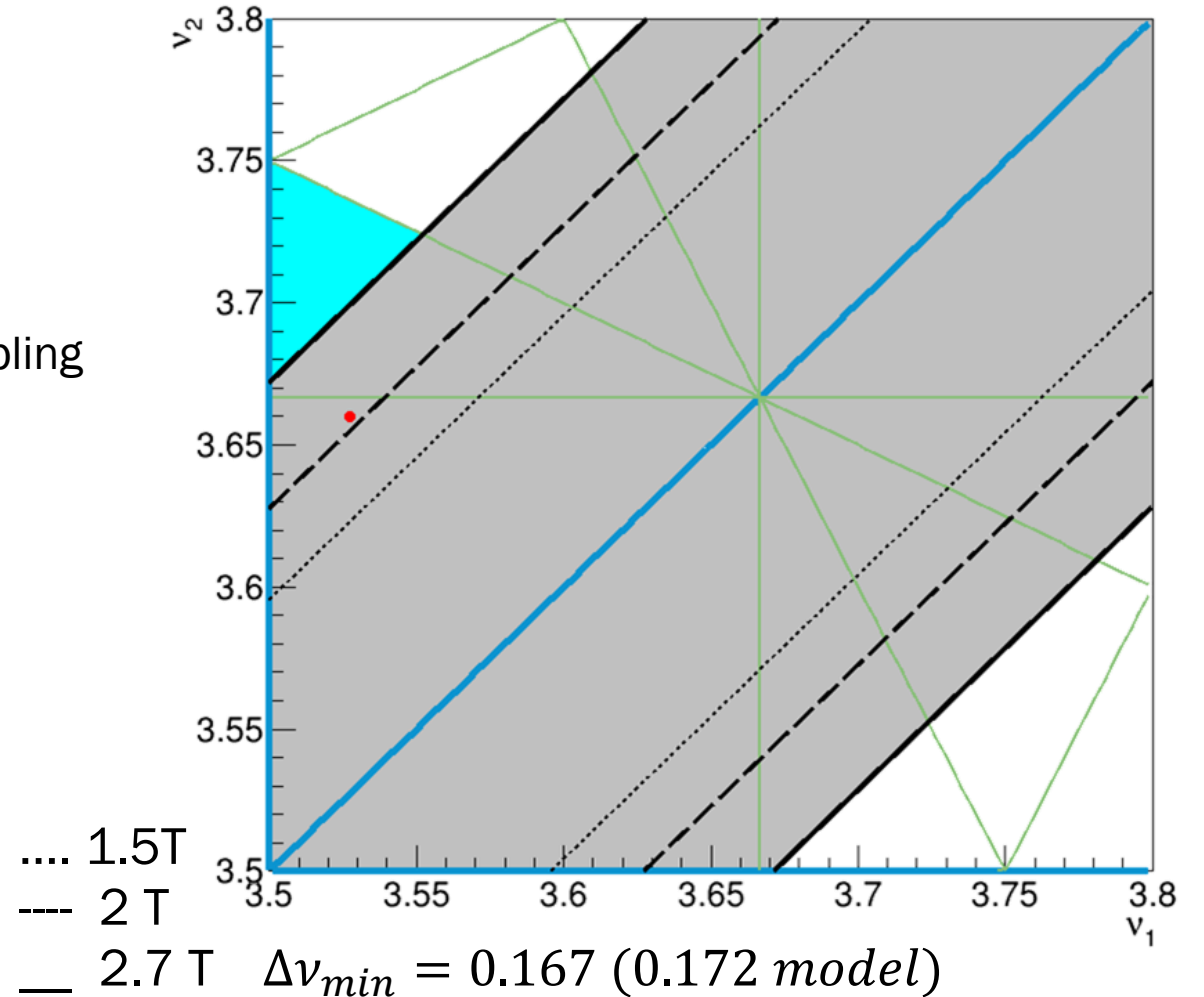


Siberian Snake

- The snake high field introduces a phase space coupling
- Tune split appears

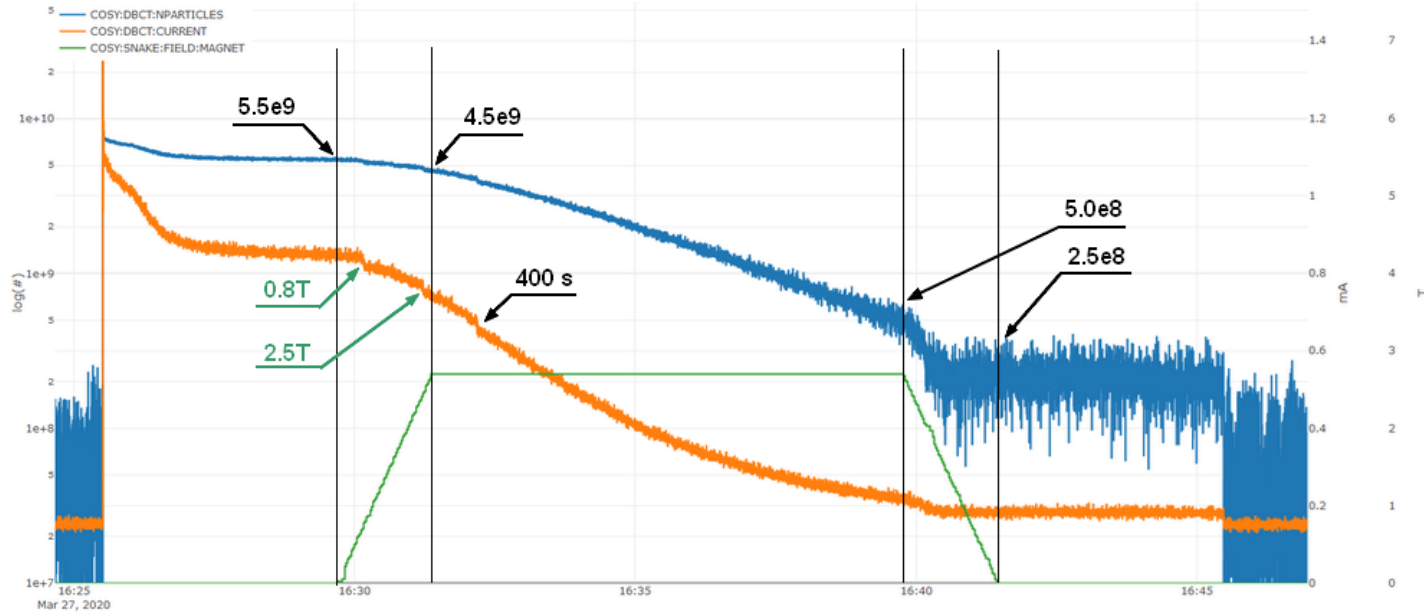
$$\Delta\nu_{min} = \frac{gB_{sol}L}{4\pi|B\rho|}$$

- Tunes near the resonance $\nu_x - \nu_y = 0$ cannot be reached while the solenoid is on.



Siberian Snake

- Initial Tunes: $\nu_x = 3.572$; $\nu_y = 3.688$
- Flattop @ 2.7 T
- MQU1/MQU5 and MQU2/MQU6 used to compensate the tune shift
- $\sim 2.5 \times 10^8$ particles survive after ramp-down



Jump	B_{Sol}	MQU 1,5	MQU 2,6	MQU 4
I	0.0 T	123%	-23%	185%
II	0.0 T - 1.5 T	-23%	-8.5	0.0%
III	1.5 T - 2.4 T	-90%	11%	0.0%
IV	2.4 T - 2.7 T	-15%	0.0%	0.0%

Conclusions

- MS70: Detector commissioning
 - Commissioned in COSY with 2 assembled quadrants
 - First measurement of target polarization
 - 4 quadrants completed and assembled; successful test with cosmic data
 - Full commissioning at COSY planned
- MS71: Snake commissioning
 - First commissioning beam time performed in March 2020
 - Compensation of the tune shift induced by the solenoid
 - Beam time requested to complete the commissioning
- MS72: Measurement of target and beam polarization
 - First measurement of target polarization with the PAX detector
 - Beam time requested to perform the beam polarization measurement
- MS73: Predictions for spin-filtering with longitudinal polarization
 - Simulations performed

Conclusions

- The PAX detector is fully assembled and functioning on a test bench in IKP, where data from cosmic have been successfully collected and analyzed.
- First commissioning test of Siberian snake completed and data acquired
- Additional beam time would have been required to properly span the the tunes phase space while ramping on the Siberian snake
- Due to IKP budget restrictions, COSY was prematurely shut-down and it was not possible to complete the WP program.