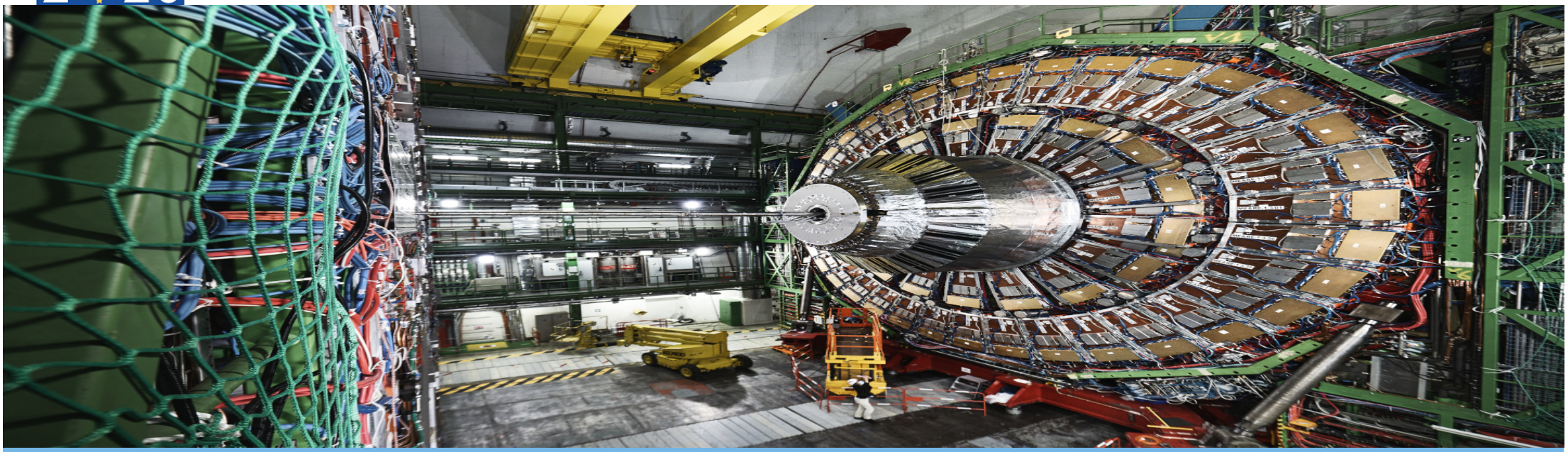

WP 30: JRA12 – Spin for FAIR

Andrea Pesce – IKP-2 (FZJ)

STRONG2020 Annual Meeting – November 8th-10th 2021

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093

JRA12 – Spin for FAIR: Motivation

- Development of an efficient method for polarizing antiproton beams at FAIR

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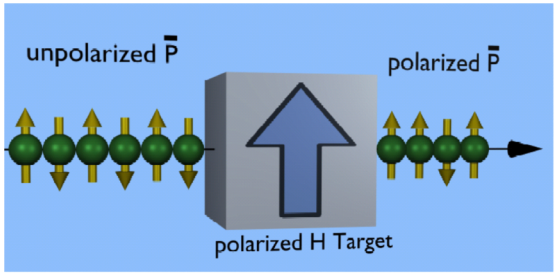

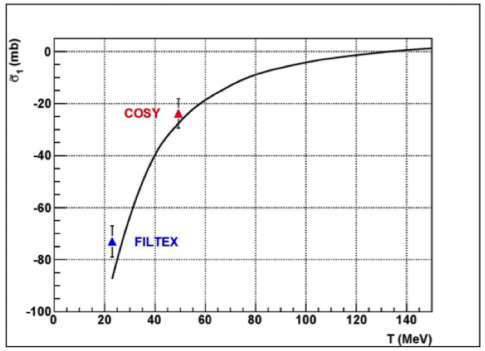

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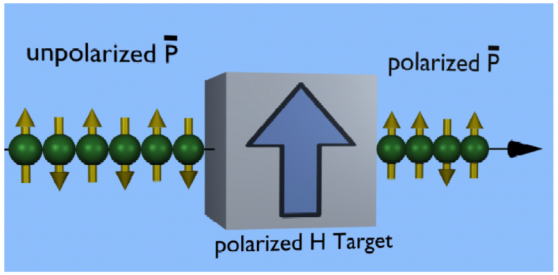
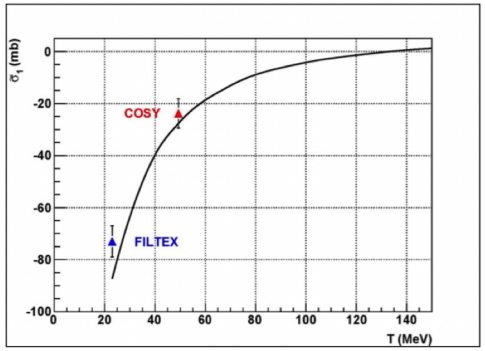
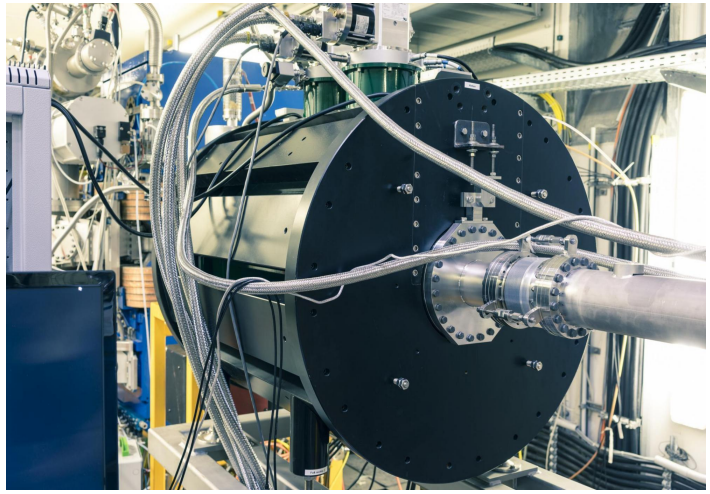
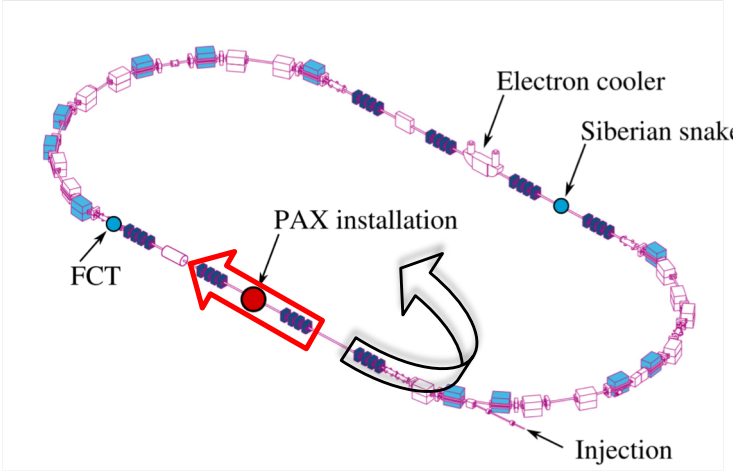




- Test with longitudinal polarization needed to complete the measurement
  - Full determination of the p_{bar}- p cross section
  - Experimental Storage Ring at FAIR

Siberian Snake Commissioning

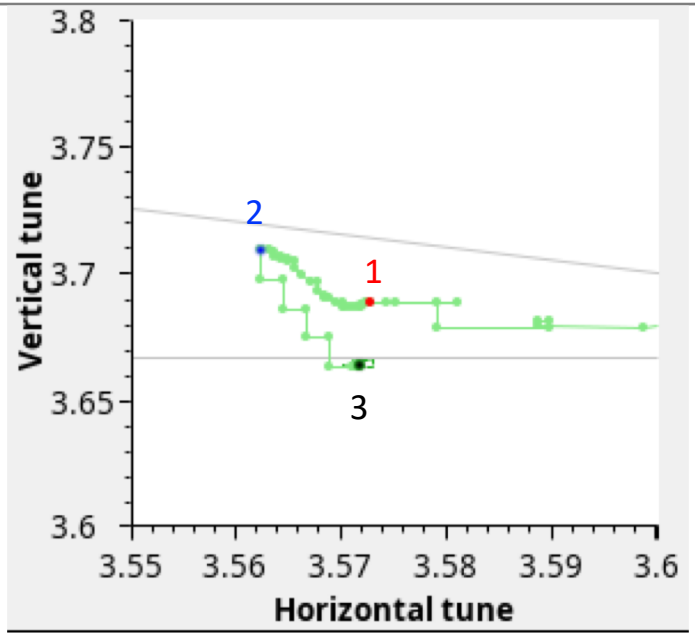


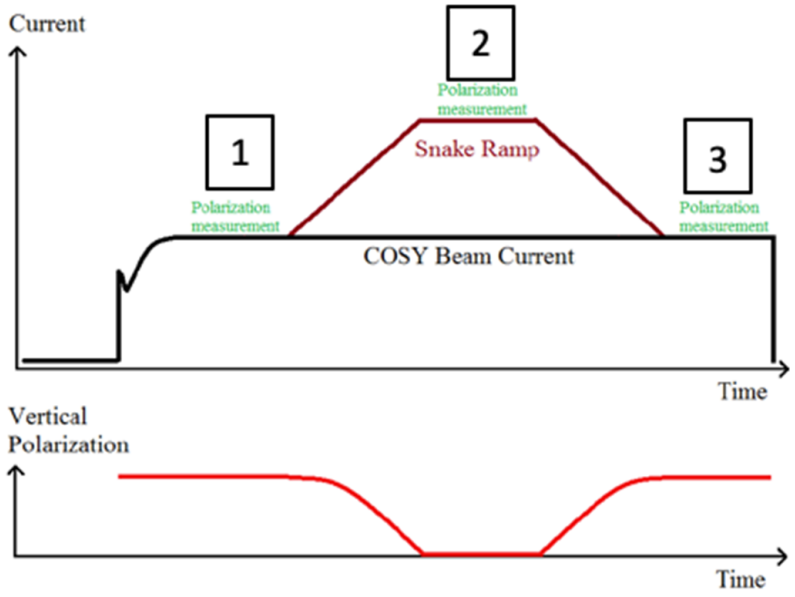


- Installed in COSY @ ANKE place
- First commissioning beam time in March 2020
- Will provide longitudinal polarization at PAX section

Siberian Snake Commissioning

- Tune shift observed during Snake ramp





(3.573; 3.688) ⟶ (3.562; 3.709) ⟶ (3.572; 3.664)

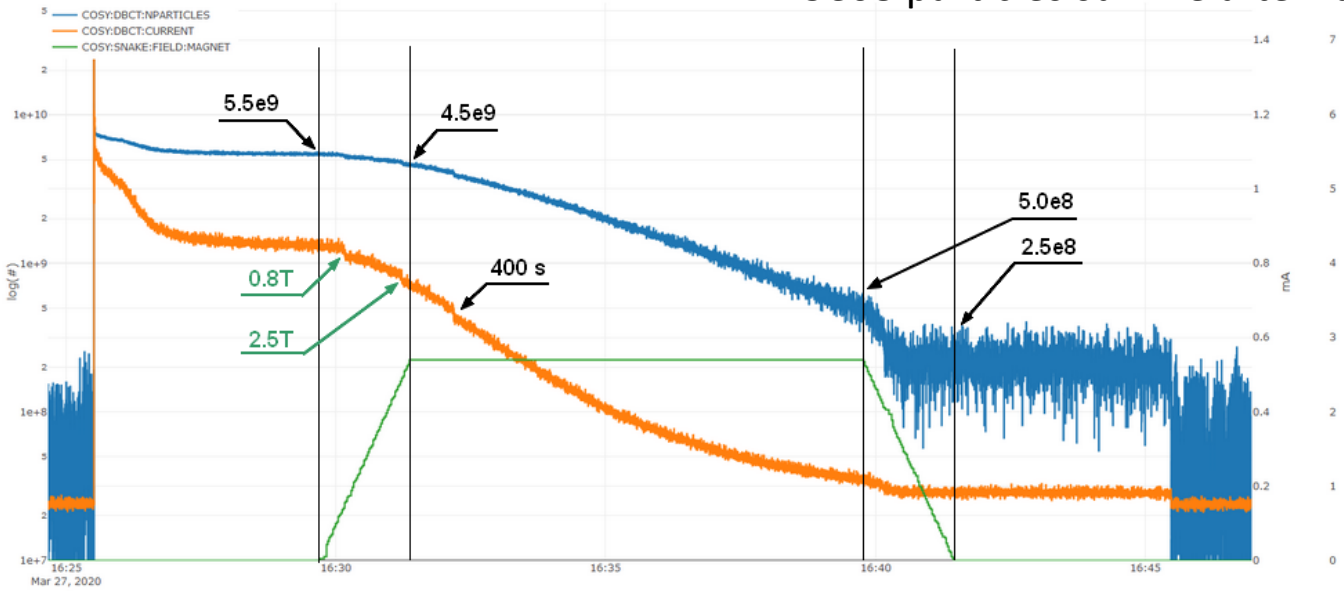
Siberian Snake Commissioning

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

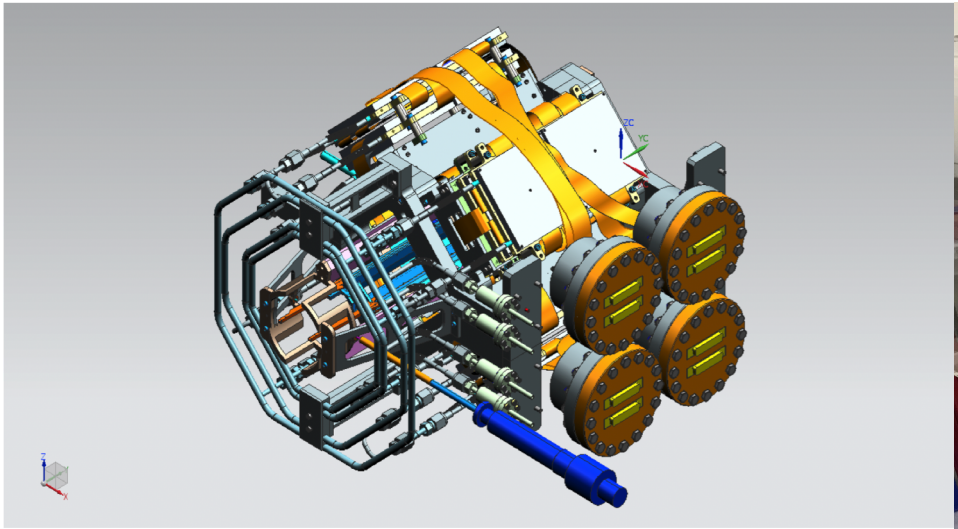
~2.5e08 particles survive after ramp-down

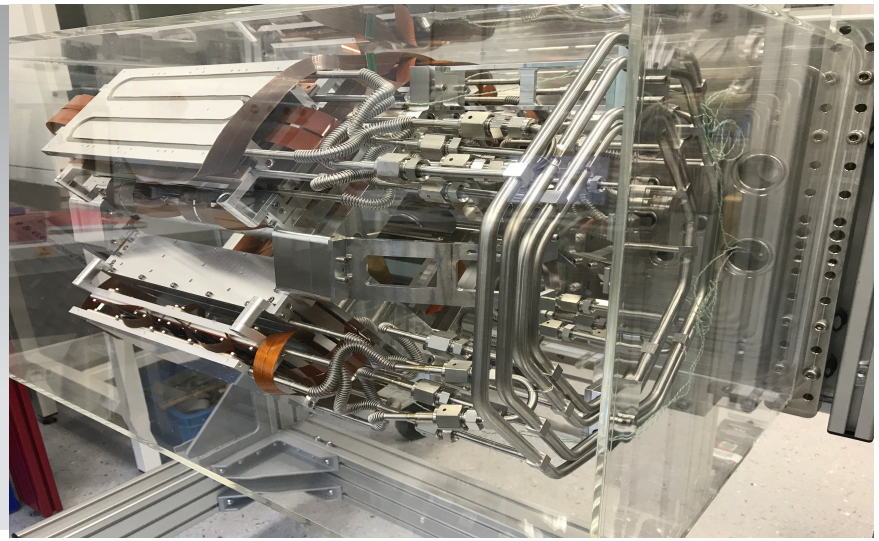


Jump	B_{Sol}	MQU 1,5	MQU 2,6	MQU 4
I	0.0 T	123%	-23%	185%
II	0.0 T – 1.5 T	-23%	-8.5	0.0%
III	1.5 T – 2.4 T	-90%	11%	0.0%
IV	2.4 T – 2.7 T	-15%	0.0%	0.0%

Second beam time delayed due to the pandemic and the budget resctrictions affecting COSY schedule

PAX Detector Commissioning

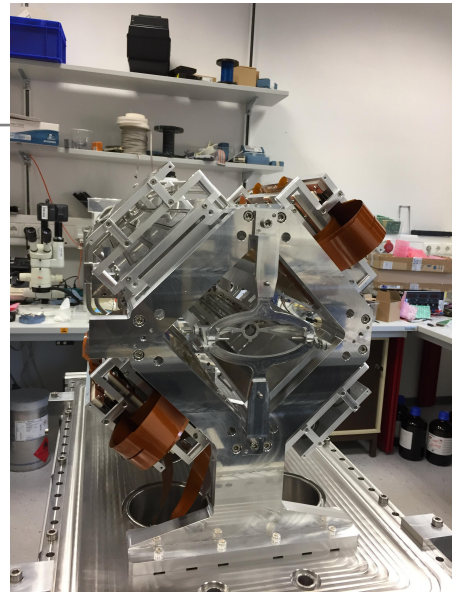




- Multi-purpose silicon vertex detector installed around the storage cell for:
  - p-p (p_{bar}-p) elastic
  - p-d elastic
  - Deuteron breakup
- Energy 30-200 MeV

PAX Detector Commissioning

- Installed at PAX section for commissioning with 2 quadrants
- Unpolarized p beam vs. polarized d target



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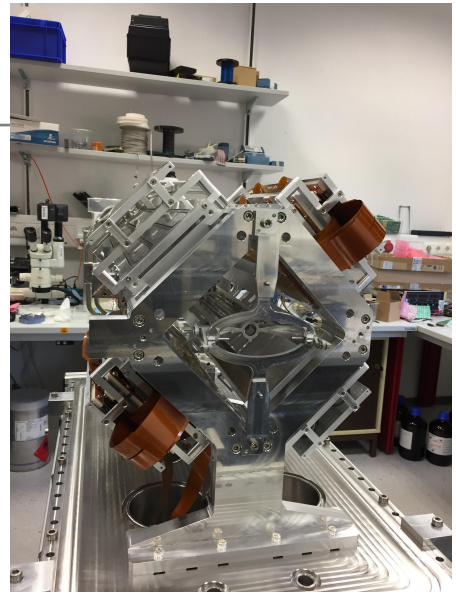
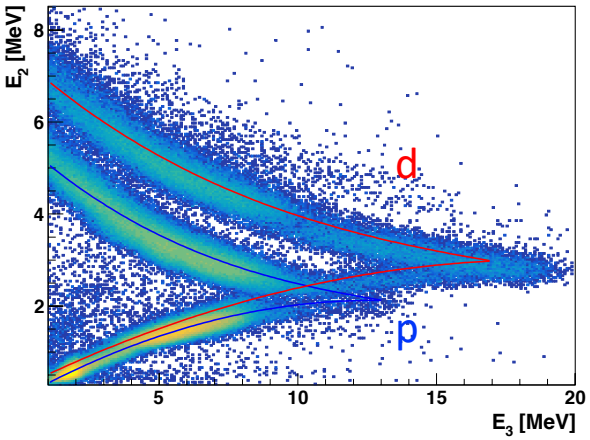
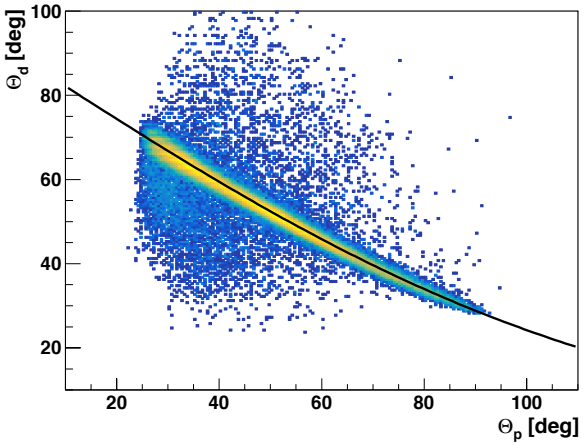
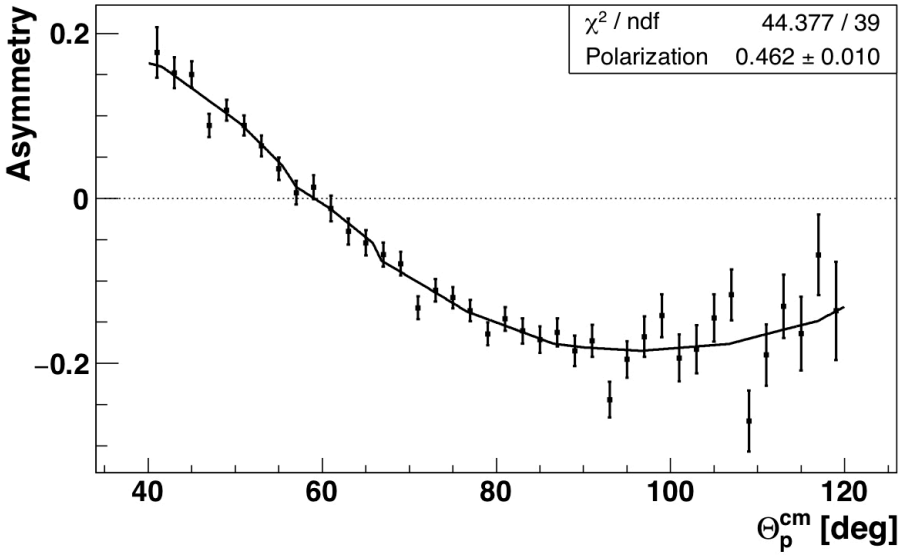


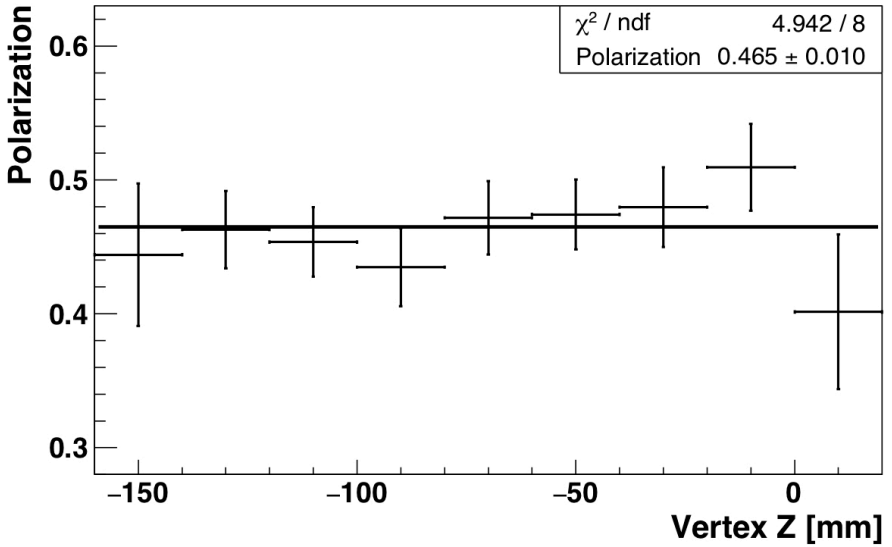
- Installed at PAX section for commissioning with 2 quadrants
- Unpolarized p beam vs. polarized d target
- Identification of p-d elastic events





Measurement of target polarization

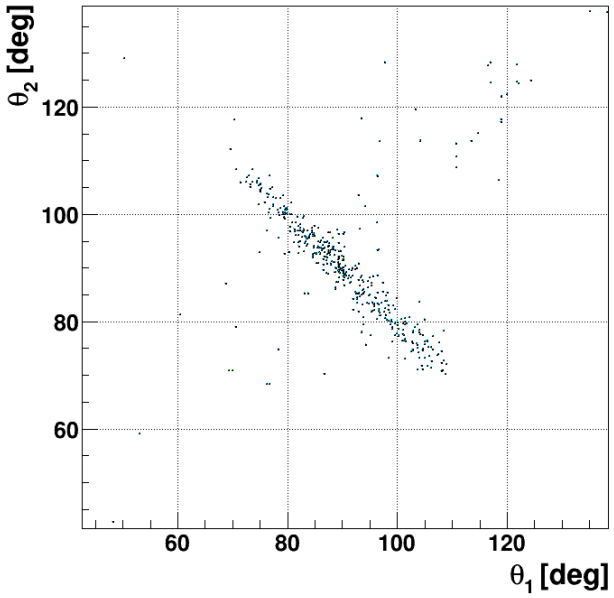


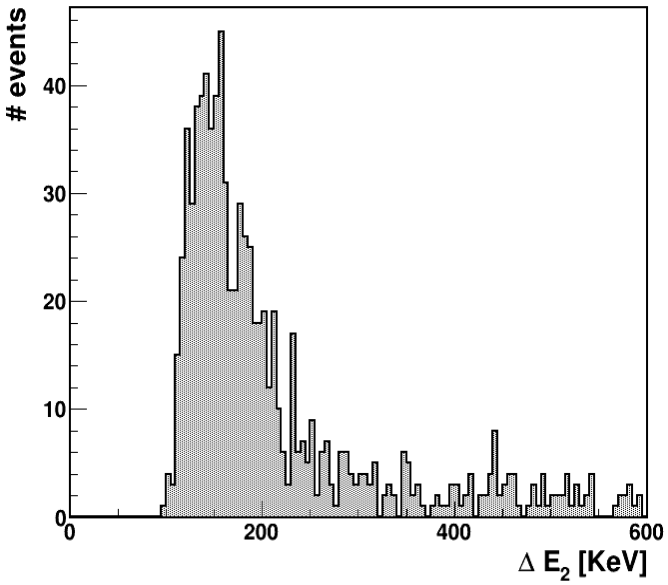


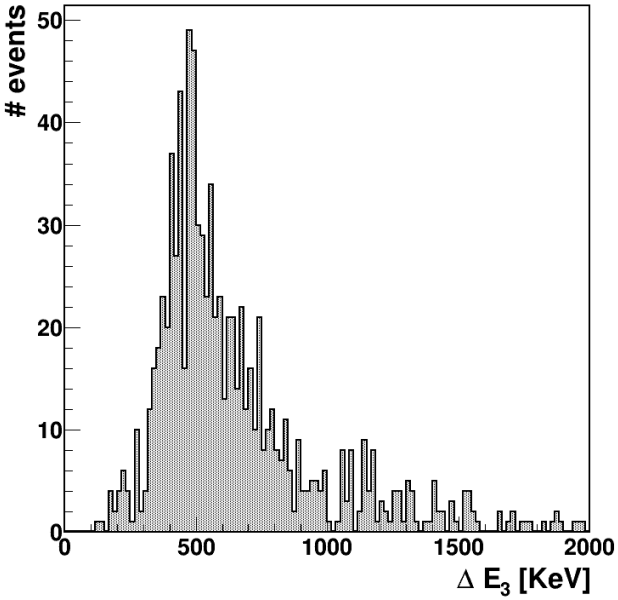
$$\langle Q \rangle = 0.462 \pm 0.010$$

Cosmics Data

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







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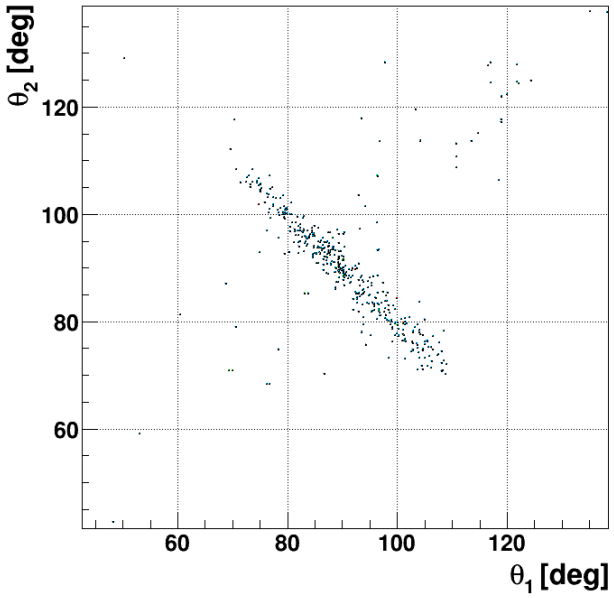

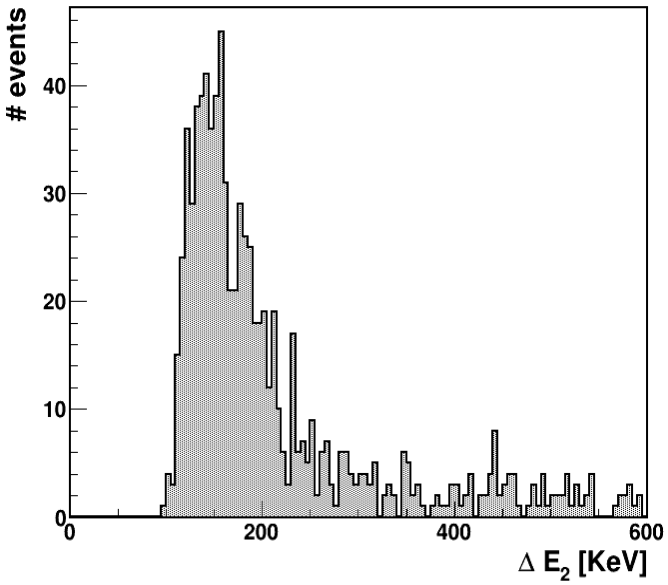

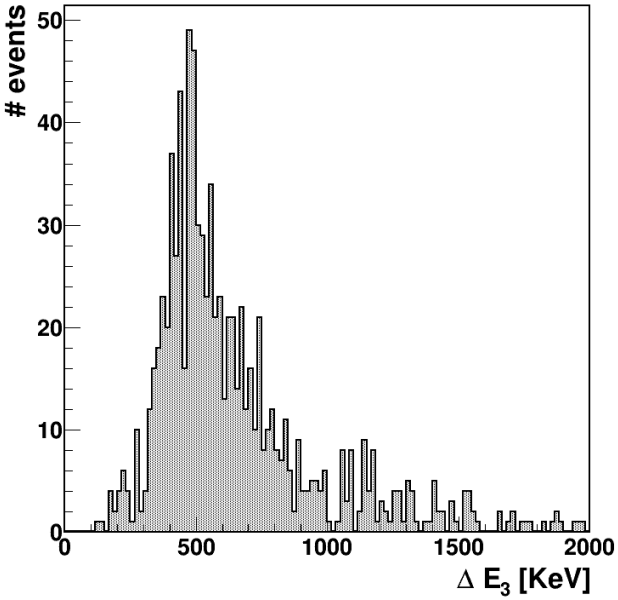

Full commissioning foreseen at COSY, according with the coordinated management of the PAX interaction point and the budget restrictions

Longitudinal buildup predictions

- The polarization buildup rate determines the minimum beam life time for a successful filtering process

---

Solving the coupled evolution equations for $P(t)$ and $I(t)$

$$P(t) = -\frac{Q(\tilde{\sigma}_1 + \Delta\sigma_1) \cdot \tanh(Q\sigma_3 d_t f t)}{Q\sigma_3 + \Delta\sigma_0 \cdot Q\sigma_3 d_t f t}$$

$$I(t) = I_0 \cdot e^{[-(\tilde{\sigma}_0 + \Delta\sigma_0) d_t f t]} \cdot \left[\cosh(Q\sigma_3 d_t f t) + \frac{\Delta\sigma_0}{Q\sigma_3} \sinh(Q\sigma_3 d_t f t)\right]$$

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$$P(t) \approx -Q d_t f t (\tilde{\sigma}_1 + \Delta\sigma_1)$$

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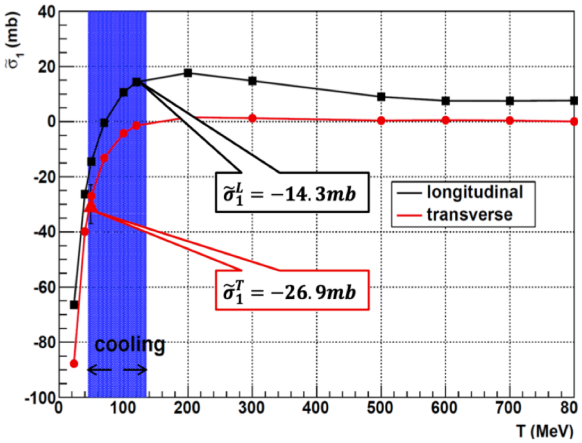

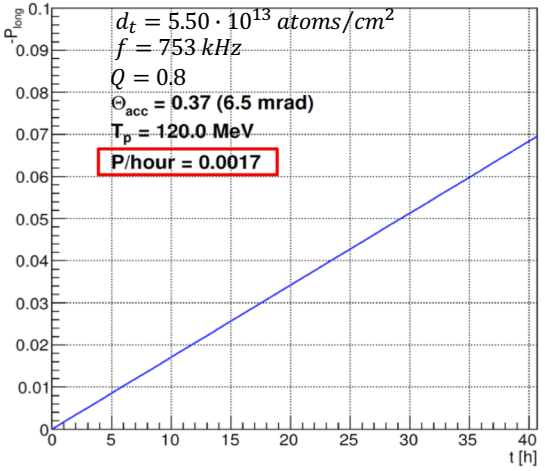

Deliverables and Milestones

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- MS71: Snake commissioning
  - ✓ First commissioning beam time performed in March 2020
  - ✓ Compensation of the tune shift induced by the solenoid
  - ➢ Second beam time requested

Deliverables and Milestones

- MS72: Measurement of target and beam polarization
  - ✓ First measurement of target polarization with the PAX detector
  - ➢ Second beam time needed to perform the beam polarization measurement

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Thank you for your attention!