The strong interaction at the frontier of knowledge: fundamental research and applications

WP 30: JRA12 – Spin for FAIR

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Universitá degli Studi di Ferrara

STRONG-2020 Kick-off meeting

October 23-25, 2019

JRA12 – Spin for FAIR: Motivation

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

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

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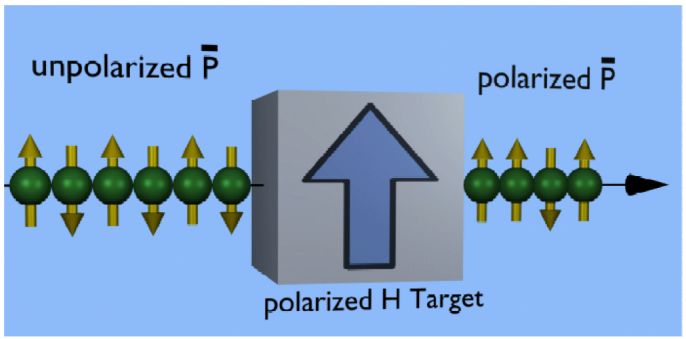
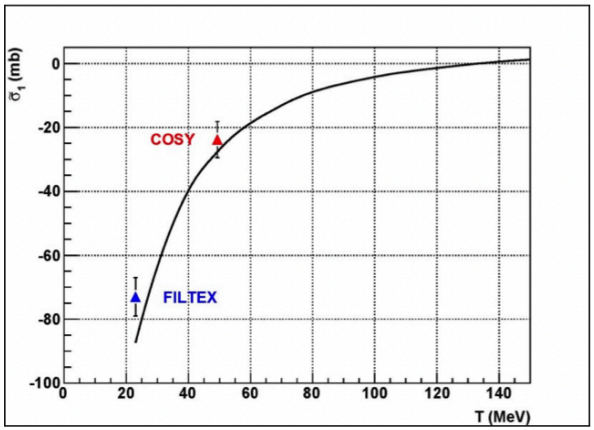
- Development of an efficient method for polarizing antiproton beams at FAIR
  - ✓ Spin filtering of protons with transverse polarization performed at COSY





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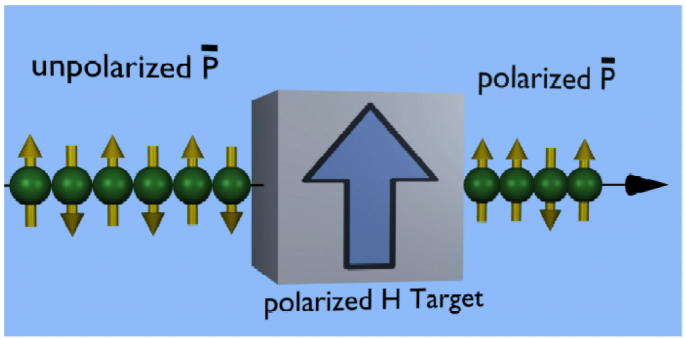

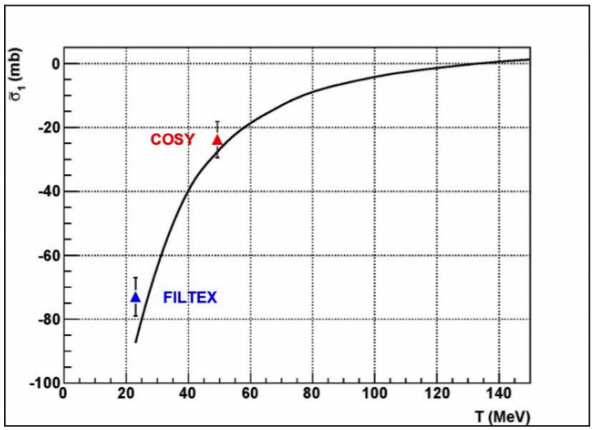

- Test with longitudinal polarization needed to complete the measurement
  - Full determination of the p_{bar}- p cross section
  - Experimental Storage Ring at FAIR

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JRA12 – Spin for FAIR: Tasks

- Snake commissioning and beam preparation
  - Snake commissioning with the JEDI Polarimeter
  - Beam and polarization lifetime studies
- Detector comissioning
  - Detector installation and commissioning
- Measurements
  - Measurement of beam and target polarization
  - Spin filtering with longitudinal polarization
- Theoretical investigations and data interpretation
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  - Data interpretation

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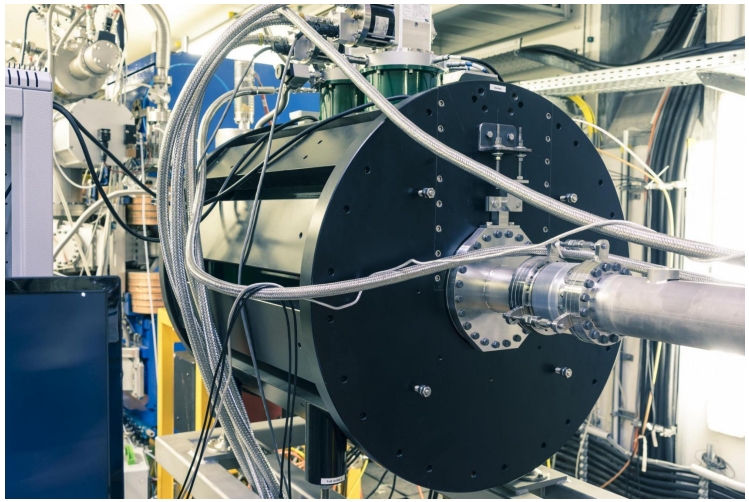
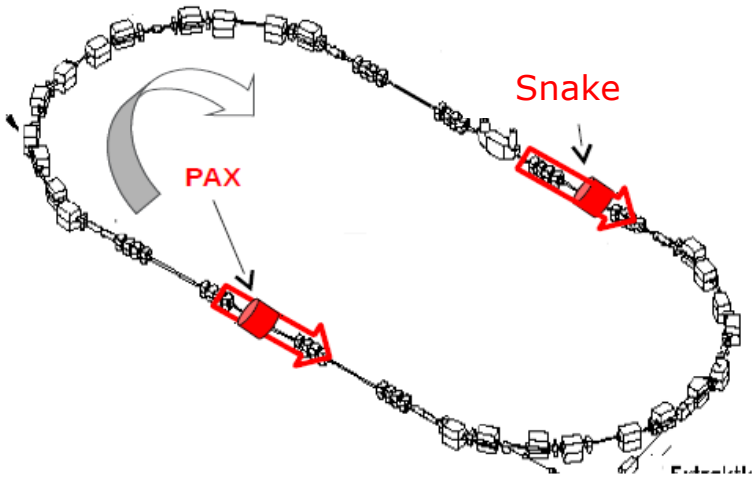
Siberian Snake
Update





- Siberian Snake installed at COSY

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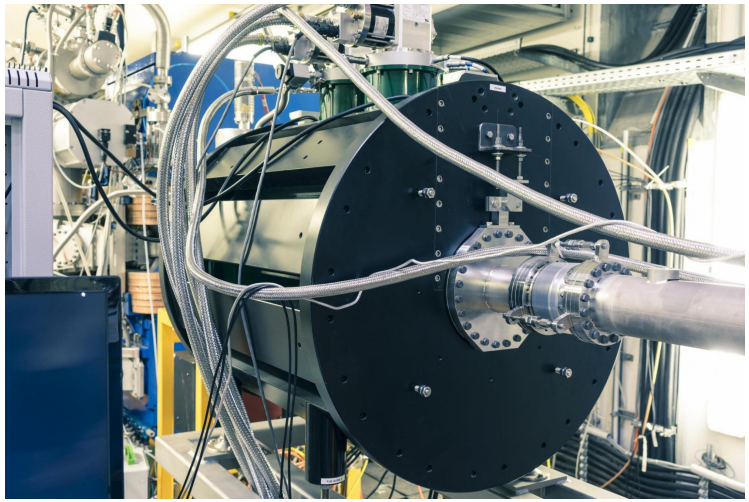

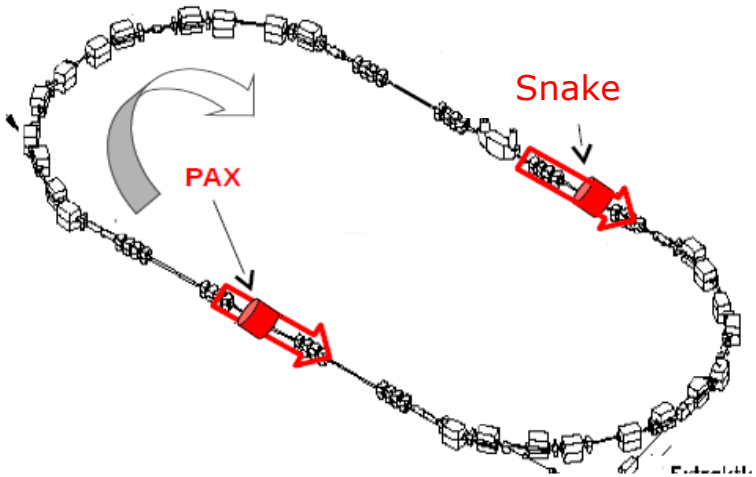

- Siberian Snake installed at COSY
  - Commissioning scheduled for March 2020

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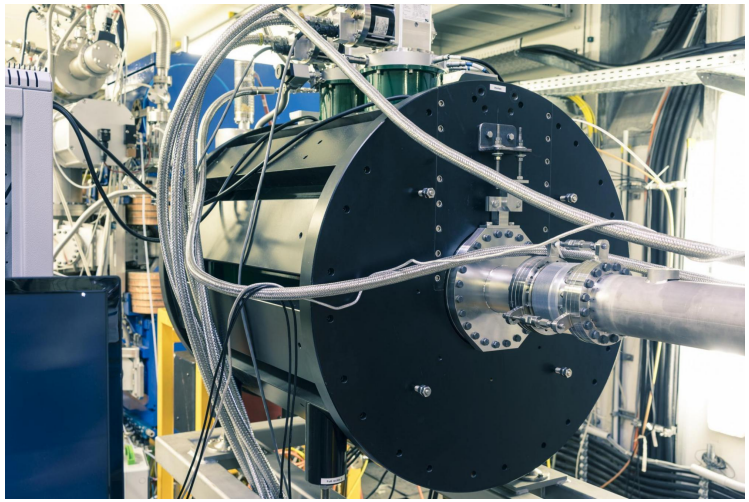

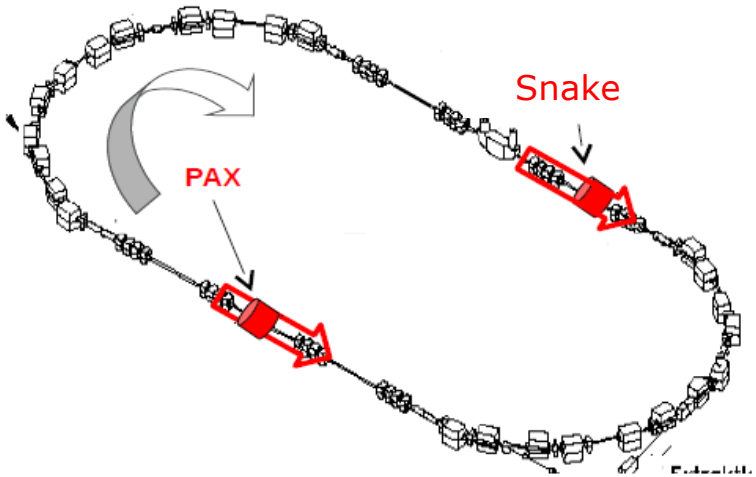

- Siberian Snake installed at COSY
  - Commissioning scheduled for March 2020
  - Will provide longitudinal polarization at PAX section

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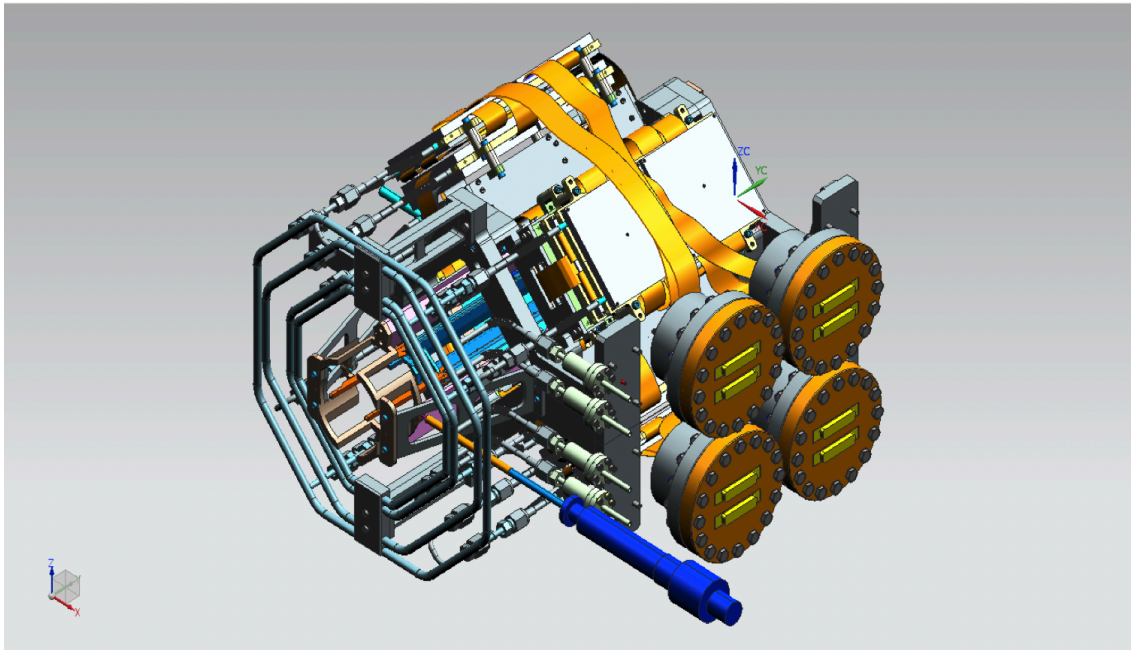
PAX Detector



- 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

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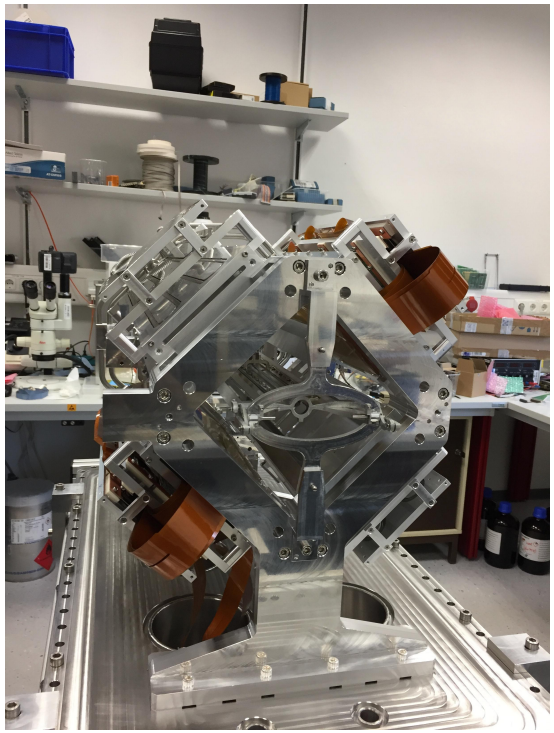
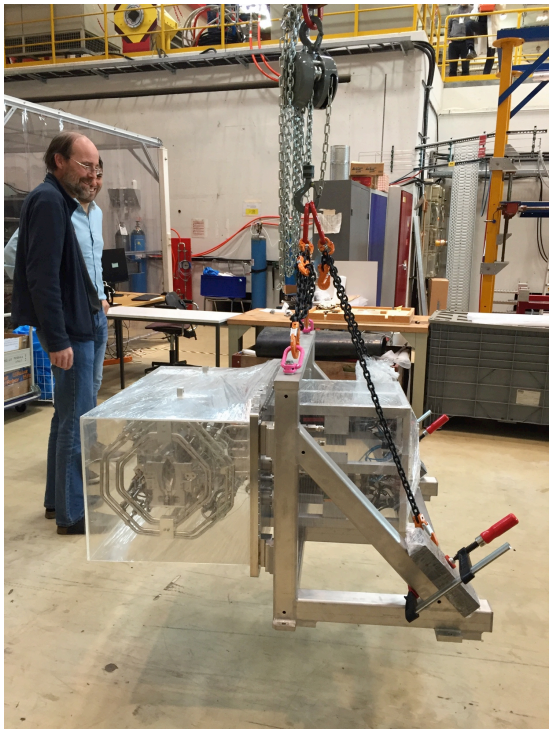
PAX Detector

Update

- Installed at PAX section for commissioning with 2 quadrants





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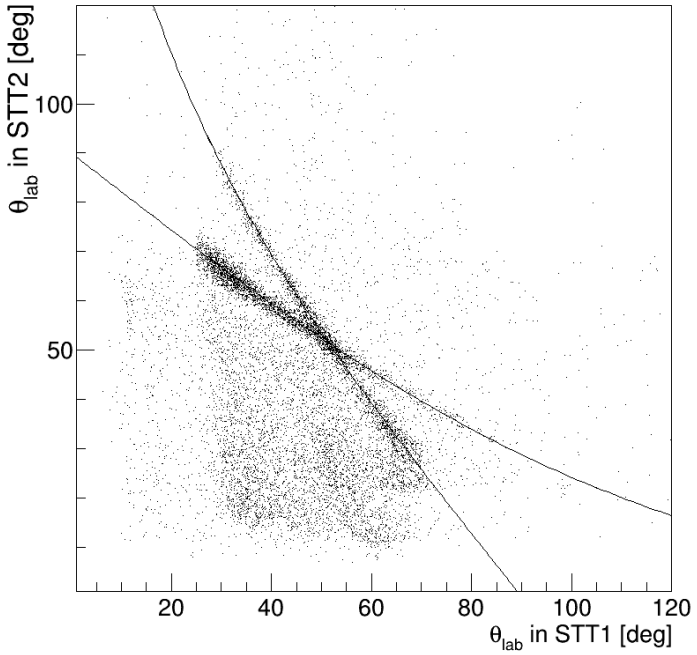
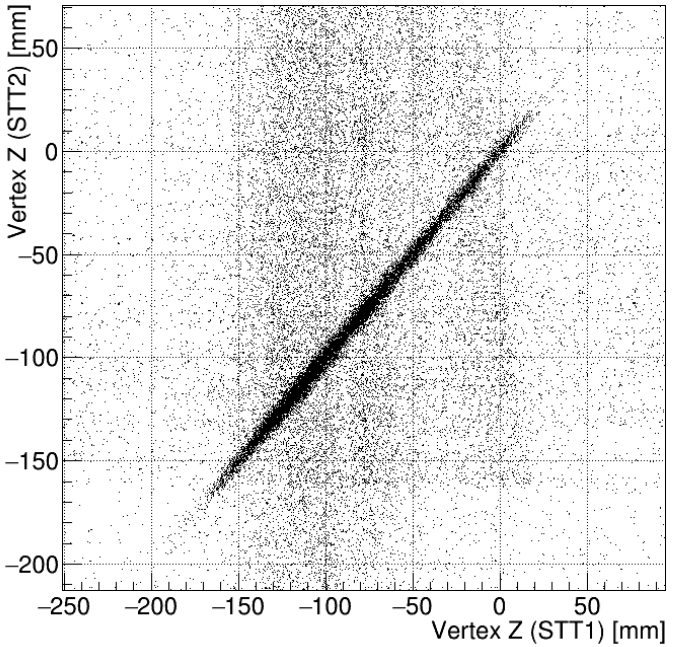
PAX Detector

First Commissioning Results

- Unpolarized p beam vs. polarized d target
- Identification of p-d elastic events





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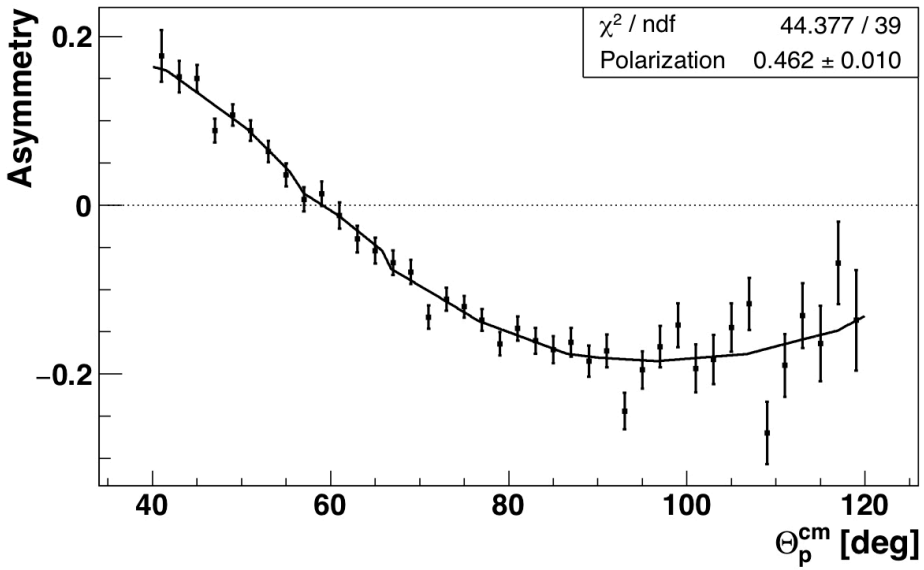
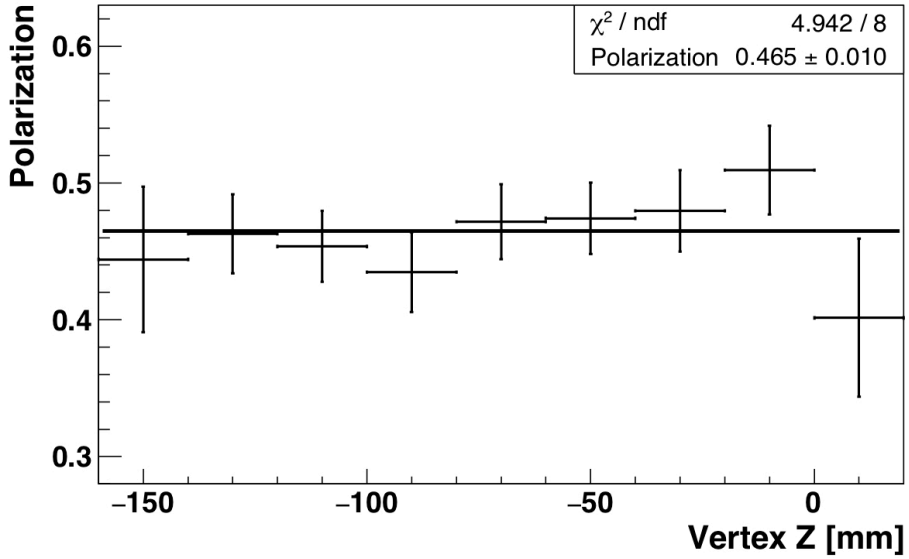
PAX Detector

First Commissioning Results

- Determination of target polarization





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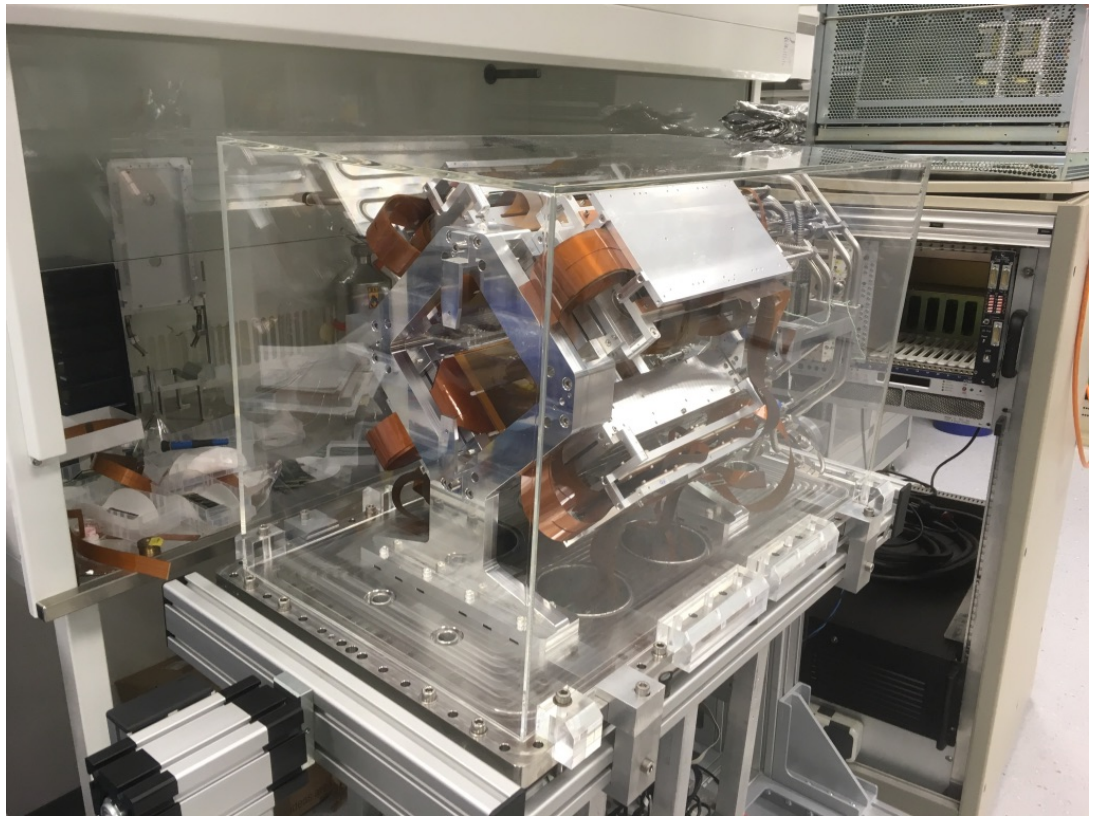
PAX Detector

Update

- 4 quadrants assembled!
- Data acquisition from cosmics started on test bench
- Full commissioning at PAX place foreseen in 2021



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JRA12 – Spin for FAIR: Deliverables

- Reporting Period: 18 months, June 2019-November 2020

- D30.1 'Report on snake and detector commissioning' due on M12 (May 2020).
  - First annual report including report on snake and detector commissioning

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D30.1	Report on snake and detector commissioning	30 - INFN	Report	Public	12

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JRA12 – Spin for FAIR: Milestones

- MS70 and MS71 have to be achieved M12 (May 2020)

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS70	Detector commissioned	30 - INFN	12	Detector installed in COSY and running as expected.
MS71	Snake commissioned	30 - INFN	12	Snake installed and COSY and performing as expected.

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- MS70: Detector commissioning
  - Commissioned in COSY with 2 assembled quadrants
  - 4 quadrants completed and assembled

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Longitudinal spin filtering experiment foreseen in 2022

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Thank you for your attention!

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BACKUP SLIDES

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Spin-filtering

Interaction between a polarized beam ($\boldsymbol{P}$) spin ½ and a polarized target ($\boldsymbol{Q}$) spin ½

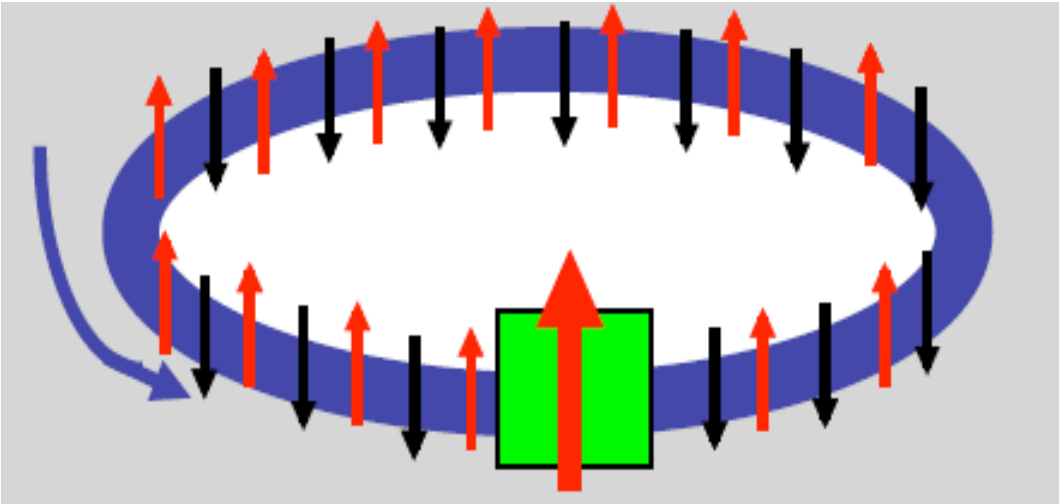
$$\sigma_{tot} = \sigma_0 + \sigma_1(\boldsymbol{P}\bullet\boldsymbol{Q}) + \sigma_2(\boldsymbol{P}\bullet\boldsymbol{k})(\boldsymbol{Q}\bullet\boldsymbol{k})$$

Transverse case

$$\sigma_{tot\pm} = \sigma_0 \pm \sigma_1 Q$$

Longitudinal case

$$\sigma_{tot\pm} = \sigma_0 \pm (\sigma_1 + \sigma_2) Q$$



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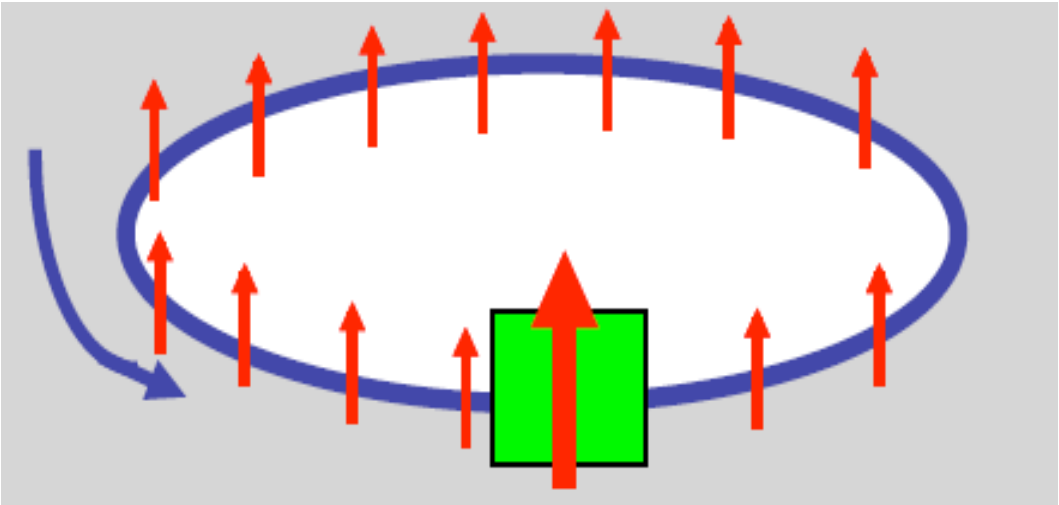

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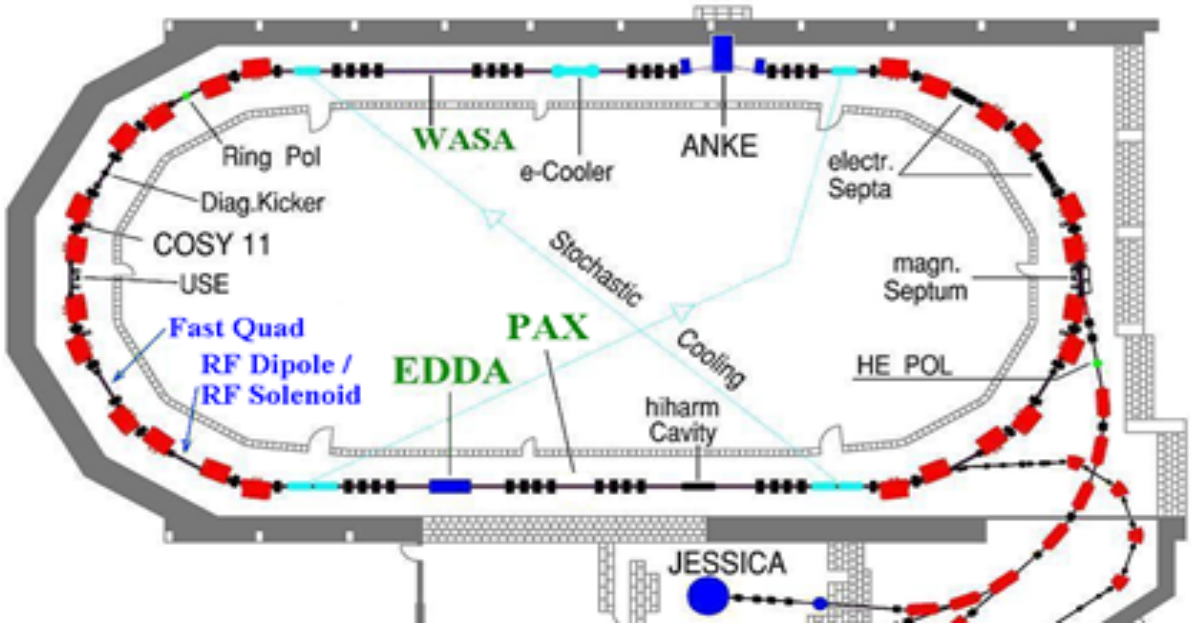
COSY

- Length: 183.4 m
- 45MeV < E(p) < 2700MeV
- 75MeV < E(d) < 2100MeV
- Electron cooling for long lifetimes up to 600 MeV/c (p)



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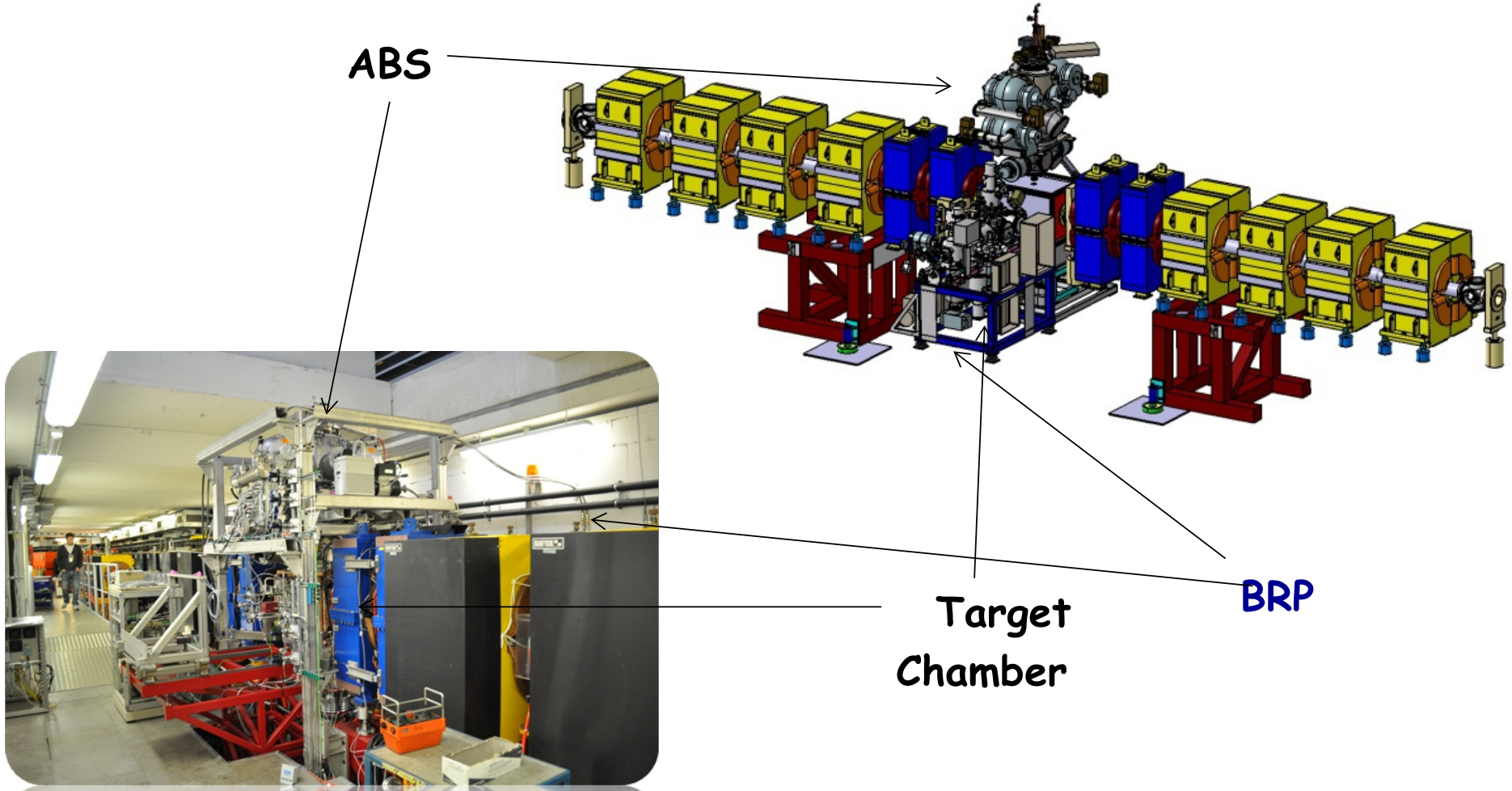
PAX Experimental Setup



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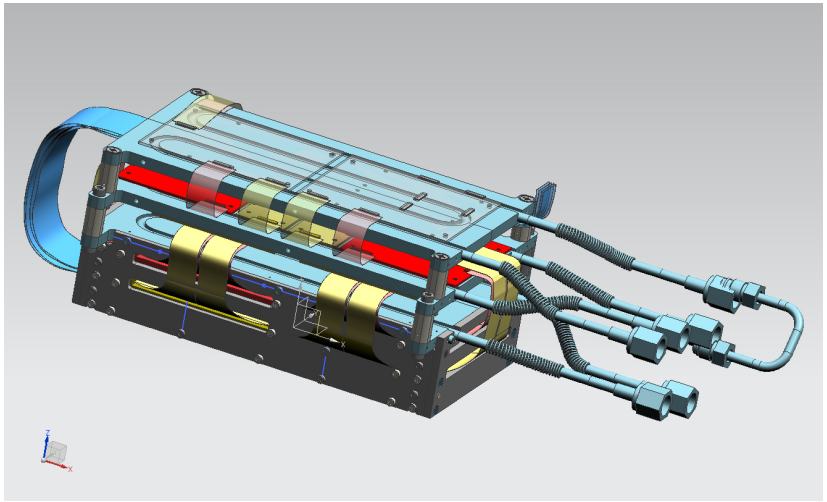
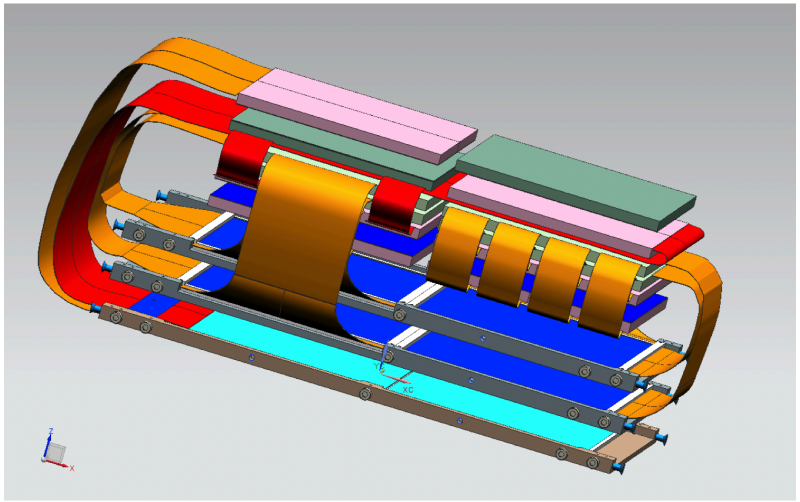
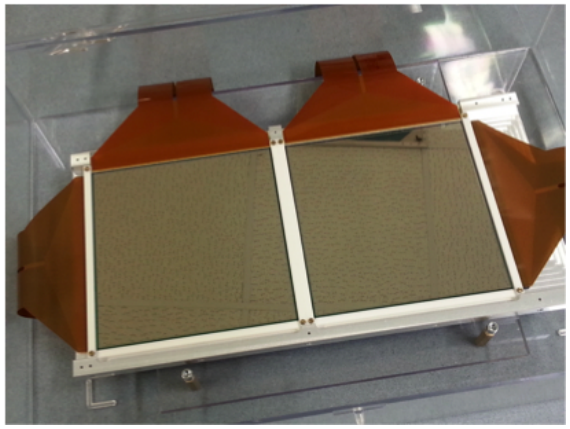
Quadrants





- 4 identical quadrants in diamond configuration
- 3 layers per quadrant
  - I layer: 2x300 μm sensors
  - II layer: 2x300 μm sensors
  - III layer: 1x1000 μm sensor



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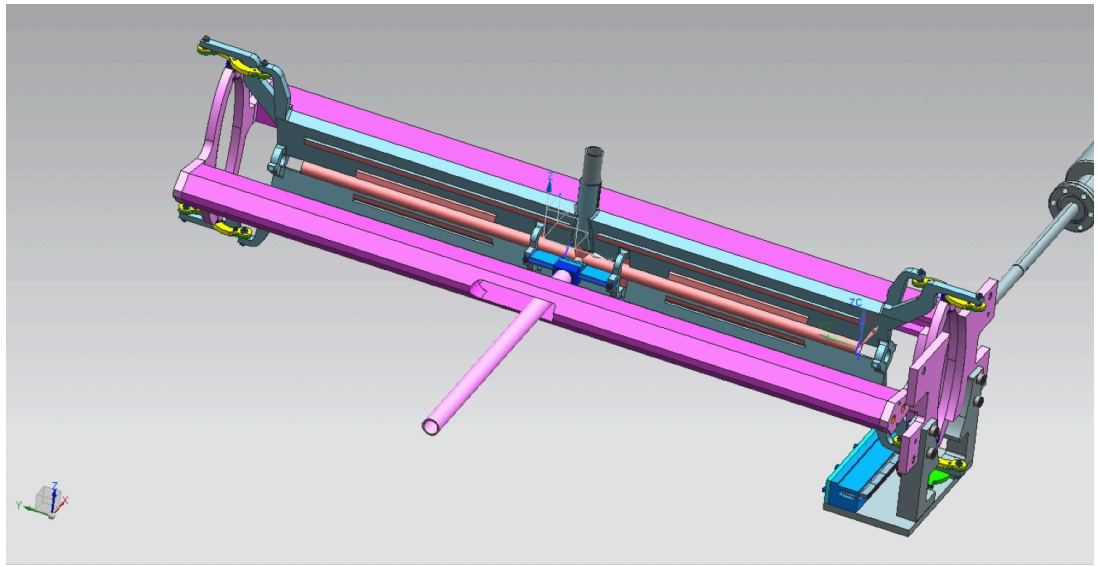
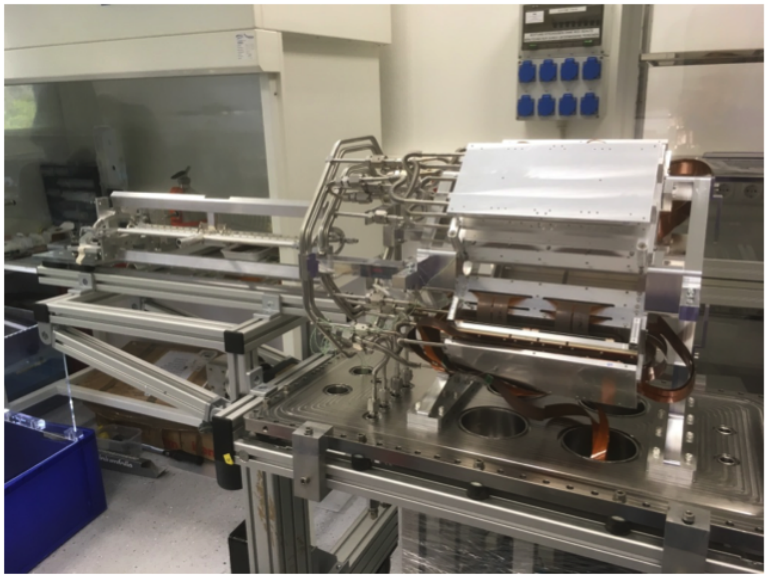
Storage Cell

- 50 μm thick aluminum foil
- 40 cm long
- 10 mm inner diameter





- Teflon coated storage cell
- Openable cell to increase acceptance at injection
- Dediceted mechanism to allow insertion and extraction

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