



# **COMPASS Polarized Target for Pion-Induced Drell–Yan Experiment**

Jan Matoušek

Charles university in Prague

**On behalf of the COMPASS Collaboration**

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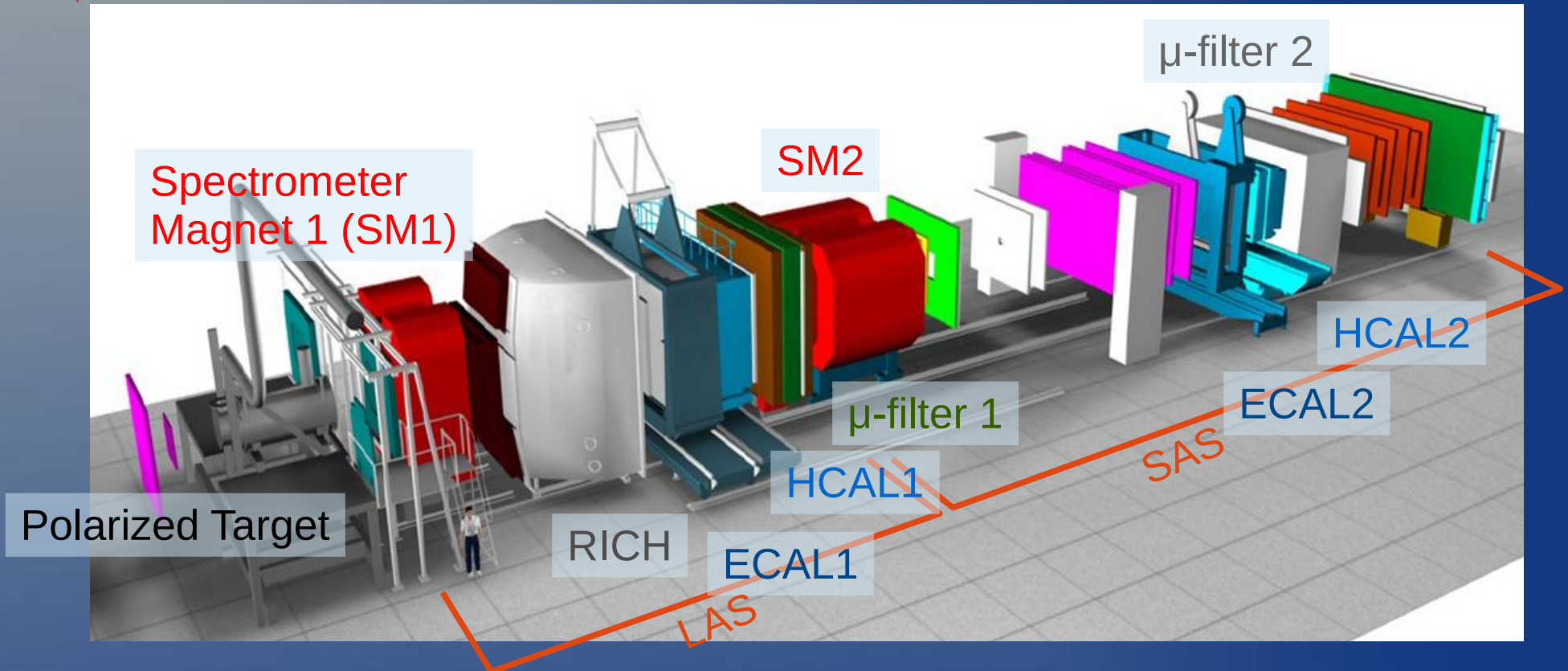


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# COMPASS Experiment at CERN



- Fixed target exp. on M2 beam-line at CERN North area, at SPS
- Both muon and hadron beams (up to 280 GeV), various targets
- Physics program: nucleon spin structure & hadron spectroscopy
- 2-staged spectrometer (LAS, SAS),  
each stage has: tracking, calorimetry, muon detection; + 1 RICH

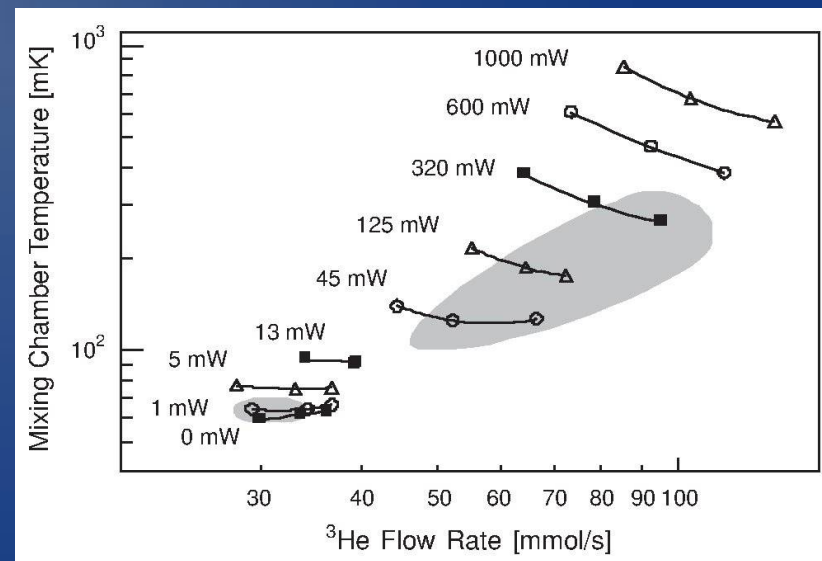
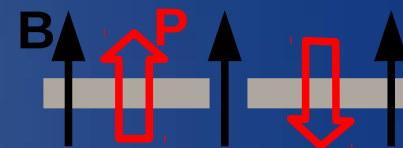
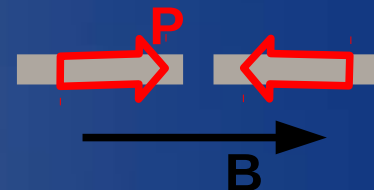


# COMPASS Polarized Target

- Essential for nucleon spin structure studies

- **Superconducting magnets:**  
2.5 T solenoid & 0.65 T dipole  
→ Both long. & transv. Polarizations  
→ Polarization rotation daily  
(to reduce systematical errors)

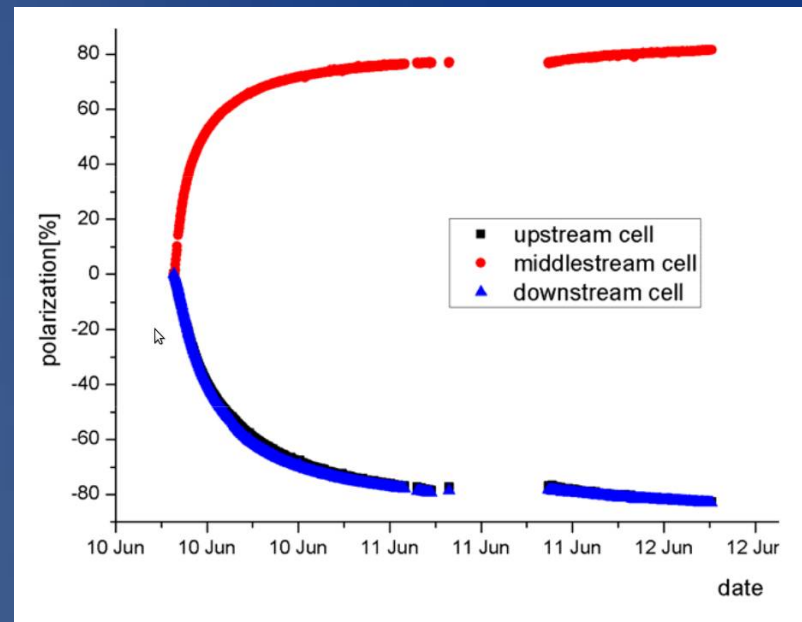
- **Dilution refrigerator (DR):**  
One of the most powerful in the world  
(5 mW at 75 mK)





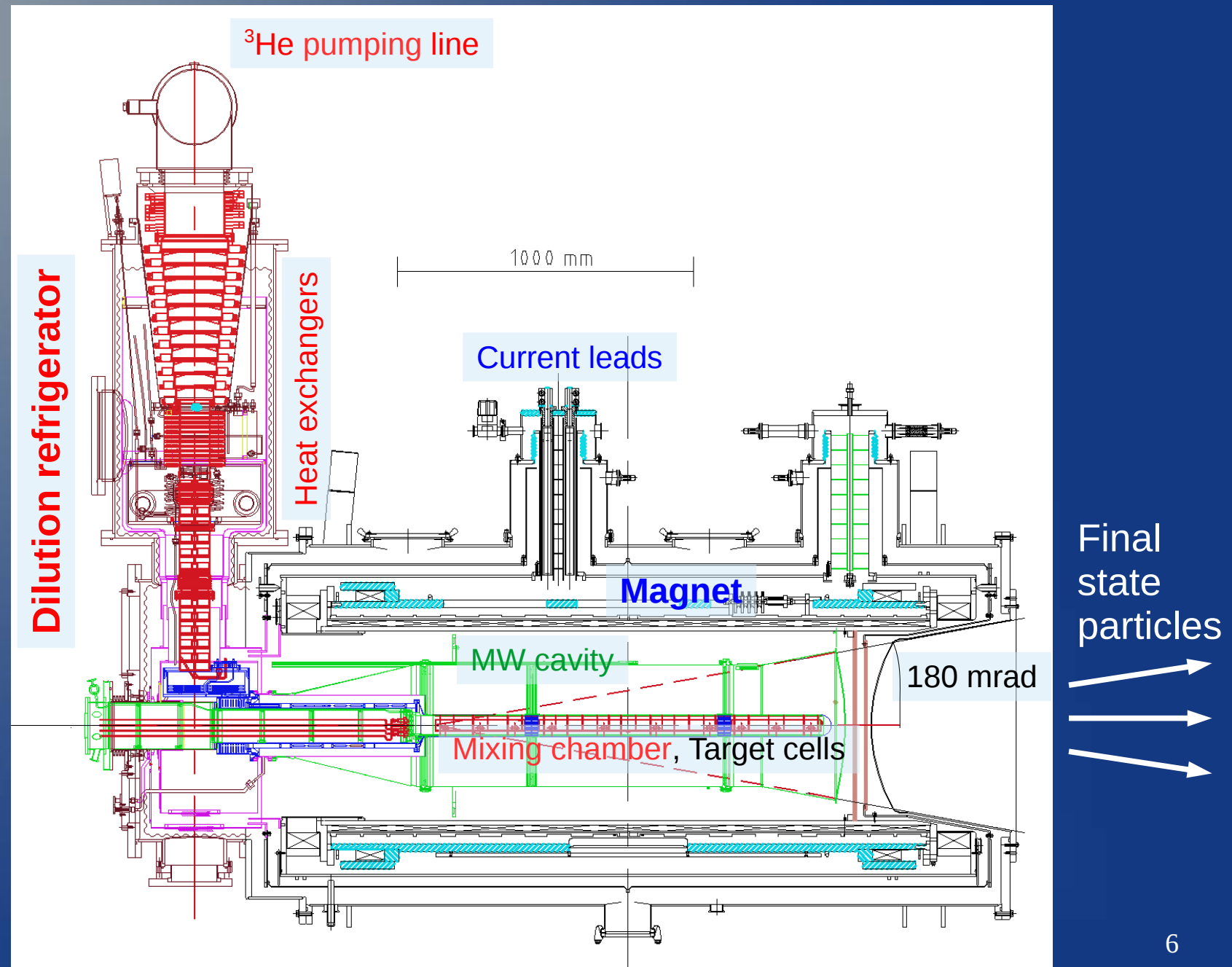
# COMPASS Polarized Target

- Proton target: Typically  $\text{NH}_3$   
(Average maximum polarization  $\approx 83\%$ )
- Polarized by **DNP** at  $\approx 0.5$  K,  
„Frozen spin mode“ at  $\approx 50$  mK  
(spin-lattice relaxation time  $\sim 1000$  h)
- Polarization measurement: **continuous-wave NMR** (multiple coils & Q-meters)





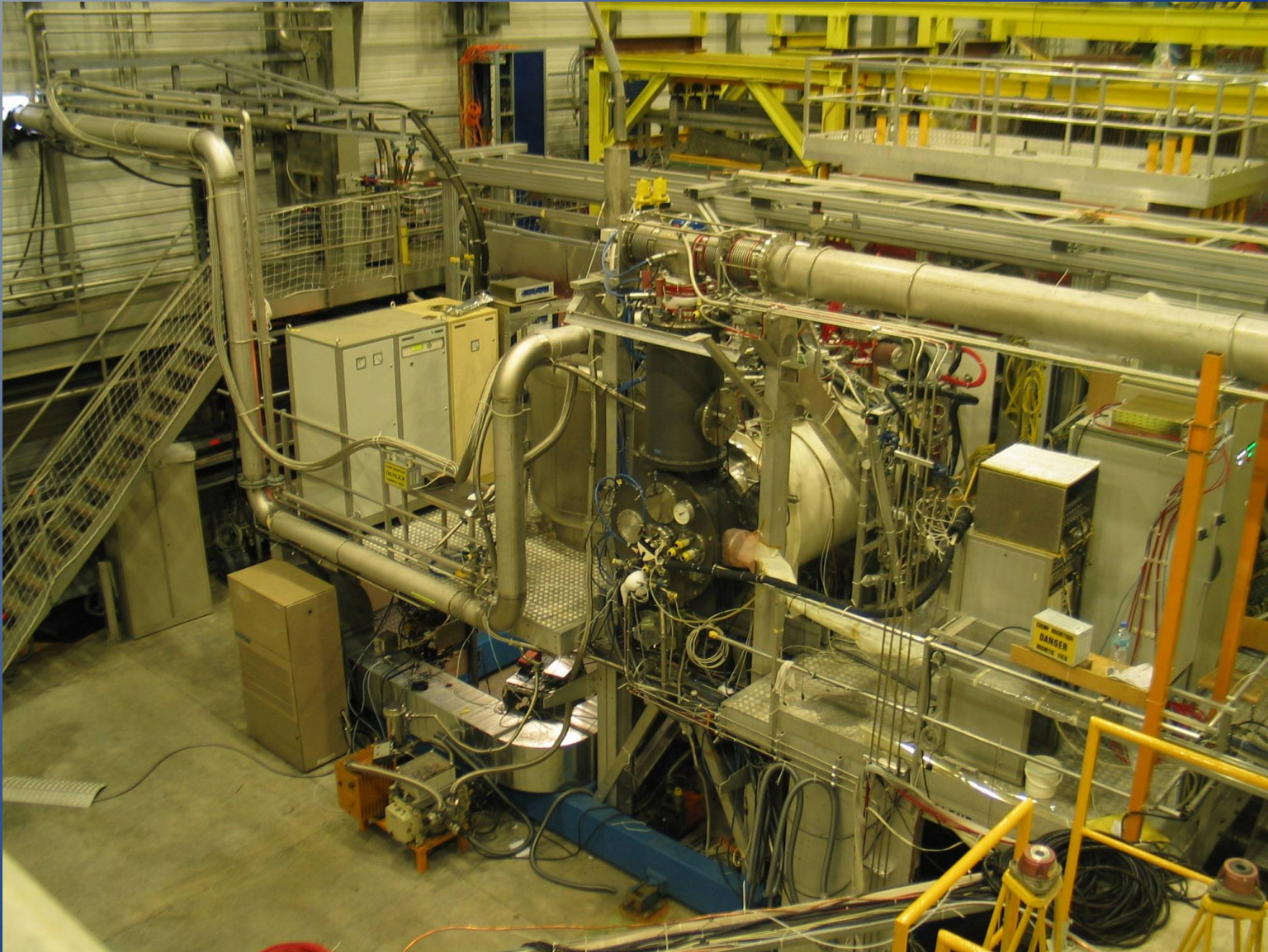
# COMPASS Polarized Target







# PT Photos







# PT Photos



25 August 2014

COMPASS polarized target for pion-induced Drell-Yan experiment

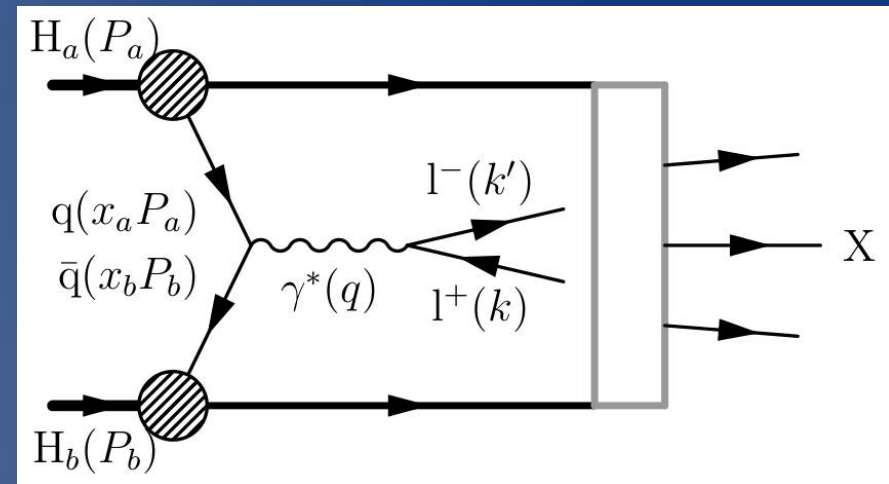




# Drell-Yan program at COMPASS

## Introduction

- Drell-Yan process: quark and antiquark from 2 hadrons annihilate, two leptons are produced.
- In case of COMPASS:
  - $\pi^-$  beam (190 GeV), polarized p target,
  - looking for  $\mu^+$  &  $\mu^-$
- Main goal: Study of hadron TMD PDFs, in particular Sivers function (to test its predicted sign change).
- Complementary to SIDIS processes studied on COMPASS before.  
 Cross sections:      SIDIS... TMDs  $\otimes$  FFs  
                              DY..... TMDs  $\otimes$  TMDs
- Physics run planned on fall 2014 (after accelerator shutdown) and on 2015

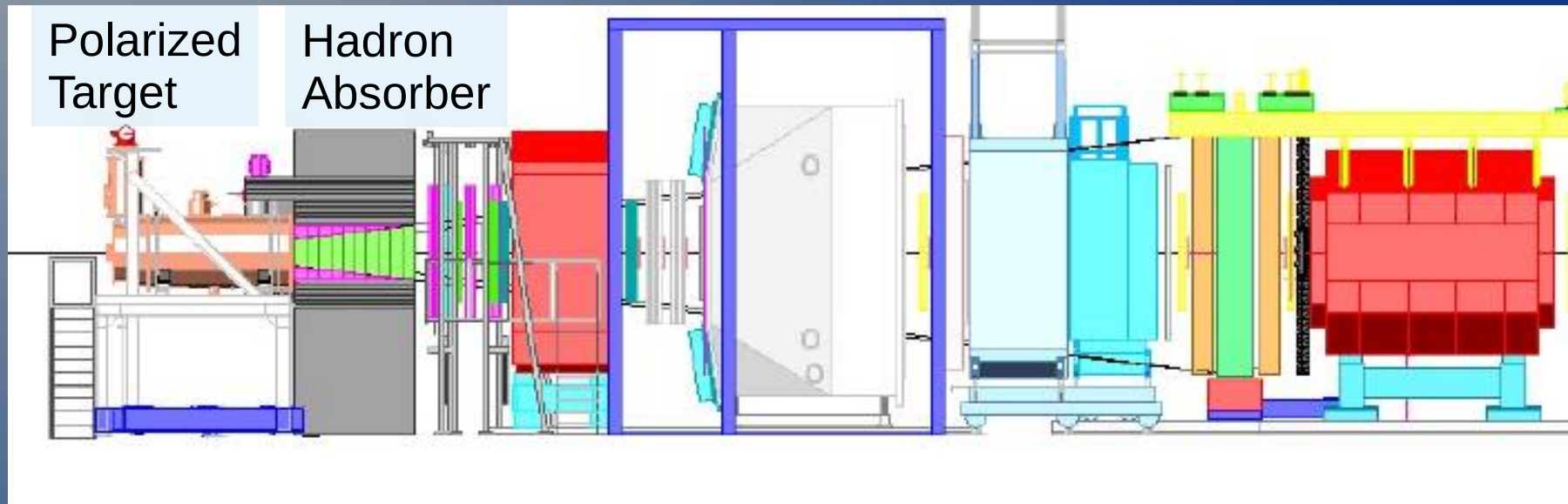


$$f_{1T}^{\perp} \Big|_{\text{DIS}} = -f_{1T}^{\perp} \Big|_{\text{DY}}$$



# Drell-Yan program at COMPASS

## COMPASS Drell-Yan setup



- Low cross section  $\rightarrow$  high hadron flux required ( $10^8 \text{ s}^{-1}$ )
  - $\rightarrow$  secondary hadrons & beam has to be stopped to avoid the spectrometer flooding up
  - $\rightarrow$  **hadron absorber** (alumina, tungsten beam plug, 22.5 t + 140 t shielding)
- Whole target moved 230 cm upstream (to free space for the absorber).
- Radiation dose in the hall would be higher than in preceding runs  $\rightarrow$  **Control room will be moved** to office bld.



# PT for the Drell-Yan program

## New target cell design

- 2 cells (55-55 cm), 4 cm in diameter.
- Hadron absorber → 20 cm gap between cells to avoid event migration between the cells with opposite polarization.
- 10 NMR coils with new design (4 long. + 1 trans. in each cell).



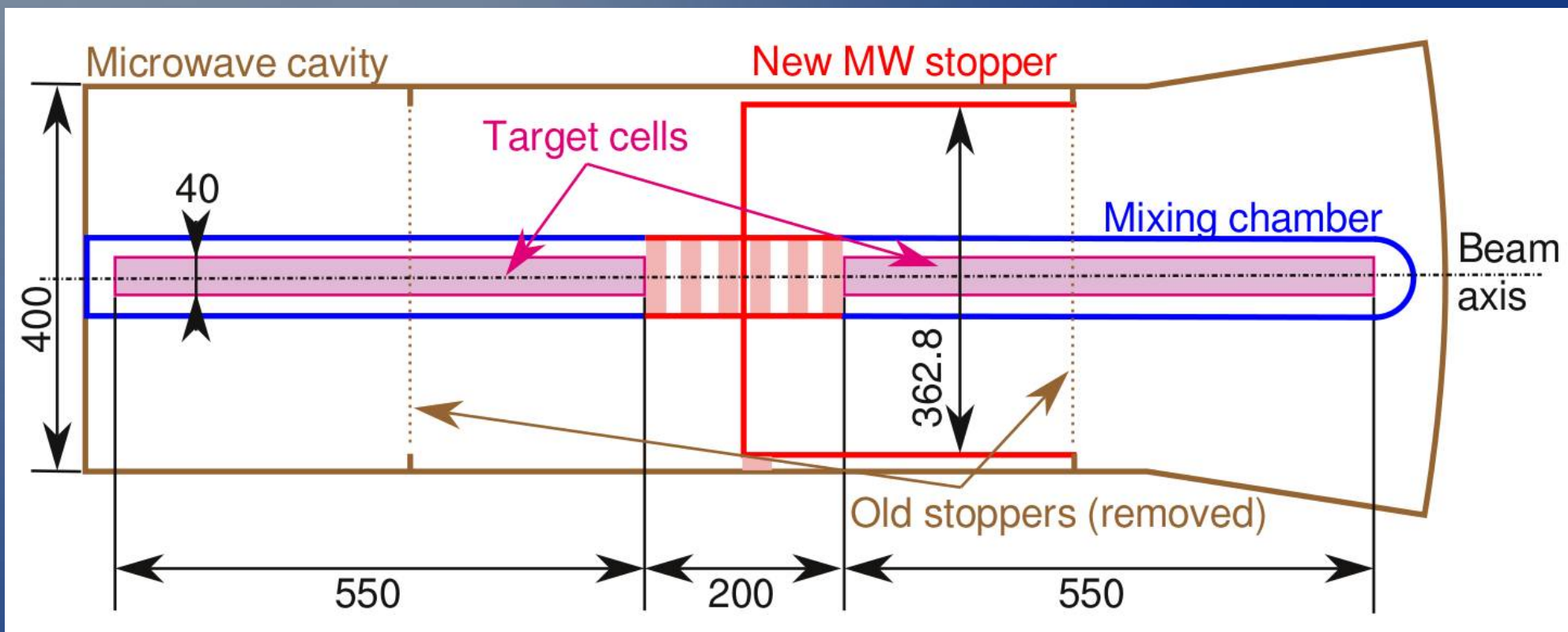




# PT for the Drell-Yan program

## Modified microwave cavity

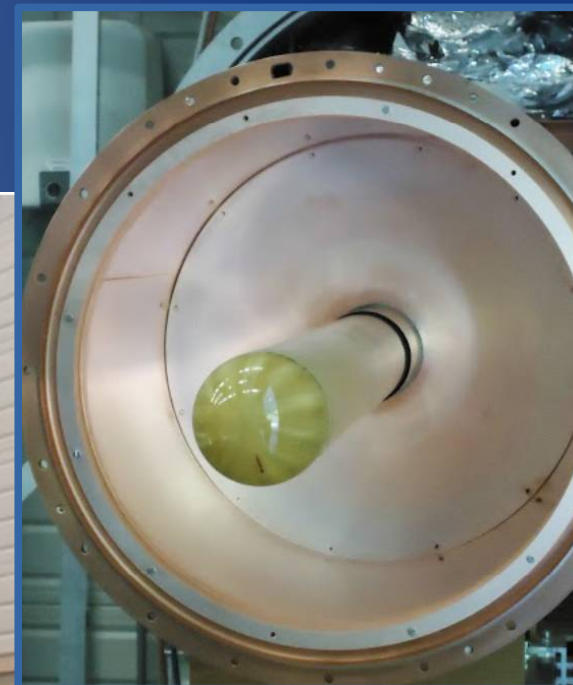
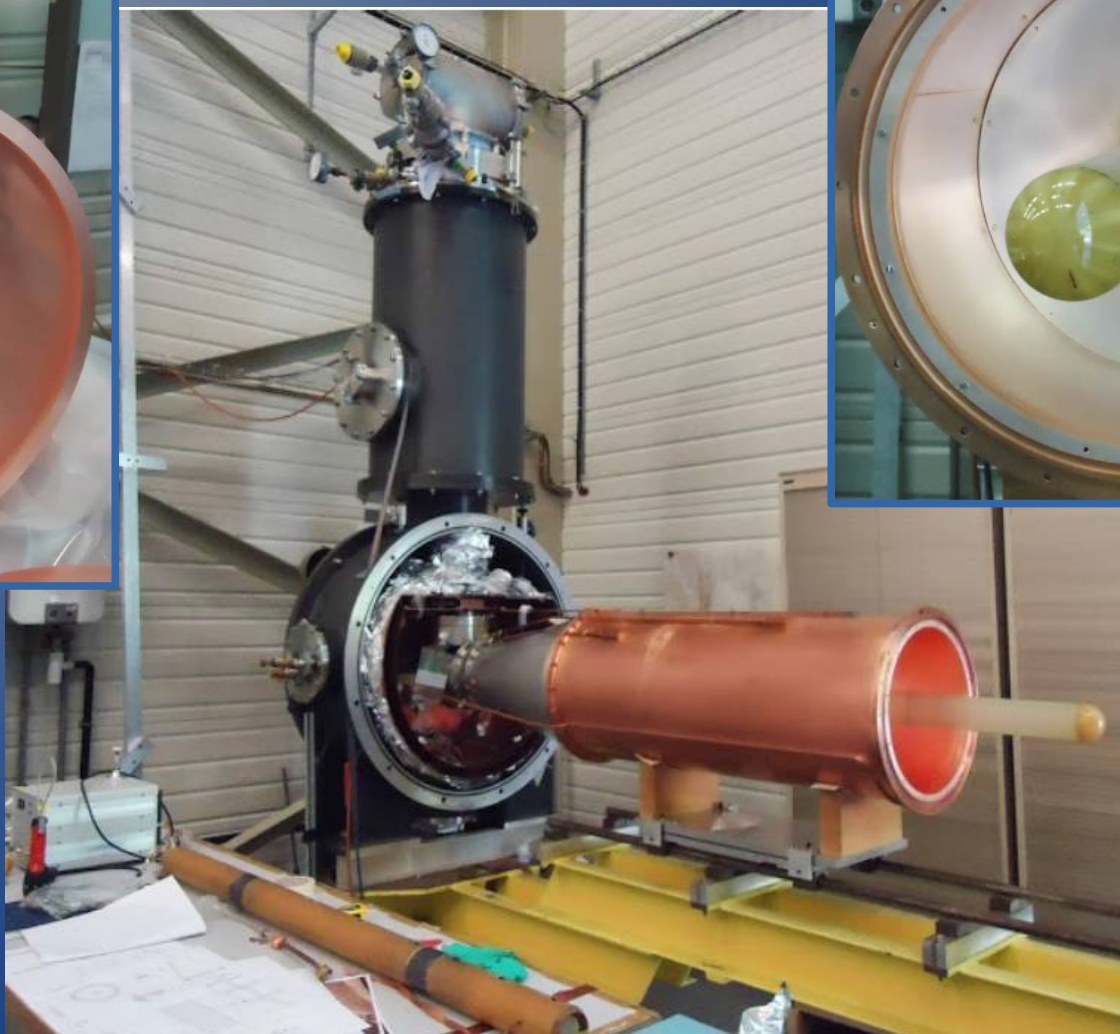
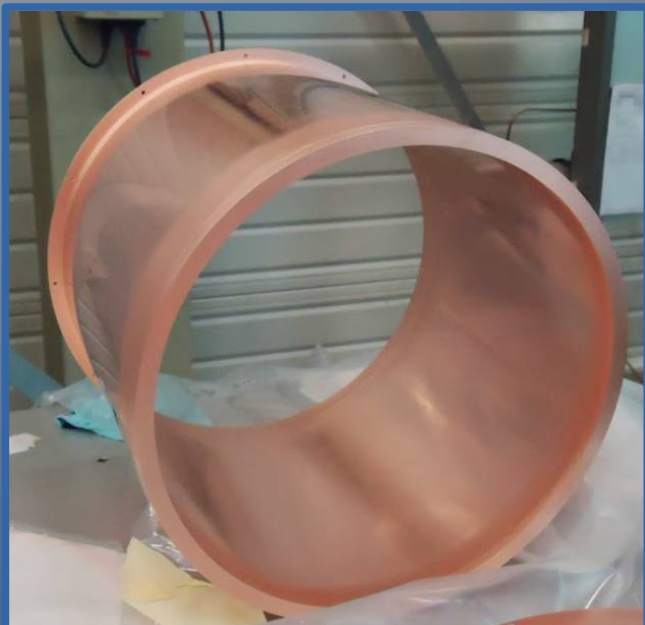
- 3-cell setup (SIDIS program) → 2-cell setup (DY)





# PT for the Drell-Yan program

## Modified microwave cavity



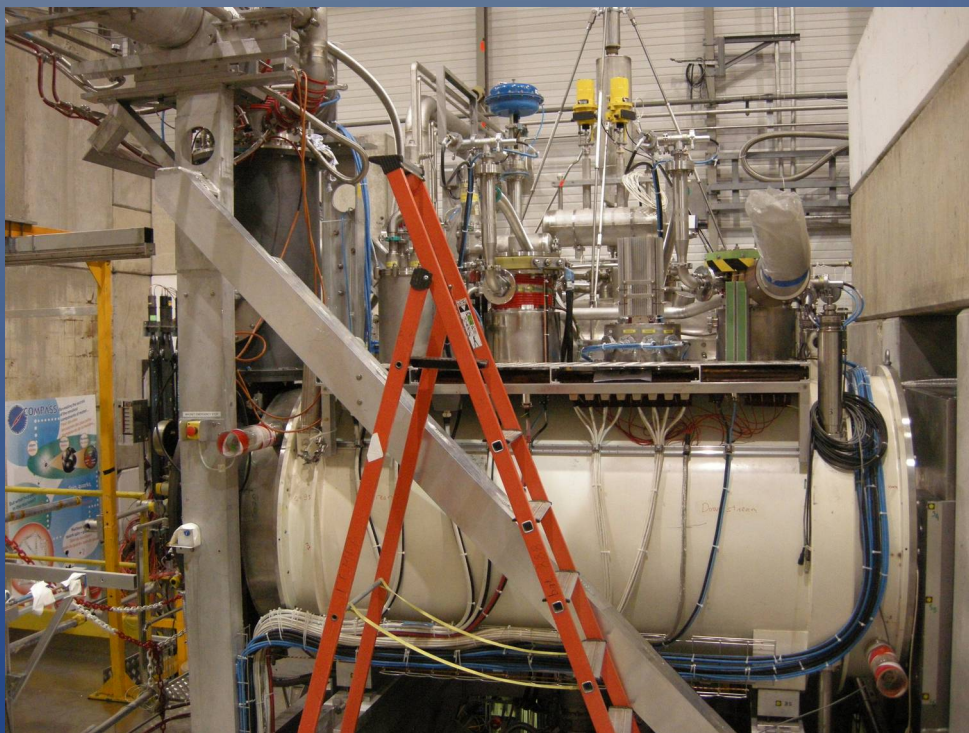




# PT for the Drell-Yan program

## Target magnet

- Target magnet was refurbished by CERN magnet group.
  - New control and safety system.
  - Better thermal isolation...
- Installed in place, commissioning is ongoing.



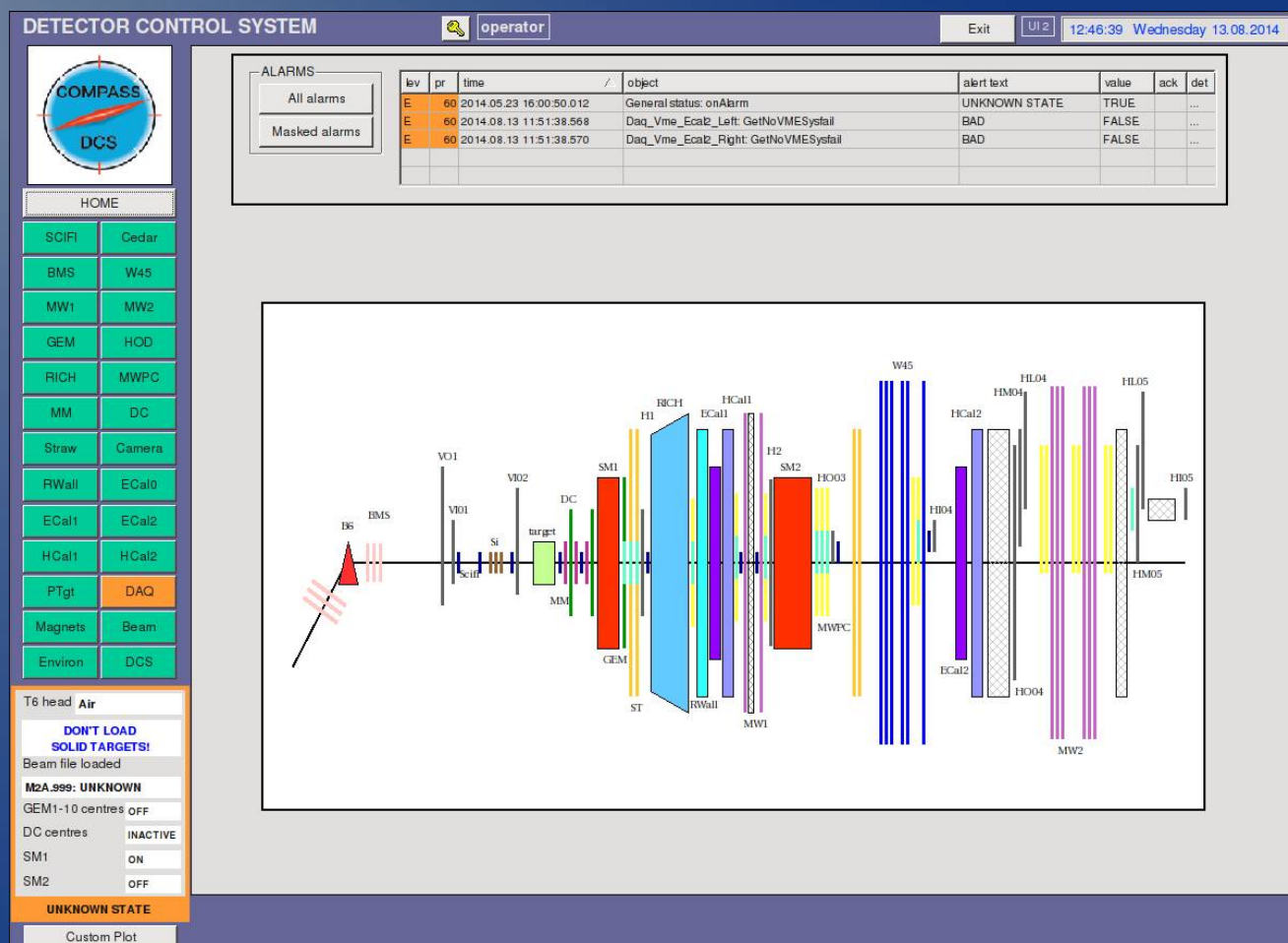




# PT for the Drell-Yan program

## New remote control system

- Control room will be moved → **remote control system is necessary**
- Decision to:
  - Abandon LabVIEW system for DR monitoring.
  - Include it under the standard **COMPASS DCS** (centralized Detector Control System).

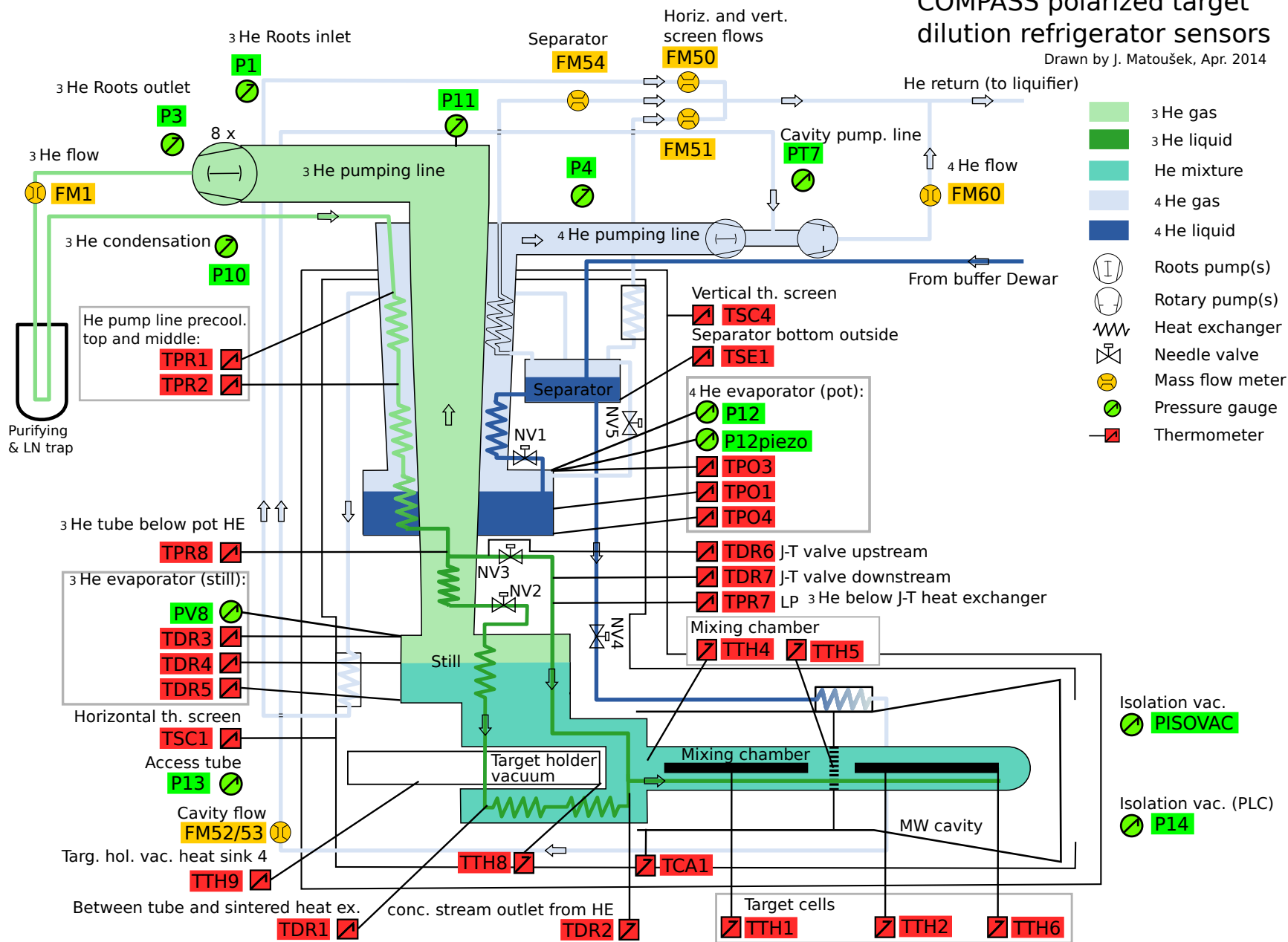




# PT for the Drell-Yan program

## COMPASS polarized target dilution refrigerator sensors

Drawn by J. Matoušek, Apr. 2014





# PT for the Drell-Yan program

## New remote control system – ptread package

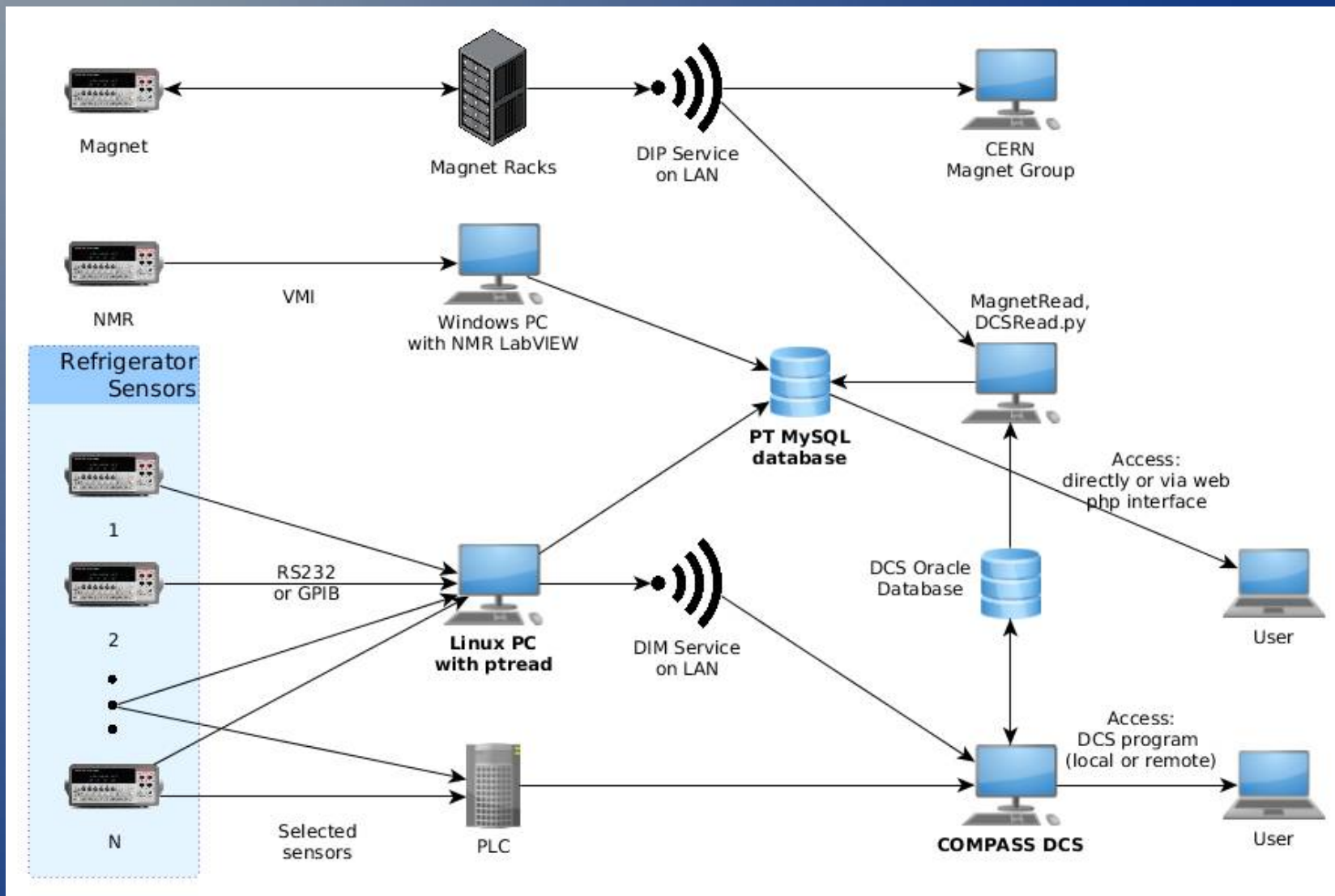
- **Monitors DR** (pressure gauges, flowmeters, > 30 thermometers...)
- **Linux platform**, open-source, modular, Perl & C++
- Output possibilities:
  - DIM service → DCS
  - MySQL or SQLite.





# PT for the Drell-Yan program

## Polarized target monitoring-data flow





# Conclusion

## Current status and plans

- Magnet is in place, commissioning is in progress.
- Installation of DR monitoring sensors is finishing.
- The new target cells are ready, NMR coils will be mounted soon.
- Target loading is scheduled in turn of September and October.
- Beam planned from beginning of October.

## Conclusion

- COMPASS PT preparation for Drell–Yan is progressing well.
- PT will be fully operational for the 2014-2015 physics run.



**Thank you for your attention!**

Jan Matoušek

Charles university in Prague

**On behalf of the COMPASS Collaboration**

[jan.matousek@cern.ch](mailto:jan.matousek@cern.ch)