

Discussion

 Take-away

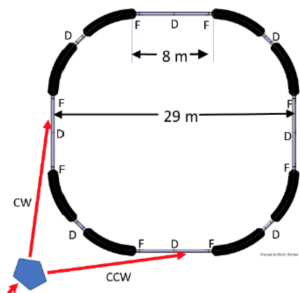
Alexander Nass and Frank Rathmann
IKP, Forschungszentrum Jülich

744. WE-Heraeus-Seminar
Towards Storage Ring Electric Dipole Moment Measurements
March 29 – 31, 2021

Stage 2: Prototype EDM storage ring (PTR)

100 m circumference

- ▶ p at 30 MeV all-electric CW-CCW beams operation
- ▶ p at 45 MeV frozen spin including additional vertical magnetic fields



Challenges – open issues

- ▶ All electric & E/B combined deflection
- ▶ Storage time
- ▶ CW-CCW
 - ▶ operation
 - ▶ orbit difference to pm
- ▶ Spin-coherence time
- ▶ Polarimetry
- ▶ Magnetic moment effects
- ▶ Stochastic cooling

Primary purpose of PTR

- ▶ study open issues.
- ▶ first direct proton EDM measurement.

Technical Design Report (ready end of 2022)

A. Nass & F. Rathmann, plus project engineer

- ▶ Present status summarized in CERN Yellow Report (CYR)
 - ▶ **Storage Ring to Search for Electric Dipole Moments of Charged Particles – Feasibility Study [1]**
- ▶ **Next step: CP EDM prepares Technical Design Report**
 - ▶ PTR Lattice design
 - ▶ Beam transfer and injection system
 - ▶ Electrostatic deflectors
 - ▶ Magnetic bends
 - ▶ Multipole elements
 - ▶ Ring vacuum system
 - ▶ Stochastic cooling
 - ▶ RF Cavity
 - ▶ Spin manipulation tools
 - ▶ Polarimeter
 - ▶ Beam diagnostics
- ▶ **Along with: Systematic studies, Spin tracking, error evaluation**

red: needs strong support (CERN, MPIK-HD, Liverpool U., ...)

green: already addressed

Technical & scientific aspects

- ▶ MPIK CSR: **Voltage ripple** $\Delta U/U \approx 7 \times 10^{-6}$
 - ▶ Estimate **beam loss mechanisms** and beam lifetime in PTR
 - ▶ Include aperture restriction in bends
- ▶ **BPMs**: Squid versus Rogowski
 - ▶ Estimate SNR for both systems
- ▶ **Vacuum** vessel: Ti, Al, or SS
- ▶ Experimentally, little is known about $\tau_{\text{SCT}}(p)$
 - ▶ **Study** $\tau_{\text{SCT}}(p)$, albeit COSY close to EOL
 - ▶ Build SCT model for d based on: $\frac{\Delta p}{p}$, $\epsilon_{x,y}$, $\xi_{x,y}$, and $I \Rightarrow$ transfer to p
- ▶ Split development of **PTR lattice elements** into:
 - ▶ electrostatic bends \vec{E}_x (PhD student)
 - ▶ magnetic bends \vec{B}_y (PhD student)
 - ▶ electrostatic quadrupoles (engineering)

Discussion II

Site for PTR

- ▶ Setup of **Bunch Accumulator + PTR** possible at CERN or elsewhere, but:
 - ▶ building, polarized ion source, pre-accelerator and bunch accumulator

Organization

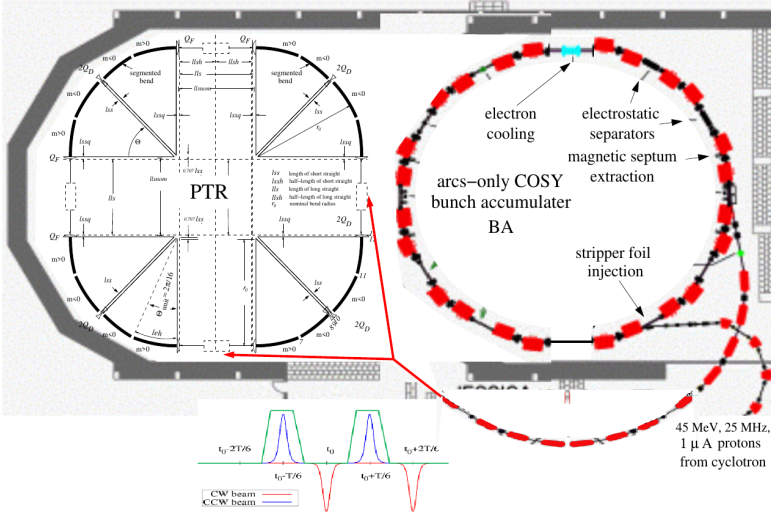
- ▶ RWTH (IAEW), IKP, CERN: design and prototyping of lattice elements
 - ▶ IAEW application to DFG
- ▶ Applicability of Gentner Program for PhD students working on electrostatic elements
- ▶ Seek support from PBC working group
- ▶ **ERC Design Study** in Horizon Europe: INFRADEV-01-01-2022
 - ▶ call opening: winter 2021, duration: 3-4 years, 2023-26
 - ▶ participants: IKP/GSI, Ferrara, CERN, RWTH, MPIK-HD, Liverpool, Cracow, Grenoble, ++

Discussion III

Maintain momentum

- ▶ Trigger discussion between GSI, CERN and FZ Jülich on PTR
- ▶ Arrange for letters of support from CERN (and other labs and groups) to
 - ▶ GSI director Paolo Giubelino
 - ▶ German BMBF
 - ▶ Helmholtz
 - ▶ North Rhine-Westphalia
 - ▶ Italian ministry of science
 - ▶ ...
- ▶ ...

Bunch accumulator and EDM Prototype Ring



References I

- [1] F. Abusaif *et al.*, “Storage Ring to Search for Electric Dipole Moments of Charged Particles - Feasibility Study,” 2019. <https://arxiv.org/abs/1912.07881>.