Development of new Beam Position Monitors at COSY

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Motivation

- Measure Electric Dipole Moment (EDM) of charged hadrons at COSY
- Use RF Wien Filter to rotate polarization
- EDM \( \eta \) rotates spin out of horizontal plane \( \Rightarrow \Delta S_z \) turn
- Study systematic effects, like misalignments of magnets, by controlling the orbit of the beam
- Improve Beam Position Monitor (BPM) system, including new BPMs
- Magnetostatic pick-ups based on Rogowski coil design

Design of Rogowski Pick-Up Coils

- Torus with:
  - Major radius \( R = 40 \text{ mm} \)
  - Minor radius \( a = 5 \text{ mm} \)
  - Winding with cooper wire \( N = 1400 \)
- Voltage induced by magnetic field \( \vec{B} \) of particle beam \( (x_0, y_0) \) in \( z \)-direction:
  \[ U_{\text{ind}} = \frac{2}{\pi \sqrt{R^2 - a^2}} x_0 \]
- \[ \frac{U_L - U_R}{U_L + U_R} = \frac{2}{\pi \sqrt{R^2 - a^2}} x_0 + O(x_0y_0, x_0^2, y_0^2) \]
- Complete linear
- Independent of beam position in \( y \)-direction

Laboratory Measurements

- Quartered BPM
- Wire representing the particle beam
- Movement of wire with micrometer screw gauge
- Two measurements:
  1. \( y_0 = 0 \text{ mm}, -30 \text{ mm} < x_0 < 30 \text{ mm} \)
  2. \( y_0 = 15 \text{ mm}, -30 \text{ mm} < x_0 < 30 \text{ mm} \)
- Linear term 10% higher than expected
- Non-linear corrections smaller
- Investigate these discrepancies with improved new test-bench

Summary & Outlook

- The presented magnetostatic pick-up measures the beam position
- A halved Rogowski coil shows a linear sensitivity over a wide range
- Negligible sensitivity to perpendicular direction
- Calibration of BPMs at new developed test bench ongoing
- Installation of calibrated, quartered Rogowski coils at COSY is planned
- Improvement of orbit control

Measurements at COSY

- Change beam position once per fill
- Measure displacement
- Complete linear
- Slope \( m \) close to 0 \( (m - 0 = 3\sigma) \)

Sensitivity

\[ m / m_0 < 1 / 400 \]

References


Vertical polarization build-up

Simulation result from [3]