

Simulation of a Prototype Proton EDM Storage Ring March 30, 2020 | Maximilian Vitz







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Floor Plan of Prototype Ring

- Circumference: 123. 358 m
- Width: 36. 252 m
- Dipole Length: 4.810 m
- Dipole E-Field: 5.061 kV/m
- Dipole B-Field: 0.023 T
- Cavity Length: 1.000 m
- Cavity Voltage: 5 kV
- Cavity Harmonic: 1

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Horizontal Betatron Tune

- Varying the quadrupol strengths and recording the horizontal tune
- Stepsize: 10^{-3}
- If there is no stable solution possible this is marked as a white spot.
- Sharp edges on upper and right side due to the fact of horizontal resonance condition $Q_x = 2$
- Inside the area of stable operation two white lines visible

$$\Rightarrow$$
 $Q_{\scriptscriptstyle X} = 1$ and $Q_{\scriptscriptstyle X} = 1.5$









Vertical Betatron Tune

- Varying the quadrupol strengths and recording the vertical tune
- Stepsize: 10^{-3}
- If there is no stable solution possible this is marked as a white spot.
- Sharp edges on lower and left side due to the fact of vertical resonance condition $Q_y=2$
- No Resonances inside area of stable operation visible. A finer scan with stepsize of 10⁻⁷ is able to show vertical Resonances of first and second order.









Maximum Dispersion

- Varying the quadrupol strengths and recording the maximum hor. dispersion
- Stepsize: 10⁻³
- If there is no stable solution possible this is marked as a white spot.
- Beam lifetime is hardly depended on the maximum dispersion.
- High maximum dispersion should be avoided

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Default optics with $Q_x = 1.371$ and $Q_x = 1.471$ as well as $\xi_x = 1.631$ and $\xi_y = 0.902$









Floor Plan of Prototype Ring

- Sextupoles placed on quadrupoles to correct chromaticity
- Sextupoles forming one group on QF
- Sextupoles forming one group on QD
- No sextupoles on QSS placed

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Spin for reference particle with $\xi_x = 0$ and $\xi_y = 0$























Summary and Outlook

• Frozen spin configuration in lattice is achieved

• Available betatron tunes have been investigated

- Ability to adjust the horizontal and vertical chromaticity to desired values
 - SCT and its dependency on the chromaticity need further investigation

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