GSI-CERN Impedance Meeting - Impedance Measurements Simulations and Measurements

Hugo Day

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Ferrite Kickers

- Present in almost all CERN machines
  - Extraction
  - Injection
  - Dumping
- Ferrite kickers not the only magnets used (laminated steel) but very common
**Why are kickers important?**

- Estimated to be a significant contributor to transverse impedance in machines (By the far the dominant source of impedance in SPS [1])
- Large numbers of the devices are present in most machines (multiple points where they are used to interact with the beam)
- Previous work has been done on reducing the impedance of these devices → Existing test case for effectiveness of impedance reduction!
MKE - SPS Extraction
Kicker Magnets - No Serigraphy

- Single wire scan in horizontal and vertical plane
- Two-wire scan in horizontal and vertical plane - No matching resistors. Very bad measurements!
MKE Measurement

Longitudinal Impedance

Measurements of Ferrite Kickers

Why Should We Care?

Measurements of MKE

Measurements of Asymmetric Structures

References
MKE Measurement

Measurements of Ferrite Kickers
Why Should We Care?
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Total Horizontal Impedance

Impedance (Ohms/m)
Frequency (MHz)

real
imaginary
MKE Measurement

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Measurements of Asymmetric Structures

References
**MKE Measurement**

![Graph of Vertical Dipole Impedance](image)

**Incorrect**
MKE Measurement

Measurements of MKE

Measurements of Asymmetric Structures

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MKE Measurement

INCORRECT
Measurements of Asymmetric Structures

- The normal parabola method [2] is nominally valid for symmetric structures only (those that exhibit top/bottom, left/right symmetry.

- We wish to know if we can generalise this to asymmetric structures whilst continuing to obtain the longitudinal, dipolar and quadrupolar impedance [3]

- IDEA - Take a known structure (Tsutsui ferrite) and test procedure to see if it returns the same answer as the parabola method. Break symmetry afterwards to compare to simulations with CST.

- HFSS used to simulate wire through a simple tsutsui ferrite kicker magnet
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Horizontal Dipole Impedance

- real
- imag
- real-analytical
- imag-analytical

Frequency (GHz)
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Vertical Dipole Impedance

Impedance (Ohms/m/m)
Frequency (GHz)

Lines:
- real-8mm (black solid line)
- imag-8mm (black dashed line)
- real-analytical (red solid line)
- imag-analytical (red dashed line)
- real-10mm (blue solid line)
- imag-10mm (blue dashed line)
- real-16mm (green solid line)
- imag-16mm (green dashed line)
- real-13mm (purple solid line)
- imag-13mm (purple dashed line)
Horizontal Detuning Impedance

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- Measurements of Asymmetric Structures

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References

- Longitudinal and Transverse Wire Measurements for the Evaluation of Impedance Reduction Measures on the MKE Extraction Kickers - Kroyer, T ; Caspers, Friedhelm ; Gaxiola, E - CERN-AB-Note-2007-028

- PROCEDURES FOR FREQUENCY AND TIME DOMAIN ELECTRO-MAGNETIC SIMULATIONS IN ASYMMETRIC STRUCTURES - E. Metral -
https://impedance.web.cern.ch/impedance/documents/ProceduresForFrequencyAndTimeDomainElectroMagneticSimulationsInAsymmetricStructures