





Impedance studies of a corrugated pipe for KARA

MT ARD ST3 meeting | speed talk

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UltraSync







- French-German ANR/DFG-funded collaboration between University of Lille, SOLEIL, and KIT
- Goal: Observe, understand and control the microbunching instability
 - Observe: Single-shot longitudinal diagnostics (EO-based)
 - Understand: Vlasov-Fokker-Planck solver for simulation
 - Control: Feedback methods acting on RF and impedance
- First sub-project at KIT:

Development and installation of a versatile impedance manipulation chamber (VIMC) at KARA

- Understanding the influence of the impedance on the beam dynamics
- Simulations and experimental investigations of the influence of the structure
- Currently investigated geometry: corrugated pipe





Corrugated pipe

Corrugated pipe impedance^a

$$\frac{Z_0^{\parallel}}{L} = \frac{Z_0}{\pi b^2} \left[\pi k_r \delta \left(k^2 - k_r^2 \right) + i \cdot \text{P.V.} \left(\frac{k}{k^2 - k_r^2} \right) \right], \quad k_r = \sqrt{\frac{2L}{bgh}} \tag{1}$$

- Excitation of a narrow frequency range
- Magnitude is strongly affected by the plate distance
 - Vertical moveable plates
- CSR impedance dominates for high frequencies
 - ♭ Resonance frequency: 50 GHz to 250 GHz



^aK.Y. Ng et. al., Explicit Expressions of Impedances and Wake Functions (2010)



Plate distance



Variable/changeable plate distance b

- Mainly magnitude affected, and not the peak frequency
- Variation of impedance amplitude by changing plate distance
 - b Design of a chamber with vertically moveable plates

Corrugation depth $h = 200 \,\mu\text{m}$ Periodic length $L = 50 \,\mu\text{m}$ Duty cycle L/g = 2





Corrugation depth



Corrugated pipe parameter

Influence on...

- Resonance frequency
- Quality factor
- Shunt impedance



Micro-Bunching: Spectrogram



Simulation with Inovesa

- Amplification of Short-Bunch-Length-Bursting (SBB)
- SBB occurs at higher currents up to Micro-Bunch Instability threshold



Summary

Corrugated pipe



- Additional impedance source
- Design of a chamber with vertically moveable plates

Outlook

- Beam dynamic simulations with Inovesa^b for different machine settings
- Determine most effective structure

^bhttps://github.com/Inovesa



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Thank you for your attention!

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