



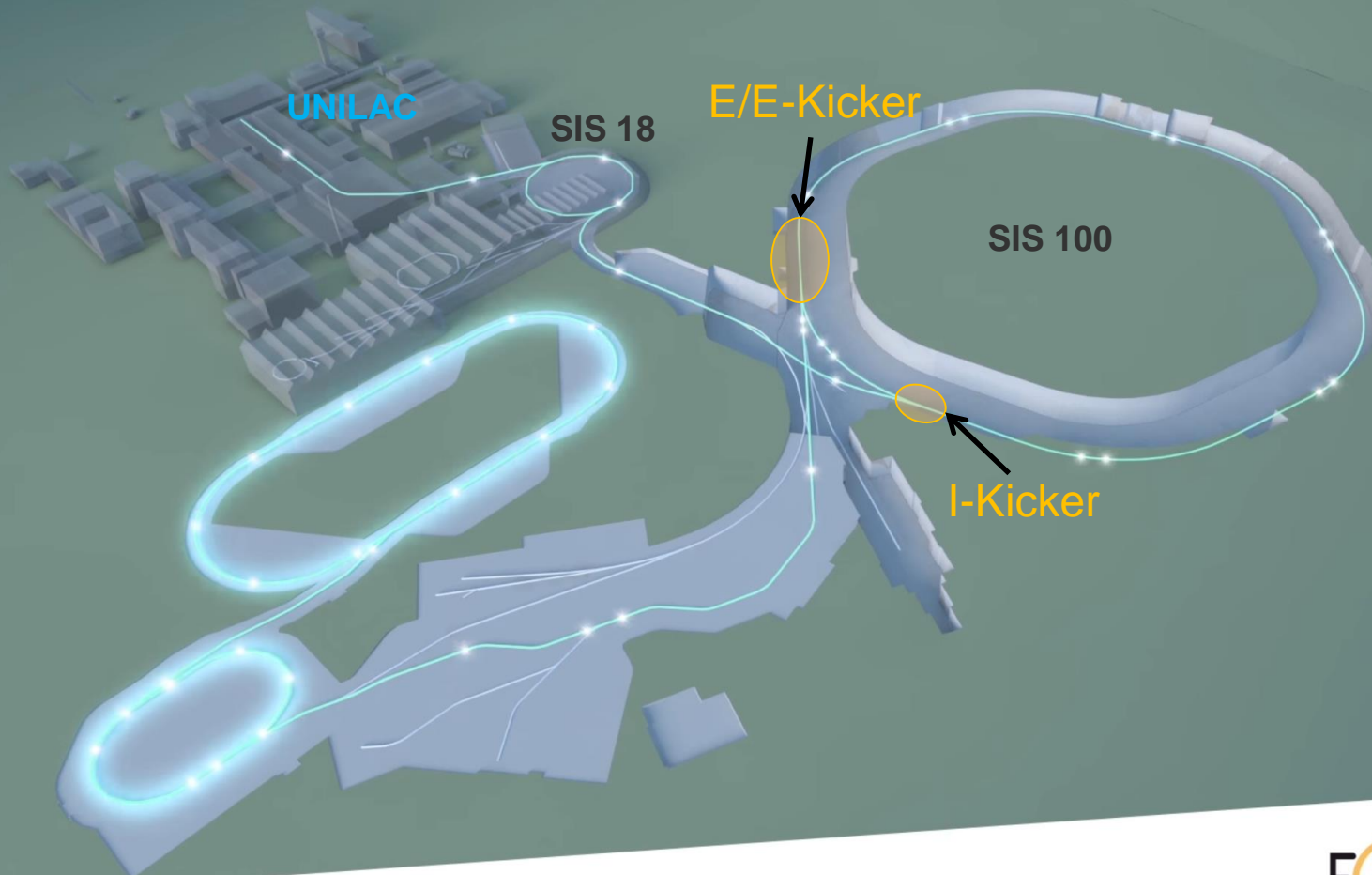
FAIR SIS100 Kicker Systems

- FAIR – Location of SIS100 Kicker Systems

- Injection Kicker
 - Specification
 - Circuit Layout
 - Project Status and System Overview

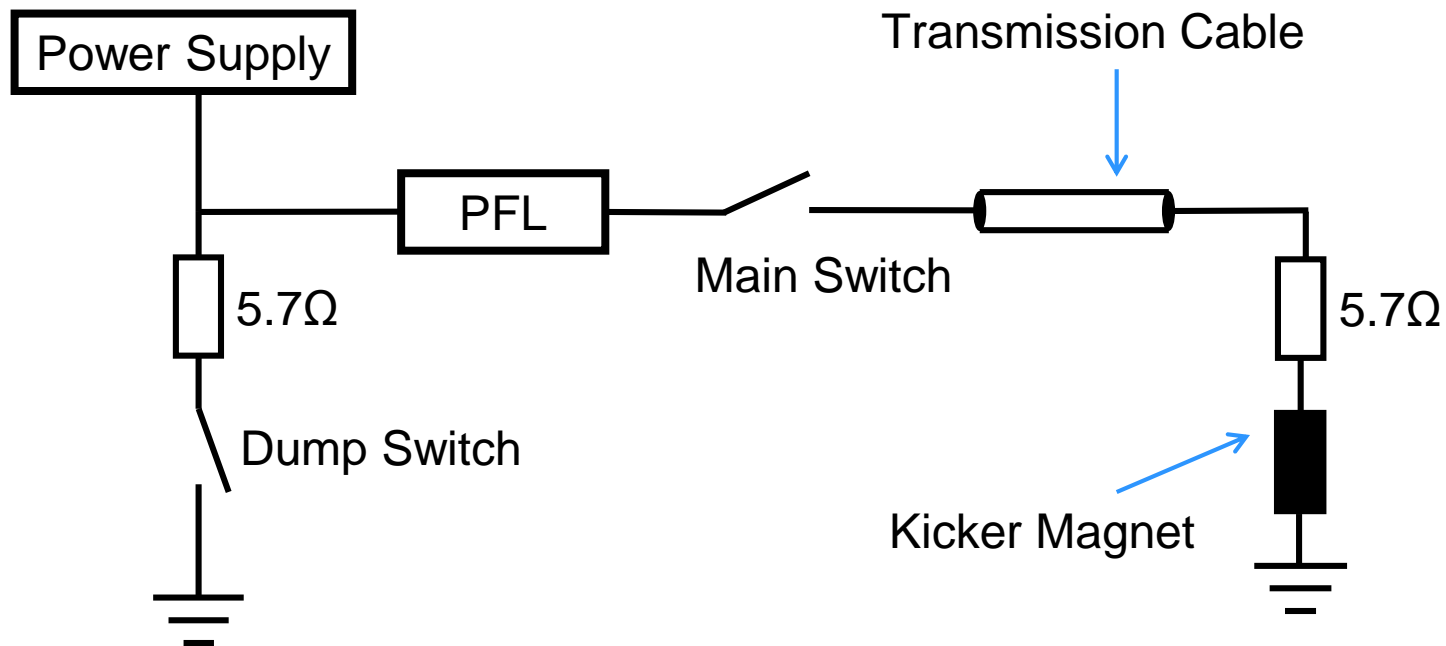
- Emergency/Extraction Kicker
 - Specification
 - Project Status and Overview
 - Circuit Layout
 - Hardware
 - Design Challenges

FAIR Facility – SIS100 Kicker Systems



Injection Kicker - Specification

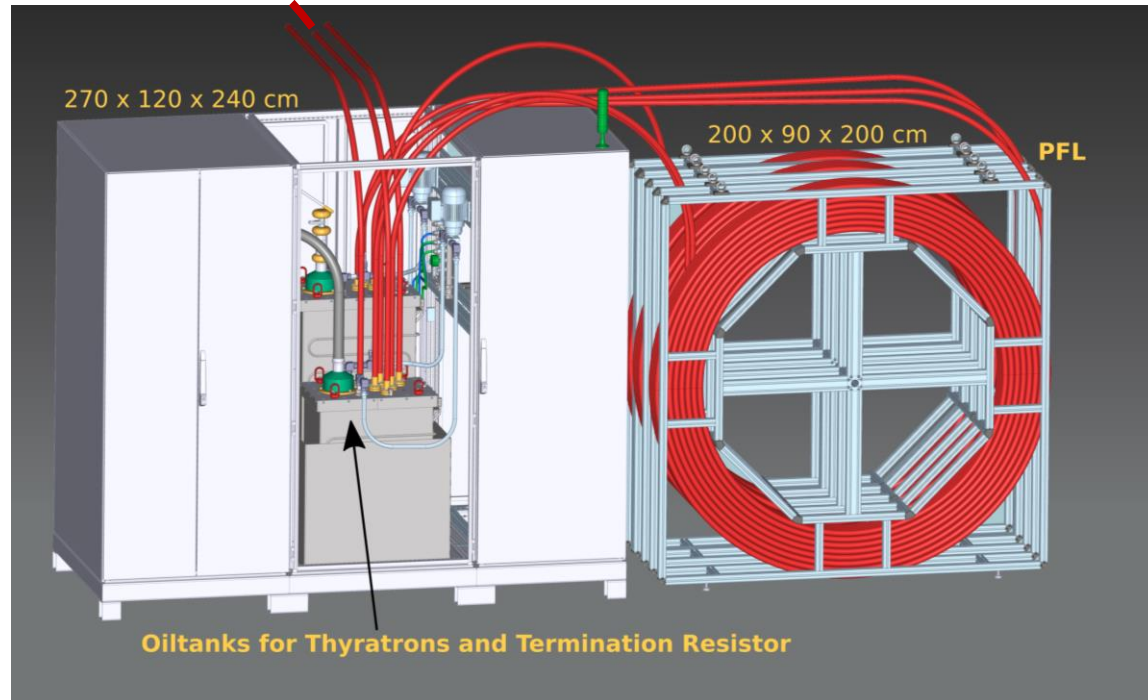
- Injects beam from the SIS18 in the SIS100
 - Deflection angle: 9 mrad
 - Max. magnetic rigidity: 18 Tm
 - Current rise time 1% - 99%: 130 ns
 - Pulse length: 0.5 μ s to 2 μ s
 - Aperture in Ferrite 120 x 65 mm (w x h)
 - Available space in beam line: \approx 2.5 m
- Max. current: 6140 A
- Max. voltage: 70 kV
- Number of windings: 1
- System impedance: 5.7 Ω
- Number of magnets 6
- Ferrite length/magnet 180 mm



- Hardware
 - e2v CX2593X Thyratrons
 - PFL and Transmission Cable Draka CPP20
 - Ferrite Ferroxcube 8C11

Injection Kicker – System Overview

- Project Status
 - Contractor Ampegon and Danfysik
 - Design is finalized
 - Procurement is almost done and assembly has started



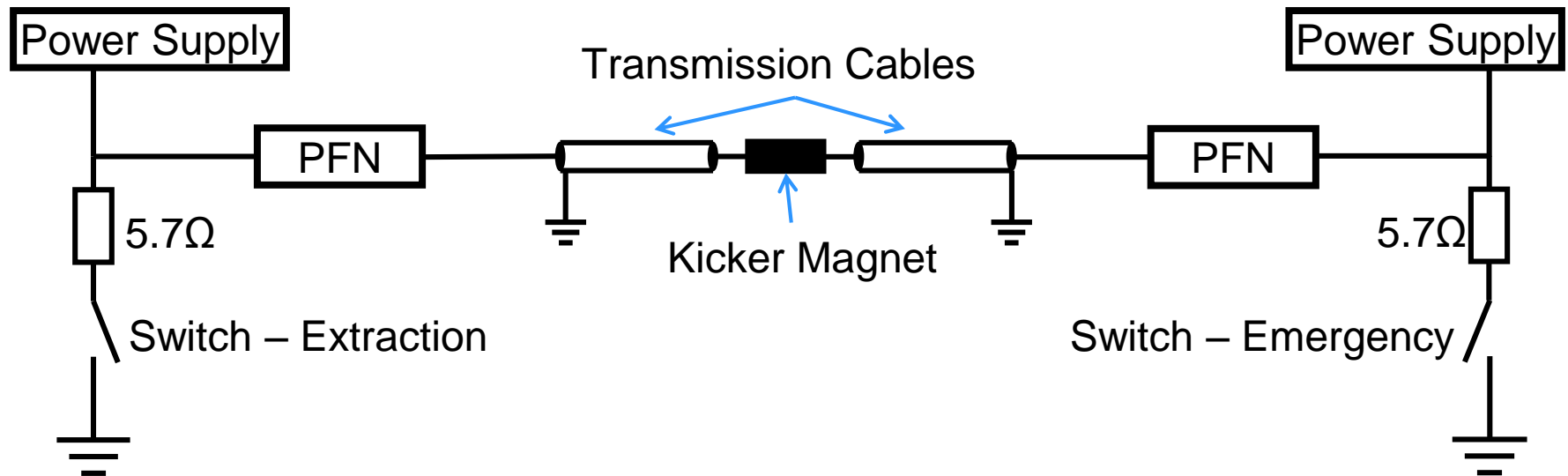
- Design of the pulse circuit has to allow an instantaneous decision between emergency and extraction kick (vertical kick up or down)
- Synchronous charging of the energy storage with beam rigidity

- Deflection angle: 6.67 mrad
- Max. magnetic rigidity: 100 Tm
- Current rise time 1% - 99%: 800 ns
- Pulse length: 7 μ s
- Aperture in Ferrite: 135 x 100 mm (w x h)
- Available space in beam line: 1 x 1.9 m
2 x 3.4 m
- Max. current: 6140 A
- Max. voltage: 70 kV
- Number of windings: 2
- System impedance: 5.7 Ω
- Number of magnets: 8
- Ferrite length/magnet: 750 mm

E/E-Kicker

Project Status and Overview

- Project Status
 - Pre-design at GSI is done
 - Tendering will start first half of this year
 - Some design aspects will be up to the future contractor
 - Following implementation and solutions are partly a proposal

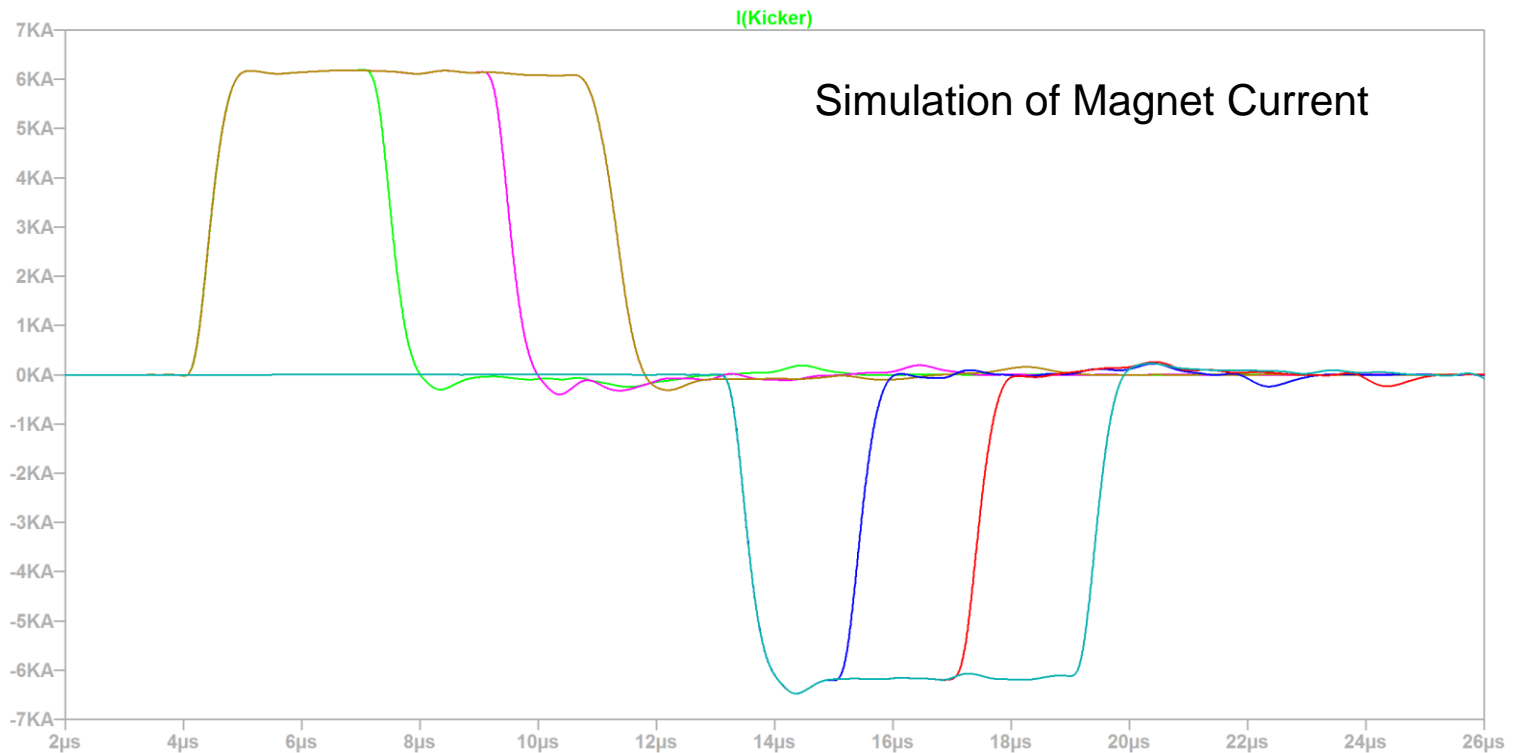


- Hardware
 - Fixed: e2v CX2593X Thyratrons
 - Transmission Cable Draka CPP20 ?
 - Ferrite Ferroxcube 8C11 or NMG CMD5005 ?

E/E-Kicker

Project Status and Overview

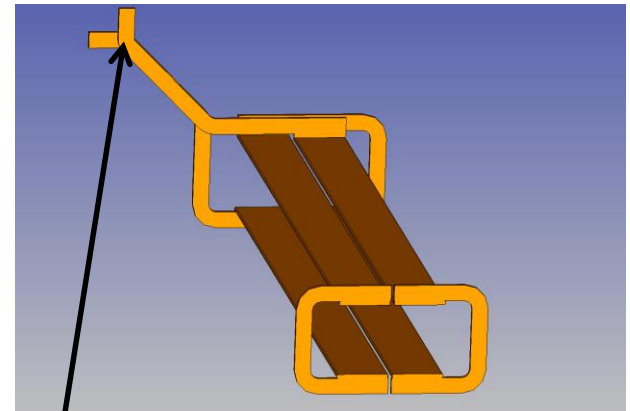
- Rise time and flattop ripple ($< \pm 1\%$) are important
- Fall time and ripples after the pulse are a minor subject
 - SIS100 cycle ends with complete emptying of the ring



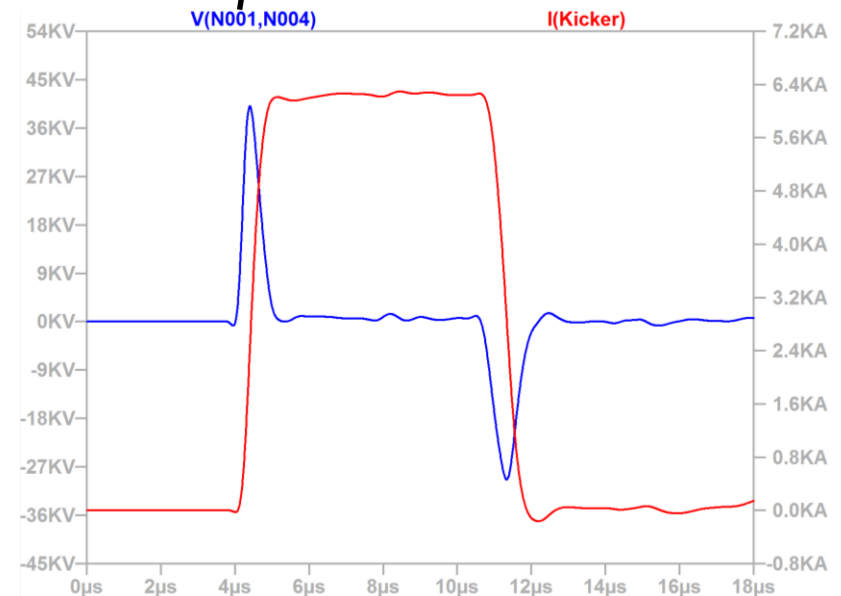
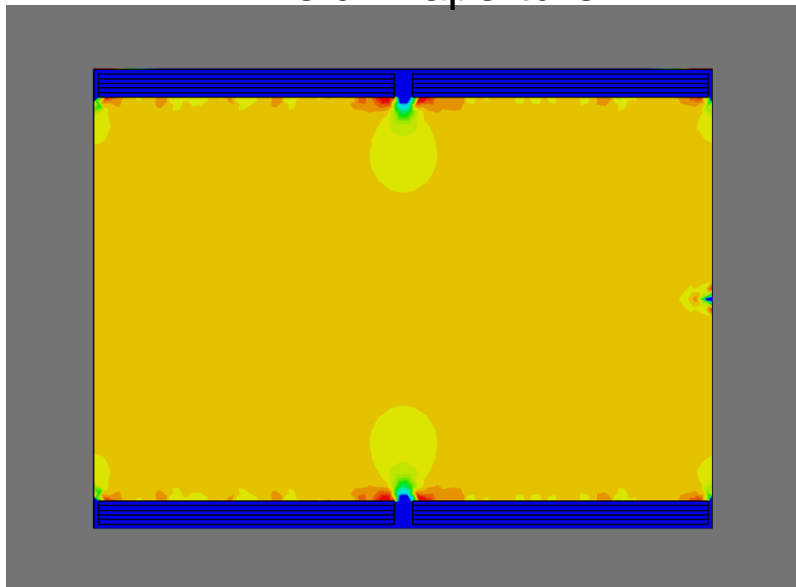
- Power Supply
 - Charging the PFN in 450ms from 7 to 70 kV with a high voltage accuracy on the ramp ($< 1 \cdot 10^{-4} \cdot U_{\max}$)
- Emergency detection
 - Voltage of the PFN has to be monitored during the charging process
 - A too high deviation from the current setpoint triggers an emergency kick
 - High dynamic measurement accuracy ($< 3\%$)
- Thyatron reliability
 - Very low faulty shot rate required over the whole voltage range 7kV to 70kV for emergency operation

E/E-Kicker Design Challenges – Coil and Magnet

- Two winding coil
 - Field quality is dependent on the gap-width between the windings
 - Sufficient isolation clearance between the windings has to be ensured
- Conflicting design goals

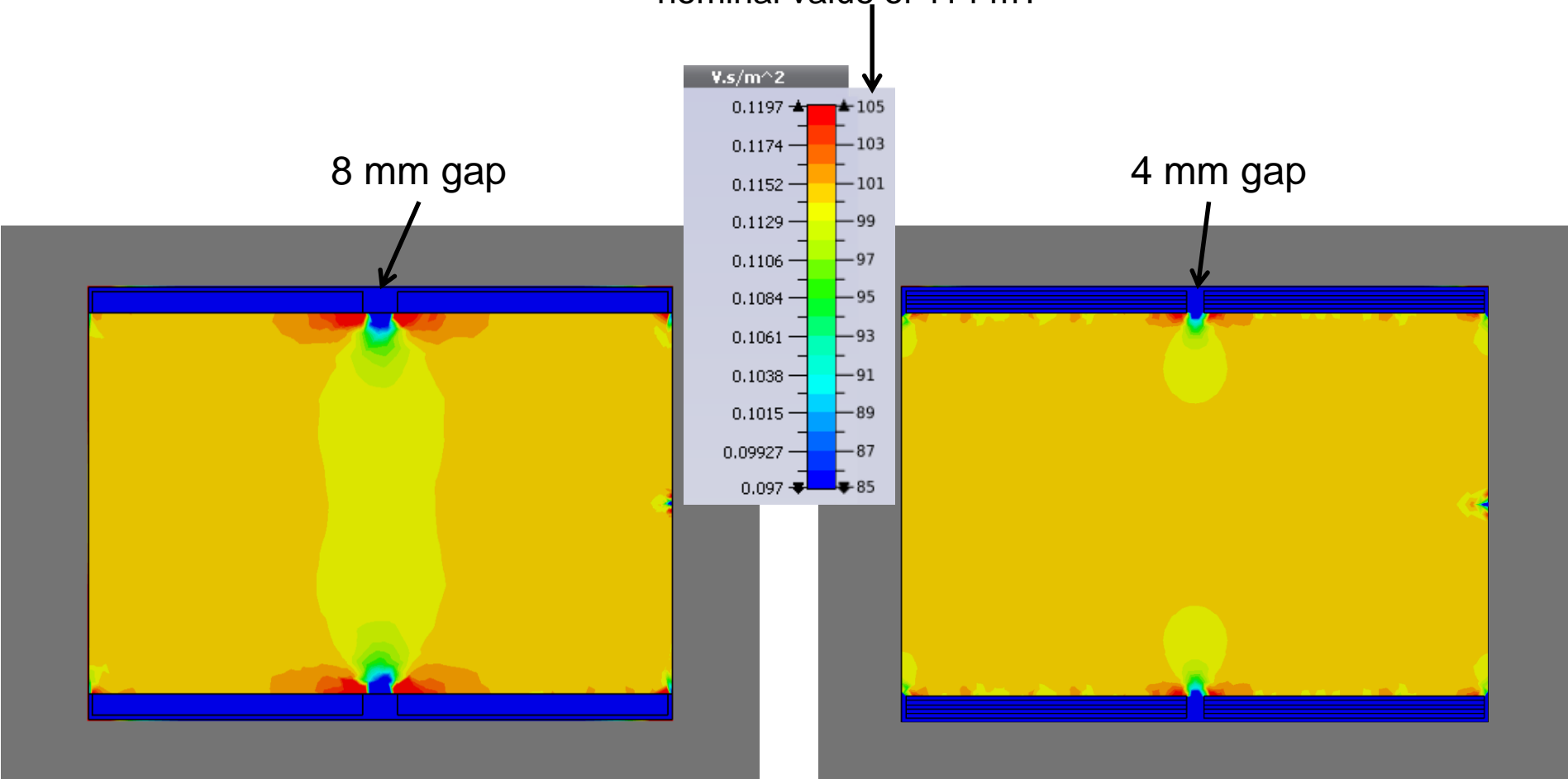


B-field in aperture



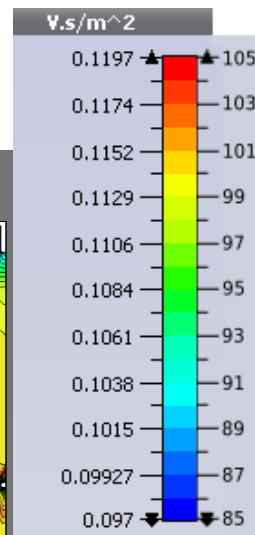
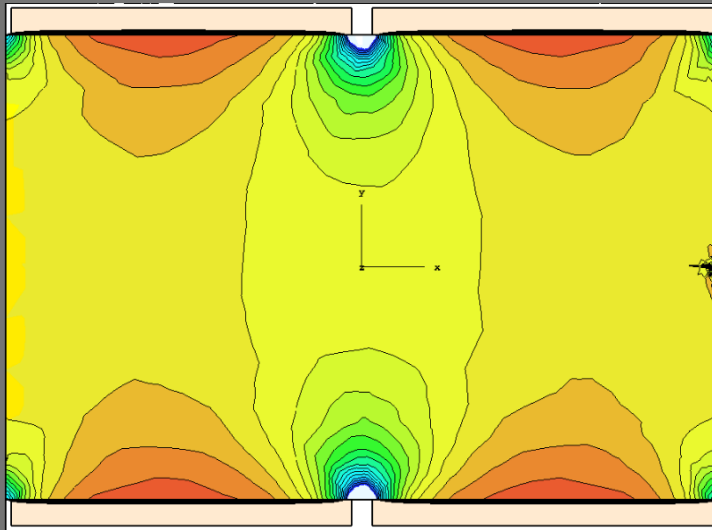
E/E-Kicker Field Quality – Impact Of Gap in Winding

Deviation of B-field [%] scaled to a nominal value of 114 mT



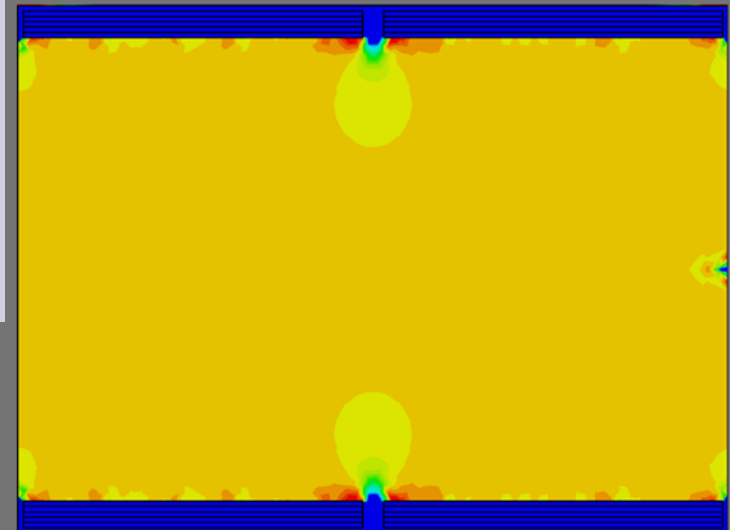
- Big (positive) influence on field quality of the current displacement in dynamic Simulation

DC-Simulation

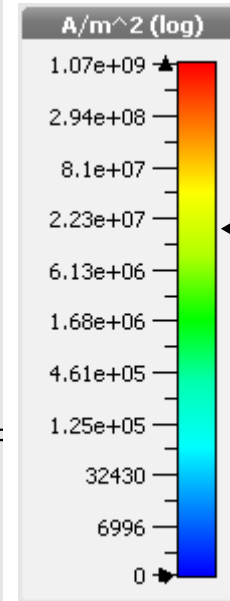
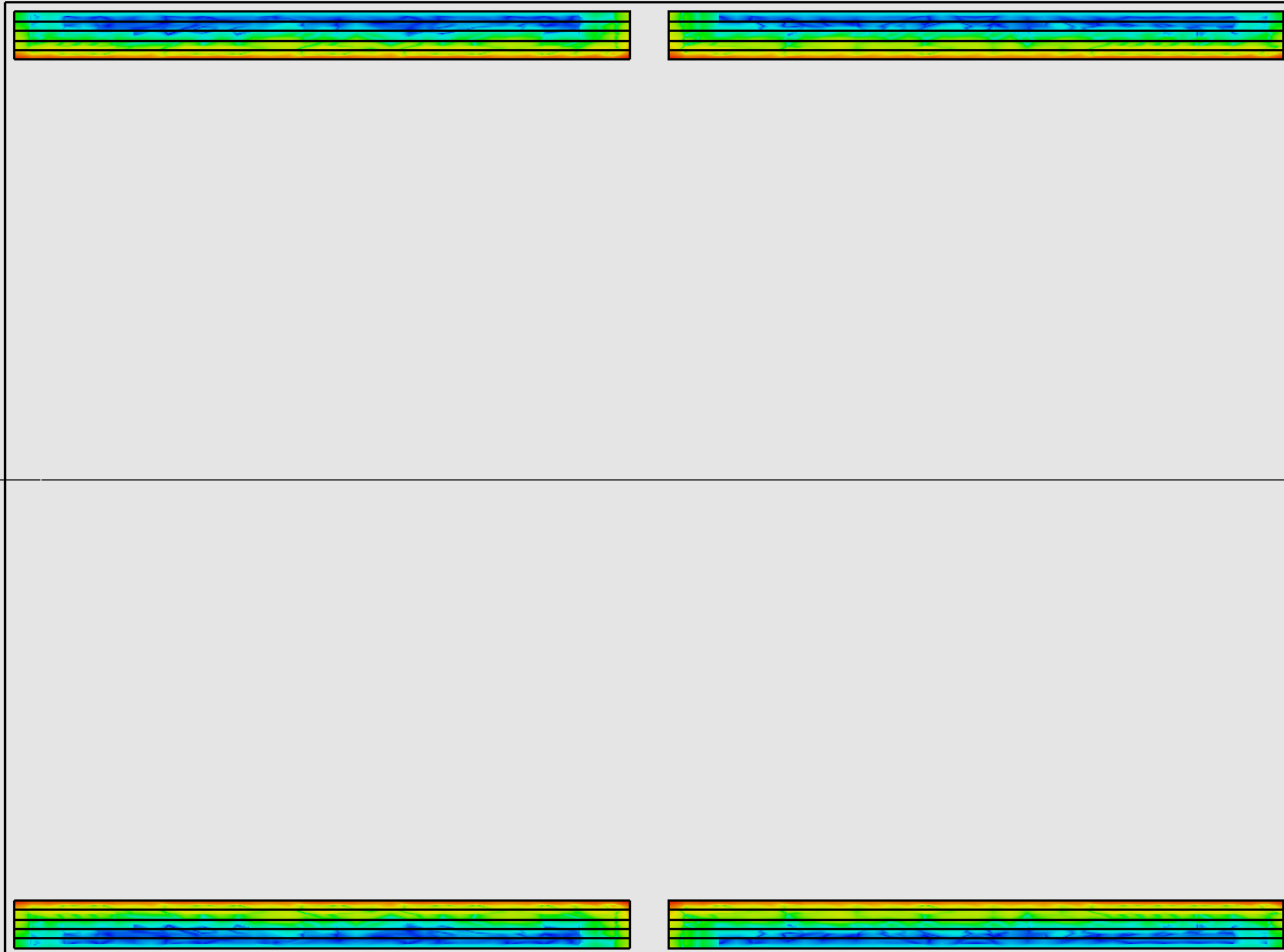


- Dynamic Simulation

- Excitation with current pulse
- 3 μ s after reaching flat top



E/E-Kicker Current Displacement



DC-equivalent
value

Thank You!

Backup

