

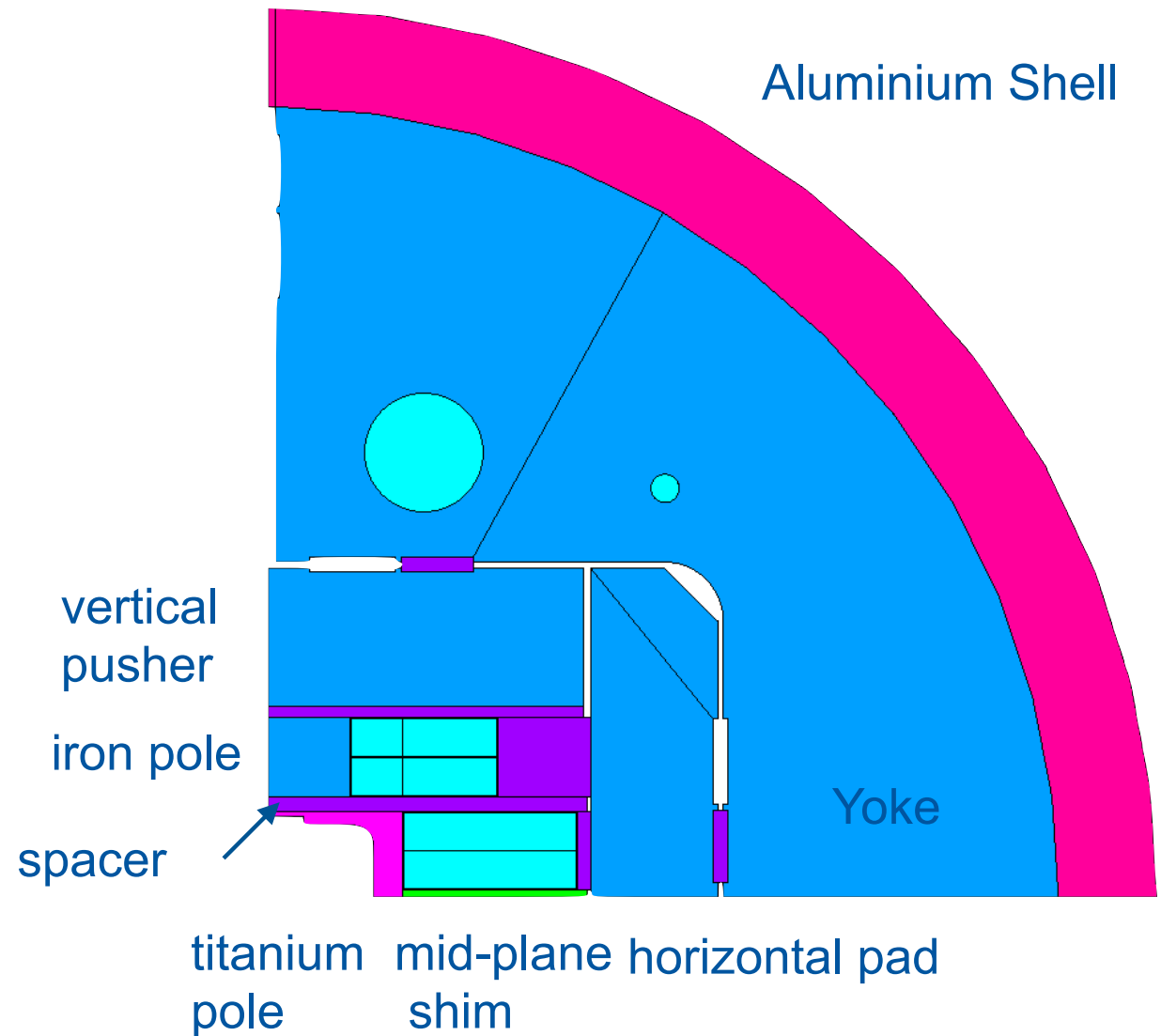
HEPDipo

Magnet protection

D. Martins Araujo & E. Ravaioli
MSC-MDT

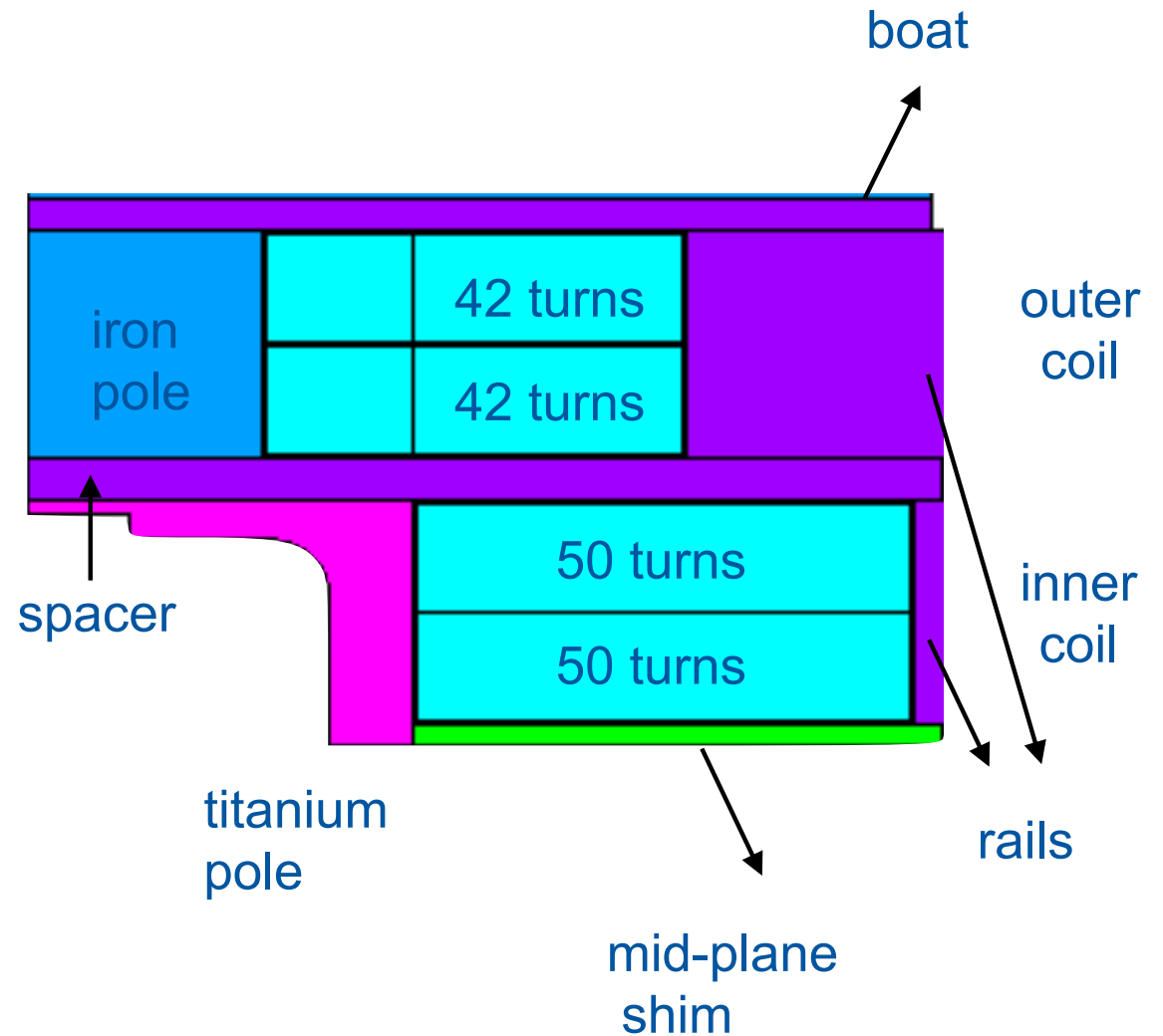
Specification and 4 coils option cross-section

	Goal
B center	15 T
% SS	85%
temperature	4.2 K
aperture	'rectangular' 150x100
length	~ 2 m
I _{nom}	14.74 kA



Cable specification

Cable data	
d_strand	1.1 mm
number of strands	44
thickness	1.95 mm
width	26.2 mm
turn insulation thickness	0.15 / 0.20 mm
min coil insulation thickness	0.5 mm
Inter-layer insulation	0.5 mm
SC:Cu	1:1



Simulation parameters

Protection based on energy extraction (EE)

Iron saturation included

Magnetic length: 1.7 m

Bore dipole field: 15.0 T

Peak field in the conductor: 15.39 T (2D opera model)

Operating current: 14.74 kA

Quench detection+validation time (t_{Quench}): 5+10 ms

EE triggering time (t_{EE}): 1 ms

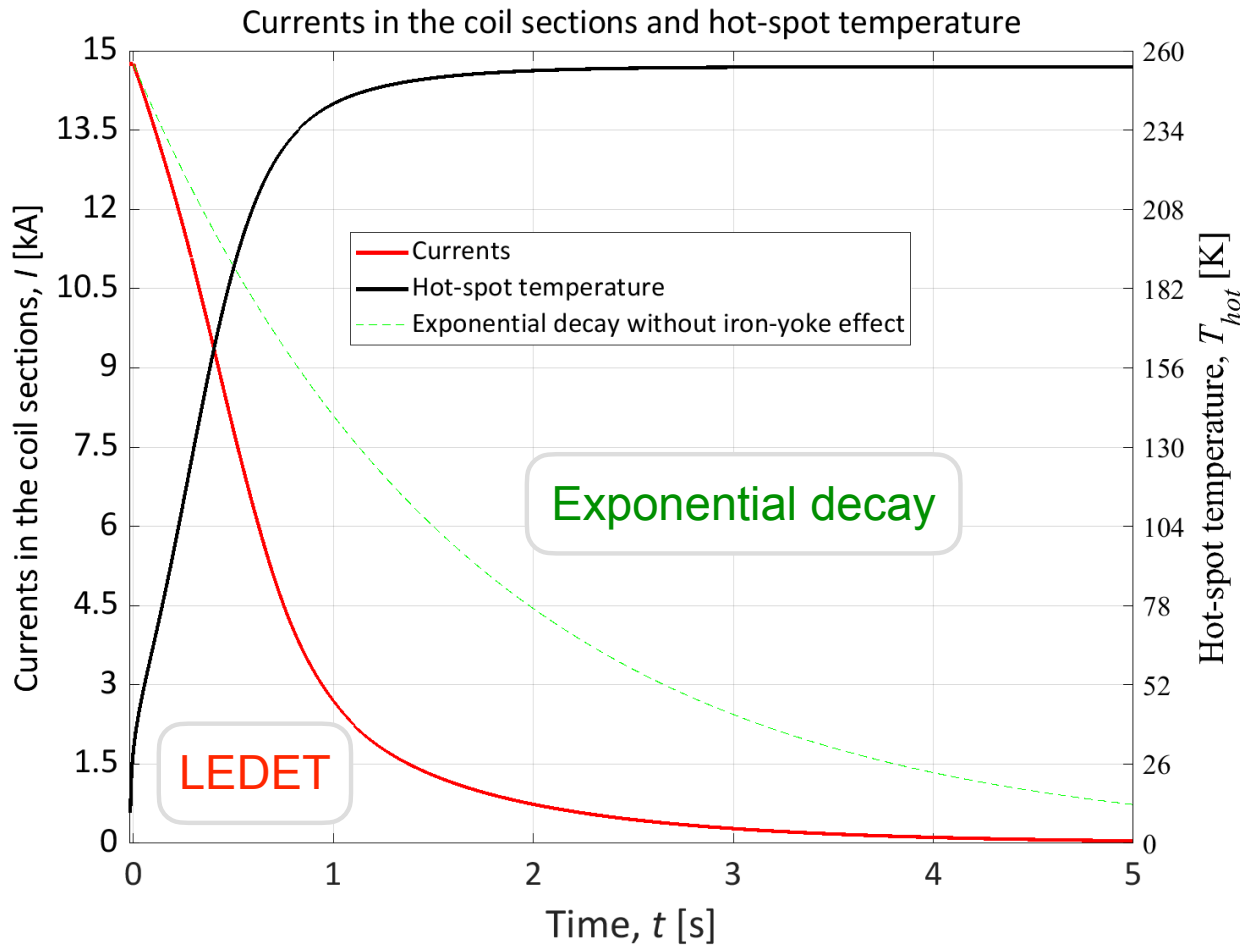
RRR: 100

Filament twist-pitch: 14 mm

Strand twist-pitch: 155 mm (in previous study, considered 120 mm)

Effective transverse resistivity factor: 1

EE discharge with $U_{EE}=1.0$ kV



Nominal current

$$I_{nom} = 14.74 \text{ kA}$$

Hot-spot temperature

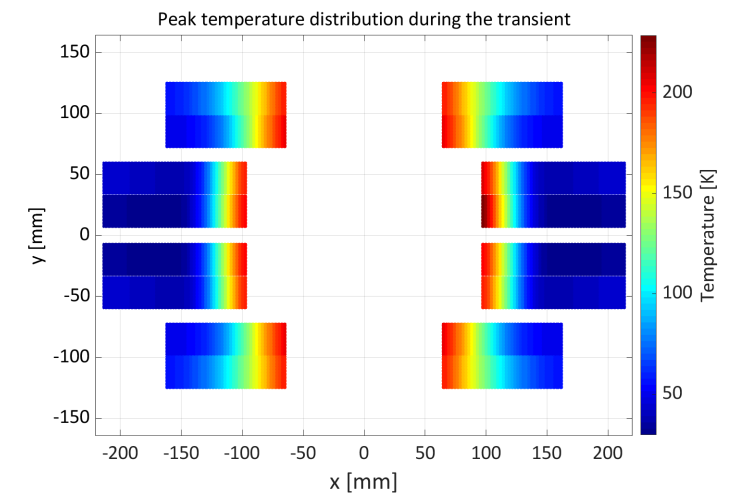
$$t_{hot} = 255 \text{ K}$$

Energy extraction resistance

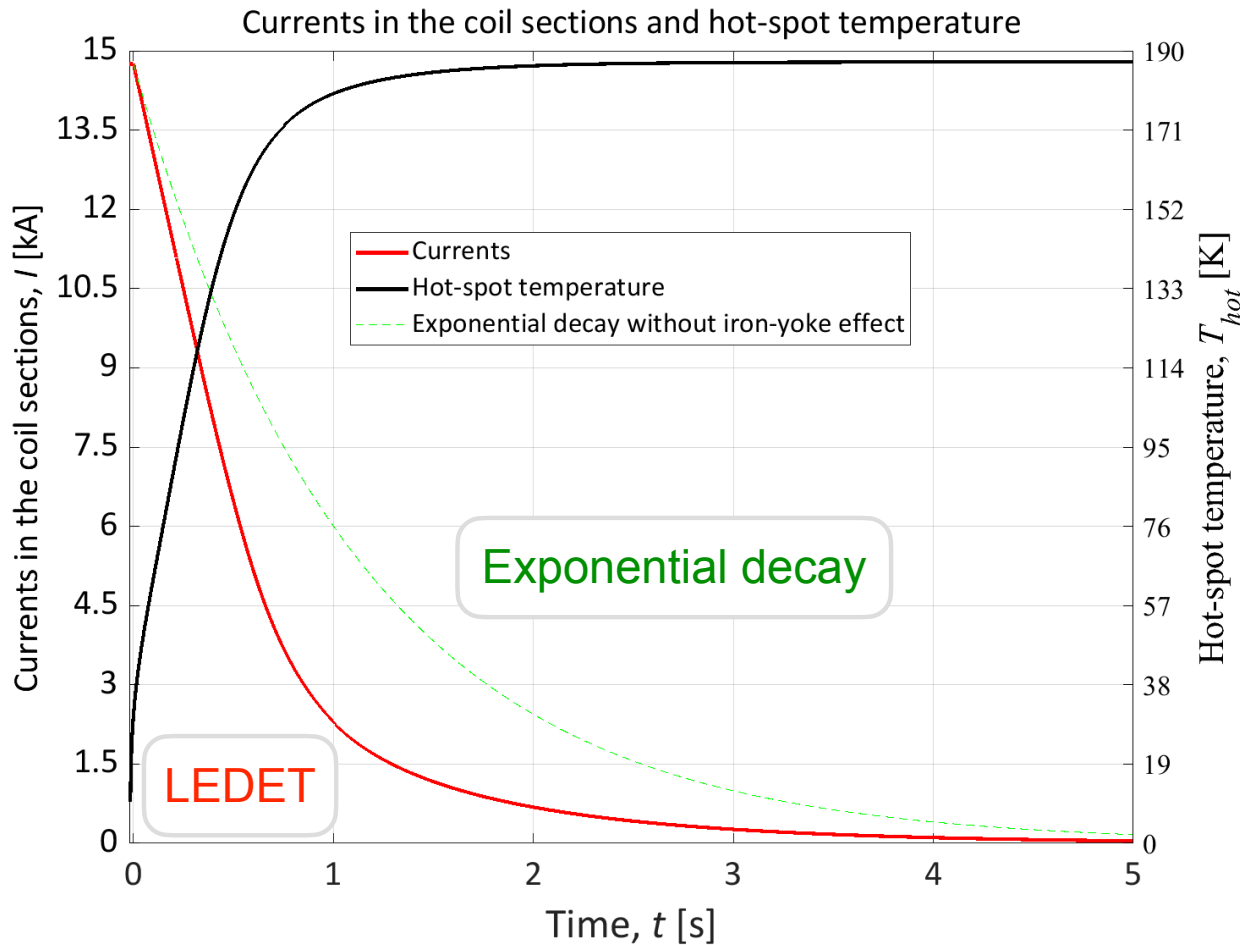
$$R_{EE} = 0.068 \Omega$$

Energy extraction voltage

$$U_{EE} = 1.0 \text{ kV}$$



EE discharge with $U_{EE}=1.5$ kV



Nominal current

$$I_{nom} = 14.74 \text{ kA}$$

Hot-spot temperature

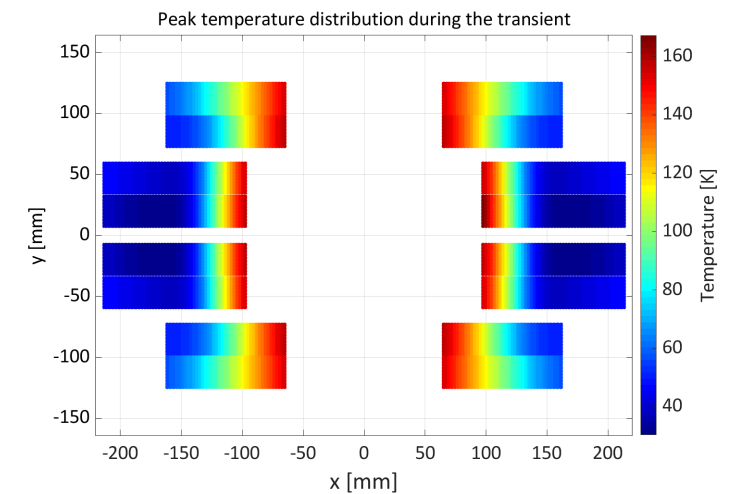
$$t_{hot} = 187 \text{ K}$$

Energy extraction resistance

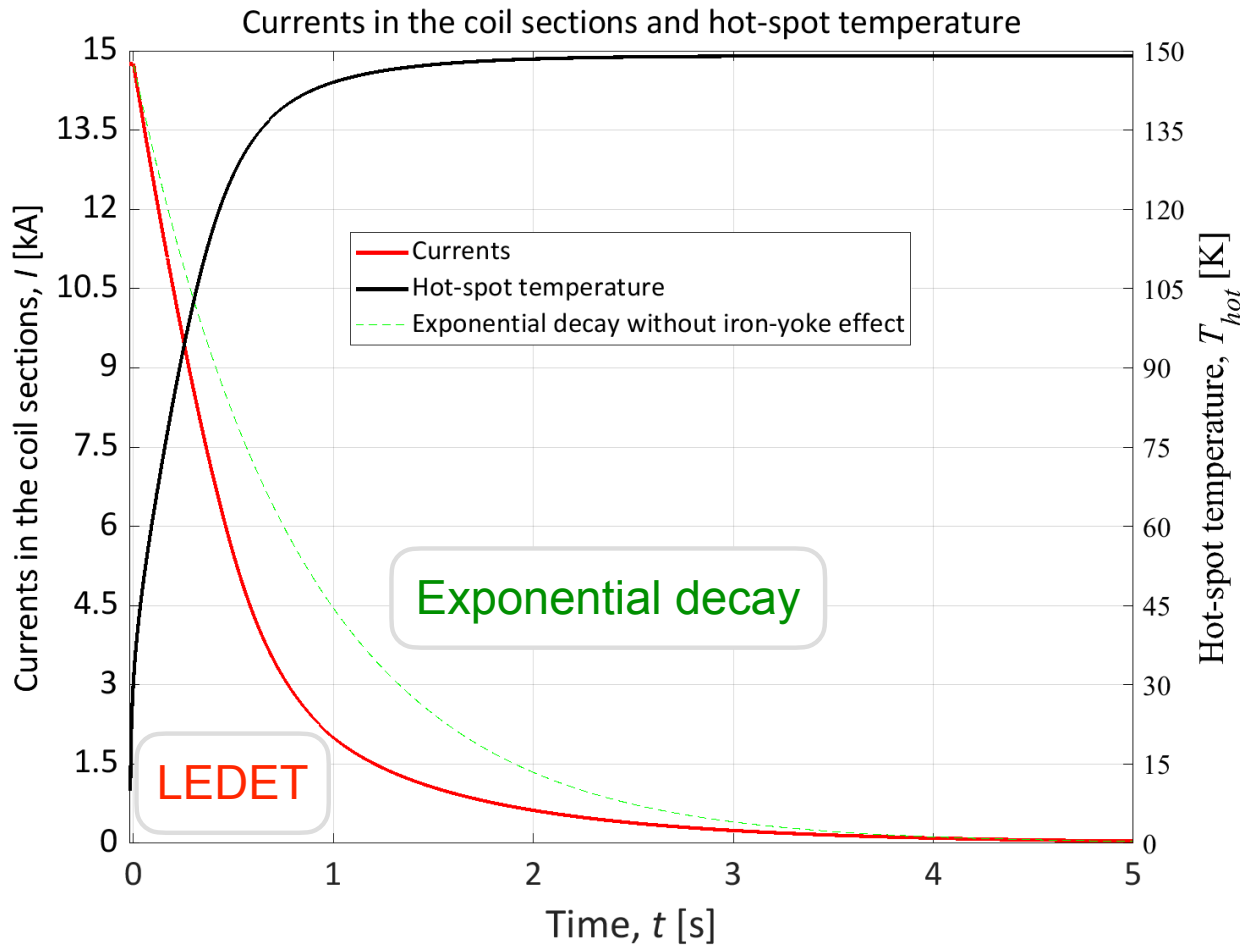
$$R_{EE} = 0.102 \Omega$$

Energy extraction voltage

$$U_{EE} = 1.5 \text{ kV}$$



EE discharge with $U_{EE}=2.0$ kV



Nominal current

$$I_{nom} = 14.74 \text{ kA}$$

Hot-spot temperature

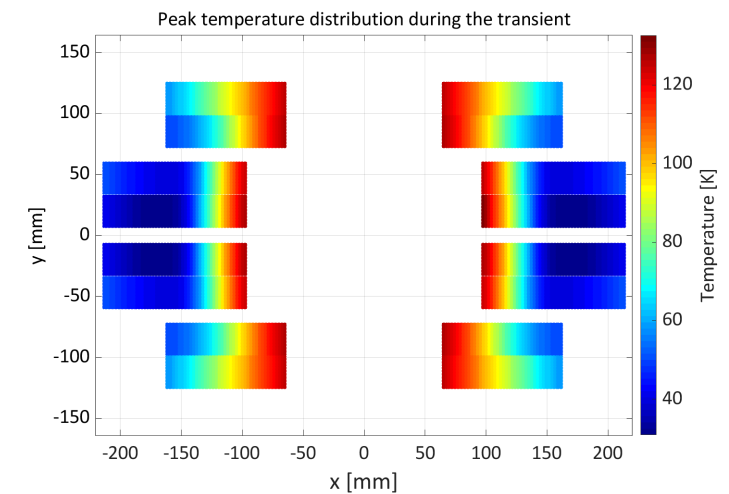
$$t_{hot} = 149 \text{ K}$$

Energy extraction
resistance

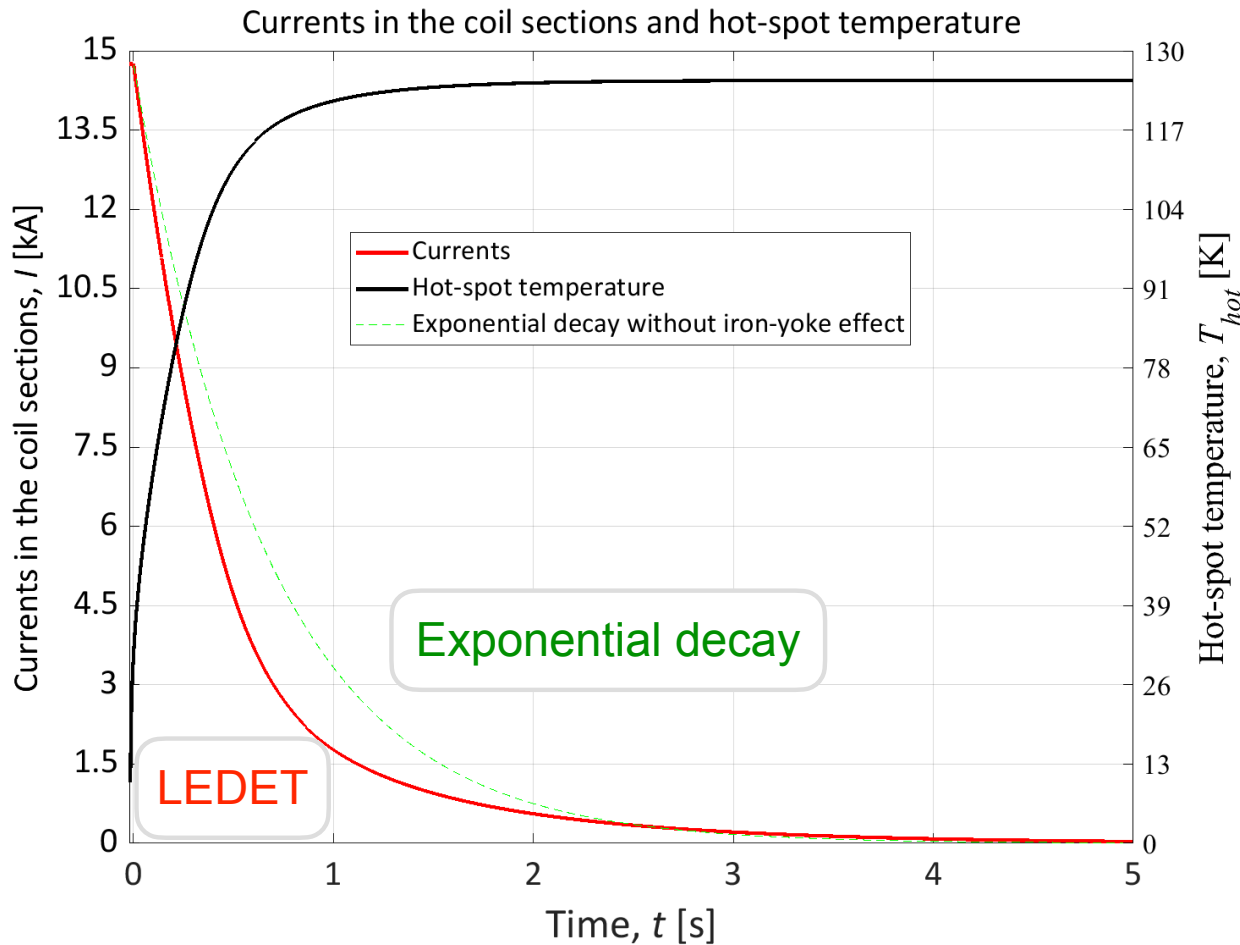
$$R_{EE} = 0.136 \Omega$$

Energy extraction
voltage

$$U_{EE} = 2.0 \text{ kV}$$



EE discharge with $U_{EE}=2.5$ kV



Nominal current

$$I_{nom} = 14.74 \text{ kA}$$

Hot-spot temperature

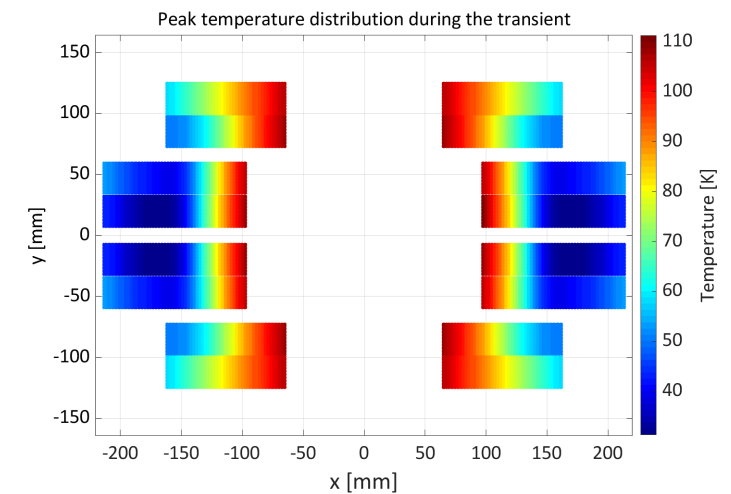
$$t_{hot} = 125 \text{ K}$$

Energy extraction resistance

$$R_{EE} = 0.170 \Omega$$

Energy extraction voltage

$$U_{EE} = 2.5 \text{ kV}$$



EE discharge t_{hot} , R_{EE} vs U_{EE}

