Powering test of the prototype CCT orbit corrector

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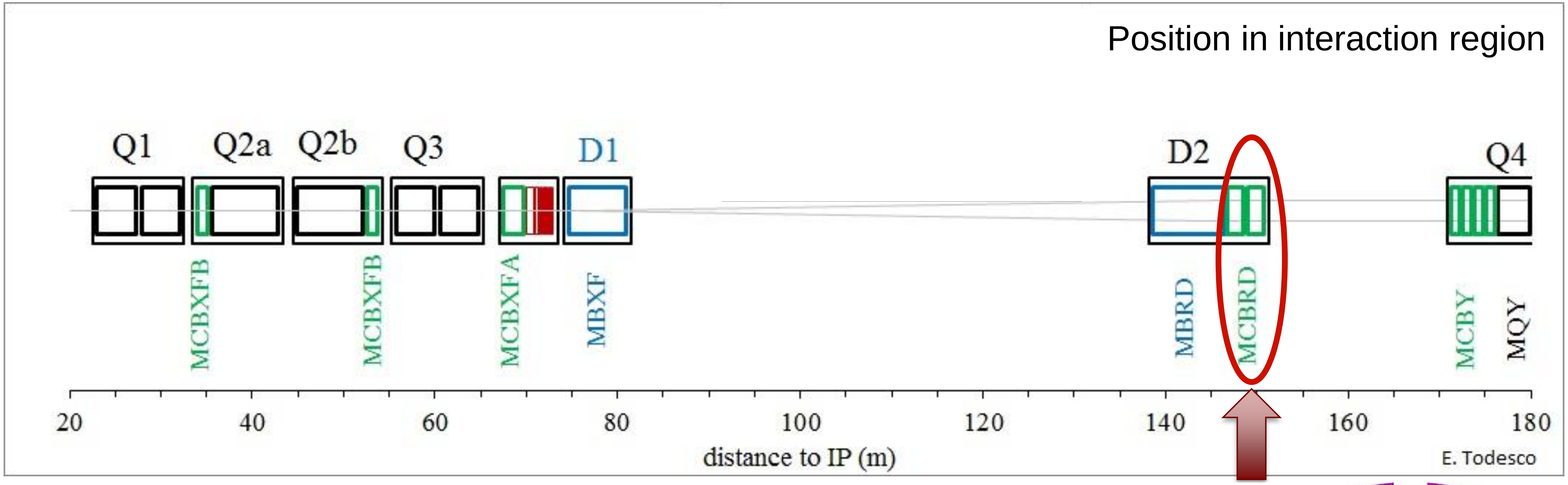
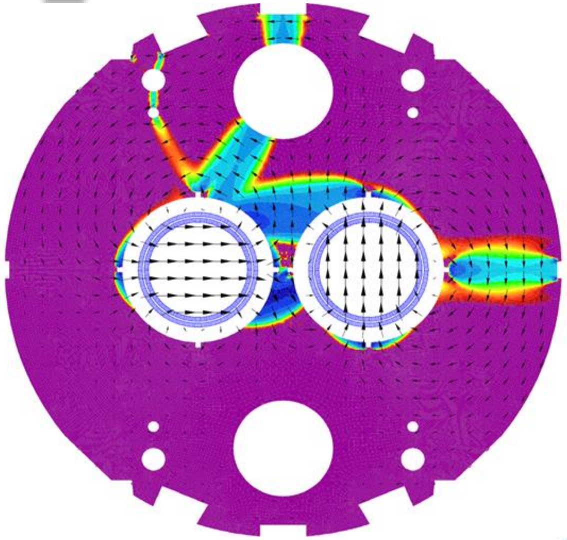
MT26 Conference – Vancouver, Canada – 2019 Sep 26

HL-LHC D2 orbit corrector “MCBRD”



Main magnet specs:

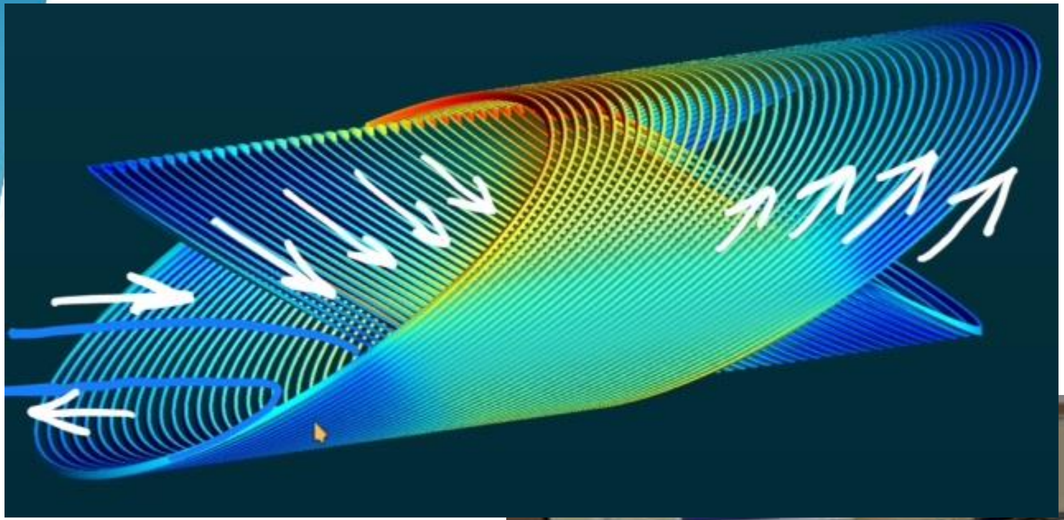
- NbTi conductor
- Nominal integrated field: 5 Tm (@ 393 A)
- Nominal / peak field: 2.6 / 3.1 T
- Length: 2.19 m
- Multipoles < 10 units
- Two independently powered apertures, with perpendicular magnetic field



HiLumi HL-LHC PROJECT

CERN

MCBRD magnet design: "CCT"



Canted **C**osine **T**heta:
Two canted solenoids generate a net dipole field

Each canted solenoid is supported on a cylindrical former with grooves for the superconducting wires

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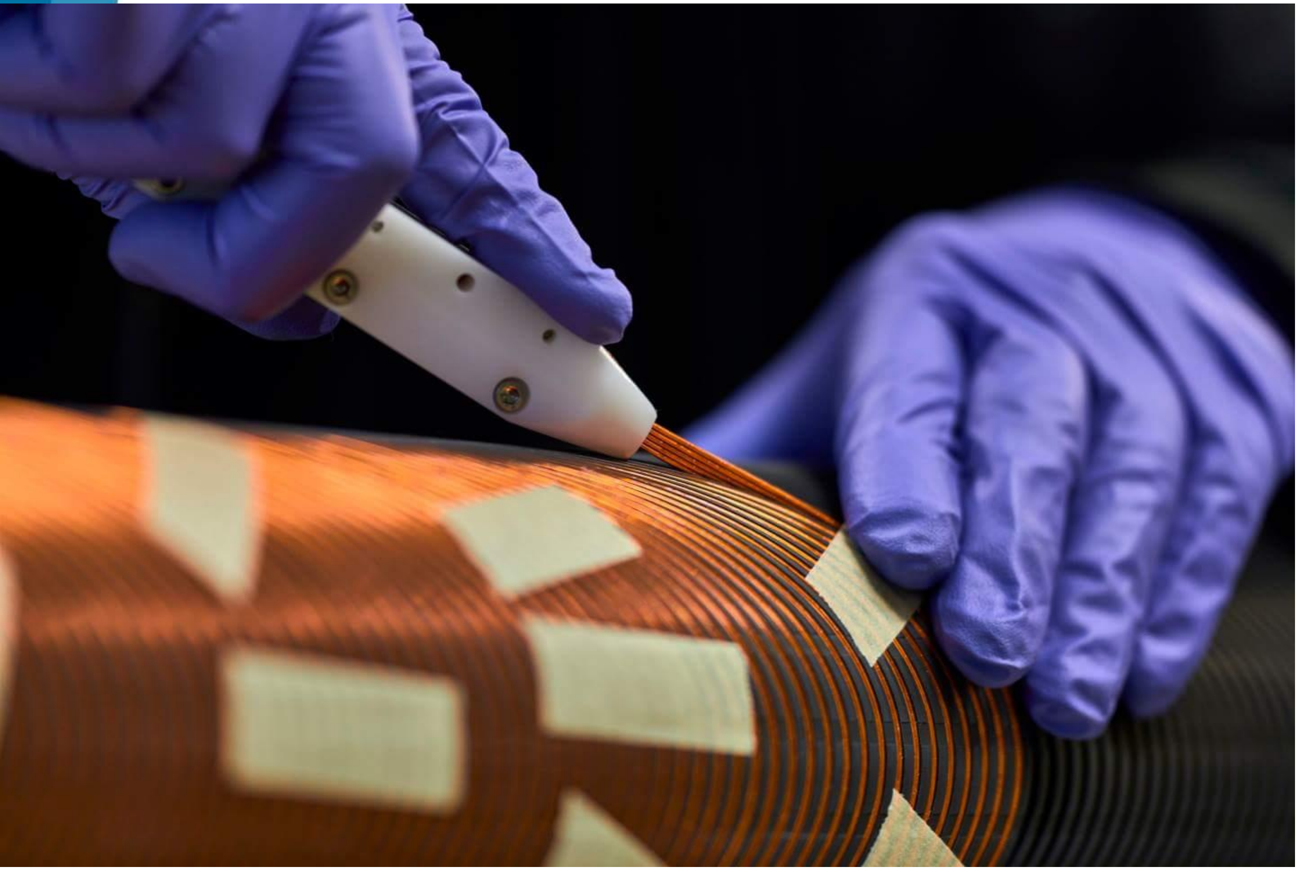
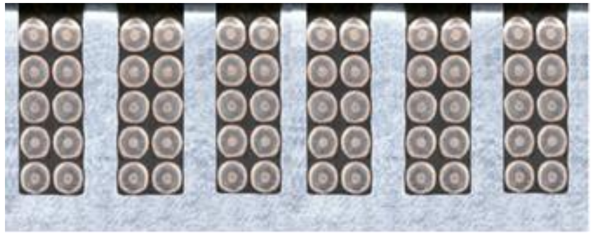
MCBRD prototype magnet



Canted solenoid winding

Superconductors in the cylinder's grooves



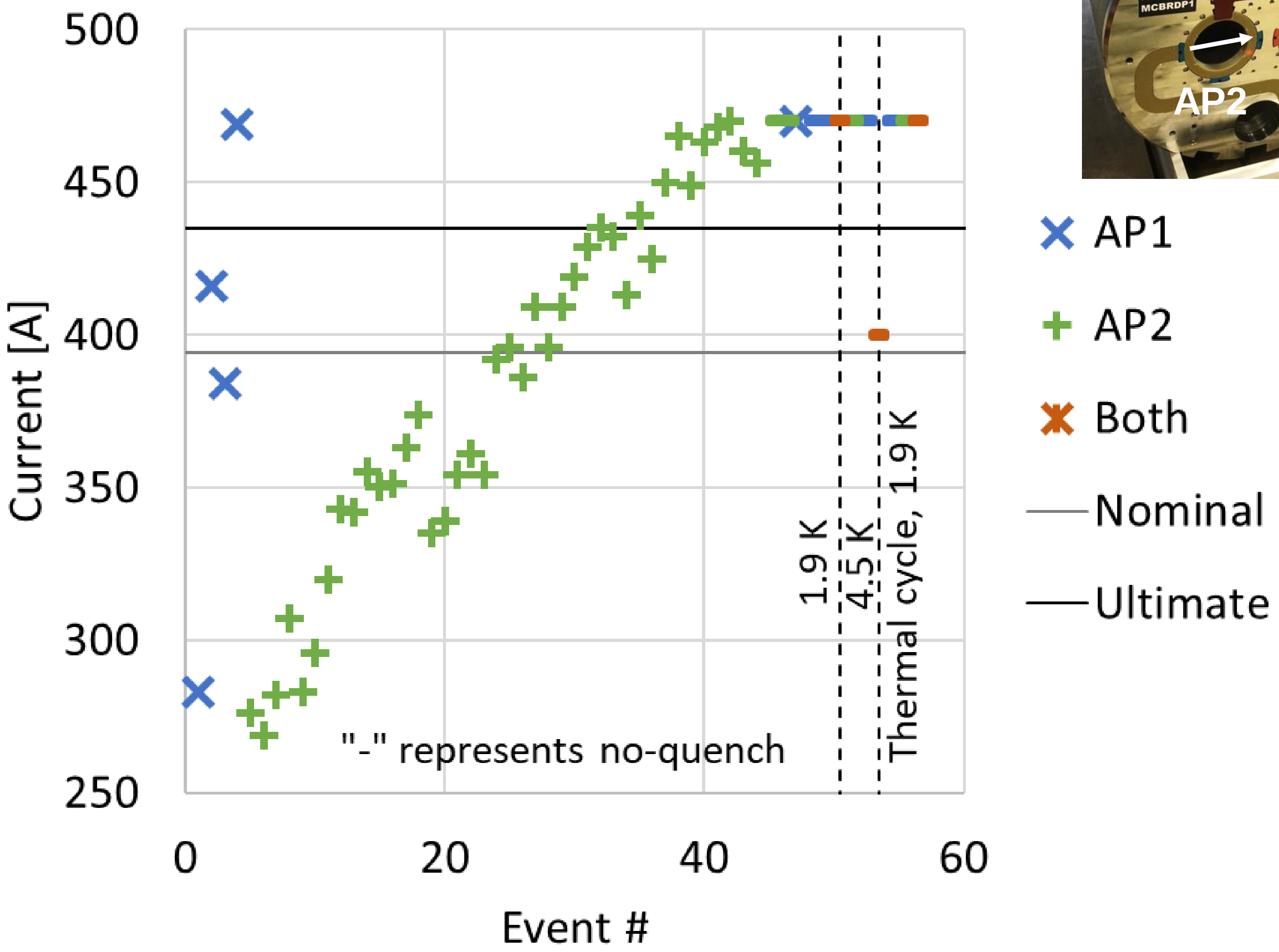
Outline

- Training
- Magnetic field quality
- Conclusions

For information about quench protection, please see Matthias Mentink's presentation

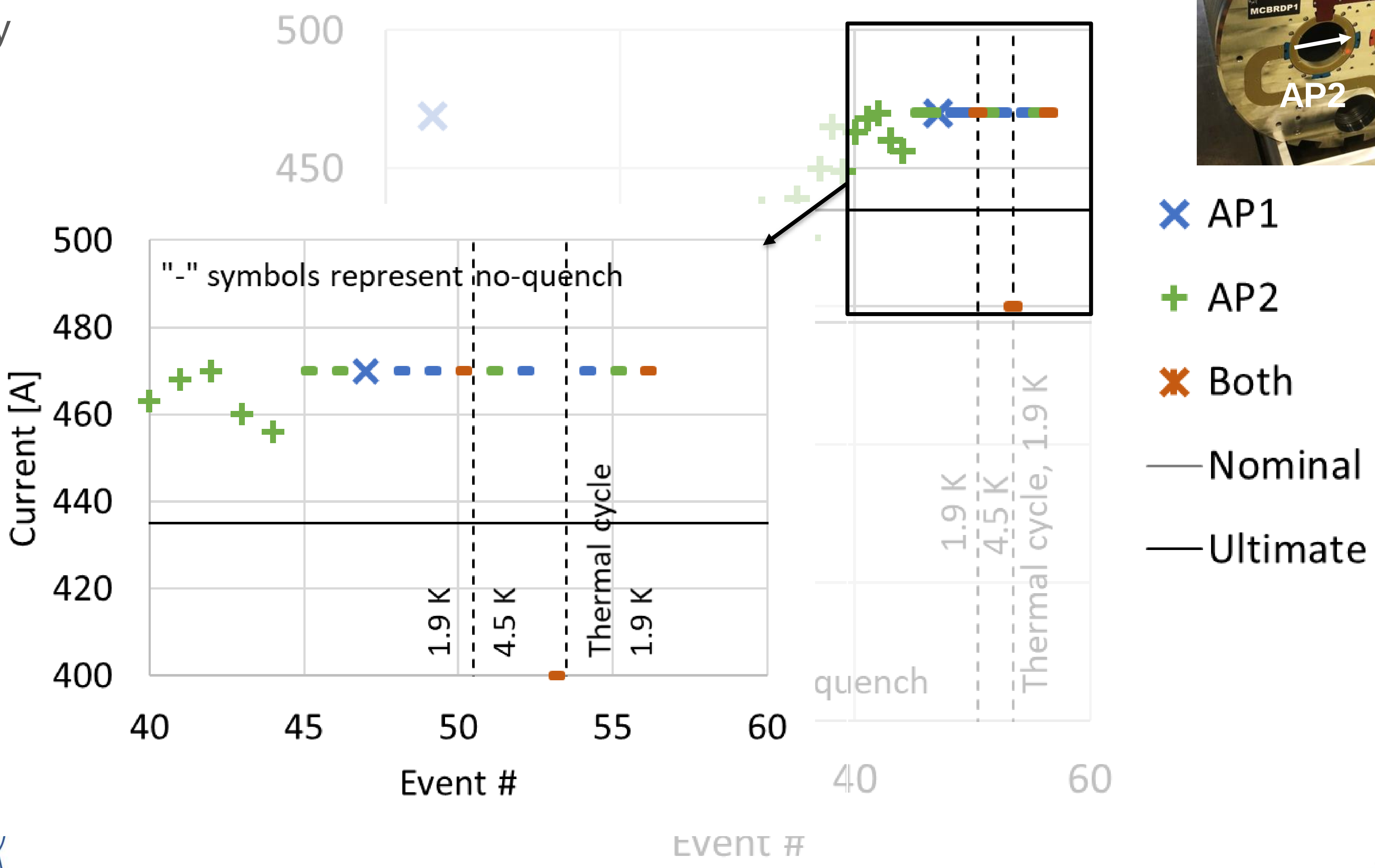
Magnet training overview

- AP2 has very slow training



Magnet training overview

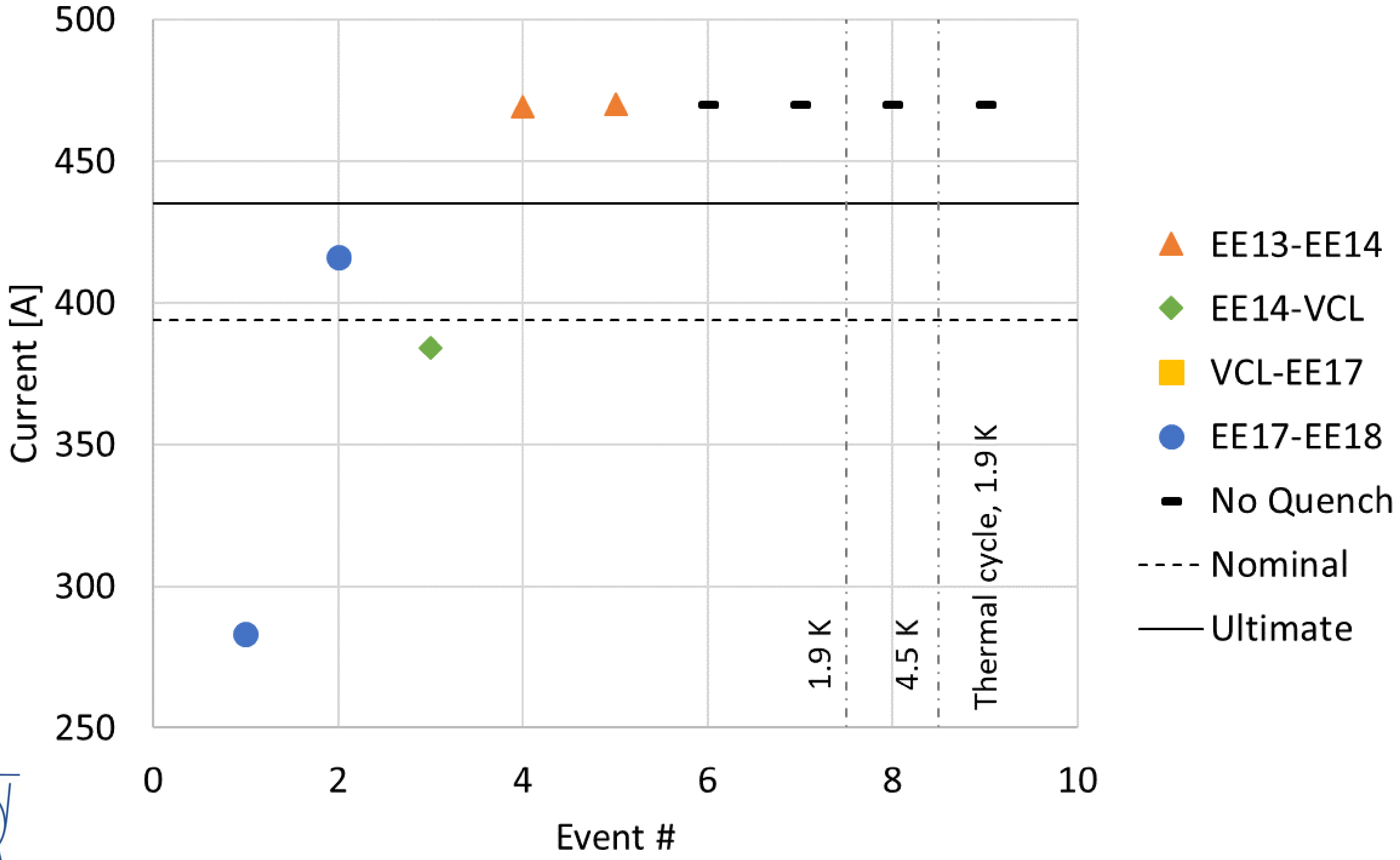
- AP2 has very slow training
- However: no detraining



Training aperture 1 (vertical field)

Shallow

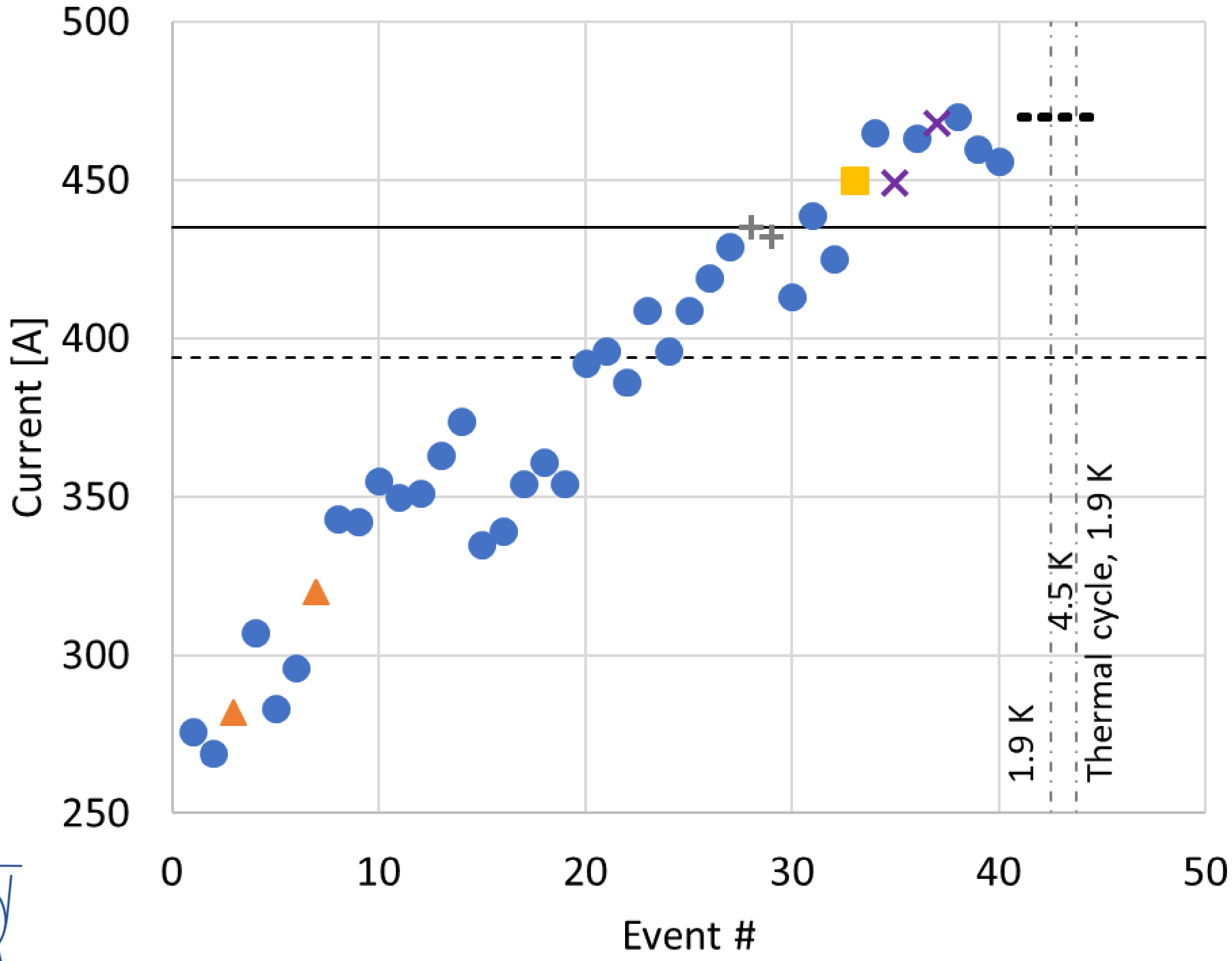
Deep



Training aperture 2 (horizontal field)

Shallow

Deep



	Precursor?
EE23-EE24	1 / 2
EE24-VCL	----
VCL-EE27	0 / 1
EE27-EE28	24 / 33

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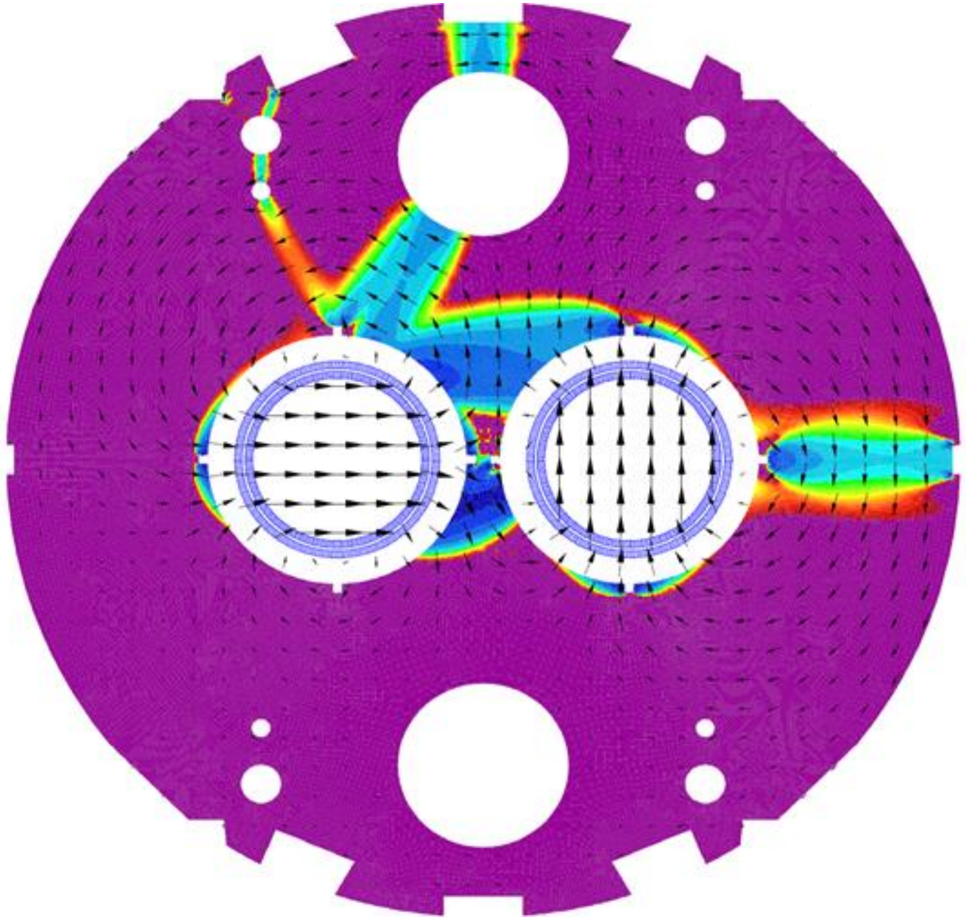
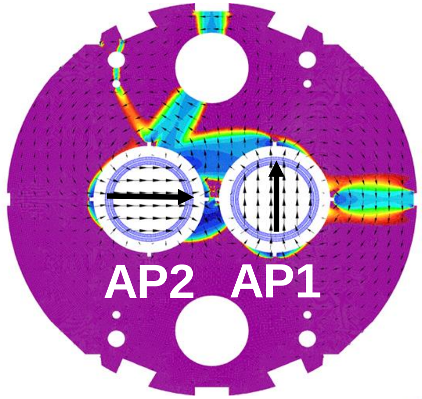
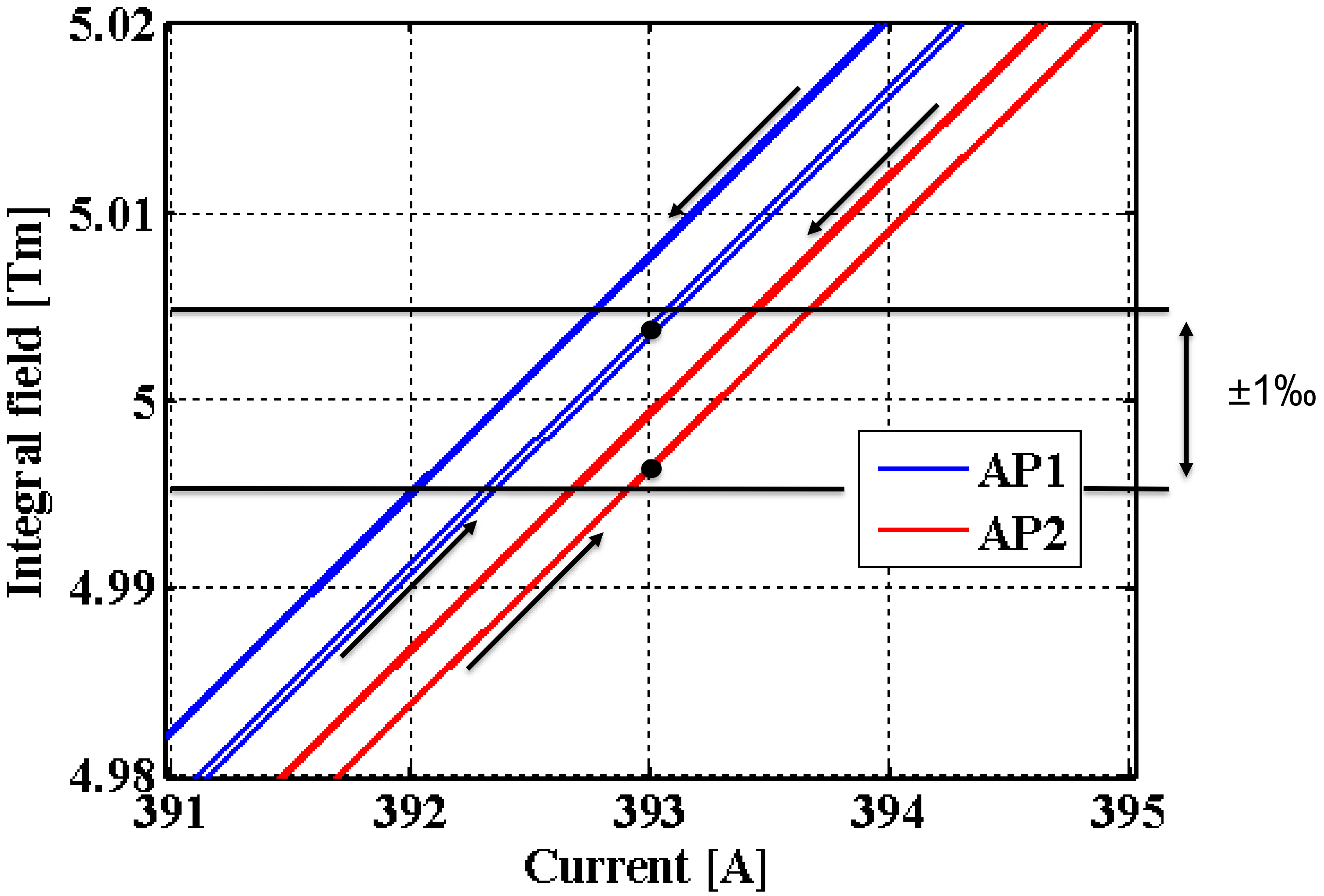


Nominal integrated magnetic field





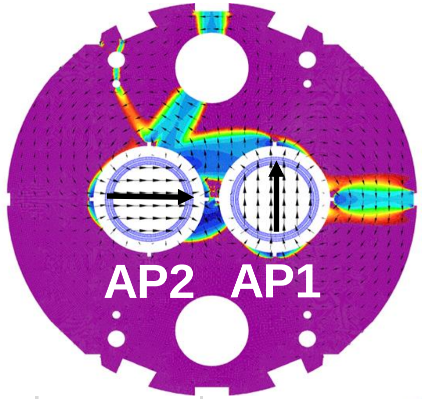
The magnet will be cycled up to nominal so we consider the branches going up.

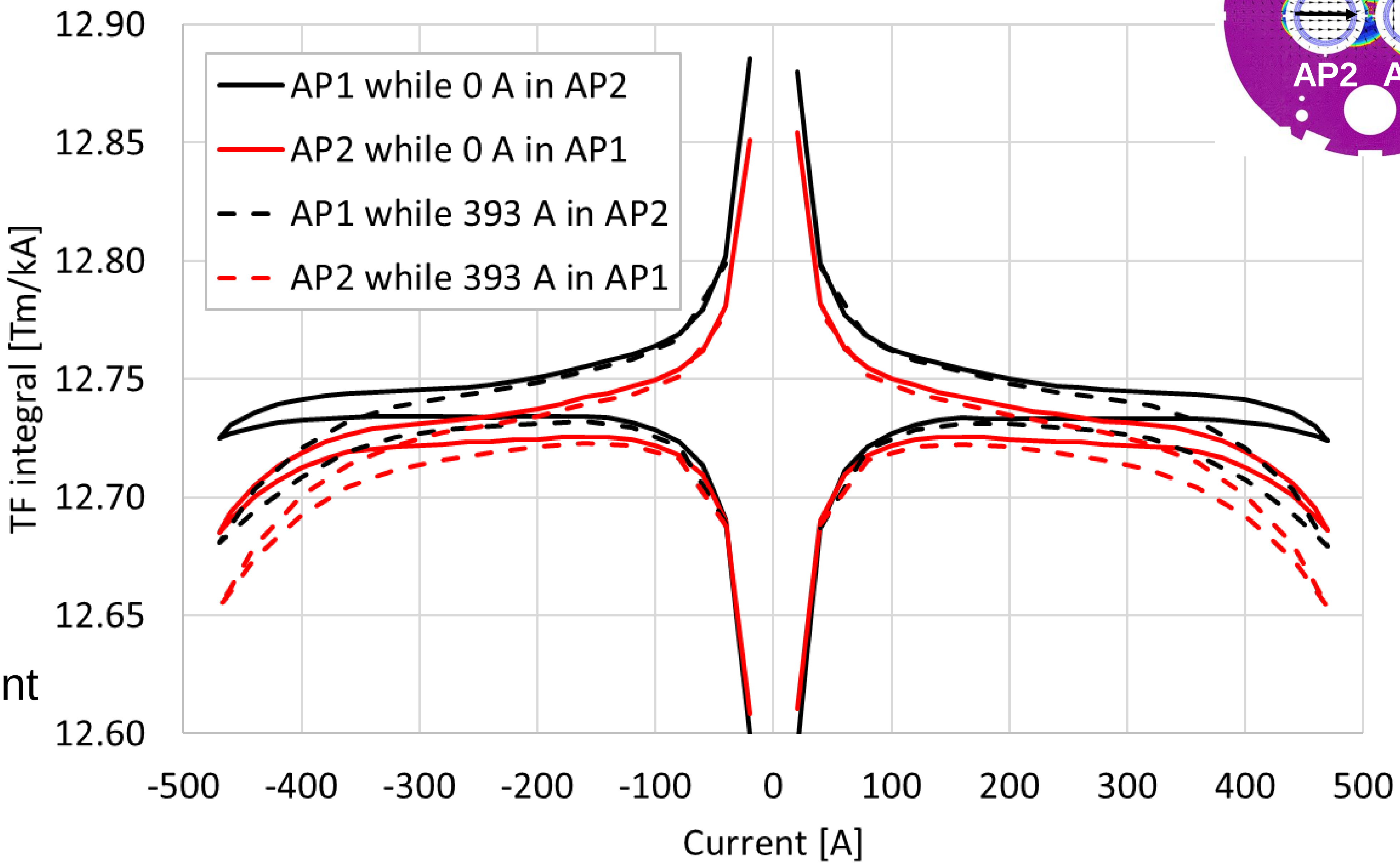
The magnet reaches 5 Tm ±1‰ at 393 A

- both polarities
- both apertures

This is 9% less than the simulated nominal current (430 A)

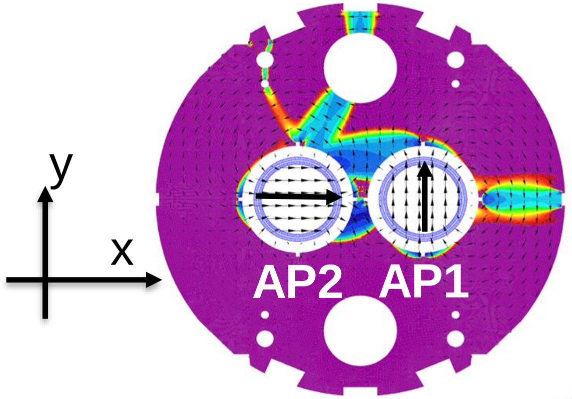
Transfer function - Crosstalk





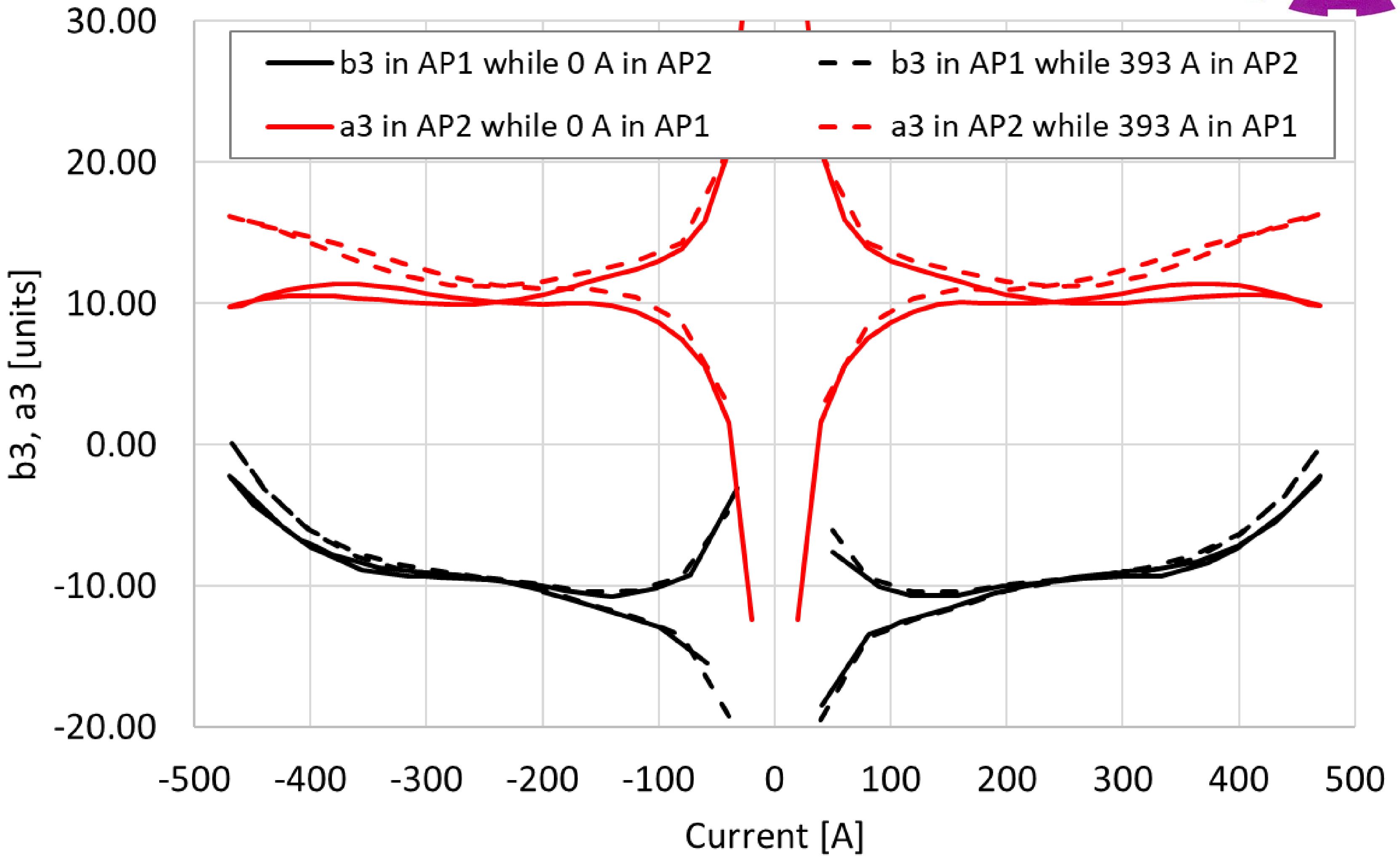
Crosstalk effect: 2‰ at nominal current

Magnetic field quality



AP1 (vertical field): all within specs (10 units) ✓
AP2 (horizontal field): all within specs except a3:

These 10 units of a3 are still present at room temperature, but they disappear when the iron is removed



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Conclusions & future plans

- **Training** to ultimate current:
  - Good in aperture 1 (3 quenches to ultimate current)
  - Very slow in aperture 2 (26 quenches to ultimate current). Mostly in the shallower three wires of the winding.
  - No further training at 4.5 K, and perfect memory after thermal cycle

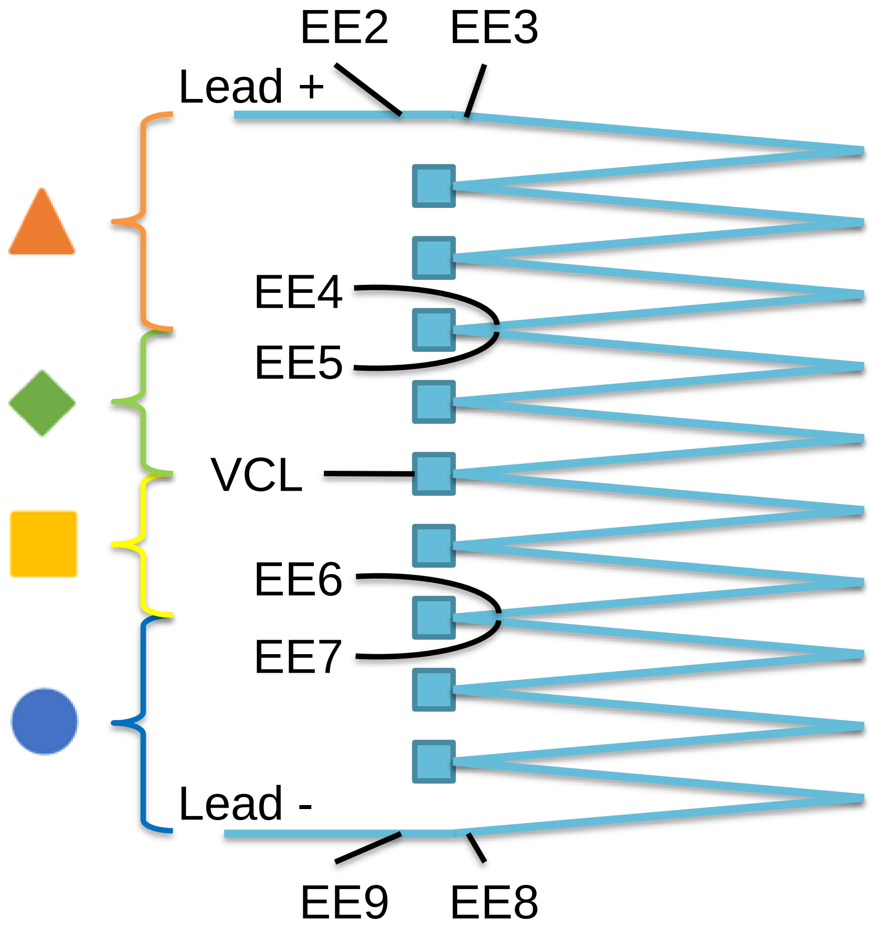
- Magnetic **field quality**:
  - Nominal field is reached at 393 A instead of 430 A, acceptable main field crosstalk (2‰)
  - Large a3 (-15 units) on aperture 2 when affected by crosstalk. All other multipoles within 10 units

- **Future work**:
  - A new aperture is being manufactured to replace AP2
  - New magnet assembly to be tested in November 2019

Test setup

- Two independent quench detection systems:
  - Baseline asymmetric QDS: ▲ vs ◆ ■ ●
  - Additional symmetric QDS: ▲ ◆ vs ■ ●

Superconductor in the groove



Wiring schema of the magnet