PSI

HFM
High Field Magnets Programme

Little Beast engineering

Simulation of the 14 T block-coil benchmark by LBE

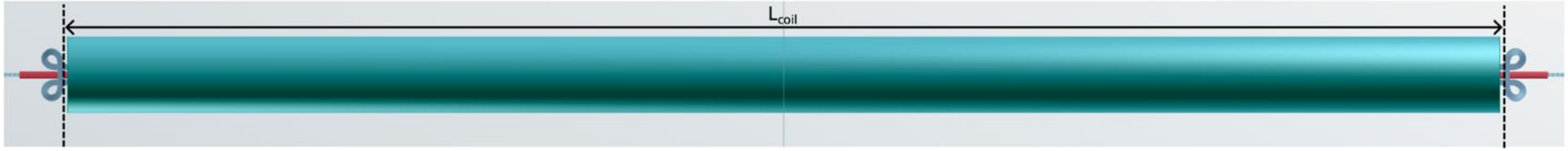
HTS Modeling WG Mtg

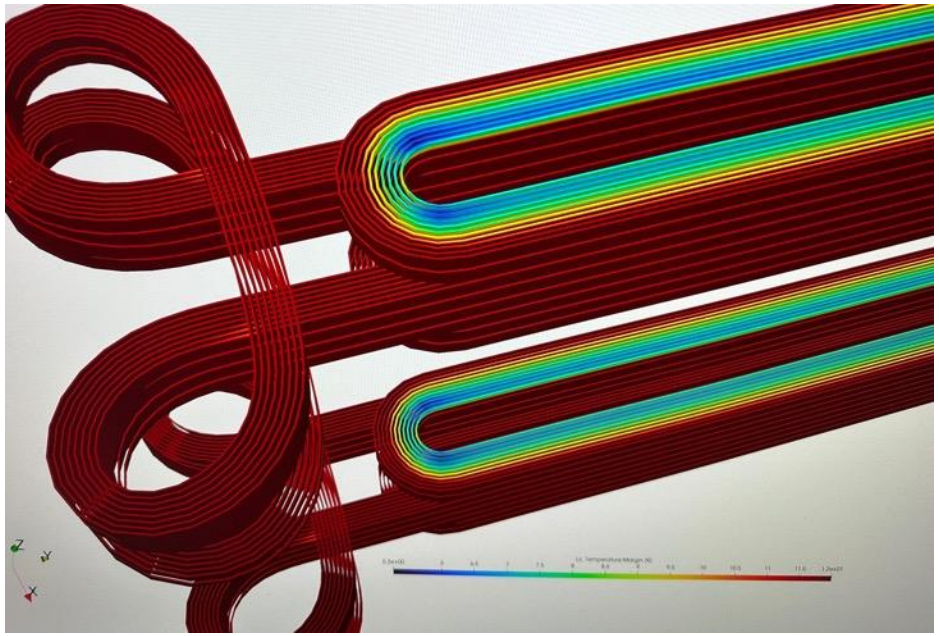
B. Auchmann
24 October 2024

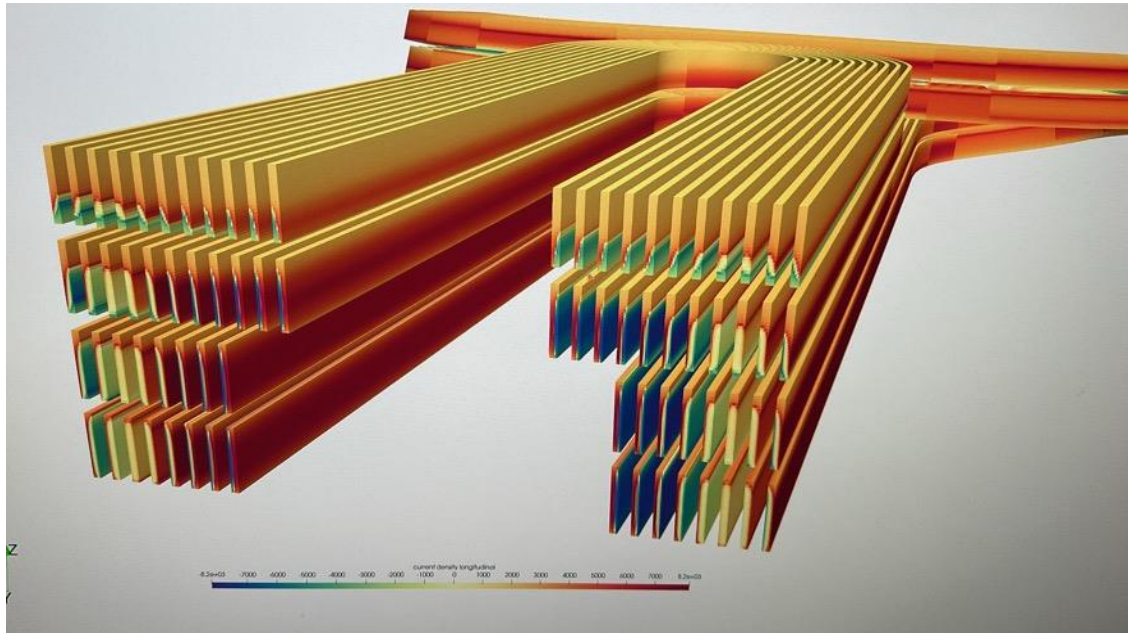
Why LBE?

- Numerically stable and efficient 3D simulation of screening currents.
  - Able to simulate small coils as we will build them soon → path towards model validation.
    - If a) our 2D models agree with LBE's straight-section results, and b) LBE's 3D models agree with our small coils measurements, then c) our 2D models have increased credibility for the study of designs for long magnets which will underpin our R&D roadmap.
- Goal remains to perform independent simulations. Other work, e.g., on STEAM FiQuS, at TU Darmstadt, and with commercial tools by Quanscient and COMSOL shall provide options.

LBE Implementation: 15 m, cloverleaf outer pancake, racetrack inner pancake







5 K temperature margin confirmed also in 3D.

LBE Results

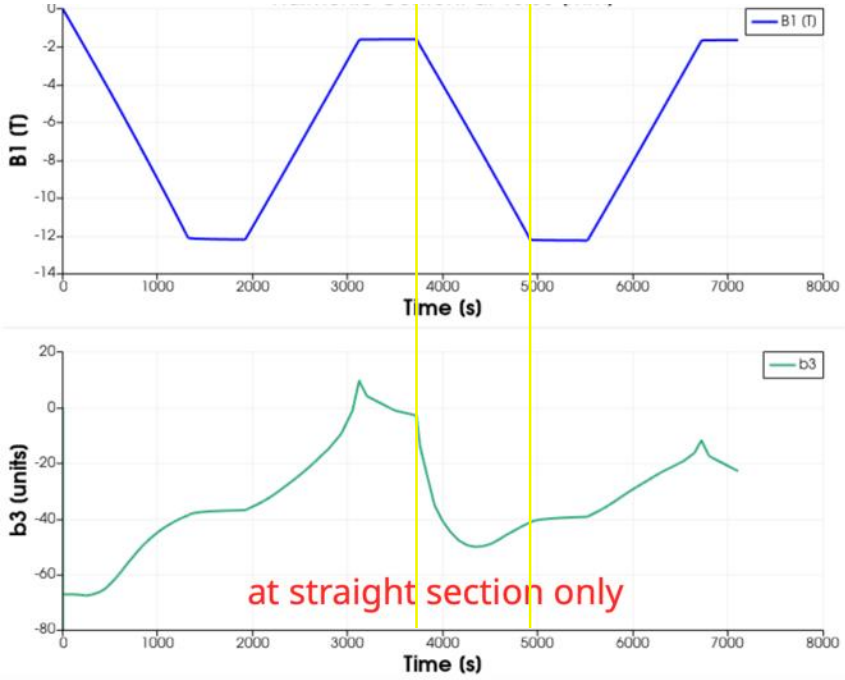
Straight section loss values reached already in 2-m-long magnet.

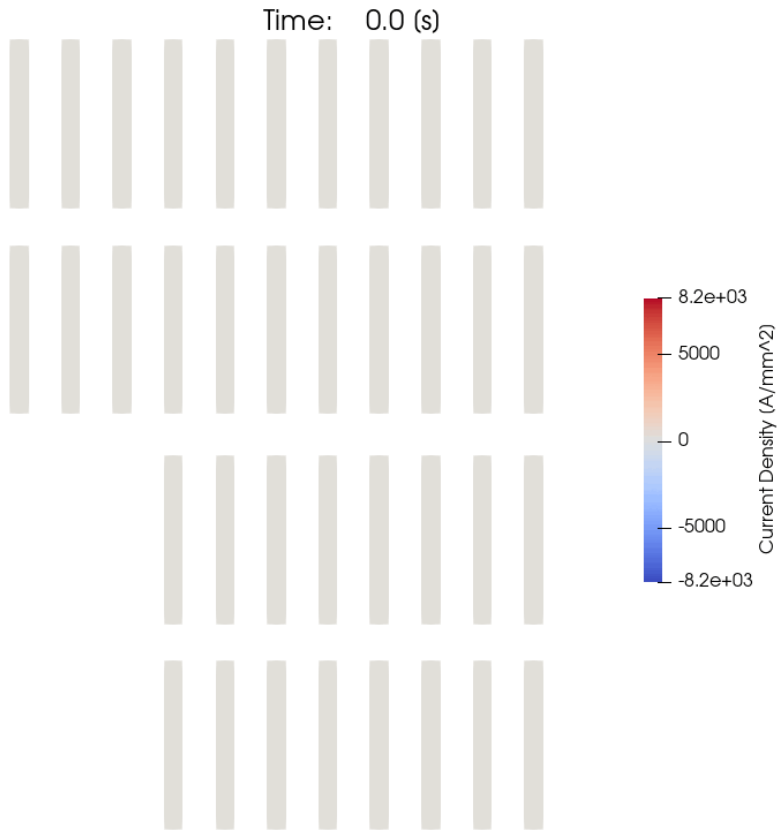
Convergence study completed.

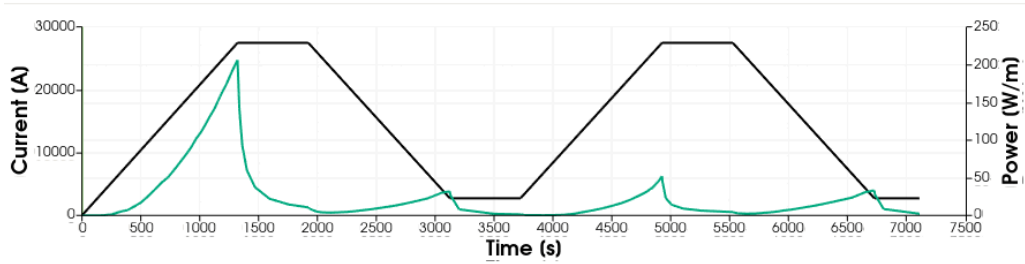
Iron-yoke represented by a field offset.

2nd and 3rd cycle losses ~identical: 44 kJ/m

Field quality: b_3 variation on ramp by ~45 units.
Long field-quality decay on plateau → plateau length now 2 hrs.







CONVERGENCE WITH NUMBER OF ELEMENTS FOR THE PSI1 14 T CASE.

num width	num thickness	Ramp-Up [J]	Ramp-Down [J]
1	1	0	0
12	3	13041	11895
24*	5*	19913	18549
40	7	22470	20843

*baseline number of elements

FINE