

3D Modeling of the Magnetization of Superconducting Rectangular-Based Bulks and Tape Stacks

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Motivation

- 3D modeling not as mature as 2D
- Benchmarking & validation between different approaches necessary
- Investigation of magnetization of two geometries relevant for applications

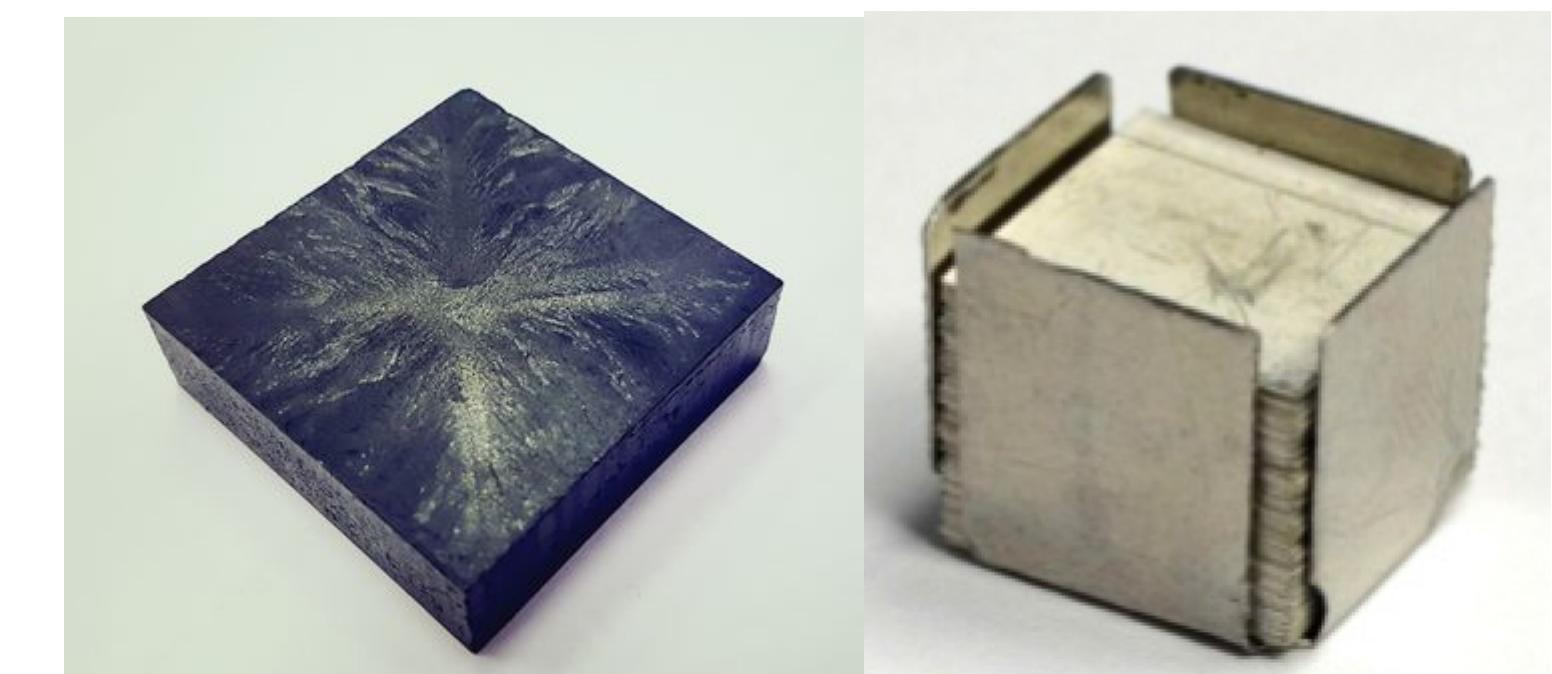
Investigated problem

- Parallelepiped 10 mm x 10 mm x 1 mm
- External AC field in the xz plane, 200 mT, 30 degrees w.r.t. x, frequency 50 Hz
- Superconductor modeled as material with non-linear resistivity $\rho(J) = \frac{E_c}{J_c} \left| \frac{J}{J_c} \right|^n$
- Stack represented by very large resistivity in the z direction
- Calculation of instantaneous power dissipation and magnetization cycles

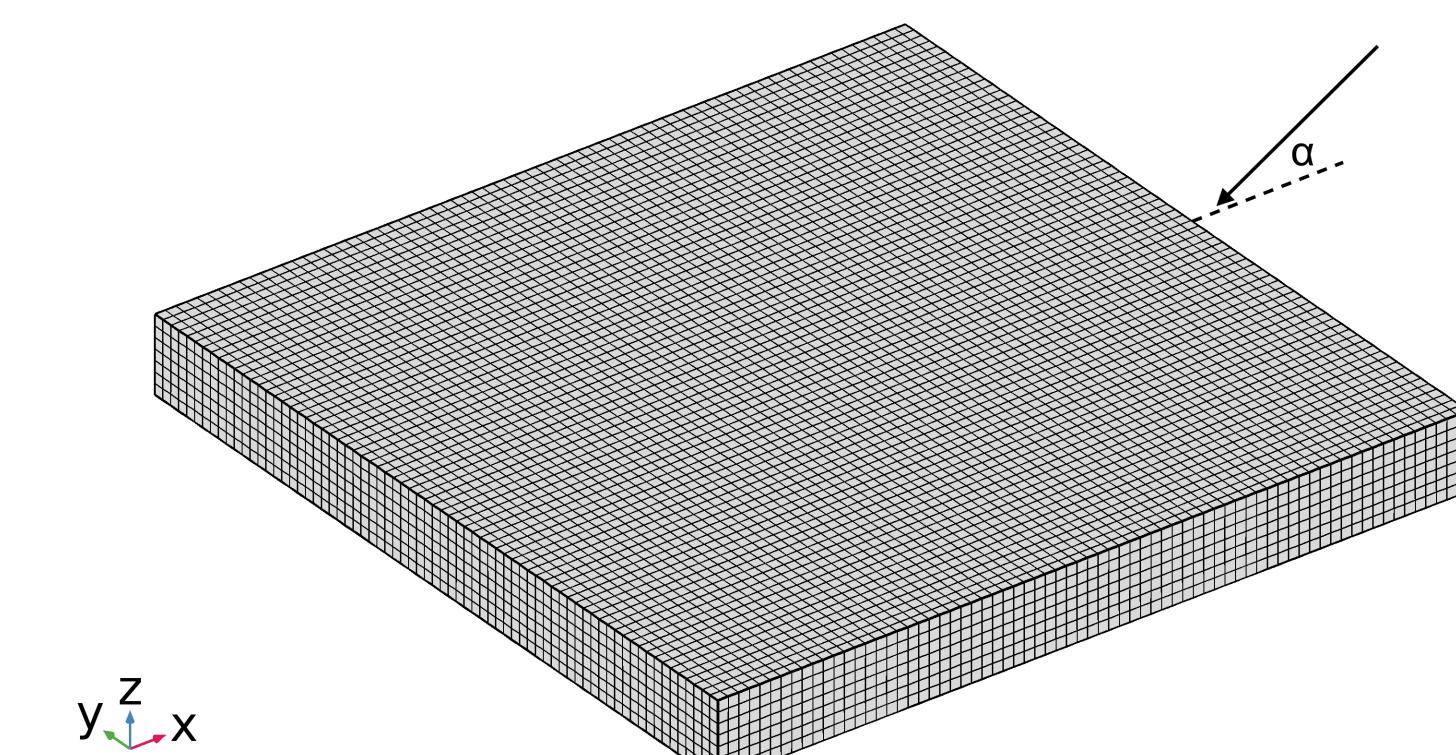
Compared numerical models

- Minimum Electro-Magnetic Entropy Production (MEMEP) [1]
- H-formulation of Maxwell's equations [2]
- Volume Integral Equation Method (VIM) [3]

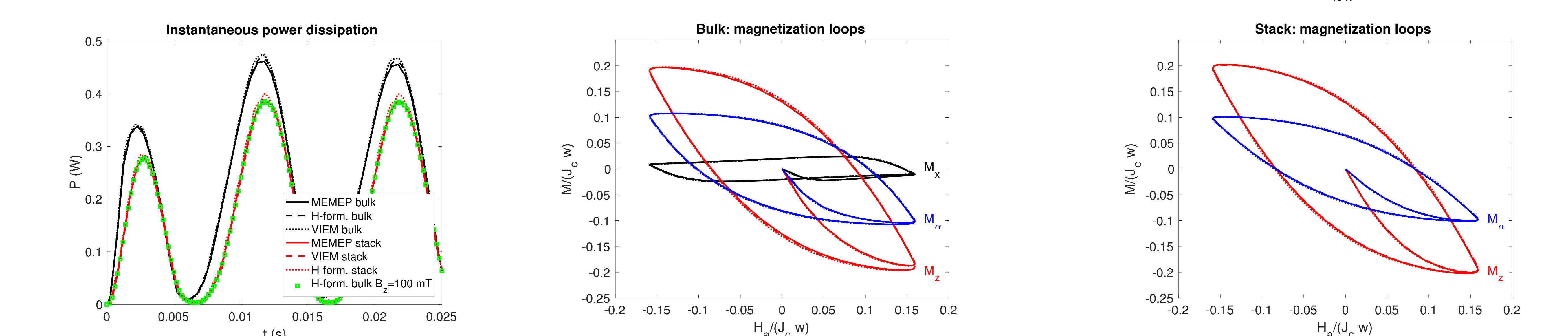
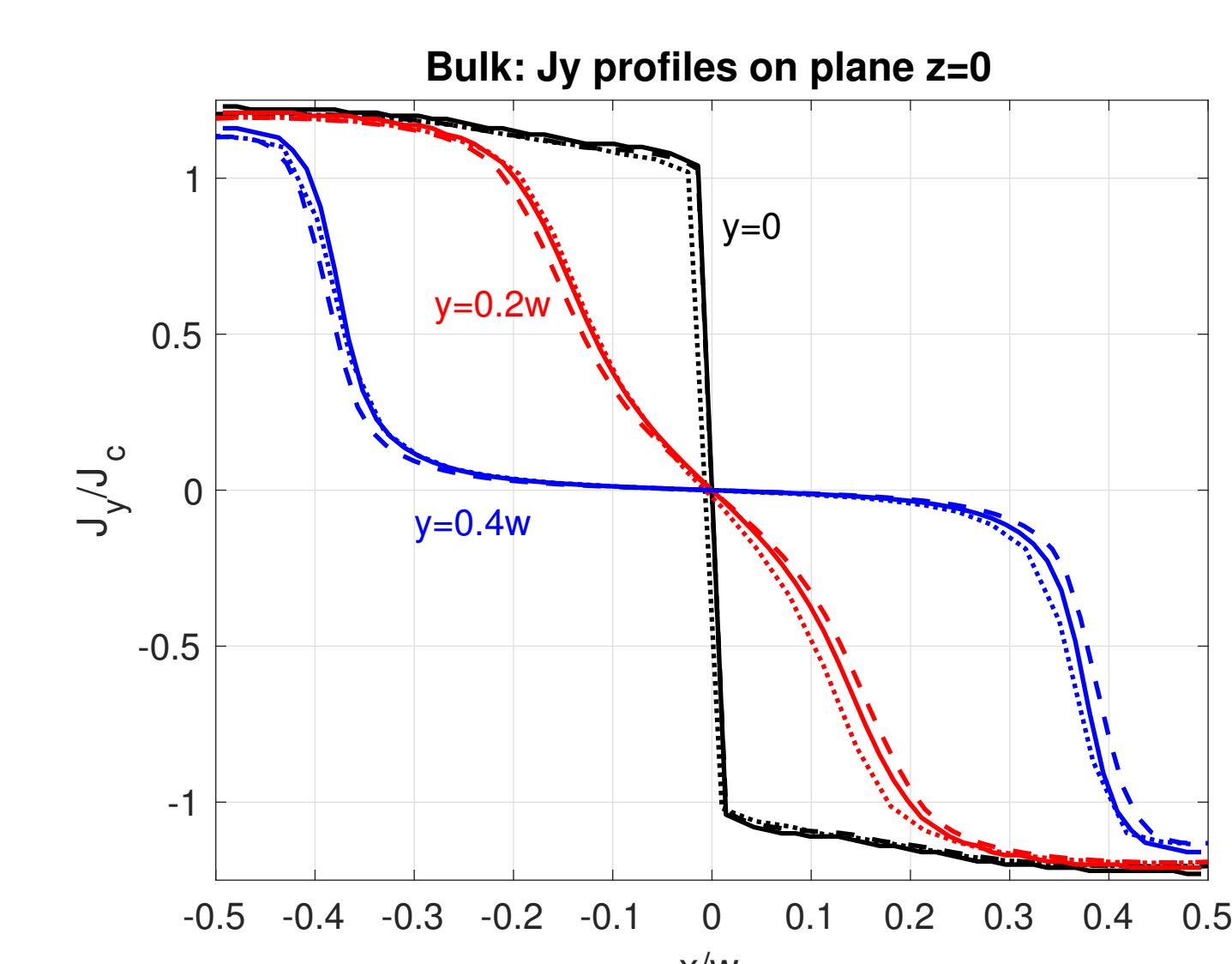
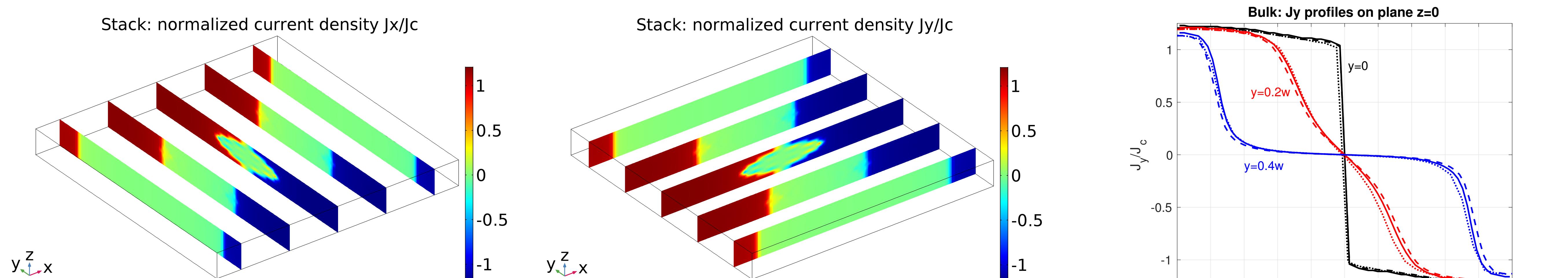
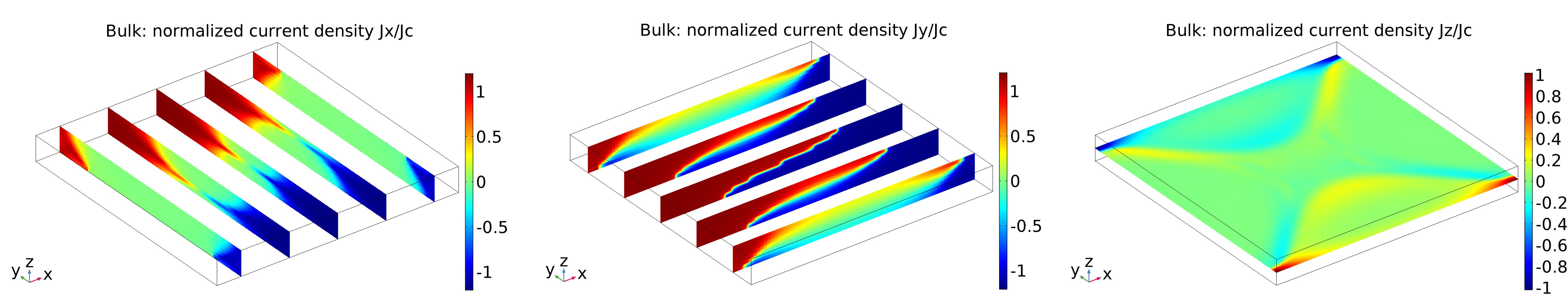
HTS Bulk Stack of HTS tapes



Source: CAN Superconductors Source: A. Patel, Cambridge Univ.



y_z
x



[1] E. Pardo, M. Kapolka, 2017 Supercond. Sci. Technol. **30** (6) 064007 doi:10.1088/1361-6668/aa69ed

[2] R. Brambilla, F. Grilli, L. Martini 2007 Supercond. Sci. Technol. **20** (1) 16-24 doi:10.1088/0953-2048/20/1/004

[3] A. Cristofolini, M. Fabbri, A. Morandi, F. Negrini, P. L. Ribani 2002 Physica C **372** 1771-1776 doi:10.1016/S0921-4534(02)01123-1

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