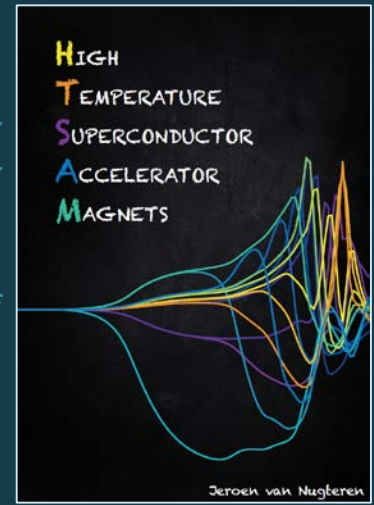


J. van Nugteren,
 "High Temperature
 Superconductor
 Accelerator
 Magnets," Ph.D.
 dissertation,
 University of
 Twente, 2016.



Exploded View of Feather-M2 Insert-Magnet



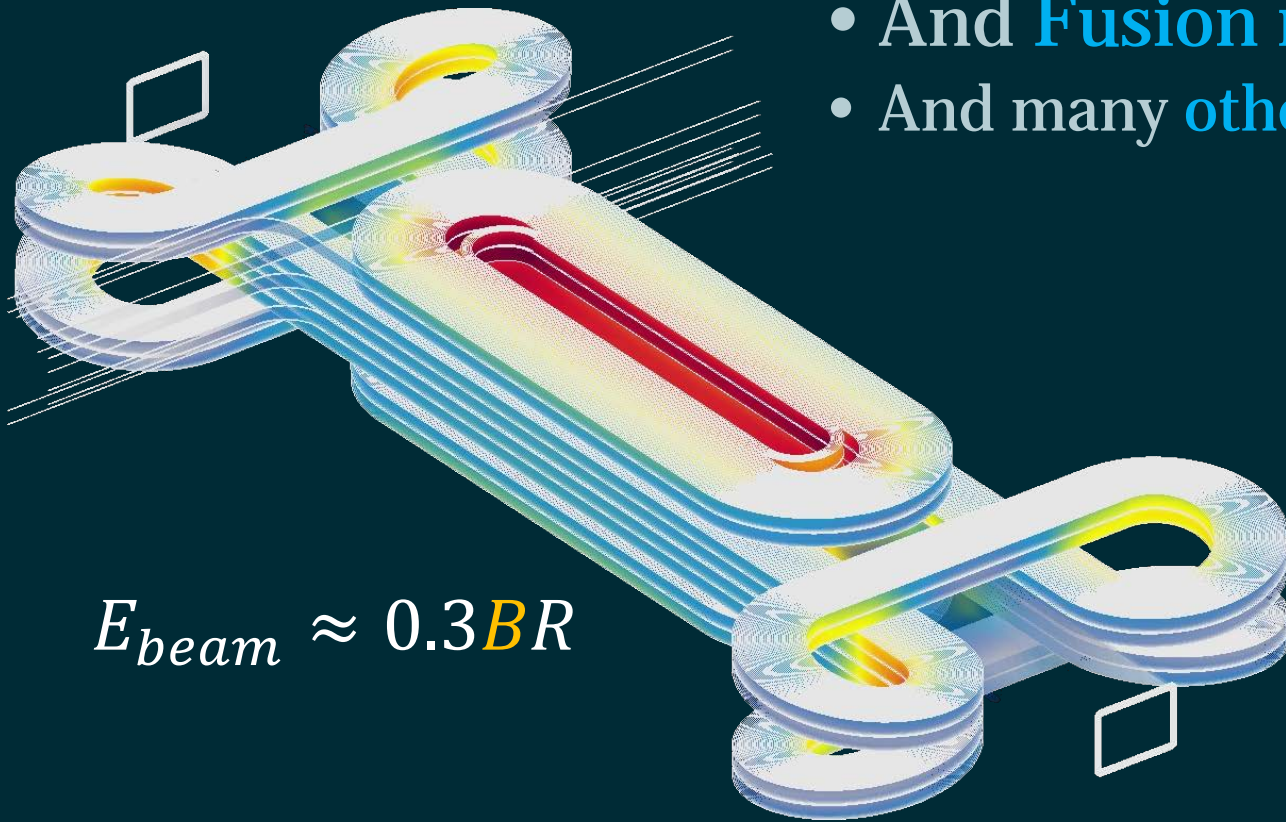
MT 2017
 J. van Nugteren

Into the
 Future with **HTS**



I believe **REBCO HTS** is THE superconducting material²
for future **high field** magnets ...

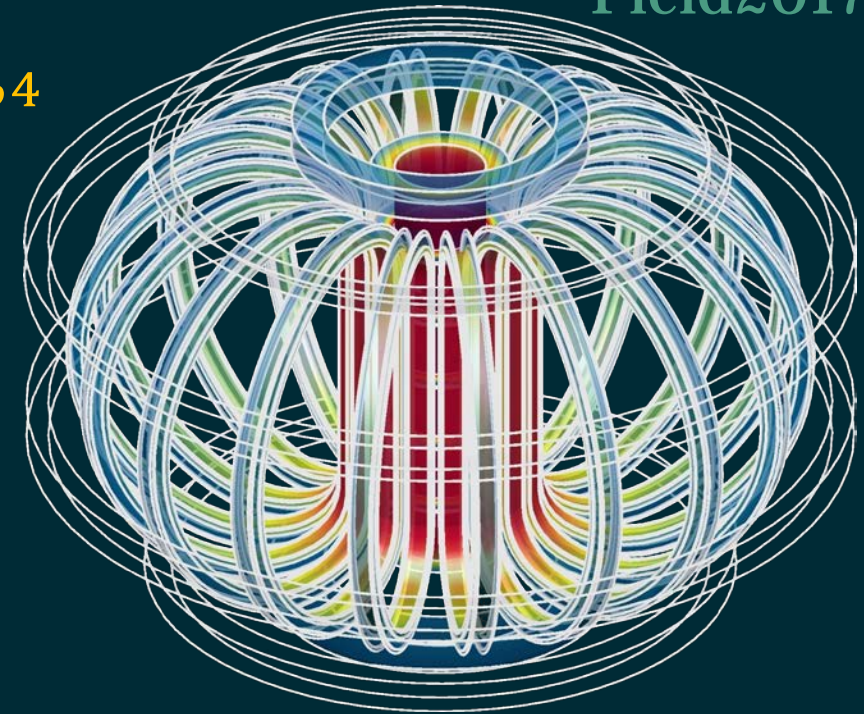
- For **particle accelerators** (di-, quadpoles)
- And **Fusion reactors** (toroids)
- And many **other** applications!



$$E_{beam} \approx 0.3BR$$

$$RR \propto B^4$$

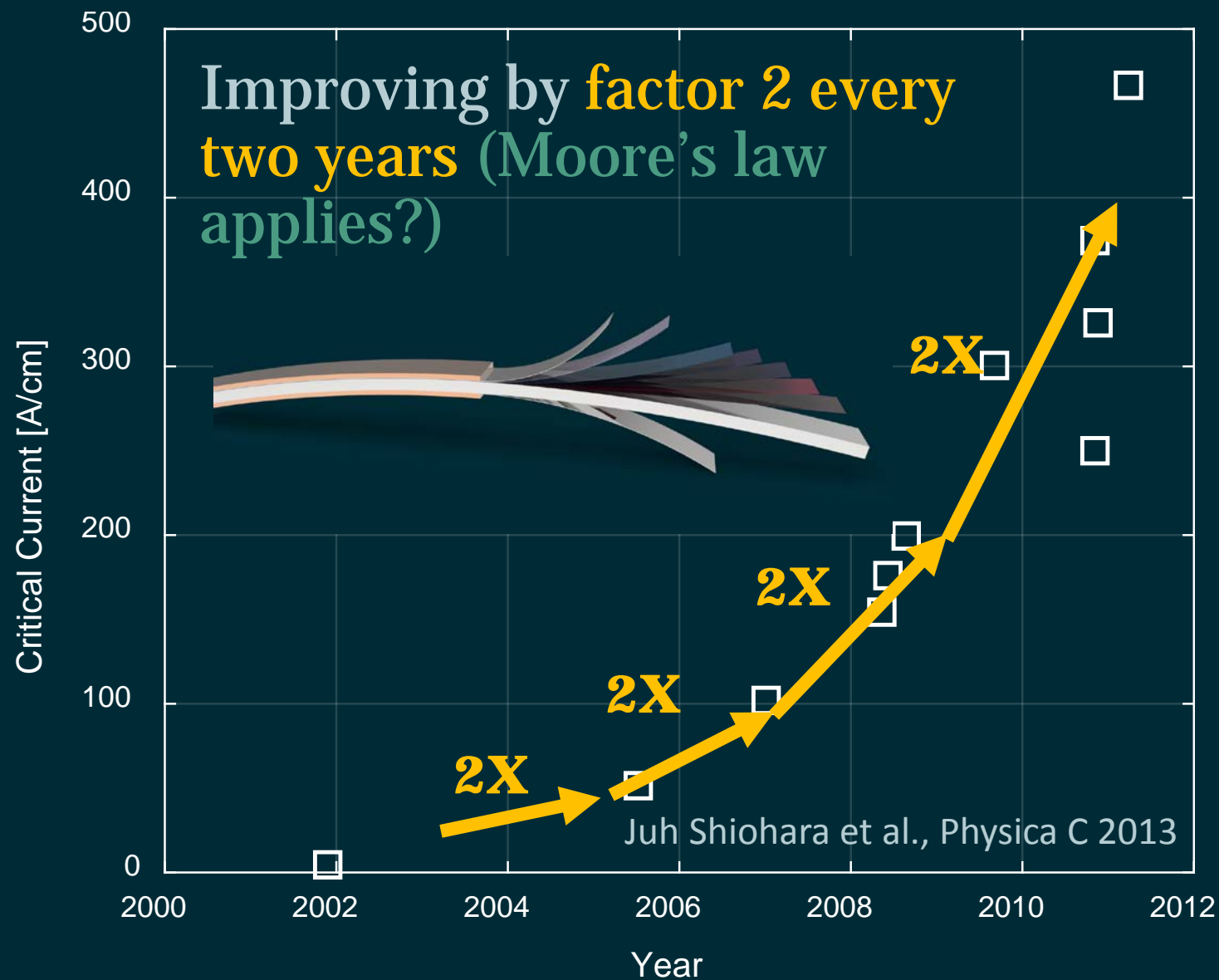
Plots with
Field2017



We are hungry for magnetic field ...

Why? – 1. High Current Density

3



Cable for next Feather-M2.3-4
(this cable exists 2017)

1000A/mm^2 @ (4.2 K, 20 T, pp)
= 18 kA

Why? – 2. High Thermal Stability I

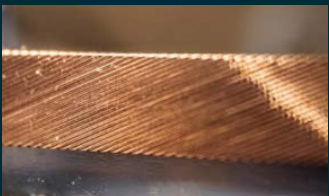
4

Stability of HTS
Conductor illustrated



Quenching
LTS wire
100 μ J

pin 0.1 g
10cm



Quenching
an HTS Tape
100mJ

apple



100 g

10cm



Quenching
an HTS cable
1J+
(depends on geometry)



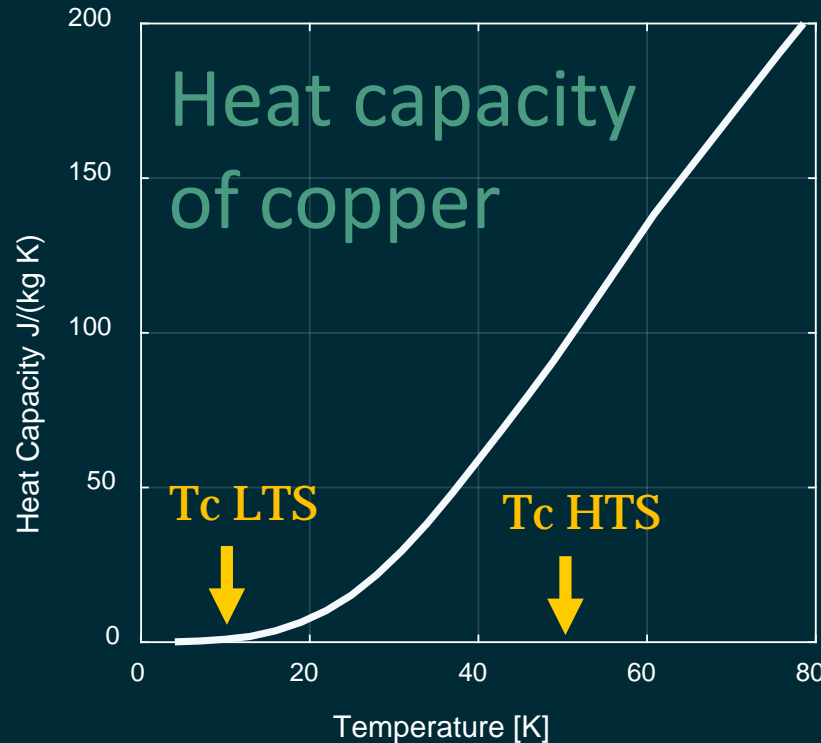
1 kg

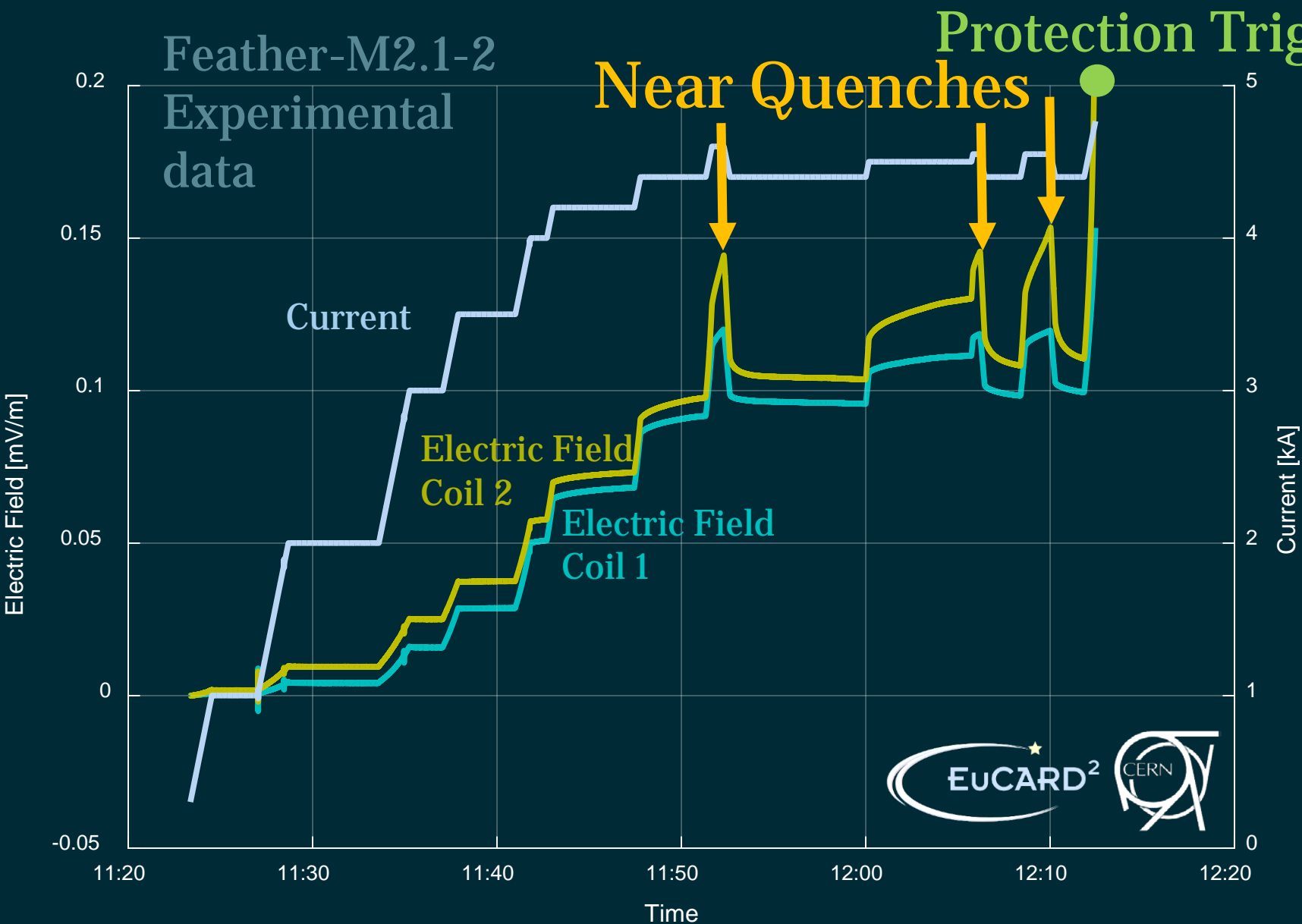
10cm

cannon
ball



Due to high temperature margin it is **super stable** and does not quench randomly and thus it does not train



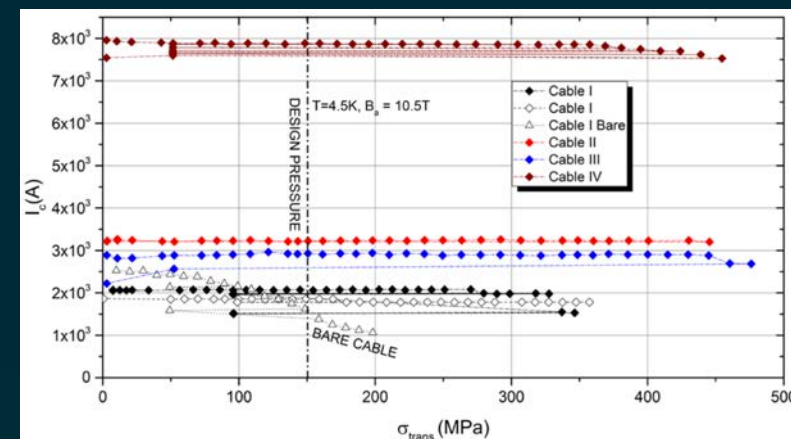


- Need to **rethink quench protection**
 - Prevent thermal runaway by looking at **drift** in electric field and temperature
- Magnet can **recover** by extracting fraction of the current
- Does this still work at **higher current densities**?

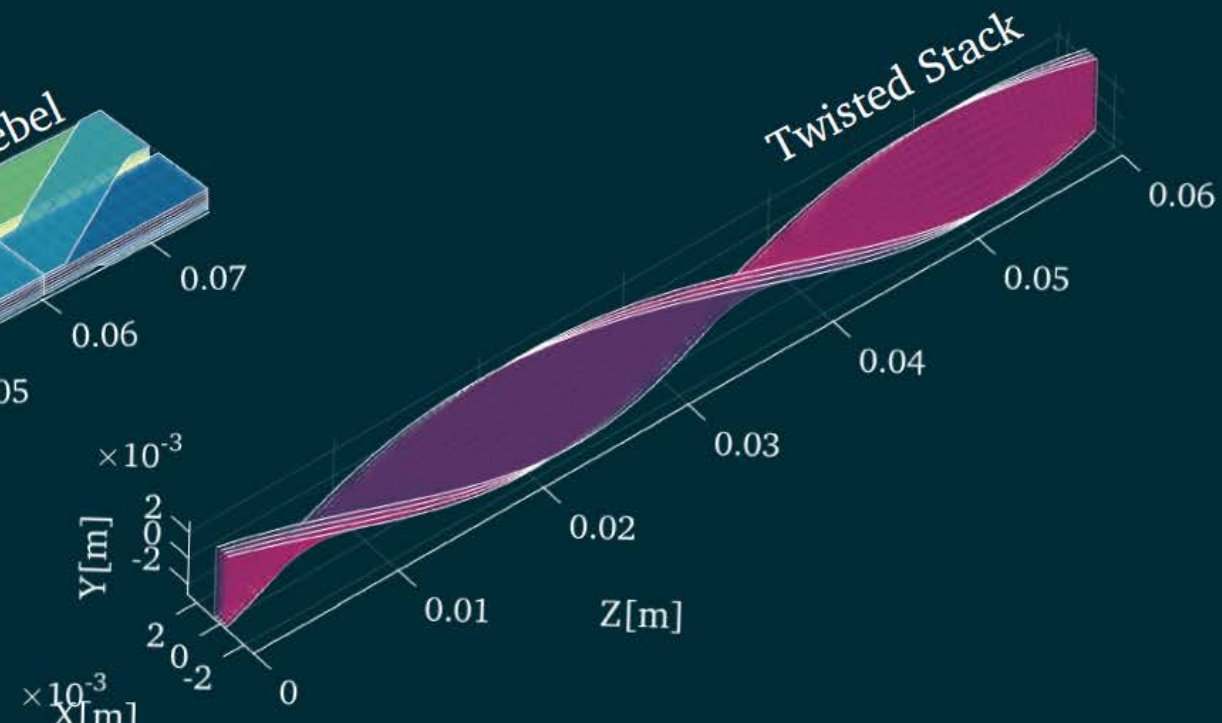
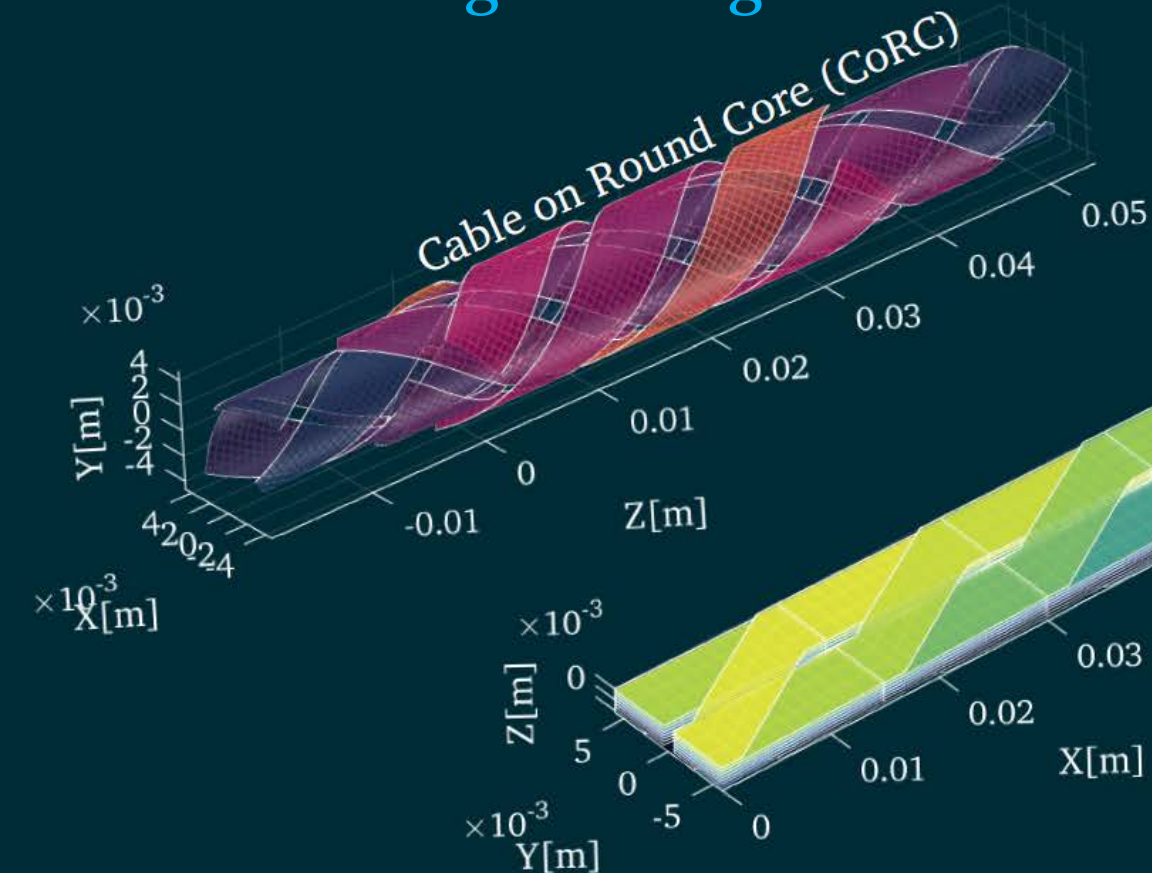
Why? – 3. Robust and Relatively Easy To Handle

6

- ReBCO coated conductor tape can withstand **600 MPa** of transverse pressure
- This seems to be also the case for **impregnated Roebel cable** as measured by the University of Twente
- No heat treatment!
- **This is a magnet designer's dream!**



P. Gao et al. in preparation, SUST



REBCO High Temperature Superconductor is **THE** future

Why?

- It has a **high current density** up to very **high magnetic fields** and moderate temperature
- It has a very **high quench energy** and is thus super stable
- Robust and relatively Easy to handle (no heat treatment)



700 A/mm² Block Coil Cross-Section

