This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under GA No 101004730.

Task 8.6 Superconducting ReBCO cable

I.FAST 3rd annual meeting, 18.04.24

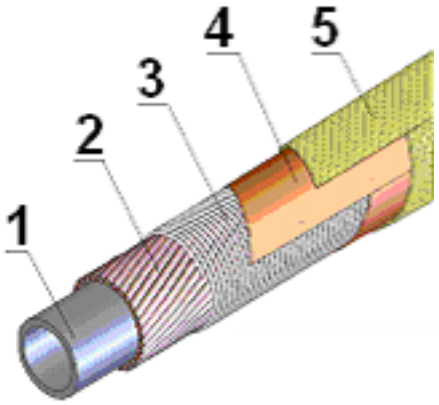
T. Winkler (GSI) on behalf of task 8.6 members

iFAST

WP/Task structure and objectives

- Design Parameters for a round, high current, low AC loss HTS ReBCO cable
- Application: fast ramped, high field accelerator magnets
- Milestone: M24 (https://doi.org/10.5281/zenodo.7995185) ✓
- Deliverable: M32 (https://doi.org/10.5281/zenodo.10697495) ✓
- Members:
  - Institute of Electrical Engineering (IEE), Slovak Academy of Sciences, Slovakia
  - ILK Dresden, Germany
  - GSI, Germany
  - EMS Chair, University of Twente (UT), Netherlands

Cable layout

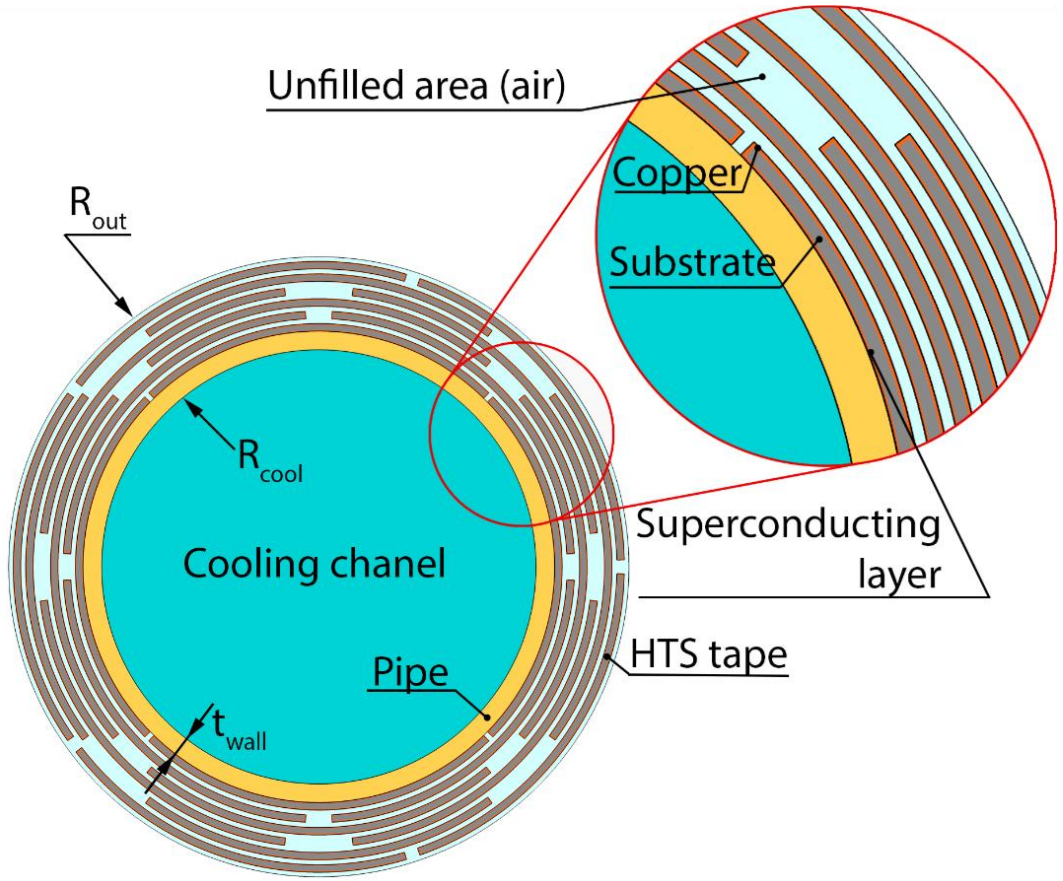


CORC by ACT, advancedconductor.com

Starting point:

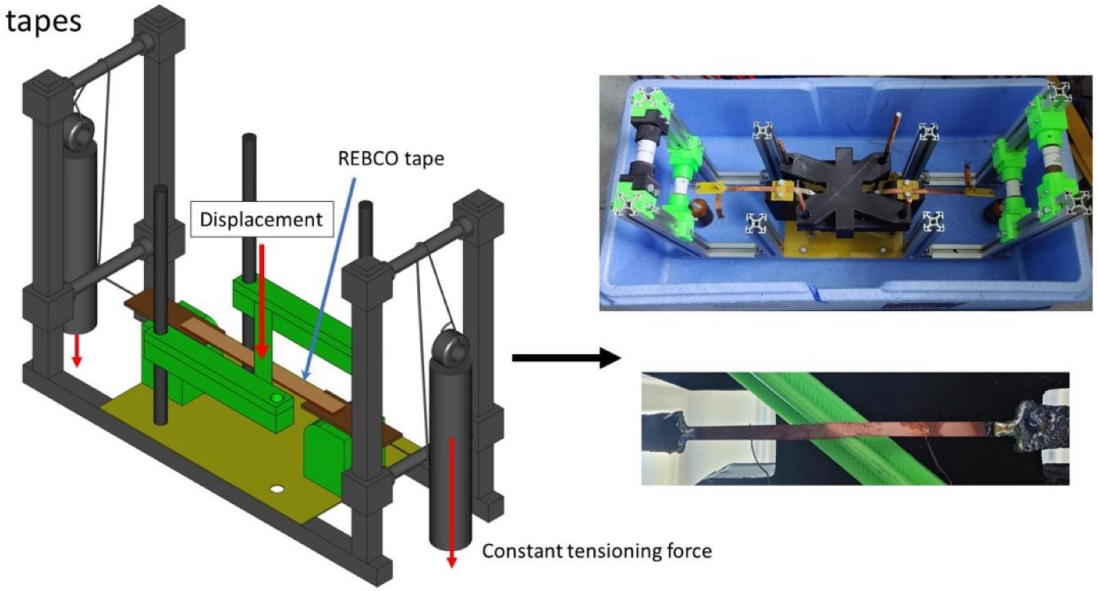
- SIS100 cable (GSI/JINR) (LTS)
- CORC/CORT type cable (ACT/IEE) (HTS)

Idea: use good direct cooling properties, and windability of SIS100 cable and apply it to HTS

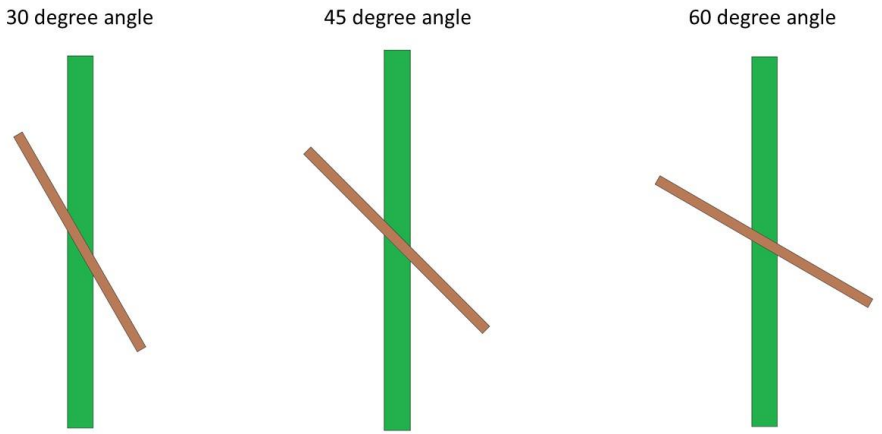


HTS tape mechanics

Measurement method for characterization of bending limits of HTS REBCO tapes



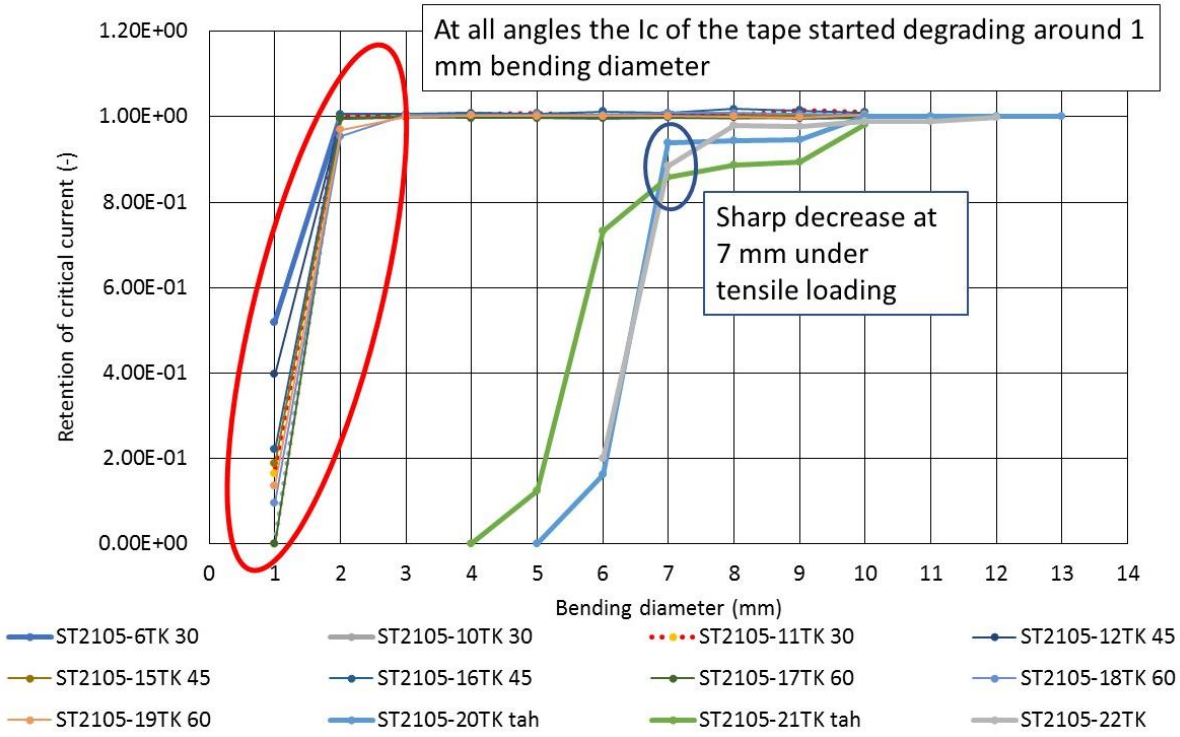
Brown: HTS tape
Green: inprinting tool with circular cross-section

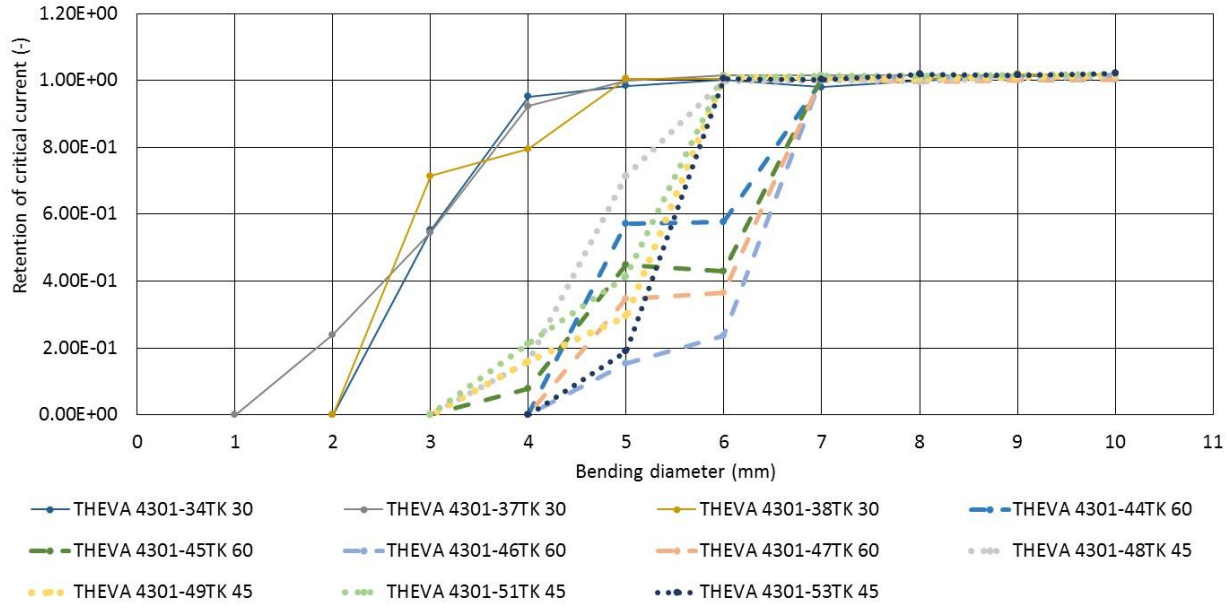


THEVA 4301 Pro Line	
Width	3 mm
Buffer Layer	3.5 µm
REBCO layer	3.1 µm
Substrate layer	100 µm
Silver layers (top and bottom	2 µm
Copper layers (top and bottom)	10 µm

Shanghai Superconductor Technology	
Width	3 mm
Buffer Layer	some nm
REBCO layer	2 µm
Substrate layer	30 µm
Silver layers (top and bottom	2 µm
Copper layers (top and bottom)	5 µm

HTS tape bending - results





AC loss and cooling - striation

From last years meeting:

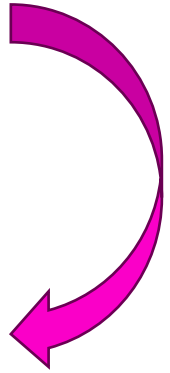
$$Q_{hT} = \frac{2}{\pi cos\alpha} B_{max} I_c w$$

AC loss for a ramp from 1.9 T to 7.5 T:

373 W/m

Extending the ramp from 1 sec to 10 sec and introducing 0.5 mm wide filaments:

4.6 W/m

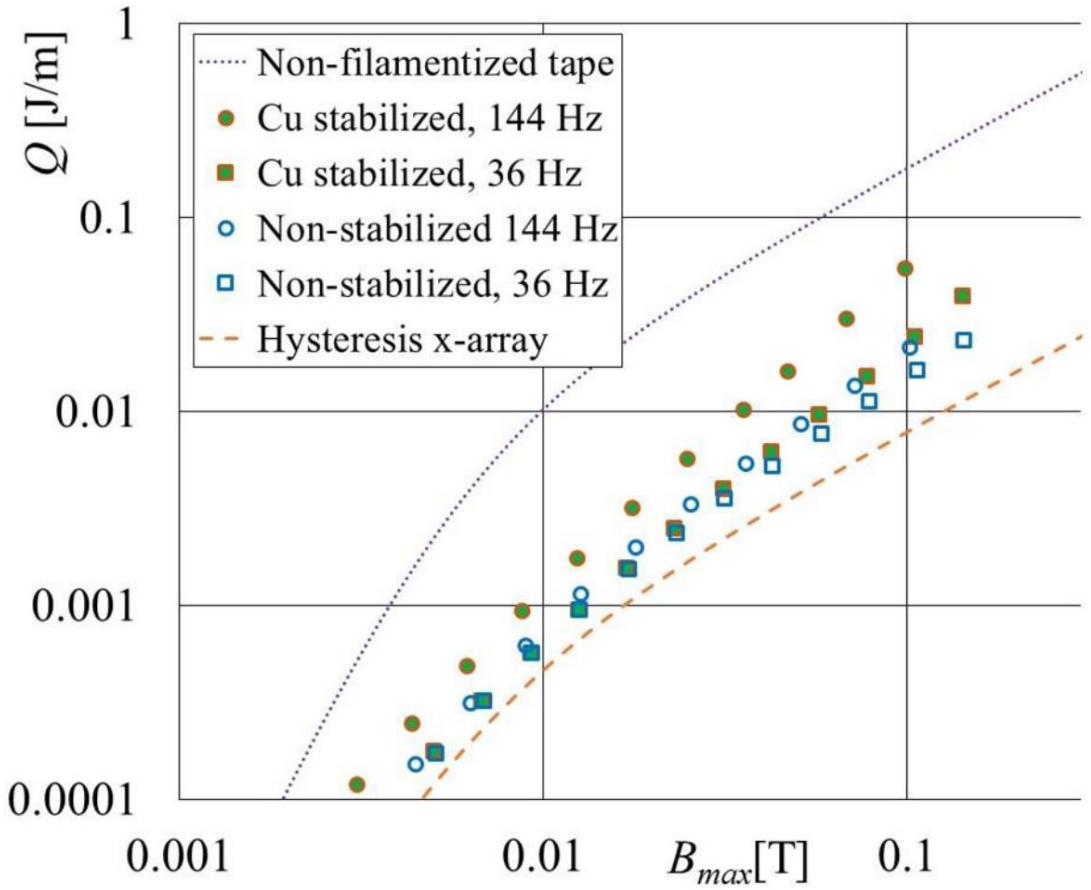


factor of **80** reduction

AC loss – tape striation

Sample:
- 230 mm length, 10 mm former diameter,
- 12 mm wide tape with 19 filaments
- wf = 0.5 mm wide, gaps of wg = 0.1 mm
- lay angle α = 67 degrees

Additional coupling loss for the Cu stabilized sample

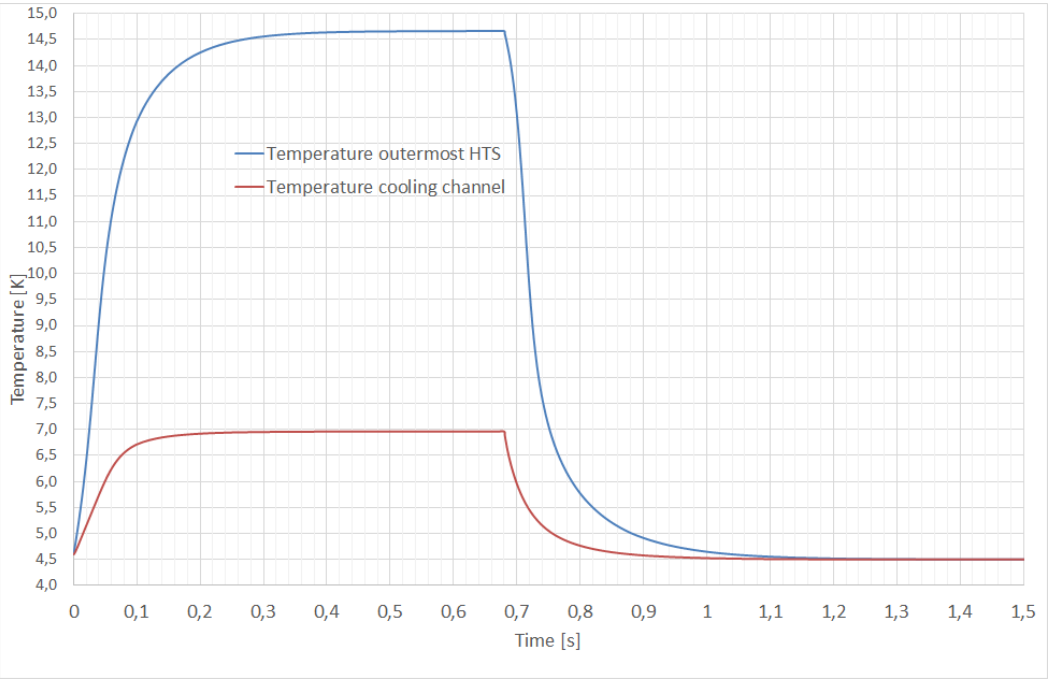


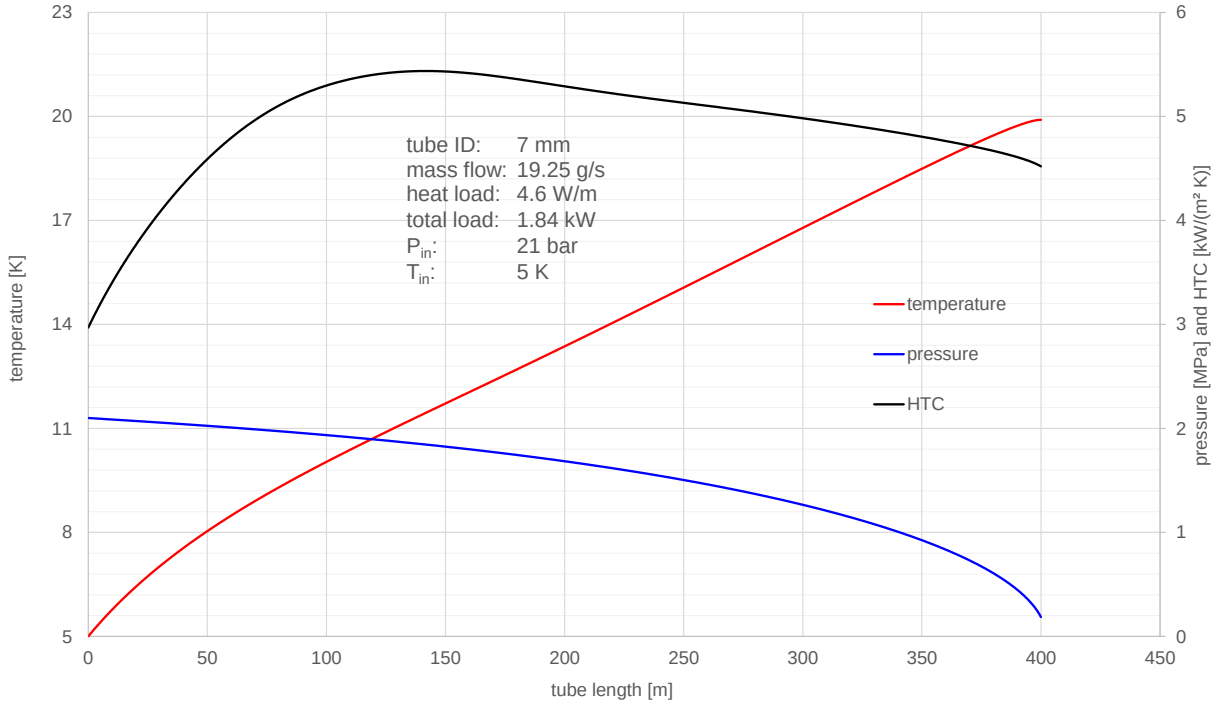
https://doi.org/10.1109/TASC.2024.3364133

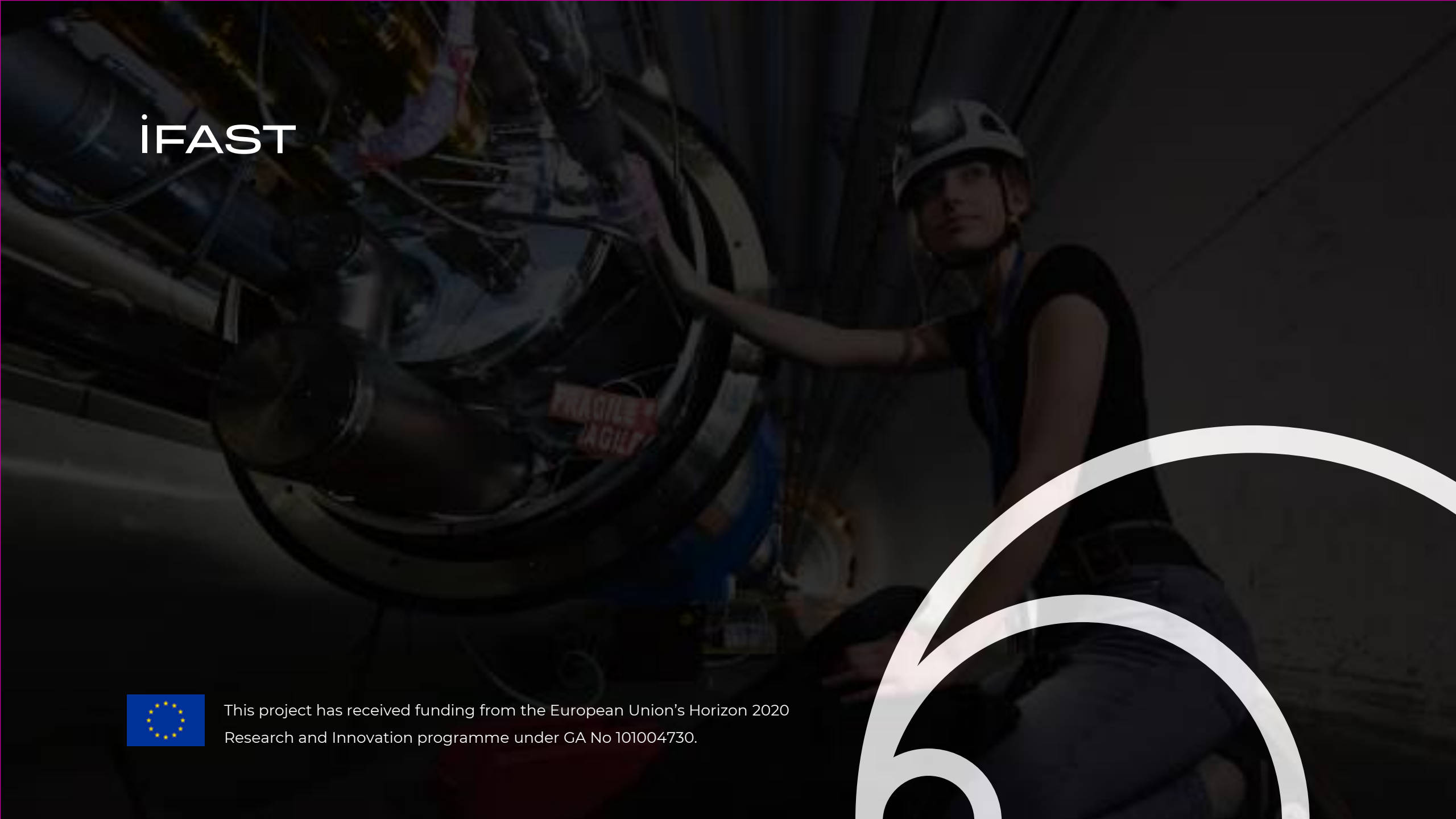
Cooling

Simulation accounts for:
- heat transfer coefficient He to pipe wall,
- ”effective” thermal conductivity of tape stack

Radial temperature for a short cable piece
Heat load 27 W/m







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