

HTS high current cable for fusion application

Nikolay Bykovsky



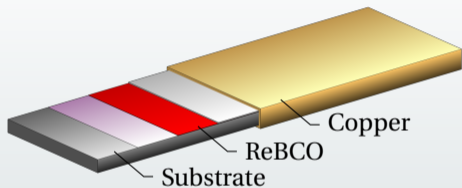
ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

**SWISS PLASMA
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25th International Conference on Magnet Technology

August 30, 2017

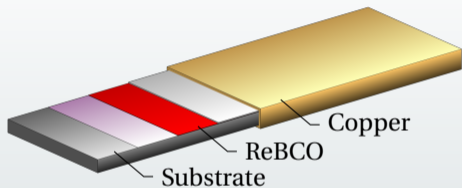
Coated conductors



- ✓ High values of j_c , T_c , B_{irr}
- ⚠ Only thin-tape geometry
- ⚠ Anisotropy of j_c and mechanical properties

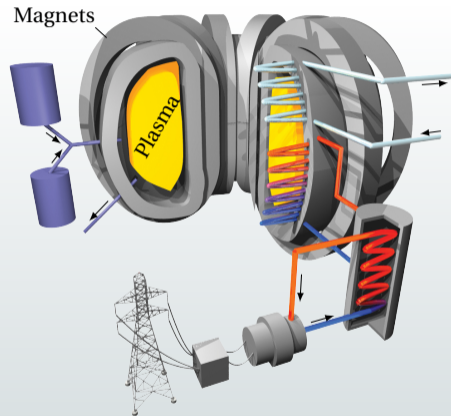
Motivation

Coated conductors



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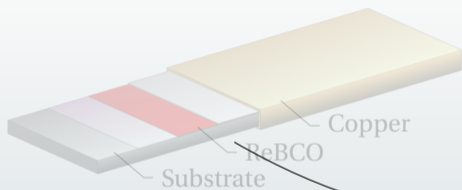
Fusion technology



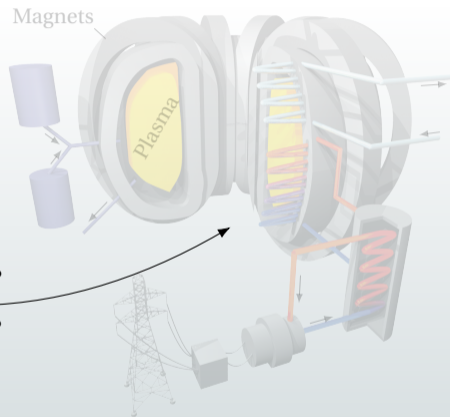
- High field / (very) high current magnets with large bending radii

Motivation

Coated conductors



Fusion technology



How?

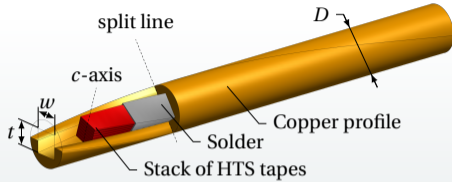
Why?

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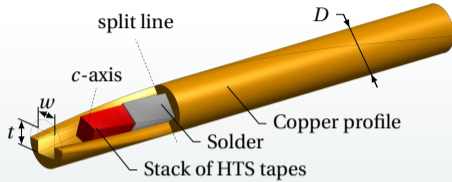
Design description

1 Strand:

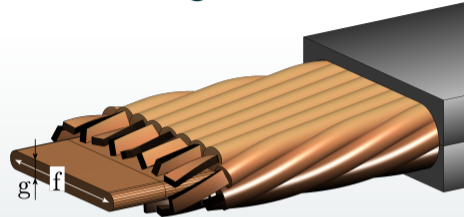


Design description

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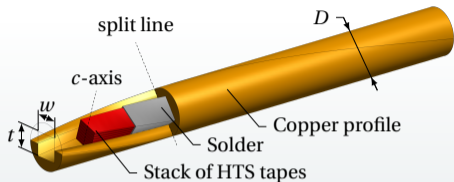


2 Cable:

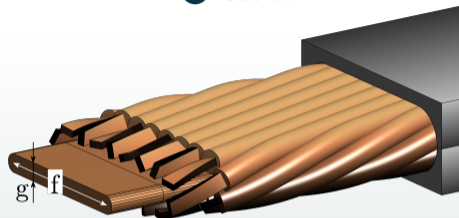


Design description

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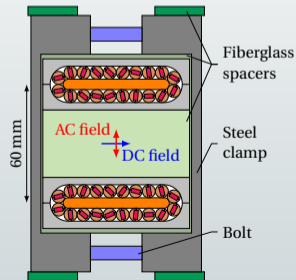


2 Cable:



➔ Full-size prototypes:

- 2 cables, made of SuperPower and SuperOx tapes
- 20 strands per cable, twisted at 100 cm
- 16 tapes per strand, twisted at 32 cm



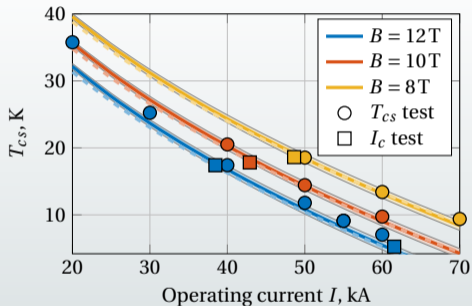
Test of the full-size prototypes

➔ $E(T) = E_0 \left(\frac{T}{T_{cs}} \right)^m$, where T_{cs} – current sharing temperature:

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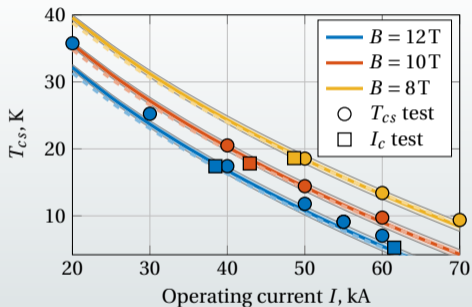


- Tape transport properties are fully retained in the prototypes
- High temperature margin even at high I/I_C ratio

Test of the full-size prototypes

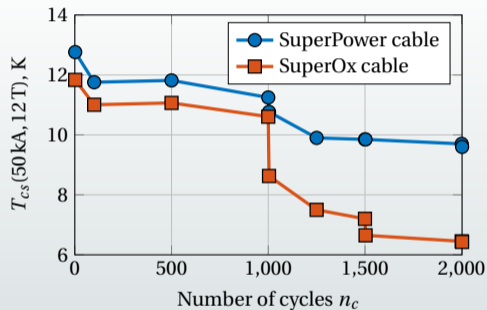
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⚠ Cycling test:

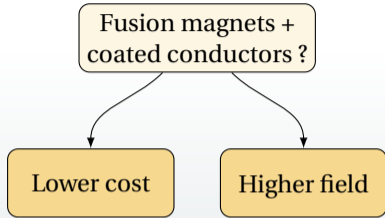


- T_{CS} drop after warm-up-cool-down and electromagnetic cycling
- Detailed investigation of the phenomenon is completed

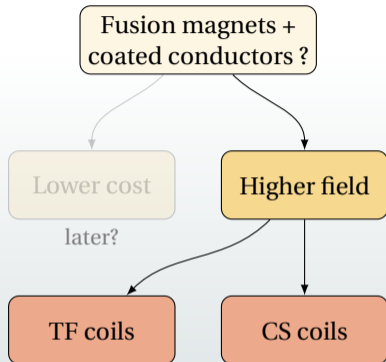
Application to fusion magnets

Fusion magnets +
coated conductors ?

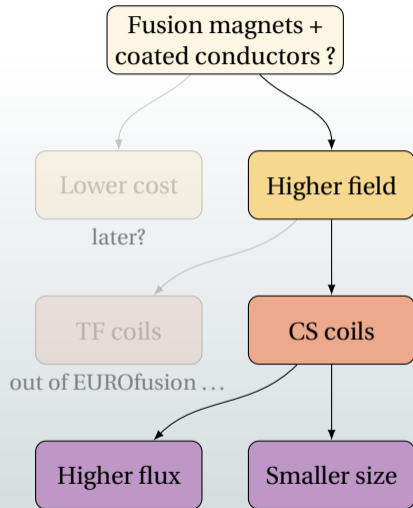
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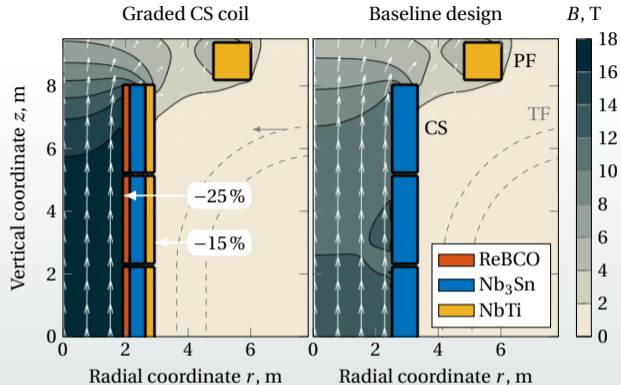
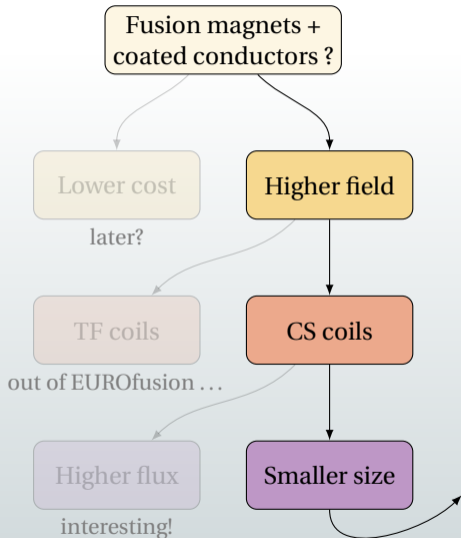
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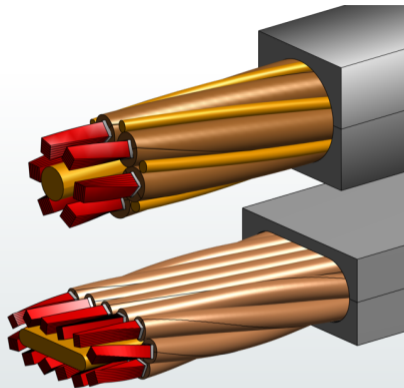
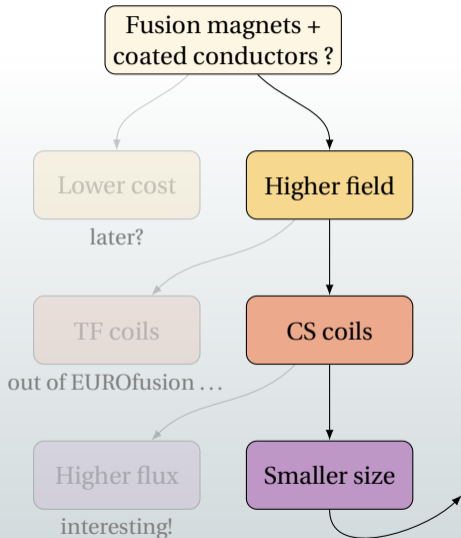


Application to fusion magnets



- Same magnetic flux is maintained, while the inner and outer radii are reduced by 25 % and 15 % → possible reduction of the overall cost!
- New prototypes for the graded CS coil, rated for 53 kA at 18 T, will soon be tested in SULTAN

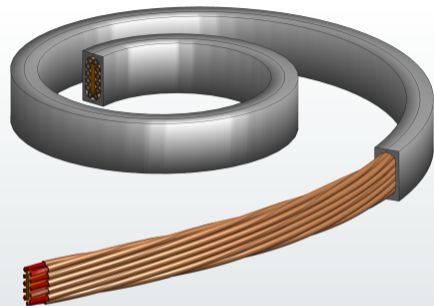
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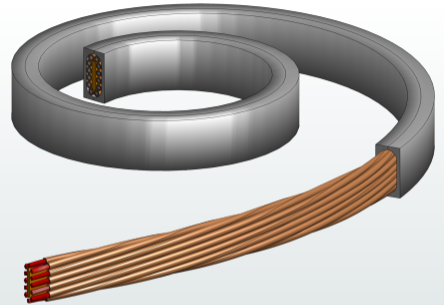
Conclusions

- The feasibility of the stacked-tape cabling concept, aiming at application in fusion magnets, has been experimentally demonstrated with the full-size prototypes.
- Performance of the central solenoid can be improved significantly by using HTS cables in the high field sections, where LTS cables are no longer efficient.



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Thank You
for your attention!