

High Tc superconductors for the future hadron collider at CERN

Ruggero Vaglio

*Department of Physics "Ettore Pancini" - University of Napoli Federico II
and CNR-SPIN*

CERN has recently started a Design Study for a possible next-generation high-energy hadronhadron collider (Future Circular Collider – FCC-hh).

The FCC-hh calls for an unprecedented center-of-mass collision energy of 100 TeV, realized by two colliding proton beams of 50 TeV steered in about 100-km circumference tunnel by over 16 T superconducting magnets. The design and operation of such a machine will require an incredible effort, pushing new frontiers of technological development.

As an example, the beams emit synchrotron radiation at high power which, to optimize cryogenic efficiency, is absorbed by a beam-facing copper-coated screen held at 50 K. Due to the wakefields generated by image currents, the surface impedance of this screen has a strong impact on the beam, and copper at 50 K does not allow sufficiently beam stability margins. This motivated CERN to investigate the possibility of High-Temperature Superconductors (HTS) coatings on the beam screen internal surface, as a possible solution.

This, however, represents a non-trivial challenge, since HTS should operate at very large magnetic fields keeping an impedance much better than copper in a narrow tube about 100km long.

In this view, we have implemented a model of the surface resistance of HTS in high fields and performed specific calculations in order to identify materials parameters that would allow a reasonable advantage in respect to copper. Experimental tests performed with HTS validated the model calculations, however further studies are required in view of a final assessment of this technology.

In this seminar we will discuss the state of the art of the experiments and discuss specific problems related to the system thermal stability as well as to the presence of nonlinear effects.



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