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Refinement and application of a generic CFD toolkit covering the heat flows in combined solid–liquid systems to investigate thermal quench limits of superconducting magnets

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The recently developed robust multi-region numerical toolkit for the modelling of heat flows in combined solid–liquid systems [1] is extended to cover larger temperature domains, crossing the superfluid to normal helium state transition, and to include NbTi cables that feature open electrical insulation, porous to superfluid helium. The aim is to be able to probe for superconducting magnets their thermal design details' influence on the temperature margin. The model enhancements are discussed and the model is applied to analyse the results of a particle beam loss test in a LHC main dipole [2]. We show and quantify which of the built characteristics of the superconducting magnet, such as electrical insulation and interlayer fishbones, are most influential on the local temperature margin and hence the quench level seen by the magnet.
[1] Development and application of a generic CFD toolkit covering the heat flows in combined solid–liquid systems with emphasis on the thermal design of HiLumi superconducting magnets, Gennaro Bozzaa, Ziemowit M. Malechab, Rob Van Weelderen, Cryogenics, Volume 80, Part 3, December 2016, Pages 253–264 Chats on Applied Superconductivity 2015 University of Bologna, Italy, 14-16 September 2015
[2] Bound-free pair production in LHC Pb-Pb operation at 6.37 Z TeV per beam, J.M. Jowett, M. Schaumann, B.Auchmann, C. Bahamonde Castro, M. Kalliokoski, A. Lechner, T. Mertens, C. Xu, Proceedings of IPAC'16, Busan, Korea, May 2016, Pages 1497-1500, ISBN 978-3-95450-147-2

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