Contribution ID: **264**

Type: **Oral presentation (15min)**

Development of a Novel Method for Exploration of the Thermal Response of Superconducting Cables to Pulse Heat Loads in Superfluid Helium

Wednesday, 9 July 2014 17:15 (15 minutes)

Management of transient heat deposition and extraction in superconducting magnets is becoming increasingly important for the purpose of bringing high energy particle accelerator performance to the limits of beam energy and intensity. Precise knowledge of transient heat deposition phenomena in the magnet cables will permit to push the operation of these magnets as close as possible to their current sharing limit, without unduly provoking magnet quenches. With the prospect of operating the LHC collider at CERN at higher beam energies and intensities an investigation into the response to transient heat loads of LHC magnets, operating in pressurized superfluid helium, is being performed.
The more frequently used approach mimics the cable geometry by resistive wires and uses Joule-heating to deposit energy. Instead, to approximate as close as possible the real magnet conditions, a novel method to deposit heat in cable stacks made out of superconducting magnet-cables has been developed. The goal is to measure the temperature evolution with time between the cable stack and the superfluid helium bath depending on heat load and pulse length. Heat generation and precise measurement of small temperature differences are major challenges. The functional principle and experimental setup are presented together with proof of principle measurements.

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Session Classification: Wed-Af-Orals Session 12

Track Classification: C-06: Heat transfer and thermo-physical properties of solids and fluids