Contribution ID: **119** Type: **Poster Presentation (120m)**

Design and construction at CERN of an enhanced thermal conductivity measurement setup in the temperature range of 1.8 K to 50 K

Tuesday 23 July 2024 14:00 (2 hours)

Within the goals of the High-Field Magnet (HFM) program at CERN, ongoing research focuses on achieving magnetic flux densities of up to 16 T using superconducting coils. Understanding the thermal properties of composite materials used as impregnation resins or insulation layers in superconducting magnets is crucial for the design of effective cooling methods. To this end, a new test stand was built at CERN in the Cryogenic Laboratory, to extend the investigation of thermal properties to a lower temperature range compared to the conventional cryocooler-based set-ups stopping at around 3 K, by linking a closed He II circuit to this system. This circuit enables to pre-cool helium gas, then gets it condensed by expansion through a Joule-Thomson valve before it gets pumped continuously via a roots pump, allowing to extend the measurement capabilities down to 1.8 K. The He II circuit is coupled to the cryocooler's cold head via a gas-gap heat switch, enabling the He circuit to be thermally decoupled from the warmer cryocooler head for measurements at the lowest temperature. By varying base temperatures of the experimental platform, provided the cooling power either by the cryocooler or by the He circuit, a steady-state heat flux measurements can be ensured from 1.8 K up to 50 K. This work details the design and construction of this new innovative test stand for thermal conductivity measurements at a lower temperature range, and its validation by measuring a reference sample.

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Session Classification: Tue-Po-1.3

Track Classification: Tracks ICEC 29 Geneva 2024: ICEC 14: New devices and novel concepts