Contribution ID: **264** Type: **Oral presention (by invitation only)**

Final SWELL mock-up cooling test results

Thursday, 8 June 2023 11:06 (18 minutes)

The cooling concept of the SWELL prototype is based on a self-sustained convection loop (open thermosyphon) in He I saturated conditions. The estimated heat load for one quarter of the SWELL 1.3 GHz prototype is 17.5 W. The 30 mm-diameter cooling tube has a length of 131 mm, which corresponds to the length of the SWELL main copper body. In the vertical SRF test arrangement, a 10 mm x 8 mm centered stainless steel tube creates a ring-shaped space to the 30 mm Cu tube surface of the SWELL quarter block and functions as the supply of saturated liquid helium. The generated flow in this cooling loop is caused by the density changes of the helium itself (mostly convection or nucleate boiling in the ring-shaped space). Tests of the heat transfer performance from that copper mock-up structure to the He flow have been conducted at the CERN Cryolab in forced flow He I saturated conditions. Additionally the same setup showed an interesting and unstable boiling condition when operated in a He II saturated bath. Short bursts of helium gas blowouts are recorded in the 30 mm tube cross section for a heat flux of 2.5 W/cm2. The observed effects can be traced back to exceeding the critical heat flux in He II in the SWELL vertical cooling arrangement. The measured temperature gradients in the mock-up by nucleate boiling in He I and He II saturated conditions are compared and recommendations for possible cooling regimes of future SWELL cavities are made.

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Session Classification: Technology R&D

Track Classification: SRF Programme