Contribution ID: **47** Type: **Contributed Oral**

C2Or2C-03: Modelling two-phase He II flow for heat load limits in EuXFEL cryomodules for CW operation

Tuesday 20 May 2025 11:45 (15 minutes)

The European XFEL is under consideration for a High Duty Cycle (HDC) upgrade to enable Continuous Wave (CW) or Long Pulse (LP) operation, enhancing the user's operational range. One of the key challenges for this upgrade is managing the increased heat load of the existing cryomodules while ensuring sufficient cryogenic capacity for stable operation. The two-phase pipe within the cryomodules plays a critical role in maintaining stable cryogenic conditions, preventing vibrations and microphonic effects.
To address these challenges, a simulation model has been developed to analyze the two-phase flow behavior of superfluid helium (He II) in EuXFEL-like cryomodules at the cryomodule test benches CMTB and AMTF. The model incorporates the Taitel-Dukler criterion to evaluate the transition from stratified smooth to stratified wavy flow under varying heat loads. Flow characteristics were systematically studied for different heat loads, helium temperatures, vapor qualities, and filling grades of the two-phase pipe.
The results highlight the maximum heat load that a EuXFEL-cryomodule can sustain before the transition to wavy flow in the two-phase pipe occurs and provide insights into optimizing operating conditions. These findings suggest potential pathways for increasing the heat load limits without requiring modifications to the cryomodule design.

Author: Dr DHILLON, Aman Kumar (Deutsches Elektronen-Synchrotron DESY)

Co-authors: BOZHKO, Yury (Deutsches Elektronen-Synchrotron DESY); RAMALINGAM, Rajinikumar (Deutsches Elektronen-Synchrotron DESY); ABASSI, Emna (Deutsches Elektronen-Synchrotron DESY); JENSCH, Kay (Deutsches Elektronen-Synchrotron DESY); BARBANOTTI, Serena (Deutsches Elektronen-Synchrotron DESY); SCHNAUTZ, Tobias (Deutsches Elektronen-Synchrotron DESY)

Presenter: Dr DHILLON, Aman Kumar (Deutsches Elektronen-Synchrotron DESY)

Session Classification: C2Or2C - Large Scale Cryogenic Systems V: Analysis and Modeling