Cavity Flux Expulsion Review for LCLS-II

Charge

Recent testing shows a significant risk that production LCLS-II cavities will have 20 to 30% greater cryogenic heat load than foreseen due to strong ambient-magnetic-field flux-trapping. We believe the cavities used for production-recipe development (so-called prototype cavities) expelled ambient magnetic field quite efficiently and there are indications the difference is caused by differences in the bulk crystalline structure of the cavity material. Indeed, recent testing shows that a modest increase in heat-treatment temperature, from 800C to 900C, causes enough re-crystallization to substantially improve flux expulsion in single cells.

The project is concerned about the risk of poor performance, and would like to consider a program to determine the risk and benefit of a limited R&D program, performed under strict constraints of an in-progress project.

Since the LCLS-II cavity production is now well underway, our proposed actions: 1) should cause no production schedule delay, 2) should be inherently low-risk, and 3) are applicable during the production cycle, so that the overall linac cryogenic heat-load is reduced.

Assumptions:

Work to the baseline design

Keep the project schedule for feeding cavities into the cryomodule production

Please consider these questions:

1)      Is the evidence for poor flux expulsion adequately substantiated? Does the proposed recipe mitigate the risk appropriately? Are further studies required for 9-cell cavities? Dressed cavities? Material samples?

2)      What are the risks associated with increased heat-treatment temperature? What can be done to protect the precision tuning of soft cavities (as compared to cavities prepared with the now-standard 800 deg. C bake)? Is the flange sealing integrity ensured? Do any other mechanical risks need to be considered? Could the HOM spectra be negatively affected?

3)      What steps and / or studies are necessary to build confidence the proposed actions meet the three criteria listed above, associated with the production process? What are the risks of doing nothing?

Thank you very much for your help,

Camille, Ed and Marc

Reviewers - Olivier Napoly, Claire Antoine, Axel Matheisen, Jacek Sekutowicz, Hitoshi Hayano, Eiji Kako, Takayuki Saeki, Takayuki Kubo, Yoshihisa Iwashita, Timergali Khabiboulline