

Continuous-Wave Horizontal Tests of Dressed 1.3 GHz SRF Cavities for LCLS-II

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Fermilab's Horizontal Test Stand has recently been upgraded to provide CW RF testing capabilities in support of the LCLS-II project at SLAC. Several cavities have been tested in this new configuration in order to validate component designs and processes for meeting the requirements of LCLS-II. Areas of study included gradient and Q_0 performance and their dependence on extrinsic factors, thermal performance of the input coupler and HOM feedthroughs, and microphonics and RF control. A description of the testing and the results obtained are presented.

HTS UPGRADES

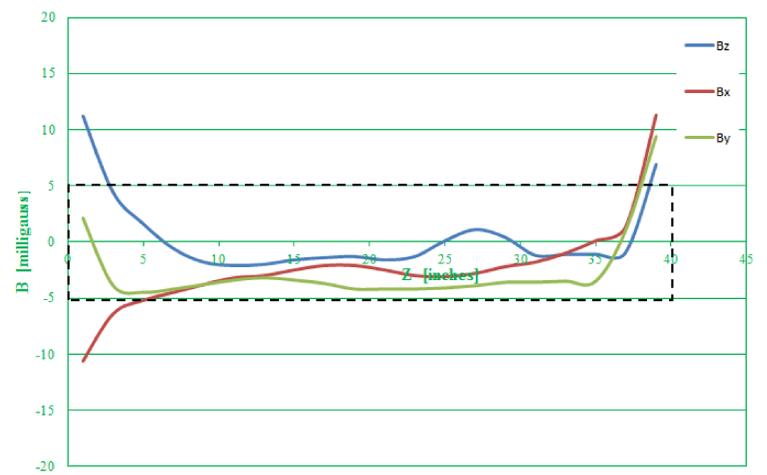
A number of new design elements for the LCLS-II cavities need to be verified:

- High- Q_0 cavities
- High thermal conductivity HOM feedthroughs
- High thermal conductivity input coupler
- New helium vessel and mag shielding
- New tuner system

The necessary testing for these verifications will be done at Fermilab's Horizontal Test Stand (HTS).

HTS was upgraded to support low-power CW cavity testing:

- Internal cabling for connecting to a high- Q_{ext} input coupler
- 200 W solid state amp as primary RF source
- Digital LLRF system with phase-locked loop
- External Helmholtz coils for cancellation of B -field inside cryostat

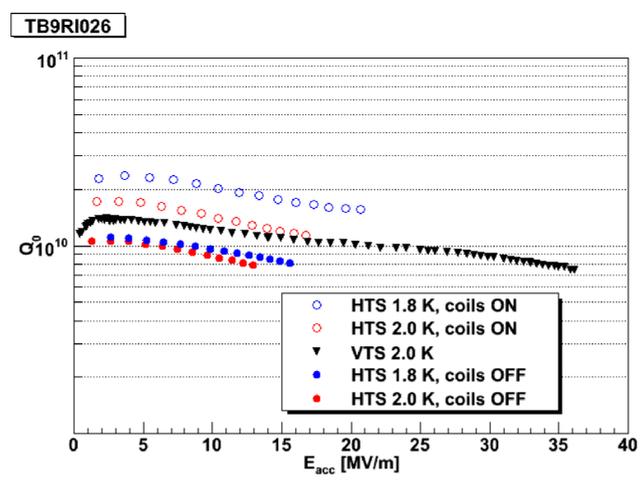


Room-temperature B -field inside ILC-style helium vessel in HTS with cancellation coils on. The average field is 6 mG; without the coils the field is 45 mG.

TB9RI026 RESULTS

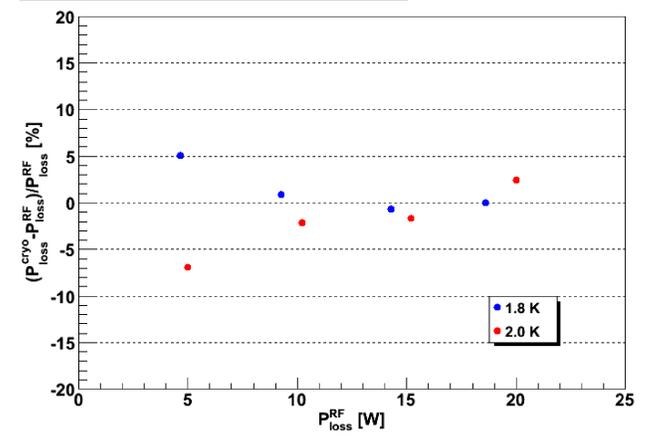


Cooling scheme for DESY HOM feedthroughs. Max ΔT was 0.5 K with end-cell field 22.6 MV/m



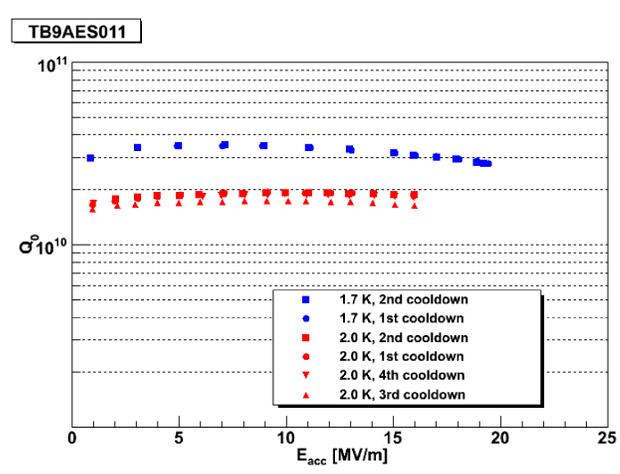
Q_0 vs. E_{acc} curves. Consistency with vertical test results

TB9RI026, cryo losses vs. RF losses



Comparison of cavity losses measured with cryo system to losses measured with RF system

TB9AES011 (N₂-DOPED) RESULTS



The observed Q_0 at 2 K was almost half of that observed in vertical tests. Cooldowns of various speeds and start temperatures, intended to maximize expulsion of trapped magnetic flux, had very little effect.

CONCLUSIONS

- HTS successfully upgraded and commissioned for CW operations
- DESY HOM feedthroughs show an acceptable temperature rise
- Nitrogen-doped cavity did not show high Q_0 in horizontal test.. Further studies are planned
- Verification of performance of LCLS-II input couplers, helium vessels, and magnetic shielding are planned