A.14: Performance characterization of first 1.3 GHz five cell SCRF cavity

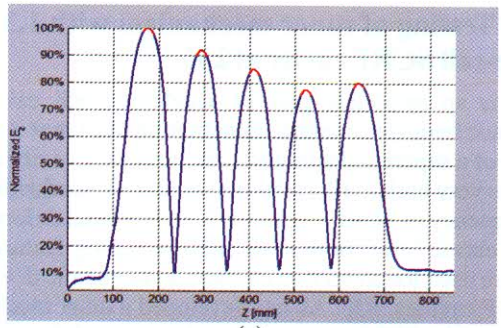
Development of 1.3 GHz five cell Superconducting Radio Frequency (SCRF) cavity has been taken up as a part of development of superconducting cavities for high intensity proton linac. The prototype 1.3 GHz five-cell SCRF cavity was fabricated and sent to Fermilab, USA under Indian Institution Femilab Collaboration (IIFC) for performance evaluation. The cavity was recently tested and has achieved accelerating gradient (E_{acc}) 20.3 MV/m at 2 K and 42 MV/m at 1.5-1.7 K with Q_0 of 2 E10.

The prototype 1.3 GHz five cell SCRF cavity was processed jointly by Argonne National Lab (ANL) and Fermi National Accelerator Lab (FNAL). The steps of cavity inspection and processing included visual inspection, mechanical measurement, vacuum leak testing, RF measurement, internal optical inspection, electro-polishing (EP), vacuum heat treatment, tuning, High Pressure Rinsing (HPR) and low temperature baking. During room temperature measurement of the cavity the resonant frequency, quality factor were measured and vacuum leak test was performed. The results are as given in Table A.14.1. The Fig. A.14.1 compares the field flatness of as received cavity (74%) and after tuning the cavity (98%). The Fig. A.14.2 shows the 1.3 GHz five cell SCRF cavity mounted on 2 K test stand. The cavity was processed with an additional stage of polishing and was tested during October 2014. The cavity achieved the accelerating gradient (E_{acc}) of 20.3 MV/m at 2 K and 42 MV/m at 1.5-1.7 K with Q_0 of 2×10^{10} as shown in Fig. A.14.3.

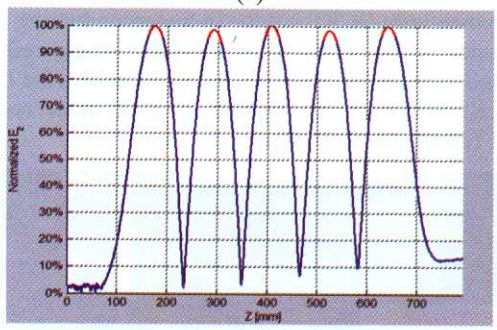
The performance of first 1.3 GHz multicell SCRF cavity is very encouraging. The above development adds to the sequence of steps made in the quest of technology development of niobium SCRF cavities, starting with 1.3 GHz single-cell SCRF cavities (October, 2011) and 650 MHz single-cell SCRF cavity (January, 2014). The experienced thus gained will facilitate in-house development of multi-cell superconducting cavities.

Table A.14.1: Room temperature test results

Parameter	Value
Pi mode Frequency	1297.8 MHz
Quality factor	9802
Vacuum test leak rate	$< 1 \times 10^{-10}$ mbar.l/sec



(a)



(b)

Fig. A.14.1: 1.3 GHz five cell SCRF cavity field flatness plot (a) before and (b) after tuning.

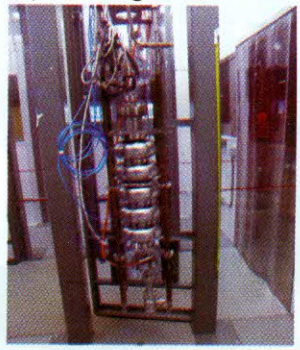


Fig. A.14.2: 1.3 GHz five cell SCRF cavity mounted on VTS stand.

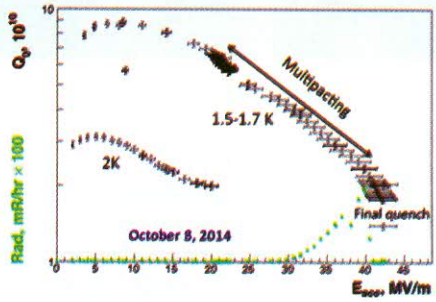


Fig. A.14.3: The Q vs E plot for TE5CAT006.

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