A.3: Development of 1.3 GHz five cell SCRF cavity

RRCAT has developed one 1.3 GHz five cell SCRF cavity, under Indian Institution Femilab Collaboration (IIFC). In past, RRCAT has developed 1.3 GHz single cell SCRF cavities which have been successfully tested at 1.8 K to achieve accelerating gradients (E_{acc}) up to 40 MV/m at Q >1.0 E10. (RRCAT Newsletter Article A.3, vol.25, issue 1, 2012)

As a next logical step, development of 1.3 GHz five-cell SCRF cavity has been taken up. A multi-cell SCRF cavity poses additional challenges involving development of dumbbells and their RF measurement, field flatness measurement and its control. This 1.3 GHz five cell cavity has been fabricated with simple end group, without HOM ports. Fig. A.3.1 shows the fabricated dumbbells. An elaborate inspection plan was formulated and implemented at each stage of cavity manufacturing involving control of mechanical dimensions and tolerances, control of RF frequency and vacuum leak testing of all the welded joints.

Fig. A.3.1: Dumbbells for 1.3 GHz Five SCRF cavity

All the dumbbells went through the iterative process of RF measurement, tuning by stretching in dedicated fixture and final trimming. Figure A.3.2 shows the tuning-trimming cycle of typical dumbbell qualification procedure.

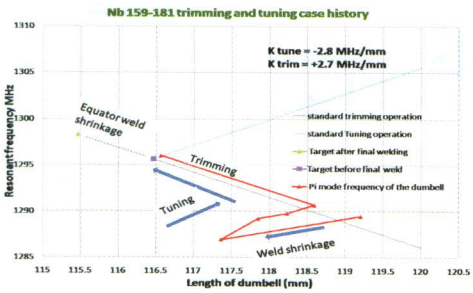

Fig. A.3.2: Tuning-Trimming cycle of dumbbell.

After completing the dumbbells, the final equator welding of five cells was carried out. Forming and trim machining of half-cells and fabrication of tooling and fixture was carried out at RRCAT. The electron beam welding of 1.3 GHz five cell cavity was done at Inter University Accelerator Centre (IUAC) facility, under MoU.

Fig. A.3.3: 1.3 GHz Five cell SCRF cavity

The fabricated 1.3 GHz five cell cavity was subjected to various mechanical and RF qualification including vacuum leak testing up to 77 K . The cavity has qualified for vacuum leak test with leak rate < 1×10^{-10} mbar l/sec up to 77 K. Table A.3.1 shows the RF measurement at different temperature.

Table A.3.1: Cavity frequency at different temperature.

π mode Frequency (MHz)	*Temperature*
1298.066370	*Room Temp. (300 K)*
1299.915500	*LN_2 Temp. (77 K)*

A bead pull measurement was also carried out on 1.3 GHz five cell cavity for field distribution. Figure A.3.4 shows the set-up of bead pull measurement and Fig. A.3.5 shows the field flatness plot. The field flatness of as fabricated cavity was 74 %.

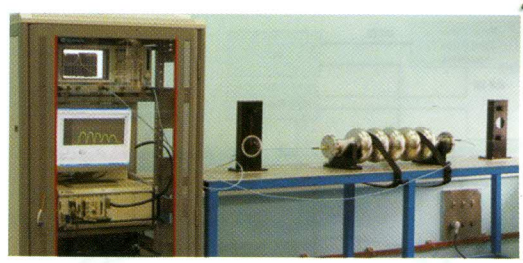

Fig. A.3.4: Bead-pull measurement setup.

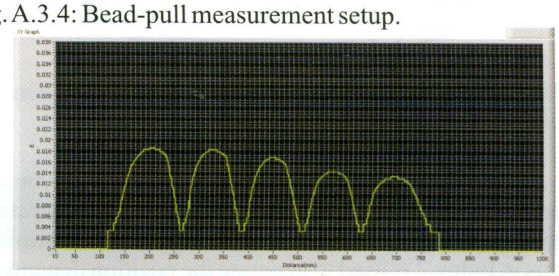

Fig. A.3.5: On axis E-field profile of five cell cavity.

The five cell SCRF cavity will be taken up for field flatness tuning, further processing and testing at 2 K for performance evaluation. The above development activity was jointly carried by various groups including, IMAS, ACDFS, PHPMS along with PLSCD.

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