INDUSTRIAL PRODUCTION OF SUPERCONDUCTING 1.3 GHZ ACCELERATOR MODULES AND COMPONENTS FOR FEL APPLICATION

Michael Pekeler, Hanspeter Vogel, Peter vom Stein,
ACCEL Instruments GmbH, Bergisch Gladbach, Germany

Abstract

Daresbury Laboratory contracted ACCEL in April for the delivery of two superconducting 1.3 GHz modules for the R&D phase of their 4GLS [1] project. The modules are delivered with guaranteed performance on cavity voltage and cryogenic losses. The modules contain 2 TESLA [2] type cavities each and are of the design developed at Forschungszentrum Rossendorf [3]. To investigate the capabilities of our cavity treatment and preparation techniques, our infrastructure was further upgraded to allow chemical treatment and high pressure rinsing of TESLA cavities. First test results on TESLA cavities produced for BESSY are very encouraging. 23 MV/m accelerating gradient were achieved in the cold vertical test. In addition 12 power couplers of the TTF III type were produced for DESY and BESSY. The conditioning of those couplers was performed at DESY in a very short time of approximately 50 hours demonstrating our high quality surface treatment capabilities.

SRF BI-CAVITY MODULES

The superconducting bi-cavity modules (s. fig.1) are optimized for operation in cw mode with moderate beam currents. The module design has been developed at Forschungszentrum Rossendorf and is used under a license agreement. ACCEL performs beside the module integration the whole cavity manufacturing and preparation including guaranteed performance values (s. tab.1). Each module is equipped with two TESLA type cavities, which run at 2 K in superfluid helium. Both cavities are mechanical coupled to a rigid string, which improves the stiffness against microphonic oscillations. The diameter of the two phase helium line connection to the helium tank is increased compared to the TESLA design to improve the performance with high dynamic rf losses.

RF frequency	1300 MHz
Operating temperature	2 K
Accelerating gradient	15 MV/m guaranteed 20 MV/m goal
Q_0 @ 15 MV/m	$5x10^9$
Rf power per coupler	8 kW cw
Stand by losses	<15 W
Length (flange to flange)	3.26 m

Table 1: Basic parameters srf bi-cavity module

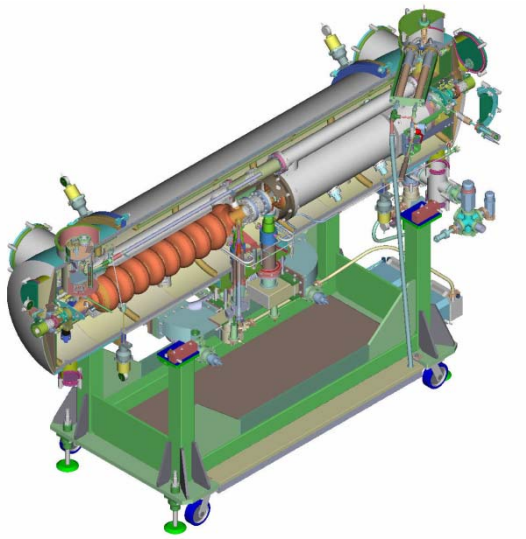

Figure 1: SRF bi-cavity module (courtesy FZ-Rossendorf)

The power capability of the rf input coupler is approx. 10 kW cw per cavity. The thermal shield of the module is cooled by liquid nitrogen at atmospheric pressure. The magnetic shielding is provided by a mu-metal shield housed at the inner side of the vacuum tank.

TESLA TYPE CAVITIES AND COUPLERS

Two 1.3 GHz TESLA cavities have been prepared at ACCEL for vertical test so far. The preparation including tuning to field flatness was done this spring. Figure 2 shows one of the cavities during the high pressure rinsing procedure.

Figure 3 and 4 show the results of cavities BE1 and BE2. The RF test was performed at DESY. The two cavities were produced for BESSY for FEL studies. During preparation of the first cavity (BE2) a leak occurred and the cavity needed to be vented and sealed again. In addition, this cavity was shipped under N2 atmosphere whereas the second cavity (BE1) was shipped under vacuum. Shipping under vacuum has the advantage that one only needs to open the all metal valve located at the cavity after pumpout of the insert pump line. Thus there is no risk of contaminating the cavity by dust accumulated in the pumping line.

Figure 2: High pressure rinsing of a nine cell 1300 MHz TESLA cavity at ACCEL.

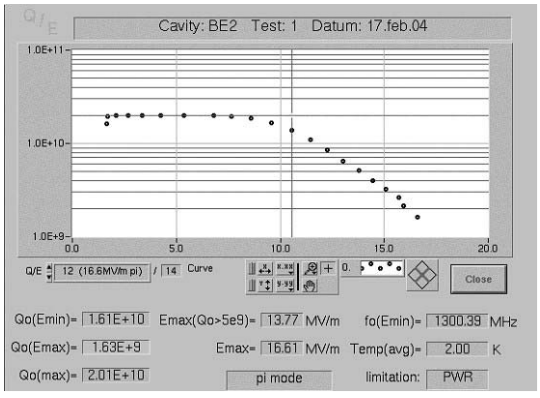

Figure 3: Test result of first prepared TESLA cavity BE1. Field emission was observed above 10 MV/m.

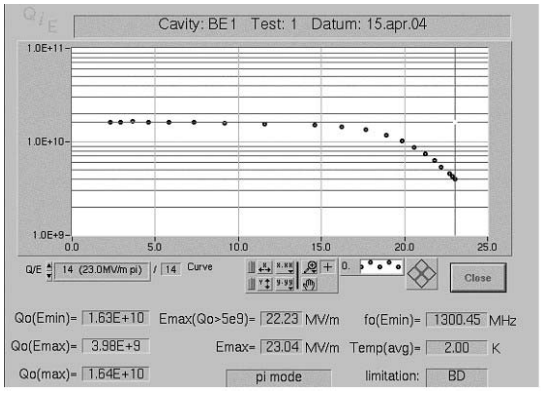

Figure 4: Test result of second prepared TESLA cavity BE2. No field emission was observed. The Q drop at highest fields is without indication of x-rays. The cavity was limited at 23 MV/m by a quench.

Cavity BE1 is now at ACCEL for the helium vessel welding. After that they will be prepared at ACCEL for horizontal test. The needed input power couplers of the TTF III style were produced also at ACCEL and have been conditioned on a test stand at DESY already. After approx. 50 h of conditioning the power couplers reached the design values [4]. The horizontal test of the cavities will be done at BESSY.

Figure 5: TTF III style power coupler

REFERENCES

[1] M.W.Poole et al.,"4GLS: A New Prototype of Fourth Generation Light Source Facility", PAC 2003, Portland, May 2003, p.189

[2] F. Richard ed.,"TESLA TDR", ECFA 2001-209, March 2001

[3] A. Büchner et al.,"The ELBE-Project at Dresden-Rossendorf", EPAC 2000, Vienna, June 2003, p. 732

[4] W. D. Möller, private communication