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FURTHER TESTS ON THE SC 325 MHz CH-CAVITY AND POWER COUPLER TEST SETUP*

M. Busch[†,1], W.A. Barth[2,3,4], M. Basten[1], F. Dziuba[3]
V. Gettmann[3], H. Podlech[1], U. Ratzinger[1], M. Schwarz[1]
[1]IAP, Frankfurt University, Frankfurt am Main, Germany
[2]GSI Helmholtzzentrum, Darmstadt, Germany
[3]HIM, Helmholtz-Institut Mainz, Mainz, Germany
[4]MEPhI, National Research Nuclear University, Moscow, Russia

Abstract

The 325 MHz CH-cavity which has been developed and successfully vertically tested at the Institute of Applied Physics, Frankfurt, has reached the final production stage. After the repair of the leaky membrane flange further tests in a vertical and horizontal environment are in preparation. The corresponding 325 MHz power couplers have been conditioned and tested at a dedicated test stand up to the power level of 40 kW (pulsed) for the targeted beam operation. Furthermore a new developed test stand for the 217 MHz power couplers has been designed and elaborated for the cavities of the sc cw-LINAC project at GSI.

PRESENT STATUS OF THE 325 MHz CH-CAVITY

After successful tests with gradients up to 14.1 MV/m at 2 K [1] the 325 MHz CH-cavity was sent back to Research Instruments for final weldings of the helium vessel and surface treatment. However, the final leak tests discovered a small leak inside the membrane bellow within the port for the power coupler.

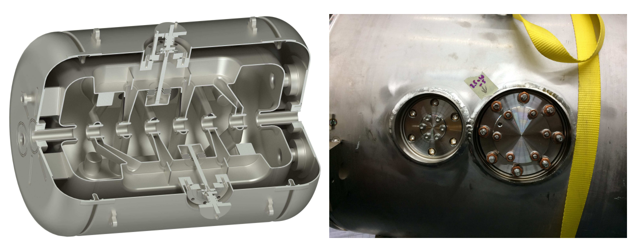

Figure 1: Left: Cross section of the 325 MHz CH-Cavity. Right: Position of the leak (power coupler port).

Due to the complex and sensitive position of the leak it was decided to cut out a race track profile around the coupler and pick-up port, respectively, including the membrane bellows (s. Fig. 1). Meanwhile a replacement "trough" has been fabricated and welded to the helium vessel (s. Fig. 2). The cavity is now being prepared for vertical tests and a horizontal test environment is under development.

Figure 2: Left: Separated helium vessel (cut out profile including membrane bellows). Right: Replacement trough welded into the helium vessel.

325 MHz POWER COUPLER TEST SETUP

The tests of the FPCs for the 325 MHz CH-cavity were performed at a dedicated test stand [2].

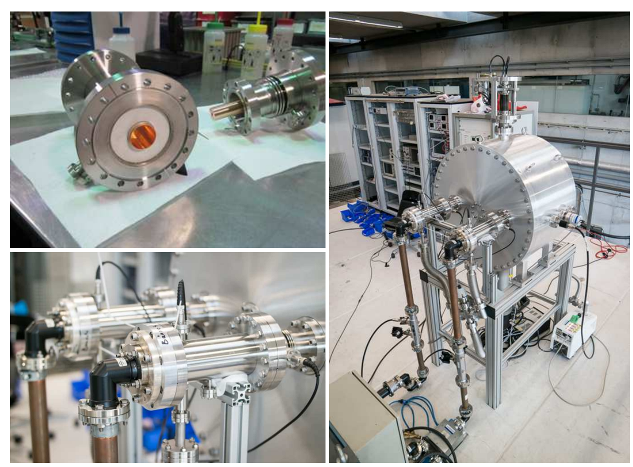

Figure 3: Pictures of the coupler's cold and warm parts (top left) and the assembly with the pill box cavity.

This setup consisted of a tuneable pillbox cavity made of aluminum and enabled two power couplers to be conditioned up to 40 kW pulsed power (s. Fig. 3). The couplers were equipped with two Langmuir probes biased with a voltage of 50 V, four Pt100 probes for temperature measurement and a pumping port for the volume between the ceramic windows. Besides the measurement of P_f and P_r the current of the Langmuir probes as well as the pressure between the alumina windows have been recorded to detect Multipacting events. In a first step the couplers were preconditioned

* Work supported by GSI, BMBF Contr. No. 05P15RFRBA
† busch@iap.uni-frankfurt.de

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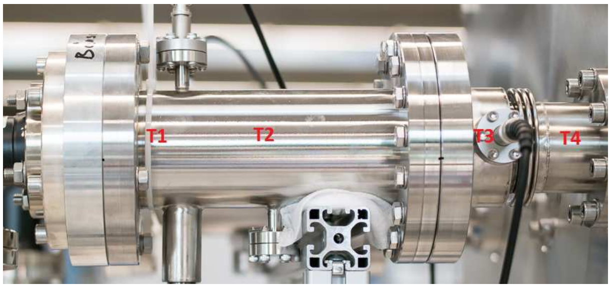

Figure 4: Temperature probes at the coupler surface.

with 200 W cw power. Then 5 Hz, 1 ms pulses were applied with progressive power from 200 W to 40 kW. In the range from 200 W to 2200 W small pressure variations occured at 1.1 kW to 1.5 kW without any rise in current. This effect is due to degassing and cleaning of the surface. Then several multipacting barriers emerged up to 2.2 kW. The conditioning time for this part was 10 h. The range from 5 kW to 11 kW took 80 min and showed only few and single barriers. The final part from 30 kW to 40 kW took 180 min. In this range only one strong Multipactor occurred at 36 kW but could easily be surmounted. During the whole processing the temperature has been recorded with four Pt100 probes attached to distinguished coupler parts (s. Fig. 4). Initially the temperature was at 21°C without input power. Then power level was ramped up to maximum value of 40 kW within 20 min. At equilibrium the maximum deviation to the initial temperature was 4.3°C at the cold window (T3) and 3.3°C at the warm window (T1), respectively.

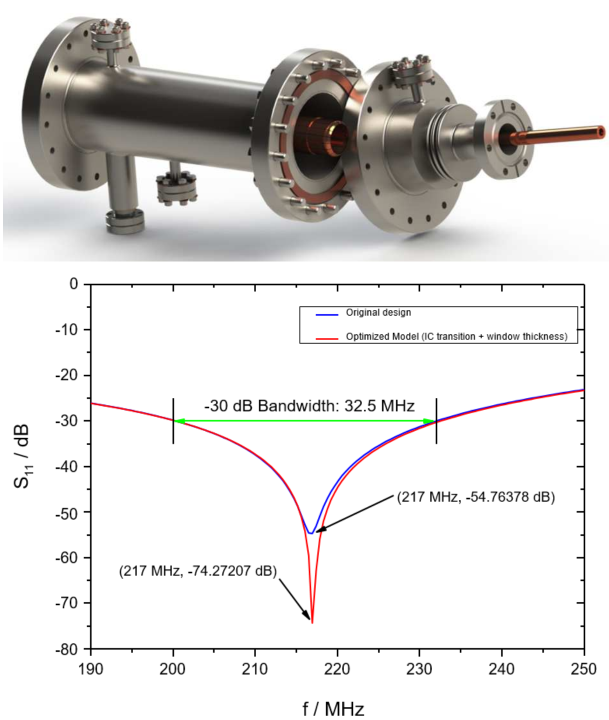

Figure 5: Top: Warm and cold end of the 217 MHz FPC. Bottom: Simulated reflection signal for the final design.

LAYOUT OF THE 217 MHz FPCs

Pursuing the goal of a future super-heavy element (SHE) production at GSI [3] a first step is the realization of a cw-LINAC Demonstrator [4]. For the sc 217 MHz CH-cavities dedicated power couplers have been developed to fulfill the design requirements (5 kW input power) of the cw-LINAC [5] (s. Fig. 5). Basing on the geometry of the 325 MHz FPCs [6] this coupler (s. Fig. 6) was optimized to 217 MHz in terms of position and thickness of the ceramic windows and regarding the transition to a smaller diameter at the cold end part of the coupler. Figure 5 shows the reflection parameter versus frequency for the optimized case enabling a broad bandwidth around the design frequency. Since the FPC is not cooled this geometry can be used for beam tests with moderate beam loading [7].

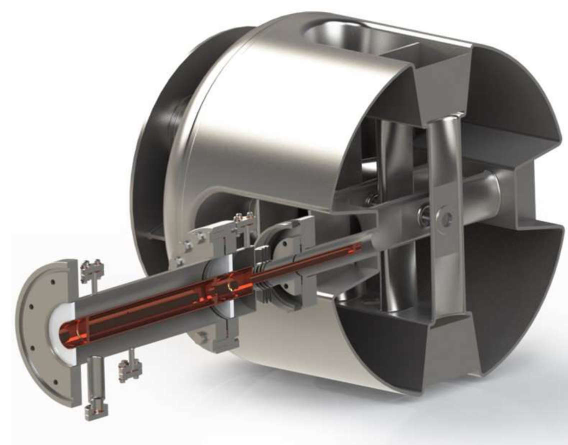

Figure 6: Sectional view of the developed power coupler connected to a 217 MHz CH-cavity.

TEST BENCH FOR 217 MHz FPCs

A new, dedicated test bench has been designed and built due to the low frequency of the cw-LINAC cavities (s. Fig. 7).

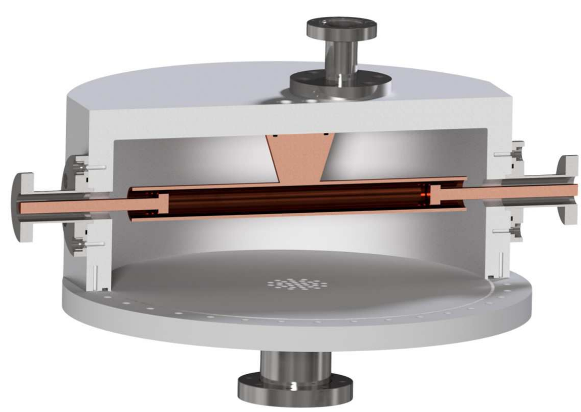

Figure 7: Cut-view of the designed test bench cavity.

This test stand features a quarter-wave-resonator related waveguide with an extended center tube to connect two

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power couplers. Within simulations a broadband transmission signal (±10 MHz) could be attained with this compact geometry enabling various coupler length configurations for testing (s. Fig. 8).

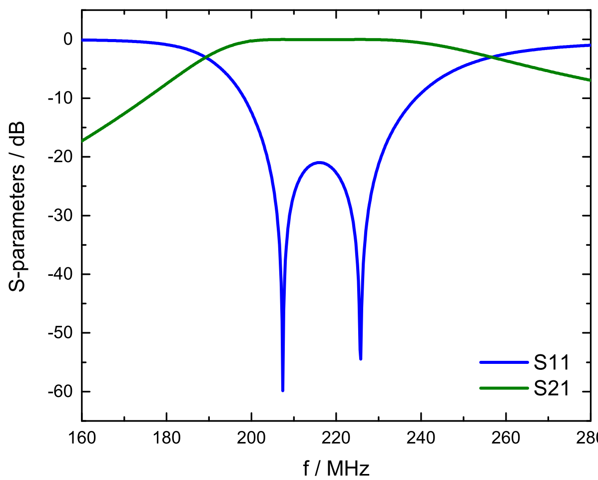

Figure 8: S-parameter properties of the QWR-like waveguide.

The cylindrical box is made of aluminum while the center conductor as well as the long centrical aligned tube are made of copper for better thermal and electrical conductivity. On the top of the box two CF40 flanges for pick-ups are mounted as well as a pumping flange (CF63) at the bottom of the housing. After the assembly of the components first measurements showed a good agreement with the simulations (s. Fig. 9). Meanwhile the FPCs have been tested up to 5 kW pulsed power in SW and TW mode [8].

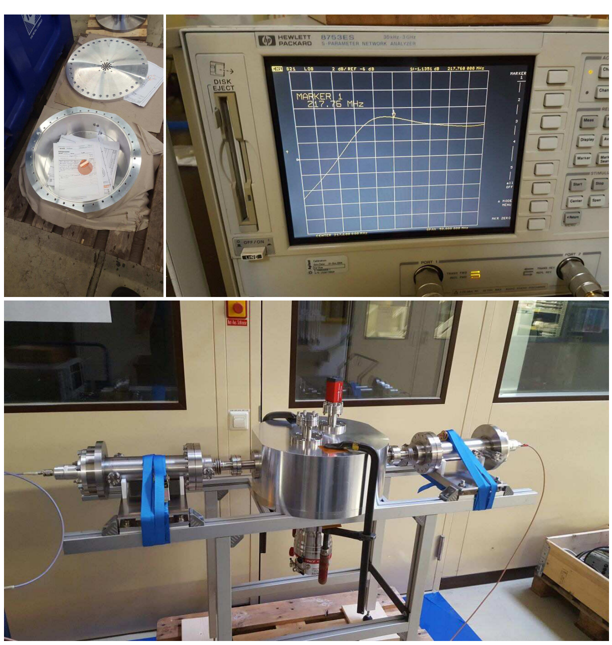

Figure 9: From top left to bottom: Single components, first measurement and picture of the assembly with two FPCs of the newly developed test bench.

ACKNOWLEDGEMENT

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