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CURRENT STATUS OF THE MYRRHA CAVITIES

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Abstract

The MYRRHA (Multi-purpose hYbrid Research Reactor for High-tech Applications) Project [1] is a planned accelerator driven system (ADS) for the transmutation of long-living radioactive waste. In order test the reliability of the planned 17 MeV injector [2], a shortened injector with 5.9 MeV consisting of the ion source, a 4-Rod RFQ, 2 Quarter Wave Rebunchers (QWRs) and a total of 7 normal conducting CH structures is currently being installed in Louvein-la-Neuve (LLN, Belgium). Before the cavities can be tested with beam, they are subjected to so-called low power tests several times during the individual construction stages in order to be able to correct any deviations. This paper describes the status of the two Quarter Wave Rebunchers, which are currently in the process of copper plating and final acceptance, as well as the first two CH structures, the first of which is already being conditioned while CH 2 is still in preparation.

STATUS OF THE QUARTER WAVE REBUNCHERS

The two identically designed Quarter Wave Rebunchers have been manufactured by KRESS (Biebergemünd, Germany). In order to meet the required resonance frequency of the structures exactly during construction, both the stem and the outer tank have been built with an allowance of several mm (see Figure 1). Since the frequency of the QWRs essentially depends on the length of the inner conductor, i.e. the stem, the frequency was adjusted in several iterative steps up to the target frequency. Only then did the final assembly of the tank take place.

The measured frequencies of the QWRs (see Table 1) are clearly above the operating frequency of the injector of 176.1 MHz. This is deliberately chosen because two tuners (one static and one dynamic) per cavity will keep the frequency stable in later beam operation.

Table 1: The Resonance Frequency f_0 of the QWRs 1 and 2 Measured BEFORE Copper Plating

Cavity	f_0 (before copper plating)
QWR 1	177.06 MHz
QWR 2	177.06 MHz

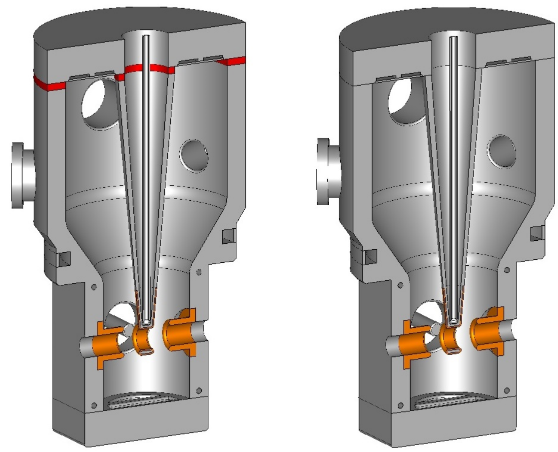

Figure 1: Comparison of a QWR with allowance (marked in red on the left picture) and without allowance.

For the comparison of the gap voltage ratios (see Figure 2), the distributions from the beam dynamics and the CST [3] simulations have been used.

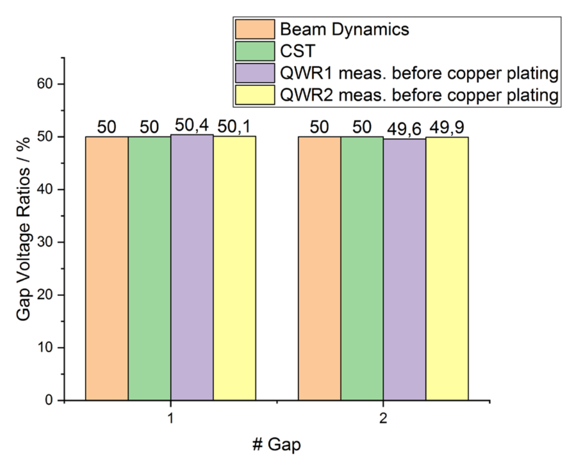

Figure 2: Comparison of the gap voltage ratios for QWR 1 and QWR 2.

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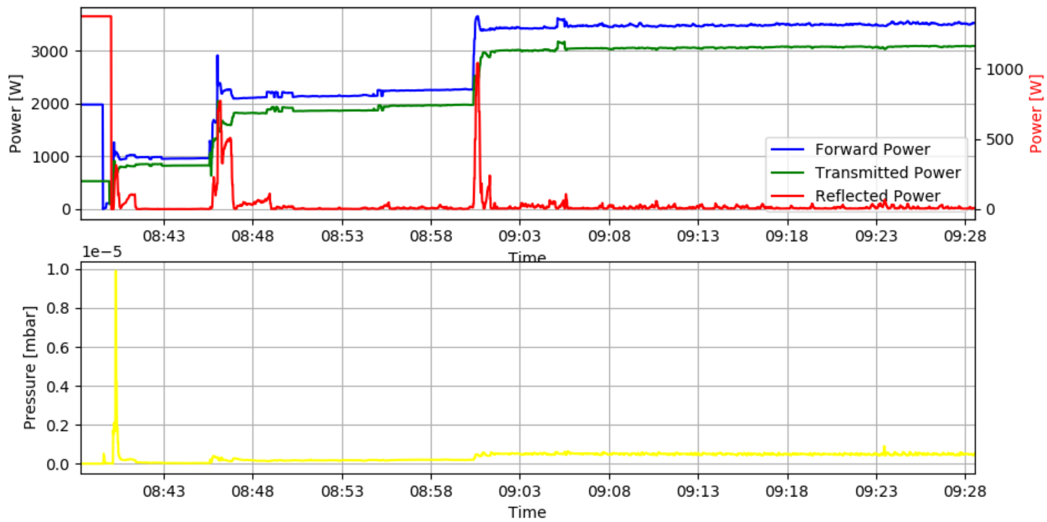

Figure 3: Measured power and pressure data for the commissioning of CH 1 up to 3 kW.

STATUS OF CH 1

CH 1 is currently located in the bunker of the IAP Frankfurt (see Figure 4) and was equipped with a vacuum system and the water cooling system, in which all channels [2] were connected in parallel and a temperature sensor is located at each water outlet and some inlets in order to determine the temperature increase during the conditioning process.

During conditioning approx. 9 kW are to be injected into the cavity, whereby for later beam operation approx. 7kW are expected to be needed to achieve the electric fields required by the beam dynamics. At the time of recording the data shown in Figure 4, 3 kW could already be coupled in stably. The short-term increases in reflected power, such as occur at about 9.00 am, are mismatches between the frequency of the forwarded power and the resonance frequency of the cavity. These mismatches can be explained by the fact that in this test setup both the frequency and the level of the forwarded power are controlled manually, while the frequency adjustment in later beam operation is ensured by a dynamic tuner in the cavity.

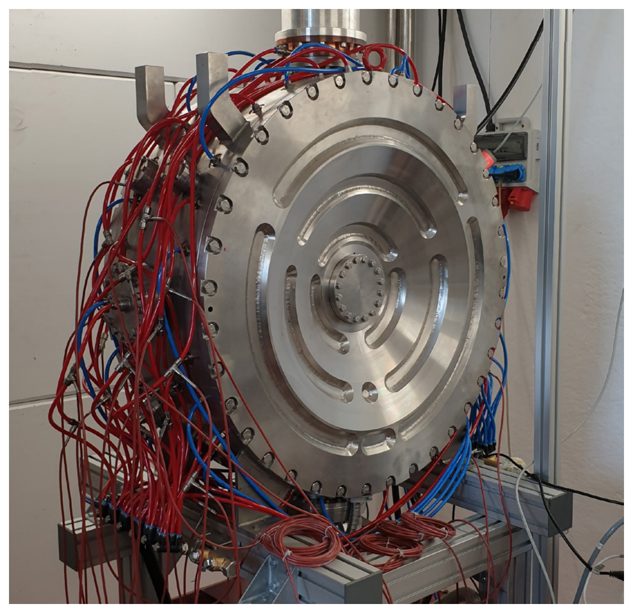

Figure 4: CH 1 in the bunker of the experimental hall of the IAP with connected vacuum and cooling water system including temperature monitoring.

STATUS OF CH 2

The CH 2 was produced by PINK (Wertheim, Germany) and will be conditioned in the bunker of the IAP Frankfurt experimental hall as soon as the conditioning of CH 1 is completed.

A comparison of the resonance frequencies and Q-values between the simulation and the measurement of the CH 2 before and after copper plating is shown in Table 2 and the comparison of the gap voltage ratios is shown in Figure 4.

Table 2: The Resonance Frequency f_0 and the Q-value of CH 2 Simulated with CST (left), Measured Before (middle) and after Copper Plating (right)

	Simulated CAD model	**Measurement before copper plating**	**Measurement after copper plating**
f_r	176.6 MHz	177.0 MHz	176.8 MHz
Q_0	$\approx 13{\cdot}10^3$	$\approx 2{\cdot}10^3$	$\approx 13{\cdot}10^3$

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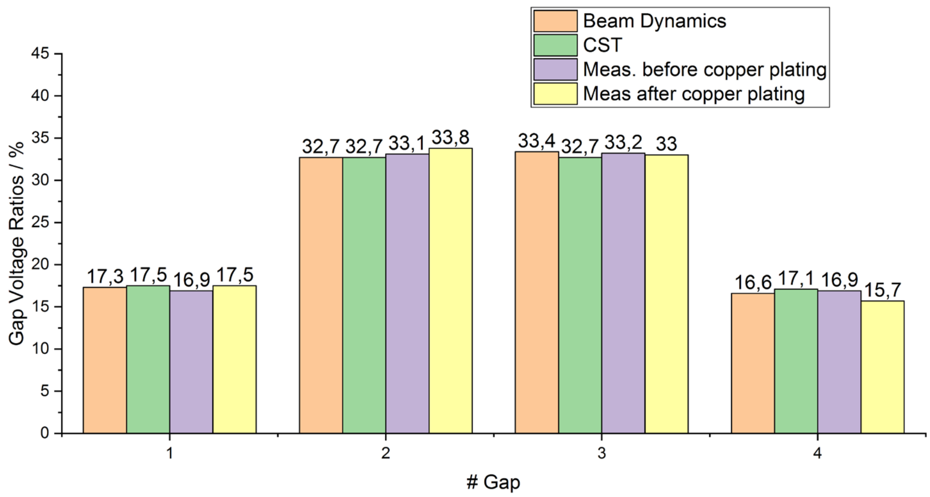

Figure 5: Comparison of the gap voltage ratios of CH 2.

The difference of approx. 0.2 MHz from the simulated to the measured resonance frequency after copper plating lies within the expected deviation and can be compensated by the length of the tuner and therefore poses no problem.

Likewise, the measured gap voltages shown in Figure 5 are within the permitted tolerances.

SUMMARY AND OUTLOOK

The first four cavities are in different stages of preparation for their use in the MYRRHA injector. QWR 1 and QWR 2 were copper plated after successfully completing low power measurements and are in final assembly before being conditioned.

CH1 is already in the conditioning process and shows no major problems so far. CH 2 was successfully subjected to low power measurements after copper plating and is currently being prepared to be conditioned directly to CH 1.

ACKNOWLEDGMENT

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