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STATUS OF THE MYRRHA CH CAVITIES

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Abstract

The MYRRHA (Multi-purpose hYbrid Research Reactor for High-tech Applications) project is a planned accelerator driven system (ADS) for the transmutation of long-living radioactive waste [1]. A critical passage for the beam quality and especially for the emittance is the injector, which for the MYRRHA project consists of a 4-rod RFQ, two Quarter Wave Rebunchers (QWR) and a total of 16 normal conducting CH-DTL cavities [2]. The first installment of the MYRRHA injector in Louvein-La-Neuve (Belgium) will include an ion source, a RFQ, the QWRs and the first seven CH cavities.

This paper will report on the status of the first tests of CH 1 and 2 as well as on further developments on CH 8 to 15.

THE CH SECTION OF THE MYRRHA INJECTOR

The CH section of the MYRRHA injector (see Figure 1) consists of 15 room temperature CH cavities and accelerates the proton beam from 1.5 MeV up to 16.6 MeV while using a constant phase configuration.

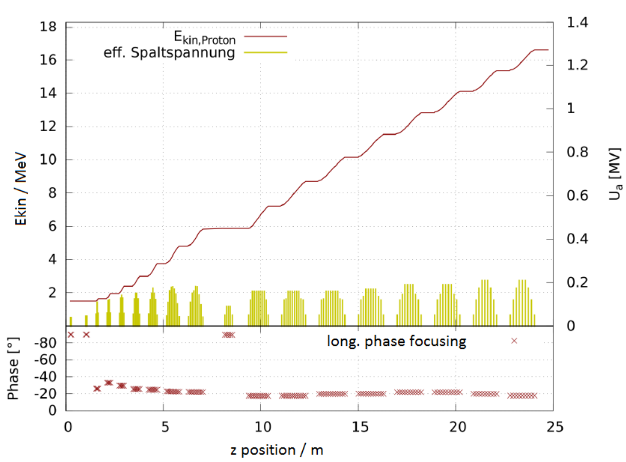

Figure 1: The estimated proton energy after the RFQ is 1.5 MeV [3] and increases up to 16.6 MeV at the end of CH 15 (upper graph in red). The effective voltages of the gaps are plotted in yellow. The lower graph shows the constant phase configuration of the CH cavities. An additional 5-gap CH Rebuncher (CHR) can be seen between CH 7 and CH 8.

Table 1: The Number of Gaps and Shunt Impedances of the CH Structures. The shunt impedances have been simulated with CST Microwave Studio [4].

Cavity	Number of Gaps	Shunt impedance [MΩ/m]
CH 1	3	22.18
CH 2	4	36.18
CH 3	5	48.38
CH 4	6	56.91
CH 5	7	61.50
CH 6	9	65.06
CH 7	9	61.06
CH 8	11	56.6
CH 9	12	53.3
CH 10	12	49.4
CH 11	11	47.8
CH 12	10	43.1
CH 13	10	41.5
CH 14	9	40.1
CH 15	9	38.8

STATUS OF CH 1

The CH 1 has been manufactured by NTG (Gelnhausen, Germany), it was copper plated at Galvano-T (Windeck, Germany) and is now in the experimental hall of the IAP (see Figure 2).

Both after production and after copper plating, measurements of the resonance frequency could be carried out and compared with the simulation result of the STEP model of the cavity (without copper plating) made with CST Microwave Studio (see Table 2).

Table 2: The Resonance Frequency f_0 of the CH 1 Simulated with CST (left), Measured Before (Middle) and After Copper Plating (right).

f_0 (simulation model) [MHz]	f_0 (before copper plating) [MHz]	f_0 (after copper plating) [MHz]
177.296	177.251	176.536

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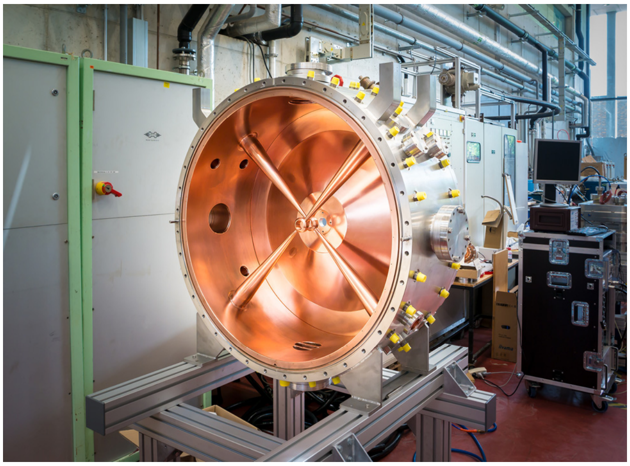

Figure 2: Copper plated CH 1 at the IAP experimental hall with open front lid.

The desired resonance frequency of 176.1 MHz will be achieved with the use of two tuning plungers, one of which is static and one dynamic to regulate the frequency during operation.

For the comparison of the gap voltage ratios, the distribution from the beam dynamics simulation could also be used (see Figure 3).

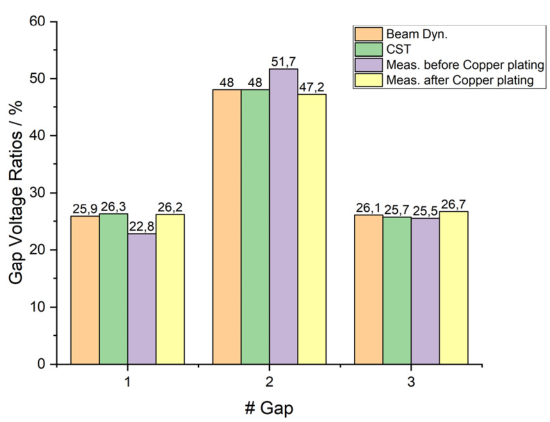

Figure 3: Comparison of the gap voltage ratios for CH 1.

In the next steps, the tuner, coupling loop and vacuum system will be installed before the CH can be conditioned with full power at IAP Frankfurt.

STATUS OF CH 2

The CH 2 cavity has been manufactured by PINK (Wertheim, Germany) and is currently being prepared for copper plating.

A comparison of the resonance frequencies between the simulation and the measurement of the CH 2 before copper plating is shown in Table 3 and the comparison of the gap voltage ratios is shown in Figure 4.

Table 3: The resonance frequency f_0 of the CH 2 simulated with CST (left) and measured before copper plating (right).

f_0 (simulation model) [MHz]	f_0 (before copper plating) [MHz]
177.006	176.711

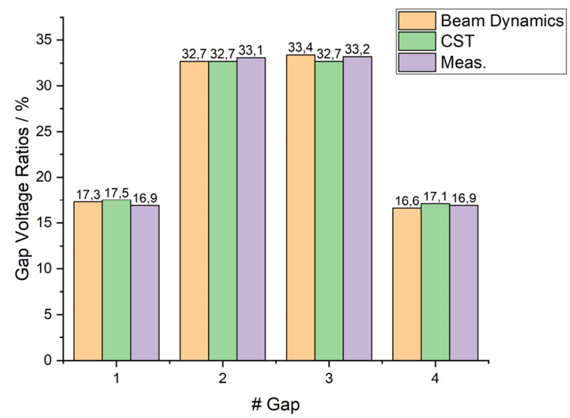

Figure 4: Comparison of the gap voltage ratios for CH 2.

DEVELOPMENTS OF THE COOLING SYSTEM

Due to the cw operation of the MYRRHA LINAC, the design of the cooling channels is very important to ensure a high reliability of the CH cavities. Therefore it was necessary to develop a new cooling channel design for the tank of CH 8 to 15, while the CH 1 to 7 and the CHR can be manufactured with the old design which is already used in the CHs 1 and 2.

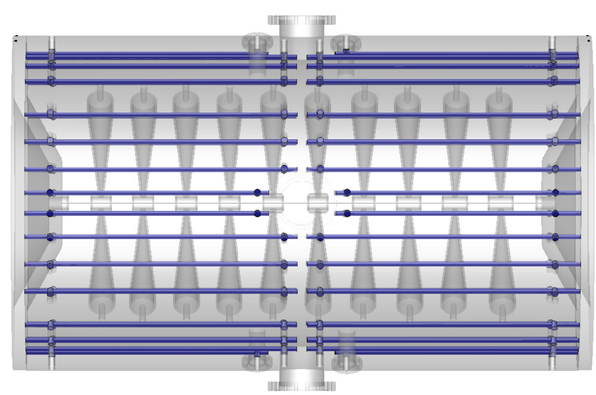

Figure 5: Cooling system of CH 8 tank (side view).

The cooling layout for the structures of CH 8 to 15 has been adjusted because of total length increase and higher power losses of the cavities [5]. Their total length exceeds one meter each and led to the decision to split each of the tank cooling channels into two separate channels (see Figure 5).

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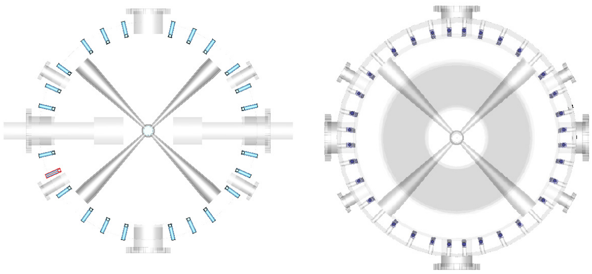

Figure 6: Comparison of the cooling channels inside the tank of CH 7 (left side) and CH 8 (right side) with additional cooling channels.

In addition, the former layout showed for the CH 8 to 15 insufficient cooling in the area of the flanges intended for the tuners, the vacuum system and the coupling. This is solved by inserting additional channels at the angle position of the flanges shown in Figures 5 and 6.

SUMMARY AND OUTLOOK

The tests on the first two CH cavities of the MYRRHA injector have started and show satisfactory results. It is planned to complete tests and the conditioning of these two by the end of the year, while at the same time the tender for CH 3 to 7 has already started. In addition, the thermal simulations for the remaining CH 8 to 15 were completed.

ACKNOWLEDGMENT

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