# Status of the IH-7-gap Structure (IH7SS) for MAFF

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Based on the the successful measurements carried out at the 1:1 copper model of one of the resonators in March 2000 [1], detailed construction drawings of a prototype of the power resonators had been produced, contractors had been contacted for offers and manufacturing finally started May 2001. An 100 kW, 202.56 MHz amplifier for this resonator with a duty cycle of 10% is already ordered and will be delivered Fall 2002. Meanwhile a test beam bench was set up at the -25$^o$ beam line of the tandem lab and preliminary emittance measurements of the test beam are already done. This way it could be confirmed, that test measurement of the prototyp reaching the required energies and pulse lenghts are possible with the equipment currently available at the tandem lab.

After recalculating the power distribution and the heat transfer during operation under maximum power, it turned out, that major changes in the cooling system of the resonator tank were neccessary. Particulary the base of the interdigital drift tube structure, that was originally planed to be made entirely out of copper plated stainless steel had to be exchanged by a watercooled copper base. Due to the low heat conductivity of V2A ($\lambda$ = 15 W/mK) compared to copper ($\lambda$ = 384 W/mK) the original design could not be cooled sufficiently over the entire power range. With the new drift tube base the maximum temperature spread between the "Hot Spots" and the cooling water is estimately 70 K. This should not cause any significant mechanical problems or detuning. Besides the fact that the linear termal growth factor of V2A and copper are nearly identical, the value of the temperature increase is too low to detune the resonator by more than 0.1 %. The drop of the conductivity due to the temperature increase is basicly more serious (27 %), but this effect is locally limited. Soldering a copper base to a stainless steel frame complicated the manufacturing of the prototyp significantly. Therefore the delivery date of the tank, that was scheduled for August 2001, was delayed until Spring 2002.

Since the final authorization to operate the Forschungreaktor München II, FRM II, is delayed, a proposal was made to modify the IH-7-gap structure in such a way, that it could be used as post accelerator for REX-ISOLDE [2].

| | Energy variable IH-7-Gap Structures for MAFF (MLL) | IH-9-Gap Post Accelerator for REX-ISOLDE (CERN) |
|---|---|---|
| Number of Resonators | 2 | 1 |
| Number of Gaps | 14 | 9 |
| Total Length [mm] | 1350 | 646 |
| Gap Length [mm] | 24 | 22 - 26 |
| Cell Length [mm] | 74 | 54 - 58 |
| Drift Tube Length [mm] | 50 | 32 |
| Drift Tube Diameter [mm] | 20/26 | 16/22 |
| A/q | 6.3 | 4.5 |
| Design Speed [ß] | 0.1 | 0.073 – 0.078 |
| Injection Energy [MeV/u] | 4.15/5.40 | 2.3 |
| Exit Energy [MeV/u] | 3.7-5.9 | 3.1 |
| Design Frequency [MHz] | 202.56 | 202.56 |
| Frequency Range [MHz] | 200.9 - 202.9 | 201.6 – 203.4 |
| Shunt Impedancy [MΩ/m] | 160 | 300 |
| Q | 18000 | 15000 |
| HF-Power / Duty cycle | 100 kW / 10 % | 100 kW / 10 % |

Fig. 1: Comparison between the characteristics of the IH-7-gap structure and the proposed 9-gap structure of the REX-Isolde upgrade.

MAFIA calculations showed that the desired energy range (2.2 MeV/u injection energy, 3.1 MeV/u final energy) can be reached at the given resonator frequency of 202,56 MHz using the resonator tank designed for the IH-7-Gap structure. This is possible without changes to the HF amplifier and the resonator tank itself. Only the drift tube structure, consisting of 6 drift tubes and their respective holder units, has to be replaced by 8 holder units (incl. the drift tubes) of basicly the same design, but with slightly different dimensions. Thus, the 7-gap structure would be turned into a 9-gap structure. Since these parts of IH7SS were designed to be adjustable and exchangeable from start on, this exchange can be easily performed.

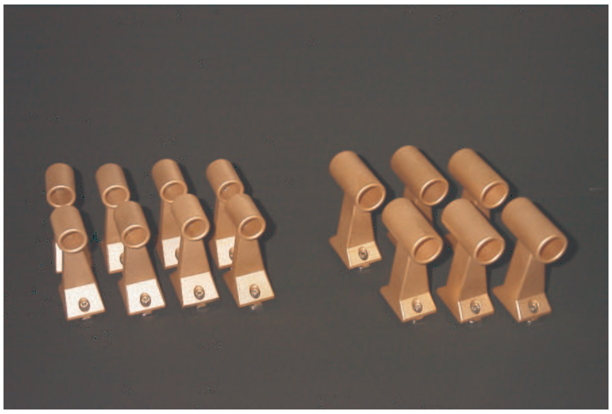

Fig. 2: The drift tubes and holder units of the IH7SS and the new proposed 9-gap structure. The basic design is identical, the radii of the new drift tubes are 2 mm smaller, the length is adjusted for the new cell length of 56 mm to 32 mm and the center part of the holding rods is 10 mm thinner.

The new drift tubes are already built and successfully tested at measurements carried out at the manufacturer (NTG) to determine the final dimensions of the resonator flanges. It could be verified that the measured resonance frequency of the IH7SS and new structure are in very good (+/- 0.05 %) agreement with the calculations.

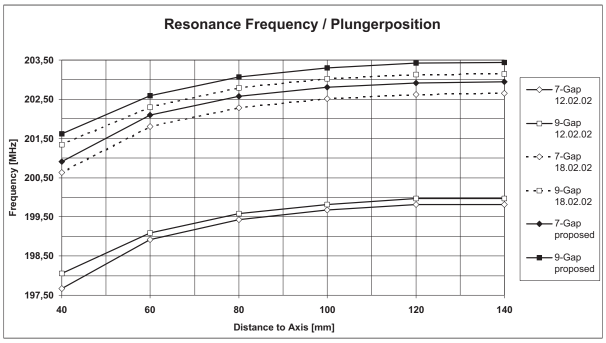


Fig. 3: Measurements of the frequency characteristic of the IH7SS and the new 9-gap structure carried out February 12th 2002 and February 18th 2002 at NTG in Gelnhausen with different flange sizes. The proposed values are based on MAFIA-calculations considering the final flange dimensions and copper plating.

## References

[1] H. Bongers *et al.*, Annual report 2000, p. 57
[2] O. Kester, D. Habs, T. Sieber, H. Bongers *et al.*, Proposal to the INTC Committe, March 2002