INVESTIGATION OF A SPLITRING RFQ FOR HIGH CURRENT ION BEAMS AT LOW FREQUENCIES

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Abstract

For hadron linacs RFQs are the first stage of acceleration. To reach very high intensities a new Splitring-RFQ is investigated. Not only a high current and high beam quality/brilliance should be achieved, also a good tuning flexibility and comfort for maintenance are part of the study. It will consist of two stages with 27 MHz and 54 MHz to accelerate ions with an A/q of 60 up to energies of 200 keV/u. Therefor RF simulations with CST MWS were done to study the quality factor and the shunt impedance as well as tuning possibilities. First results and the status of the project will be presented.

DIFFERENT DESIGN STUDIES

As a first step, some general studies have been performed to evaluate advantages and disadvantages for different design concepts based on a splitring geometry. According to some studies at TRIUMF [1], three main concepts were chosen: the wine glass shaped, the heart shaped and the tulip shaped geometry (see Fig. 1). All three have in common to consist of one main ring (respectively part of one ring) perpendicular to the beam axis where all electrodes are mounted.

The wine glass geometry has its beam axis at the upper level of the ring. The holding of the electrodes is horizontally mounted at the ends of the ring part with its length depending on the opening angle of the ring.

The other two geometries have the beam axis right in the centre of the ring. Therefor the holdings for the heart shaped design are bent with half the radius of the big ring. The holdings for the tulip design are as well as the ones for the wine glass design mounted at the ends of the ring. In contrast, they have a constant length, but their orientation depends on the opening angle.

GEOMETRY INFLUENCE ON ACCELERATOR PARAMETERS

Parameter sweeps were performed for numerous geometry parameters with all three geometry designs to find out their influence on several accelerator parameters such as resonance frequency, shunt impedance or quality factor. For example, some are shown in fig. 2 with the tulip design: e.g. the length and width of the stem; the radius, the opening angle and the longitudinal as well as radial width of the main ring; longitudinal and vertical width of the holding; length of the electrodes or rather the distance between to ring modules.

As much parameters as possible have been varied to investigate their influence on the accelerator parameters. Figure 2 e.g. shows the influence on the resonance frequency respectively the quality factor by the radius of the ring, the longitudinal width of the ring, the angle of the ring (all three marked with blue arrows in fig. 3) and the distance between the ring and the cavity wall. Naturally different variations have diverse and diverse strong influence on the resonance structure.

COMPARISON OF DIFFERENT DESIGNS

Every design concept was optimized to the highest possible quality factor at the specific resonance frequency of 27 MHz. The results are shown in table 1. The differences are marginal at this early state of investigation. To obtain more significant results the structures will be developed more in detail. So this is why the next steps will be performed as well with all three concepts.

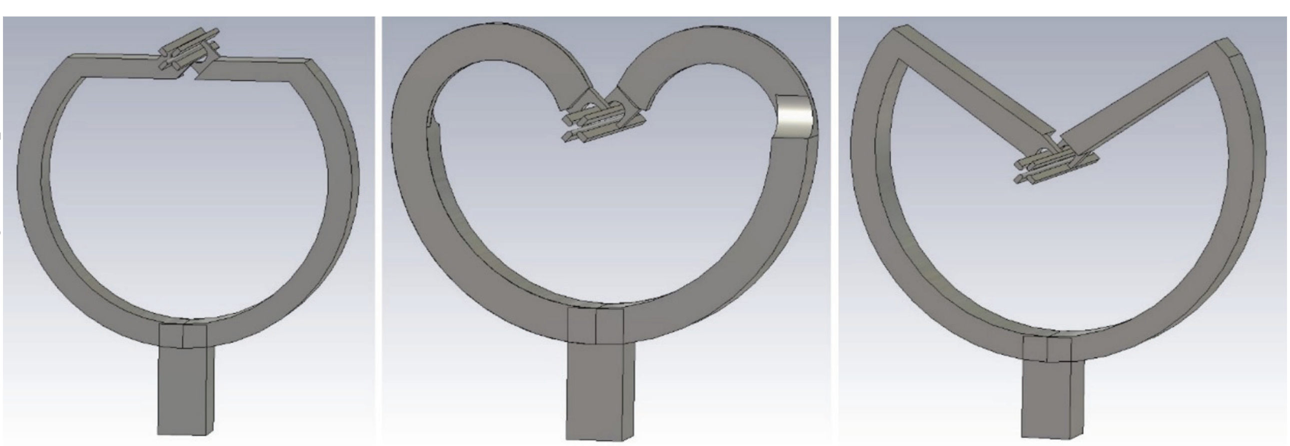
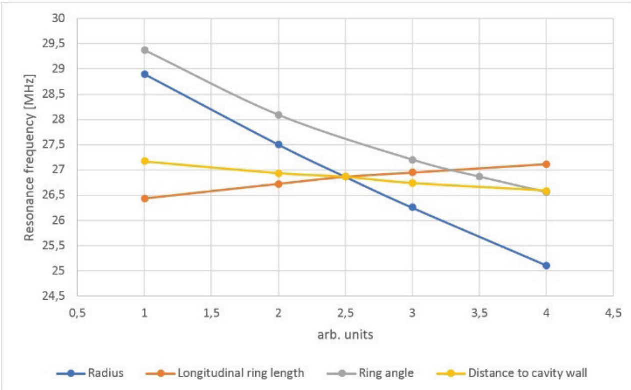


Figure 1: The three design concepts: on the left the wine glass shaped, in the middle the heart shaped and on the right the tulip shaped splitring RFQ.



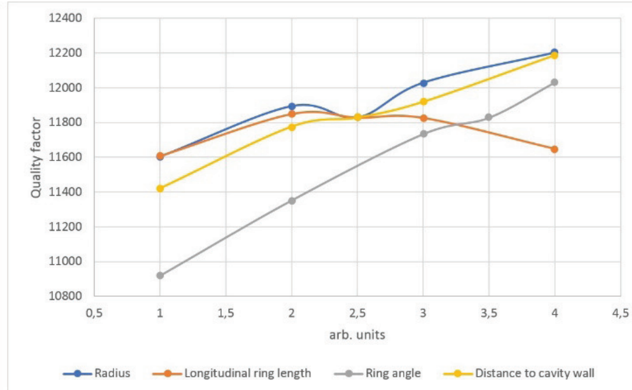


Figure 2: The influence of some geometry variations on the resonance frequency (left) and the quality factor (right) using the example of the tulip design.

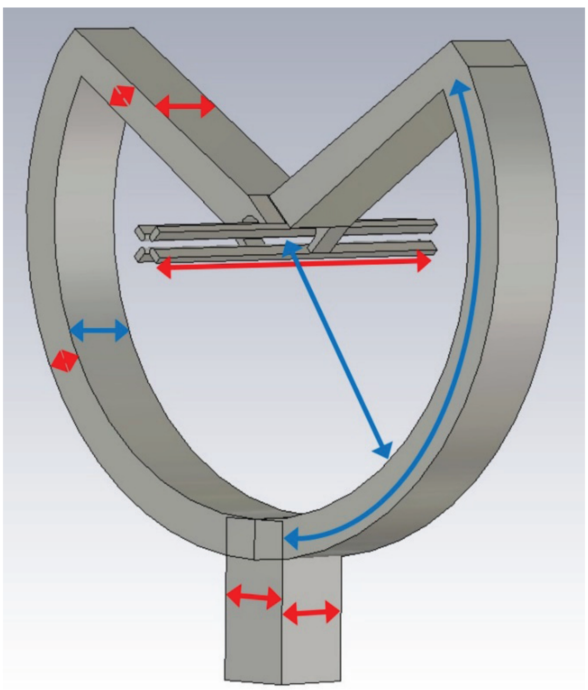


Figure 3: Examples for varied parameters with the tulip design. Similar and other parameter sweeps were done with the other designs, too.

Table 1: Accelerator Parameters

	Resonance frequency [MHz]	Quality factor	R_P-value [kΩm]
Wine glass	27.02	11700	1360
Heart	27.05	11300	1420
Tulip	27.01	10800	1470

CONCLUSION

First analysis with different design concepts were performed. None of these will be excluded at this state, more studies will be done with more detailed models.

Next step will be to improve the simulation results and develop a structure that shows a good performance as well as mechanical stability. Finally, tuning options and comfort for maintenance will be part of further development.

This will be followed by an adaption for another splitring RFQ with 54 MHz. Investigations will follow with both RFQs coupled together. In parallel beam dynamic simulations are performed for both RFQs.

REFERENCES

[1] P. G. Bricault *et al.*, “RFQ Cold Model Studies”, in *Proc. PAC 1995*, Dallas, USA, May 1995.

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