Status of the IH-Structure of REX-ISOLDE

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The accelerating structure of REX-ISOLDE consists of a 4-rod radio-frequency-quadrupole (RFQ) accelerator, an interdigital-H-type (IH) structure and three 7-gap resonators. The IH-structure accelerates ions with a charge-to-mass ratio of 1/4.5 from 0.3 MeV/u up to an extraction energy between 1.1 MeV/u and 1.2 MeV/u. The REX-IH is scaled from *tank 1* of the IH-structure of the LINAC3 at CERN [1]. The Resonator tank consists of a center frame which carries the drift tube structure and two half shells similar to the GSI-HLI IH-structure. The resonant frequency is half the CERN frequency of 101.28 MHz.

The partical dynamics of the REX-ISOLDE IH-structure has been examined with the program LORARS [2] in order to get information about injection emittances and final phase and energy spread of the beam. From this calculation a voltage distribution of the 4.16 MV total resonator voltage has been derived, and in a second step the rf-properties of the resonator have been examined. The most important features are the frequency tuning of the accelerating mode (the H_{111}-Mode) and the establishment of the right gap voltage distribution. In the H_{111}-Mode the magnetic field lines are parallel to the beam axis which is typical for an H-type structure. In a cavity without any drift tube structure the electrical field is perpendicular to the axis. Due to the high capacity load of the drift tubes the electric field is concentrated between the drift tubes. Thus the resonator tank degrades to an inductance and the resonant frequency can easily be tuned by variation of the radius of the tank half shells. In order to examine the cavity modes and the gap voltage distribution MAFIA (solution of **MA**xwell equations by use of **F**inite **I**ntegration **A**lgorithms) has been used [3]. The programm allows an CAD-like input of two- and three-dimensional structures and determines the electromagnetic field distribution. Fig. 1 shows the drift tube geometry created by the MAFIA mesh generator.

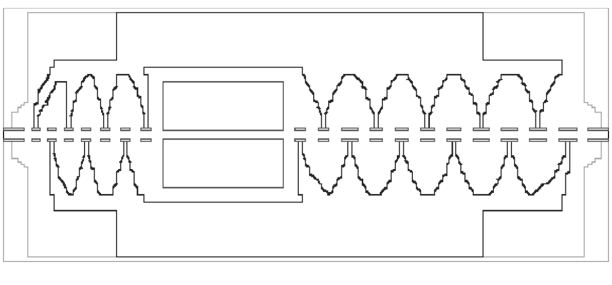

Fig. 1: The IH-structure geometry output of the MAFIA mesh generator

In order to match the gap voltage distribution by MAFIA calculations, we changed in several steps the length of the undercuts (L1 and L2, see fig. 2) at the girders ends (the magnetic flux inductors). As shown in fig. 2 the gap voltage distribution depends significantly on the length of the undercuts because the value of the magnetic field flux through the undercuts determines the gap voltage at the ends of the resonator [4]. Increasing the length L1 and L2 the distribution gets more flat in comparison to the distribution without undercuts.

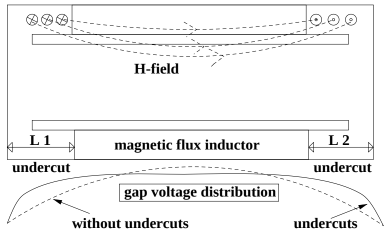

Fig. 2: Principle of the magnetic flux inductor

As a result fig. 3 shows the design distribution for the extraction energies 1.1 MeV/u and 1.2 MeV/u in comparison to the calculated distribution for the proper values for L1 and L2.

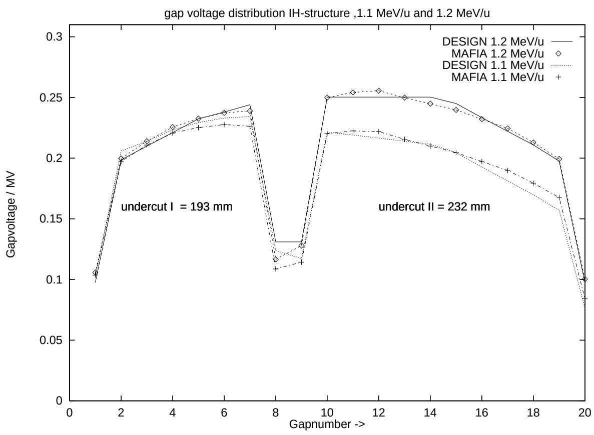

Fig. 3: Design data and MAFIA calculation

The variation of the final energy of the IH-structure will be achieved by tuning the gap voltage distribution via capacitive plungers (see fig. 4).

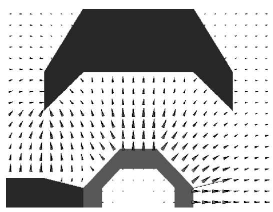

Fig. 4: Capacitive plunger over the drift tube

This tuning is done by increasing the drift tube capacity locally. The next step is the frequency tuning of the cavity with a second plunger using MAFIA calculations.

References

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