The IH-Structure of REX-ISOLDE

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The interdigital-H-type (IH)-structure of the REX-ISOLDE LINAC [1] is used as a booster to accelerate 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 maximum energy gain of 0.9 MeV/u corresponds to 4.05 MV effective resonator voltage or 5.04 MV absolute voltage respectively. The very special of the REX-ISOLDE IH-structure is the possibility to vary the exit energy of the particles by changing the gap voltage distribution due to the adjustment of two capacitive plungers (fig. 1). The plunger at the low energy (NE-TK) side changes the gap voltage distribution via capacitive influence on the drift tubes, which is shown in fig. 1. In order to tune the resonator to the required frequency a massive plunger at the high energy side (HE-TK) of the IH-structure has to be moved away from the drift tubes.

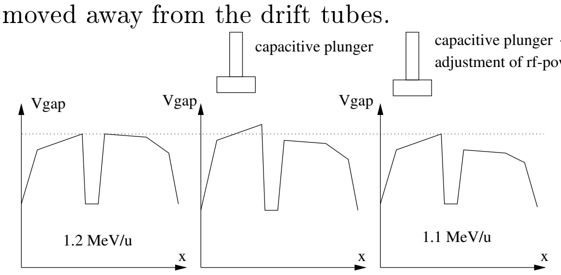

Fig. 1: Principle of the adjustment of the gap voltage (V_{gap}) distribution of the IH-Structure via capacitive plungers

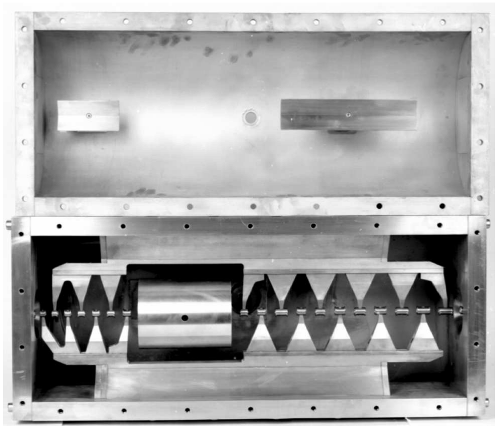

Fig. 2: The 1:2 down scaled model of the IH-structure. Low energy drift tube section on the left and high energy side of the structure are separated by a drift tube housing a magnetic triplet lens

The IH-structure works in the TE111 resonant mode, where the electric field has a transverse direction to the beam axis. The drift tubes, which are mounted (interdigitally) alternately at opposite walls of the resonator, lead the electric field lines in axial direction, where the field strength depends on the capacity of the drift tubes. To examine the cavity modes and the gap voltage distribution the software-tool MAFIA (solution of **MA**xwell-equations by using **F**inite **I**ntegration **A**lgorithms) has been used [2]. The program allows an CAD-like input of two- and three-dimensional structures and determines the electromagnetic field distribution. To prove the calculations an 1:2 model has been built (fig. 2). The following measurements have been done with the model [3]:

1. Examination of the gap voltage distribution in dependence on the undercut length (distance between the drift tube stem support and the resonator wall) and the cross section of the half-shells.
2. Measurement of the gap voltage distribution in dependence on the position of the capacitive plungers, to realize the design gap voltage distribution.
3. Measurement of the resonant frequency, the quality factor and the shunt impedance in dependence on the features explained above and frequency tuning.

Fig. 3 shows the change of the gap voltages with the variation of the capacitive plungers in comparison with the design gap voltage distribution. Between a drift tube and the lens housing or the resonator end, the gap voltage is the difference of the drift tube potential to ground potential, whereas between two drift tubes the gap voltage is the difference of both drift tube potentials. Thus the gap voltages at the resonator end and at the lens housing are only half the value of the voltage between two drift tubes. The measurements of the gap voltages have been performed at the required tuning frequency of 202.56 MHz. The frequency tuning is a problem, because undercut length and half shell cross section influence the resonator frequency and the gap voltage distribution. With the plungers the most effective frequency tuning can be done, which is shown in fig. 4. The eigenmode of the plunger at the low energy side can be clearly seen in fig. 4, which can disturb the gap voltage distribution. The position, where cavity and tuner mode frequency are identical, must be avoided.

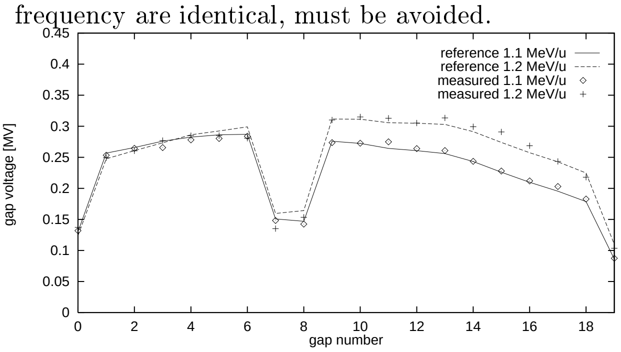

Fig. 3: Measured gap voltage distributions in comparison with the design values

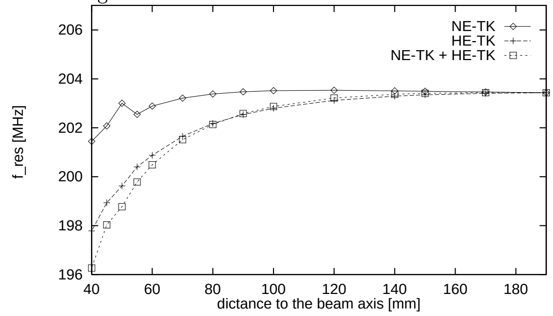

Fig. 4: Resonant frequency in dependence on the position of the capacitive plungers

References

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[2] T. Weiland, Proc. IEEEE PAC84151984245
[3] B. Keil, diploma thesis, LMU München, 997