CAVITY DESIGNS FOR THE CH3 TO CH11 OF THE SUPERCONDUCTING HEAVY ION ACCELERATOR HELIAC

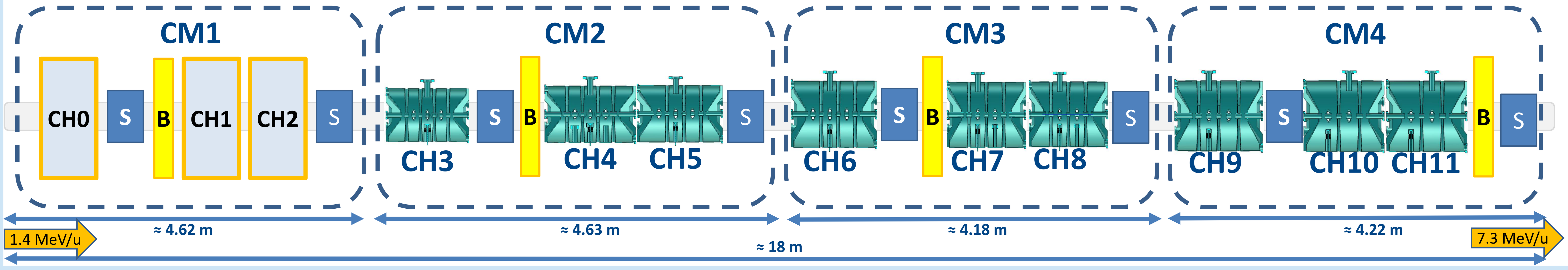
T. Conrad[#1], K. Aulenbacher[2,3,4], W. Barth[2,3,4], M. Basten[4], M. Busch[1], F. Dziuba[2,3,4], V. Gettmann[4], M. Heilmann[4], T. Kürzeder[2,4], S.Lauber[2,3,4], J.List[2,3,4], M. Miski-Oglu[4], H. Podlech[1], A. Rubin[4], A. Schnase[4], M.Schwarz[1], S. Yaramyshev[4]

[1]IAP, Goethe University Frankfurt, Frankfurt am Main, Germany
[2]Helmholtz-Institue Mainz, Mainz, Germany
[3]Johannes Gutenberg University, Mainz, Germany
[4]GSI Helmholtzzentrum, Darmstadt, Germany

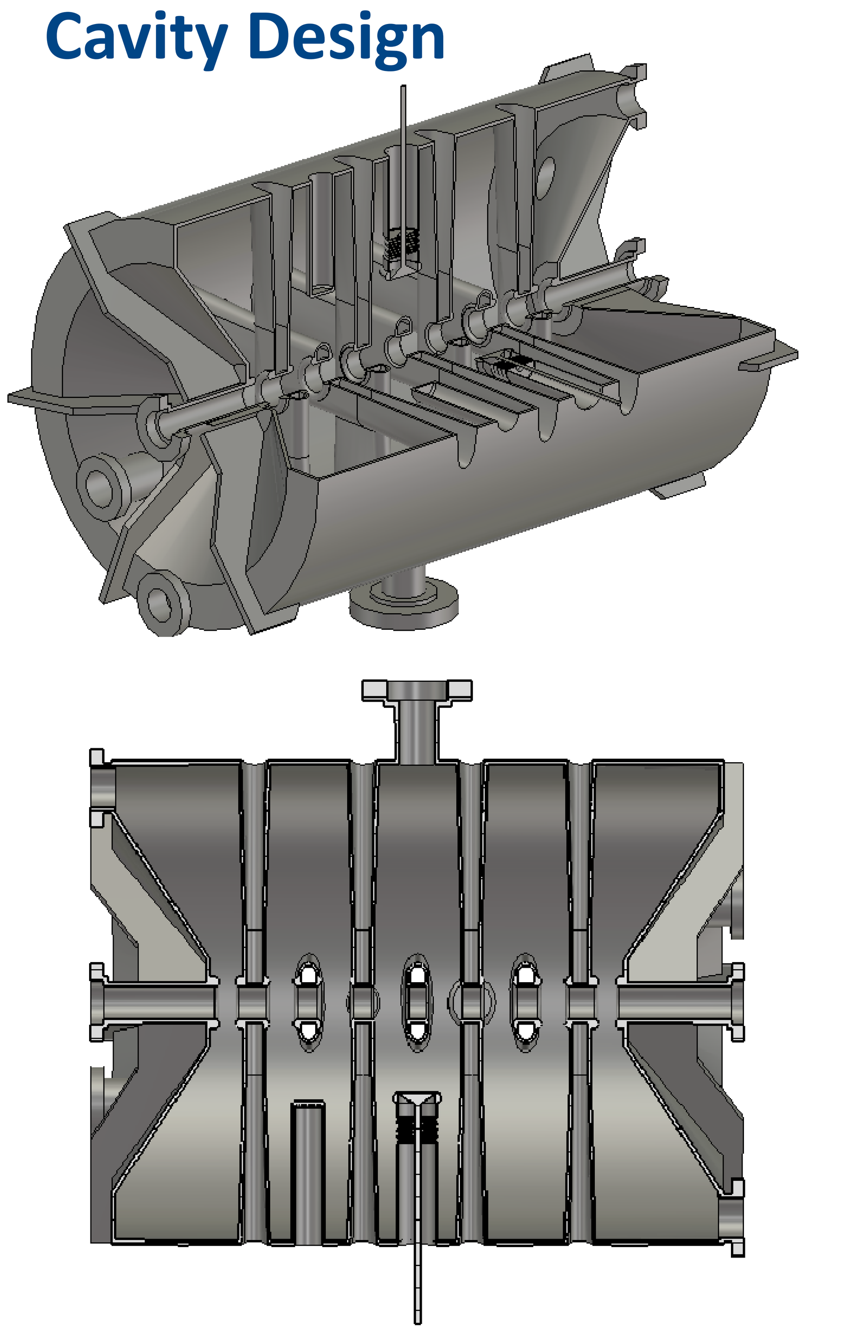
Abstract

In collaboration of GSI, HIM and the Goethe University Frankfurt, the superconducting linear accelerator Helmholtz Linear Accelerator (HELIAC) is being built at GSI in Darmstadt. The cw-mode operated linac with a final energy of 7.3 MeV/u at a mass-to-charge ratio of A/q = 6 and a frequency of 216.816 MHz is intended for various experiments, especially with heavy ions at energies close to the Coulomb barrier for the research of superheavy elements. The entire planned linac consists of four cryostats, four superconducting buncher, four solenoids and twelve superconducting CH-cavities. After successful beam tests with CH0 and successful high frequency tests with CH1 and CH2, CH3 to CH11 will be designed. Based on previous experience and successful test results, individual optimizations of the cavity design will be performed. Among other things, attention has been paid to reducing production costs by designing as many components as possible, such as spokes or the tank caps with the same geometries. Despite this cost reduction, it was possible to improve the theoretical performance in the simulations.

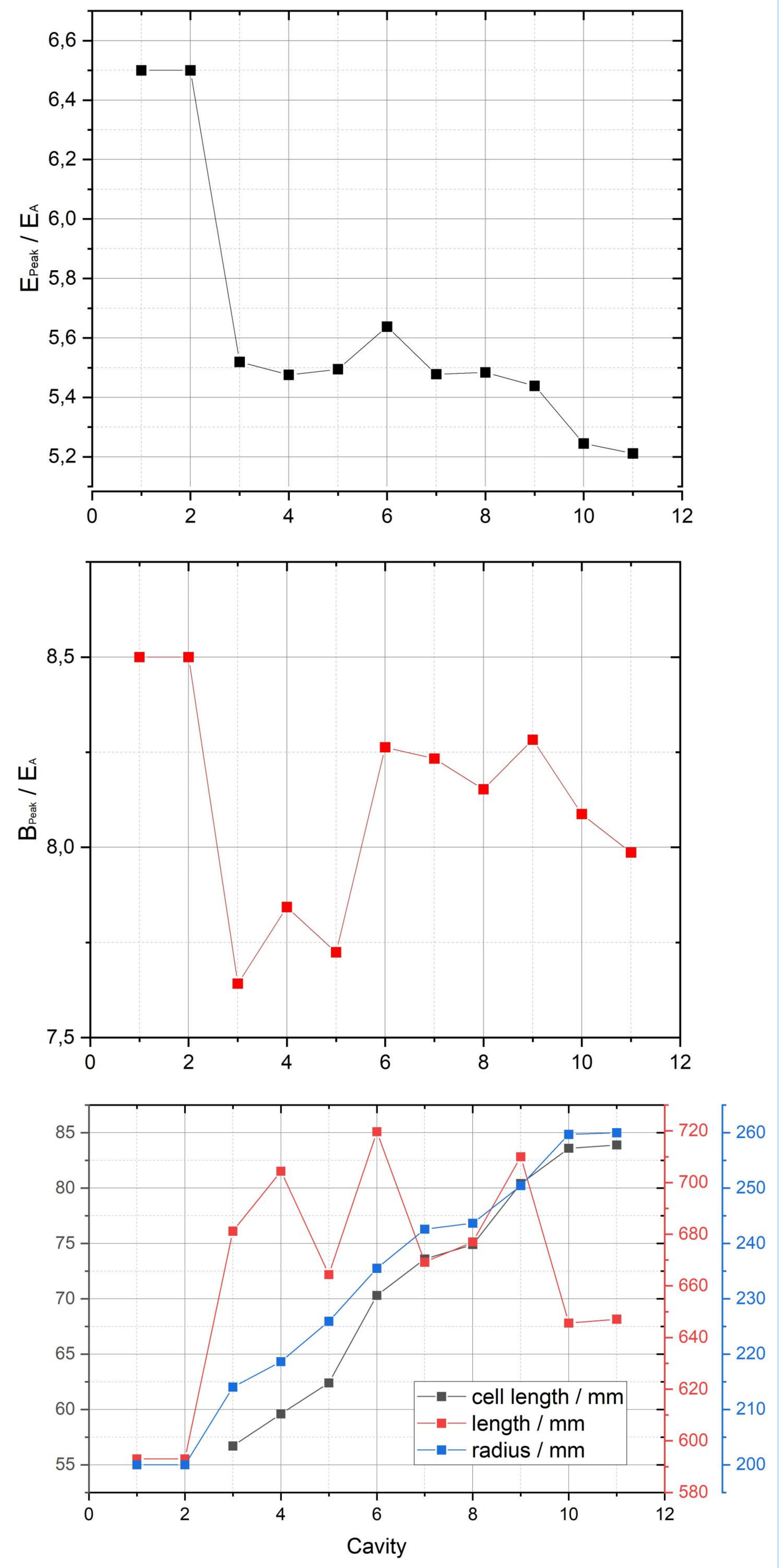
HELIAC

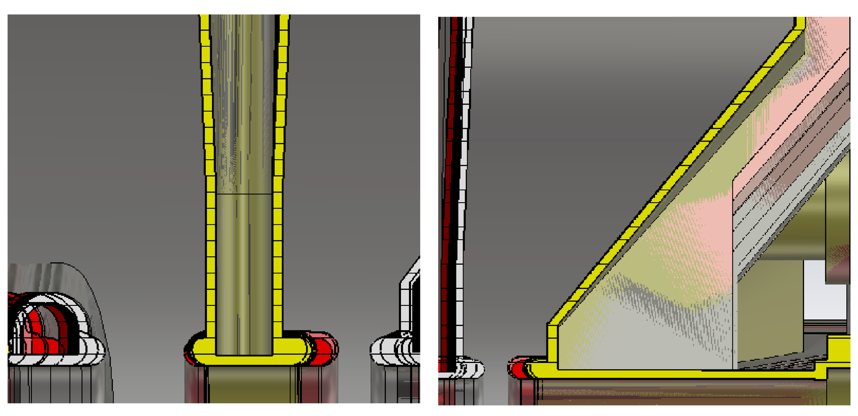


Cavity Design



Cavity Design CH3 with new Bellow Tuner Design

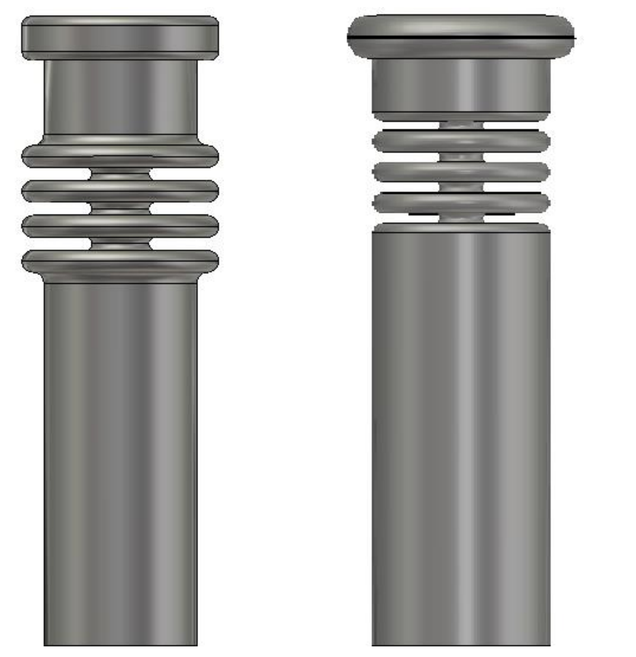




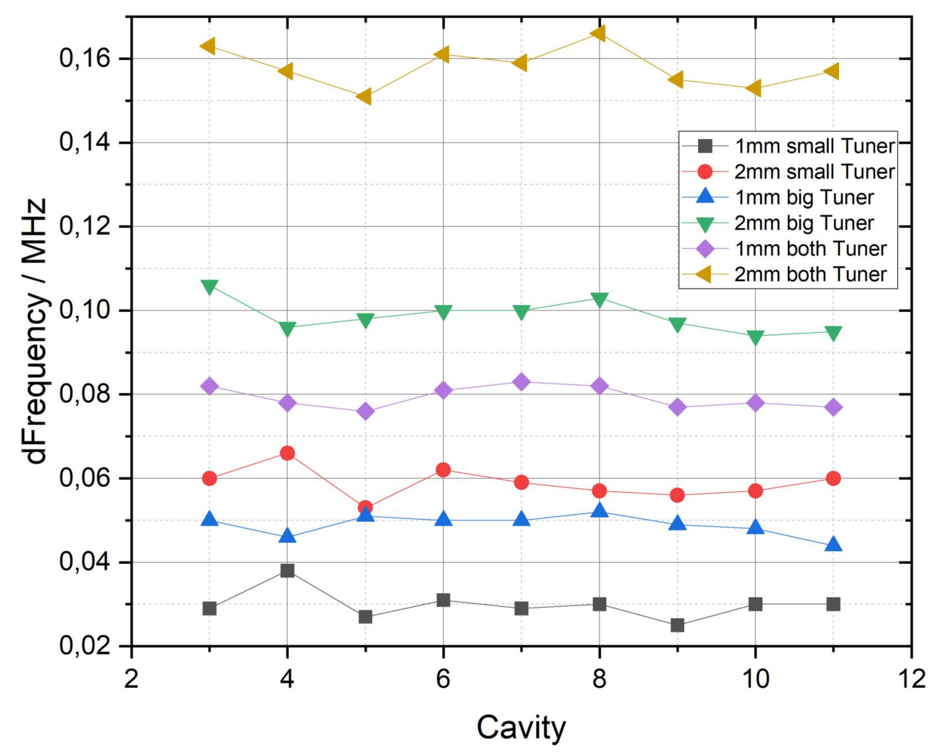
Comparisons of E_{Peak}/E_A and B_{Peak}/E_A ratios and plot of geometric dimensions of all cavities from CH1 to CH11 (↑)

Superimposed cavities CH3 to CH11 each over the geometrically identical spokes and the geometrically identical lids (←)

Bellow Tuner Design



The new Bellow Tuner Design (right) and the old Design of CH1 and CH2 (left)



Cavities Parameters

# CH	No. of gaps	r_{Cavity} / mm	l_{Cavity} / cm	l_{Cell} / mm	Bellow Tuner	Static Tuner	β_{in}	β_{out}
CH3	8	214.05	68.12	56.7	2	2	0.076	0.083
CH4	8	218.65	70.44	59.6	2	2	0.083	0.090
CH5	7	225.92	66.44	62.4	2	2	0.090	0.096
CH6	7	235.5	71.97	70.3	2	2	0.096	0.102
CH7	6	242.58	66.92	73.6	2	2	0.102	0.107
CH8	6	243.4	67.67	73.9	2	2	0.107	0.112
CH9	6	250.2	71.00	80.4	2	2	0.112	0.116
CH10	5	259.6	64.56	83.6	2	2	0.116	0.121
CH11	5	260	64.71	83.9	2	2	0.121	0.121

Summary and Outlook

Currently, the multipacting and secondary electron behavior of the cavities of CH0 and CH1 are being investigated. During cold tests of the CH1 and CH2 cavities, one with and the other without the helium tank attached, it was noticed that the multipacting conditioning at low field levels was significantly more time consuming and difficult than for CH0. The aim of the current investigations is to find out where this difference originates and, if necessary, to adapt the designs of CH3 to CH11 so that they exhibit similarly few problems during conditioning and commissioning as CH0. After these possible adjustments to the design, the design phase is finished and the tender can begin. A new design of the additional cavities for the HELIAC superconducting accelerator at GSI could be created. These designs represent a compromise between performance improvement as well as cost and manufacturing time reduction. Components such as the spokes and the tapered lids were designed to be geometrically identical without reducing the functionality of the cavities. A new design of the dynamic bellow tuner enabled both the reduction of peak electrical fields and increased flexibility for operators during accelerator operation.

Thorsten Conrad - Institute for Applied Physics - Max-von-Laue Str. 1 - 60438 Frankfurt am Main - conrad@iap.uni-frankfurt.de - www.linac-world.de
Supported and financed by the BMBF 05P18RFRBA