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Recent Measurements on the sc 325 MHz CH-Cavity*

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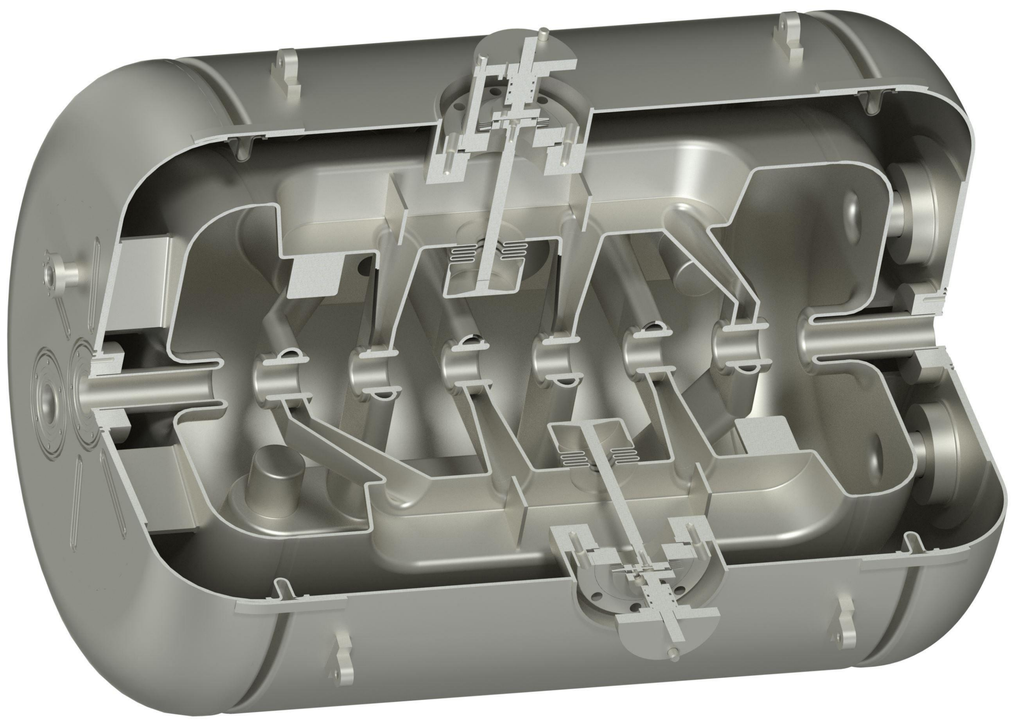
Abstract:

At the Institute for Applied Physics, Frankfurt University, a superconducting 325 MHz CH-Cavity has been designed, built and extensive tests have successfully been performed. The cavity is determined for a 11.4 AMeV, 10 mA ion beam at the GSI UNILAC. This resonator consists of 7 gaps and is envisaged to deliver a gradient of 5 MV/m. Novel features of this structure are a compact design, low peak fields, improved surface processing and power coupling. Furthermore a tuner system based on bellow tuners attached inside the resonator and driven by a stepping motor and a piezo actuator will control the frequency. In this contribution measurements executed at 4 K and 2 K at the cryo lab in Frankfurt will be presented.

Cavity Properties and Performance

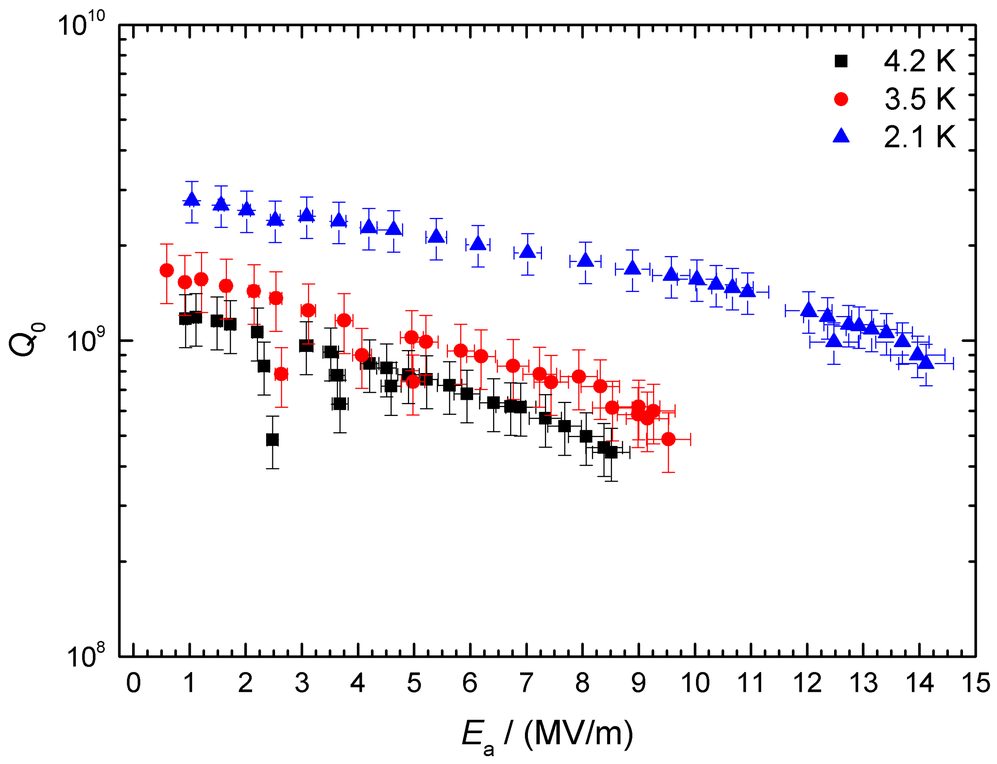
In the cryo lab of IAP a measurement environment comprising a vertical cryostat has been installed for various test purposes allowing power measurements at 4 K and 2 K, respectively. The Helium can either be collected and recovered or the croystat can be evacuated by a roots pump to achieve 2 K. The forward power is delivered by a 500 W broadband amplifier. Further equipment like the rf control system, scopes, power meter and an rf generator is arranged in three racks. At 2 K maximum accelerating fields of 14.1 MV/m could be reached corresponding to 7 MV voltage gain.



Rendering of the cavity with welded helium vessel.

Parameter	β	f	#cells	Eff. Length	Inner diam.	E_a	E_p/E_a	B_p/E_a	G	R/Q	R_a*R_s
Unit	-	MHz	-	mm	mm	MV/m	-	mT/(MV/m)	Ω	Ω	kΩ²
Value	0.16	325.224	7	505	347.4	5	5.1	13	66	1260	80

Main parameters of the cavity.

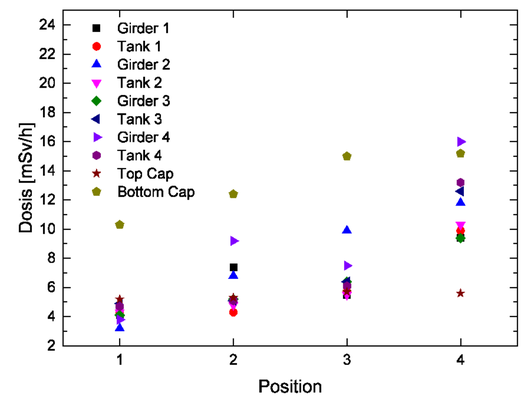


Q versus E curve.

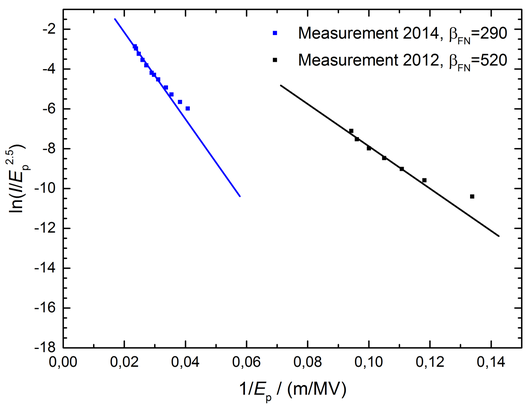
Cold Measurements

The cavity shell has been provided with four low-temperature probes and fourty Thermo-Luminescence-Dosimeter to record field emission events. The analysis of the TLDs yielded a small potential field emitting site located at the bottom of the cavity. Analyzing the Fowler-Nordheim plot for two different measurement campaigns yields to a distinct reduction of the enhancement factor due to an improved surface cleaning.

Setup for the cold measurement.

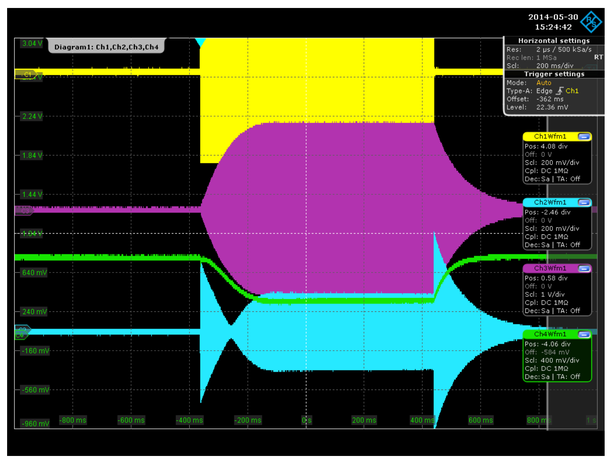


Dosis distribution among TLDs.

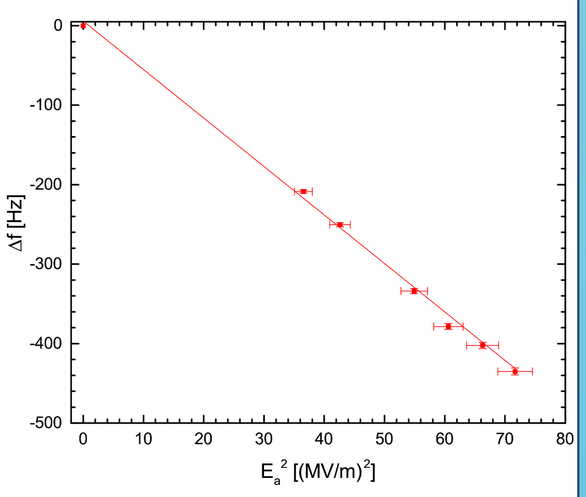


Fowler-Nordheim plot.

LFD Measurements



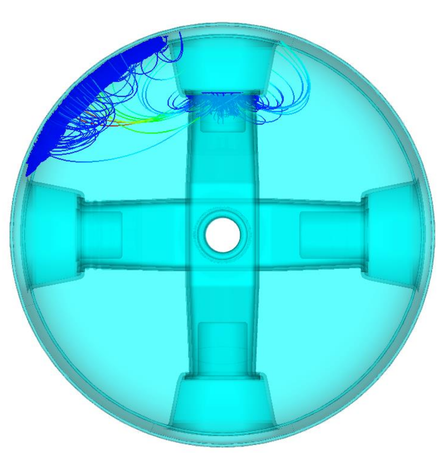
VCO response (green) at a field level of 8.5 MV/m.

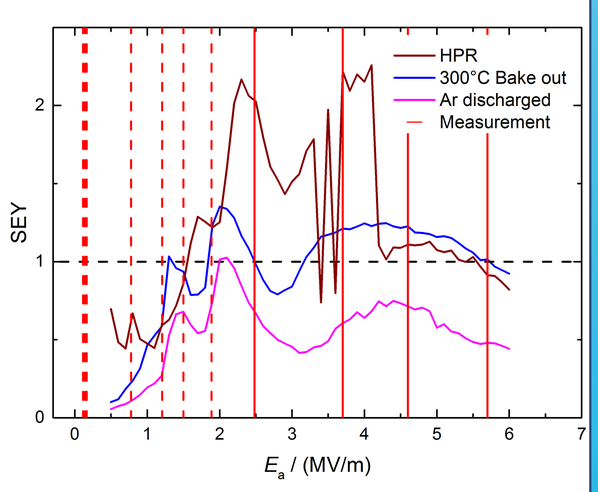


LFD Analysis, K_L=-6.1 Hz/(MV/m)².

Measurements regarding Lorentz-Force-Detuning have been performed showing a maximum frequency shift of 440 Hz during an rf pulse at 8.5 MV/m gradient..

Multipacting Simulations and Measurements





Multipacting simulations indicate soft multipacting barriers in the range between 1.5 MV/m and 5.5 MV/m (depending on surface preparation). Measurements were able to validate the barriers at various gradients.

Outlook

Final parts of the Helium vessel are currently being welded to the cavity at Research Instruments. Further high gradient tests in a new, dedicated vertical test environment with an additional cleaning process are scheduled for Q4 '15.