

A prototype cavity for ICS x-ray light source applications

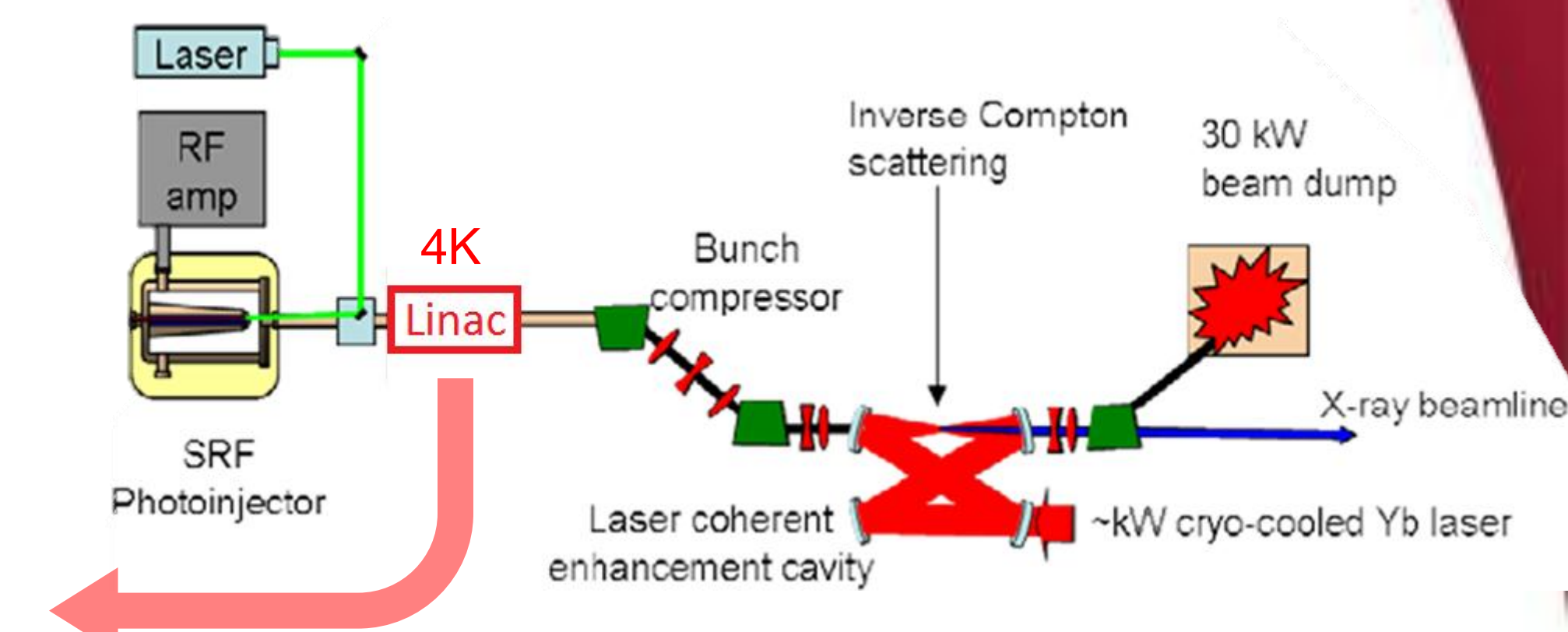
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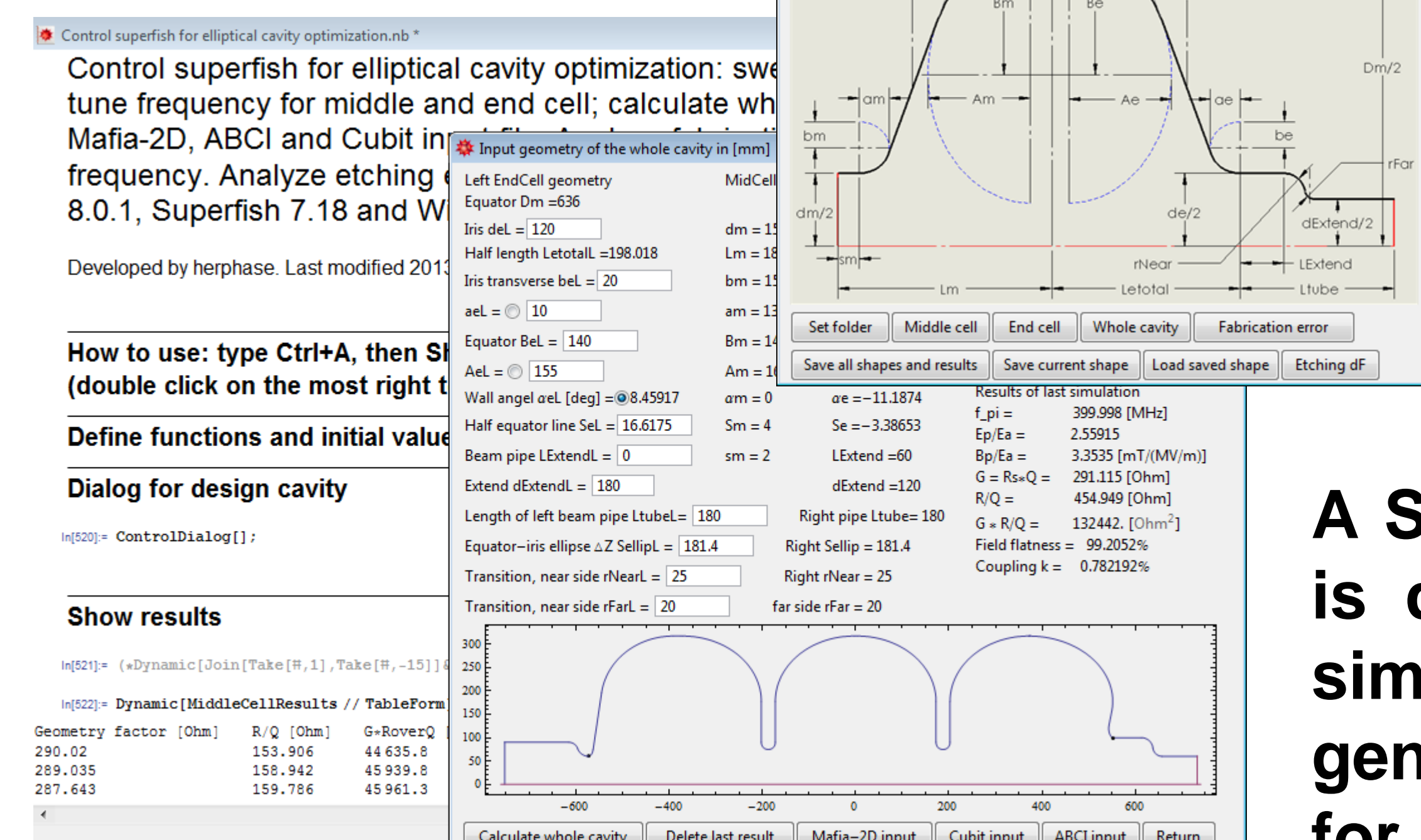
Introduction

Great interest has been generated by the possibility of compact, high brilliance X-ray source based on inverse Compton scattering (ICS) since the rapid advancement in laser and accelerator technologies. JLab is developing the concept of a compact cryostat, which contains two elliptical, 400MHz, 3-cell cavities, to demonstrate the SRF technology for ICS application [1]. The crucial requirement to the cavity is low dynamic load, i.e. high shunt impedance. In this paper, the RF optimization, HOM criteria, mechanical analysis, fabrication experience and the initial test results of the prototype cavity are reported.

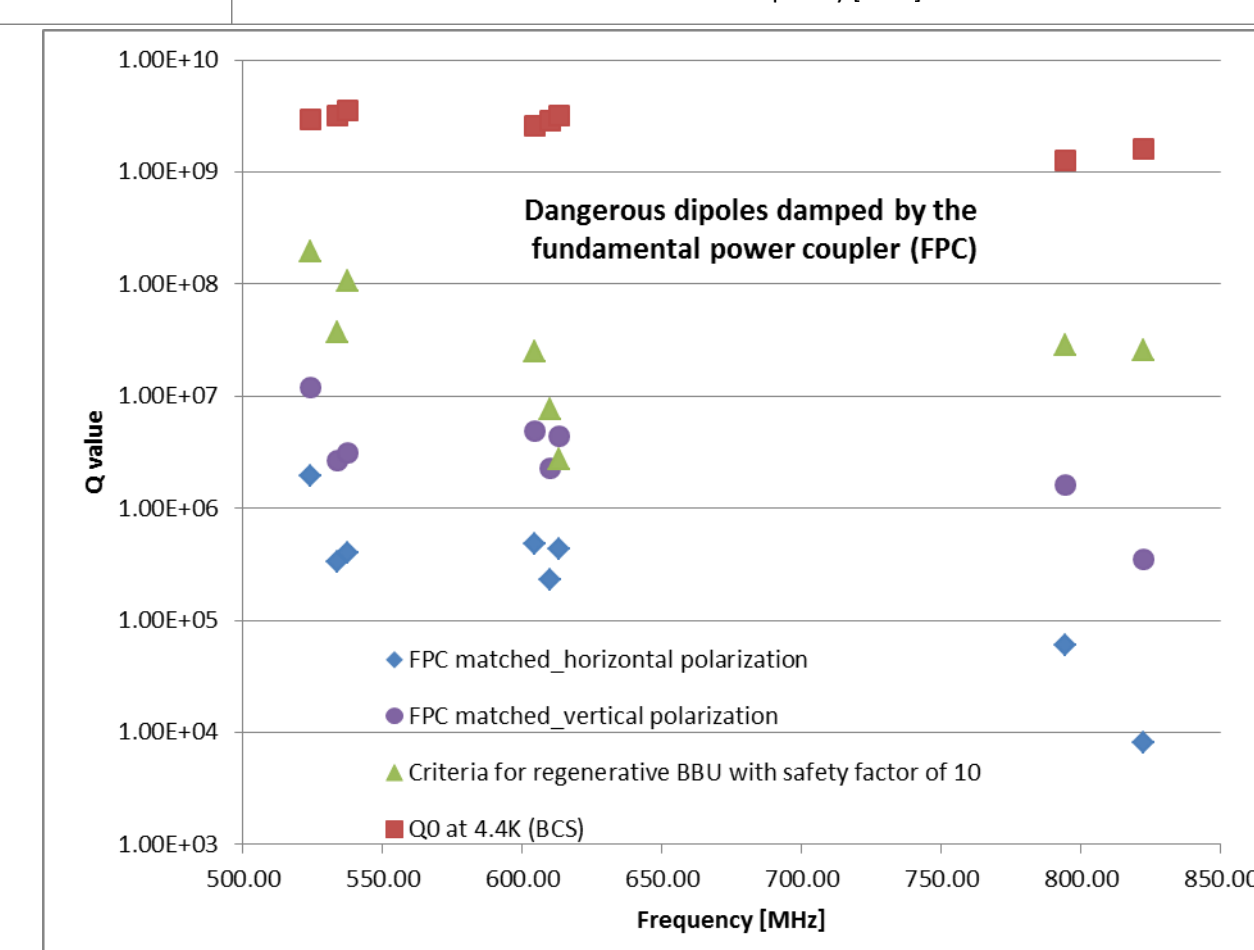
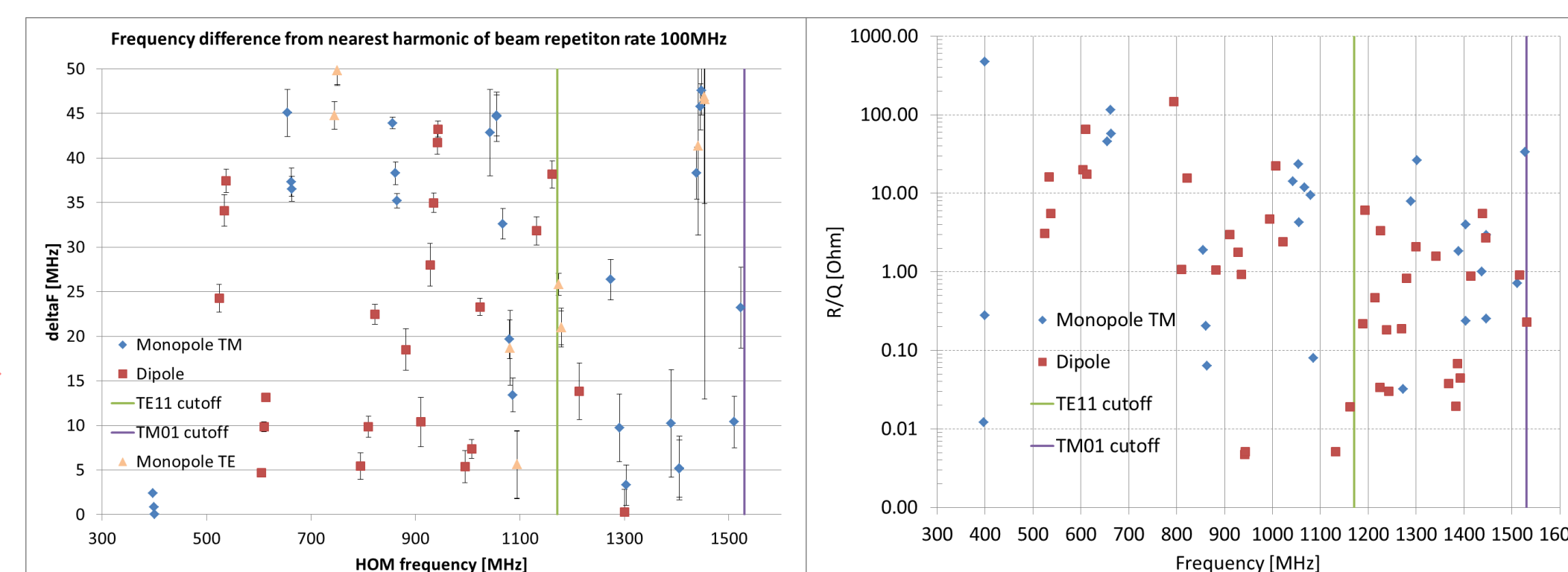
Requirement to the linac	
Beam current	1 mA
Repetition rate	100 MHz CW
FWHM length	1.1 ps
ϵ_n	0.3 mm*mrad
Energy in	4 MeV
Energy out	21 MeV



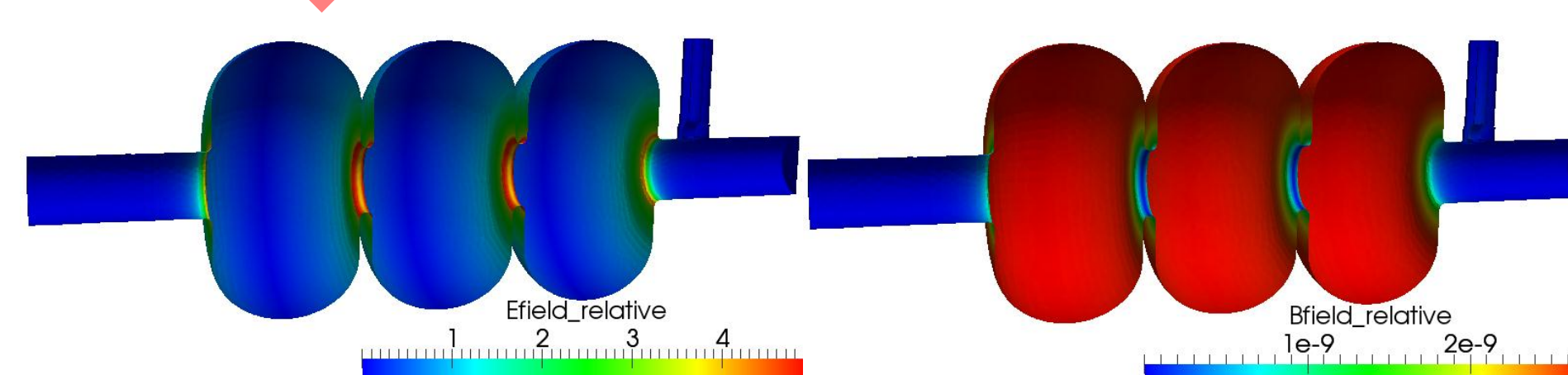
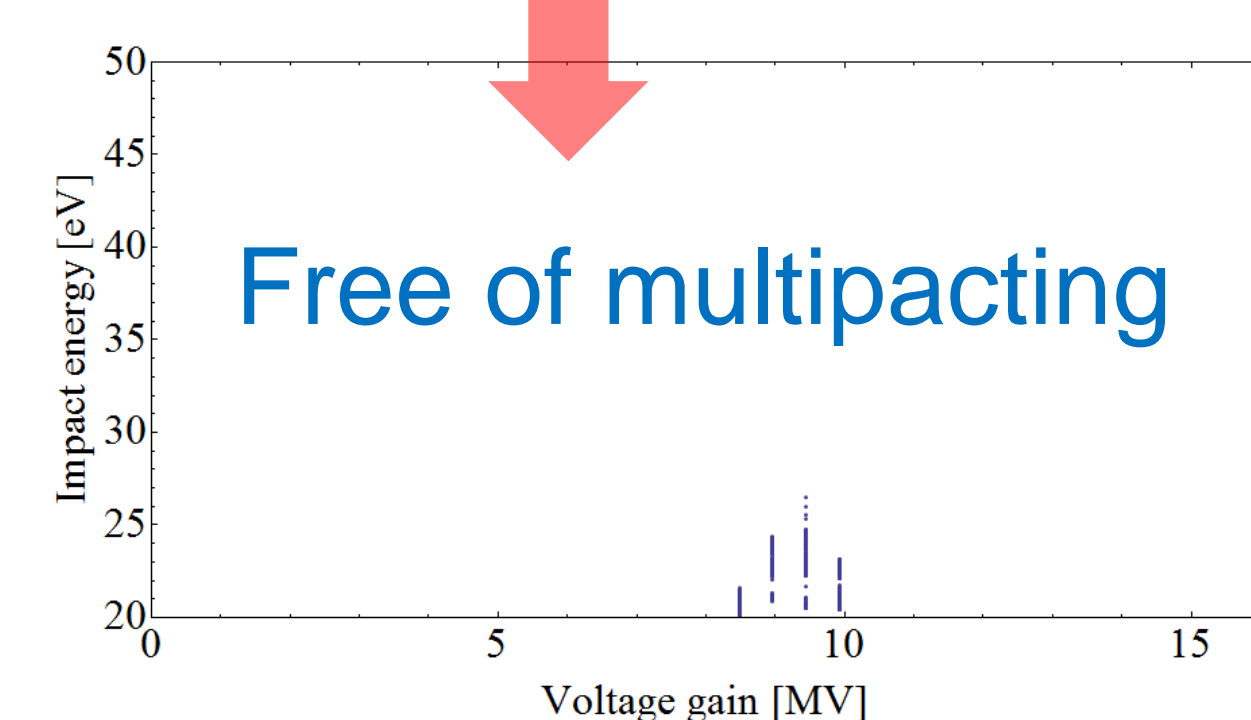
Cavity design



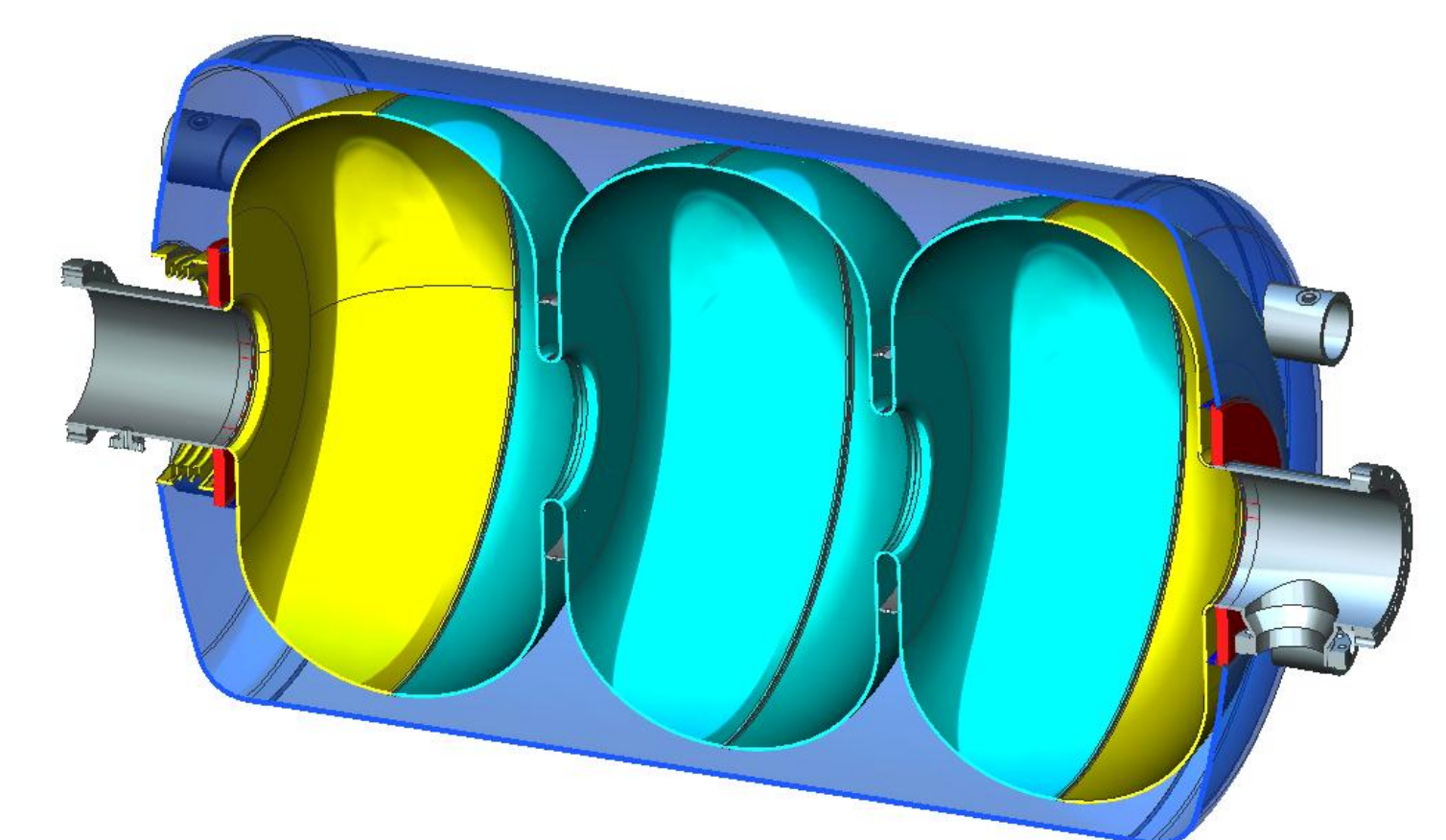
A Superfish frontend is developed for RF simulation, and for generating input files for other analyses



FPC also serves as HOM damper



Cavity frequency will be controlled



Design of tuner is in progress

Frequency [MHz]	Ep/Ea	Bp/Ea [mT/(MV/m)]	G [Ω]	R/Q [Ω]	coupling k	Eacc* [MV/m]	Q ₀ *	Dynamic heat load [W]	Length [m]	Weight [kg]	df/dP** [Hz/Torr]	Tuning sensitivity** [kHz/mm]
400	2.55	3.26	288	468	0.78%	7.6	3.5 x 10 ⁹	44	1.47	120	33	88

* Target value. Assuming Rres=20nΩ
** With Ti helium vessel

Experiences earned on a single cell prototype cavity



The clamps that hold dies on press machine weight 55kg



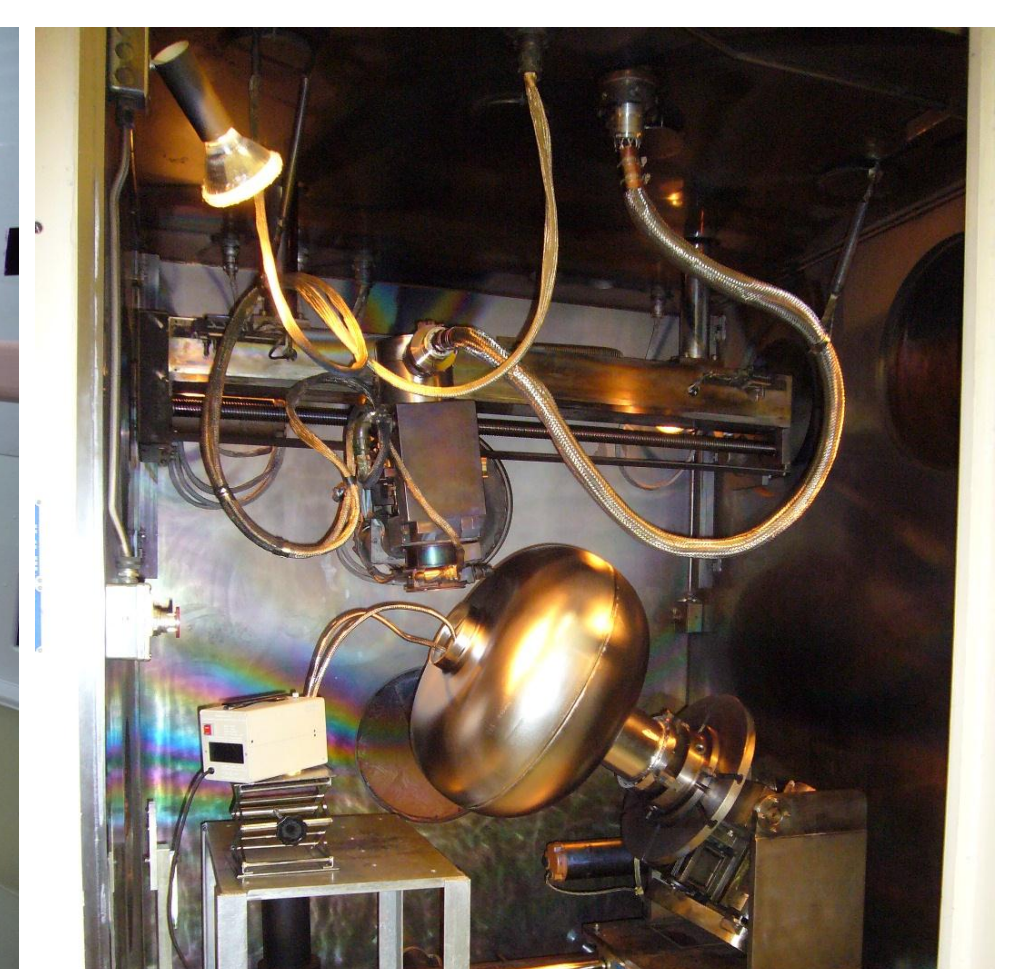
Half cells had to be in an angle during 600C x 10hr annealing



200t hydraulic press was needed to press cell into trimming fixture



The welds were bench etched due to construction in walk-in hood



It is tricky to focus beam through long distance and in big angle

Huge amount of challenges have been overcome in the last two months. More efforts are still on the way

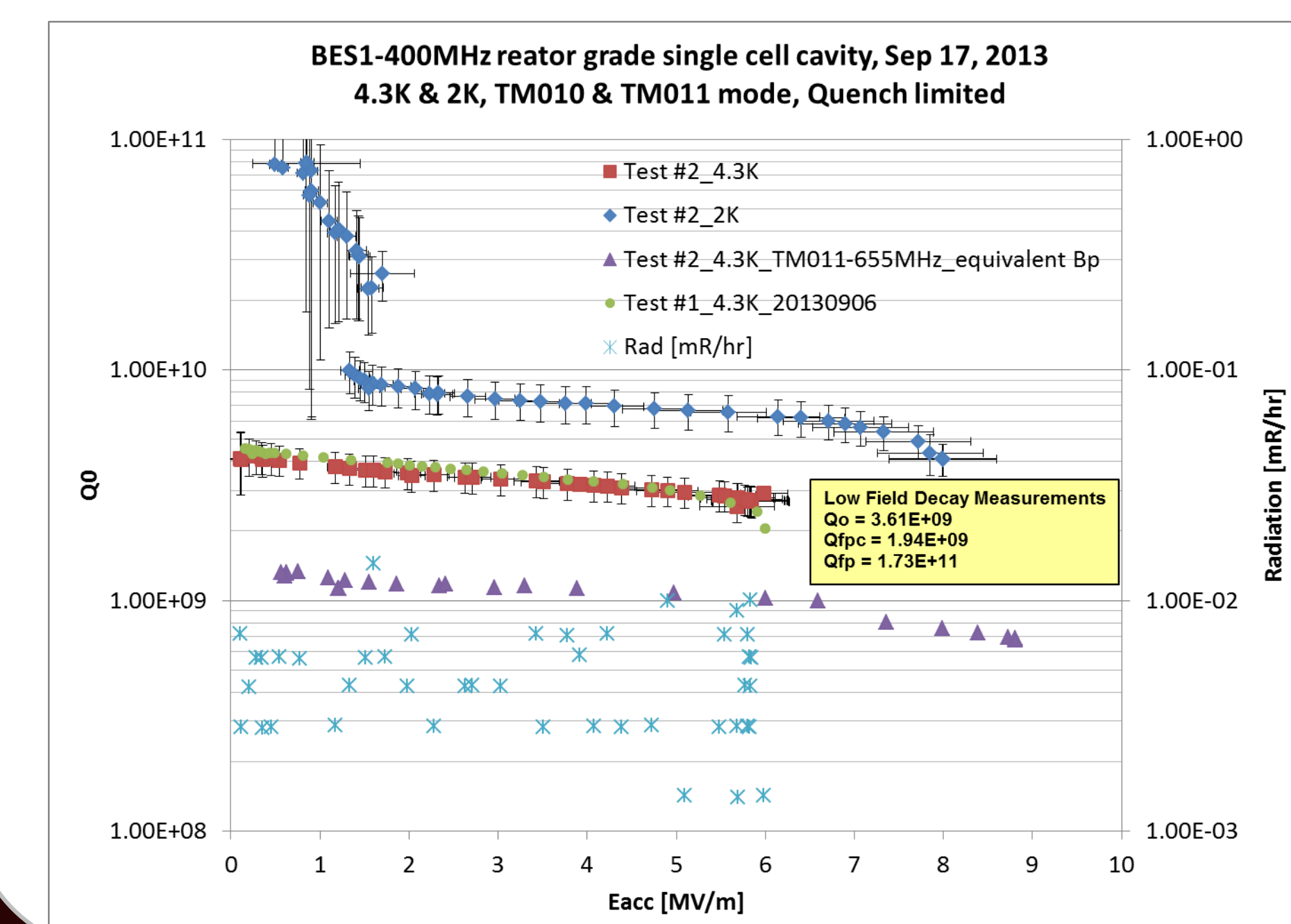
Vertical test with active pumping and OST

Followed by leak check, the HPR was done with a special nozzle

100 liters of acid were inside the cavity during the BCP



Cavity needs to be tilted to fit the ultrasonic tank.



Conclusion

- A high efficiency cavity is designed for small scale 4K linac application
- The size is beyond the experience at JLab, but challenges have been overcome.
- We are busy working to make it better

Reference :

- [1] F. He, et al. "Comparison of linacs for small-scale inverse Compton scattering light source applications", MOP019, this conference.
- [2] Superfish frontend written in Mathematica by F. He: <https://docs.google.com/file/d/0B7jeOkUDj9HMHUfYumJMTzhfRG8/edit?usp=sharing>

ACKNOWLEDGEMENT :

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