Mechanical design and horizontal tests of a dressed 166.6 MHz quarter-wave β=1 SRF cavity system

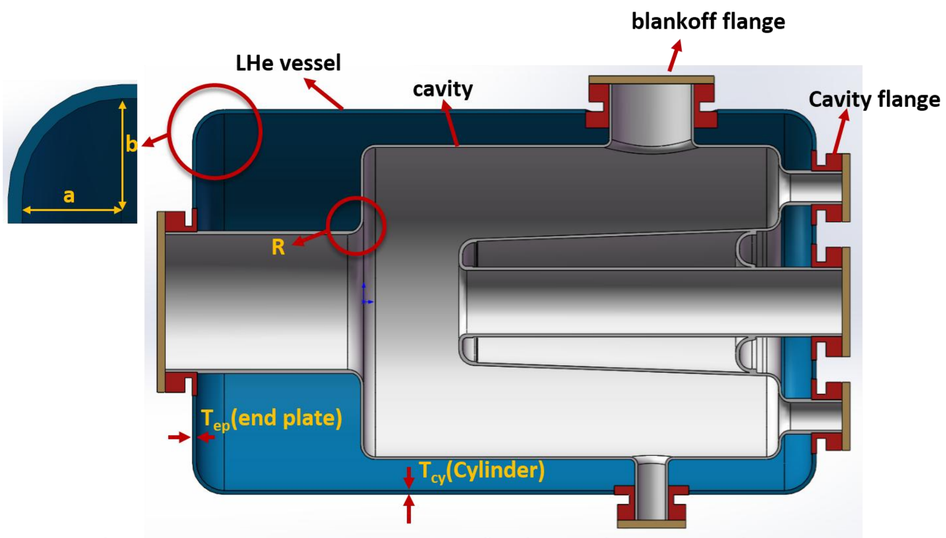
X.Y. Zhang, P. Zhang, Z.Q. Li, Q.Y. Wang, H.Y. Lin, Q. Ma, Z.H. Mi, X.R. Hao, D.B. Li,

Institute of High Energy Physics, Beijing, China

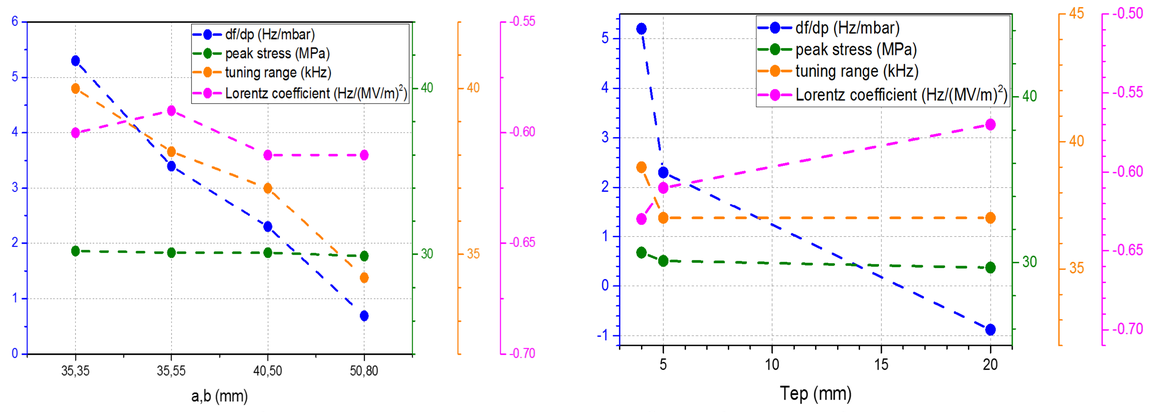
Abstract

A 166.6MHz quarter-wave β=1 superconducting proof-of-principle cavity has been designed and recently been dressed with a helium jacket, fundamental power coupler and tuner. The cavity was subsequently installed in a modified cryomodule and tested in a horizontal manner at both 4.2K and 2K. The helium jacket was successfully developed with a focus on minimizing frequency shift due to helium pressure fluctuation while retaining a reasonable tuning range. The Lorentz force detuning (LFD) and microphonics were also optimized during the design. The df/dp and LFD coefficient were measured to be -3.1 Hz/mbar and -0.76 Hz/(MV/m)^2. These are in good agreement with simulations. Future work is mainly to reduce the stiffness of the cavity and further suppress the vibration mode of the inner conductor.

1. Design of the dressed cavity



The cross section of the dressed cavity

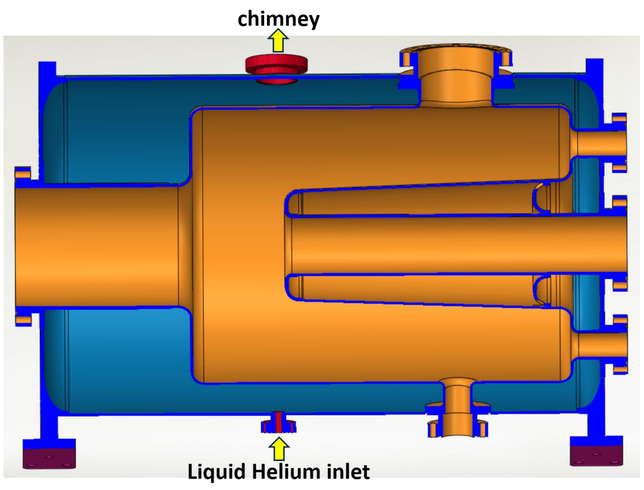


The optimization of a, b, and Tep

Mechanical properties

parameter	unit	cavity	dressed cavity
df/dp	Hz/mbar	359.4	-0.88
peak stress	MPa	46.9	29.7
Lorentz coefficient	Hz/(MV/m)^2	-5.2	-0.57
tuning rang	kHz	100	37

2. Fabrication

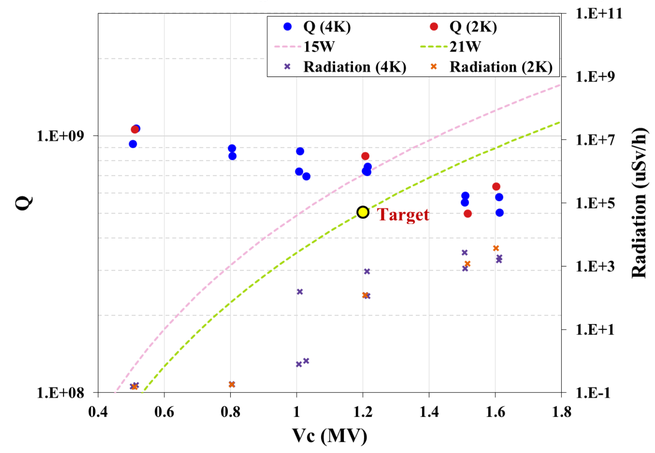


3D schematic

The fabricated LHe vessel

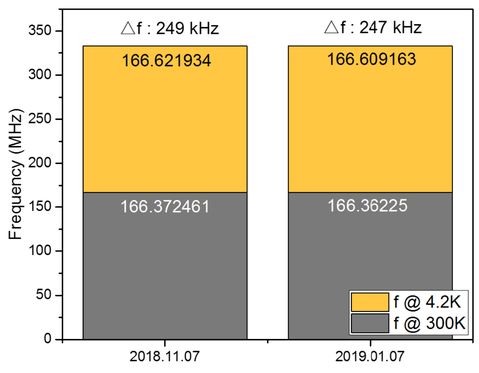
3. The horizontal test

The dressed cavity installed in cryomodule

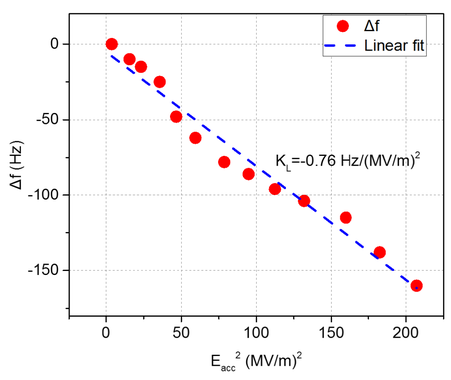


The HT results of the dressed cavity

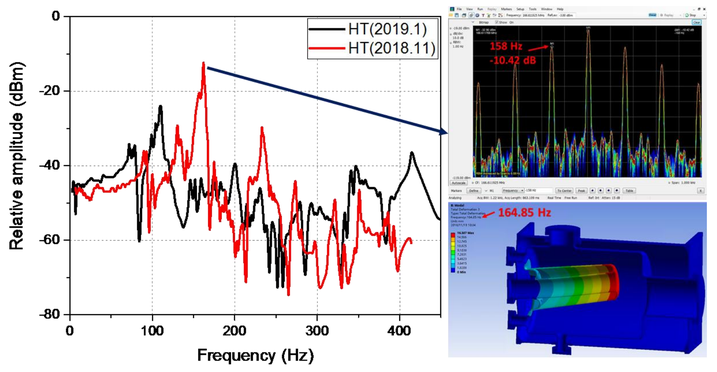
4. Measurements of mechanical properties



Δf at cool down process



The results agreed well with simulations



Microphone spectrum measured at HT

The measured pressure sensitivity (unit:Hz/mbar)

Simulation	Measured	Remark
-0.88	-3.1	cool down (2K→4K)
	-3.7	warm up (4K→2K)