Tuner Design and Test for 166.6 MHz SRF Cavity of HEPS

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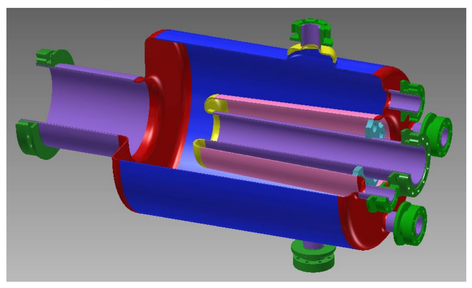
Abstract

The 166.6 MHz superconducting RF cavities have been proposed for the High Energy Photon Source (HEPS), a 6 GeV kilometer-scale light source. The cavity is of quarter-wave type made of bulk niobium with β=1. Each cavity will be operated at 4.2 K providing 1.2 MV accelerating. To compensate the frequency change due to manufacturing uncertainty, Lorentz force, beam loading, He pressure and microphonics the plunger tuner and gap tuner are chosen as options. Now the plunger tuner and low temperature gap tuner have been test with cavity, while the warm gap tuner is being designed. Details of the design and summary of the test results of the two type tuners with cavity are presented in this paper.

1. 166.6 MHz SRF cavity

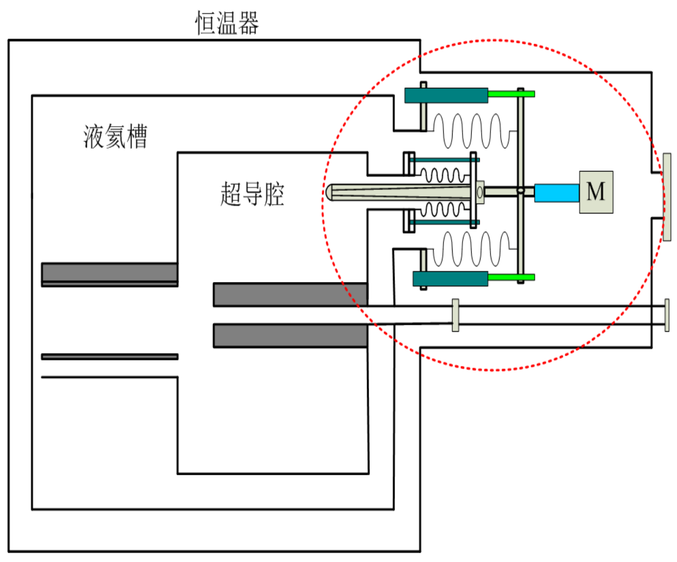
A new SRF cavity be designed for light source



Parameter	Value
Frequency	166.6 MHz
Operating temperature	4.2 K
Current	200 mA
E_{acc}	14.5 MV/m
Designed voltage	1.5 MV

2. The plunger tuner design

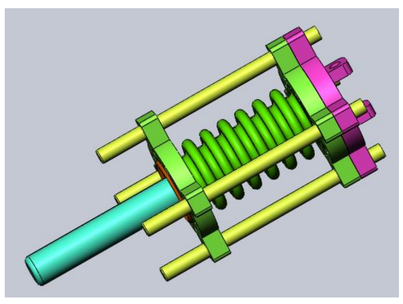
Parameter	Value
Tuning range	±66.8 kHz
Motor stroke	±20 mm
Tuning resolution	<20 Hz
Tuning sensitivity	3.34 Hz/um
Operating temperature	4.2 K

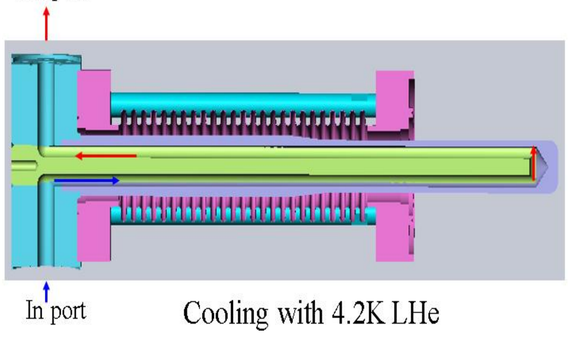


Proof-of-Principle Plunger tuner

Maximize learning on:

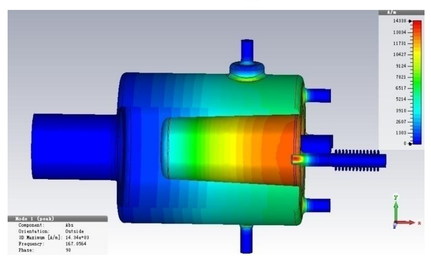
- Manufacturing
- surface treatment
- Assemble with cavity

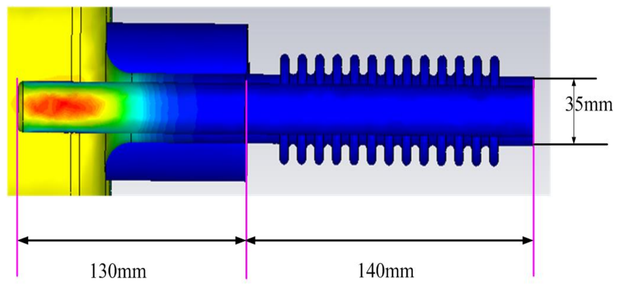


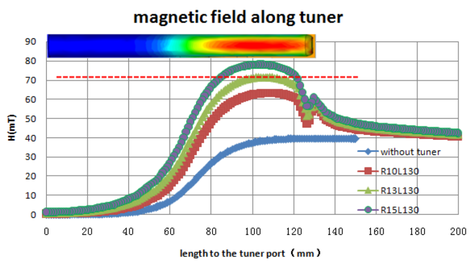


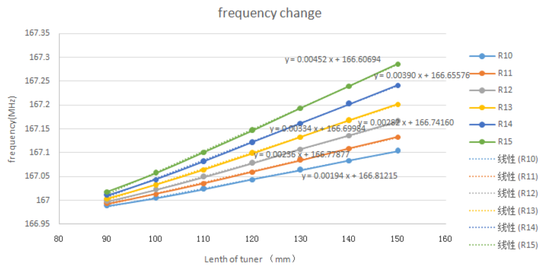
3. The RF design and test of plunger tuner

- RF design

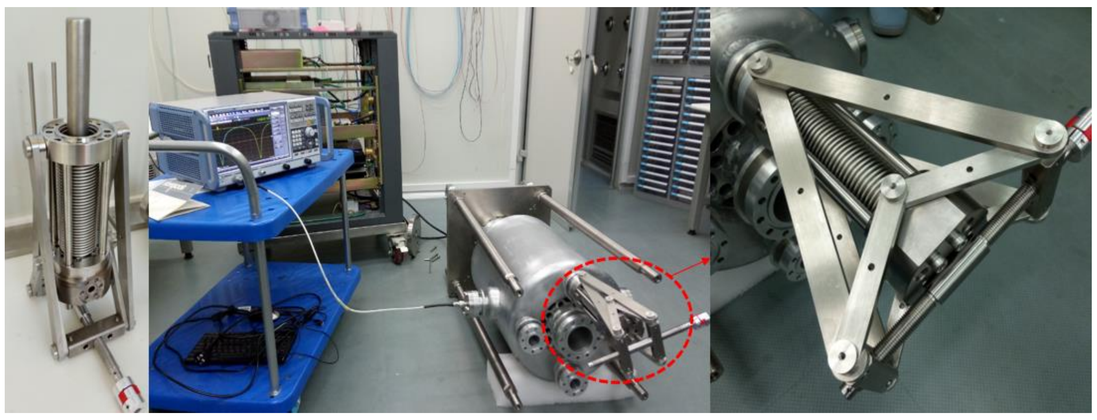


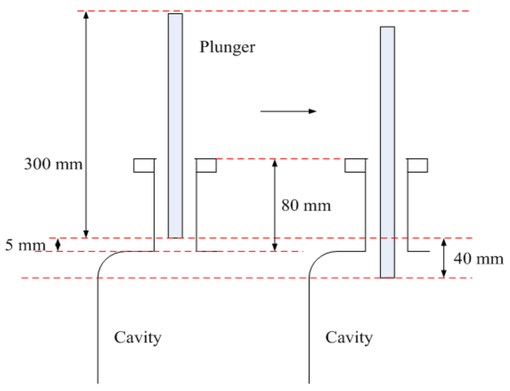




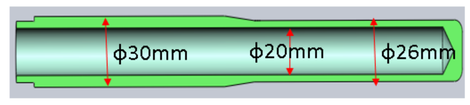


- Warm temperature test



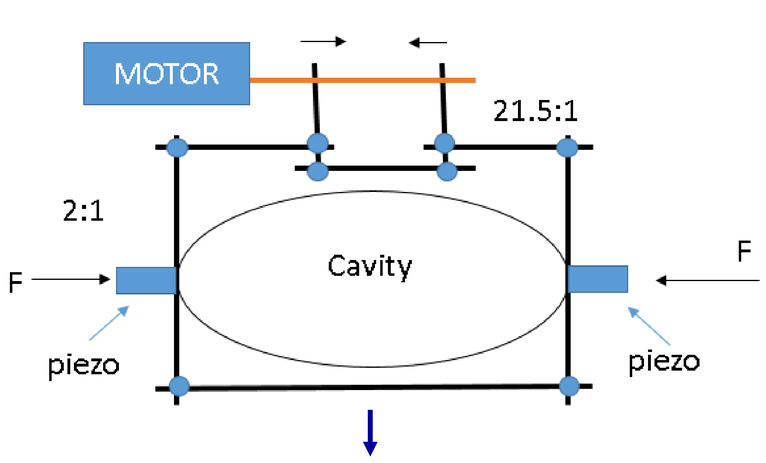


- Tuner stroke：40 mm
- Frequency tuning range: ~128 kHz
- Tuning sensitivity：~3.2 kHz/mm



Plunger

4. The gap tuner design and test for 166.6 MHz proof-of-principle cavity



Parameters	Design value
Motor tuning range	>1mm （90 kHz）
Piezo tuning range	> 2 kHz
Harmonic reduction ratio	1:200
Arm Mechanical Advantage	43:1
Motor tuner resolution	1 Hz
Piezo tuner resolution	1Hz