PERFORMANCE OF THE 650MHZ SRF CAVITY TUNER FOR PIP II PROJECT *

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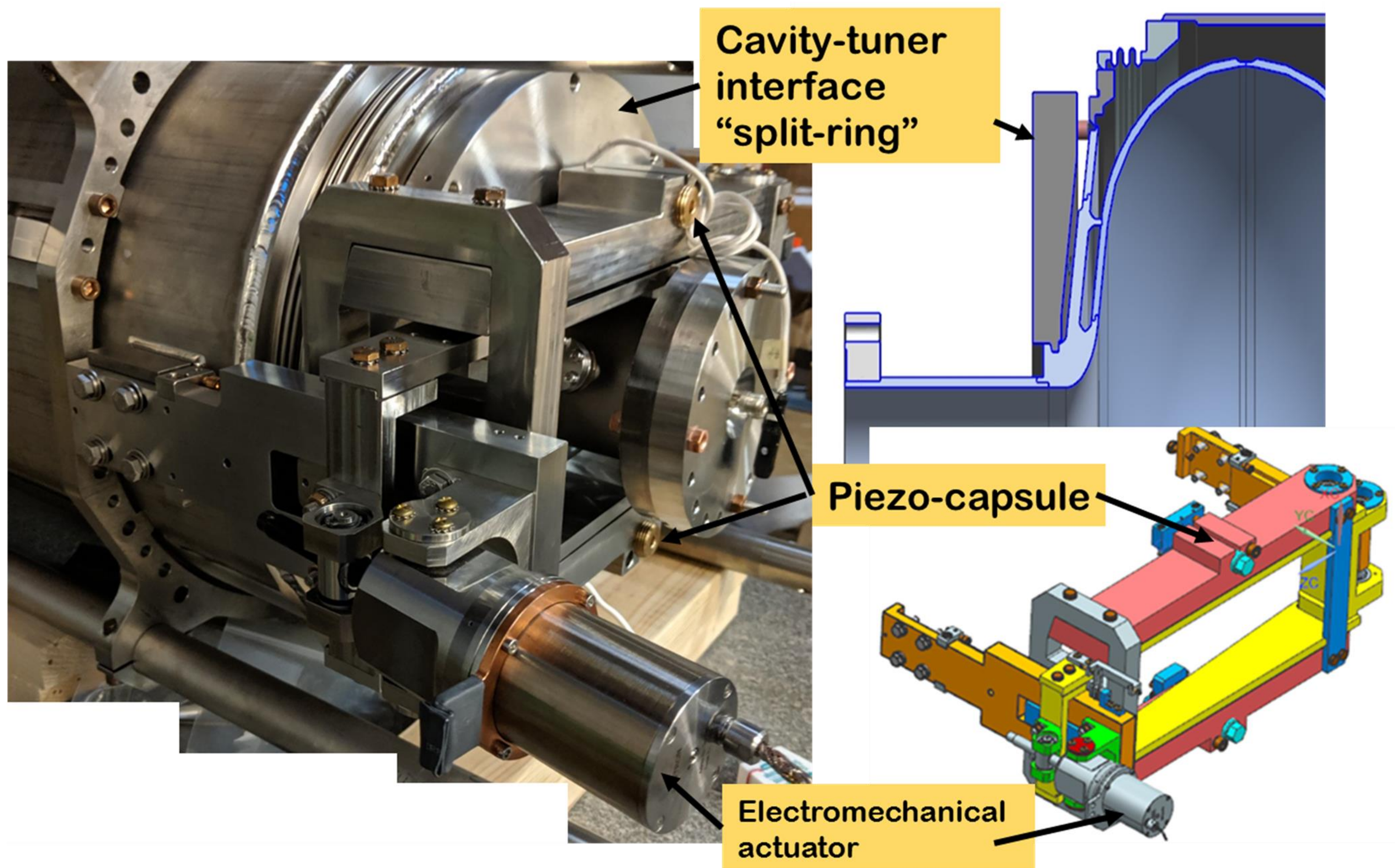
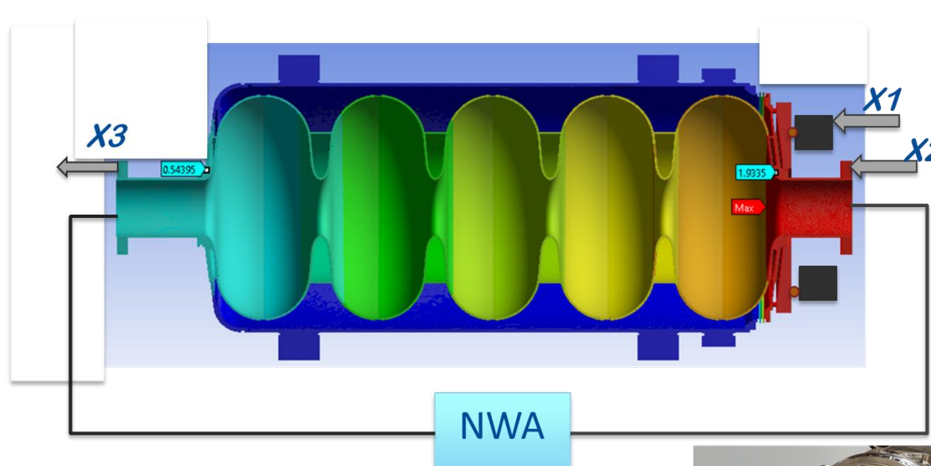
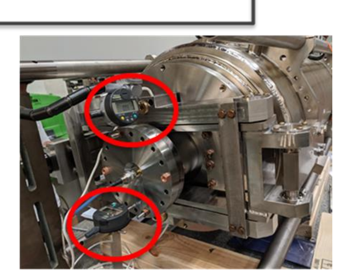
The PIP II linac will include fifty-seven 650MHz SRF cavities. Each cavity will be equipped with tuner for coarse and fine frequency tuning. Design and operations parameters shall be presented. Results from room temperature tests with prototype tuner installed on a 650MHz beta=0.90 elliptical cavity shall be presented.



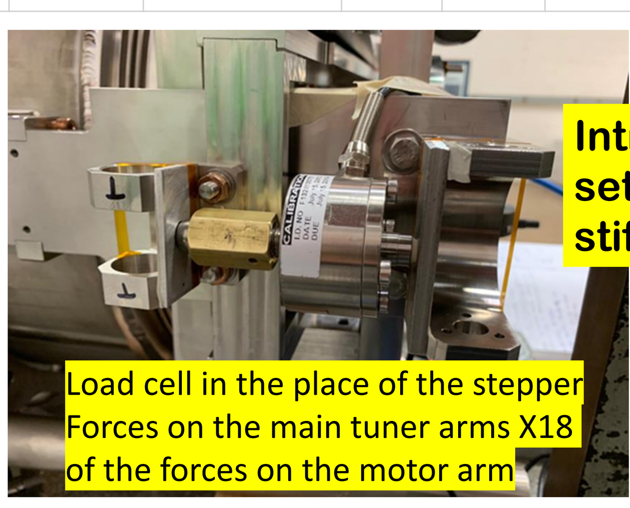
Experimental Test Setup



3 dial indicators & NWA

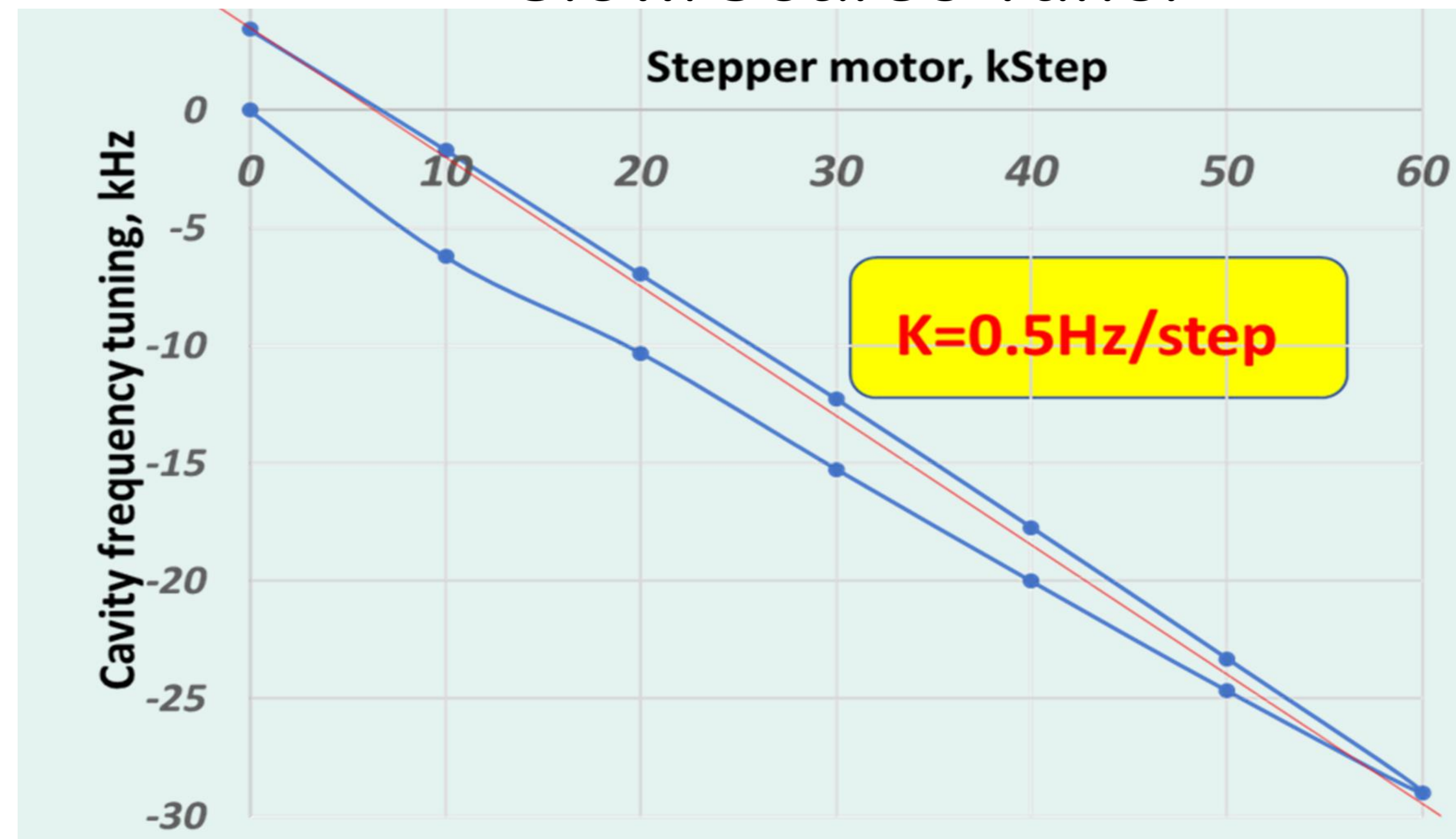


X_0 stroke on the tuner shaft	X_0* tuner arm stroke with 100% efficency (X0:18)	X1	X2	X3	cavity compression X2-X3	dF, cavity detuning, kHz	cavity compression from dF (180kHz/mm) *X2-X3*	Tuner efficiency (X2-X3)/X_0*
6000um	330um	250um	200um	45um	155um	29kHz	160um	47%



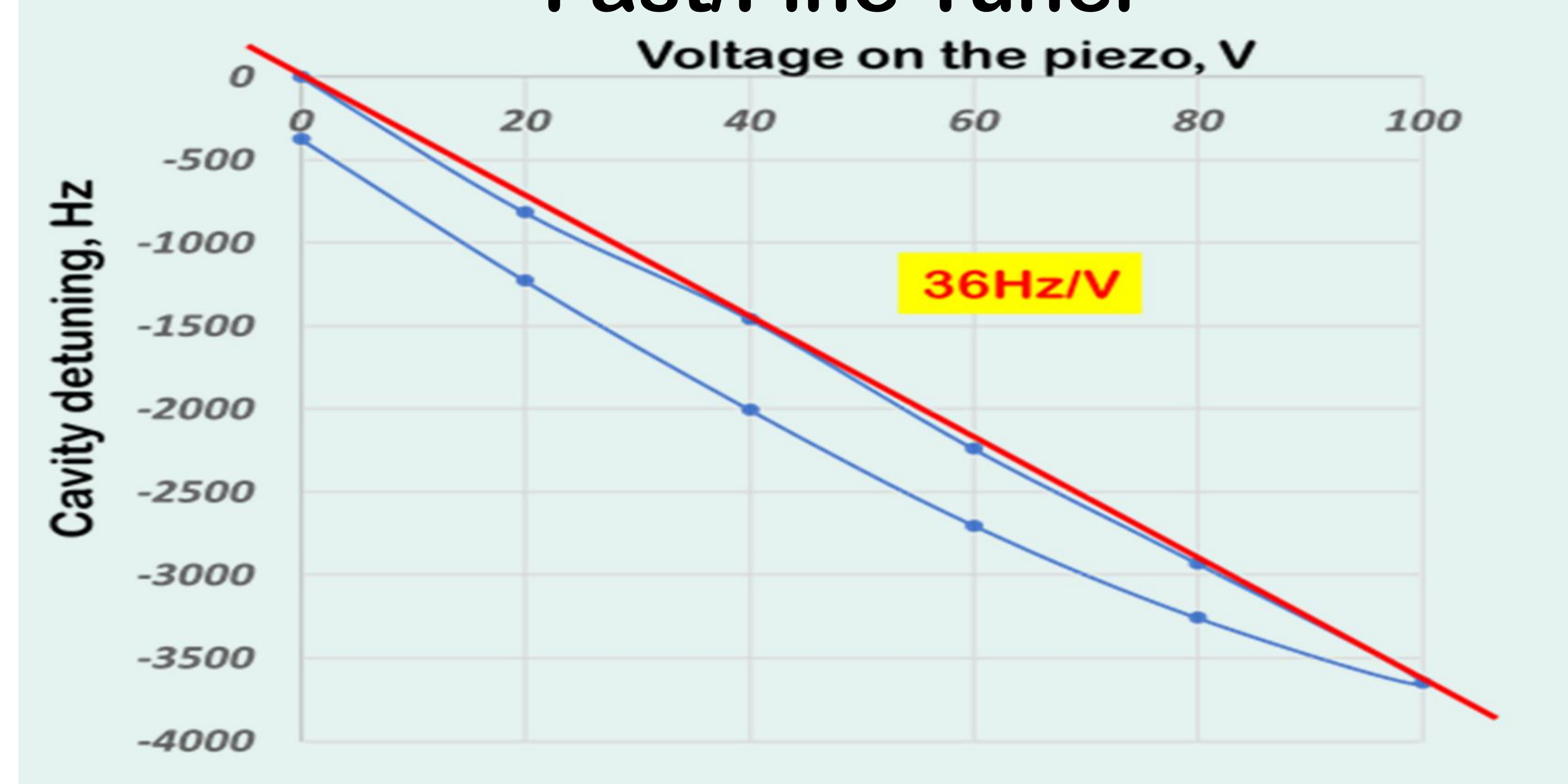
Introducing load cell into setup we got for tuner stiffness K_{TUNER}~35-40kN/mm

Slow/Coarse Tuner



6mm/18=330um – tuning range when tuner translate 100% of the stroke to compress cavity… or k=330*18kHz/60kStep =1Hz/step.
Efficiency of the coarse tuner ~50%

Fast/Fine Tuner

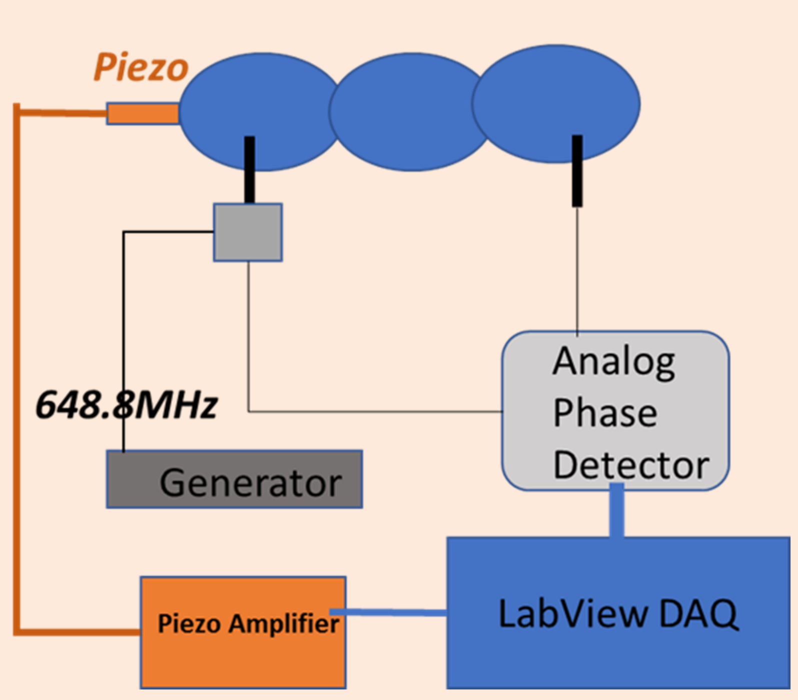


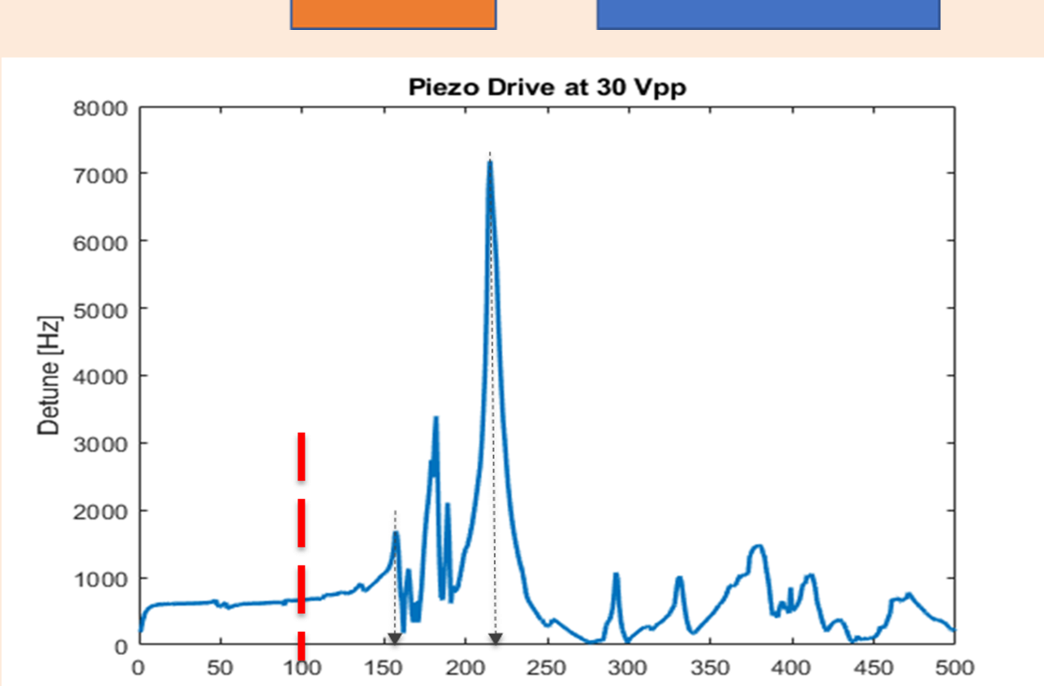
Per vendor specs warm piezo deliver stroke ~0.3um/V or 54Hz/V (with 180Hz/um).
Fine/piezo tuner efficiency ~ 66%

36Hz/V (warm) → ~ 7HzV(cold) ….20% of stroke at T=20K
Expected range at cold for V_{max}=120V → 800Hz

Transfer Function measurements of the dressed cavity/Tuner system

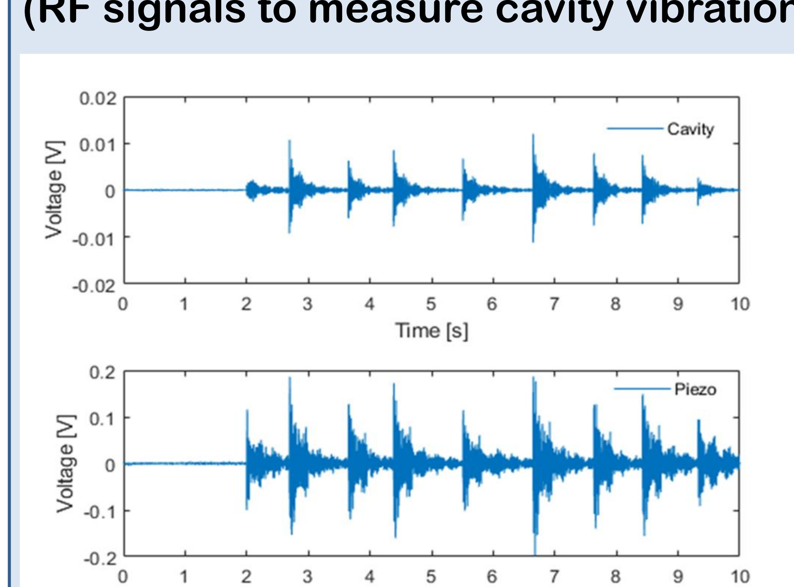
Our goal is to design and built system that have internal resonances above 100Hz. Based on LCLS II and other project experiences external sources of the vibrations that contribute into SRF cavities micropnonics (TAO, cryo-flow induced vibrations, pumps and motors) have frequencies bellow 100Hz.

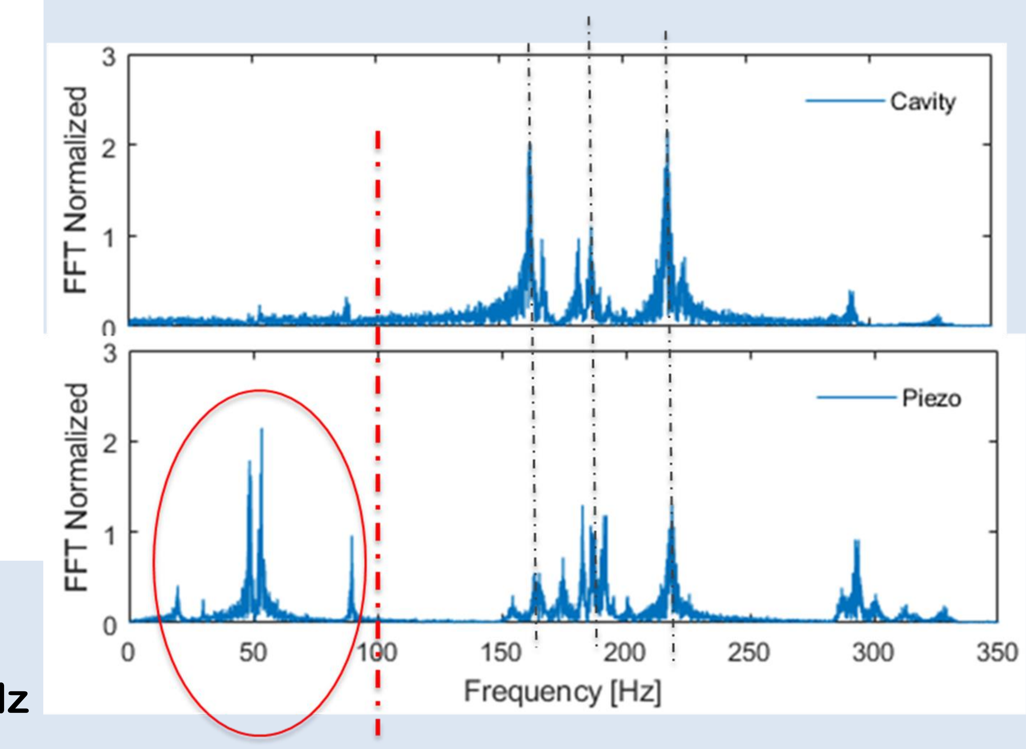




Cavity was driven with 30 Vpp sinusoidal drive signal and frequency was stepped between 1Hz to 500Hz with increment of 1Hz.
Each sinewave (f=N Hz) drive cavity for 3 sec and 3 second idle… to let cavity vibration attenuate before next f=N+1Hz sinevawe.
Forward and transmitted signals feed of an AD8032 analog phase detector.
Output signal from AD8032 is proportional to the phase difference between P_F&P_T digitized at the rate of 10kHz.

Method#2: Slightly tapping on the cavity flange (opposite to tuner) with hammer (small wooden block) (during interval of 10sec) and measure response signals from AD8032 (RF signals to measure cavity vibrations) and from piezo-stack as a sensor.





There is good correlation between picks (resonances) as seen by Piezo signals and RF-system (160Hz, 180Hz and 220Hz)

There are low frequencies resonances (below 100Hz) observed in piezo response.. We contribute these resonances to transversal cavity's vibration… rather than longitudinal … so far we don't have concerns about these resonances