RFD SPS TUNER
SM18 tests CD1 + CD2

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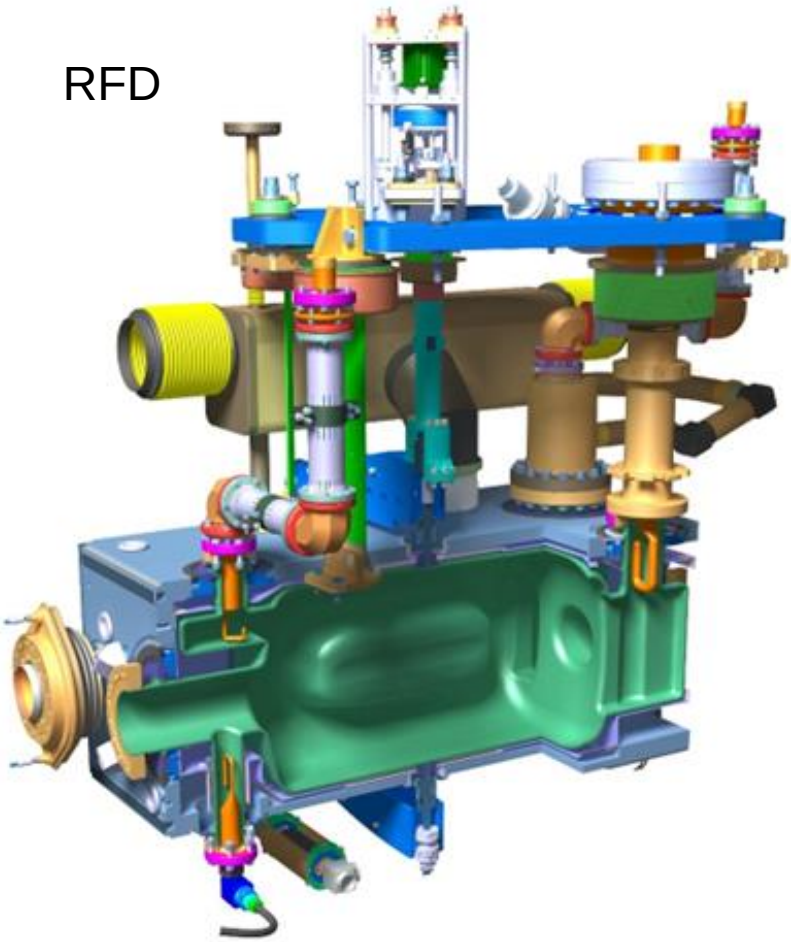
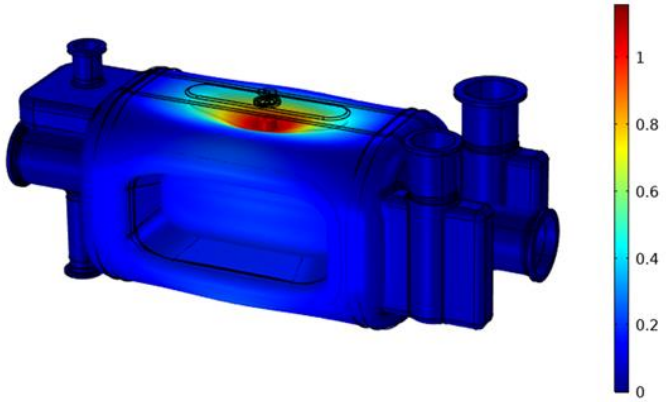
Reminder: Tuning principle HL LHC RFD

RFD



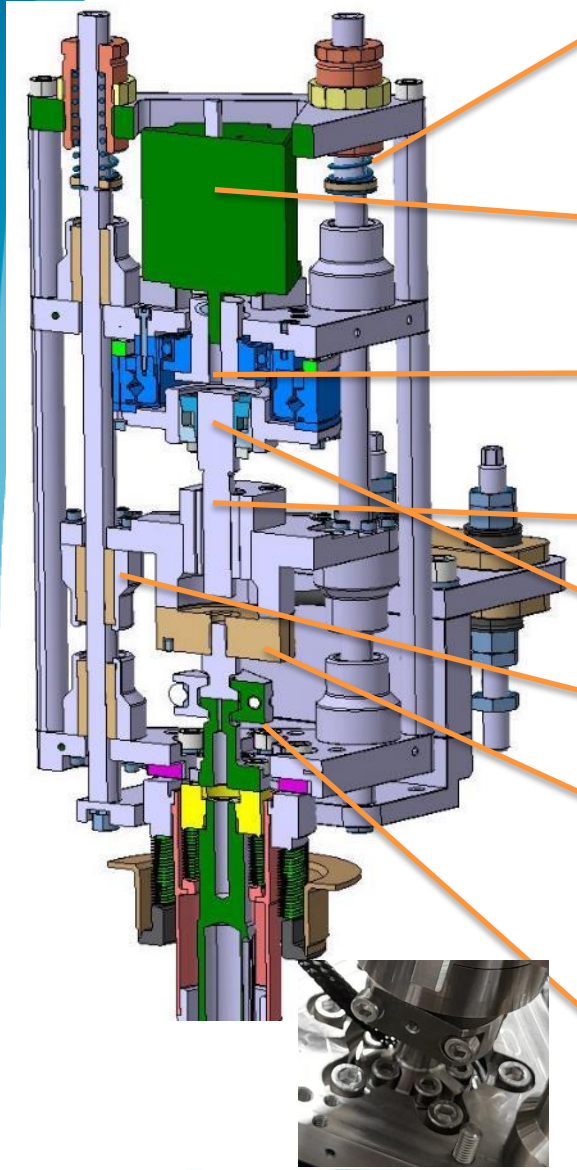


Requested **precision** ~ 80 Hz

RFD
Tuning Sensitivity:
512 kHz/mm*
Cavity tuning stiffness:
2.8 kN/mm*
Specified tuning range at 2 K:
± 150 kHz
Elastic limit range at 2 K:
± 1.22 MHz
± 2.38 mm*****
± 6.7 kN

Overview components

ACTUATOR SPS proto



Vertical Spring pre-load from alignment plate

Stepper motor
1.3 Nm bipolar, motor step 1.8 deg, micro stepping 8000/360 , not ramped open loop, limited to 2000 steps/sec

Harmonic drive HFUS-20-100-2SO
Ratio 100, Accuracy < 1 arcmin, precision <0.1 arcmin (5 nm)
Fa Dyn 7.7 kN

Radhard grease SYNRAD 1252

Roller screw
Rollvis RV 12 x 1 static load capacity 17 kN

coupling

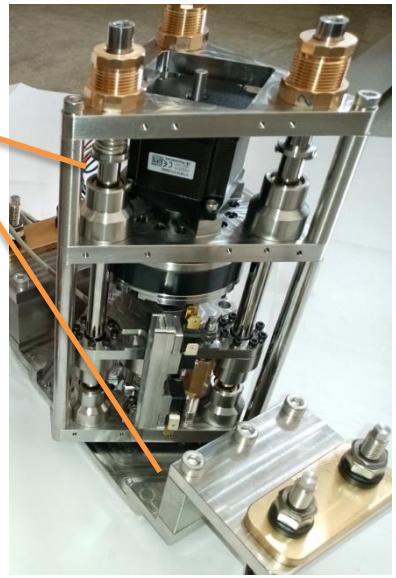
Sferax Compact GBL 1219 bearings XA +A (all metal) and guides

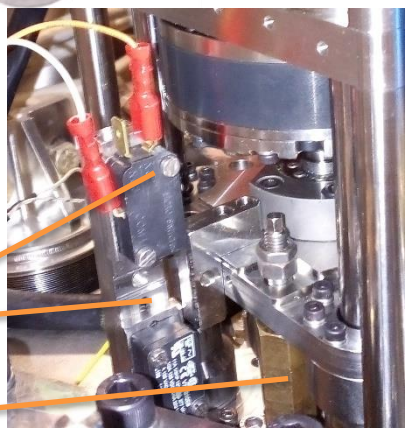
Loadcell
So far: Kistler 10 kN 4576A55C1 class 0.1

Limit switches
Difficult to set, not so reliable

Mechanical end stops with max load interlock on load cell conditioner

Actuator coupling
Allows quick change of actuator + connection without frequency change
Incorporates heater

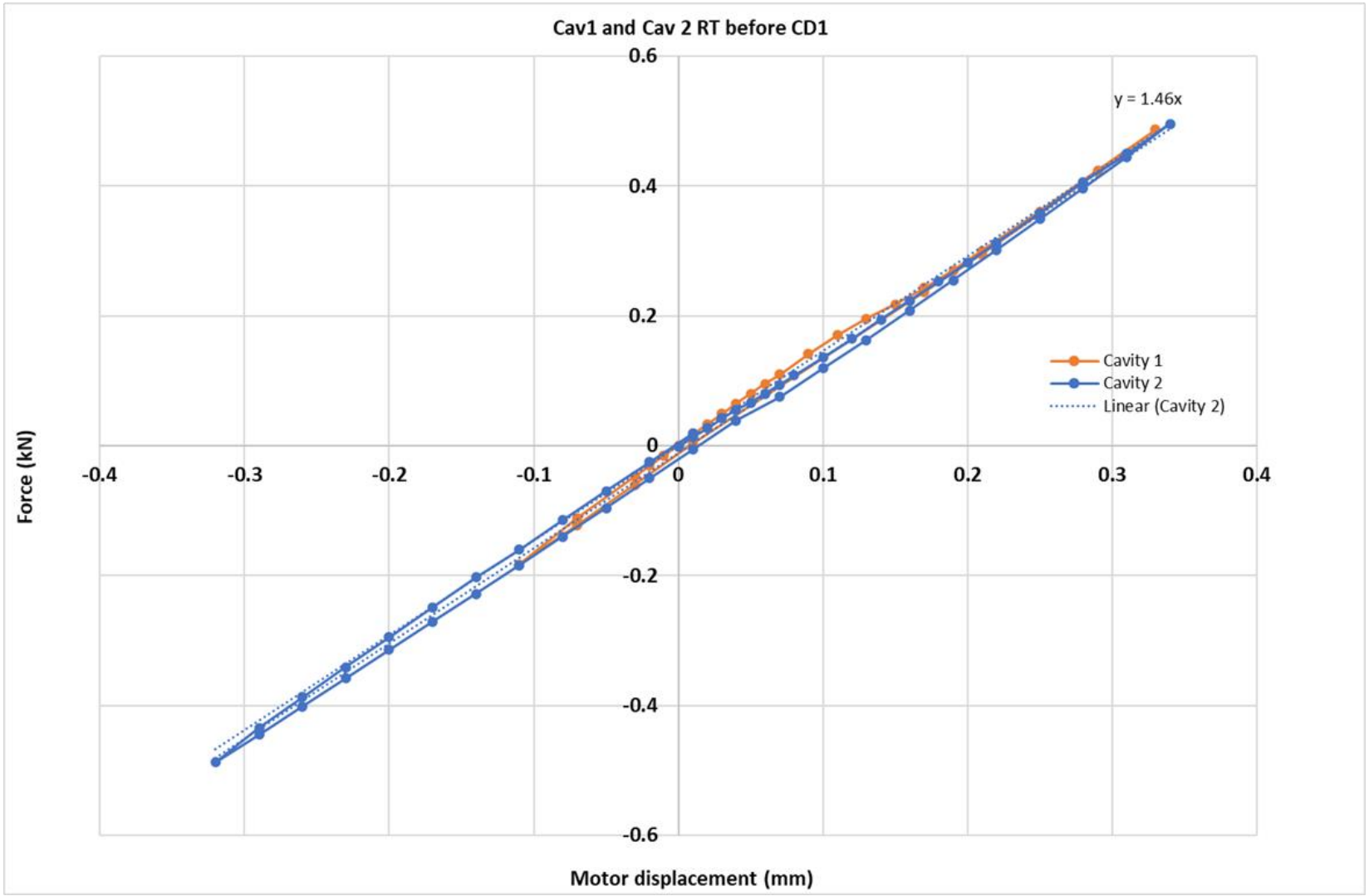




Installation Actuators + RT test

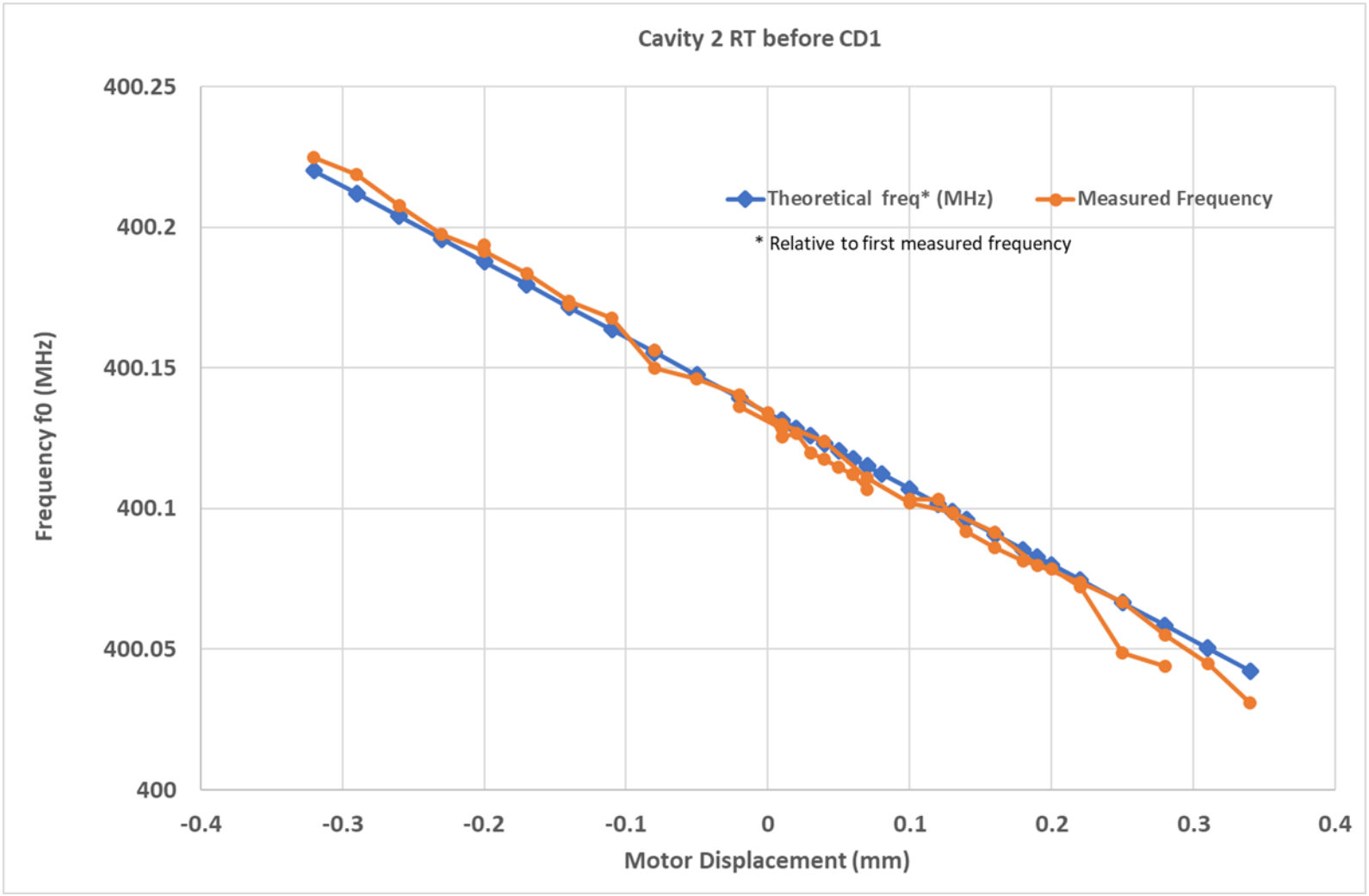
- Interference actuator springs with turned and tilted waveguide
- Interference between cable gauge FPC with actuator support

RT cycle before CD 1, OVC open



*Cycle on Cav1 shortened due to x-rays in evening

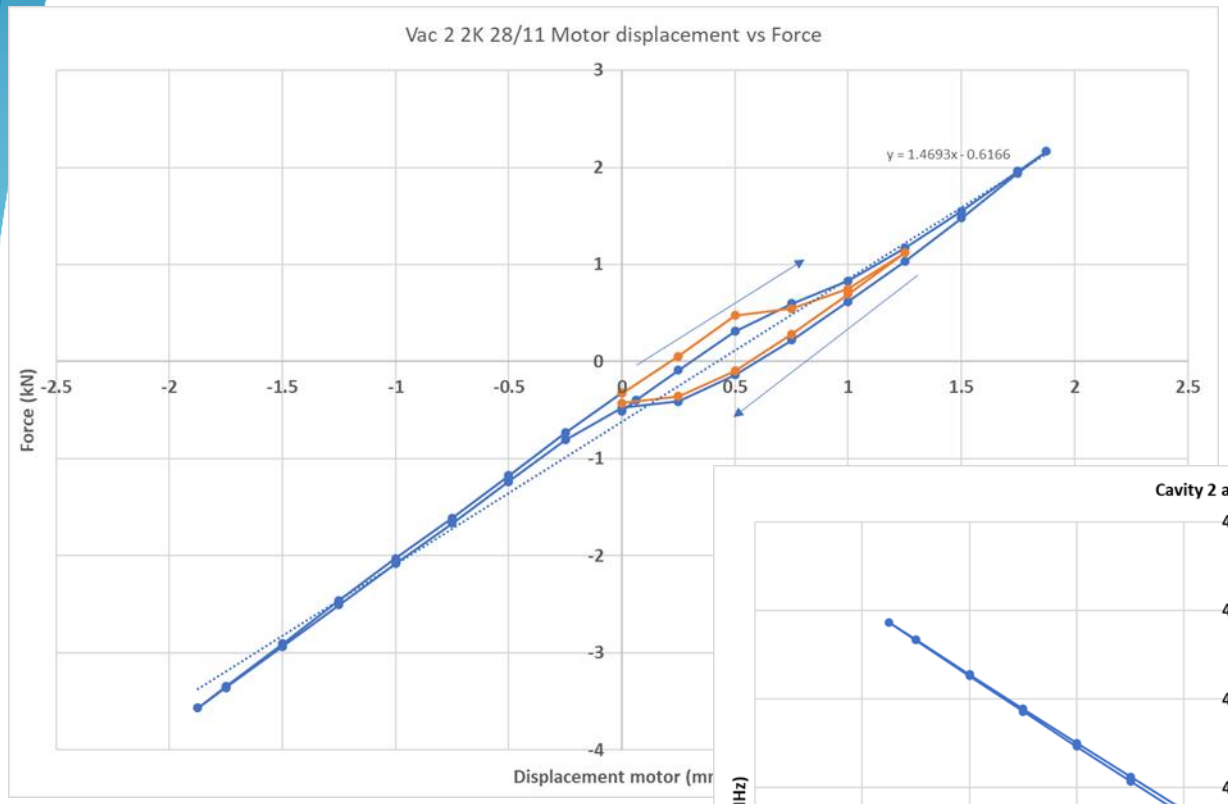
RT before CD 1, OVC open

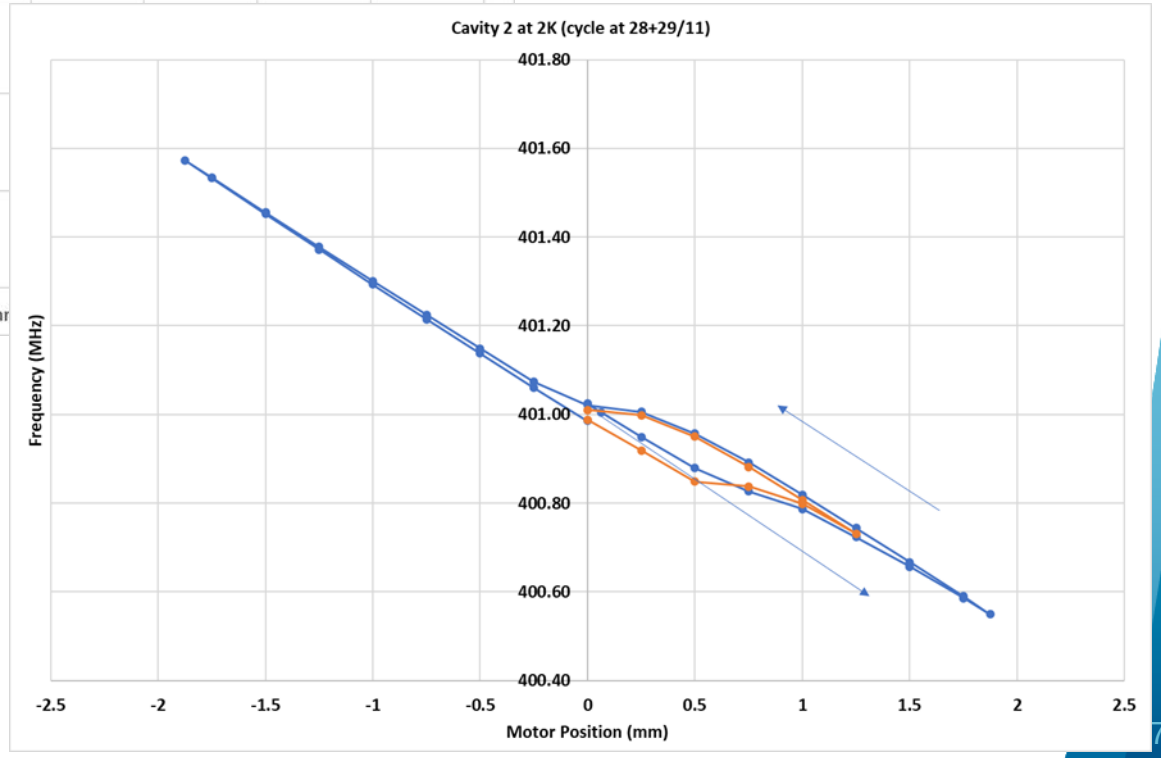


Additional: 14/11/23 Tuner and HOM measurements at RT

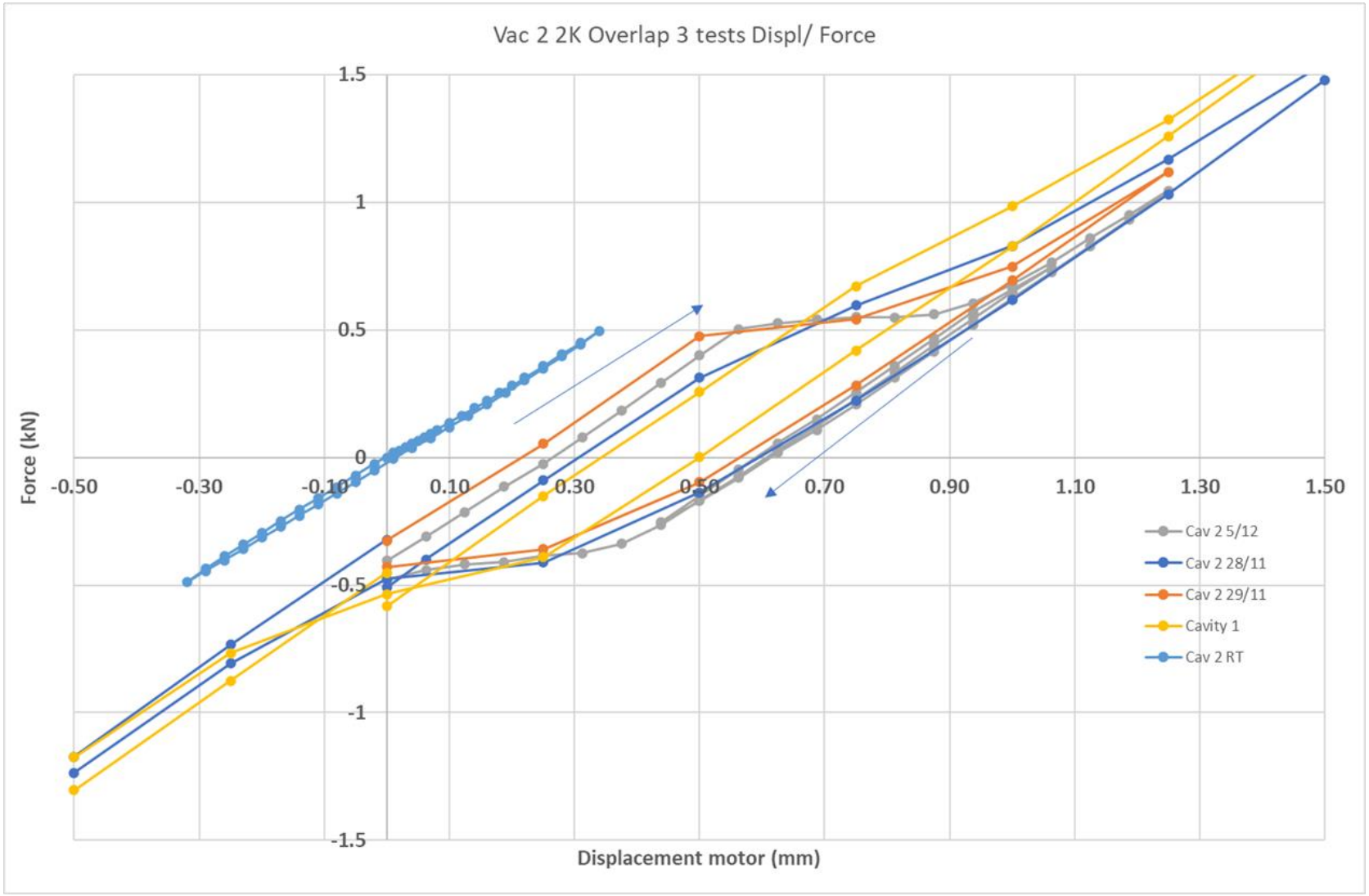
Cool Down 1 to 2 K

- No tuner force measurements during cool down
- Non-linearity measured on cavity 2 and cavity 1 (backlash with a twist)

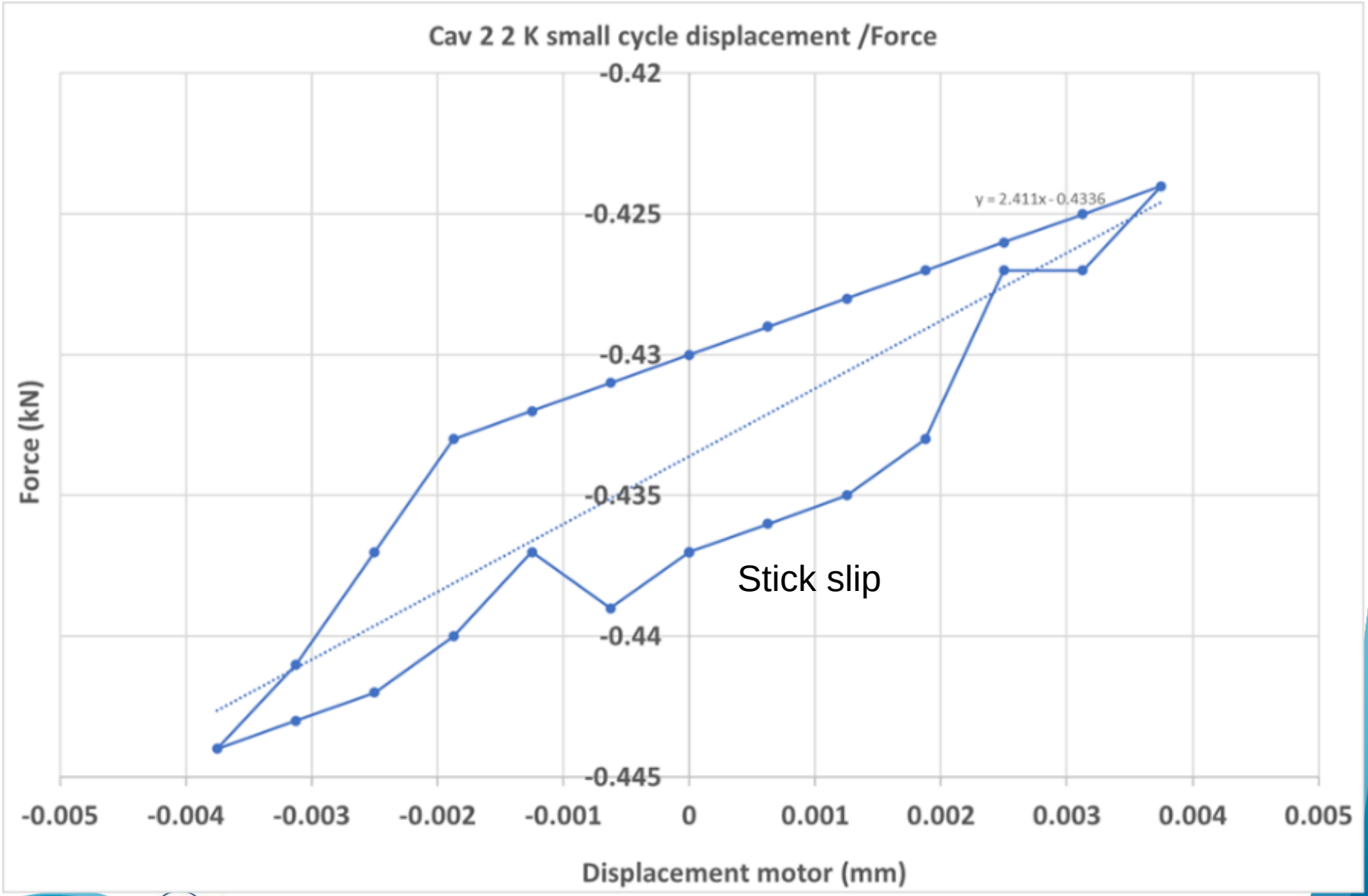




Cav 1 + 2, CD1 several cycles



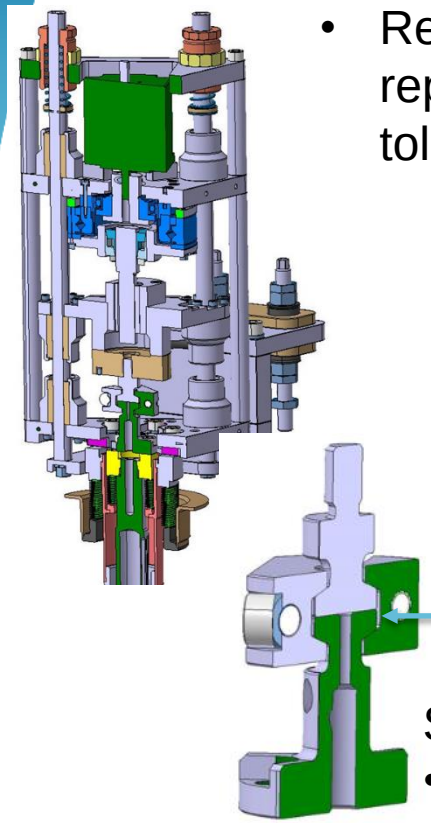
Small precision cycle CD1



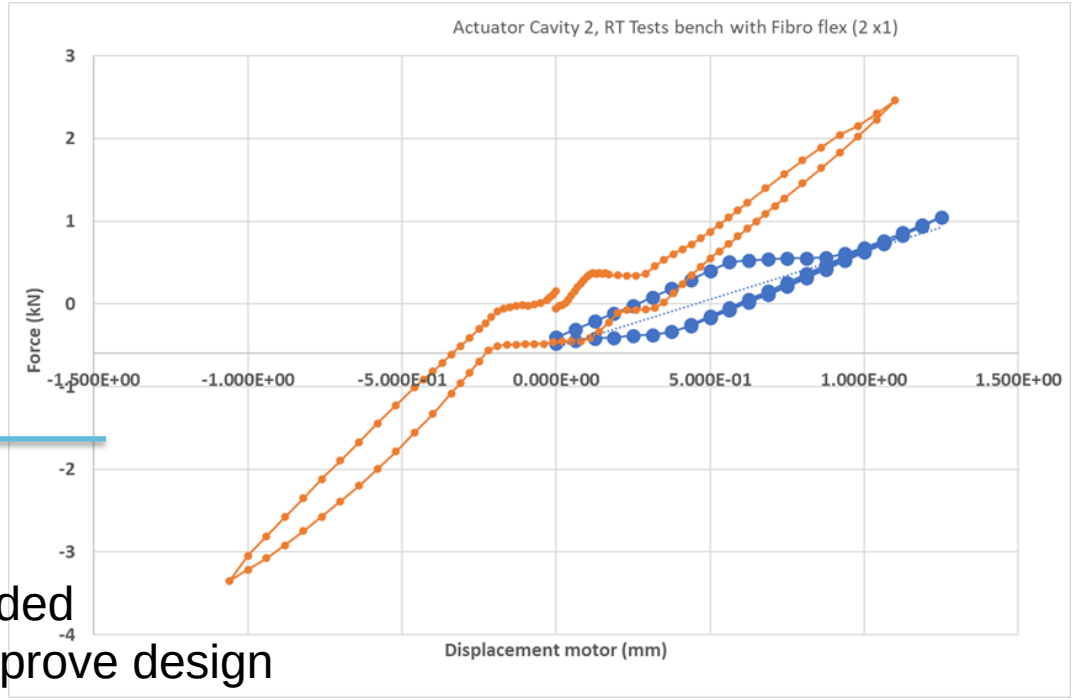
CD1 Other observations tuner

- Tuner laterally blocked on sliding pads support
- During assembly tuner, bearings very hard to align, some “hard points” in guidance
- No ice nor condensation observed during CD1 run on tuner feed through

Adjustments actuator before CD2



- Reason for the backlash: play in actuator clamp reproduced on actuator test bench, part out of tolerance

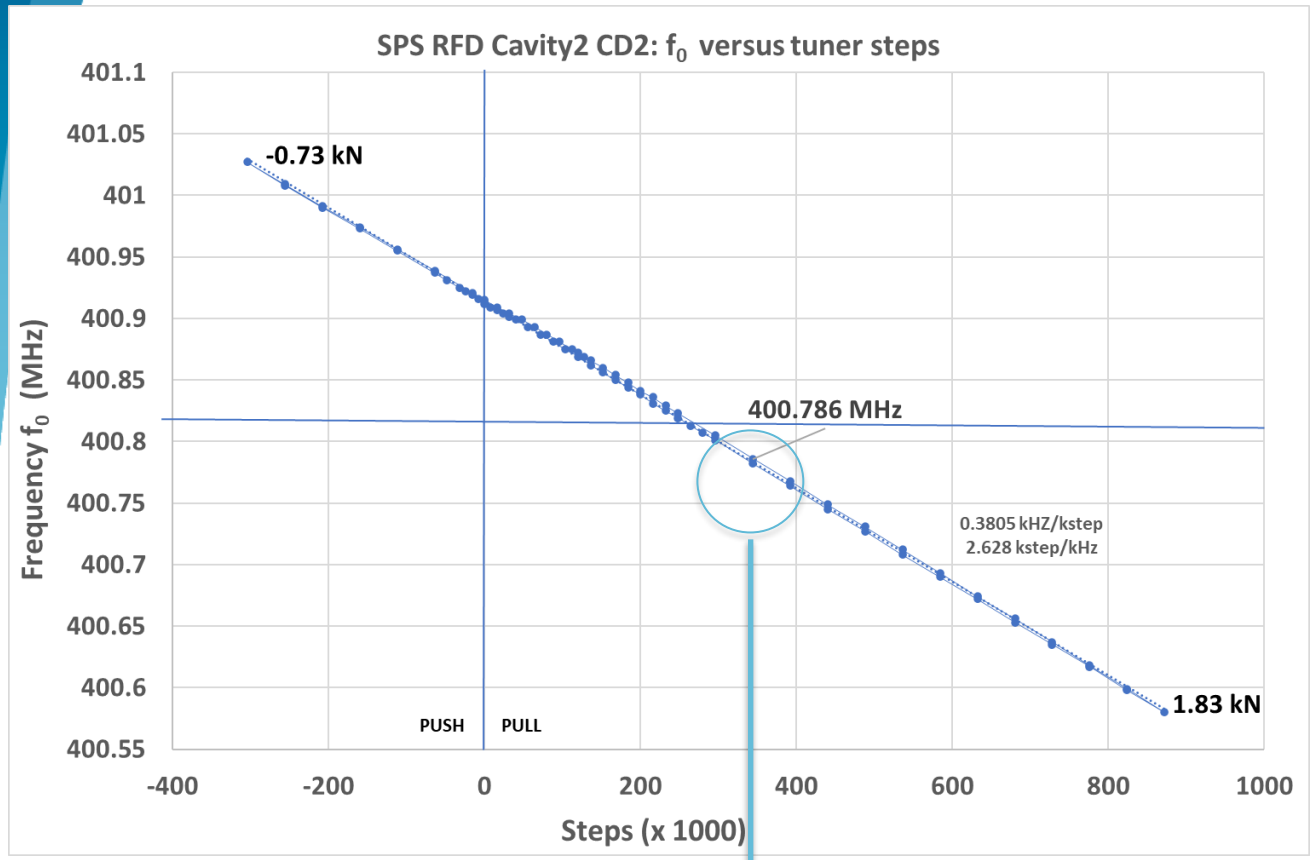


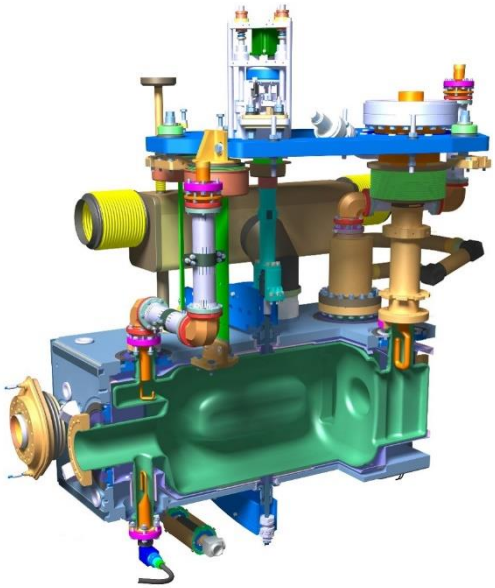
Solution:

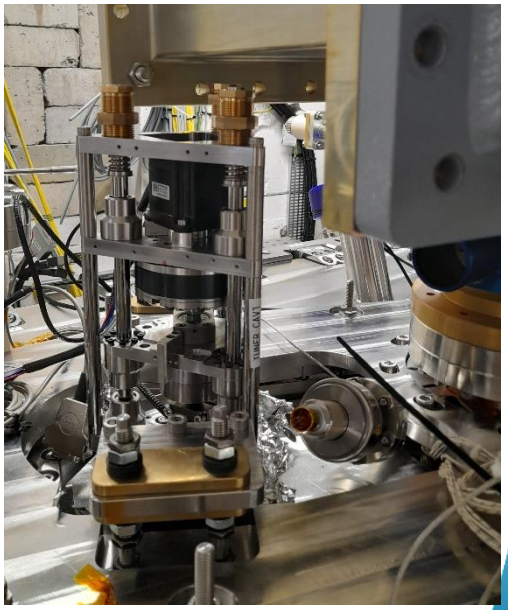
- spacer added
- We will improve design

- Removed the actuator support + springs. The actuator now “sits” completely on cavity. This to reduce the restraints on bearings + bonus: no more interference with waveguide or cable FPC

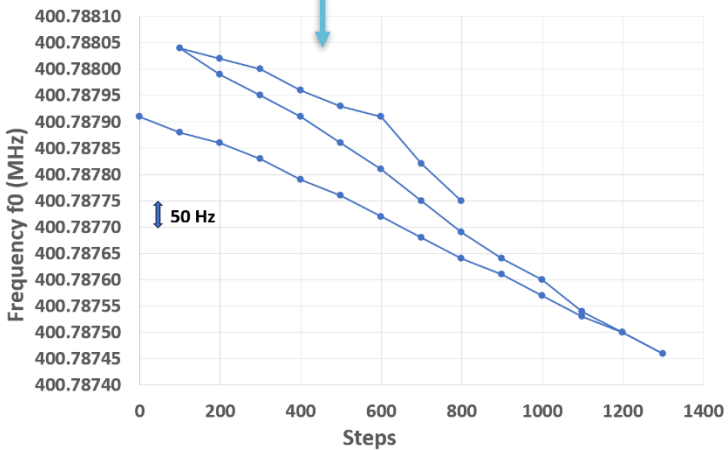
Tuning SPS-RFD SM18 Cavity 2 CD2







Small cycle
(Frequency is drifting during test)

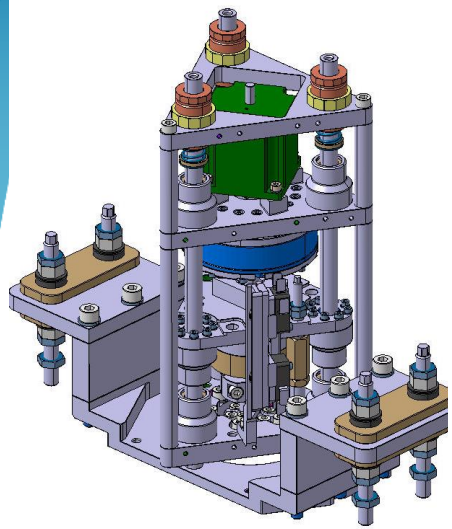


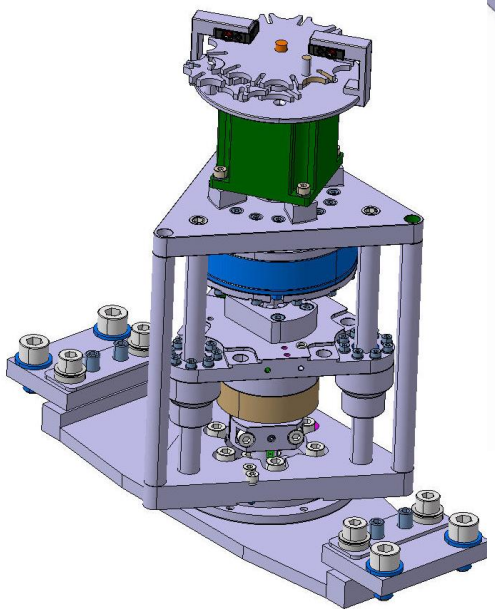
Acceptance testing tuner

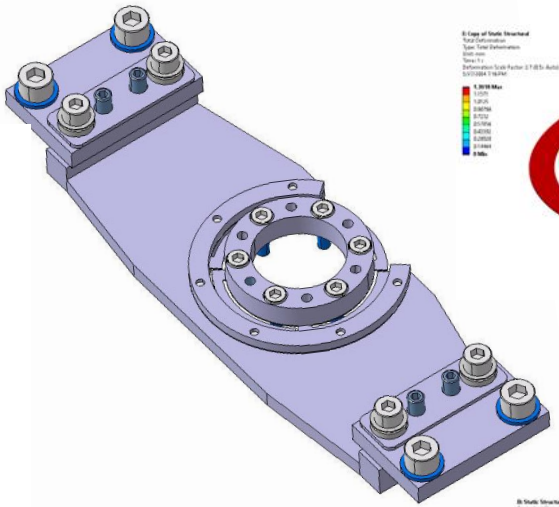
Remark: The 80 Hz precision steps (uni directional + bidirectional) are difficult to measure: the frequency measured is drifting slowly + superimposed noise.

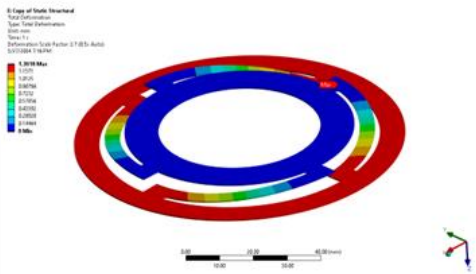
Up to LLRF to say if tuner precision is sufficient.

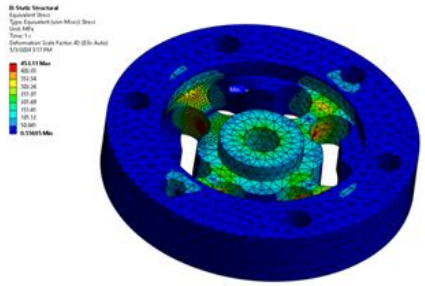
Ongoing upgrade design actuator:











- Actuator support with flexural guide
- 3 times less ball bearings
- Limit switches + mechanical stops: improved reliability + better access: on going
- Rad-hardness components+ dismountability in situ: ongoing
- Improving the load cell + rad –hardness
- Need to improve reliability + easier access heater: idea to include in clamp to be verified
- Reintroduce a pre-load spring (AUP RFD)
- Preparing purchase components