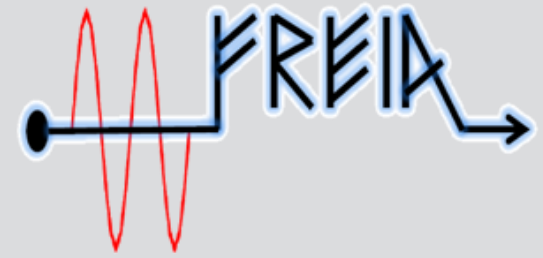




UPPSALA
UNIVERSITET



ESS weekly meeting (2022 W09)

A. Miyazaki et al



W08 & W09 progress / W10 planning



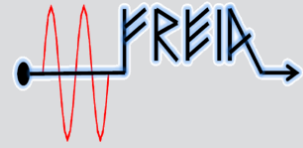
week		W08												
date		MON		TUE		WED		THU		FRI		SAT	SUN	
		21-feb		22-feb		23-feb		24-feb		25-feb		26-feb	27-feb	
		m	a	m	a	m	a	m	a	m	a			
present CM	CM08	LHe cooling		4K filling	2K pumping	2K pumping retry	MP conditioning only CAV OUT		CTS & MP cond of CAV IN		move CTS & static heat load	dynamic heat load of CAV OUT	dynamics heat load continued	f vs p and warming up
next CM	CM09			doorknob mounting	leak checked									
next next CM	CM10	preparation at Orsay												

week		W09											
date		MON		TUE		WED		THU		FRI		SAT	SUN
		28-feb		01-mar		02-mar		03-mar		04-mar		05-mar	06-mar
		m	a	m	a	m	a	m	a	m	a		
previous CM	CM08	warming up	break insulation vacuum	warming up completed	disconnect vacuum pumps	disconnect cryogenics	swap modules		doorknob dismounting	dry N2 filling	out going test	waiting in the box	
present CM	CM09			open the bunker					cryogenic connection	vacuum connection		pumping vacuum	
next CM	CM10	preparation at Orsay											

We are here

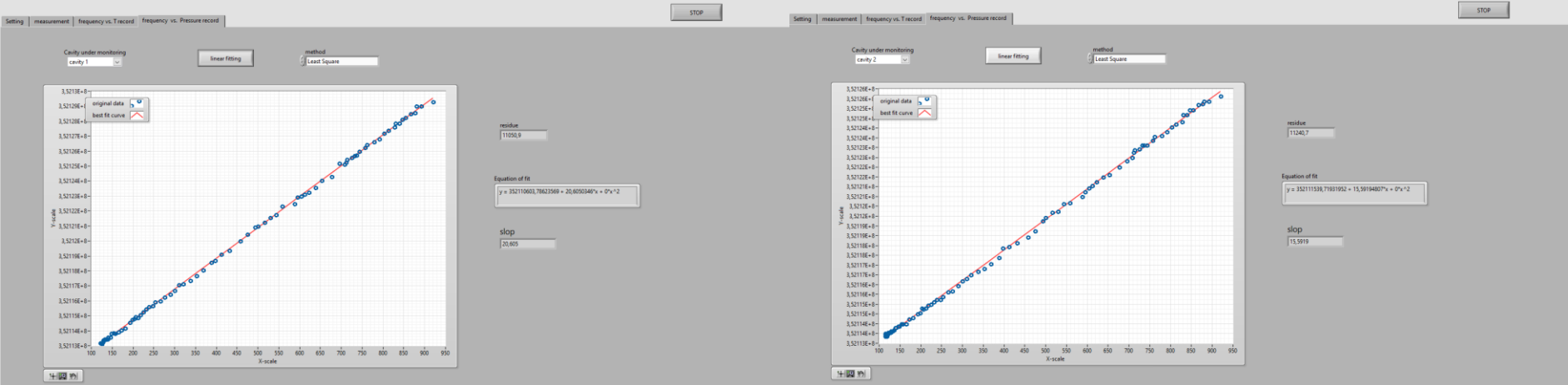
week		W10											
date		MON		TUE		WED		THU		FRI		SAT	SUN
		07-mar		08-mar		09-mar		10-mar		11-mar		12-mar	13-mar
		m	a	m	a	m	a	m	a	m	a		
previous CM	CM08	spare day for out going test		departure to ESS		preparing report		publish report					
present CM	CM09	coupler warm conditioning with DB station											
next CM	CM10	transport from Orsay					arrival at UU		reception test				

f vs p during measured again



CAVIN

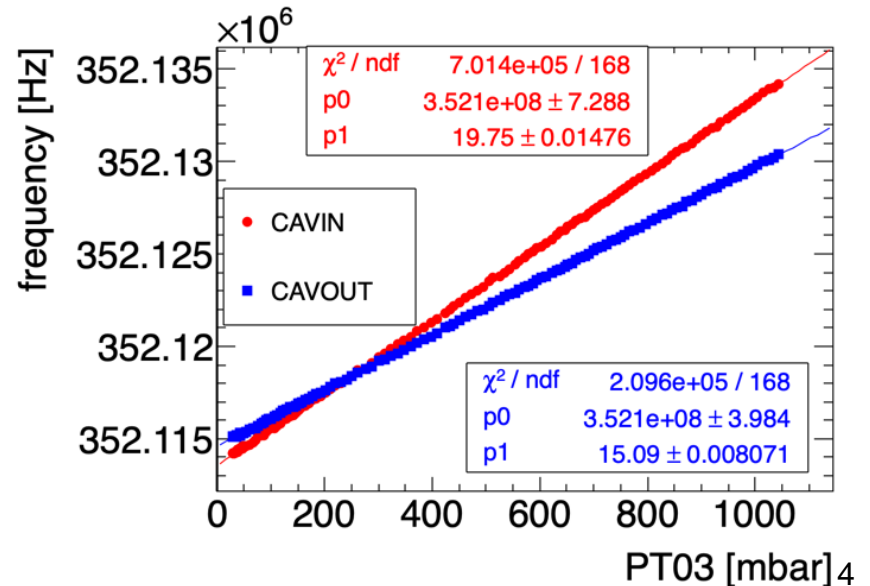
CAVOUT



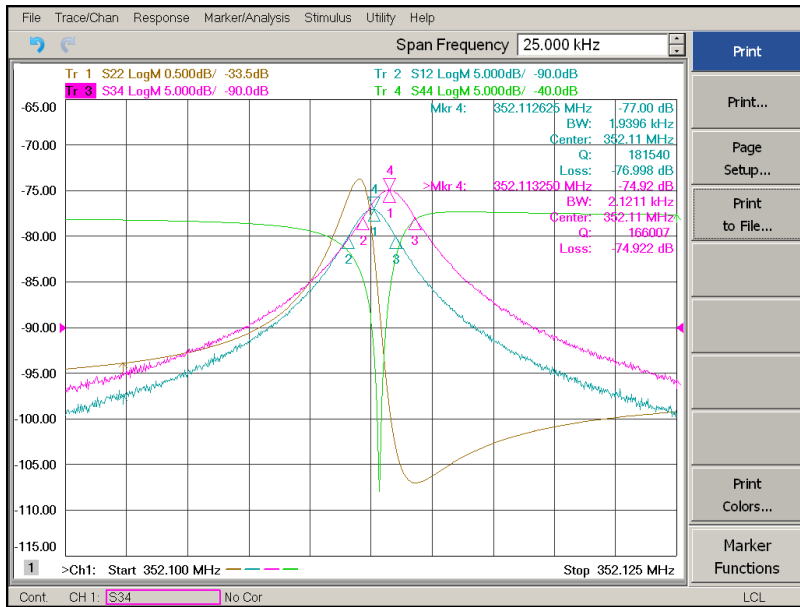
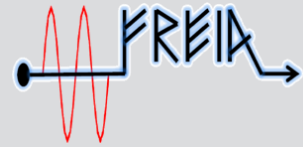
~~$df/dp = -20.61 \text{ Hz/mbar}$~~

~~$df/dp = -15.59 \text{ Hz/mbar}$~~

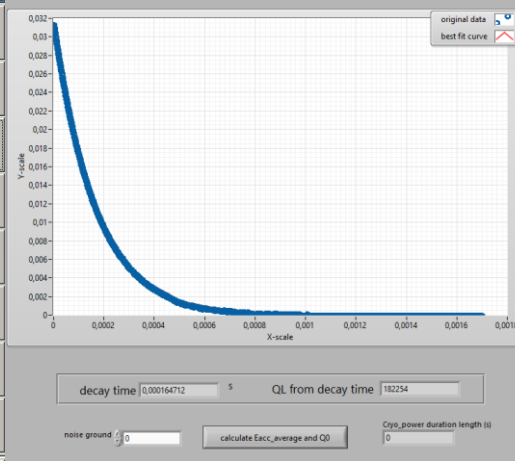
- The pressure measurement was malfunctioning during pumping
- We performed another measurement during 2K → 4K
- We confirmed that CAVIN is softer than usual but still on spec →



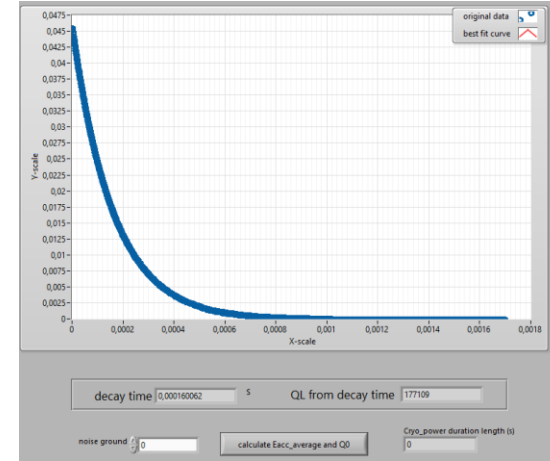
CM08: QL from VNA and field decay



CAVIN



CAVOUT



		CAV IN	CAV OUT
VNA	Γ [kHz]	1.94	2.21
	Q_L	1.82e5	1.66e5
decay	τ_L [us]	164	160
	Q_L	1.82e5	1.77e5

- Specification is **>1.74e5**

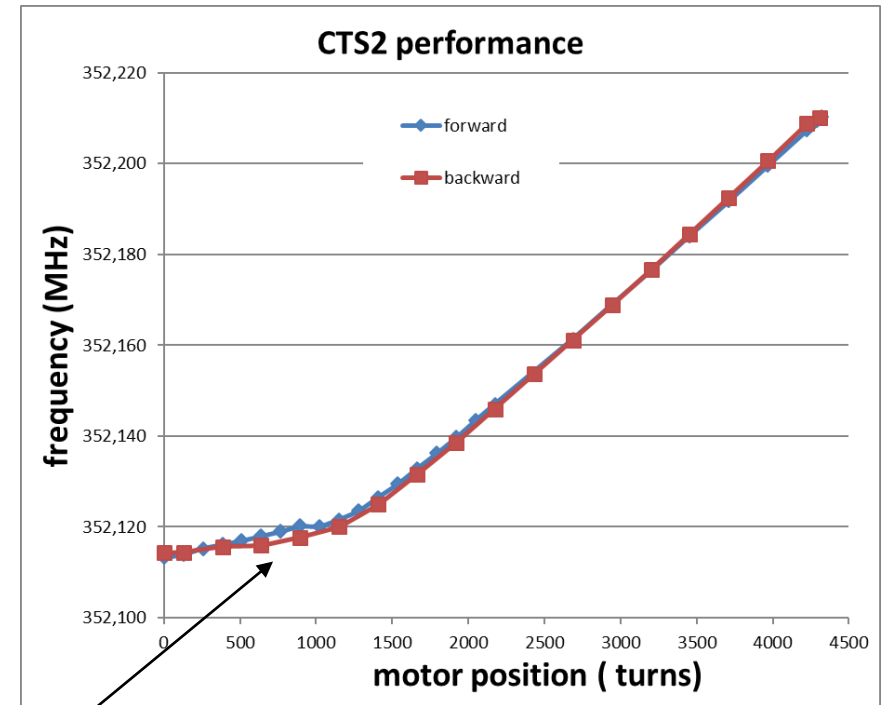
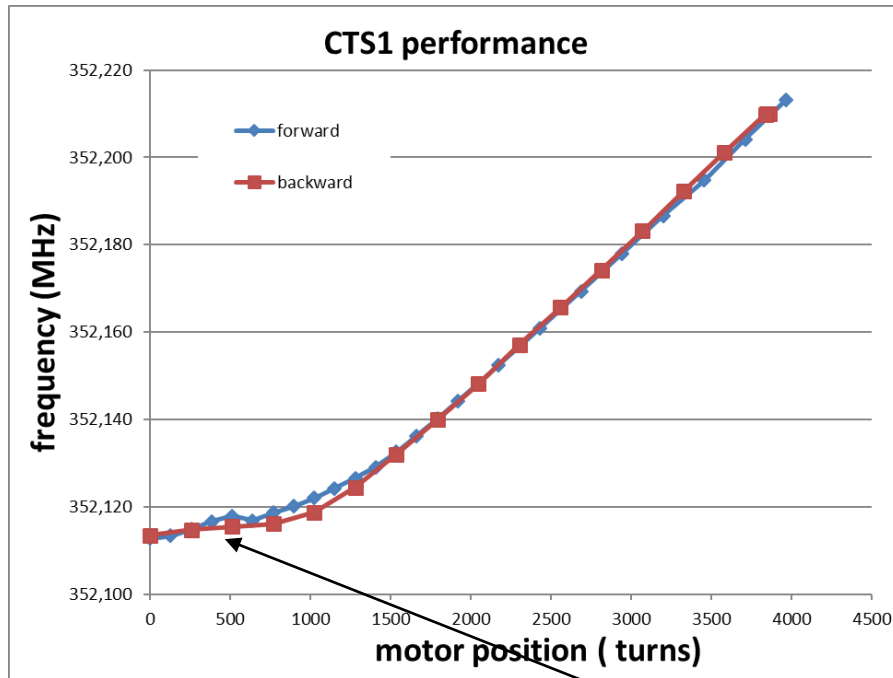
$$\tilde{P}(f) \propto \frac{1}{(f - f_0)^2 + (\Gamma/2)^2}$$

$$V(t) \propto e^{-t/\tau_L}$$

$$\tau_L = \frac{1}{\pi\Gamma} \quad \text{Fourier transform}$$

$$Q_L = \frac{f_0}{\Gamma}$$

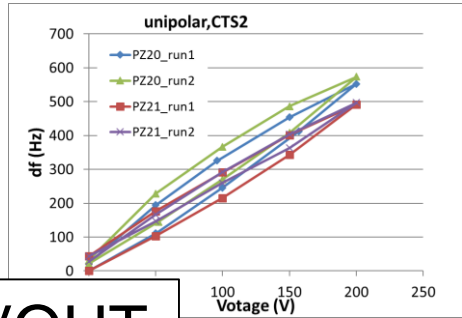
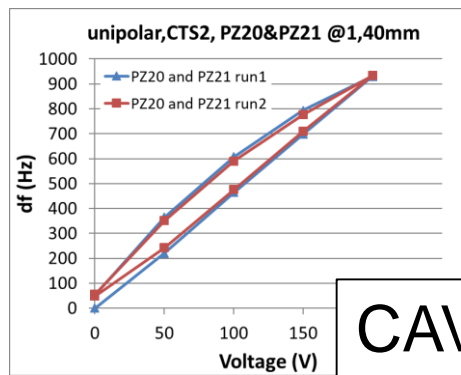
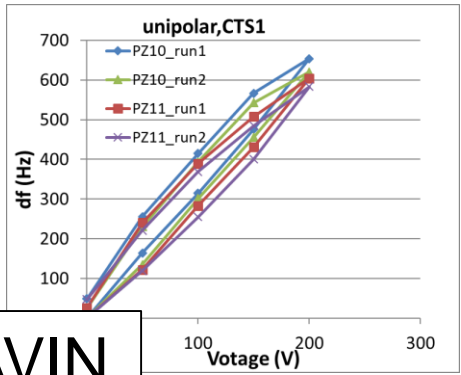
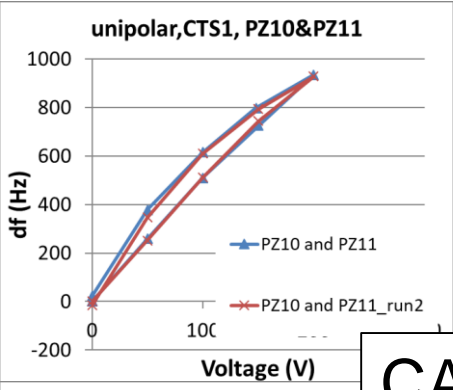
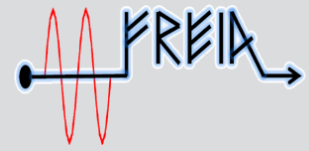
CTS measurement completed



Backlash before the linear zone for both CTSs

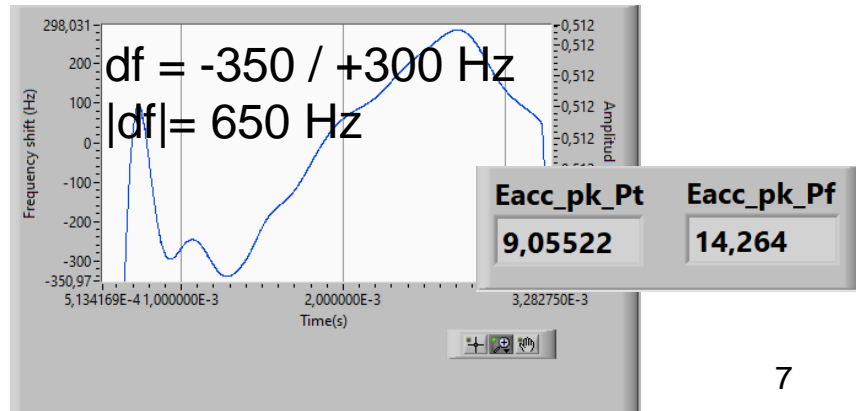
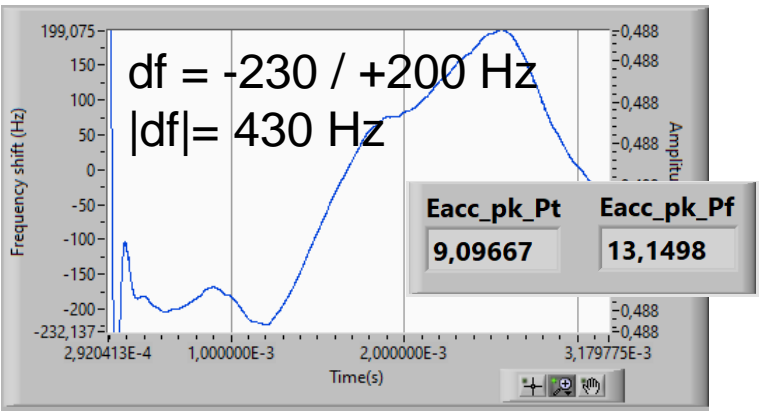
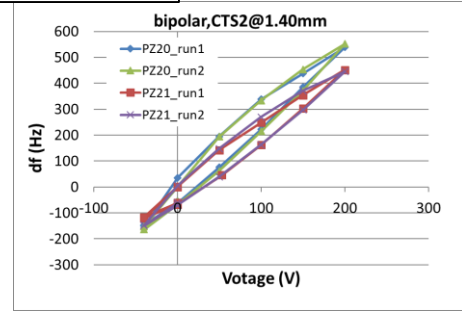
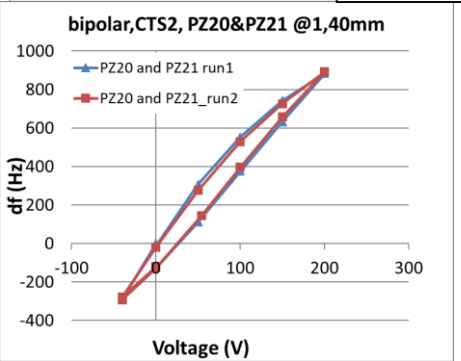
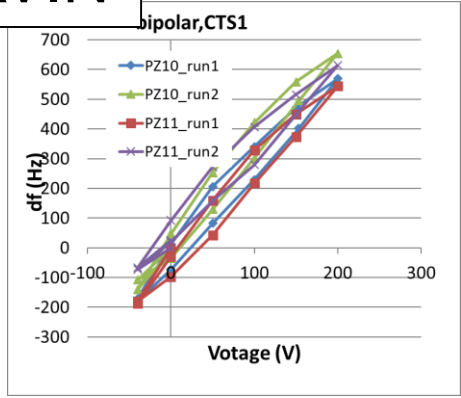
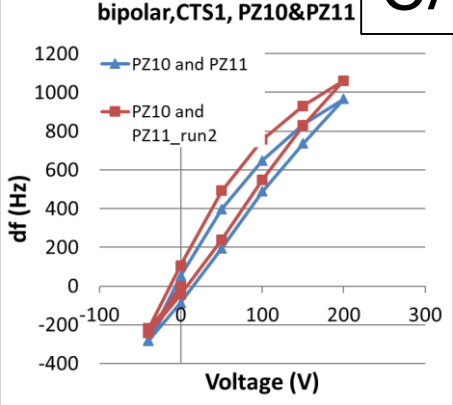
- They worked well regardless of the backlash
- The new Beckhoff driver was used for the test

Piezos and LFD with doubt in E_{acc}



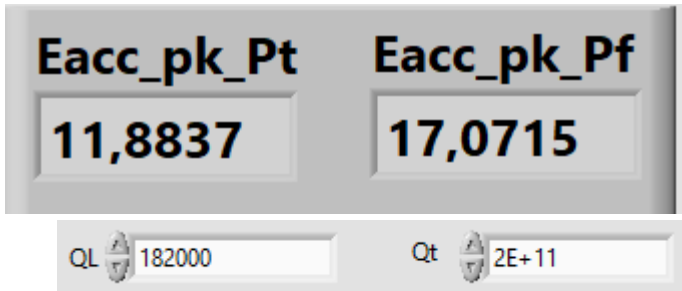
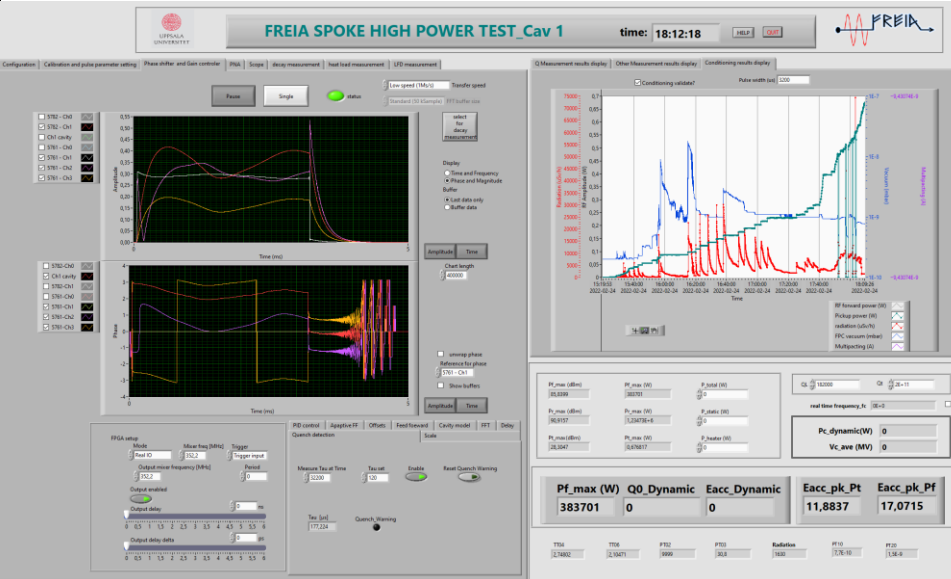
CAVIN

CAVOUT

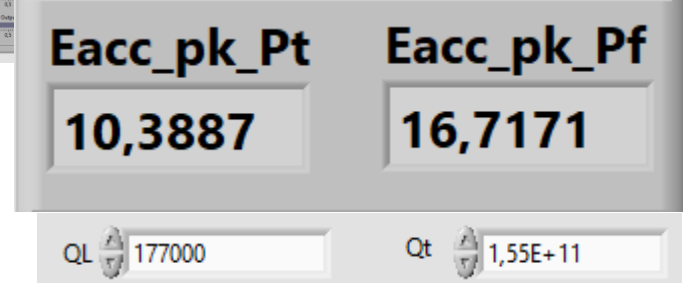
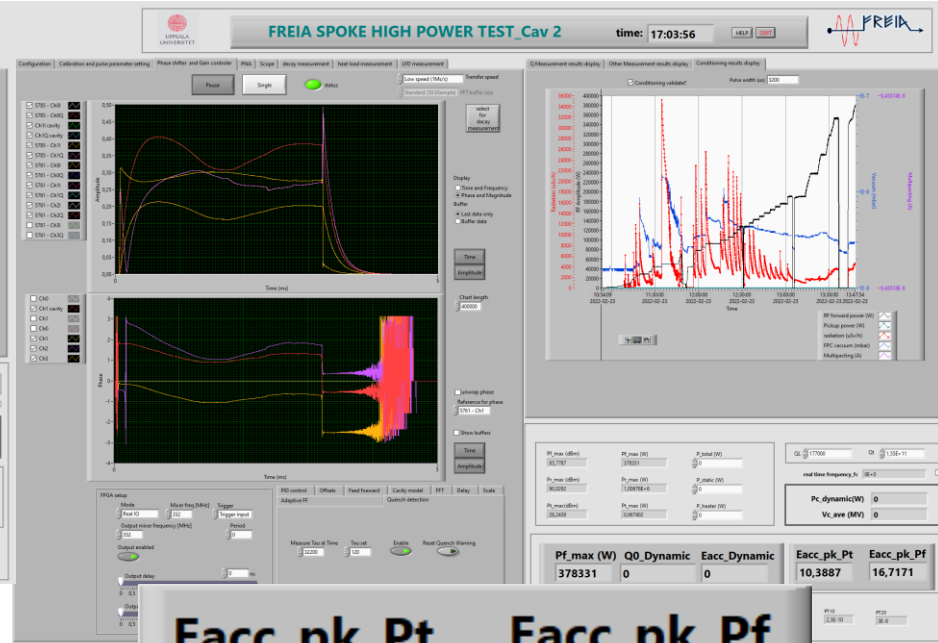


CAVIN limited by amplifier

CAVOUT limited by amplifier



228 kW to reach 9MV/m estimated from Qt

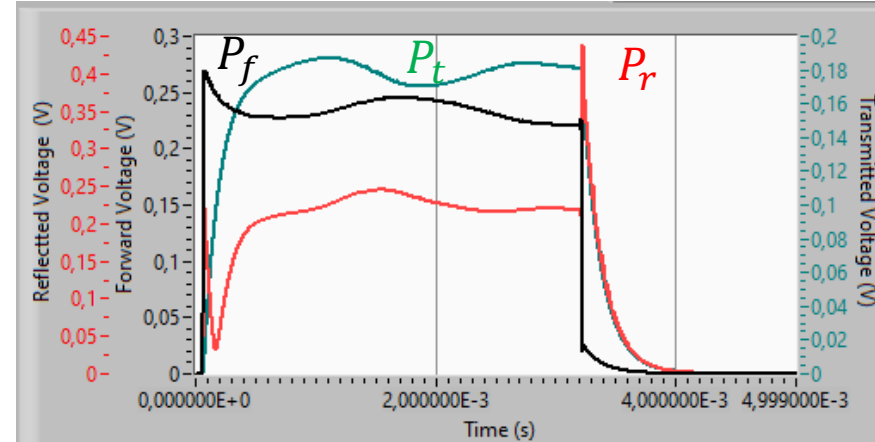
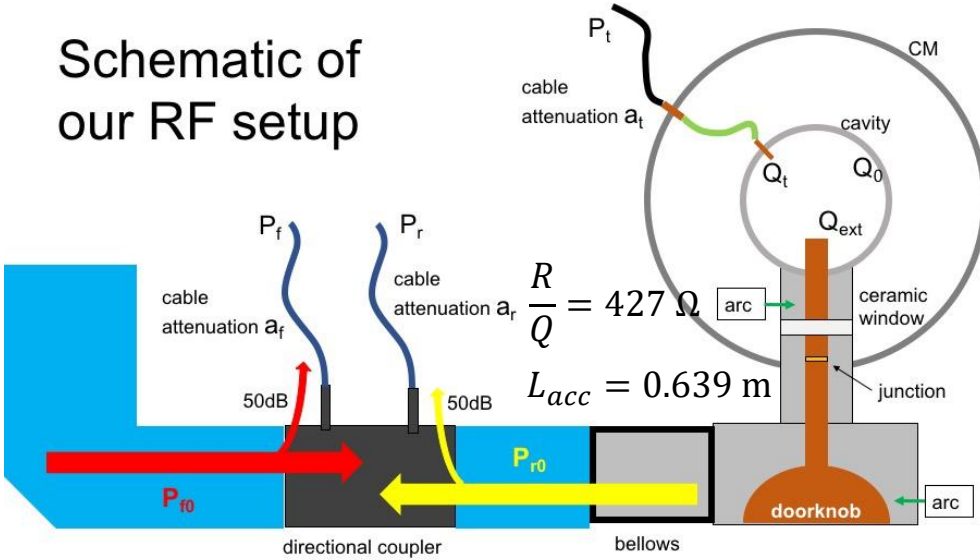


277 kW to reach 9MV/m estimated from Qt

Cavity gradient: disagreement in 3 methods



Schematic of our RF setup



From transmitted power and Q_t from IJCLab

$$E_{acc}^t = \frac{\sqrt{R/Q}}{L_{acc}} \sqrt{Q_t P_t}$$

From forward power and Q_L

$$E_{acc}^f = \frac{\sqrt{4R/Q}}{L_{acc}} \sqrt{Q_L P_f}$$

From reflected power and Q_L

$$E_{acc}^r = \frac{\sqrt{R/Q}}{L_{acc}} \sqrt{Q_L P_r}$$

Worst disagreement (CM08; cavity out)

$$E_{acc}^t = 9.06 \text{ MV/m}$$

$$E_{acc}^f = 14.26 \text{ MV/m}$$

$$E_{acc}^r = 12.21 \text{ MV/m}$$

60 % uncertainty!
(150% in power)

- We calibrated cables, directional couplers, and power meters only to find maximum 20% error to the field
- We report the **conservative** value
 - All cavities showed $\min \{E_{acc}\} > 9 \text{ MVm (spec)}$

CAVIN

Eacc_pk_Pt

9,04263

Eacc_pk_Pf

9,72392

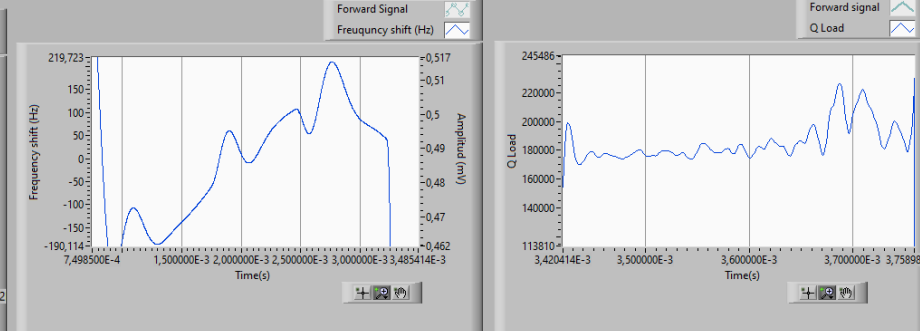
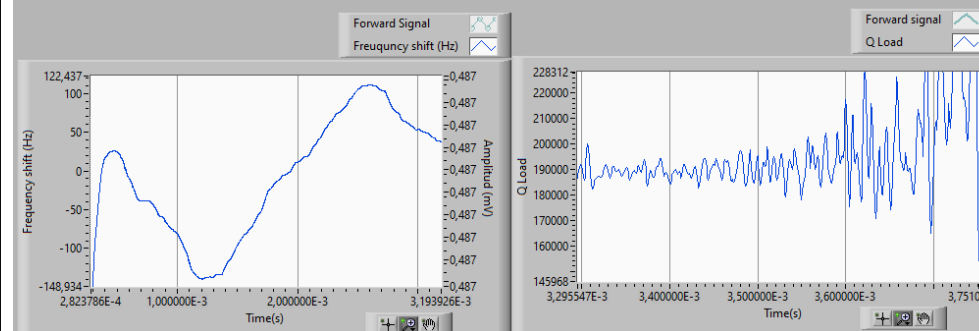
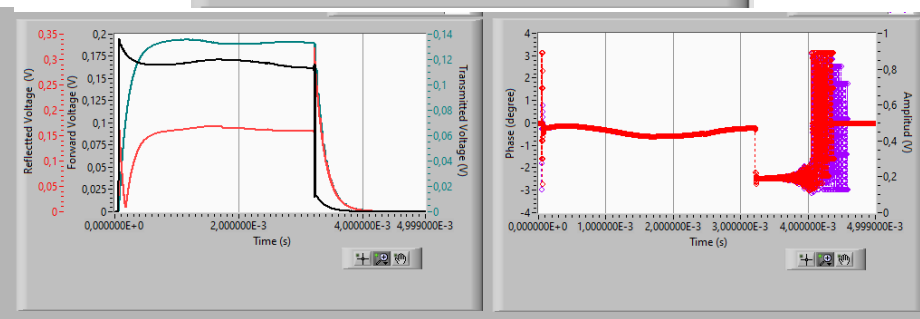
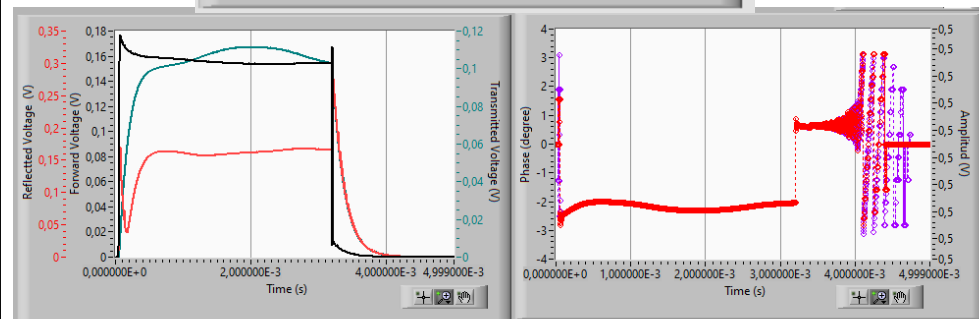
CAVOUT

Eacc_pk_Pt

9,02885

Eacc_pk_Pf

10,2858



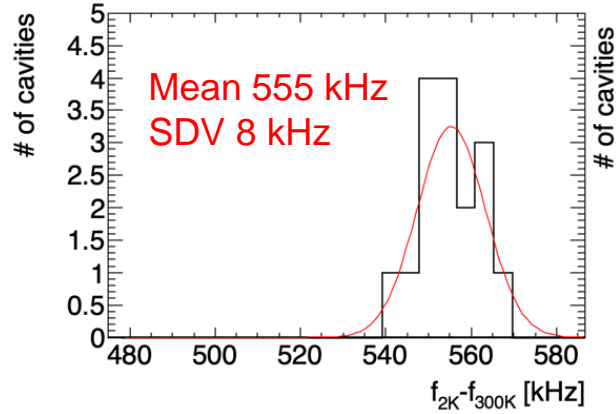
$$df = -148 / +122 \text{ Hz}$$

$$|df| = 270 \text{ Hz}$$

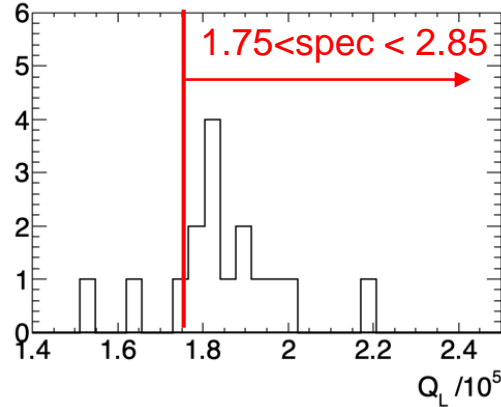
$$df = -190 / +220 \text{ Hz}$$

$$|f| = 410 \text{ Hz}$$

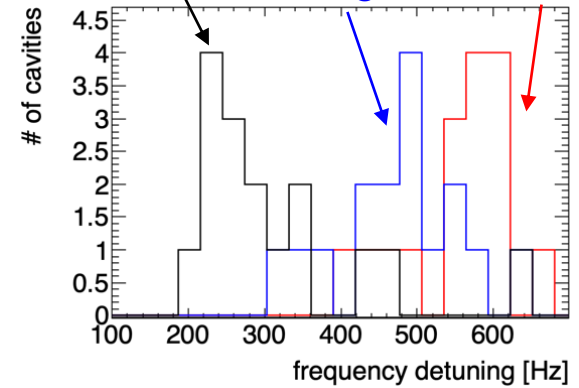
Frequency shift by cooling down



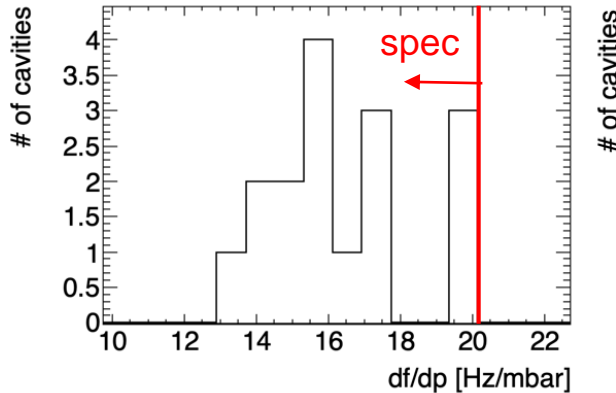
Loaded Q (for beam loading)



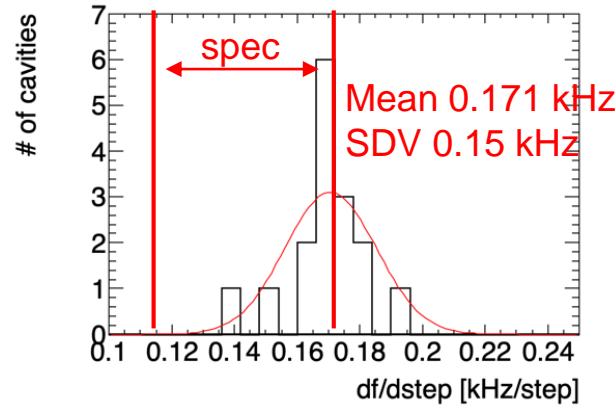
Lorentz force detuning **Piezo 2 tuning** **Piezo 1 tuning**



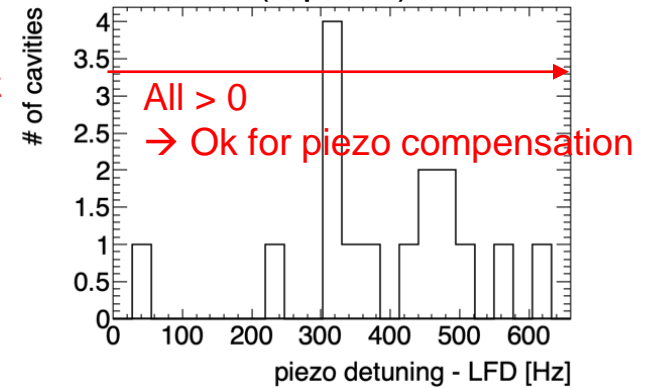
Frequency shift by pressure



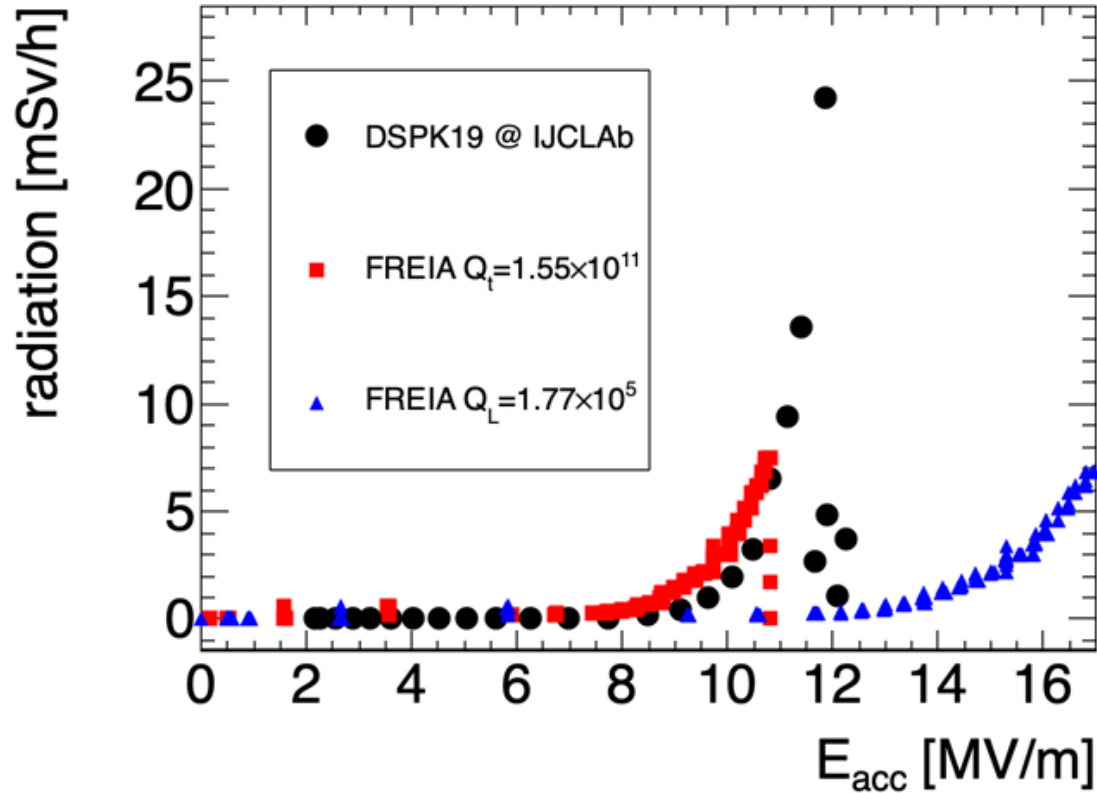
Stepper motor sensitivity



Piezo1 (bipolar) > LFD

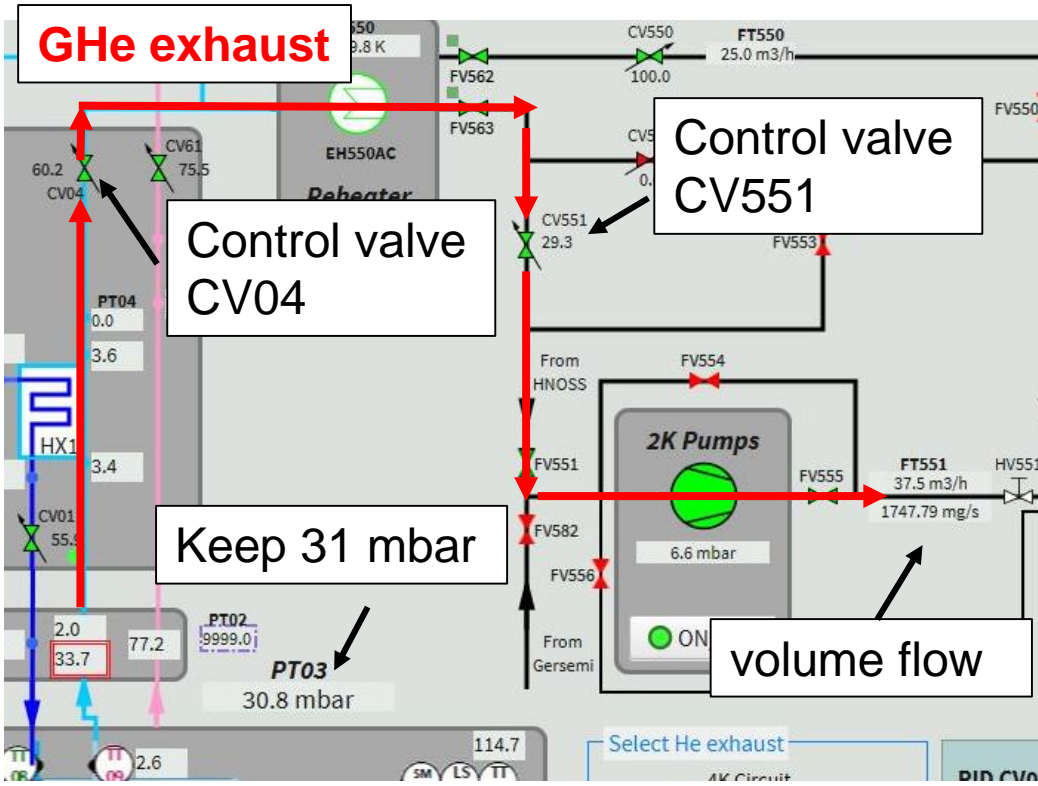


- $|df| < 500$ Hz at 9 MV/m is statistically more probable



- The field emission on-set was the same in FREIA and VT at IJCLab
- These 2 measurements share the same Q_t from field decay calibration in VT
 - The antenna may not be loosen during transport
- The field suggested by QL calibrated at FREIA shows higher field

We tried a new method in heat load



$$\dot{Q}(W) = L\dot{m} = 1.07 \times \dot{V}$$

(L: latent heat)

CM01-07 were measured with a fixed CV04 (43% or 60%) and also fixed CV551 and manually keep 31 mbar

- CM02 showed 10-13W
- CM03-CM06 showed 13-15W
- CM07 showed >20W

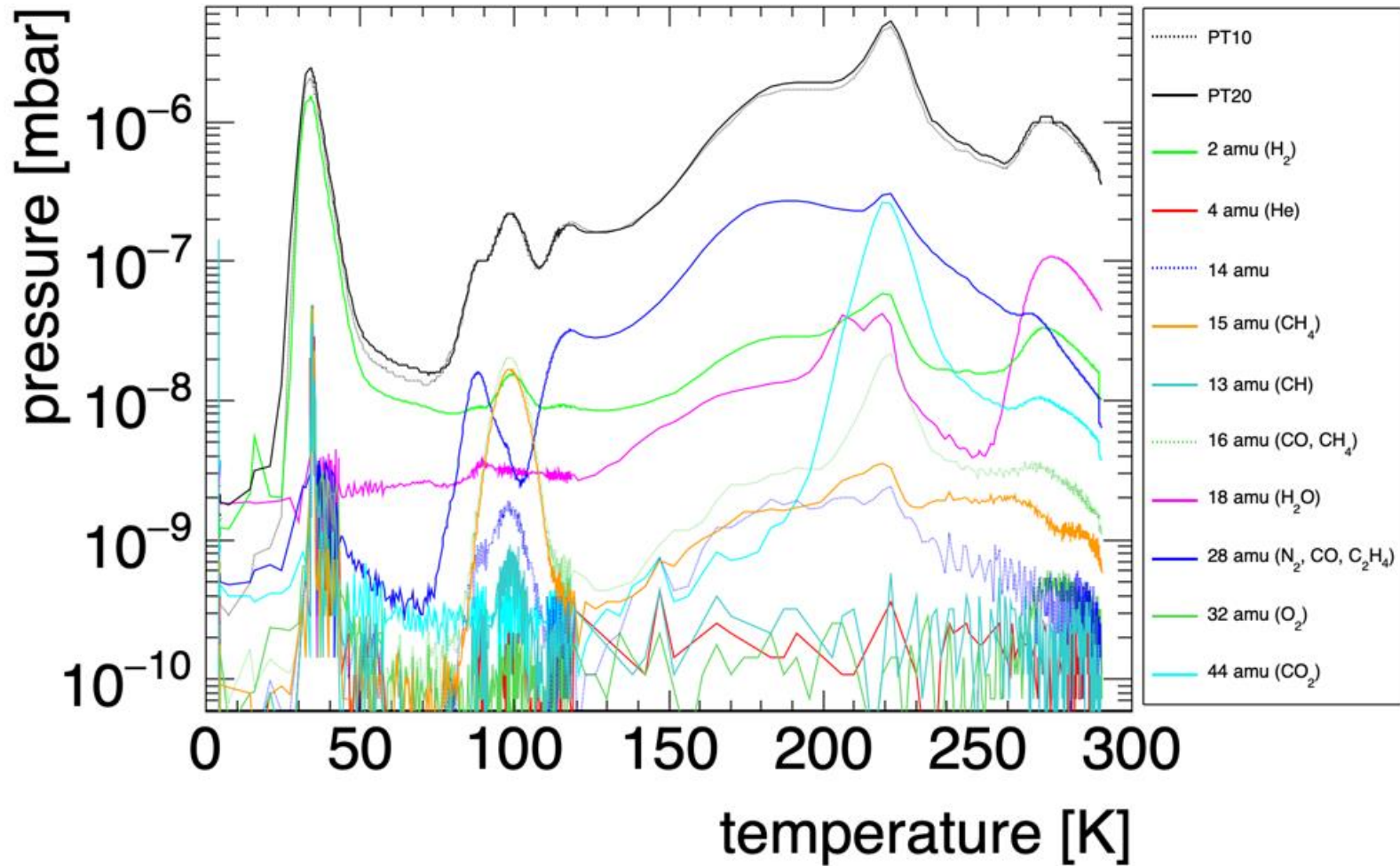
We tried CV04 regulation for CM08

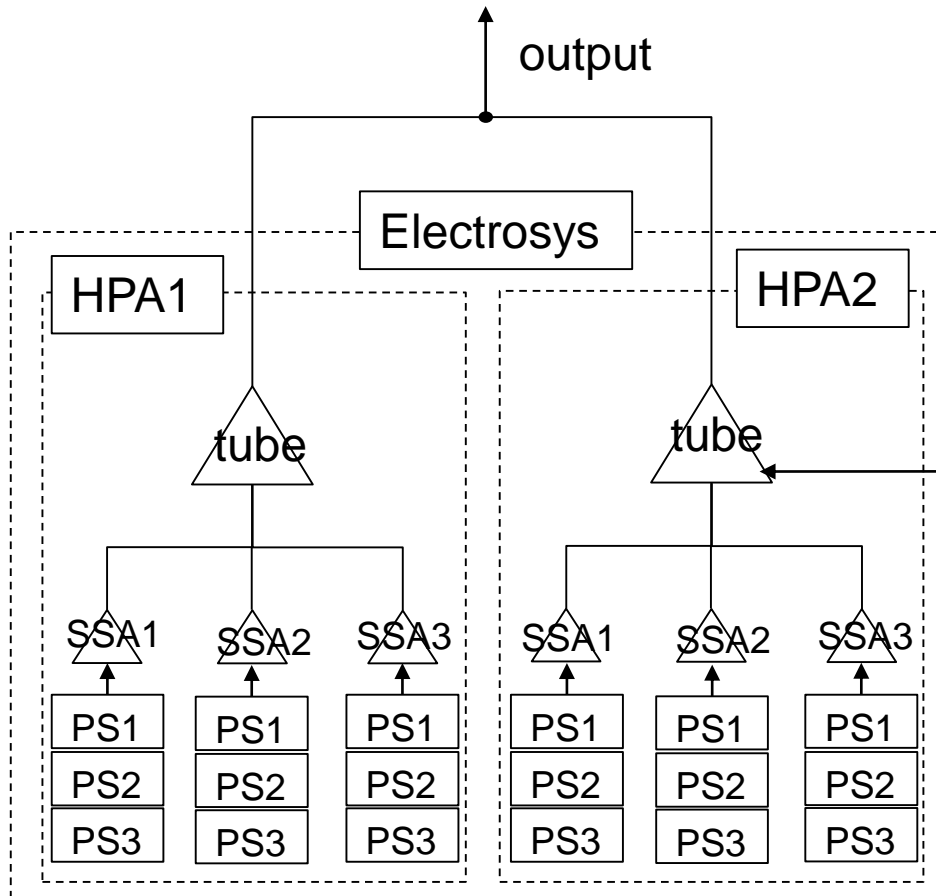
- Standard method showed 24W
- New method showed 14-17W

The heat load is still not clear

- We report 17W +/- 1W for CM08
- Flow varies a lot with CV04 under regulation
 - The value changes a lot by changing the averaging range
- RF heat load is zero consistent within the statistical error (1W)
 - Pressure rise vs time was also measured for future comparison (CAD)

Hydrocarbon peaks were observed as usual





Over Voltage Limit

Filament PS

- This is a standard power supply for high current 8V 200A (DELTA)

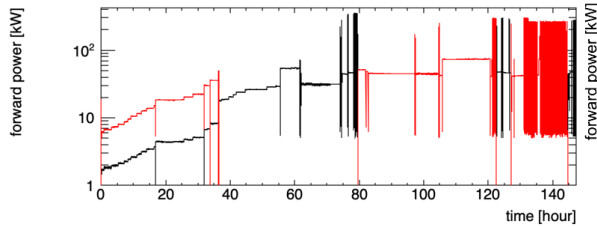
- We are trying to fix this power supply in Electrosys
 - One spare was ordered from Ireland
- If it will not be on time, we need to condition CM09 couplers one by one



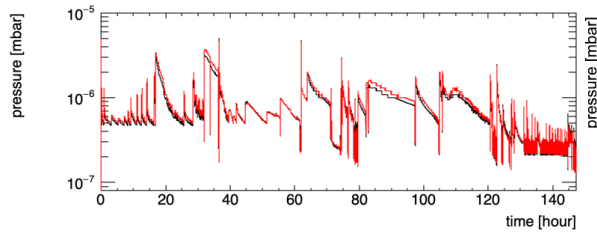
Coupler warm conditioning



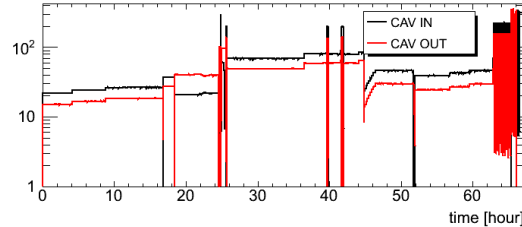
1 station dead: 6-7 days



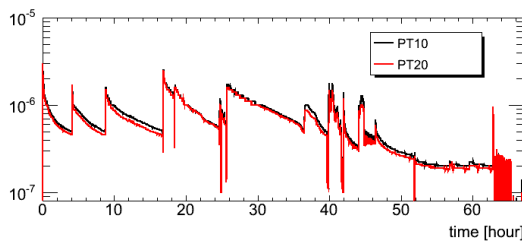
(CM04)



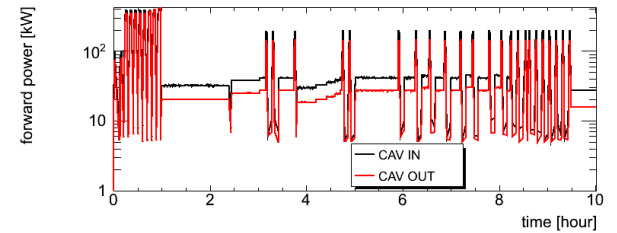
Standard: 3-4 days



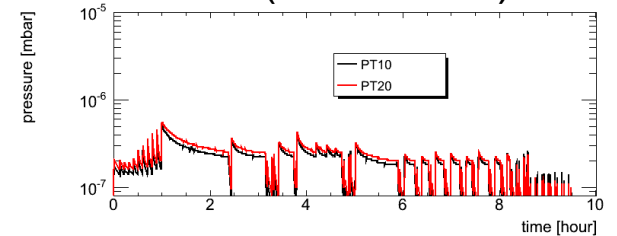
(CM05)



2nd conditioning: <1 day



(CM02 2nd)



7 days are reserved but hopefully shorter

week		W10											
date		MON		TUE		WED		THU		FRI		SAT	SUN
		07-mar		08-mar		09-mar		10-mar		11-mar		12-mar	13-mar
		m	a	m	a	m	a	m	a	m	a		
previous CM	CM08	spare day for out going test		departure to ESS		preparing report		publish report					
present CM	CM09	coupler warm conditioning with DB station											
next CM	CM10	transport from Orsay						arrival at UU		reception test			

week		W11											
date		MON		TUE		WED		THU		FRI		SAT	SUN
		14-mar		15-mar		16-mar		17-mar		18-mar		19-mar	20-mar
		m	a	m	a	m	a	m	a	m	a		
present CM	CM09	coupler warm conditioning with DB station continued		LN2 cooling		LHe cooling		4K filling		coupler cold conditioning			
next CM	CM10												