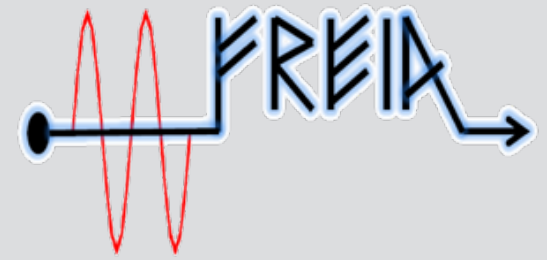




UPPSALA
UNIVERSITET



ESS weekly meeting (2021 W44)

A. Miyazaki et al.



FREIA Planning		2021-11-04													2022				
		October					November				December				January				
Equipment	Responsible	27	4	11	18	25	1	8	15	22	29	6	13	20	27	1	8	15	22
		week #																	
		39	40	41	42	43	44	45	46	47	48	49	50	51	52	1	2	3	4
Liquefier & 2K pumps	Esat	Blue	Blue	Yellow	Yellow	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Grey	Blue	Blue	Blue	Blue
RF power stations	Mykhailo				Green		Green		Green			Green		Green					Green
Cryomodule test stand	Akira	CM04	Yellow		Green	CM03	Yellow		Green	Yellow	CM06	Yellow		Green	Grey		Yellow	CM07	Yellow
Hnoss	Rocio	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey
Gersemi (plan A)		Red	Red	Red	Red	Yellow	Yellow	Blue	Blue	Blue	Yellow	Blue	Blue	Blue	Grey	Yellow	Yellow	Yellow	Blue
Gersemi - cavity insert	Akira														Grey				
Gersemi - magnet insert	Kevin						test magnet				test magnet				Grey				CCT China

We are here



Absence of Akira
Oct 4 – Nov 26

uncertain

- We need a very important test of the vertical cryostat in W46 and W47
- We may delay CM06 cooling down but no major impact to the planning
 - Still a chance to send CM06 & receive CM08 by the end of the year



W43 & W44 progress



week		W43											
date		MON		TUE		WED		THU		FRI		SAT	SUN
		25-Oct		26-Oct		27-Oct		28-Oct		29-Oct		30-Oct	31-Oct
		m	a	m	a	m	a	m	a	m	a		
present CM	CM03	2K pumping		2K pump does not work after restarting control cabinet		2K pump service	2K pumping	MP conditioning at 2K		CTS test at 2K		Issue in N2 flow --> cryogenics tripped	stand-by operation
		f vs p	RF calibration	RF interlock setup									
next CM	CM06	reception test LEMO		reception test VNA									
next next CM	CM07	preparation at Orsay											

week		W44											
date		MON		TUE		WED		THU		FRI		SAT	SUN
		1-Nov		2-Nov		3-Nov		4-Nov		5-Nov		6-Nov	7-Nov
		m	a	m	a	m	a	m	a	m	a		
present CM	CM03	4K filling		2K pumping	LFD; DHL; start warming up	vent insulation vacuum		warming up completed		disconnecting things			
next CM	CM06	doorknob mounting & water leak check								waiting in the docking area			
next next CM	CM07	preparation at Orsay											

We are here

Despite a lot of cryogenic issues, we managed 😊
(note: without Han Li and Akira on-site → a major milestone)



W45 & W46 & W47 planning



week		W45											
date		MON		TUE		WED		THU		FRI		SAT	SUN
		8-Nov		9-Nov		10-Nov		11-Nov		12-Nov		13-Nov	14-Nov
		m	a	m	a	m	a	m	a	m	a		
present CM	CM03	disconnect cryogenic line		swap modules		filling dry N2		doorknob dismounting	outgoing test (LEMO, VNA) shock sensors	activate shock sensors, close the box		waiting in the box	
next CM	CM06	water leak check				connect cryogenic lines	beam pumps, leak check	beam vacuum pumping		RF calibration			
next next CM	CM07	preparation at Orsay											

week		W46											
date		MON		TUE		WED		THU		FRI		SAT	SUN
		15-Nov		16-Nov		17-Nov		18-Nov		19-Nov		20-Nov	21-Nov
		m	a	m	a	m	a	m	a	m	a		
previous CM	CM03	departure to ESS		preparation of documents				publish test report					
present CM	CM06	coupler warm conditioning											
next CM	CM07	transport from Orsay				reception at UU morning				thermalization at UU			

week		W47											
date		MON		TUE		WED		THU		FRI		SAT	SUN
		22-Nov		23-Nov		24-Nov		25-Nov		26-Nov		27-Nov	28-Nov
		m	a	m	a	m	a	m	a	m	a		
present CM	CM06	Purging	N2 cooling	cooling down		4K filling	coupler cold conditioning	2K pumping	RF calibration at cold	MP conditioning		CTS thermalization	
next CM	CM07	reception test				waiting in the docking area							
next next CM	CM08	preparation at Orsay											



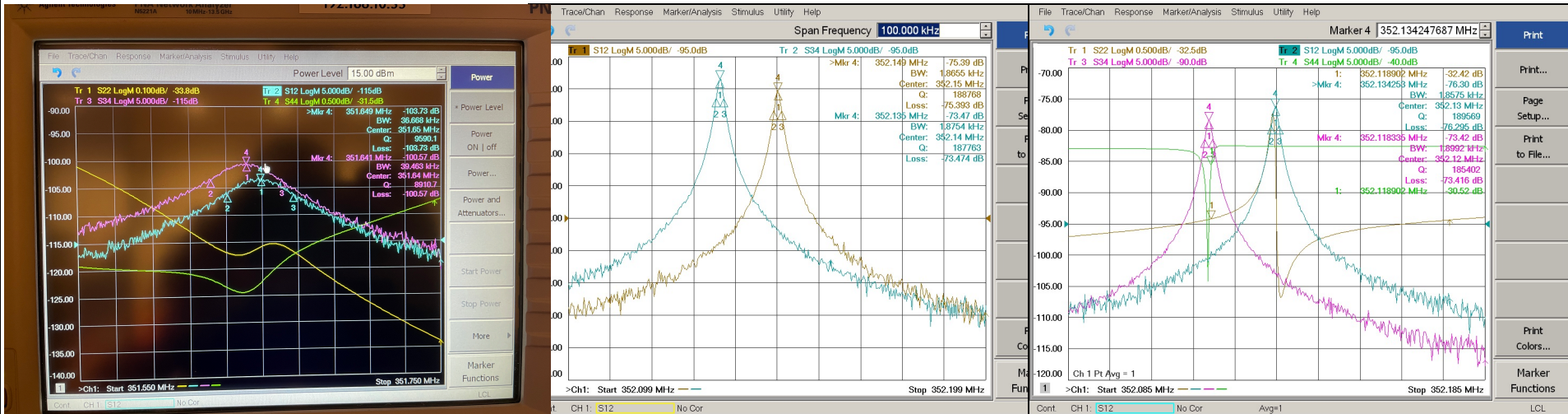
CM03 cavities: f and QL shift **correction**



300K w/ insulation vacuum

4K

2K



		300K w/o-insulation	w/ insulation	4K	2K
CAV IN	f0 MHz	351.638	351.649	352.149	352.134
	QL	8974	9590	1.89e5	1.90e5
CAV OUT	f0 MHz	351.627	351.641	352.135	352.118
	QL	9223	8910	1.88e5	1.85e5

+12 kHz

+500 kHz

-15 kHz



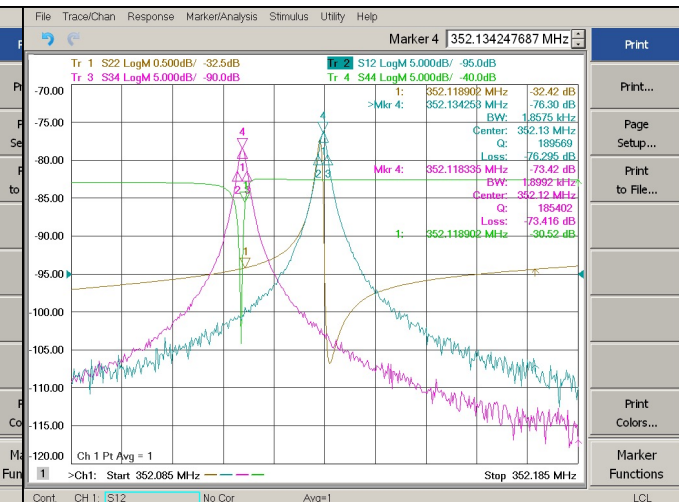
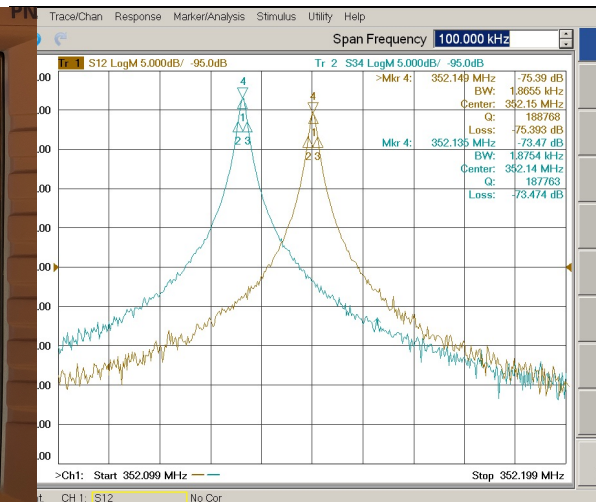
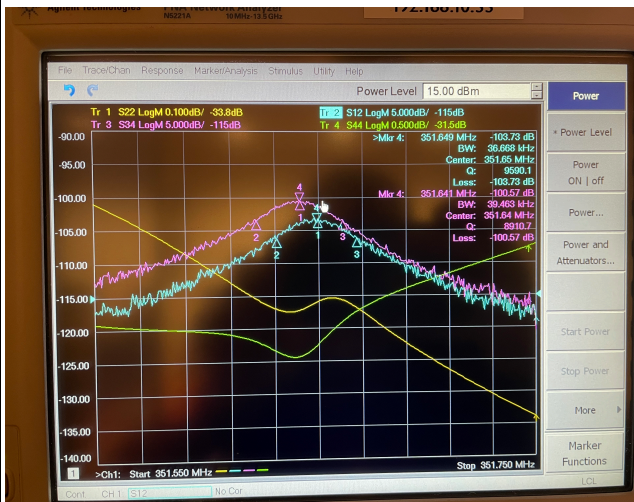
CM03 cavities: f and QL shift **correction**



300K w/ insulation vacuum

4K

2K



	300K w/o insulation	w/ insulation	4K	2K
--	----------------------------	----------------------	-----------	-----------

2021-10-11 11:01 SE JE CS MZ CM03 2nd: Vacuum in insulation volume.

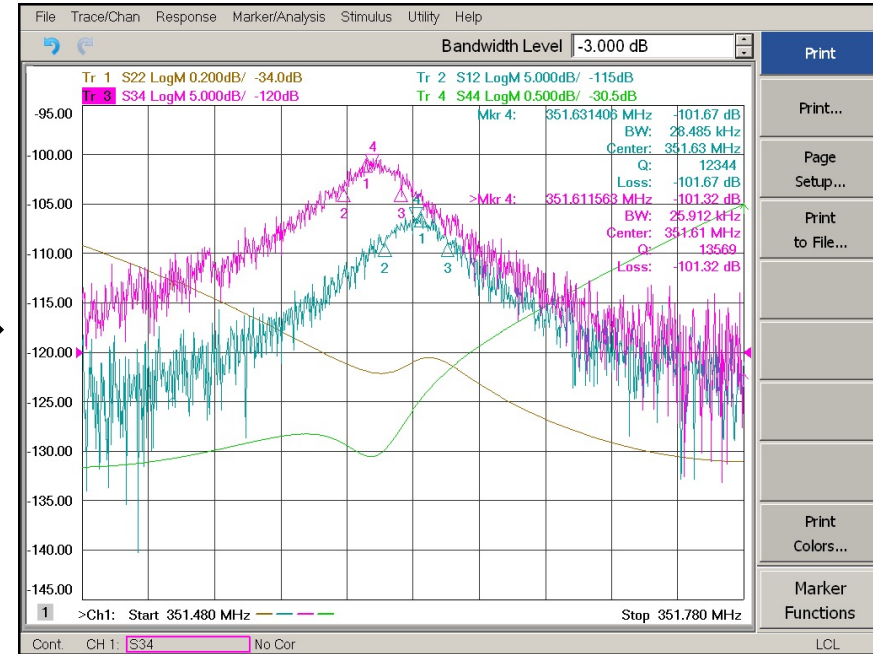
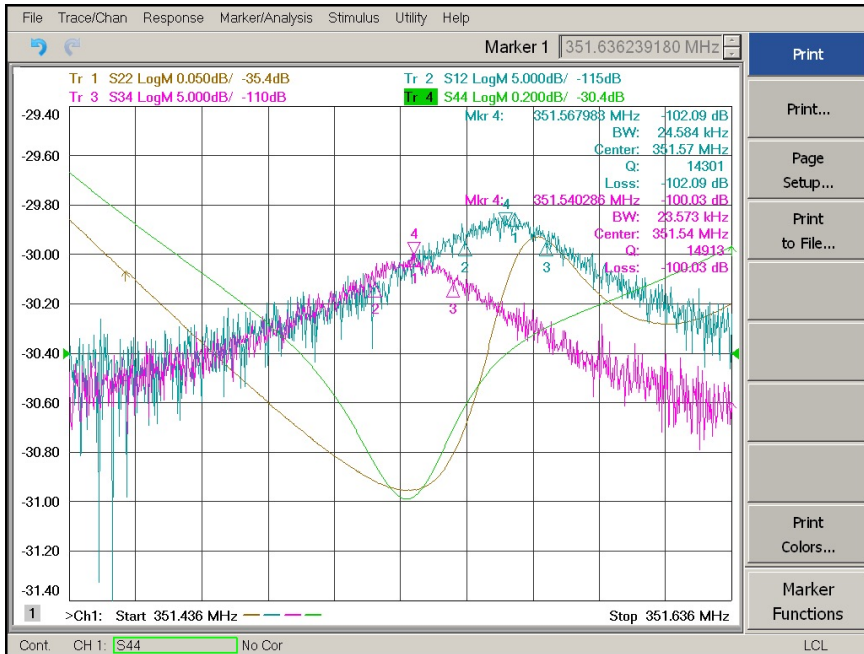
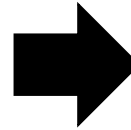
CAV	f0 MHz	351.627	351.641	352.135	352.118
			8910	1.88e5	1.85e5

Insulation vacuum was in vacuum at the reception!

↪ **+12 kHz** ↪ **+500 kHz** ↪ **-15 kHz**

w/o insulation vacuum

w/ insulation vacuum

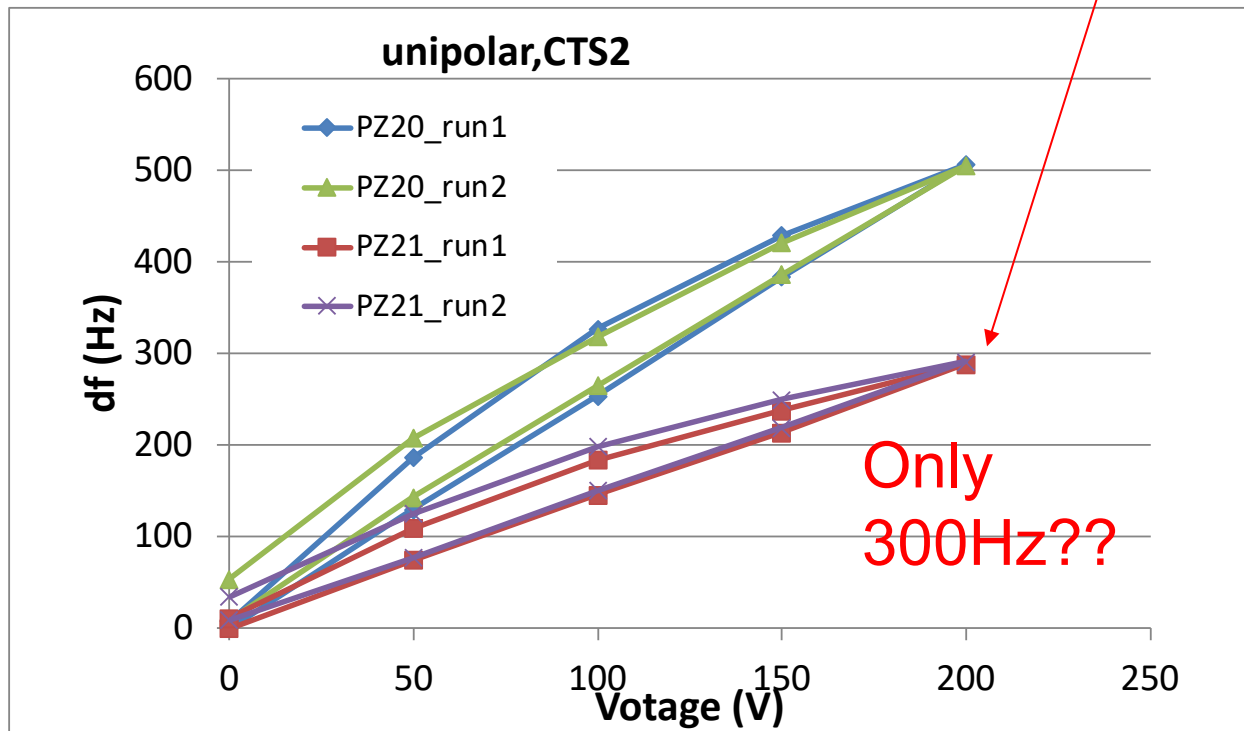


	300K w/o insulation	300K w/ insulation	Δf kHz
CAV IN	351.568	351.631	+63
CAV OUT	351.540	351.612	+72

The reception test of CM03 (2nd) must be offset by a similar value
 → Question: why the insulation vacuum was in vacuum?

Han Li kindly pointed out an inconsistency between the value and the plot

Piezo2 tuning range (Hz)	unipolar	421	566
	bipolar	478	657



- Two measurements of piezo were mixed up in the excel
 - Issue of hysteresis
- I corrected the document and will redistribute it

CM03: CAV IN reached 12 MV/m





FREIA SPOKE HIGH POWER TEST_Cav 1

time: 17:12:06

HELP QUIT



Configuration Calibration and pulse parameter setting Phase shifter and Gain controller PNA Scope decay measurement heat load measurement LFD measurement

Pause

Single

● status

High speed (10Ms/s) Transfer speed

Standard (50 kSample) FFT buffer size

select for decay measurement

5782 - Ch0

5782 - Ch1

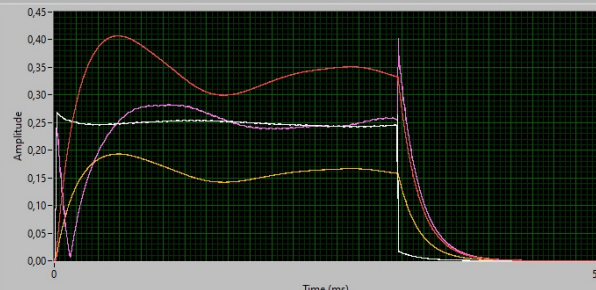
Ch1 cavity

5761 - Ch0

5761 - Ch1

5761 - Ch2

5761 - Ch3



Amplitude

Time (ms)

5782 - Ch0

Ch1 cavity

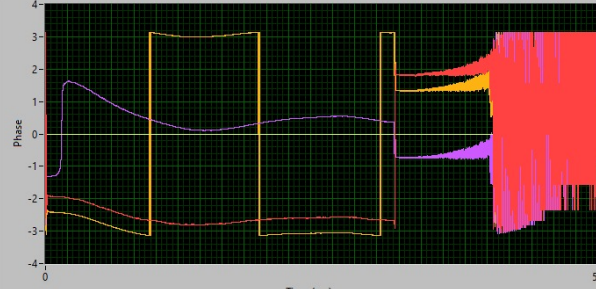
5782 - Ch1

5761 - Ch0

5761 - Ch1

5761 - Ch2

5761 - Ch3



Phase

Time (ms)

Display

Time and Frequency

Phase and Magnitude

Buffer

Last data only

Buffer data

Amplitude Time

Chart length 400000

unwrap phase

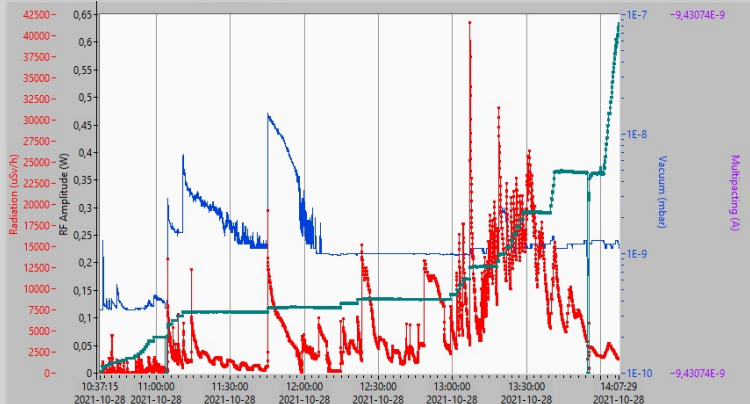
Reference for phase 5761 - Ch1

Show buffers

Amplitude Time

Q Measurement results display Other Measurement results display Conditioning results display

Conditioning validate? Pulse width (us) 3200



Radiation (uSv/h)

RF Amplitude (W)

Vacuum (mbar)

Multipacting (A)

RF forward power (W)

Pickup power (W)

radiation (uSv/h)

FPC vacuum (mbar)

Multipacting (A)

Pf_max (dBm) 84,5596	Pf_max (W) 285736	P_total (W) 0	QL 193587	Qt 2,2E+11
Pr_max (dBm) 88,2636	Pr_max (W) 670445	P_static (W) 0	real time frequency_fc 0E+0	
Pt_max (dBm) 28,0133	Pt_max (W) 0,632897	P_heater (W) 0	Pc_dynamic(W) 0	
			Vc_ave (MV) 0	

Pf_max (W)	Q0_Dynamic	Eacc_Dynamic	Eacc_pk_Pt	Eacc_pk_Pf
285736	0	0	12,0526	15,1935

TT04	TT06	PT02	PT03	Radiation	PT10	PT20
2,10335	2,07474	9999	32,8	1720	1,1E-9	1,1E-9

FPGA setup

Mode Real IO Mixer freq [MHz] 352,2 Trigger Trigger input

Output mixer frequency [MHz] 352,2 Period 0

Output enabled

Output delay 0 ns

Output delay delta 0 ps

PID control Apaptive FF Offsets Feed forward Cavity model FFT Delay

Quench detection

Measure Tau at Time 32200 Tau set 130 Enable Reset Quench Warning

Scale

Tau [us] 182,007 Quench_Warning

CM03: CAV OUT reached 12 MV/m

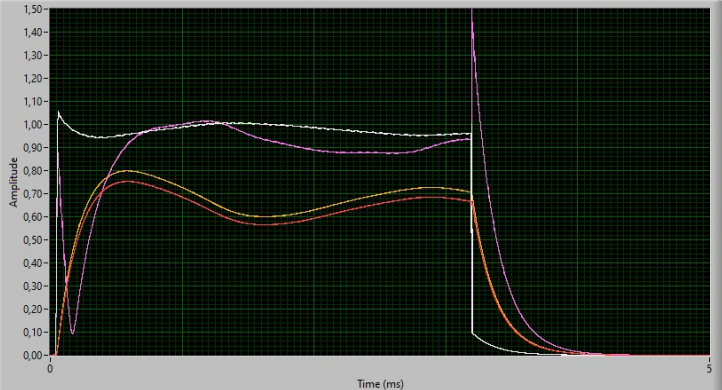


Configuration Calibration and pulse parameter setting Phase shifter and Gain controller PNA Scope decay measurement heat load measurement LFD measurement

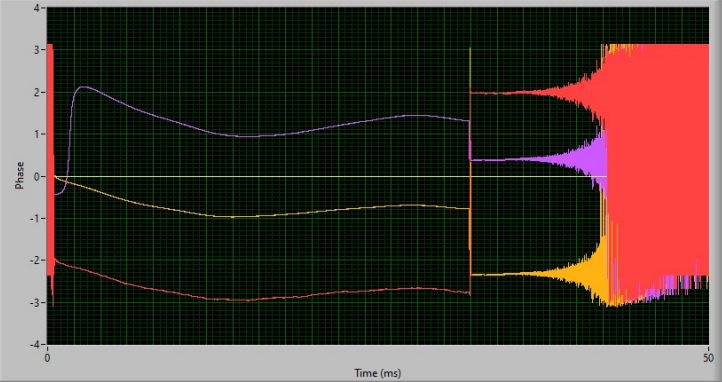
Pause Single status

High speed (10Ms/s) Transfer speed
Standard (50 kSample) FFT buffer size

- 5785 - Ch0I
- 5785 - Ch0Q
- Ch1I cavity
- Ch1Q cavity
- 5785 - Ch1I
- 5785 - Ch1Q
- 5761 - Ch0I
- 5761 - Ch0Q
- 5761 - Ch1I
- 5761 - Ch1Q
- 5761 - Ch2I
- 5761 - Ch2Q
- 5761 - Ch3I
- 5761 - Ch3Q



- Ch0
- Ch1 cavity
- Ch1
- Ch0
- Ch1
- Ch2
- Ch3



select for decay measurement

Display
 Time and Frequency
 Phase and Magnitude
 Buffer
 Last data only
 Buffer data

Time
Amplitude

Chart length
400000

unwrap phase
Reference for phase
5761 - Ch1

Show buffers
Time
Amplitude

FPGA setup

Mode: Real IO Mixer freq [MHz]: 352.2 Trigger: Trigger input

Output mixer frequency [MHz]: 352.2 Period: 0

Output enabled:

Output delay: 0 ns

Output delay delta: 0 ps

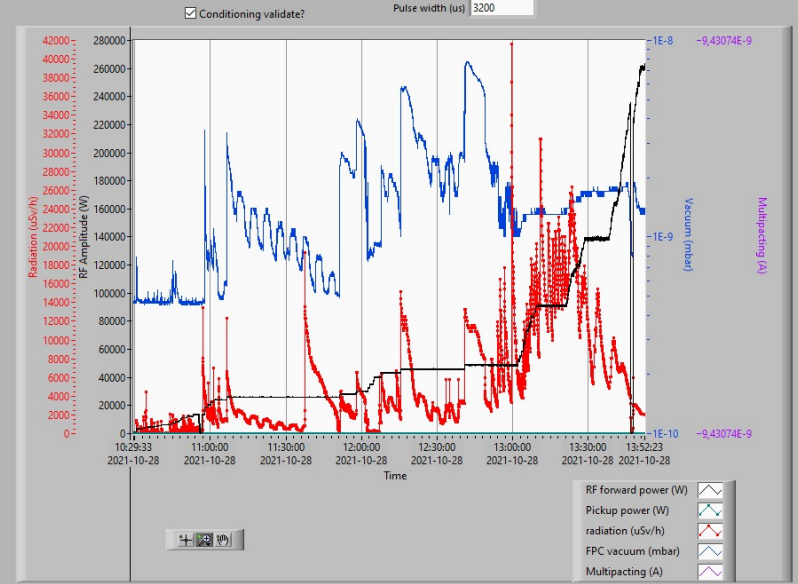
PID control Offsets Feed forward Cavity model FFT Delay Scale

Adaptive FF Quench detection

Measure Tau at Time: 32200 Tau set: 125 Enable: Reset Quench Warning:

Tau [µs]: 174.95 Quench Warning:

Q Measurement results display Other Measurement results display Conditioning results display



Pf_max (dBm)	Pf_max (W)	P_total (W)
84,2136	263852	0
Pr_max (dBm)	Pr_max (W)	P_static (W)
87,4057	550267	0
Pt_max (dBm)	Pt_max (W)	P_heater (W)
28,1876	0,658803	0

QL: 184474 Ct: 2,1E-11

real time frequency_fc: 0E+0

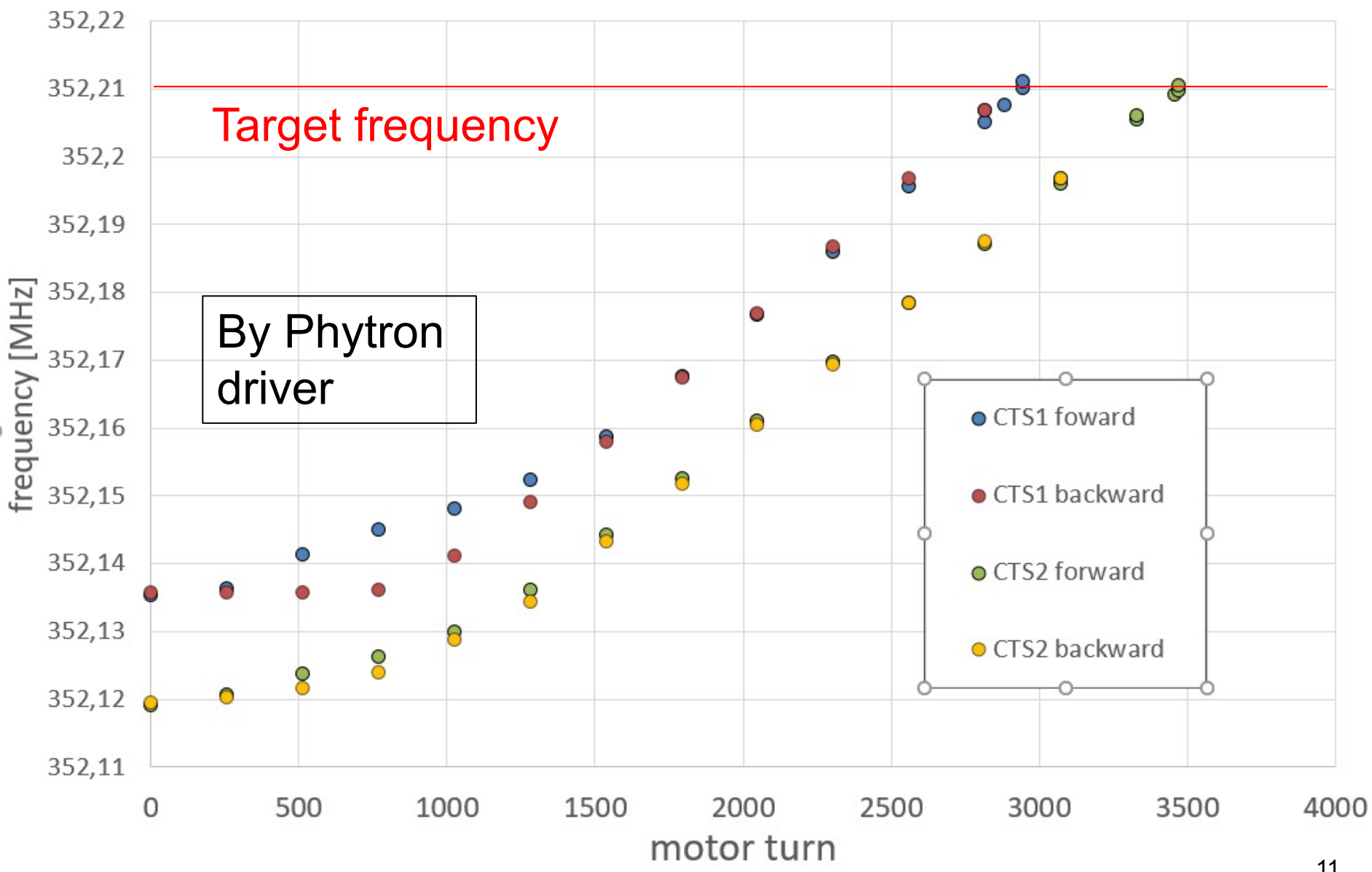
Pc_dynamic(W): 0

Vc_ave (MV): 0

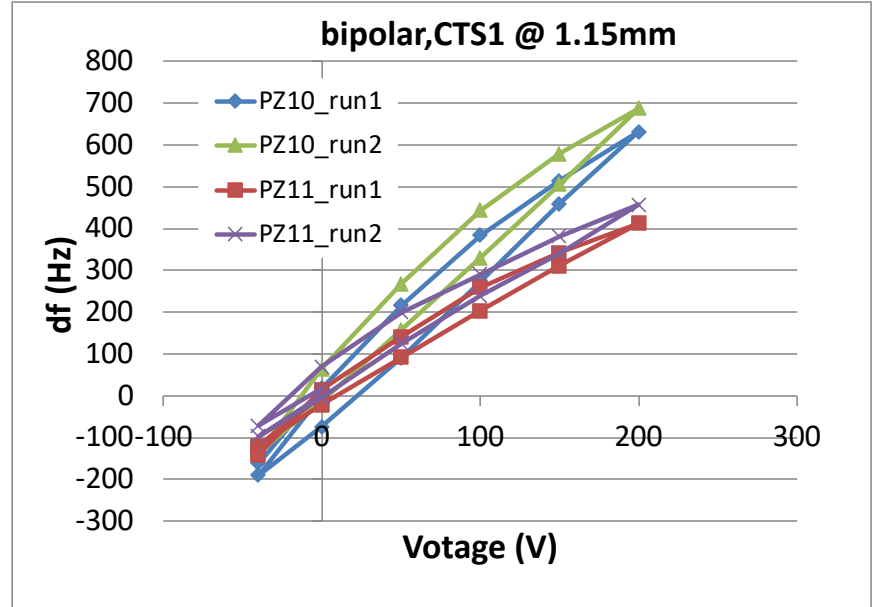
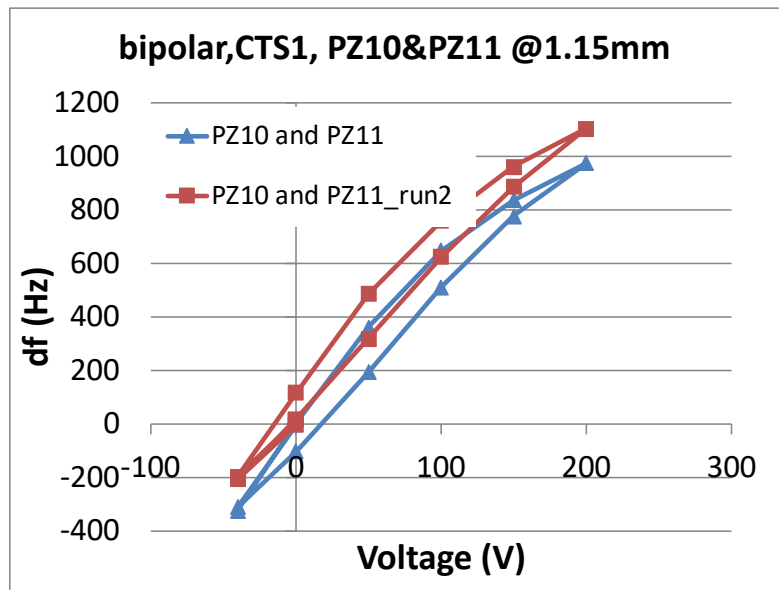
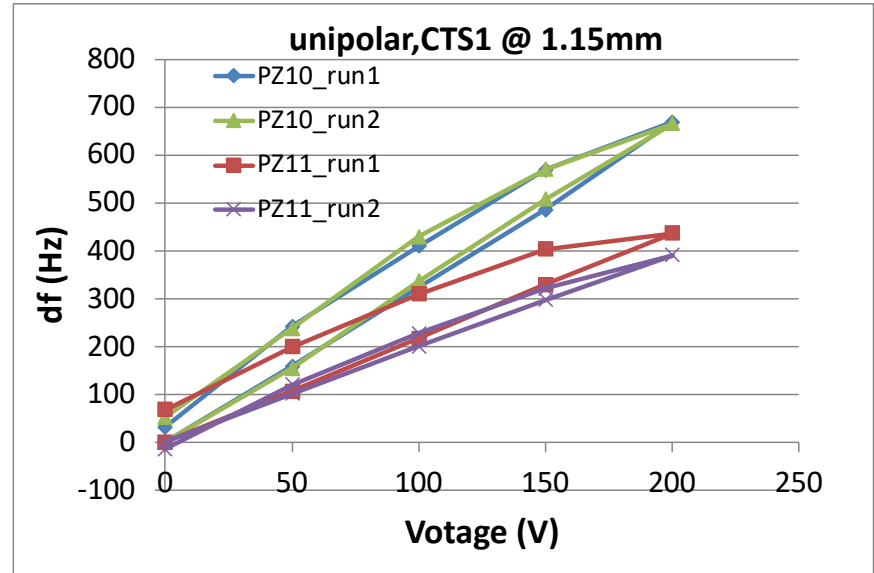
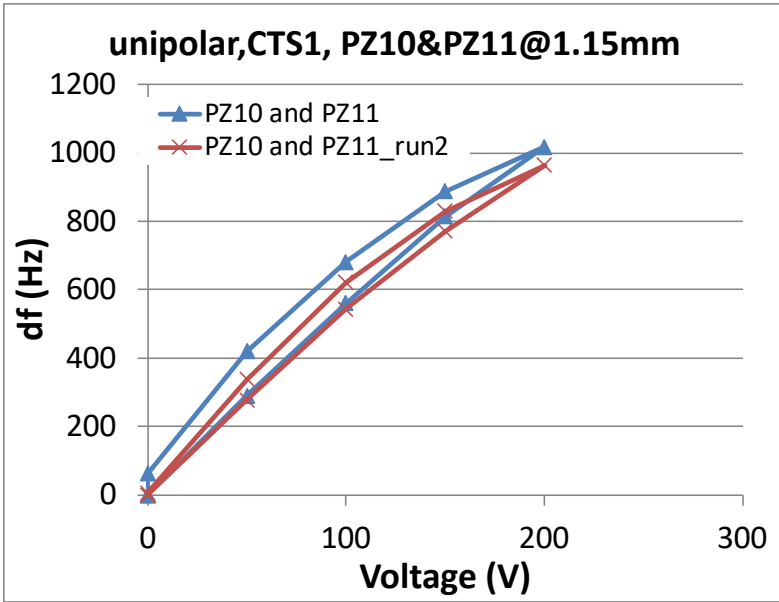
Pf_max (W)	Q0_Dynamic	Eacc_Dynamic	Eacc_pk_Pt	Eacc_pk_Pf
263852	0	0	12,0141	14,2523

TT05	TT07	PT02	PT03	Radiation	PT10	PT20
2,16547	2,11301	9999	33,7	1990	1,3E-9	1,4E-9

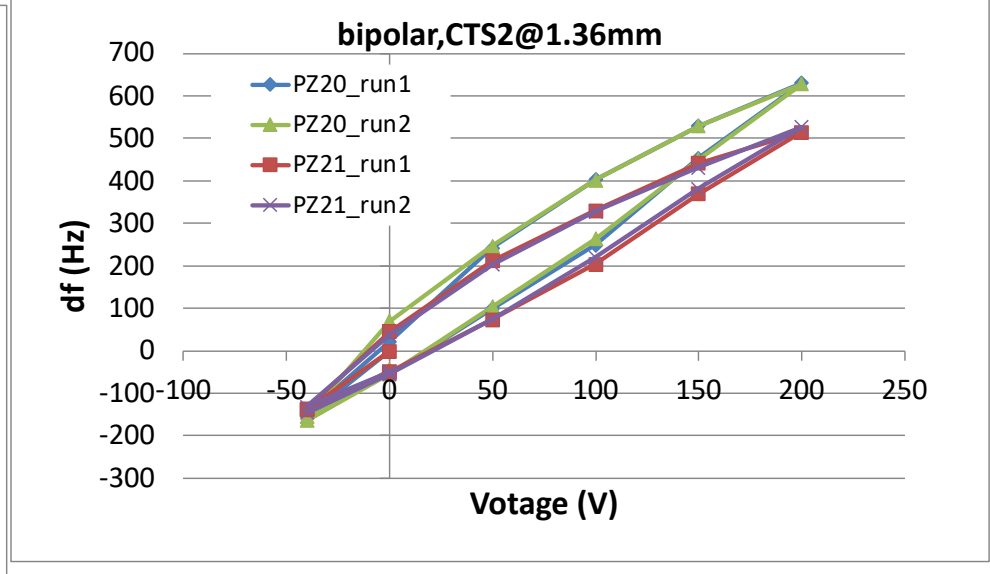
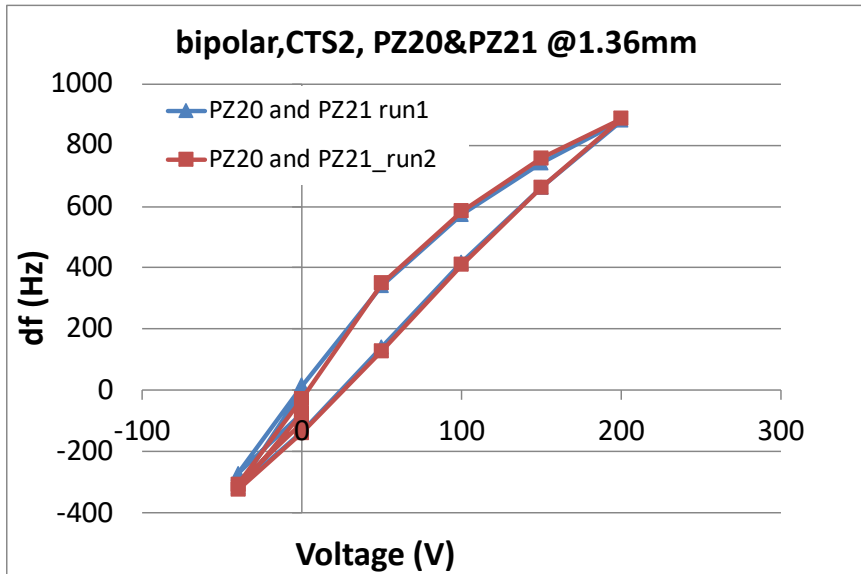
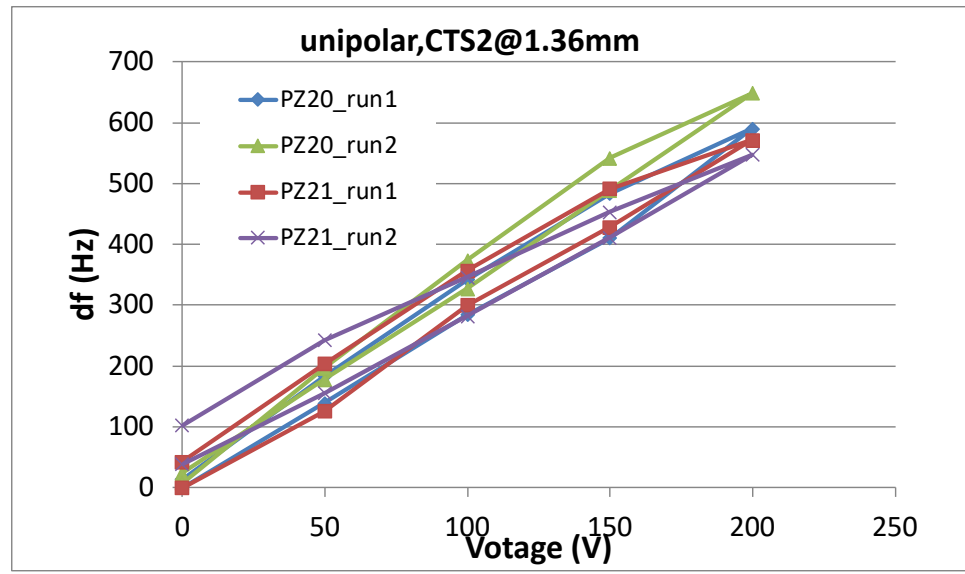
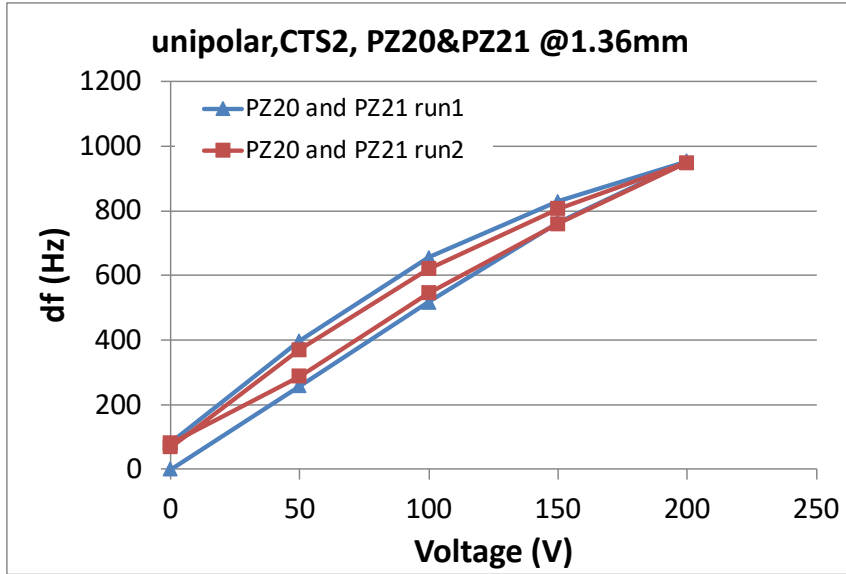
CM03: CTS moved well



CM03: piezos on CTS1



CM03: piezos on CTS2



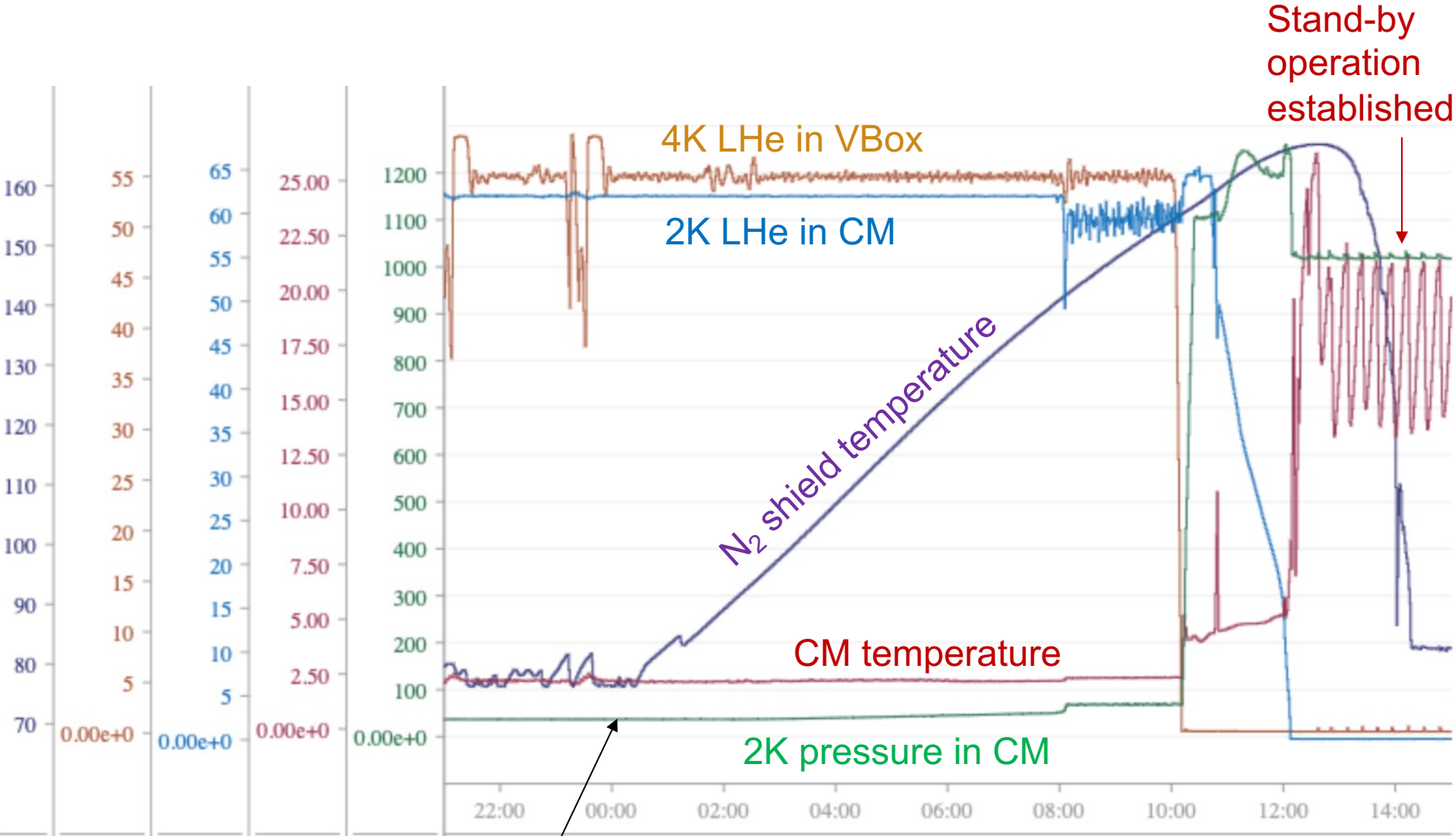
		Δf [Hz]
PZ10	unipolar	666
	bipolar	825
PZ11	unipolar	405
	bipolar	554
PZ10&PZ11	unipolar	963
	bipolar	1309

		Δf [Hz]
PZ20	unipolar	640
	bipolar	792
PZ21	unipolar	509
	bipolar	673
PZ20&PZ21	unipolar	879
	bipolar	1210

Remark:

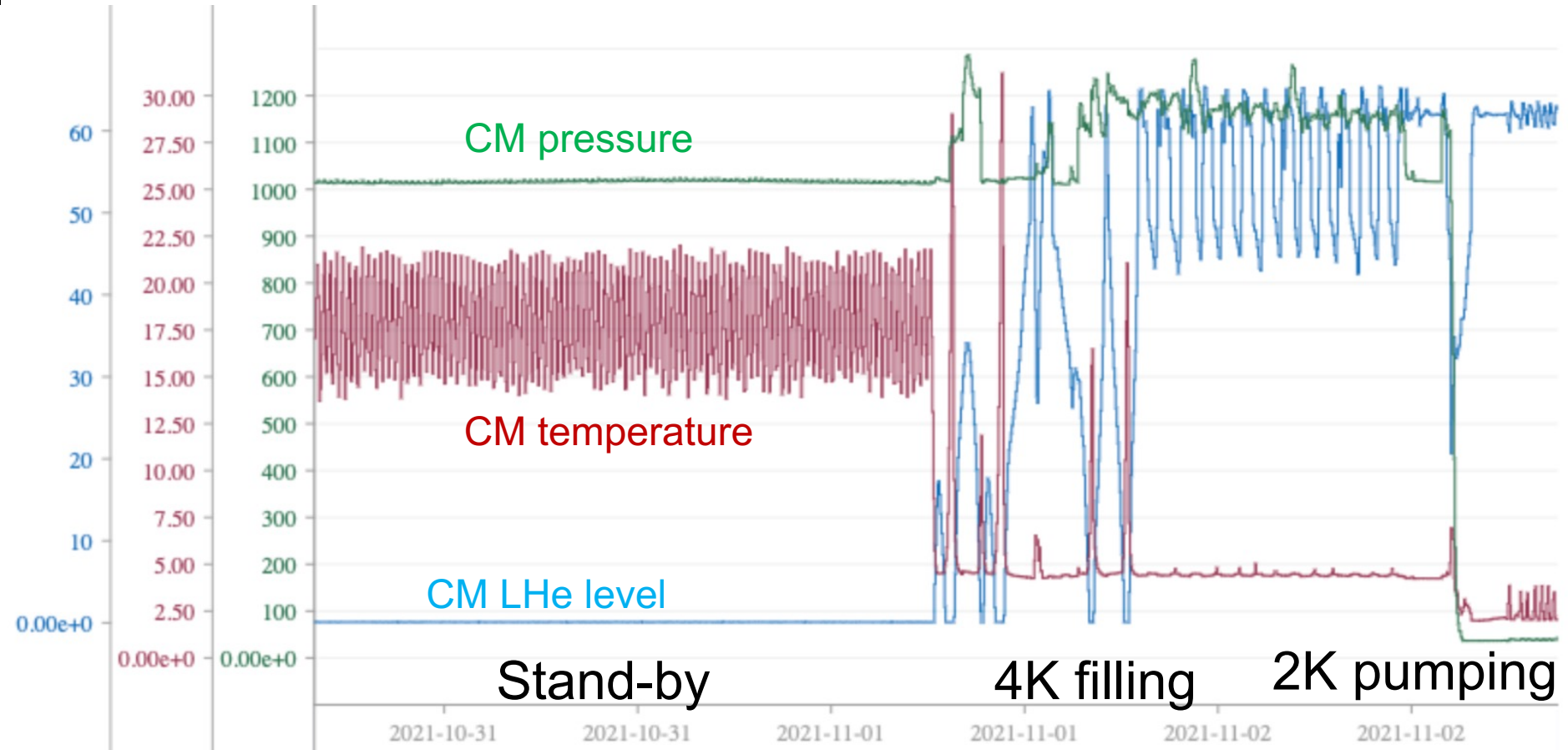
- Resonant frequency was shifted (?) by a few hundred hertz during the 1st measurement of PZ10&PZ11
- We recognized this issue and performed 2nd measurement
- The pressure was very stable, so we do not have any reason why the frequency was shifted
- We doubt the timing when we center the frequency in VNA
 - **Before or after the initial training cycles**

Something happened at Friday midnight

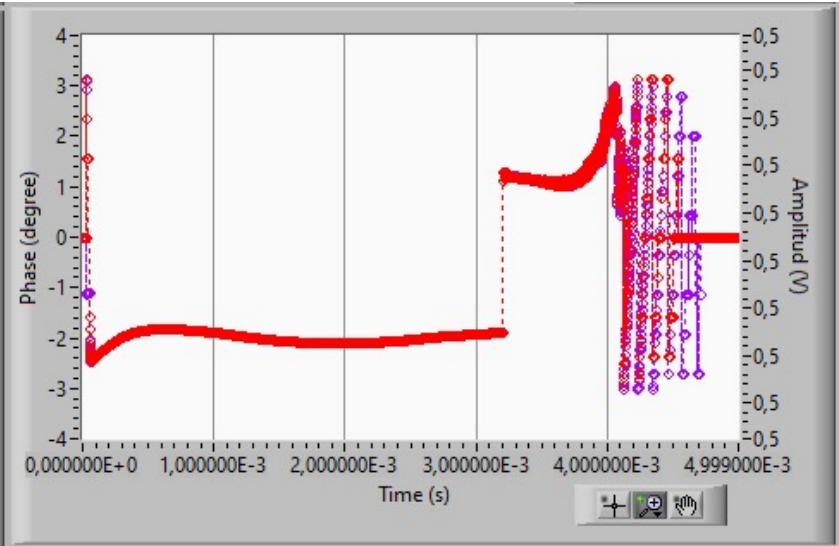
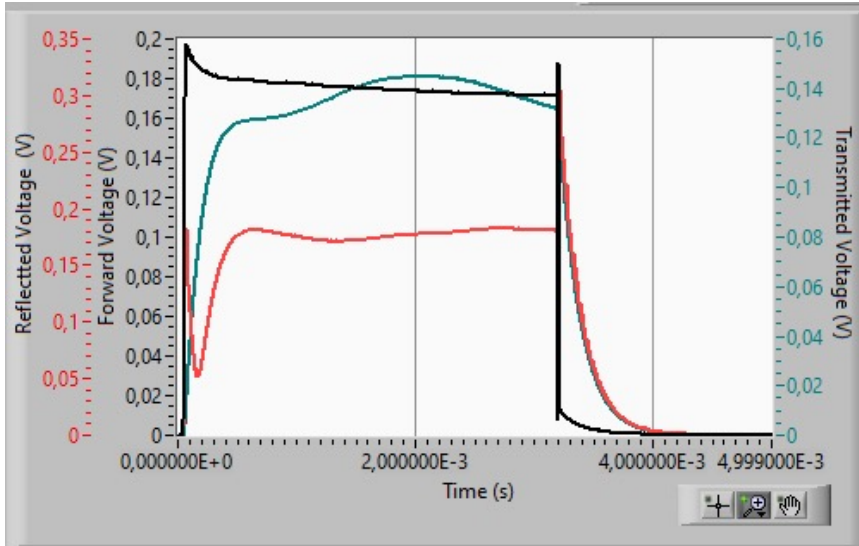


N₂ flow blocked

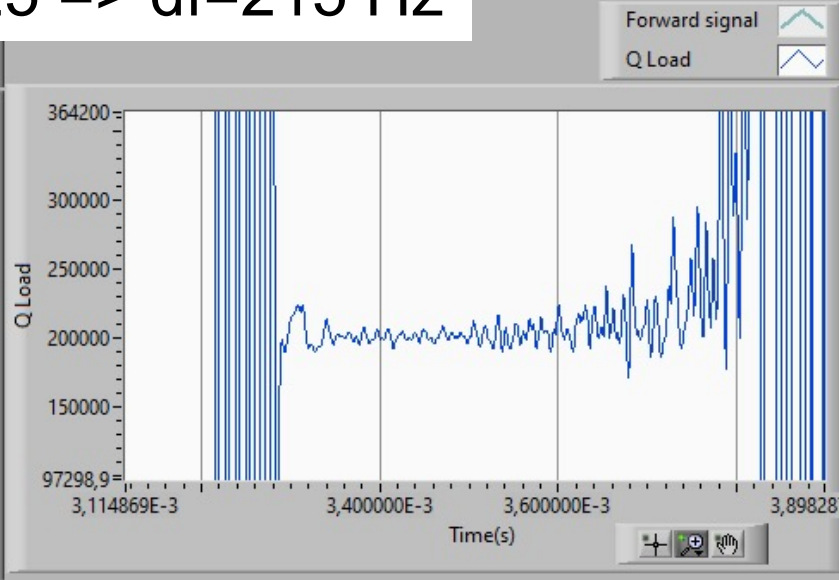
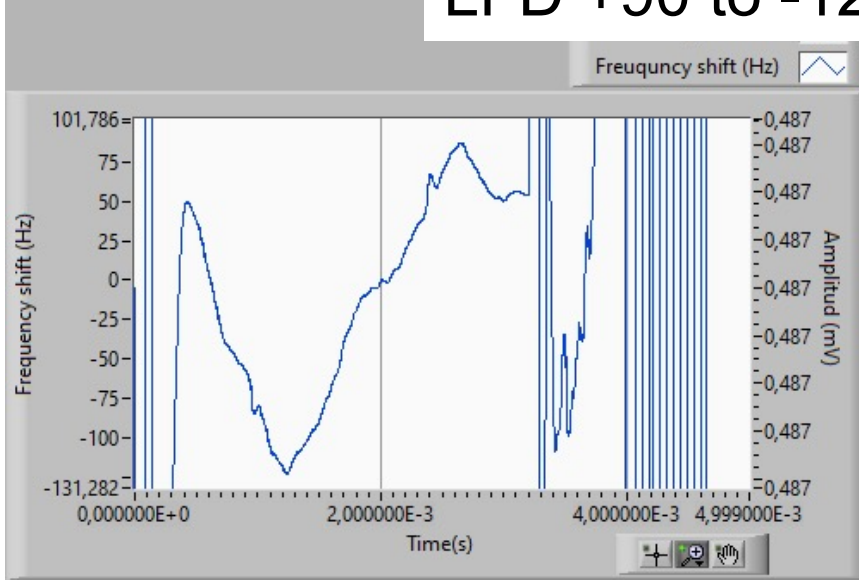
We went back on Monday & Tuesday



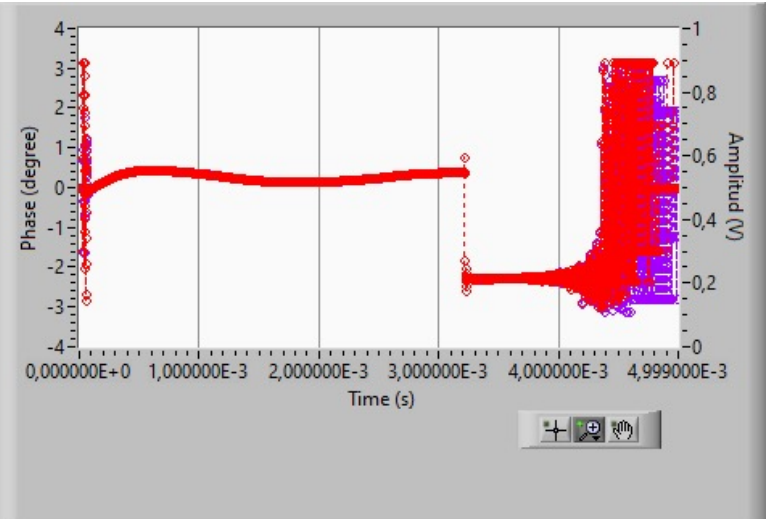
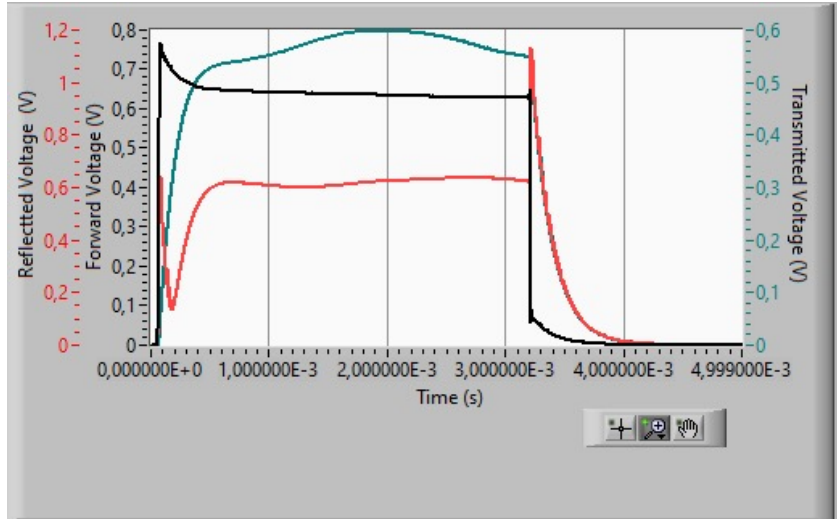
Recovery was rather smooth



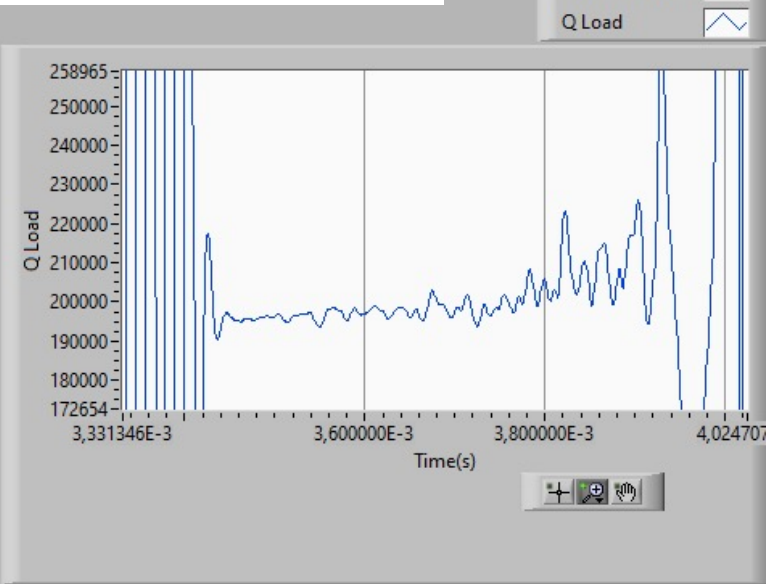
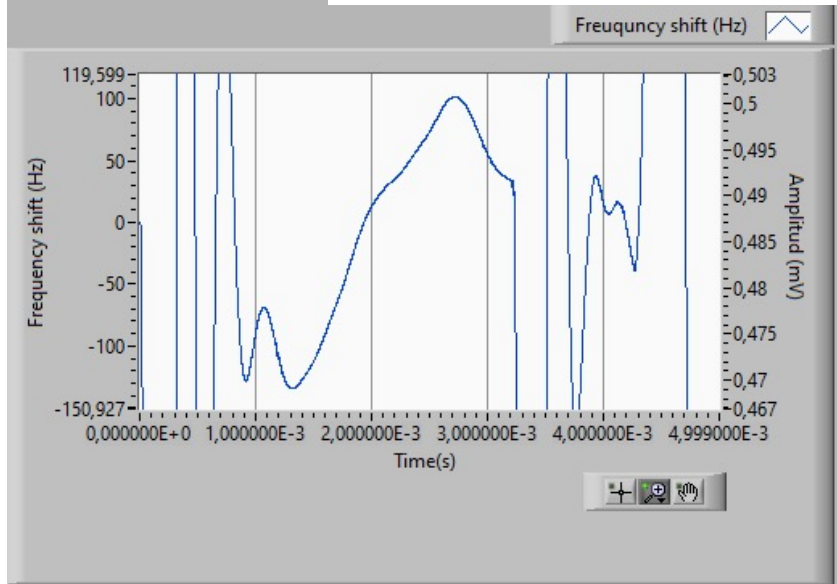
LFD +90 to -125 => $\Delta f = 215$ Hz



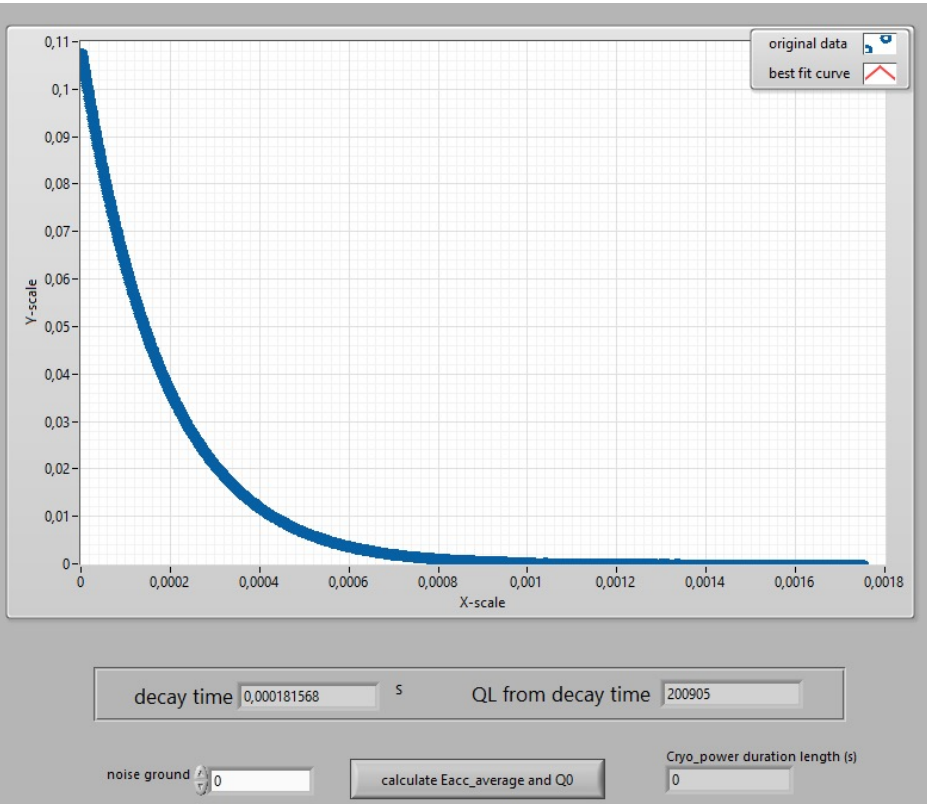
CM03 CAV OUT: LDF@9MV/m, 352.21MHz



LFD +100 to -135 => df=235 Hz

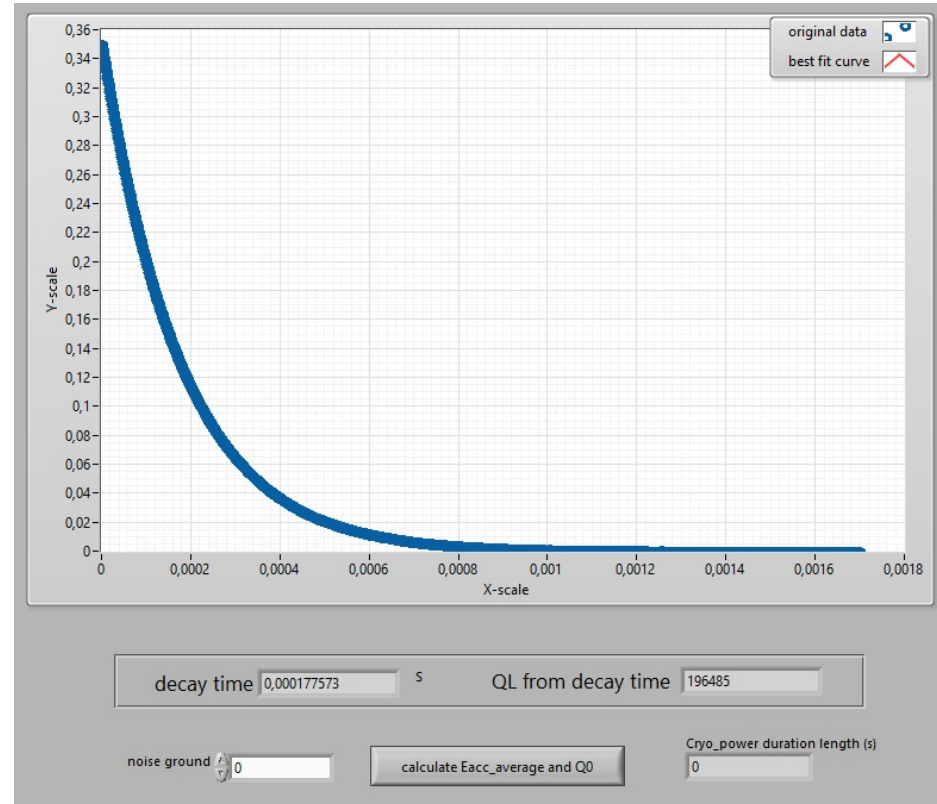


CAV IN



QL = 2.00e5

CAV OUT

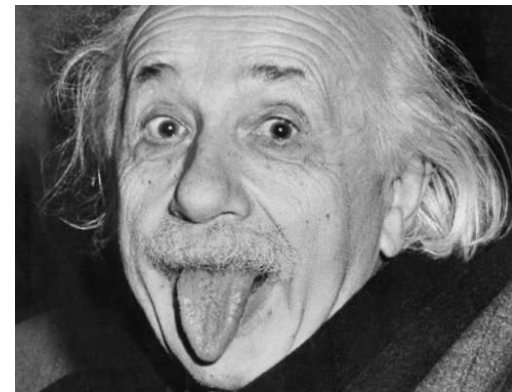


QL = 1.96e5

Value name	Dynamic*	Dynamic	Dynamic	Dynamic	Dynamic	Dynamic	Static
Cav 1	9 MV/m	9 MV/m	12 MV/m	0 MV/m	0 MV/m	9 MV/m	0 MV/m
Cav 2	9 MV/m	0 MV/m	0 MV/m	9 MV/m	12 MV/m	9 MV/m	0 MV/m
FT551 [m3/h]	13.92	14.5	14.52	14.33	13.82	14.38	14.33
Heat Load [W]	14.89	15.52	15.54	15.33	14.79	15.39	15.33

Negative energy

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$



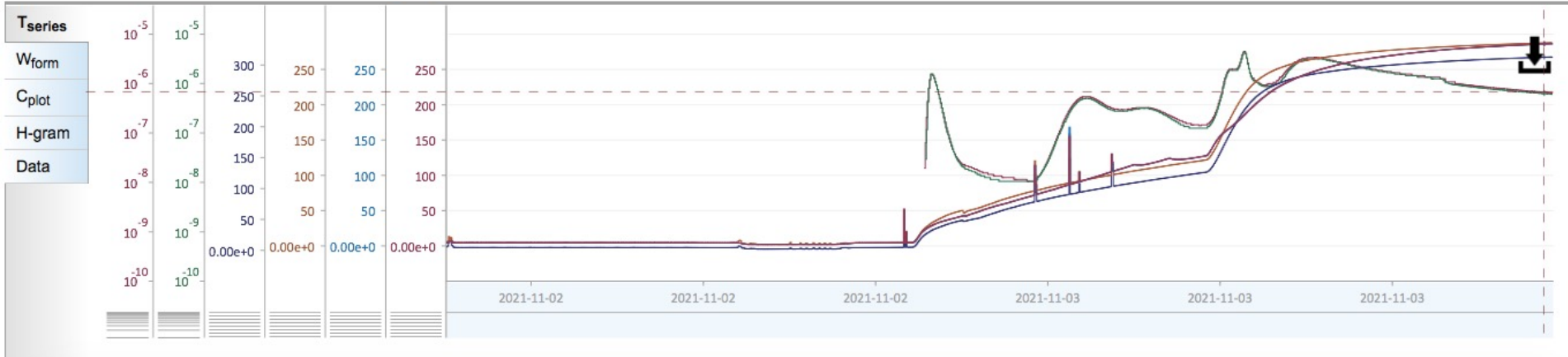


CM03: Warming up completed



Del	Plot	Name	DBRType	Units	Processing	Scale	Time (local)	Value	Notes
x	<input checked="" type="checkbox"/>	CM-Vac:PT20:sRdV	DBR_SCALAR_DOUBLE		<input type="text" value=""/>	log10	2021-11-03 05:14:16	2.2166666666666668e-7	
x	<input checked="" type="checkbox"/>	CM-Vac:PT10:sRdV	DBR_SCALAR_DOUBLE		<input type="text" value=""/>	log10	2021-11-03 03:56:54	1.7e-8	
x	<input checked="" type="checkbox"/>	CM-CM:TT06:sRdV	DBR_SCALAR_DOUBLE	K	<input type="text" value=""/>	linear	2021-11-04 07:08:38	312.6394531453716	
x	<input checked="" type="checkbox"/>	CM-CM:TT07:sRdV	DBR_SCALAR_DOUBLE	K	<input type="text" value=""/>	linear	2021-11-04 07:08:38	287.483425131546	
x	<input checked="" type="checkbox"/>	CM-CM:TT04:sRdV	DBR_SCALAR_DOUBLE	K	<input type="text" value=""/>	linear	2021-11-04 07:08:38	285.9135285270371	
x	<input checked="" type="checkbox"/>	CM-CM:TT05:sRdV	DBR_SCALAR_DOUBLE	K	<input type="text" value=""/>	linear	2021-11-04 07:08:38	286.0592449169982	

WINDOW SIZE: END: 2021-11-04 07 :39 :03



Preparation for shipping next week and
expected departure on Monday Nov 15th