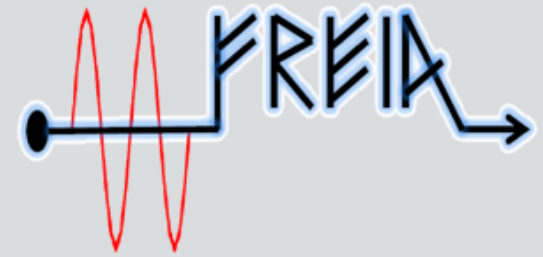




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# ESS weekly meeting (2022 W19)

A. Miyazaki, et al





# W18 & W19 progress / W20 plan



week		W18											
date		MON		TUE		WED		THU		FRI		SAT	SUN
		02-maj		03-maj		04-maj		05-maj		06-maj		07-maj	08-maj
		m	a	m	a	m	a	m	a	m	a		
present CM	<b>CM10</b>	2K pumping	RF calibration	tuner test		tuner test continued / CTS2 disengage		RF interlock setup	CAVOUT MP conditioning	CAVIN MP conditioning			
next CM	<b>CM11</b>	leak test								doorknob mounted			
next next CM	<b>CM12</b>	preparation at Orsay											


week		W19											
date		MON		TUE		WED		THU		FRI		SAT	SUN
		09-maj		10-maj		11-maj		12-maj		13-maj		14-maj	15-maj
		m	a	m	a	m	a	m	a	m	a		
present CM	<b>CM10</b>	heat load measurement / FREIA LLRF tests						<b>We are here</b>		start warming up		break insulation vacuum	warming up
next CM	<b>CM11</b>	waiting in the docking area											
next next CM	<b>CM12</b>	preparation at Orsay											

week		W20											
date		MON		TUE		WED		THU		FRI		SAT	SUN
		16-maj		17-maj		18-maj		19-maj		20-maj		21-maj	22-maj
		m	a	m	a	m	a	m	a	m	a		
present CM	<b>CM10</b>	warm up completed	CTS test		<b>If it moves at warm</b>		LN cooling	LHe cooling	4K filling				
next CM	<b>CM11</b>					<b>If it moves at warm</b>		waiting in the docking area					
next next CM	<b>CM12</b>	preparation at Orsay											

**If it not, TBD**

# CM10: CAVOUT reached $> 11.6$ MV/m






**FREIA SPOKE HIGH POWER TEST\_Cav 2**

time: **11:28:32**

[HELP](#) [QUIT](#)



---

Configuration
Calibration and pulse parameter setting
Phase shifter and Gain controler
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

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

FPGAs setup

Mode: Real IO Mixer freq [MHz]: 352 Trigger: Trigger input

Output mixer frequency [MHz]: 352 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: 128 Enable: ● Reset Quench Warning: ●

Tau [us]: 163,111 Quench\_Warning: ●

Q Measurement results display
Other Measurement results display
Conditioning results display

Conditioning validate? Pulse width (us) 3200

RF forward power (W)

Pickup power (W)

radiation (uSv/h)

FPC vacuum (mbar)

Multipacting (A)

Pf_max (dBm)	Pf_max (W)	P_total (W)	Qt_Toms Method
86,0676	404351	0	2,42394
Pt_max (dBm)	Pt_max (W)	P_static (W)	Qt_fr_PrefL_max
89,1781	827572	0	2,55259
Pt_max (dBm)	Pt_max (W)	P_heater (W)	Qt_fr_Pforw_eoc
28,8315	0,764105	0	4,10534
			QL_fr_Decay
			182273

**Pf\_max (W)**

**404351**

**Q0\_Dynamic**

**0**

**Eacc\_Dynamic**

**0**

**Eacc\_pk\_Pt**

**11,6414**

**Eacc\_pk\_Pf**

**17,1206**

TT05	TT07	PT02	PT03	Scale_fact_Integral	PrefLeoc	PrefL_max
2,03862	2,75607	9999	30,5	0,0005486	0,084445	0,215142
	Radiation	PT10	PT20	Scale_fact_PrefL	Pforw_eoc	Decay_Integral
	3000	7,1E-10	3,7E-9	0,4388	0,0879416	162,7307
				Scale_fact_Pforw	Ptrans_eoc	
				1,7265	0,0369839	

# CM10: CAVOUT reached > 11.6 MV/m



**FREIA SPOKE HIGH POWER TEST\_Cav 2**      time: 11:28:32      HELP    QUIT

Configuration | Calibration and pulse parameter setting | Phase shifter and Gain controler | 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

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

Time    Amplitude    Chart length: 400000

Amplitude vs Time (ms) graph showing multiple channels (5785 - Ch0l to 5761 - Ch3Q).

Phase vs Time (ms) graph showing phase for channels Ch0 to Ch3.

FPGAs setup: Mode, Mixer freq [MHz], Trigger, Real IO, 352, Trigger input, Output mixer frequency [MHz], 352, Period, 0, Output enabled, Output delay, 0 ns, Output delay delta, 0 ps.

PID control: Adaptive FF, Measure Tau at Time, 32200, Tau set, 128, Tau [us], 163,111, Quench\_W.

Q Measurement results display: Conditioning validate? Pulse width (us) 3200

Graphs: Radiation (uSv/h), PF Amplitude (W), Vacuum (mbar), Multipacting (A).

Summary values:

- QL: 173700
- Qt: 1,7E+11
- Qt\_Toms Method: 2,42394
- Qt\_fr\_Prefl\_max: 2,55259
- Qt\_fr\_Pforw\_eoc: 4,10534
- QL\_fr\_Decay: 182273
- Pc\_dynamic(W): 0
- Vc\_ave (MV): 0
- Eacc\_pk\_Pt: 11,6414
- Eacc\_pk\_Pf: 17,1206

PF\_max (W) 404351    P\_total (W) 0  
Pr\_max (W) 827572    P\_static (W) 0  
Pt\_max (W) 0,764105    P\_heater (W) 0

QL\_Toms Method 2,42394  
Qt\_fr\_Prefl\_max 2,55259  
Qt\_fr\_Pforw\_eoc 4,10534  
QL\_fr\_Decay 182273

Scale\_fact\_Integral 0,0005486    Prefl\_eoc 0,084445    Prefl\_max 0,215142  
Scale\_fact\_Prefl 0,4388    Pforw\_eoc 0,0879416    Decay\_Integral 162,7307  
Scale\_fact\_Pforw 1,7265    Ptrans\_eoc 0,0369839



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# CM10: CAVIN reached 12MV/m



## FREIA SPOKE HIGH POWER TEST\_Cav 1

time: 16:35:46

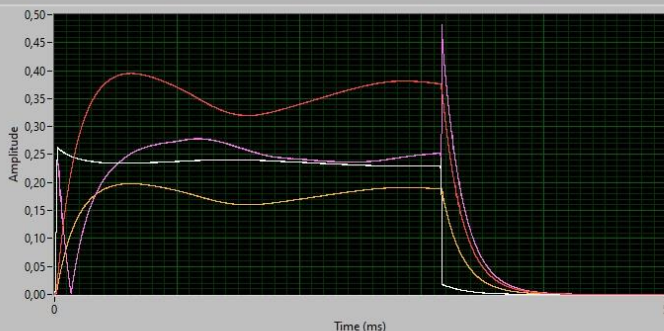
HELP QUIT



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

- 5782 - Ch0
- Trans\_Q-det
- 5782 - Ch1
- 5761 - Ch0
- Forward
- Reflected
- Transmitted



select for decay measurement

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

Amplitude Time

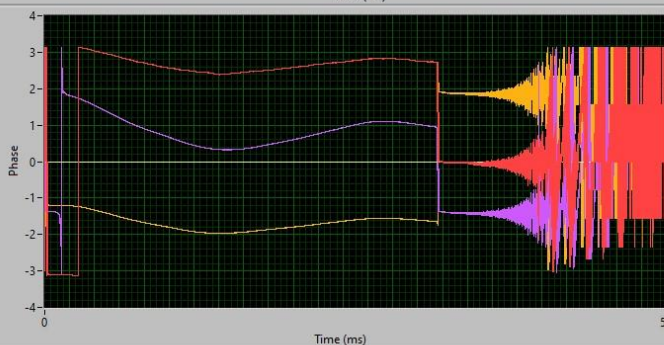
Chart length

400000

unwrap phase  
 Reference for phase  
 5761 - Ch1  
 Show buffers

Amplitude Time

- 5782 - Ch0
- Trans\_Q-Det
- 5782 - Ch1
- 5761 - Ch0
- Forward
- Reflected
- Transmitted



Amplitude Time

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 Scale

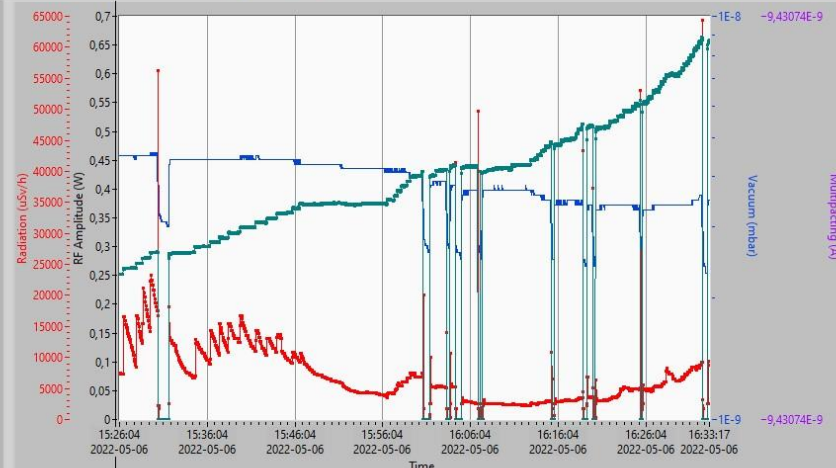
Measure Tau at Time Tau set Enable Reset Quench Warning

Tau [us] Quench\_Warning

165,38

Q Measurement results display Other Measurement results display Conditioning results display

Conditioning validate? Pulse width (us) 3200



- RF forward power (W)
- Pickup power (W)
- radiation (uSv/h)
- FPC vacuum (mbar)
- Multipacting (A)

Pf_max (dBm)	Pf_max (W)	P_total (W)	Qt_Toms Method
84,6275	290232	0	2,76128
Pr_max (dBm)	Pr_max (W)	P_static (W)	Qt_fr_Prefl_max
89,9056	978505	0	2,76701
Pt_max(dBm)	Pt_max (W)	P_heater (W)	Qt_fr_Pfow_eoc
28,1837	0,658219	0	2,65058
			QL_fr_Decay
			184536

QL 177000 Qt 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  
 290232 0 0 12,0087 14,6419

TT04	TT06	PT02	PT03	Scale_fact_Integr	Prefl_eoc	Prefl_max
2,96663	2,60752	9999	30,6	0,00052561	0,063692	0,233281
	Radiation	PT10	PT20	Scale_fact_Prefl	Pfow_eoc	Decay Integral
	8750	3,5E-9	1,2E-9	0,420395	0,0528471	186,1970
				Scale_fact_Pfow	Ptrans_eoc	
				1,77765	0,0354426	

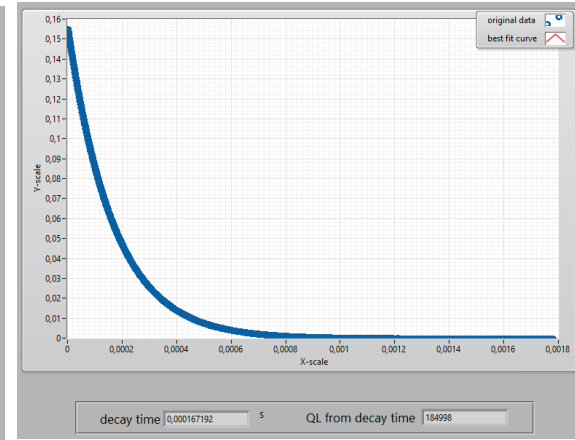
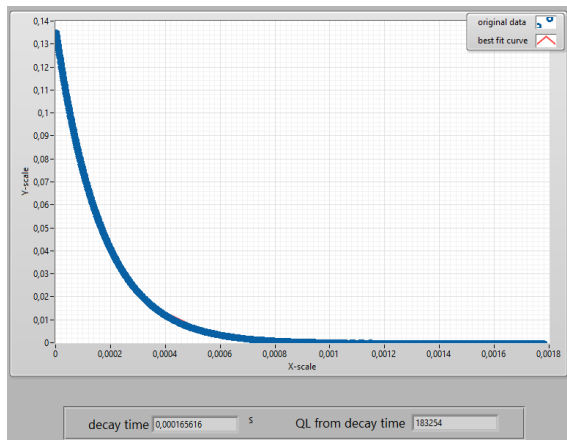
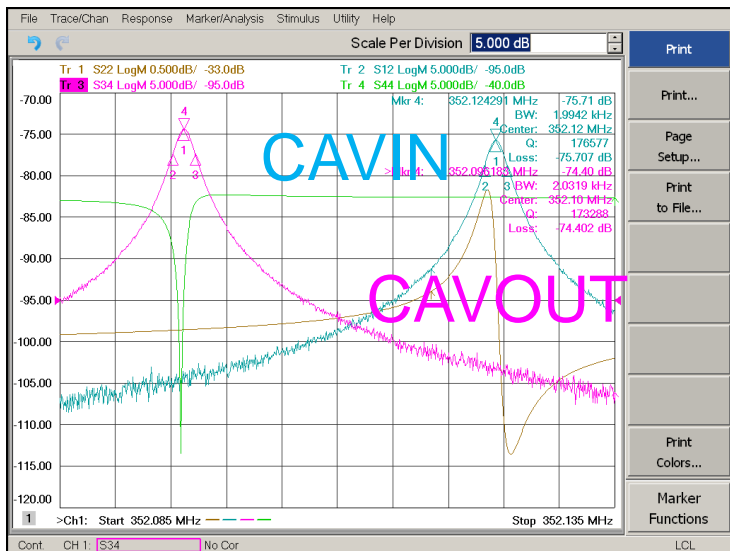


# CM10: $Q_L$ from VNA vs field decay



## CAVIN

## CAVOUT



	CAVIN	CAVOUT
BW $\Gamma$ [kHz]	1.99	2.03
$Q_L$ (VNA)	1.77e5	1.73e5
$\tau$ [us]	166	167
$Q_L$ (field decay)	1.83e5	1.85e5

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

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

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

As usual, the values estimated from the field decay are larger,





# CM10: CTS1 piezo results

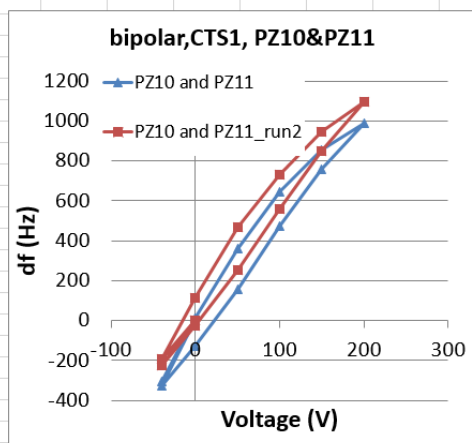
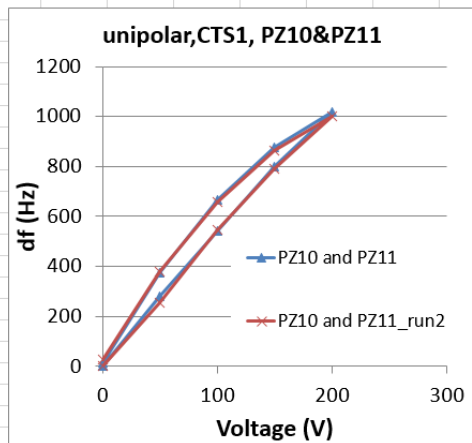


CAV IN BW (Hz) 1994

20220506 TT11=105K

both piezos simultaneously

Voltage (V)	Phase (°)	df(Hz)
0	100,22	0
50	112,84	279,6031
100	124,64	541,0387
150	136,36	800,7018
200	146,19	1018,491
150	139,8	876,9169
100	130,24	665,1098
50	117,08	373,5427
0	100,84	13,73644
0	100,74	0
50	112,26	255,232
100	125,3	544,1404
150	136,48	791,8396
200	145,87	999,8802
150	139,7	863,1804
100	130,34	655,8044
50	117,84	378,86
0	101,96	27,02978
0	101,27	0
-40	86,54	-326,351
0	95,46	-128,724
50	108,4	157,9691
100	122,67	474,1289
150	135,47	757,72
200	145,85	987,6947
150	139,74	852,3242
100	130,46	646,7207
50	117,48	359,1416
0	101,89	13,73644
-40	87,54	-304,196
0	96,73	0
-40	86,56	-225,322
0	95,52	-26,8082
50	108,2	254,1242
100	121,89	557,4338
150	134,95	846,7853
200	146,06	1092,934
150	139,44	946,2638
100	129,67	729,804
50	117,75	465,7098
0	101,74	110,9993
-40	87,97	-194,083
0	96,72	-0,22156

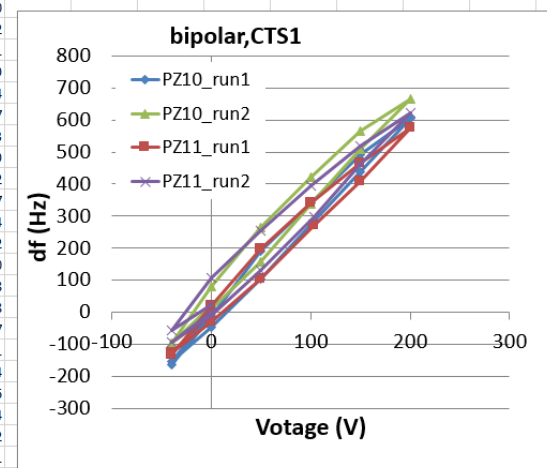
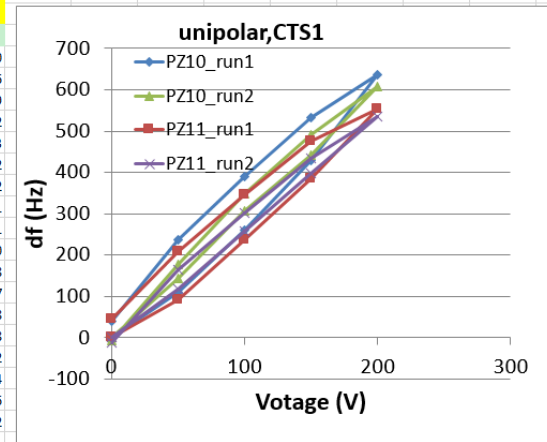


PZ10 only

Voltage (V)	Phase (°)	df(Hz)
0	100,79	0
50	105,75	109,8916
100	112,59	261,4356
150	120,11	428,0453
200	129,45	634,9782
150	124,78	531,5118
100	118,4	390,1593
50	111,49	237,0644
0	102,53	38,55067
0	102,39	0
50	108,84	142,9033
100	116,25	307,076
150	122,37	442,668
200	129,78	606,8407
150	124,52	490,3024
100	118,13	348,7284
50	110,39	177,2444
0	102,1	-6,42511
0	102,34	0
-40	95,35	-154,867
0	100,26	-46,0836
50	106,96	102,3587
100	114,65	272,7349
150	122,19	439,7878
200	129,64	604,8467
150	124,46	490,0809
100	117,81	342,7464
50	110,9	189,6516
0	101,78	-12,4071
-40	95,01	-162,4
0	99,74	0
-40	95,42	-95,712
0	100,15	9,083778
50	106,81	156,6398
100	114,97	337,4291
150	122,62	506,9191
200	129,82	666,4391
150	125,22	564,5236
100	118,8	422,2849
50	111,63	263,4296
0	103,4	81,08933
-40	95,33	-97,706
0	100,64	19,94

PZ11 only

Voltage (V)	Phase (°)	df(Hz)
0	101,93	0
50	106,08	91,94556
100	112,62	236,8429
150	119,25	383,7342
200	126,92	553,6673
150	123,39	475,4582
100	117,54	345,8482
50	111,31	207,8191
0	103,93	44,31111
0	103,89	0
50	109,16	116,7598
100	115,53	257,8907
150	121,85	397,9138
200	128,06	535,4998
150	123,46	433,5842
100	117,48	301,094
50	111,28	163,7296
0	103,31	-12,8502
0	102,82	0
-40	97,02	-128,502
0	101,45	-30,3531
50	107,48	103,2449
103	115,05	270,9624
150	121,27	408,77
200	128,8	575,6013
150	123,86	466,1529
100	118,16	339,8662
50	111,76	198,0707
0	103,8	21,71244
-40	96,78	-133,82
0	100,85	0
-40	96,66	-92,8318
0	100,44	-9,08378
50	106,73	130,2747
103	114,28	297,5491
150	121,72	462,3864
200	128,94	622,3496
150	124,25	518,44
100	118,71	395,6982
50	112,3	253,6811
0	105,74	108,3407
-40	98,29	-56,7182
0	101,86	22,37711



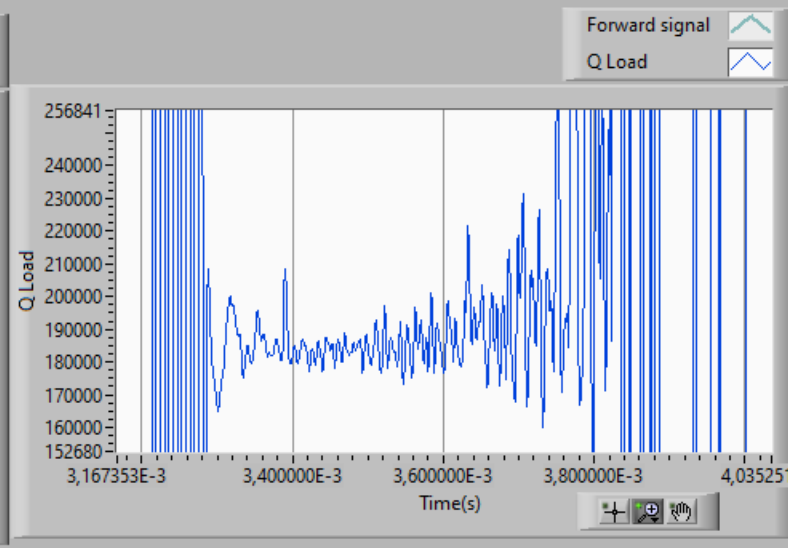
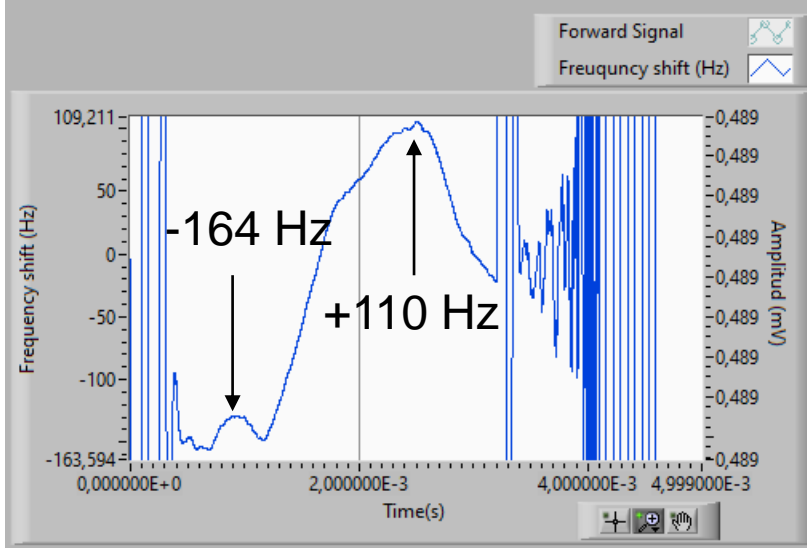
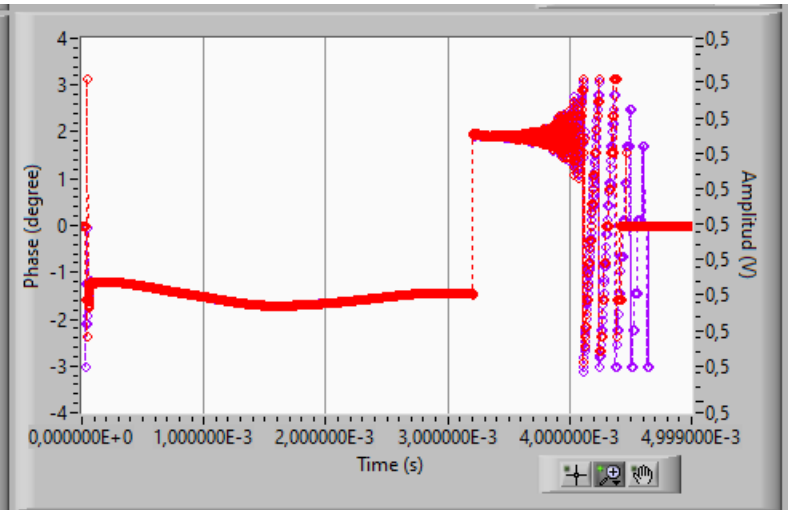
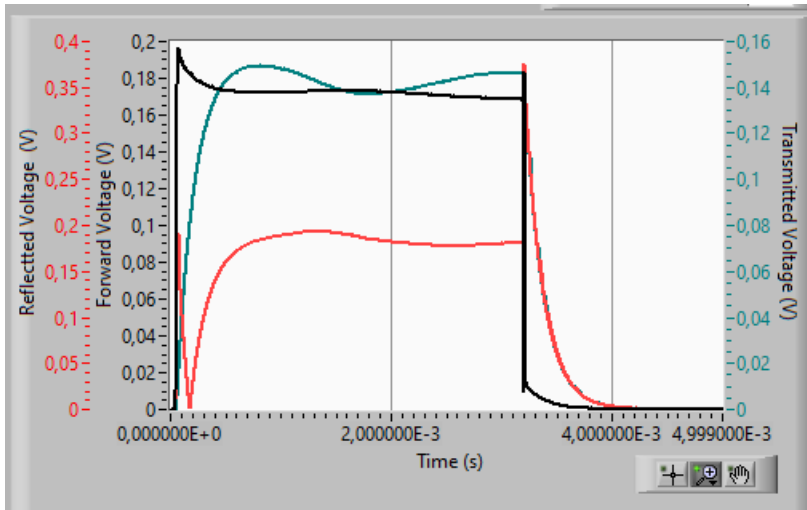
tuning range bp 1318,256  
tuning range up 999,8802

tuning range bp 764,1451  
tuning range up 613,2658

tuning range bp 715,1813  
tuning range up 548,35

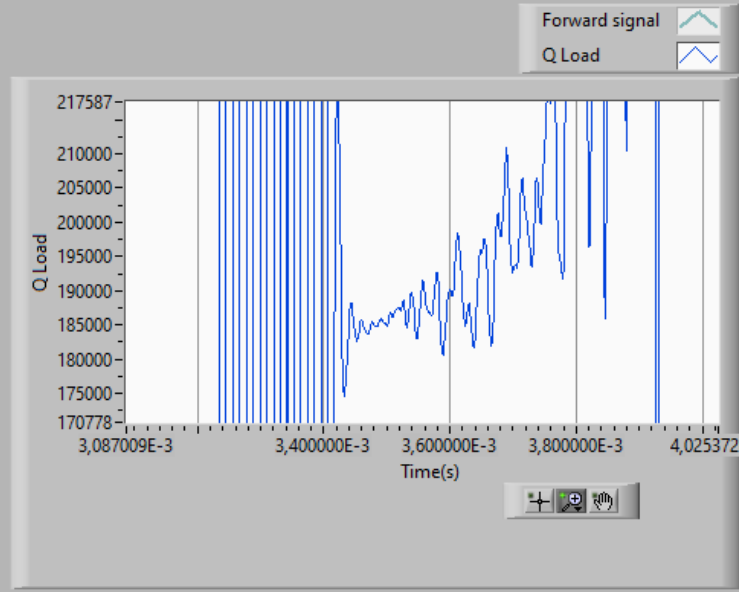
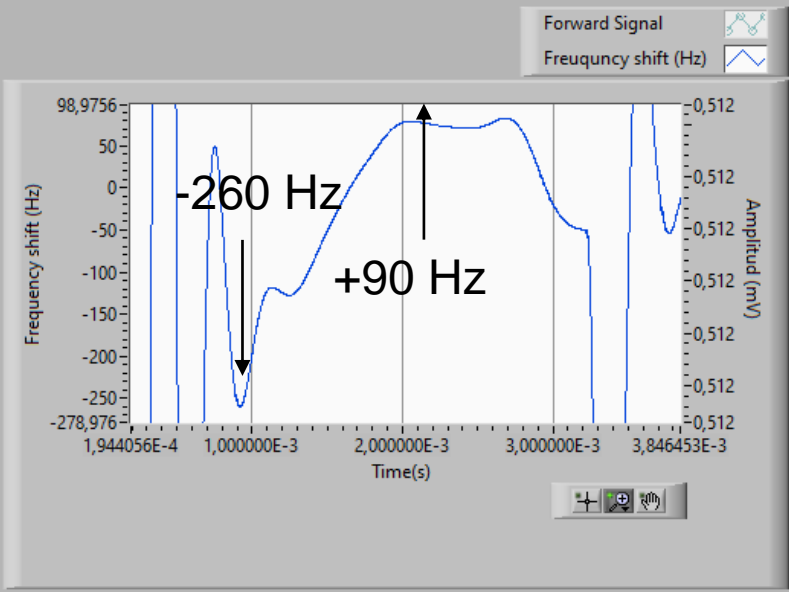
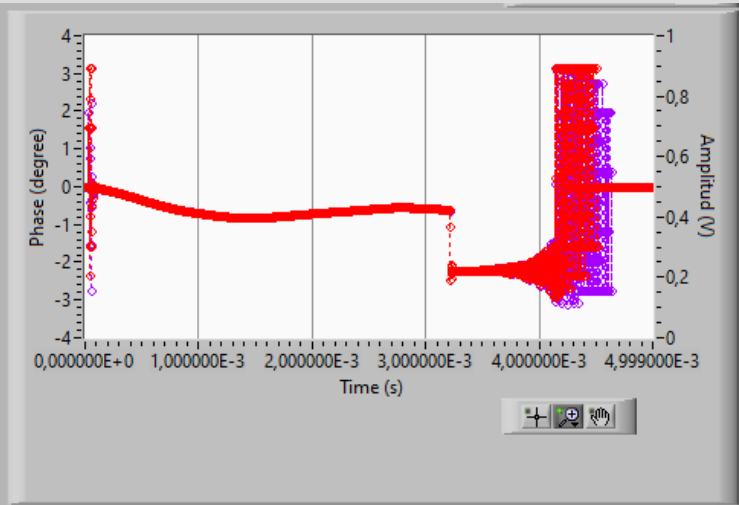
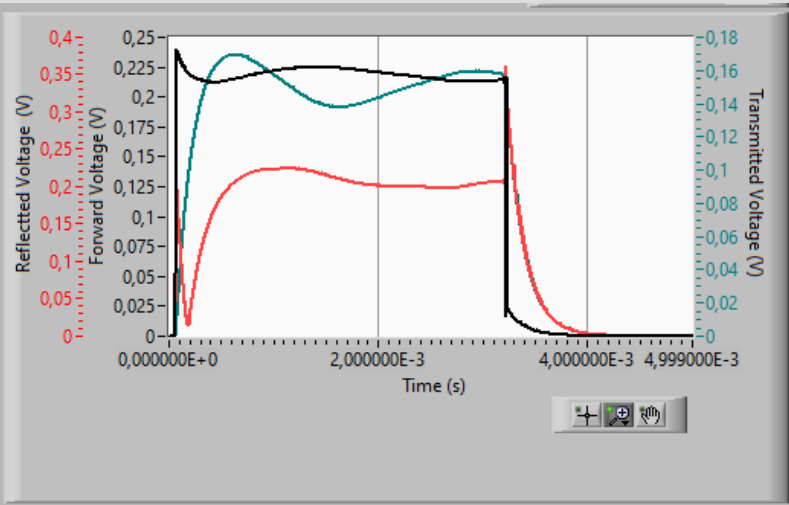


# CM10: CAVIN LFD at 9MV/m at 352.21 MHz

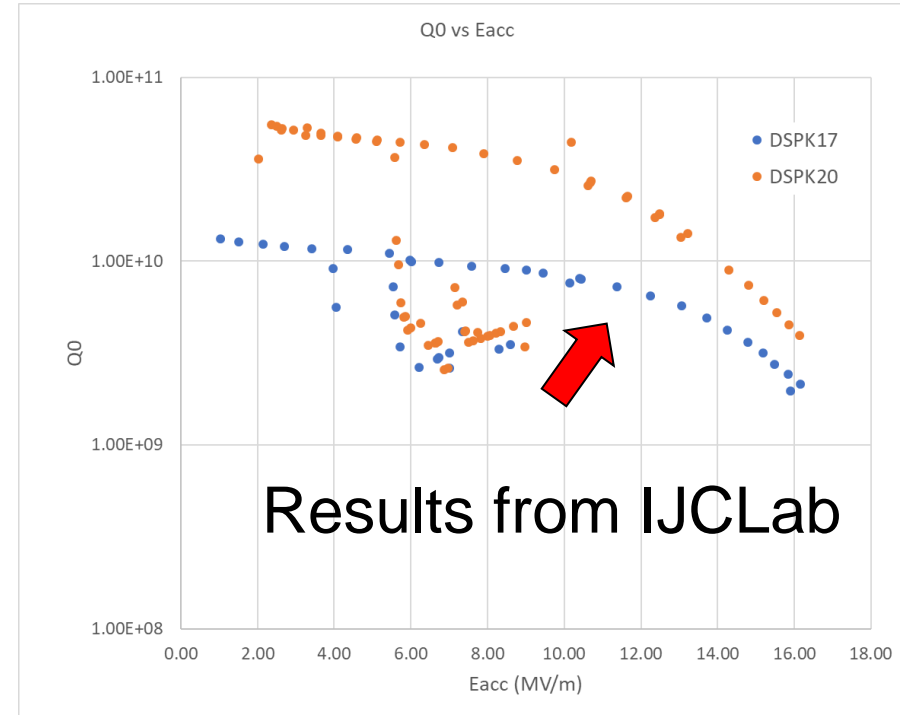
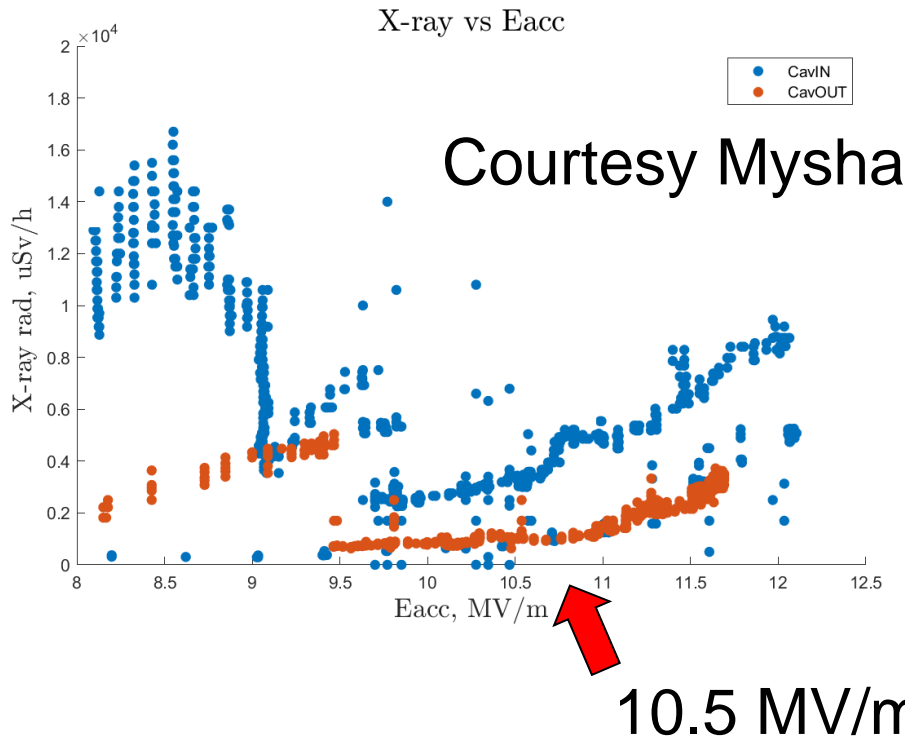
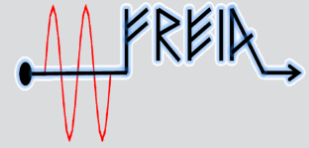


$$|\Delta f| = 270 \text{ Hz}$$

# CM10: CAVOUT LFD at 9MV/m **no CTS**

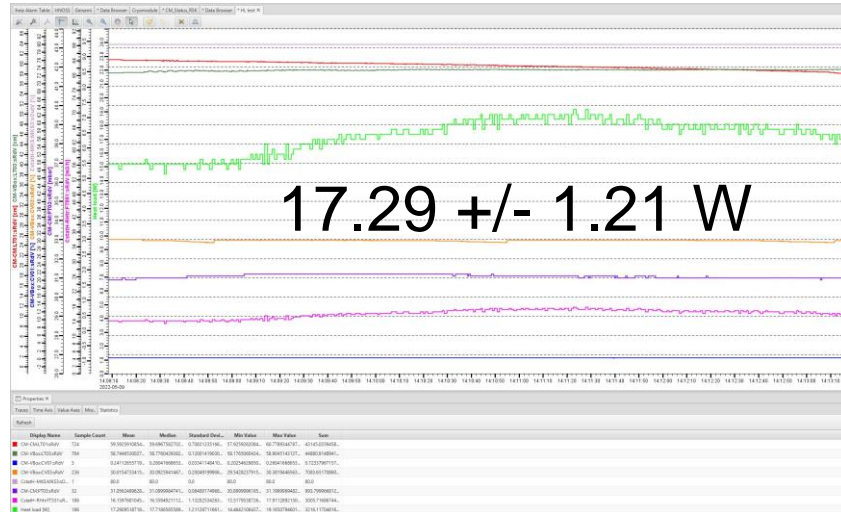


$|\Delta f| = 350 \text{ Hz}$

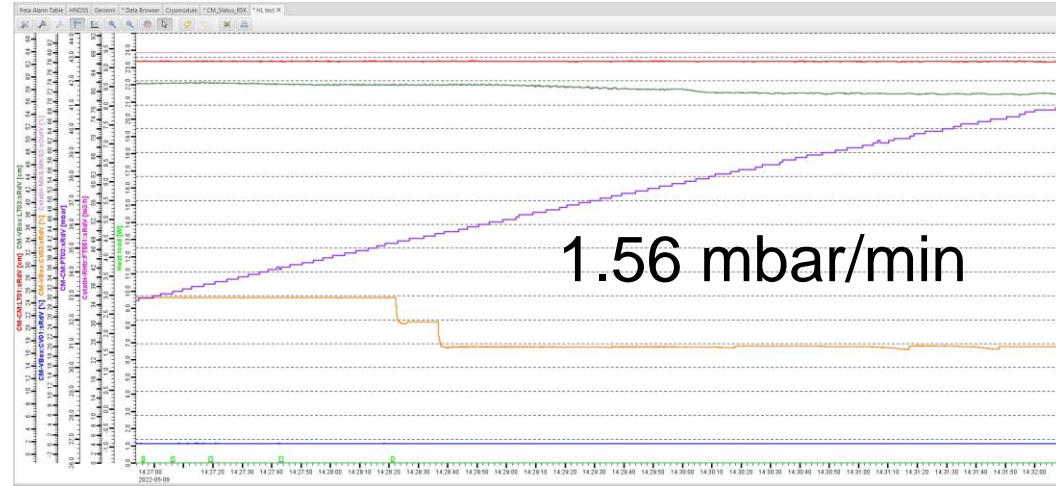


(But  $Q_t$  may be underestimated)

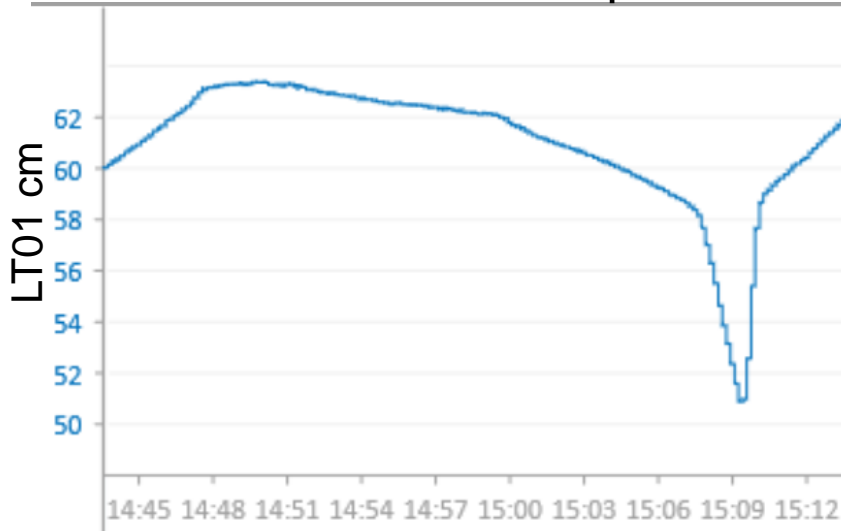
## From the GHe flow



## From pressure rise



## From LHe drop



- Data is ready
- Once L vs H is given, we will convert pressure & LHe to the heat load
- We may ask some detail of the calculation