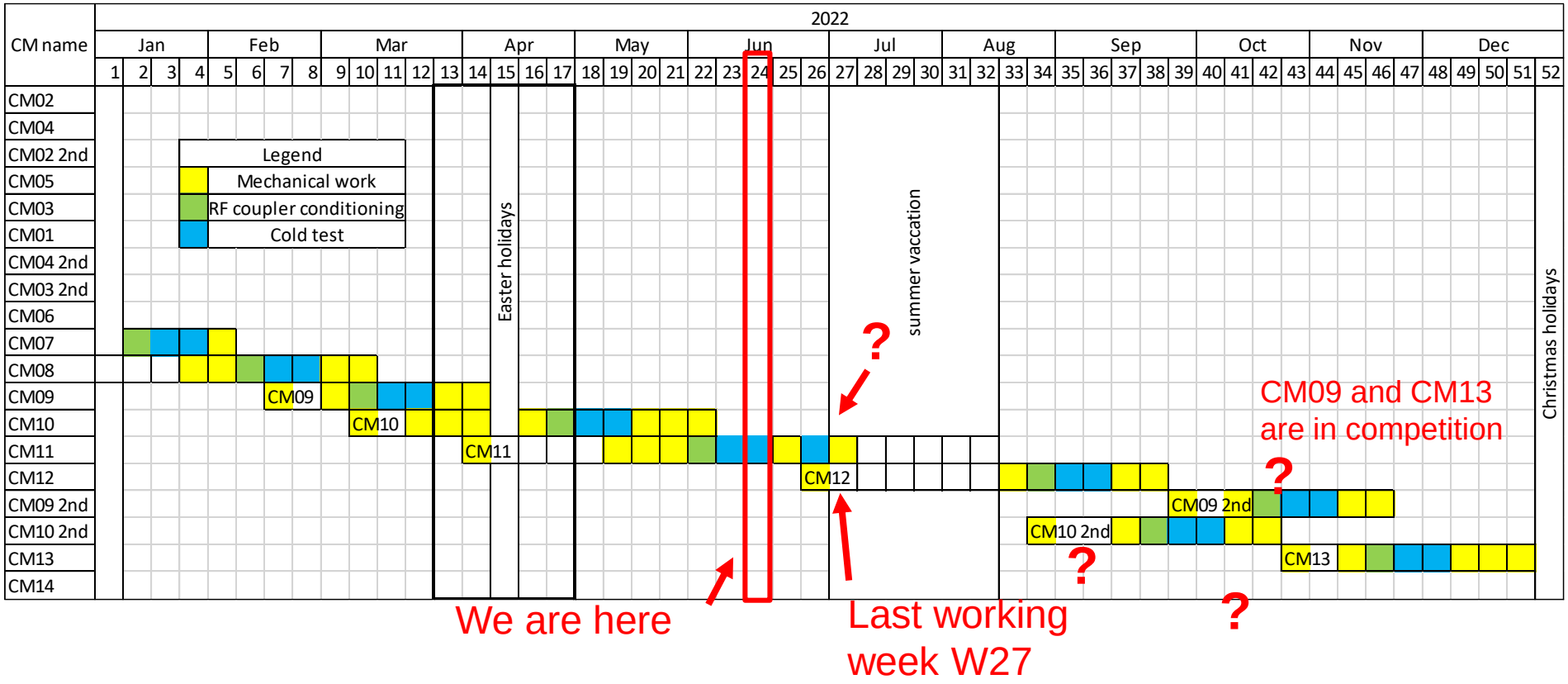
UPPSALA
UNIVERSITET

ESS weekly meeting (2022 W24)

A. Miyazaki, et al

Global planning updated (very preliminary)



- CM12 has no more leak in the thermal screen and FREIA can receive it on June 30th (W26)
- CM10 will be fixed by Nicolas before mid-July so CM10 will be back to FREIA in August
- CM09 will be disassembled in W26 or W27 and will be shipped to FREIA in September
- CM13's cavities will be tested in W25 and in case of success it will be shipped to FREIA in October

Progress of W22, W23, and W24

week		W22													
date		MON		TUE		WED		THU		FRI		SAT	SUN		
		30-maj		31-maj		01-jun		02-jun		03-jun		04-jun	05-jun		
		m	a	m	a	m	a	m	a	m	a				
previous CM	**CM10**	out-going test (VNA)		close the transport box		departure to ESS		publish report							
present CM	**CM11**	RF calibration	coupler warm conditioning			to fix by-pass valve in requifier						warming up cryogenic system			
next CM	**CM12**	preparation at Orsay													

week		W23											
date		MON		TUE		WED		THU		FRI		SAT	SUN
		06-jun		07-jun		08-jun		09-jun		10-jun		11-jun	12-jun
		m	a	m	a	m	a	m	a	m	a		SUN
present CM	**CM11**	National day of Sweden		fix cryogenic system		coupler warm conditioning	LN2 cooling	4K cooling	LHe filling	standby operation		filling up the Dewar	
next CM	**CM12**			preparation at Orsay									

We are here

week		W24											
date		MON		TUE		WED		THU		FRI		SAT	SUN
		13-jun		14-jun		15-jun		16-jun		17-jun		18-jun	19-jun
		m	a	m	a	m	a	m	a	m	a		
previous CM	**CM11**	4K cooling	LHe filling	2K pumping	CTS motor test cold coupler	RF calibration and piezos	MP conditioning	warm up requifier while keeping LN in CM		fix requifier		filling up the Dewar	
next CM	**CM12**	preparation at Orsay											

- Lots of issues in cryogenic system in the past weeks
- We tried to fix the issue which might generate more problems
- CM11 CAV OUT showed strong field emission

Tentative planning of W25, W26, and W27

week		W25													
date		MON		TUE		WED		THU		FRI		SAT	SUN		
		20-jun		21-jun		22-jun		23-jun		24-jun		25-jun	26-jun		
		m	a	m	a	m	a	m	a	m	a				
previous CM	**CM11**	4K cooling	Lhe filling	2K pumping	heat load measurement & investigte field emission in CAV OUT			start warming up	midsummer holidays						
present CM	**CM12**	preparation at Orsay													

Nobody may want to break the insulation vacuum on midsummer day

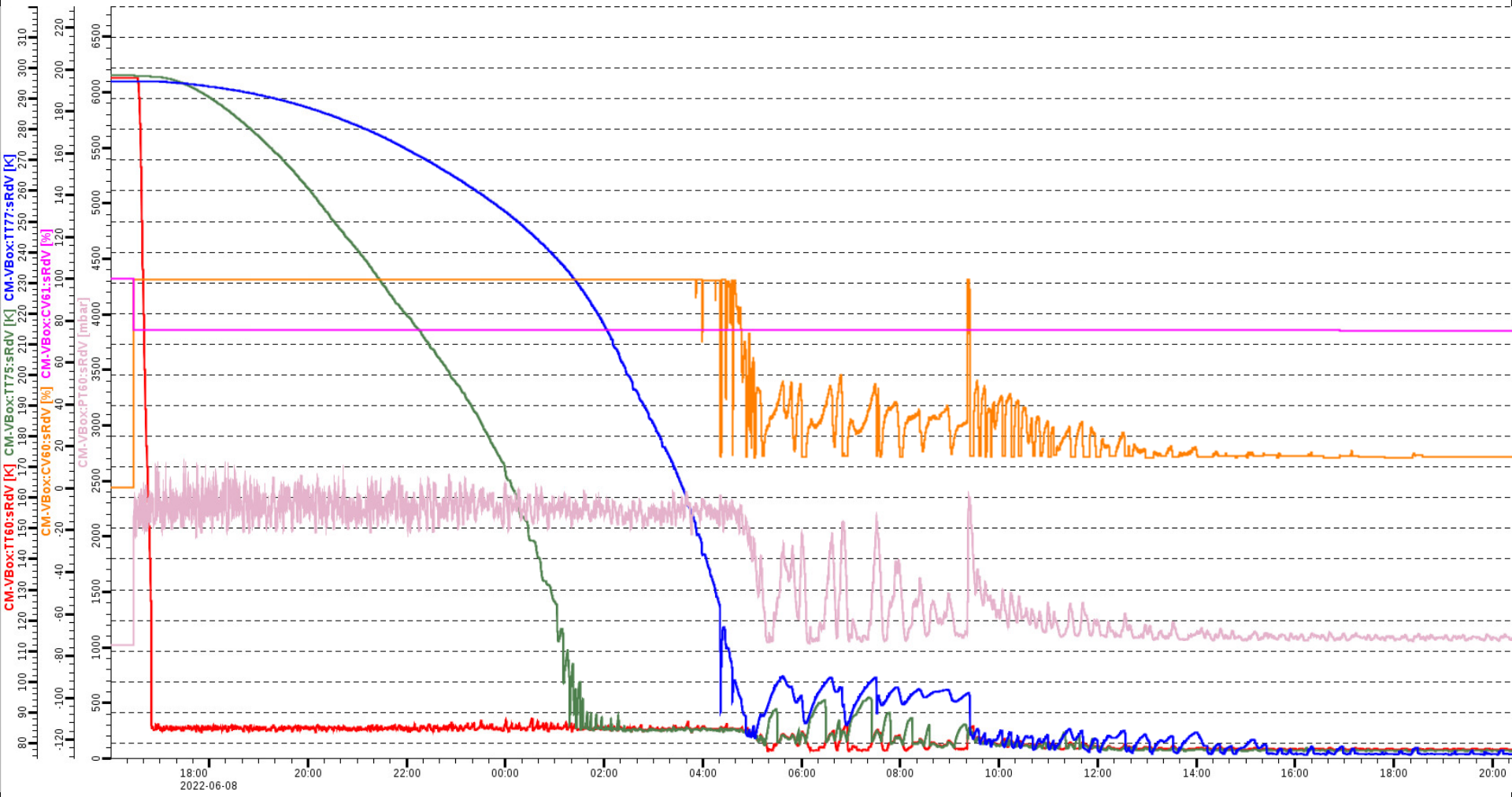
week		W26											
date		MON		TUE		WED		THU		FRI		SAT	SUN
		27-jun		28-jun		29-jun		30-jun		01-jul		02-jul	03-jul
		m	a	m	a	m	a	m	a	m	a		
previous CM	**CM11**	break insulation vacuum		warming up completed		disconnect lines		N2 filling		out going test			
present CM	**CM12**	departure at Orsay		transport				arrival at FREIA		in-coming test			

optimistic

week		W27											
date		MON		TUE		WED		THU		FRI		SAT	SUN
		04-jul		05-jul		06-jul		07-jul		08-jul		09-jul	10-jul
		m	a	m	a	m	a	m	a	m	a		
previous CM	**CM11**	depature to ESS		report writing				publish report					
present CM	**CM12**	doorknob mounting		move into the bunker	connect lines		leak test, vacuum pumping			close angle valves			

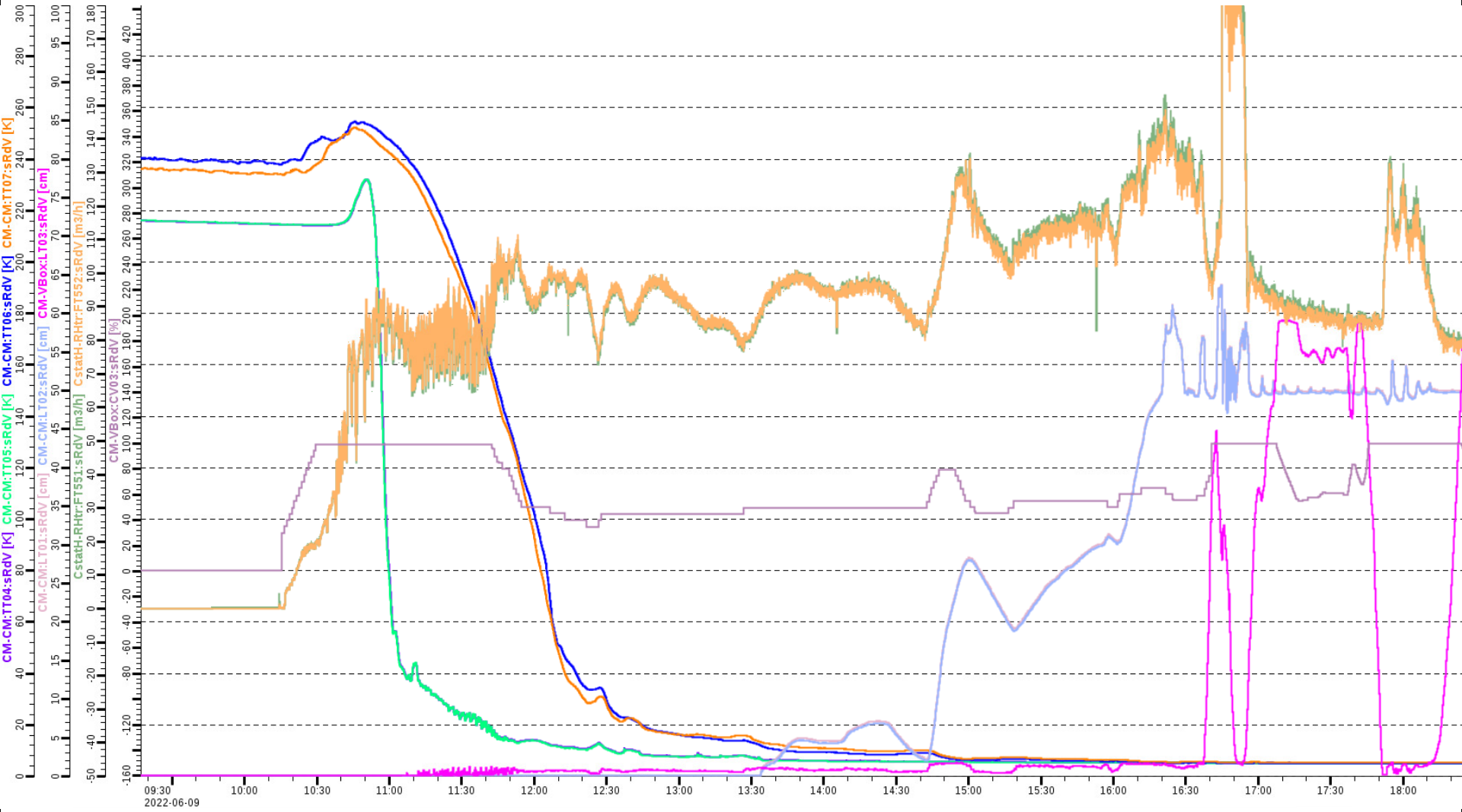
- Decision making on CM11 will be the key
- FREIA needs to collect all the information for this decision

CM11: LN shield cooling



12 hours

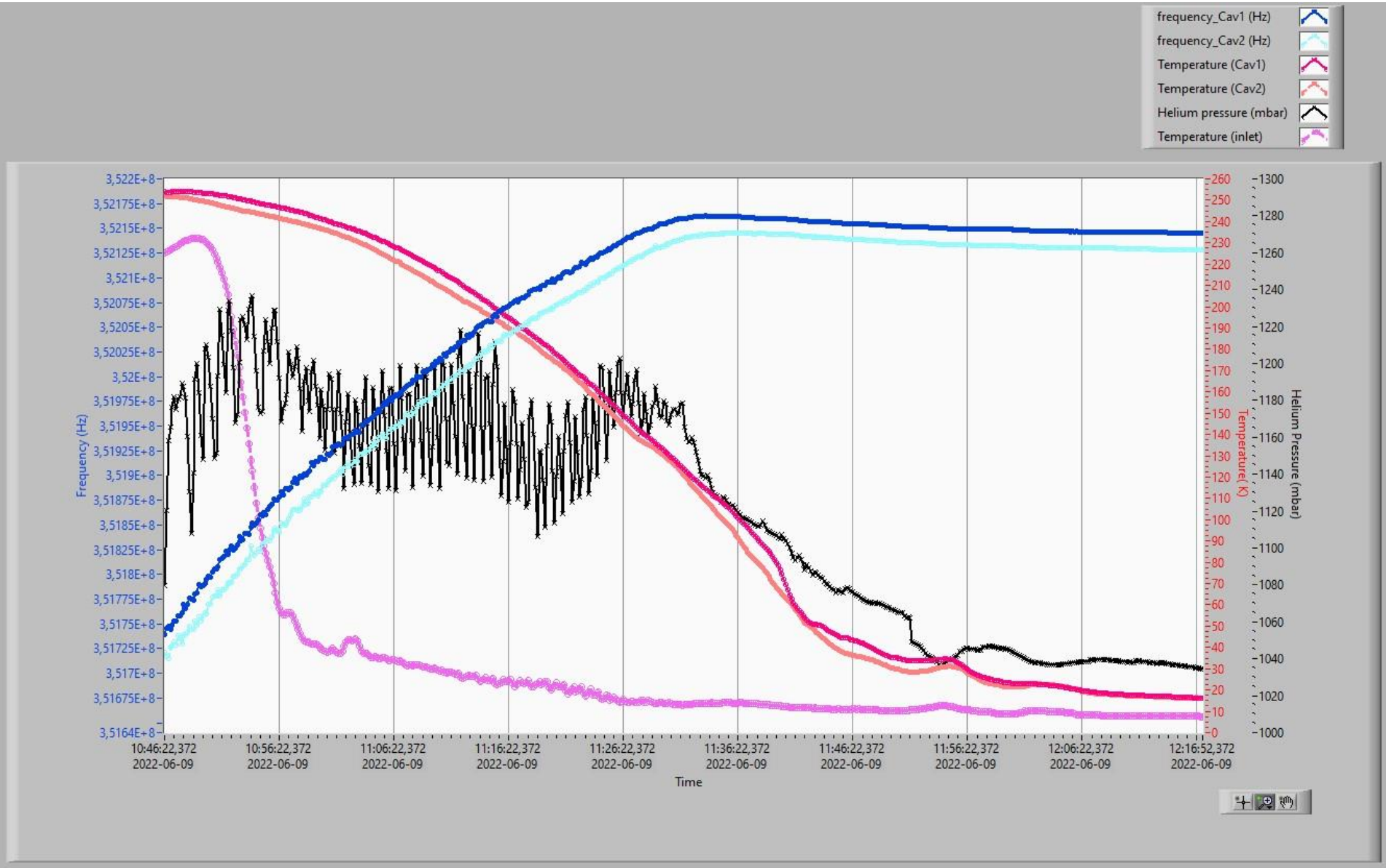
CM11: LHe cooling



- LHe in the CM in 3h 15 min
- But no LHe in the VBox after one night and Lhe Dewar got almost empty

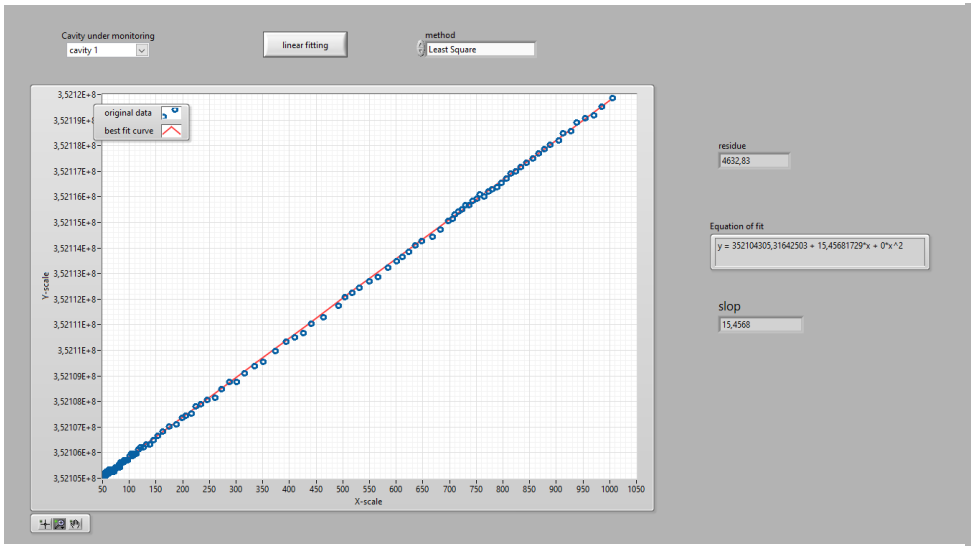
→We went to stand-by (20-50K) and filled up the Dewar over the weekend

CM11: LHe cooling and f vs T



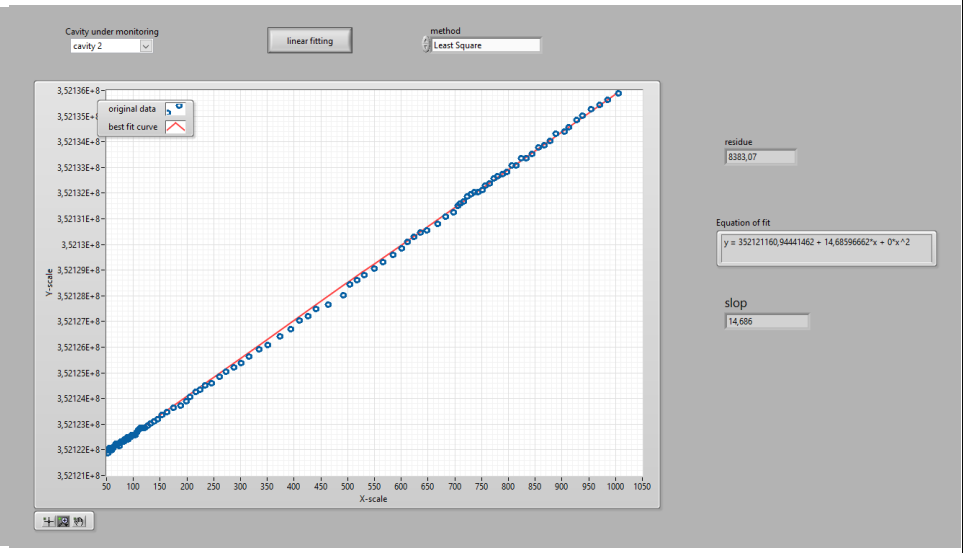
CM11: 2K pumping

CAV IN



df/dp = 15.5 Hz/mbar

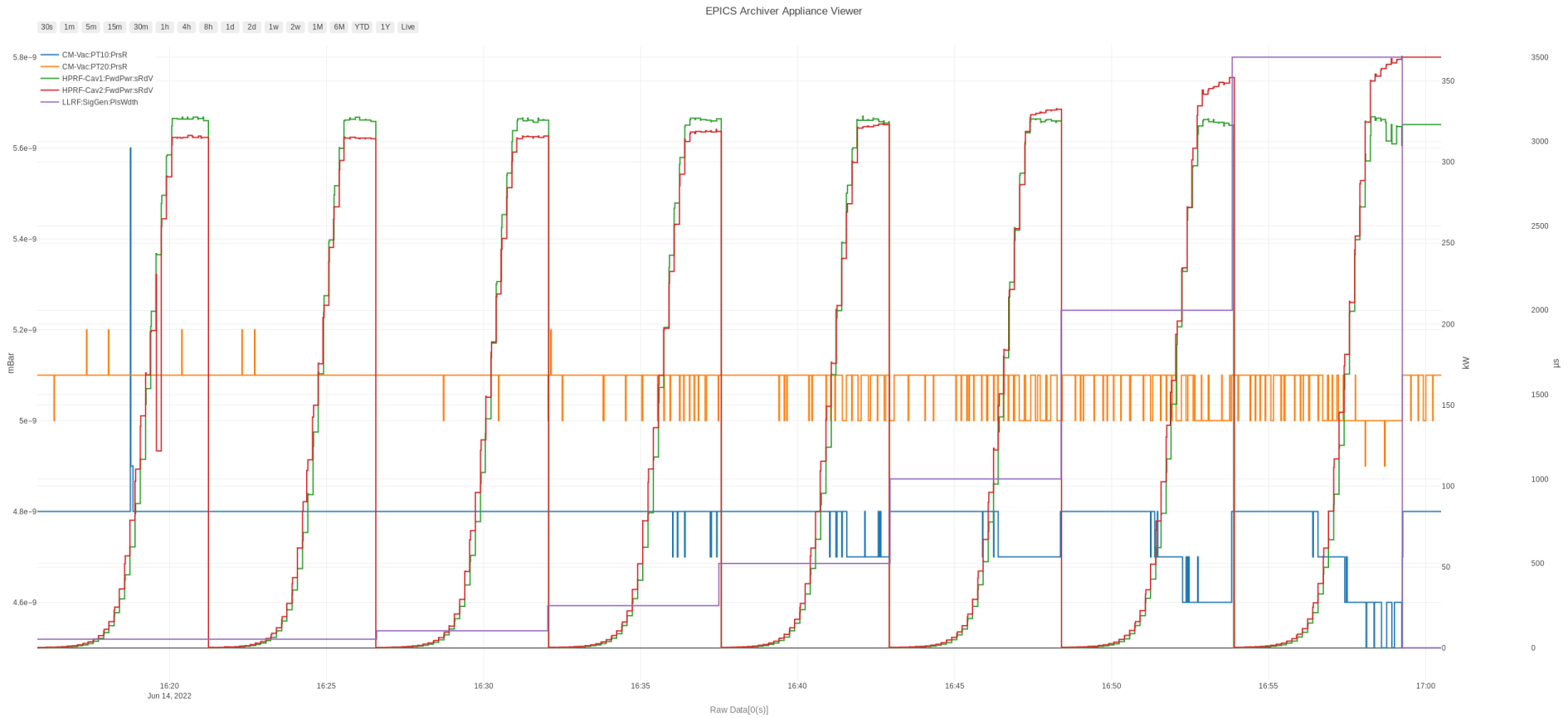
CAV OUT



df/dp = 14.7 Hz/mbar

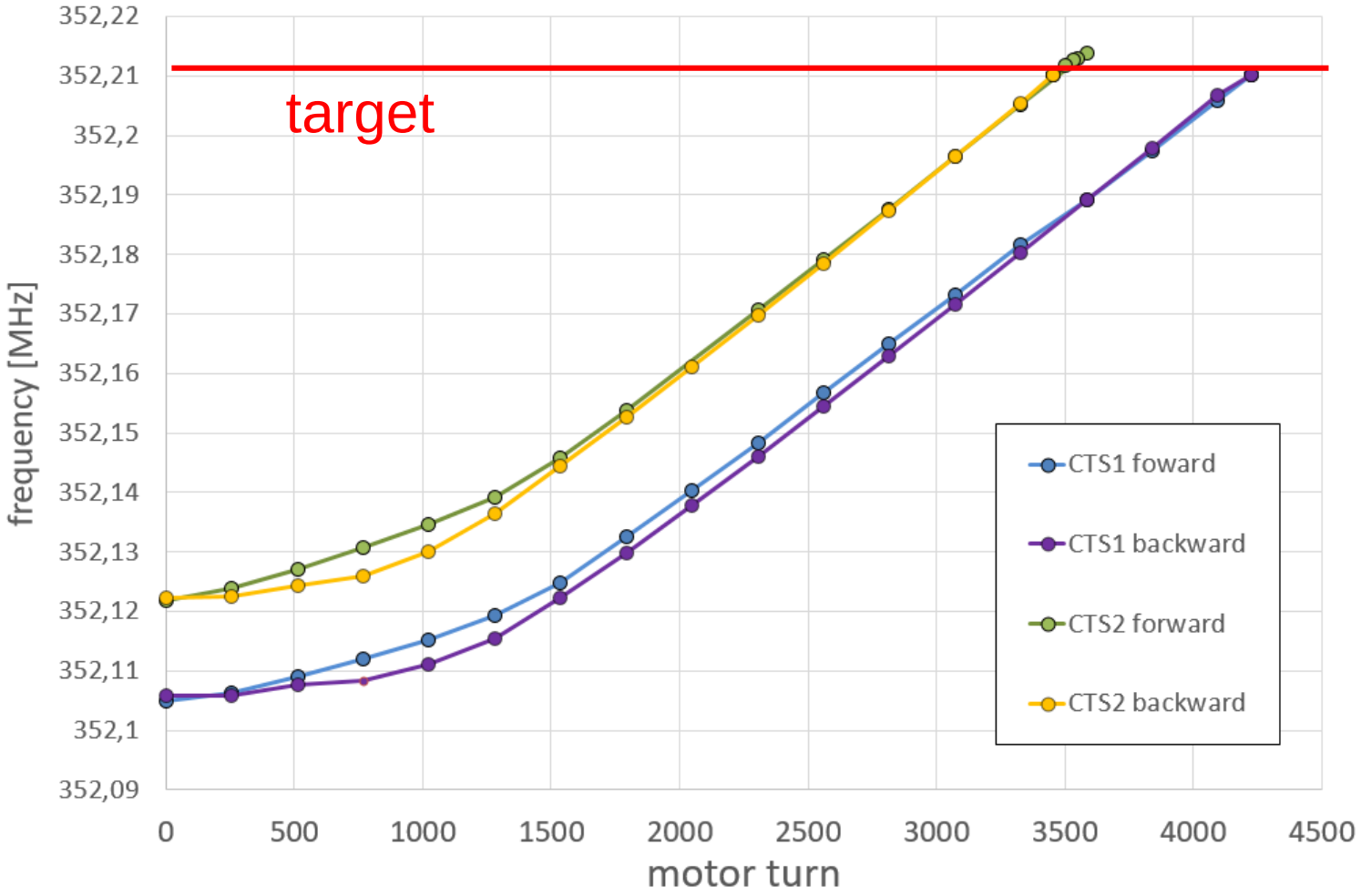
OK ☺

CM11: cold coupler conditioning



OK ☺

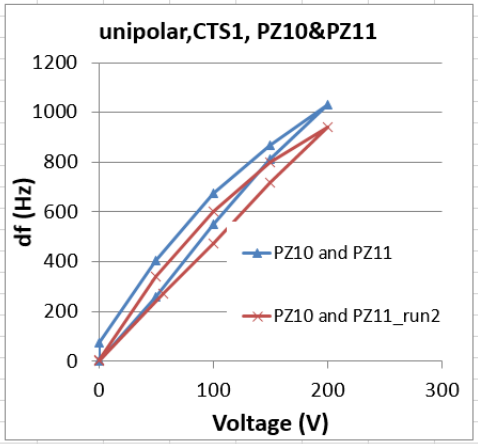
CM11: CTS stepper motor test

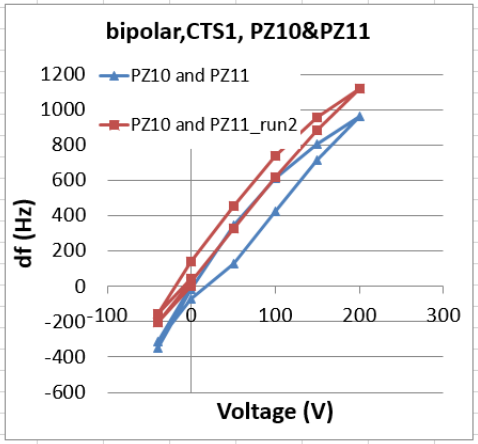


- Used Phytron to check if we can move back to the limit switch at cold
- Used Beckhoff (suggested by ESS) to push CTSs forward to reach the target frequency

CM11: CAV IN CTS1 piezos

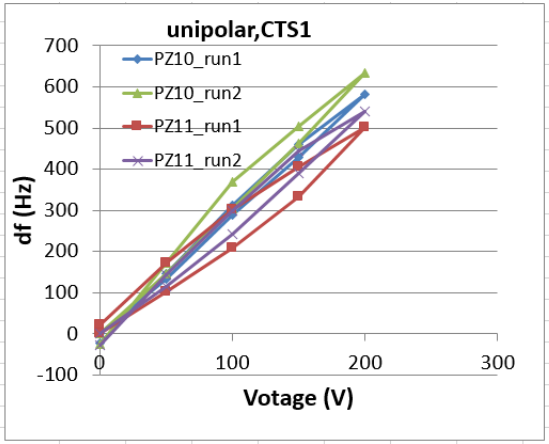
both piezos simulaneously		
Voltage (V)	Phase (°)	df(Hz)
0	87,04	0
50	97,89	259,315
100	110,09	550,895
150	120,94	810,21
200	130,2	1031,524
150	123,29	866,375
100	115,33	676,131
50	103,9	402,954
0	90,2	75,524
0	89,56	0
56	100,9	271,026
100	109,32	472,264
150	119,52	716,044
200	128,99	942,377
150	123,08	801,128
100	114,71	601,085
50	103,86	341,77
0	89,75	4,541
0	89,49	0
-40	76,37	-313,568
0	86,64	-68,115
50	94,93	130,016
100	107,13	421,596
150	119,47	716,522
200	129,64	959,585
150	123,03	801,606
100	115,13	612,796
50	104,03	347,506
0	88,77	-17,208
-40	74,91	-348,462
0	82,35	0
-40	73,69	-206,974
0	83,34	23,661
50	95,96	325,279
100	108,13	616,142
150	119,25	881,91
200	129,27	1121,388
150	122,22	952,893
100	113,23	738,032
50	101,29	452,666
0	88,18	139,337
-40	75,88	-154,633
0	84,07	41,108
tuning range bp		1328,362
tuning range up		942,377

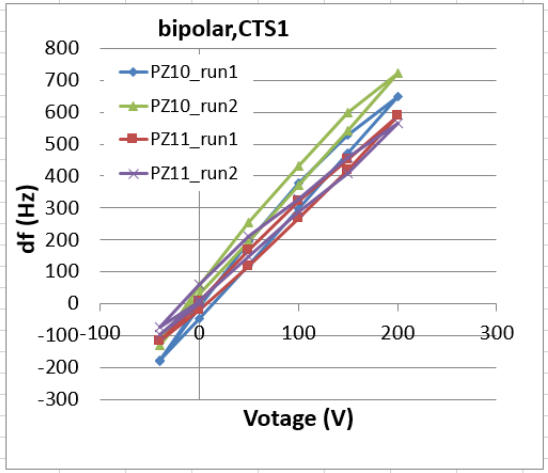




PZ10 only		
Voltage (V	Phase (°)	df(Hz)
0	87,61	0
50	93,22	134,079
100	99,68	288,473
150	105,56	429,005
200	111,99	582,682
150	106,8	458,641
100	100,66	311,895
50	93,67	144,834
0	86,71	-21,51
0	86,98	0
50	93,13	146,985
100	99,7	304,008
150	106,32	462,226
200	113,48	633,35
150	108,04	503,334
100	102,42	369,016
50	94,2	172,558
0	85,9	-25,812
0	85,77	0
-40	78,35	-177,338
0	83,77	-47,8
50	90,81	120,456
100	98,24	298,033
150	105,5	471,547
200	112,91	648,646
150	107,86	527,951
100	101,63	379,054
50	93,85	193,112
0	85,31	-10,994
-40	78,15	-182,118
0	82,37	0
-40	77,81	-108,984
0	83,63	30,114
50	90,42	192,395
100	97,86	370,211
150	105,08	542,769
200	112,62	722,975
150	107,35	597,022
100	100,44	431,873
50	93,07	255,73
0	84,76	57,121
-40	76,95	-129,538
0	83,25	21,032
tuning range bp		852,513
tuning range up		659,162

PZ11 only		
Voltage (V	Phase (°)	df(Hz)
0	87,48	0
50	91,72	101,336
100	96,16	207,452
150	101,44	333,644
200	108,5	502,378
150	104,46	405,822
100	100,06	300,662
50	94,64	171,124
0	88,42	22,466
0	88,21	0
50	93,05	115,676
100	98,34	242,107
150	104,54	390,287
200	110,87	541,574
150	106,79	444,062
100	100,74	299,467
50	94,17	142,444
0	87	-28,919
0	86,8	0
-40	81,89	-117,349
0	85,97	-19,837
50	91,67	116,393
100	97,93	266,007
150	104,24	416,816
200	111,45	589,135
150	105,65	450,515
100	100,18	319,782
50	93,86	168,734
0	87,09	6,931
-40	81,91	-116,871
0	85,79	0
-40	81,73	-97,034
0	86,18	9,321
50	91,95	147,224
100	97,81	287,278
150	102,9	408,929
200	109,41	564,518
150	104,97	458,402
100	99,49	327,43
50	94,62	211,037
0	88,24	58,555
-40	82,72	-73,373
0	86,03	5,736
tuning range bp		661,552
tuning range up		570,493





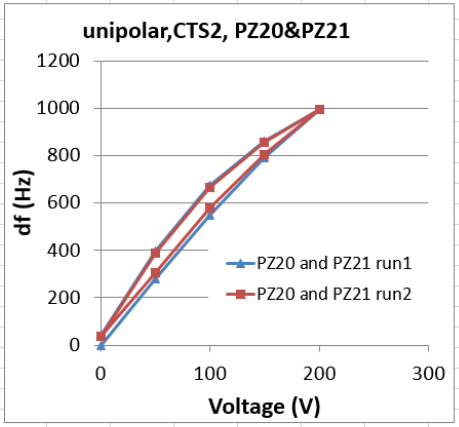
OK ☺

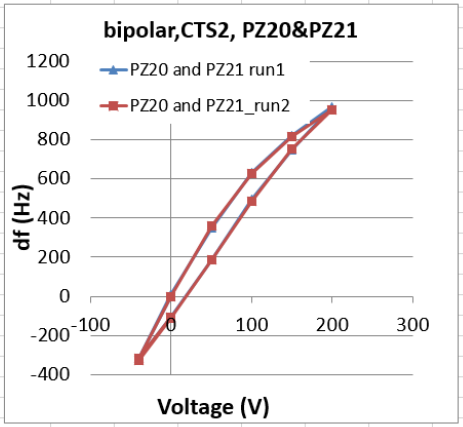
CM11: CAV OUT CTS2 piezos

20220615 TT21=107,4K

both piezos simulaneously

Voltage (V)	Phase (°)	df(Hz)
0	40,48	0
50	54,15	277,9567
100	67,56	550,6267
150	79,35	790,3567
200	89,48	996,3333
150	82,78	860,1
100	73,56	672,6267
50	60,04	397,72
0	42,6	43,10667
0	42,27	36,39667
50	55,43	303,9833
100	68,94	578,6867
150	80,02	803,98
200	89,5	996,74
150	82,6	856,44
100	73,2	665,3067
50	59,62	389,18
0	42,23	35,58333
0	42,06	0
-40	26,57	-314,963
0	36,71	-108,783
50	51,28	187,4733
100	66,33	493,49
150	78,91	749,2833
200	89,62	967,0533
150	82,48	821,8733
100	73,24	633,9933
50	59,34	351,36
0	42,5	8,946667
-40	26,54	-315,573
0	36,75	-107,97
-40	25,98	-326,96
0	36,47	-113,663
50	51,11	184,0167
100	65,88	484,34
150	79,08	752,74
200	88,87	951,8033
150	82,27	817,6033
100	72,82	625,4533
50	59,83	361,3233
0	41,87	-3,86333
-40	26,5	-316,387
0	36,8	-106,953
tuning range bp		1278,763
tuning range up		961,1567



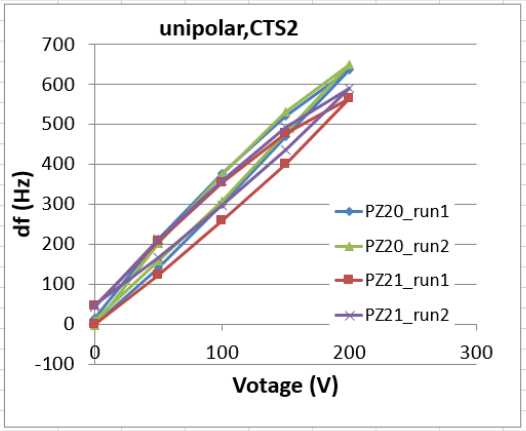


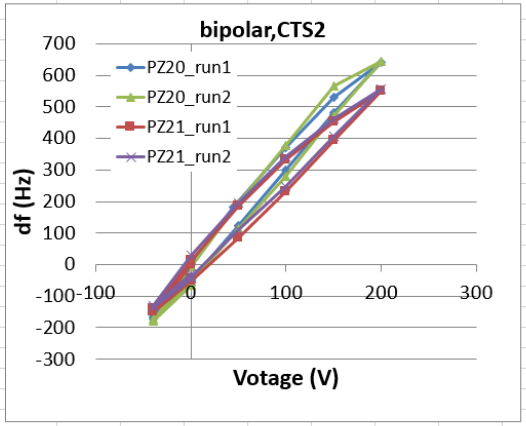
PZ20 only

Voltage (V)	Phase (°)	df(Hz)
0	41,53	0
50	48,39	139,4867
100	56,31	300,5267
150	64,66	470,31
200	72,84	636,6367
150	67,14	520,7367
100	60,12	377,9967
50	52,03	213,5
0	42,26	14,84333
0	42,02	9,963333
50	49,35	159,0067
100	56,64	307,2367
153	65,63	490,0333
200	73,47	649,4467
150	67,63	530,7
100	59,94	374,3367
50	51,48	202,3167
0	41,3	-4,67667
0	41,06	0
-40	32,86	-166,733
0	38,7	-47,9867
50	47,1	122,8133
100	55,77	299,1033
150	64,8	482,7133
200	72,54	640,0933
150	67,15	530,4967
100	59,28	370,4733
45	50,03	182,39
0	41,29	4,676667
-40	32,54	-173,24
0	38,31	-55,9167
-40	32,61	-171,817
0	38,37	-54,6967
50	46,68	114,2733
100	54,75	278,3633
150	64,28	472,14
200	72,76	644,5667
150	68,88	565,6733
100	59,7	379,0133
50	50,72	196,42
0	40,82	-4,88
-40	32,31	-177,917
0	37,88	-64,66
tuning range bp		811,91
tuning range up		654,1233

PZ21 only

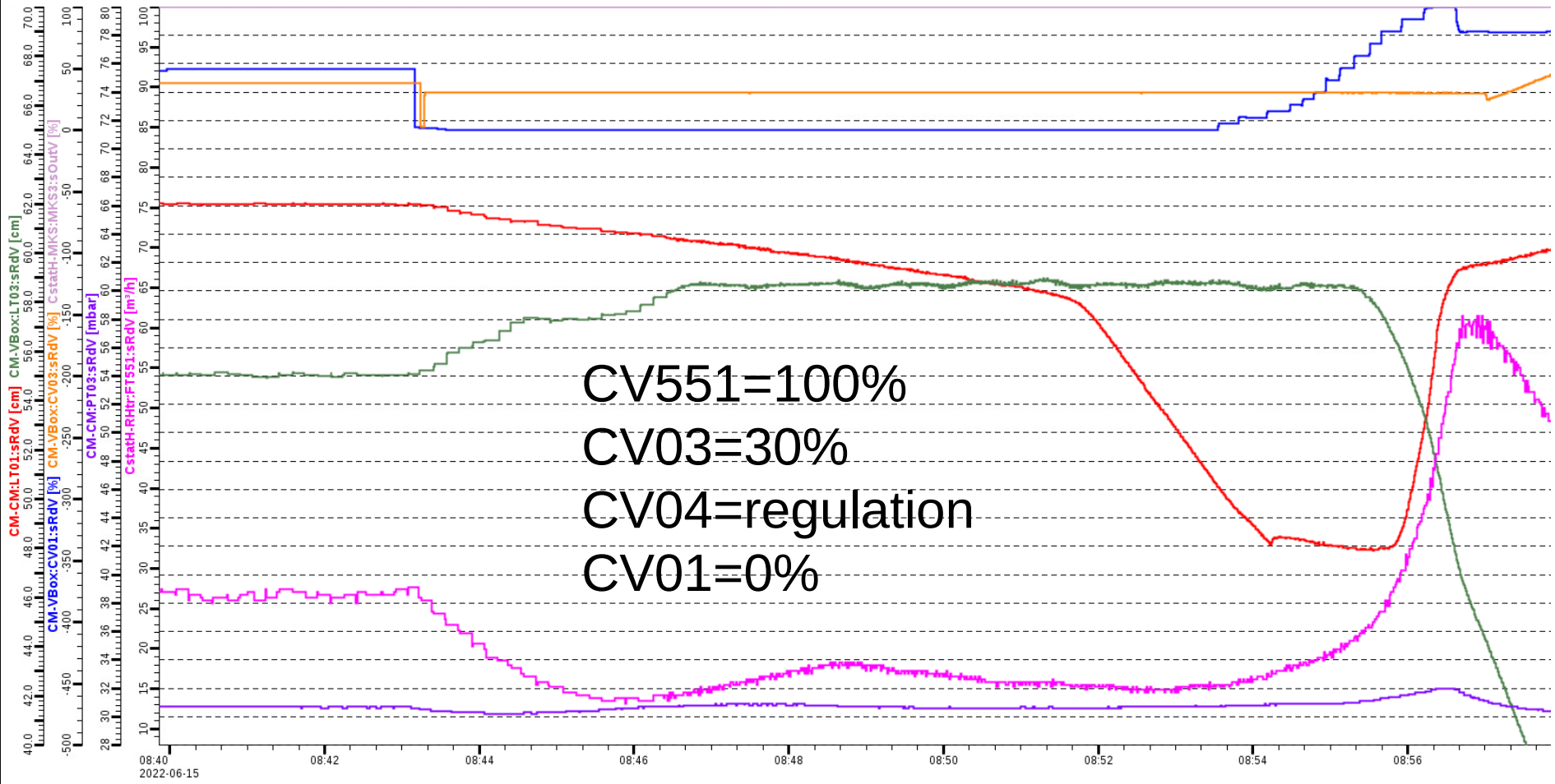
Voltage (V)	Phase (°)	df(Hz)
0	40,91	0
50	46,93	122,4067
100	53,58	257,6233
150	60,53	398,94
200	68,68	564,6567
150	64,41	477,8333
100	58,31	353,8
50	51,06	206,3833
0	43,1	44,53
0	43,21	46,76667
50	49,14	167,3433
100	55,48	296,2567
150	62,3	434,93
200	69,93	590,0733
150	65,14	492,6767
100	58,52	358,07
50	51,41	213,5
0	43,02	42,90333
0	42,68	0
-40	35,32	-149,653
0	40,08	-52,8667
50	46,78	83,36667
100	54,12	232,6133
150	62,01	393,0433
200	69,66	548,5933
150	64,89	451,6033
100	58,97	331,23
50	51,86	186,66
0	43,38	14,23333
-40	35,78	-140,3
0	40,49	-44,53
-40	35,93	-137,25
0	40,7	-40,26
53	48,06	109,3933
100	54,82	246,8467
150	62,71	407,2767
200	70,12	557,9467
150	65,47	463,3967
100	59,54	342,82
50	52,23	194,1833
0	44,18	30,5
-40	36,28	-130,133
0	41,21	-29,89
tuning range bp		685,8433
tuning range up		547,17





OK ☺

CM11: static heat load

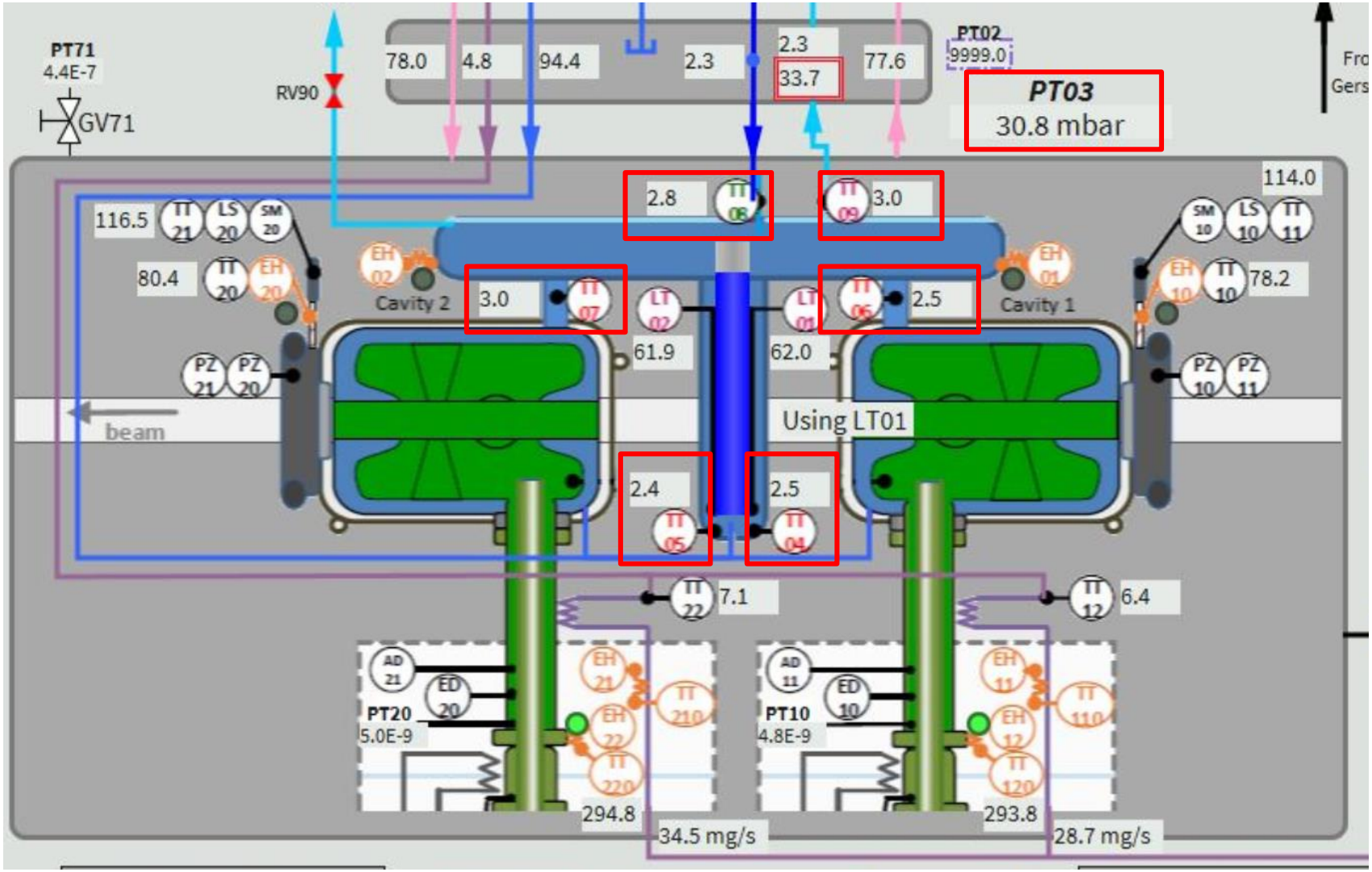


GHe exhaust flow FT551 = 16.03 m3/h (std dev 1.17 m3/h)

→ **17.15** +/- 1.25 W

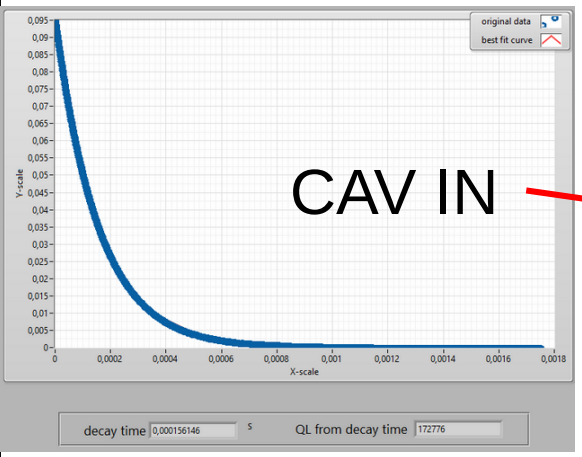
Consistent with other recent modules

CM11: strange CERNOX reading

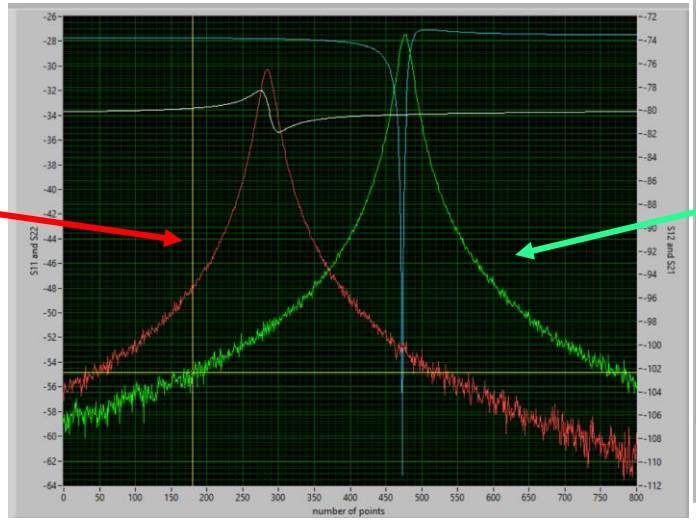


30 mbar is confirmed by other pressure gauges but all the CERNOX in CM11 show warmer value corresponding to around 100 mbar

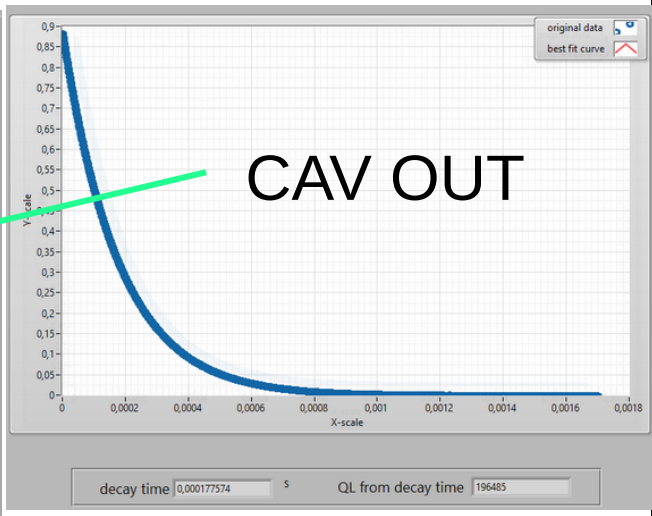
CM11: frequency and Q_L



CAV IN



CAV OUT

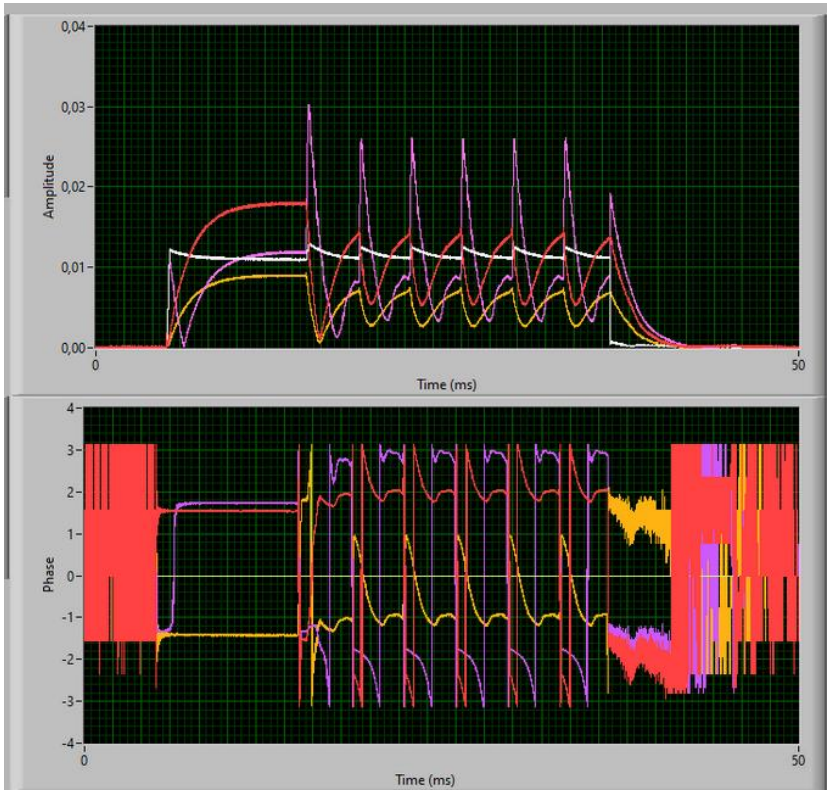


	CAV IN	CAV OUT
f_0 at 2K [MHz]	352.105	352.122
BW with VNA [kHz]	2.12	1.86
Q_L with VNA	1.66e5	1.90e5
τ with decay [us]	156	178
Q_L with decay	**1.73e5**	1.96e5

Spec: > 1.74e5

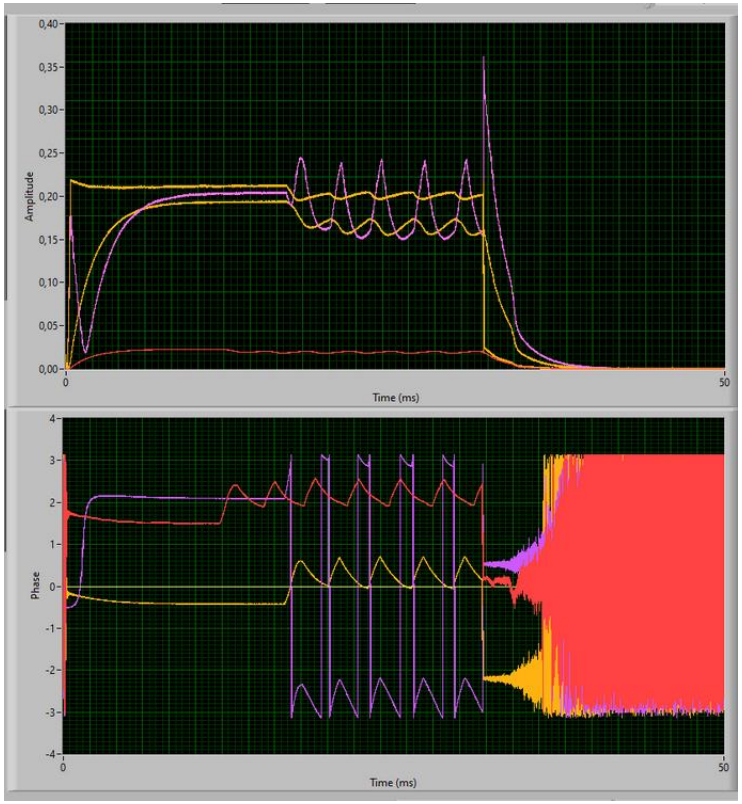
CM11: energizing cavities

CAV IN



Eacc_pk_Pt	Eacc_pk_Pf
0,637747	0,755588

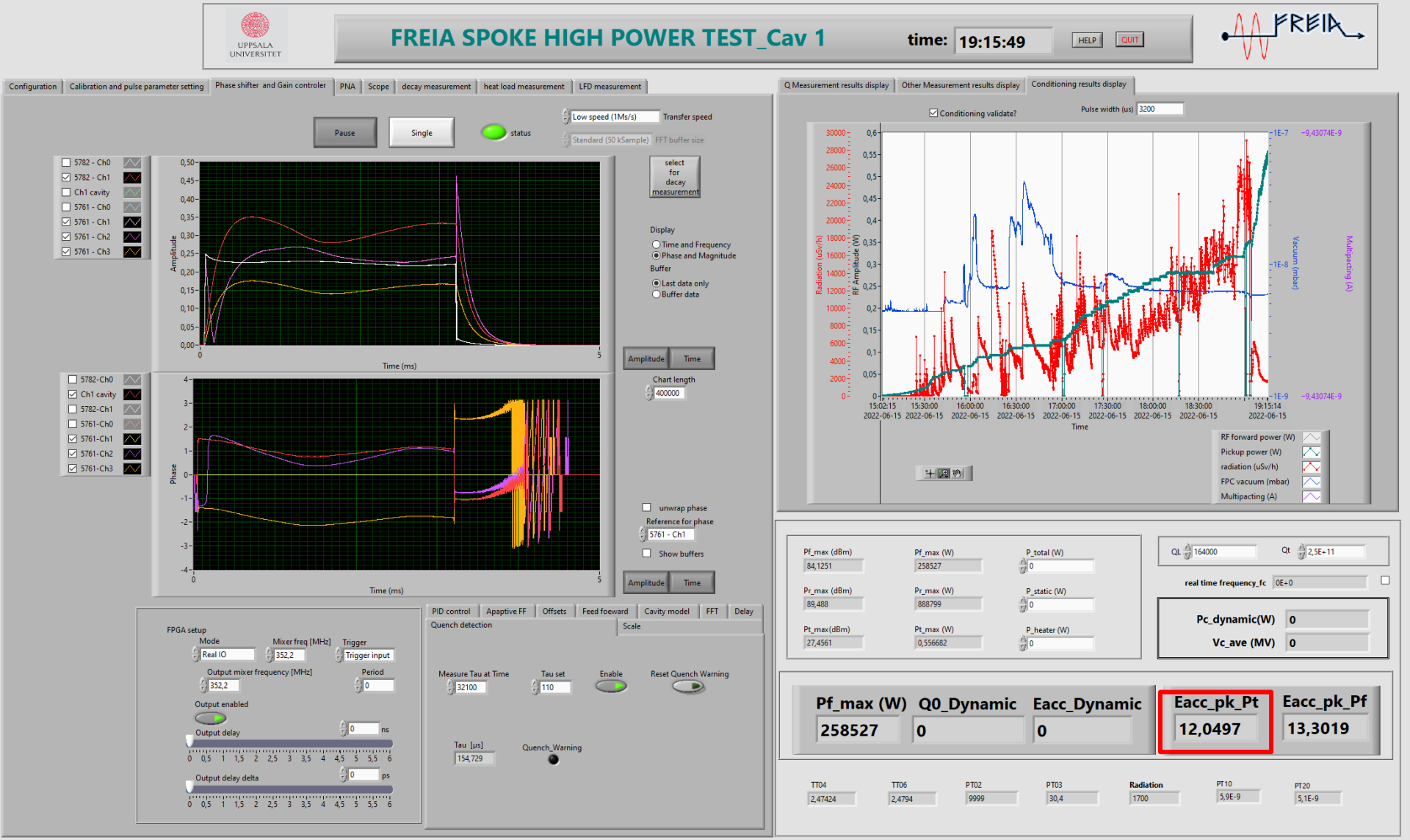
CAV OUT



Eacc_pk_Pt	Eacc_pk_Pf
0,661242	0,946428

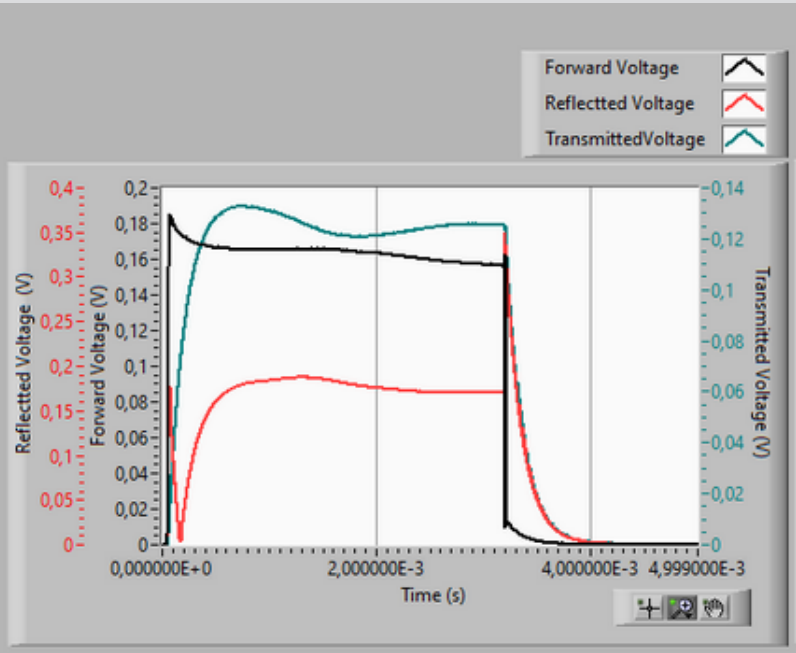
Local quench & thermal feedback is ALWAYS observed at very low field in the spoke cryomodules so far

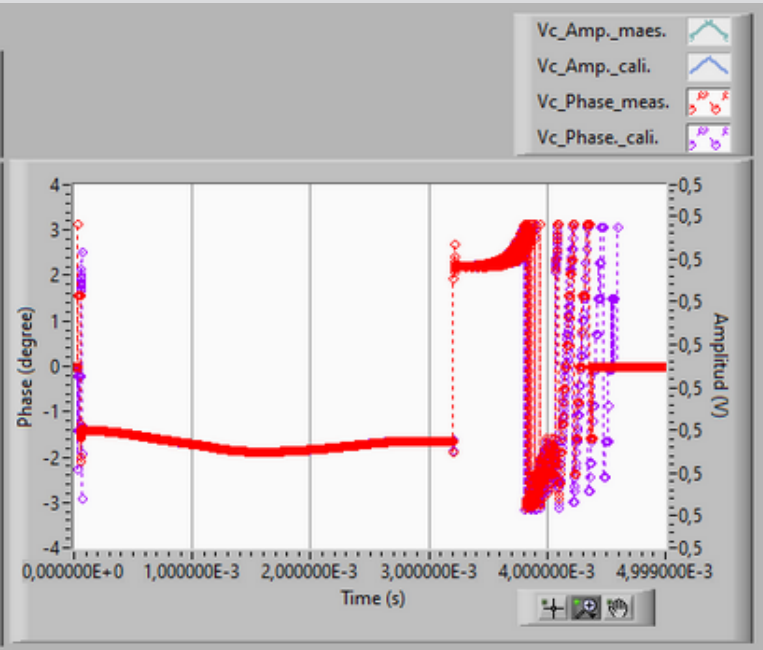
CM11: CAV IN reached 12 MV/m



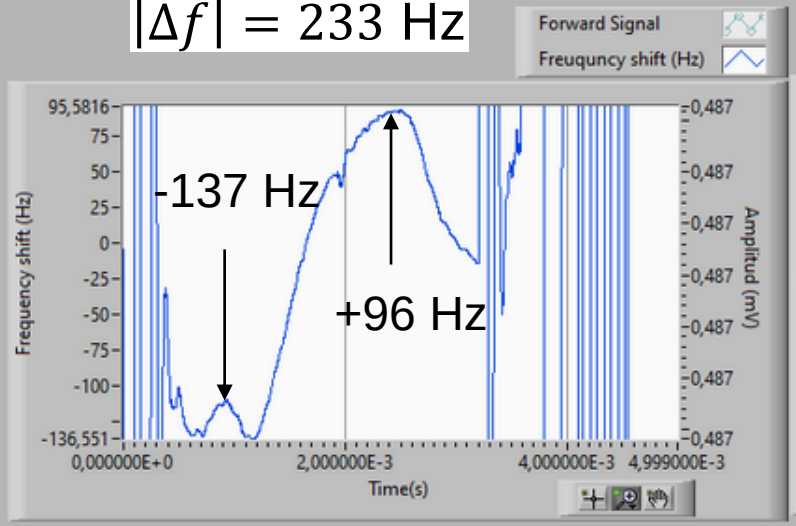
No clear indication of field emission

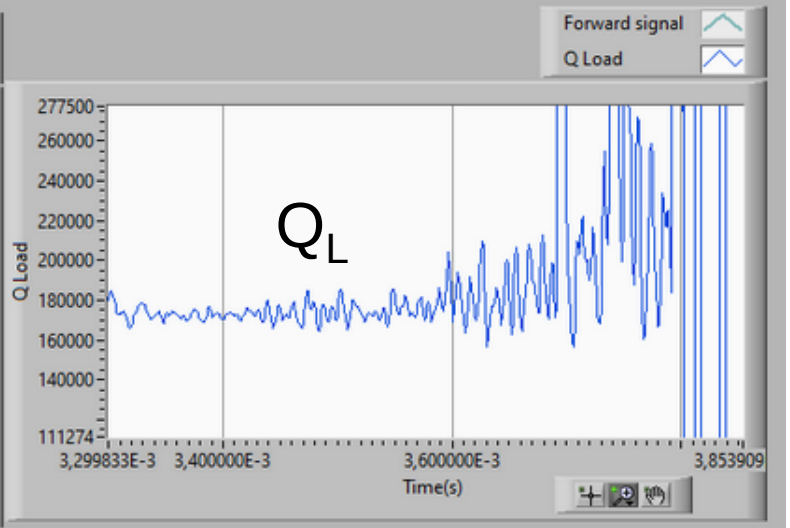
CM11: CAVIN LFD @ 9MV/m



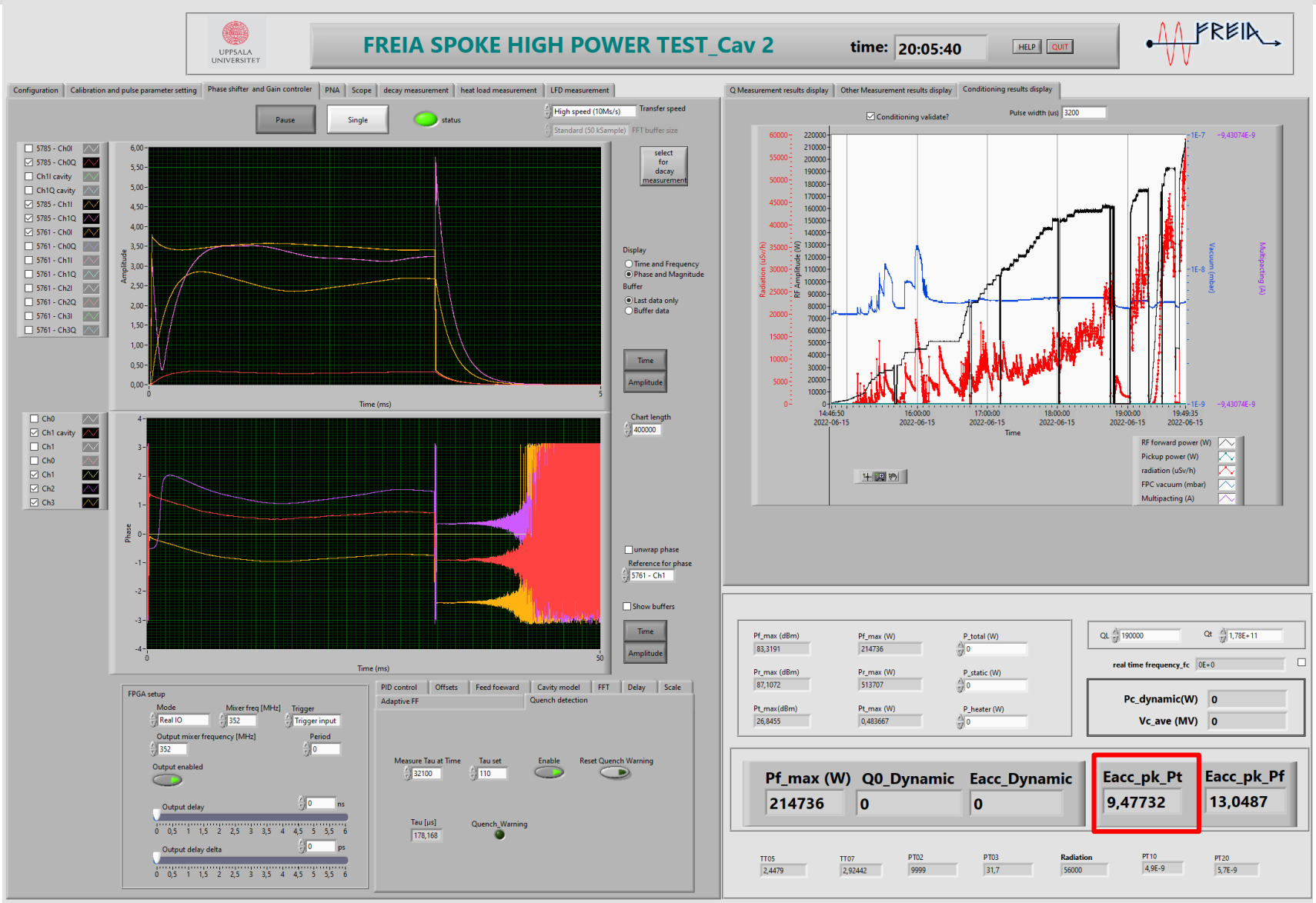


$|\Delta f| = 233$ Hz



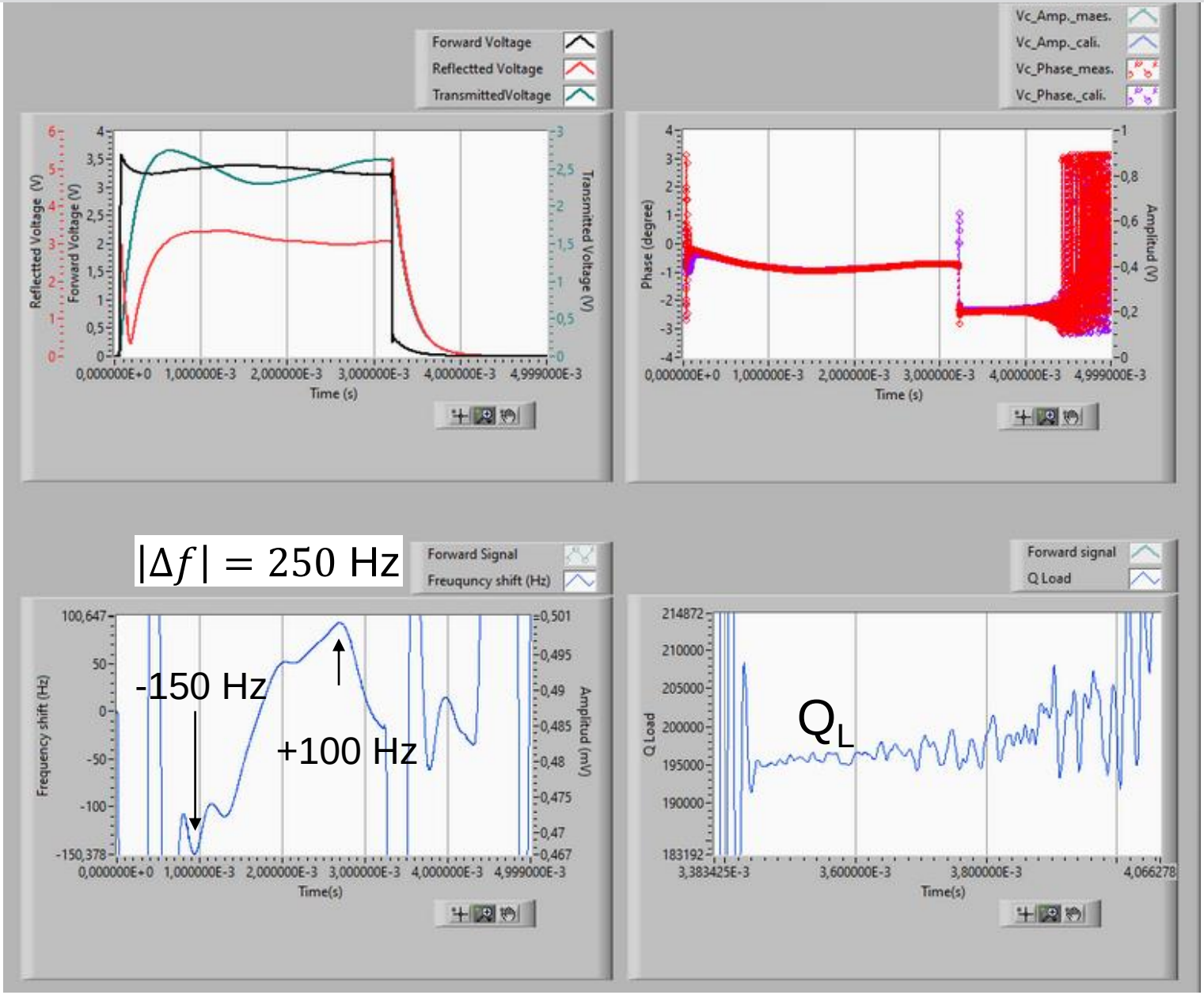


CM11: CAV OUT is problematic



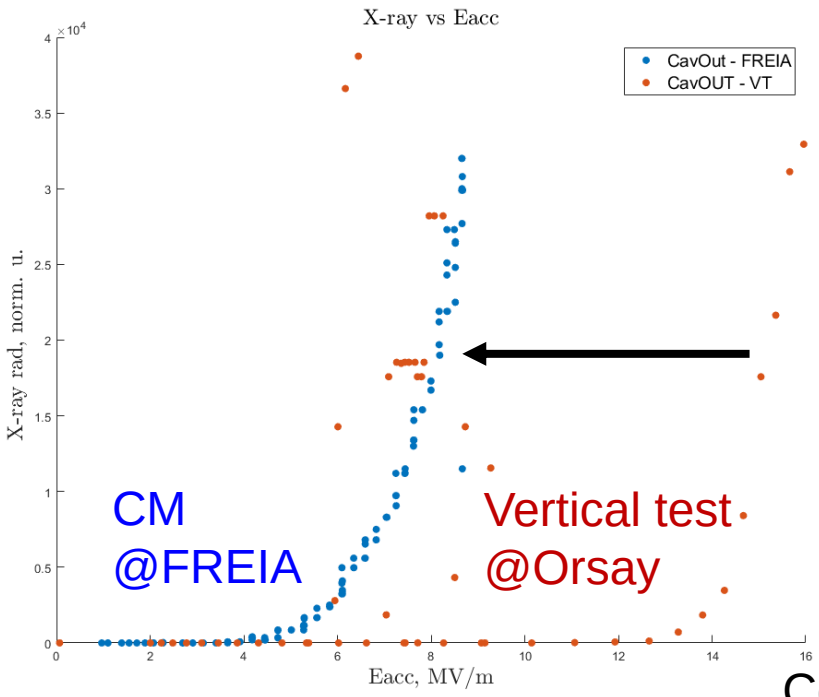
We stopped at 9.5 MV/m due to very high heat load with X-rays

CM11: CAV OUT LFD @ 9MV/m

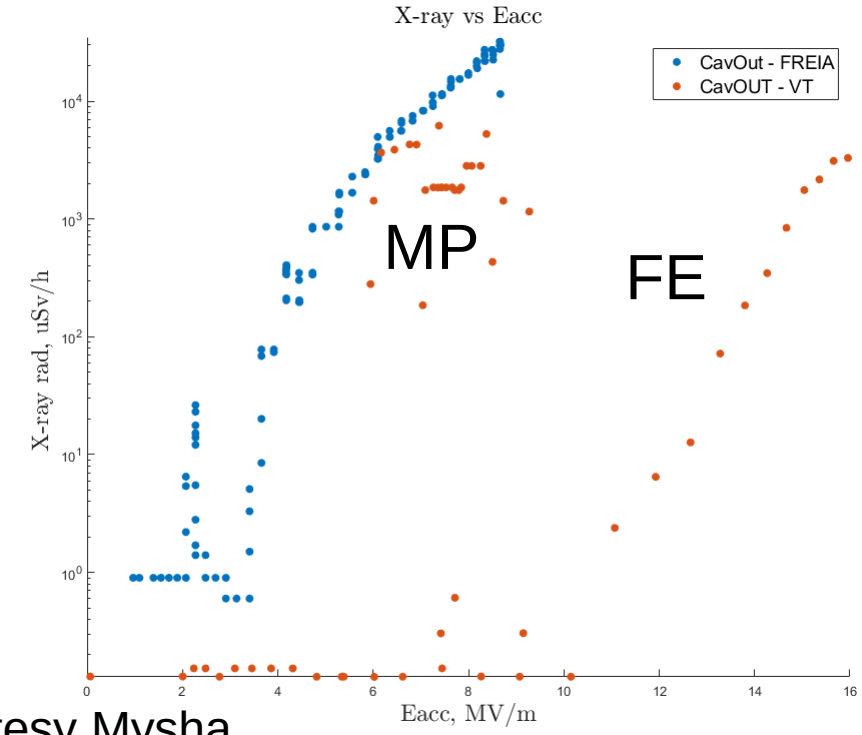


CM11: CAV OUT strong field emission

Linear scale



Logarithmic scale

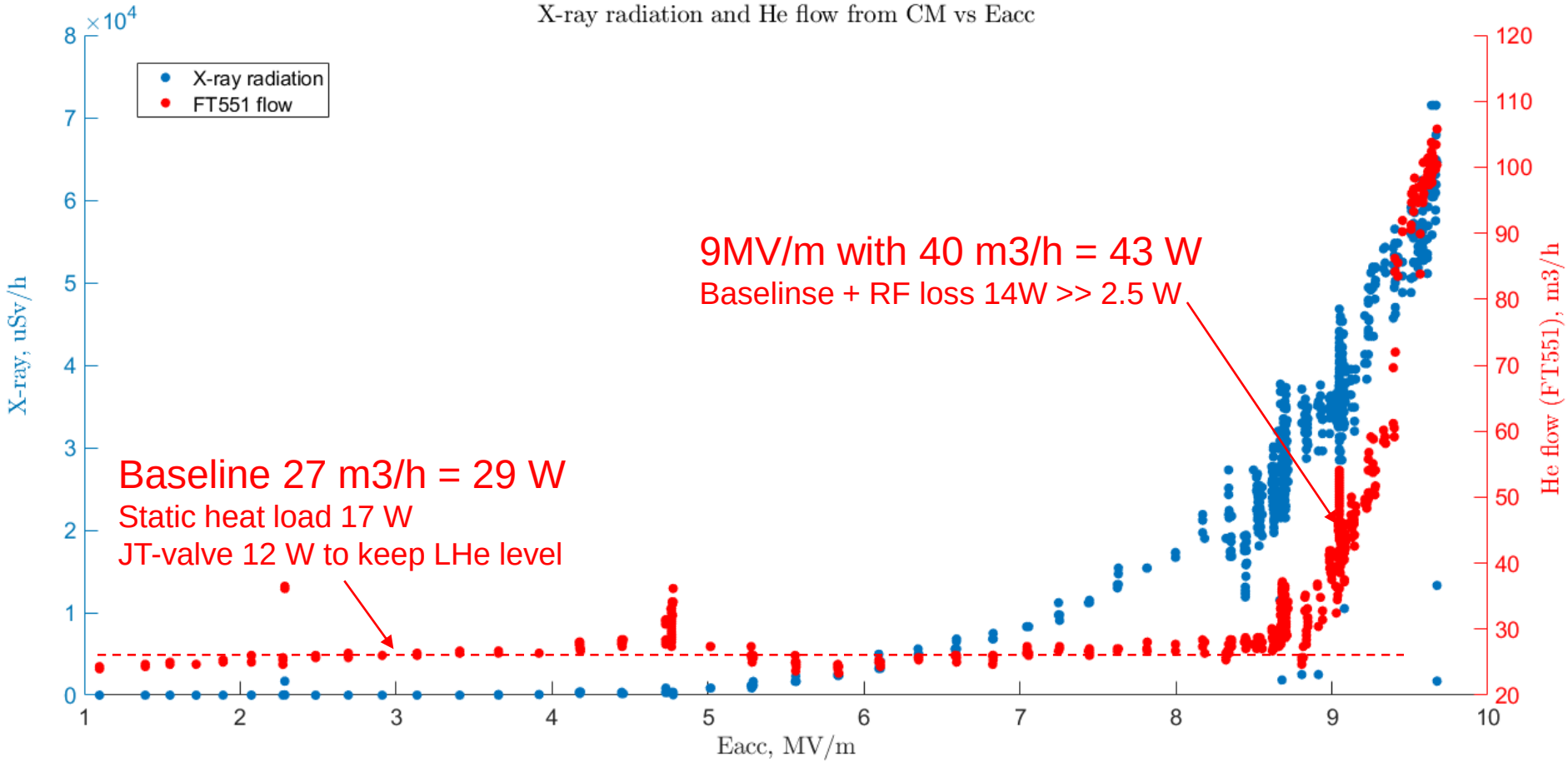


Courtesy Mysha

- Field emission onset around 5 MV/m and overlaps with MP
- The cavity (DSPK24) had field emission with onset around 13 MV/m
- The same pick-up antenna calibration Qt=1.78e11

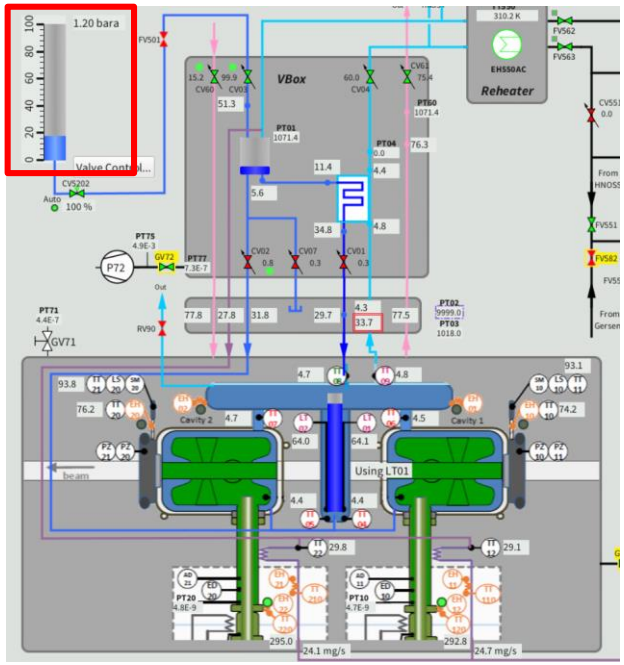
→ It seems that the field emission onset was degraded in CM

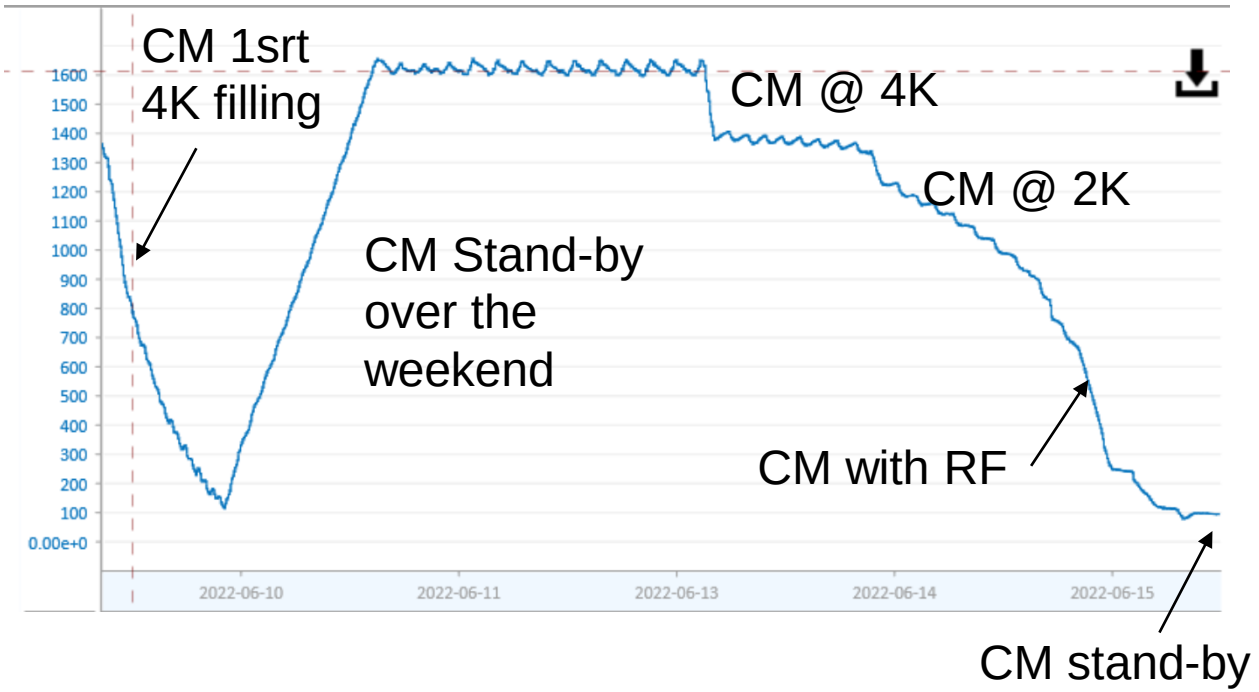
CM11: CAV OUT heat load



- In terms of heat load, 8.5 MV/m seems available
- In terms of radiation level, 8.5 MV/m shows 20 mSv/h (what is the administrative limit in the ESS tunnel to protect other devices?)
- A LLRF closed loop operation with nonlinear effect is tricky so 8.5 MV/m may not be possible to be “locked”

Issue in requifier





- We could not keep the LHe level in the 1st 4K filling
- We filled up the Dewar while the CM was in stand-by (20-50 K with GHe)
- Successful 2nd 4K filling but rapid drop in LHe at 2K
- The substantial heat loss due to the field emission accelerated the level drop in the Dewar
- Currently, requifier cannot produce LHE even with stand-by operation

→ We warm up the requifier while keeping LN in CM's thermal screen at 77K