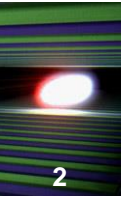


XFEL AMTF Cavity and Module RF Measurement Procedures

Hamburg 2013.05.28

European Linear Collider Workshop ECFA LC2013

Krzysztof Krzysik



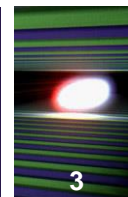
RF Team has to test ...

840 Cavities



103 Modules





Incoming inspection

- spectrum measurement (warm)

Preparation

- spectrum measurement (warm)
- HOM couplers tuning
- cables connection (insert) + TDR check

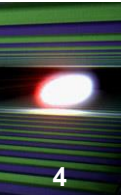
Vertical test

- cables connection (test-stand) and calibration
- spectrum measurement (cold)
- power rising (qe curves)

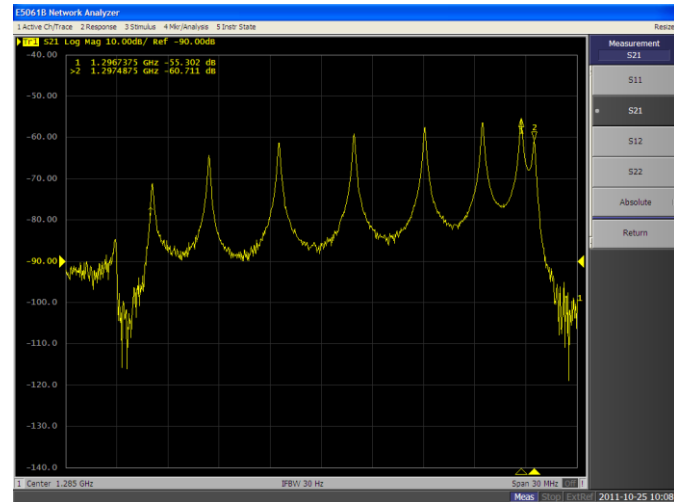
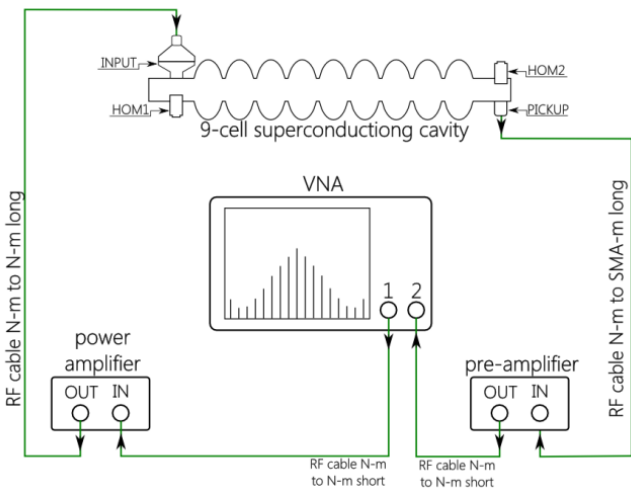
Outgoing inspection

- spectrum measurement (warm)

Spectrum measurement (warm)

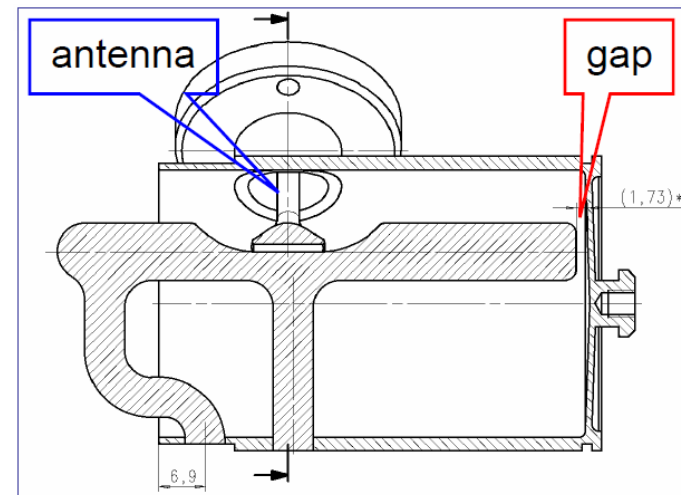


- Array of points (freq, S_{21})_{input-pickup}
- Frequencies of fundamental modes
- “Field flatness”



HOM couplers tuning

- Setting up minimum of the rejection filter: hom1, hom2
- Array of points (freq, S_{21})_{pickup-hom1 / input-hom2}



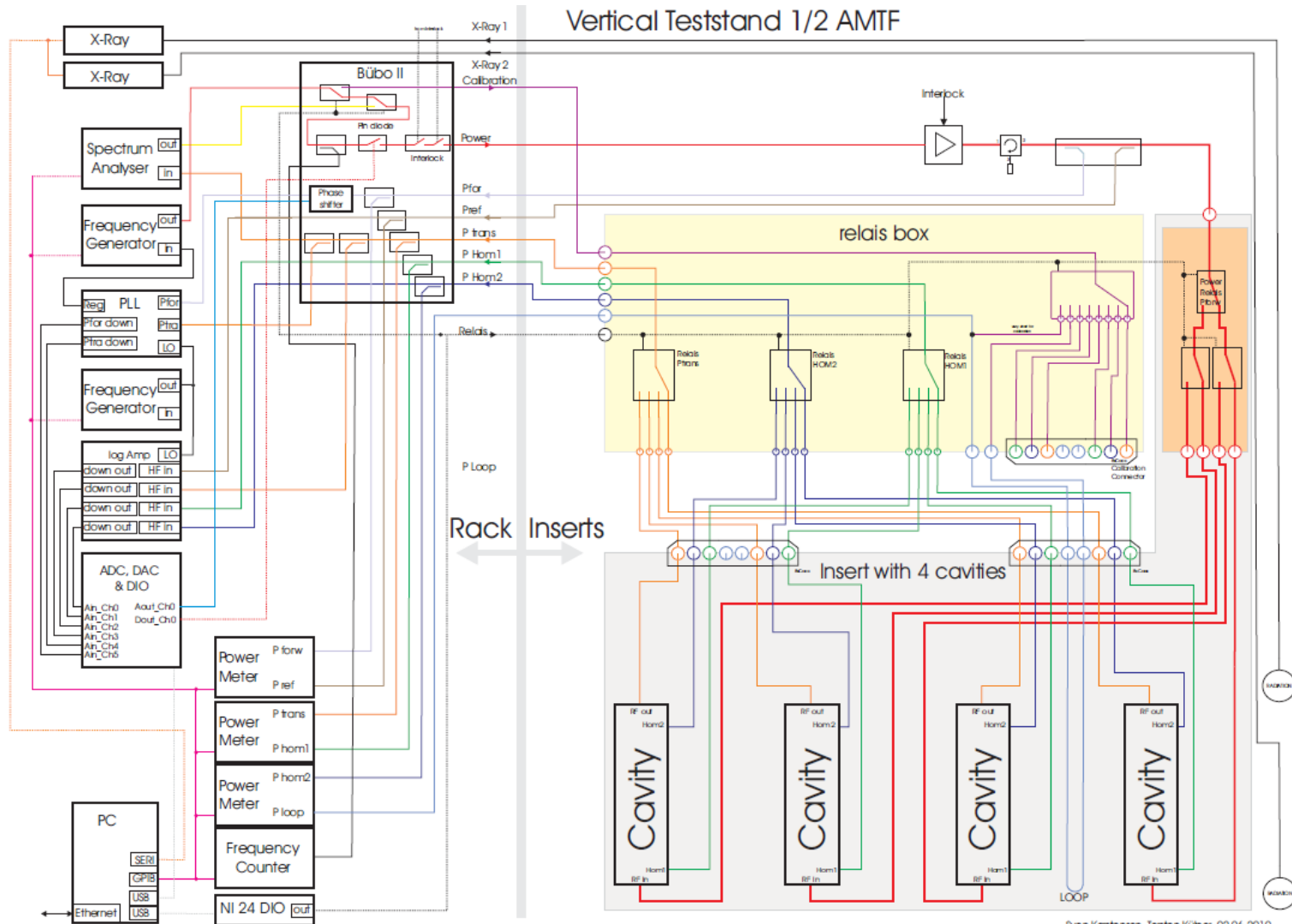
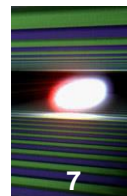
Cables connection (insert) and TDR check

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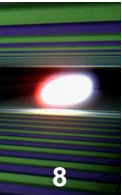
- Cables connection in insert
- Circuit check (discontinuity, short) with Time Domain Reflectometry



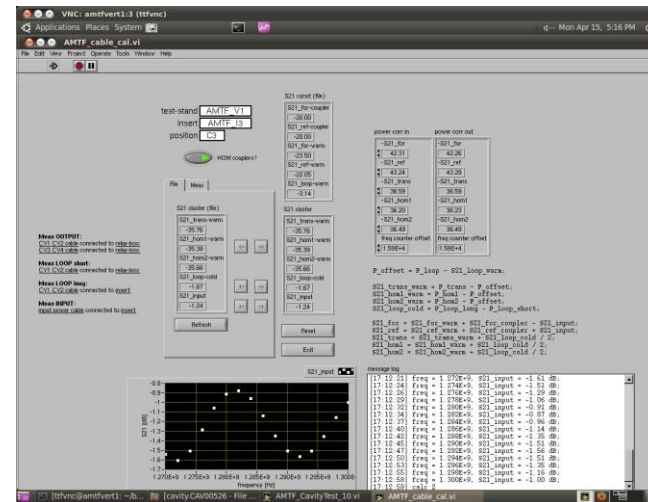
Vertical test-stand - schematic



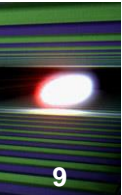
Cable connection (test-stand) and calibration



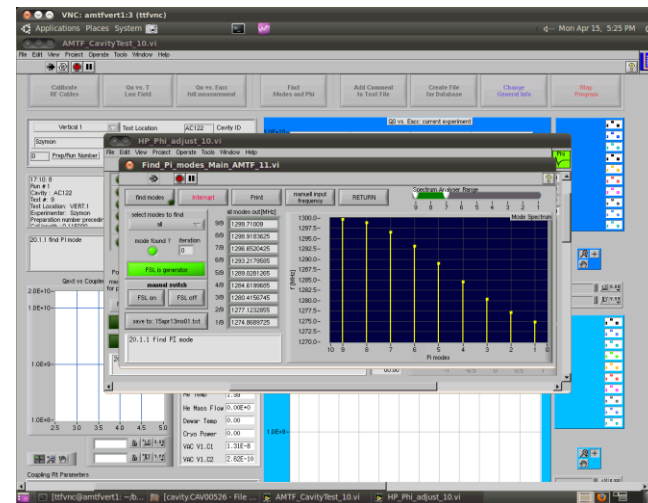
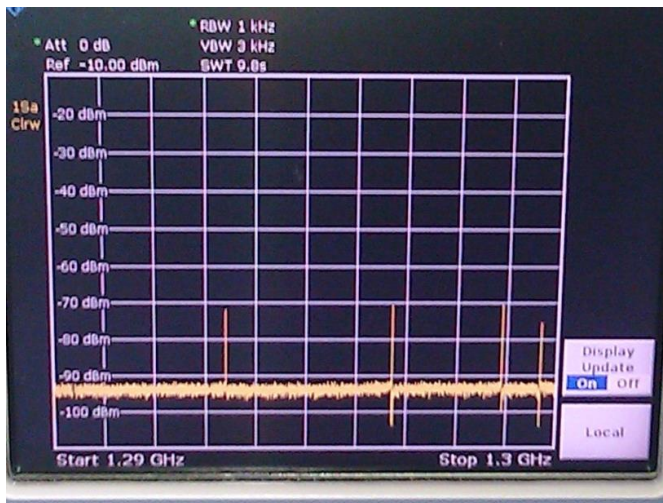
- Cable connection in test-stand
- Calibration – power correction measurement



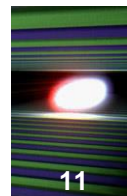
Spectrum measurement (cold)



- Frequencies of fundamental modes
- Lock on $9/9\pi$ mode
- Phase (P_{for} , P_{trans})



Test of Module



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Incoming inspection

- spectrum measurement (warm)

Preparation

- warm coupler conditioning
- coupler conditioning during cool-down

Test @ 2K (low power)

- cold cables calibration
- cavities tuning with VNA
- Q_{ext} adjustment
- HOM spectra measurements

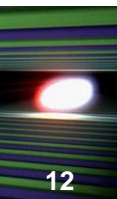
Test @ 2K (high power)

- cavities fine tuning
- cavities calibration
- cavities performance test
- heat loads measurements

Outgoing inspection

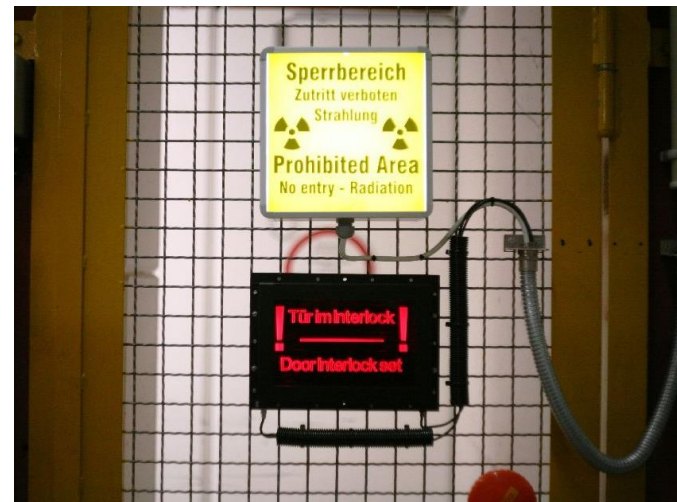
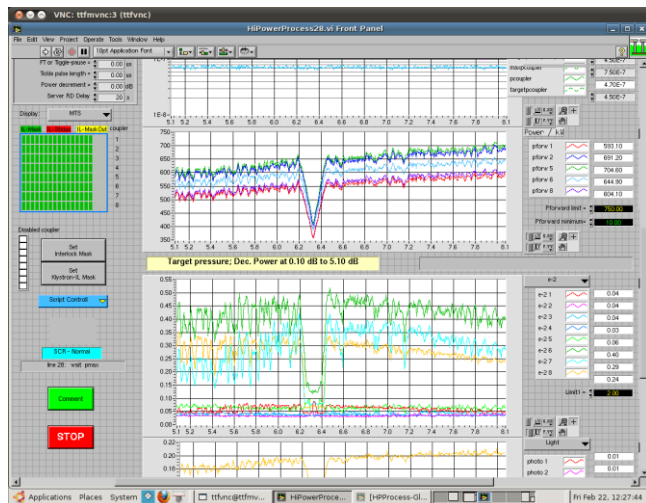
- spectrum measurement (warm)

Warm coupler conditioning / Coupler conditioning during cool-down

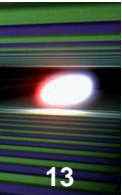


12

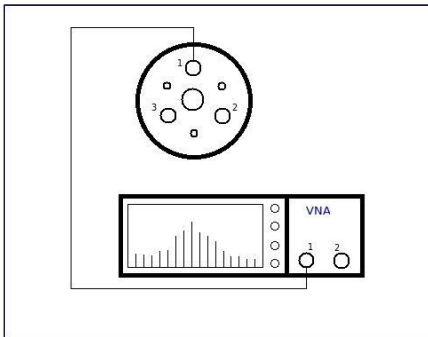
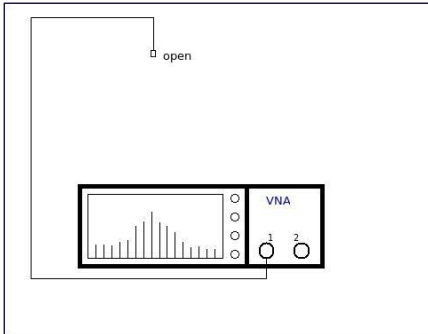
- Removal of impurities from the couplers
- Sequence of pulses (power, length)_{out of resonance}
- Warm: room temperature, cool-down: up to 100K



Cold cables calibration



■ Cold cables calibration – reflection mode (S11)



Preferred values: Span 40kHz, Center Frequency 1.3GHz, points 801

Number of Points: 801

Span: 4E+7

Center Frequency: 1.3E+9

Operator: 29Aug2012 01:56
Karol Kasprzak

VISA resource name: %TCPIP0:192.168.1.15::INSTR

DUT information: Cavity No. 8, Teststand CMTB, Comment: MODUL: PXFEL3_1

Test Device: NA Agilent 5062A SN00649, Result path: %/home/kasprk/Desktop

Attenuation dB: 1.00

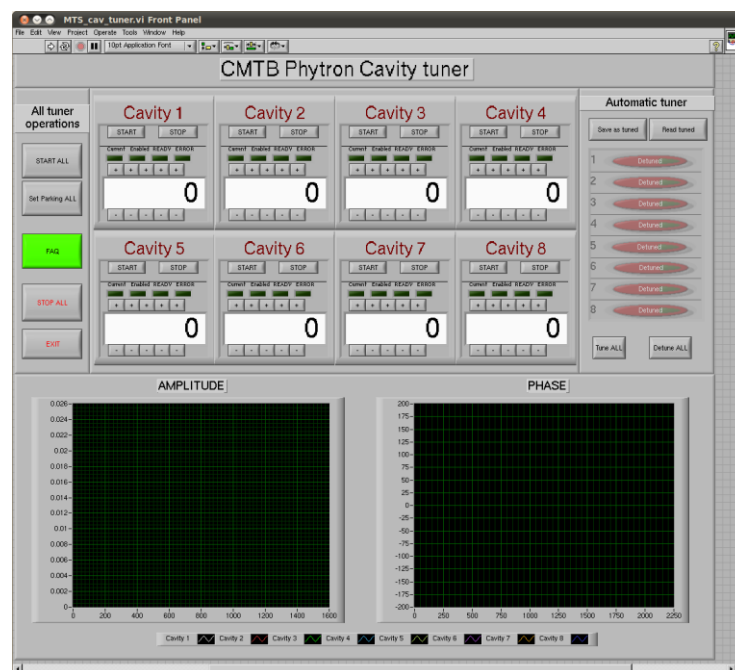
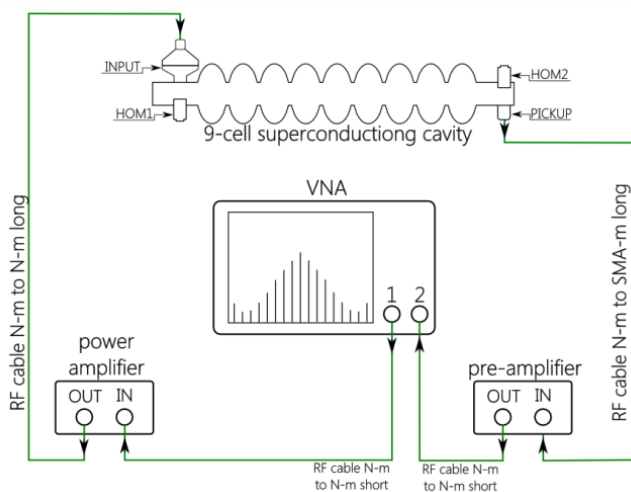
Buttons: END, MEASURE POINT, Add Result, SAVE, SET CONDITIONS, CLEAR ARRAY

Wyniki

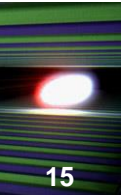
DUT information	Cavity No.	Attenuation dB
Probe	8	1.0451
DUT information	Cavity No. HOM1	Attenuation dB 0.865E
DUT information	Cavity No.	Attenuation dB 0
DUT information	Cavity No.	Attenuation dB 0
DUT information	Cavity No.	Attenuation dB 0
DUT information	Cavity No.	Attenuation dB 0
DUT information	Cavity No.	Attenuation dB 0
DUT information	Cavity No.	Attenuation dB 0
DUT information	Cavity No.	Attenuation dB 0
DUT information	Cavity No.	Attenuation dB 0
DUT information	Cavity No.	Attenuation dB 0

Cavities tuning with VNA / Q_{ext} adjustment

- Cavities tuning near resonance: with VNA and tuning application (rough frequency tuning)
- Q_{ext} adjustment: with VNA (manually) or with klystron (motors on couplers)

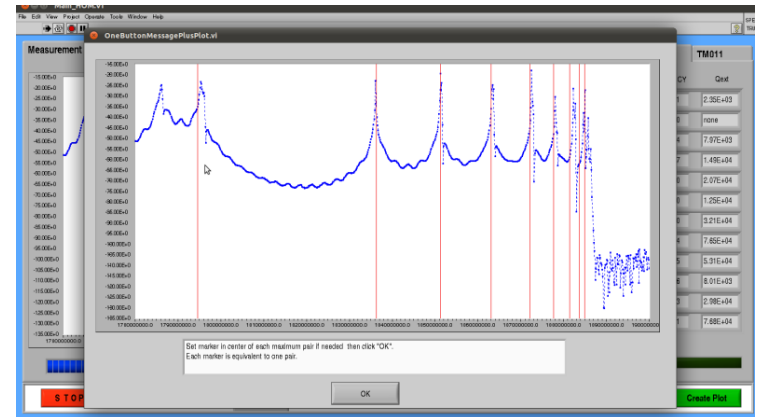
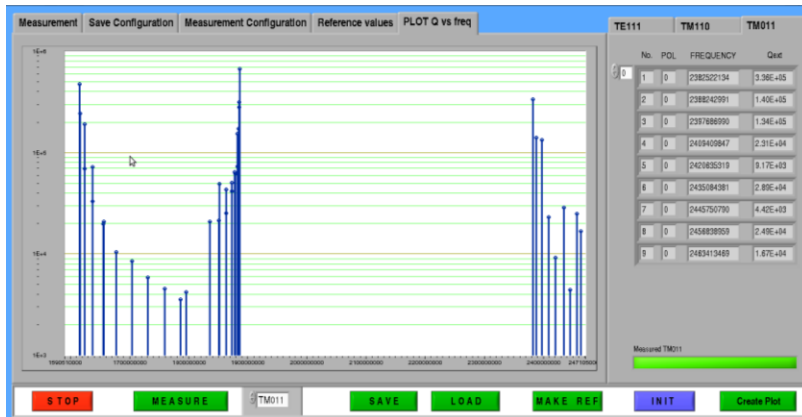


HOM spectra measurement

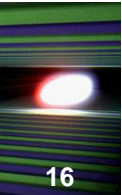


- Frequencies and $Q_{\text{hom1}} / \text{hom2}$ for TM011, TE111 and TM110 peaks.

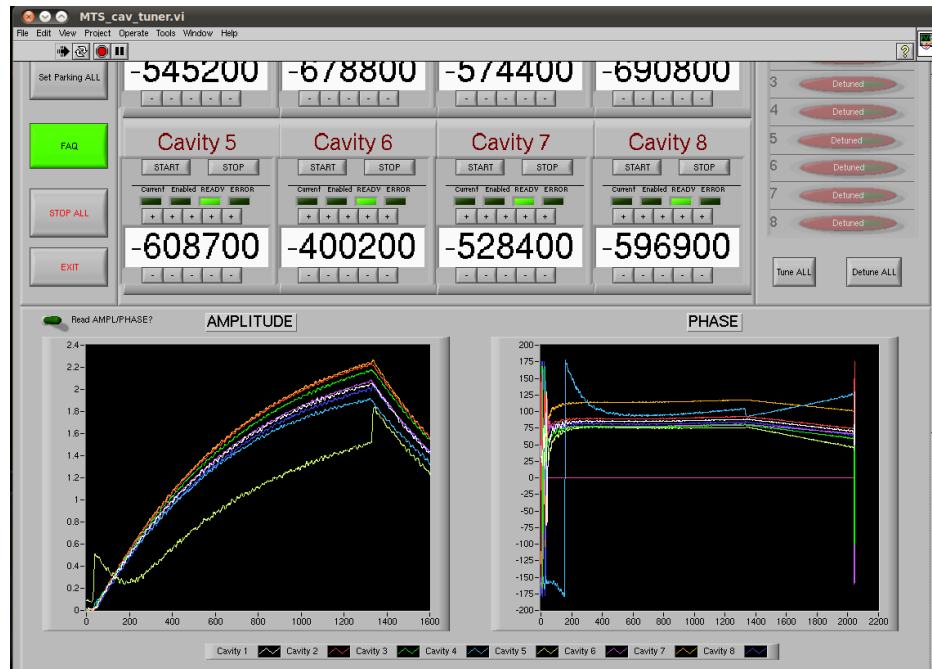
MOD	MODE	FREQUENCY	Q
0	1	179385327	2.79E+03
1	2	179450870	none
2	1	1838058455	8.83E+03
2	2	1838314588	1.47E+04
3	1	1851125550	2.11E+04
3	2	185128880	none
4	1	1862819006	1.78E+04
4	2	1863051747	4.95E+04
5	1	1871811181	2.51E+04
5	2		
6	1		
6	2		
7	1		



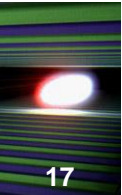
Cavities fine tuning



- Cavities fine tuning – with LLRF Monitoring system and Tuning Application

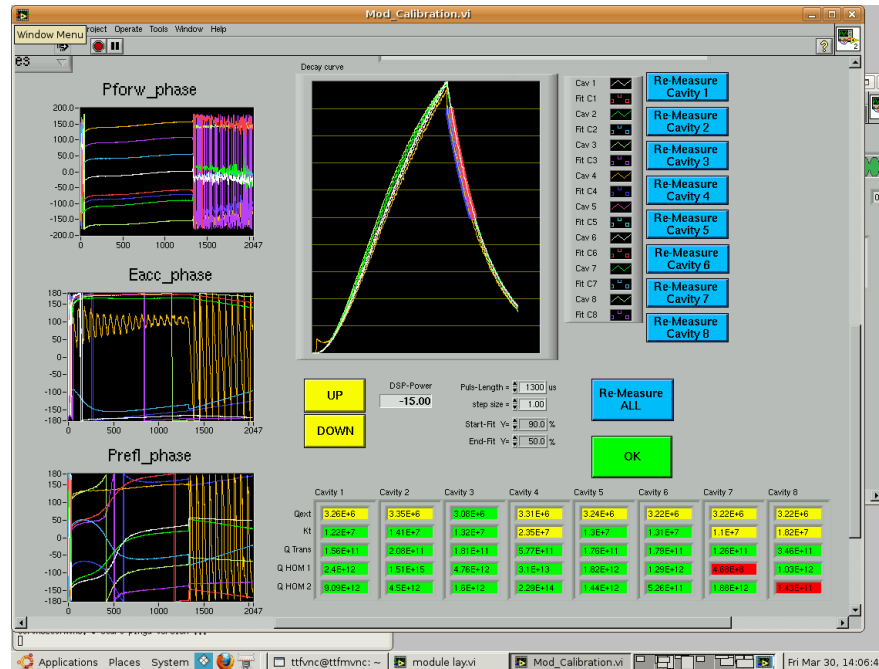


Cavities calibration

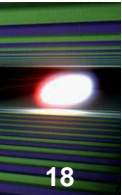


■ Cavities calibration (before flat-top):

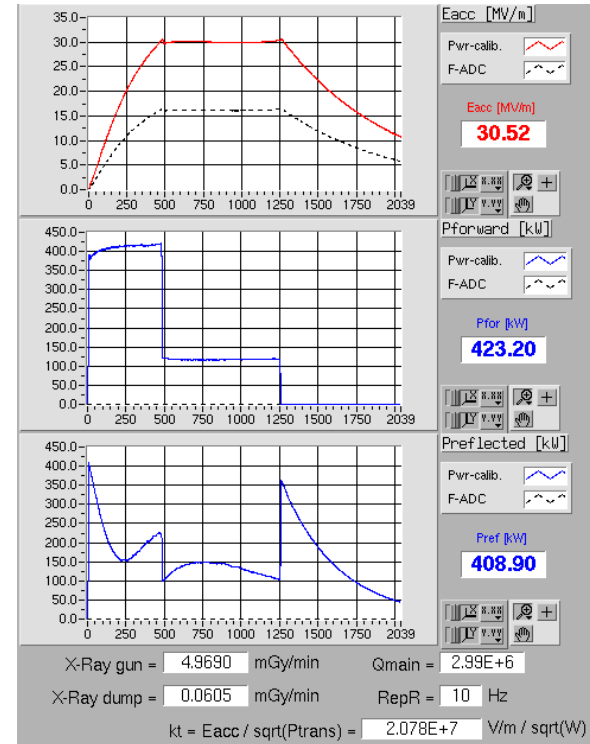
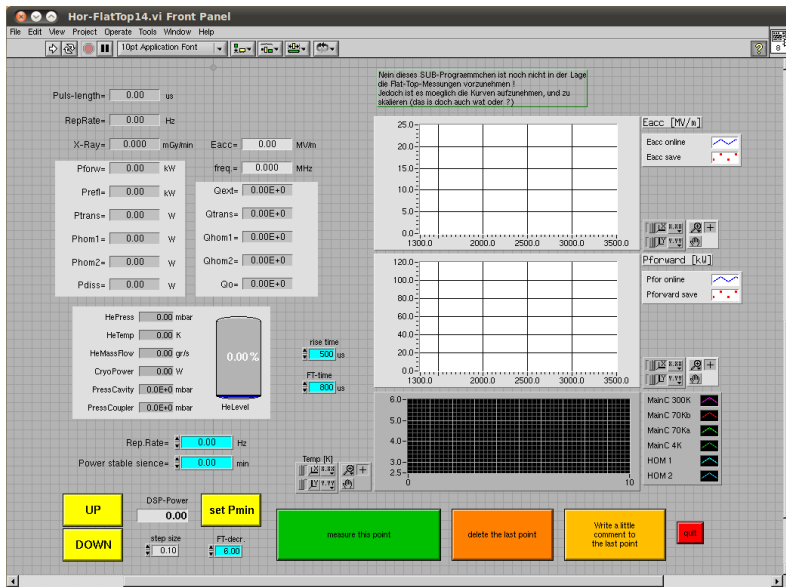
- K_t
- Q_{load} , Q_{trans} , Q_{hom1} , Q_{hom2}



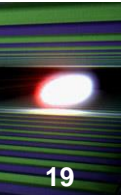
Cavities performance test (flat-top)



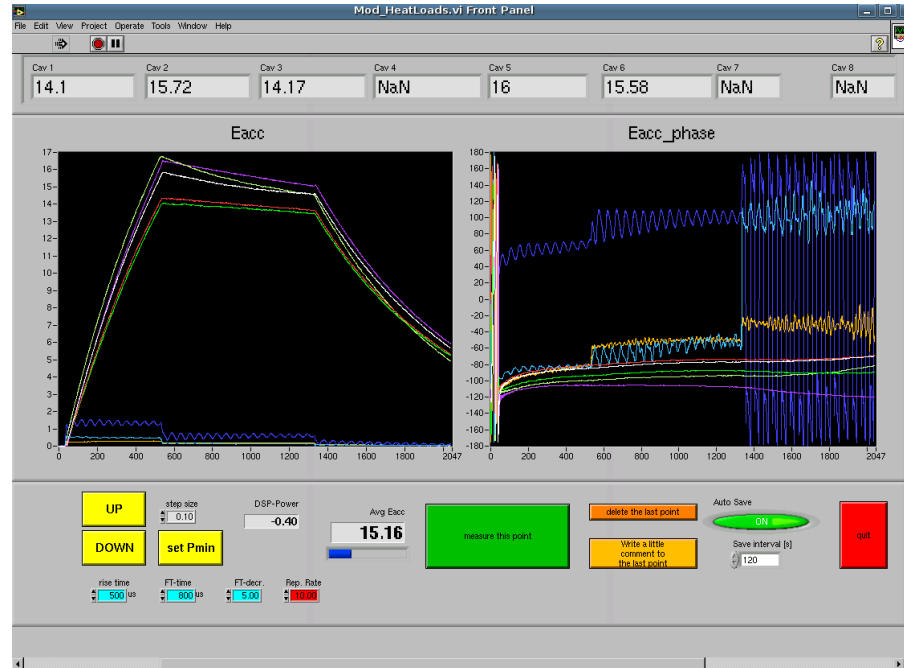
- Max E_{acc} (limitation)
- E_{acc} @ radiation = 10^{-2} mGy/min (operating gradient)

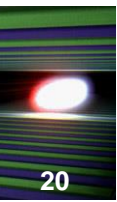


Heat loads measurement



- Heat loads
- $\sim Q_0$ -factor vs. E_{acc}





Thank You for Your attention