SIMULATIONS OF THE ACCELERATION IN TWO-BEAM TEST STAND IN CTF3 AND COMPARISON WITH THE MEASUREMENTS

Oleksiy Kononenko
BE/RF/SR, CERN

1. Analyzed Energy Measurements

Analyzed energy measurements (events) in TBTS including the corresponding timestamps are gathered here:

http://elogbook.cern.ch/eLogbook/eLogbook.jsp?shiftId=1032364
http://elogbook.cern.ch/eLogbook/eLogbook.jsp?shiftId=1032385
http://elogbook.cern.ch/eLogbook/eLogbook.jsp?shiftId=1032677

Temperature, C	Number of Events
37	17
50	6
55	5
60	11

Table 1. Total number of the analyzed events at different temperatures

2. HFSS Simulations

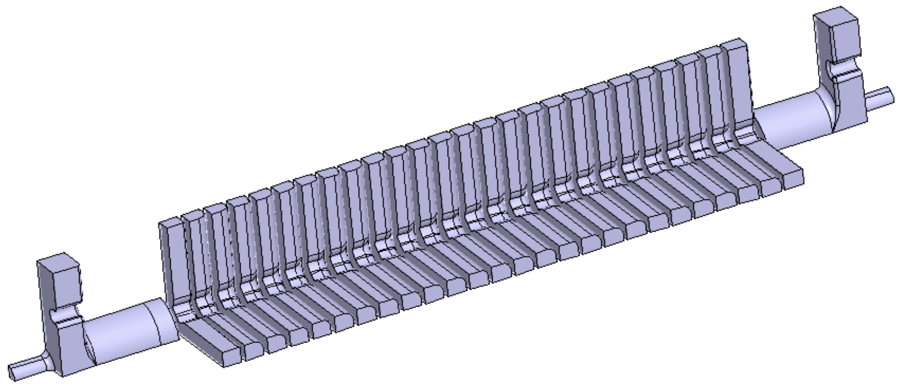

Figure 1. One quarter of the TD24_tank (12WDSDVG1.8T) accelerating structure installed in TBTS

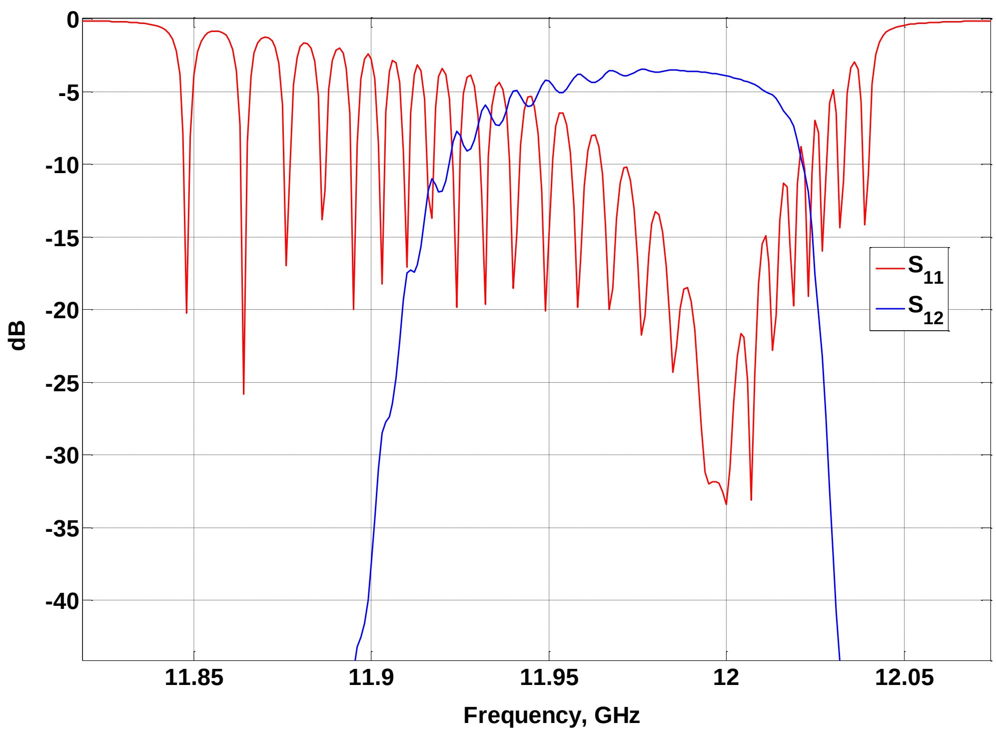

Figure 2. Results of the S-parameters HFSS simulation

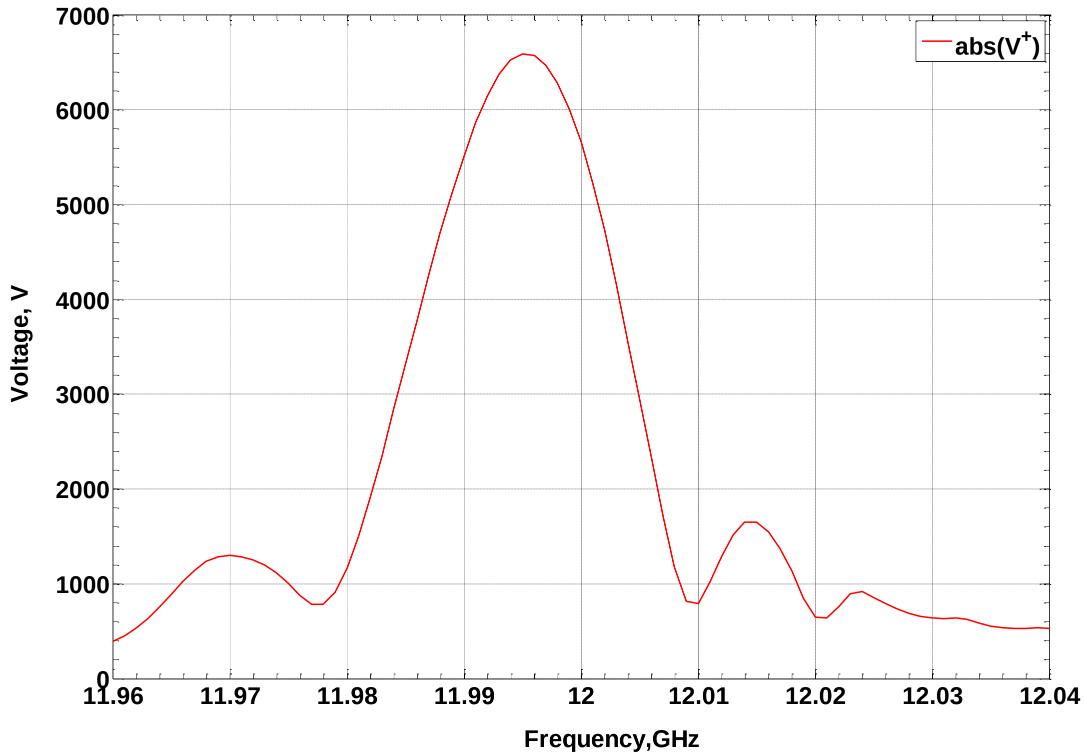

Figure 3. Accelerating voltage for the input power of 4W in frequency domain

3. Acquisition System

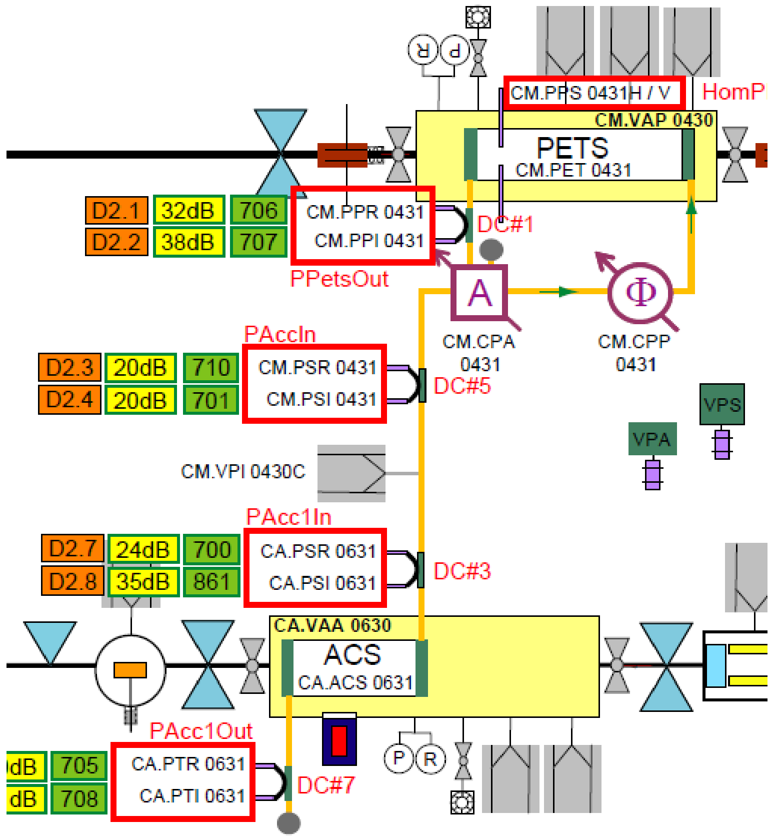

Figure 4. PETS and accelerating structure in TBTS layout

In the acquisition data array dt_CK_COND_TBTS_EventAcquisition structure was used. Input signal PSI0631 appeared to be non reliable so the PPI0431 signal was used:

pxPPetsOutFwd_values – power amplitude, 2ns time step
pxUSignal28_values – power phase, 4ns time step
petsAttAttP – is a fraction of the power which goes from PETS to AS
accAttTranP – is an attenuation by the coupler before the AS (!)

where x=1,2,3 and px are the consecutive pulses. Finally to calculate the power at the input of the AS the following formula was used:

$$P_{in} = pxPPetsOutFwd\_values * petsAttAttP * accAttTranP$$

For the transmitted through the AS power PTI0631 signal was used:

pxPAcs1OutFwd_values – power, 2ns step
pxUSignal12_values – phase, 4ns step

The data (power amplitude and phase) were averaged over the 3 consecutive pulses for each energy measurement:

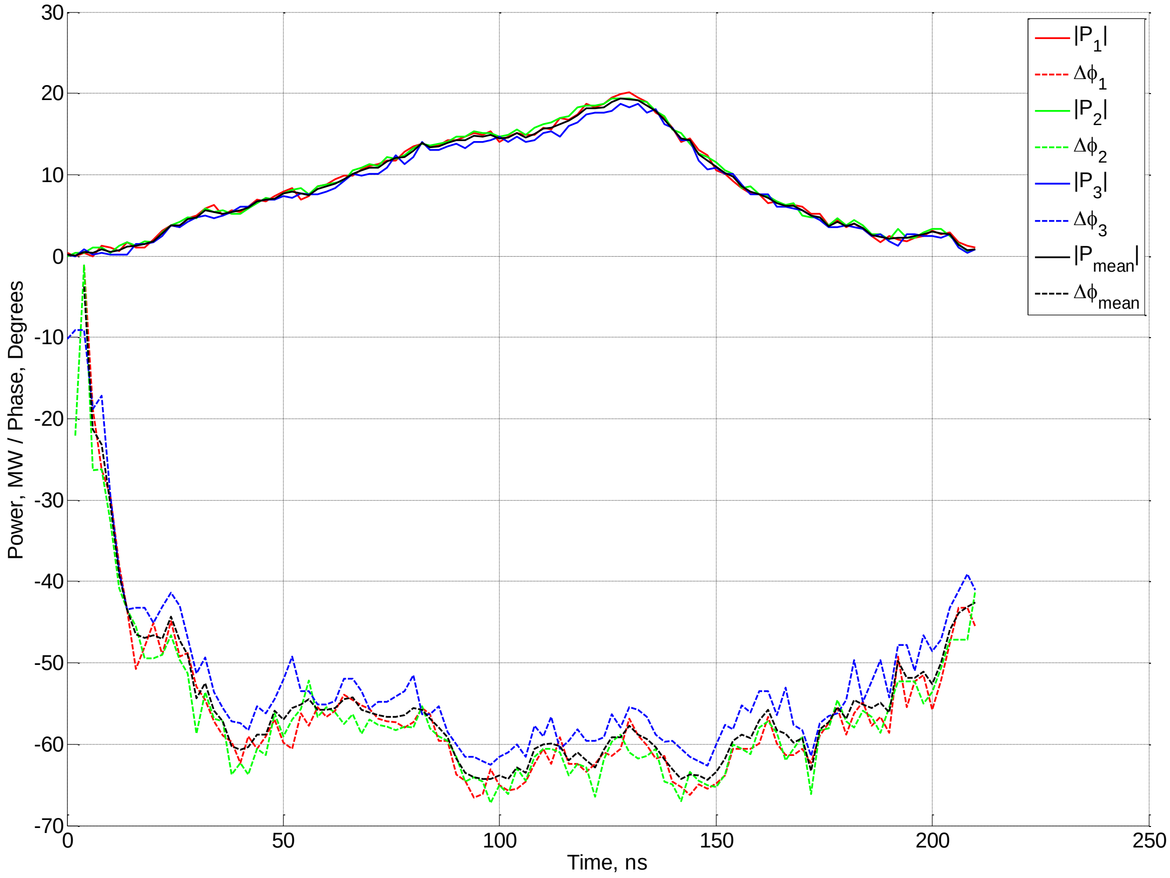

Figure 5. Averaging of the power amplitude and phase over the 3 consecutive pulses

4. Simulation of the Energy Gain

To calculate accelerating voltage in TBTS we use this formula:

$$\boldsymbol{V_{acc}(t) = \mathrm{conv}(P_{in}(t), V_R(t))}$$

where $\boldsymbol{V_R(t)}$ is the time response of the structure, $\boldsymbol{P_{in}(t)}$ is an input power.

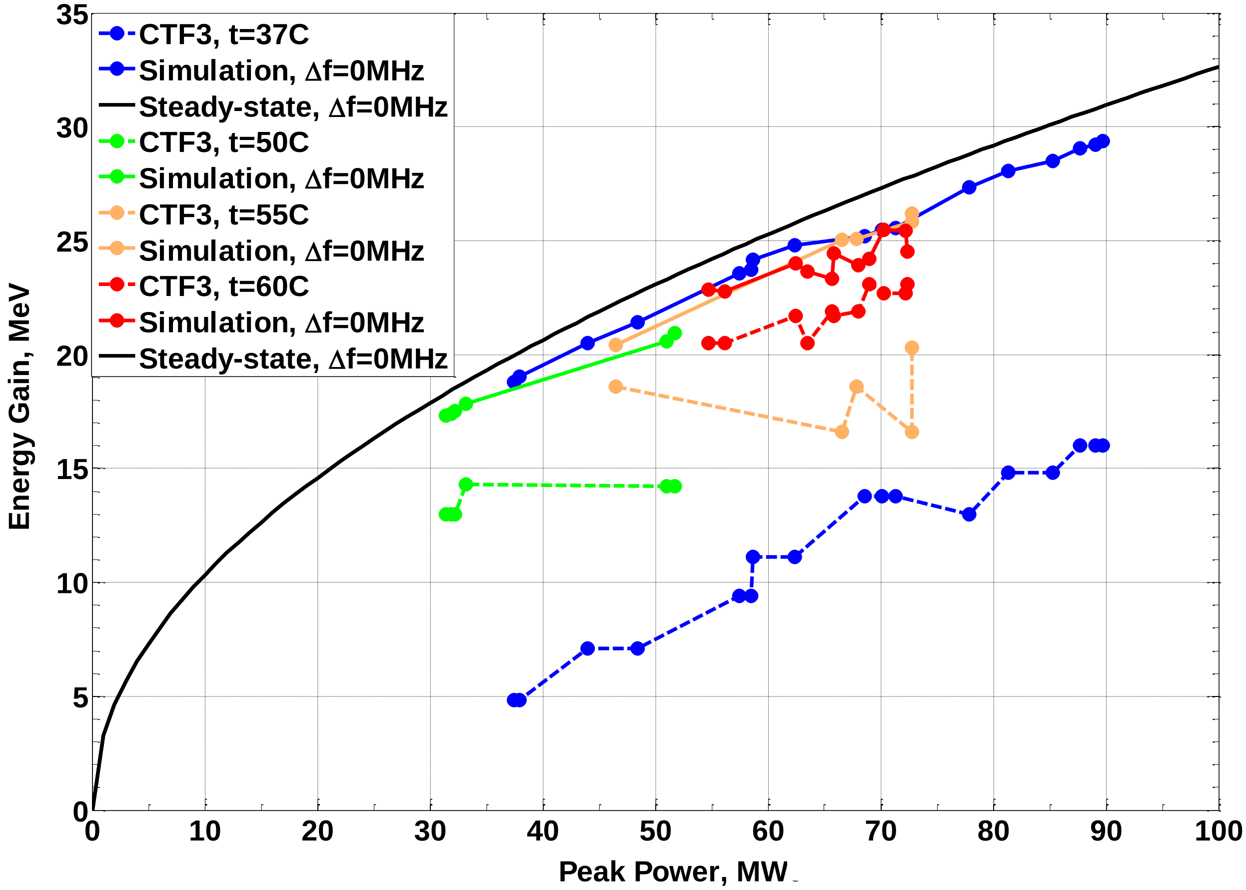

Figure 6. No detuning simulations and measurements of the acceleration in TD24 at different temperatures.

To simulate detuning of the structure the frequency response of the structure shown in Fig. 3. was shifted in frequency by $\boldsymbol{\Delta f}$. Assuming that initially the structure was **+10 MHz** off at **30C** and taking into account that there is **1 MHz** per

5C detuning dependence we introduce detuning in the simulation and compare it with the measurements.

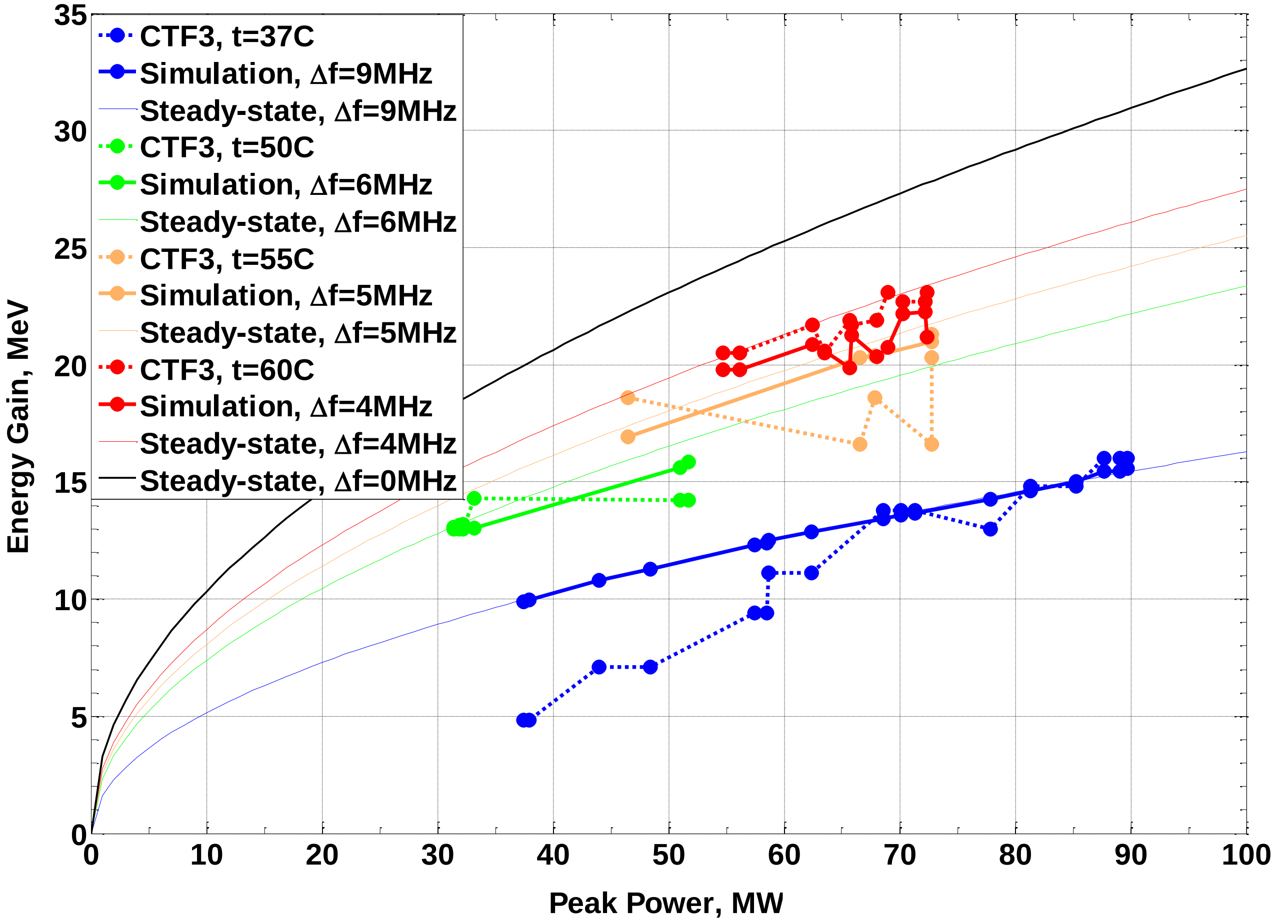

Figure 7. Simulations and measurements of the acceleration in TD24 at different temperatures.

5. Calculation of the transmitted power

To calculate a transmitted power for a given input pulse $\mathbf{P_{in}(t)}$ we use the following formula:

$$P_{trans}(t) = \mathrm{conv}(P_{in}(t), S_{12}(t))$$

where $S_{12}(t)$ is an inverse Fourier transform of $S_{12}(\mathrm{f})$ shown in the Fig. 2.

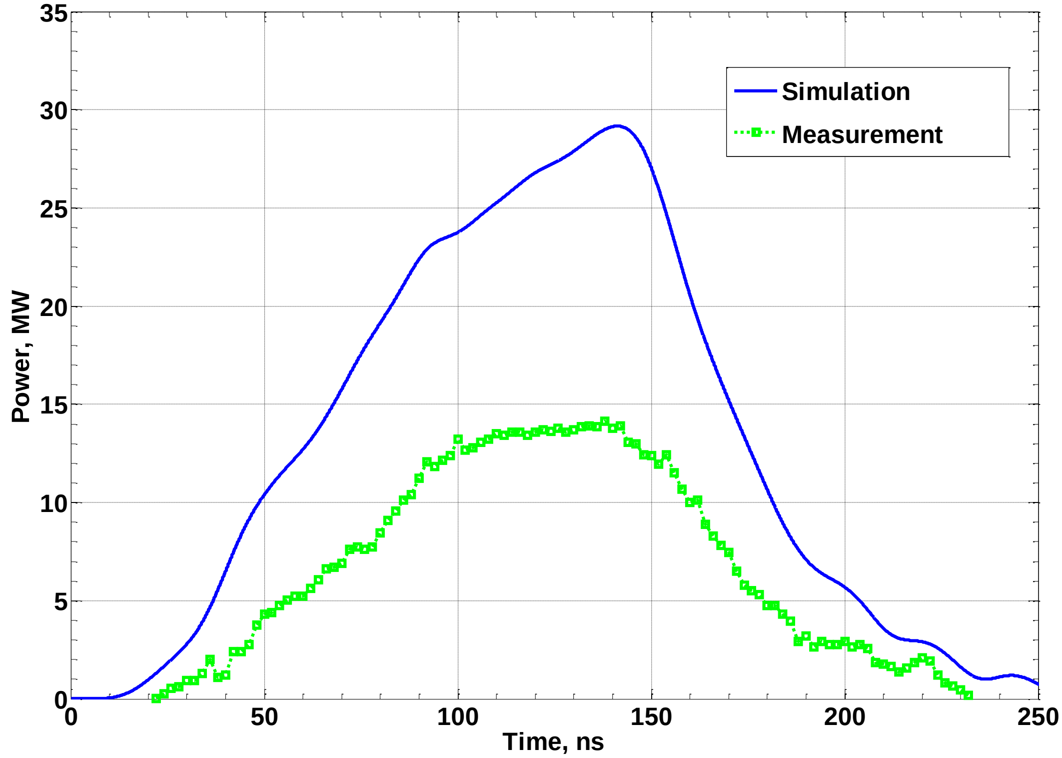

Figure 8. Measured transmitted pulse (measurement with the timestamp of 129235013376600000) and the corresponding simulated one.