

## Description and First Experience with the RF Measurement Procedure for the European XFEL SC Cavity production

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### Abstract

Cavity production for the European XFEL was recently started with first niobium sheets arriving. From this stage to the accelerating module being ready for the linac installation, many critical RF measurements are necessary.

During the mechanical cavity fabrication the cavity half-cells, dumb-bells and end-groups are measured and sorted. The cavity spectrum and field profiles are measured and tuned.

The HOM (Higher Order Modes) couplers filter tuning, vertical cavity RF tests, cavity checks during the string assembly and final cavity performance measurements in the module as well as the fundamental mode and HOM RF spectra measurements complete the sequence.

We present the procedures of the RF measurements and discuss the first results for the XFEL prototype modules with special attention for the cavity tuning.

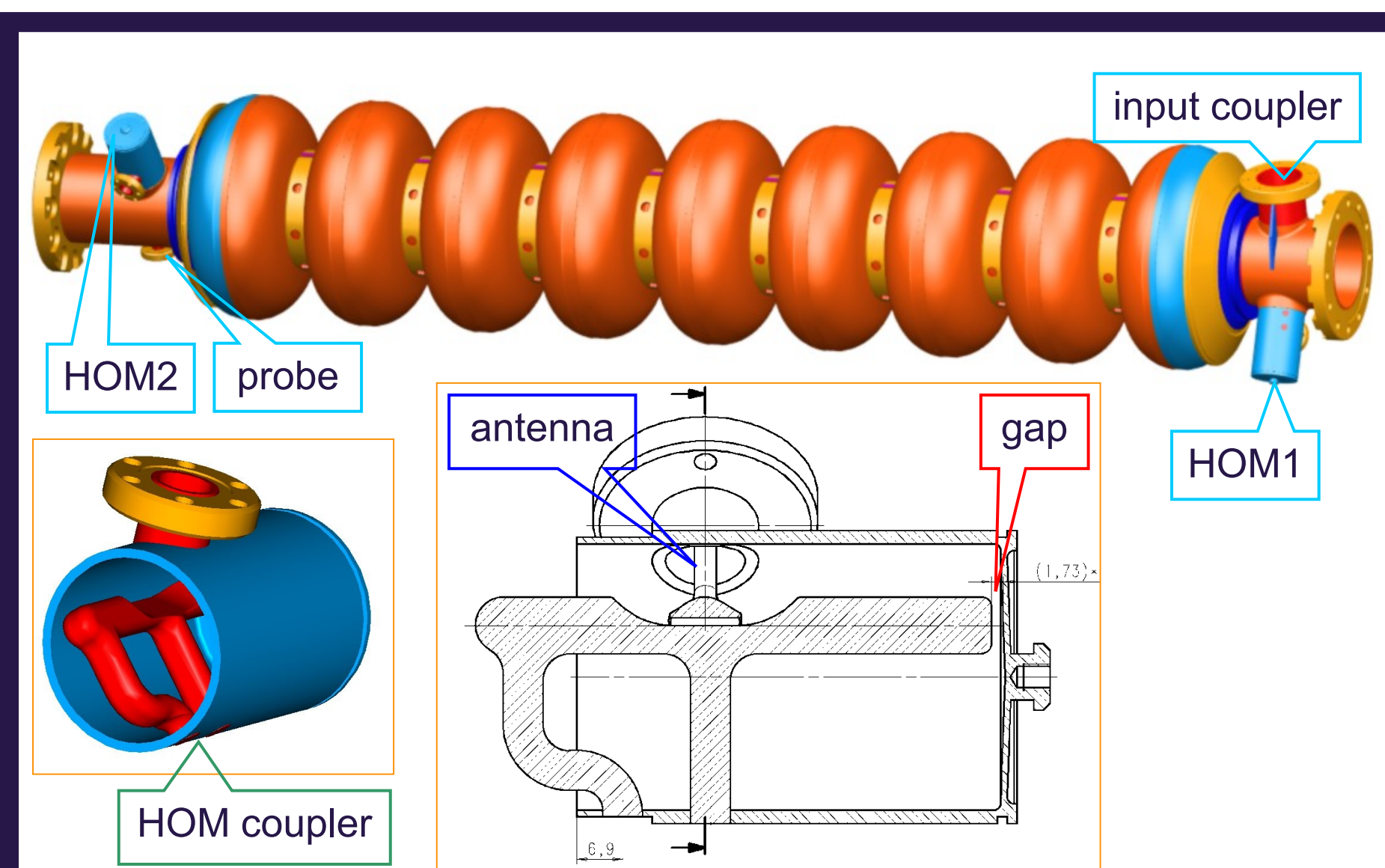


Figure 6. HOM couplers rejection filter tuning.

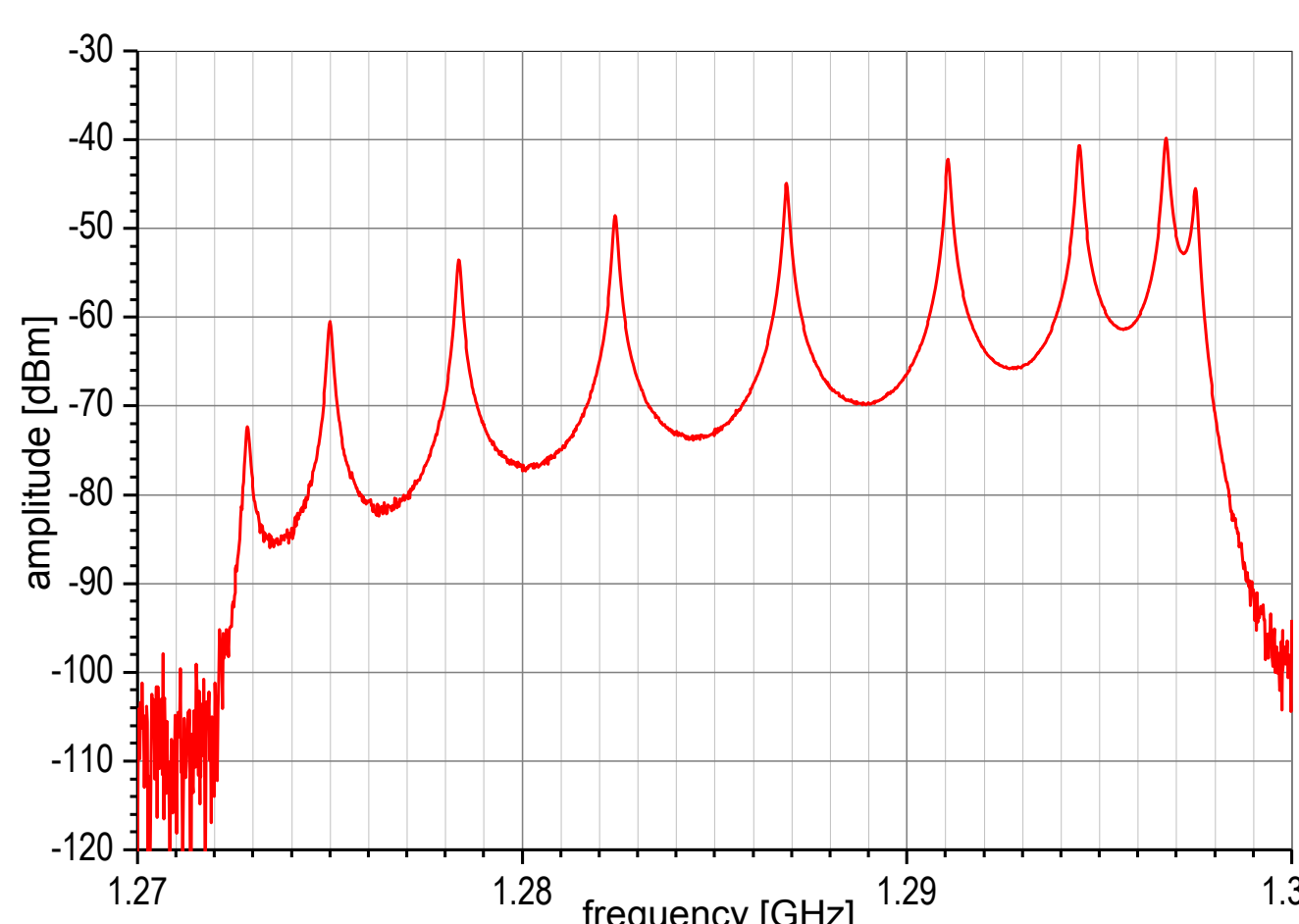


Figure 7: Fundamental mode spectrum.

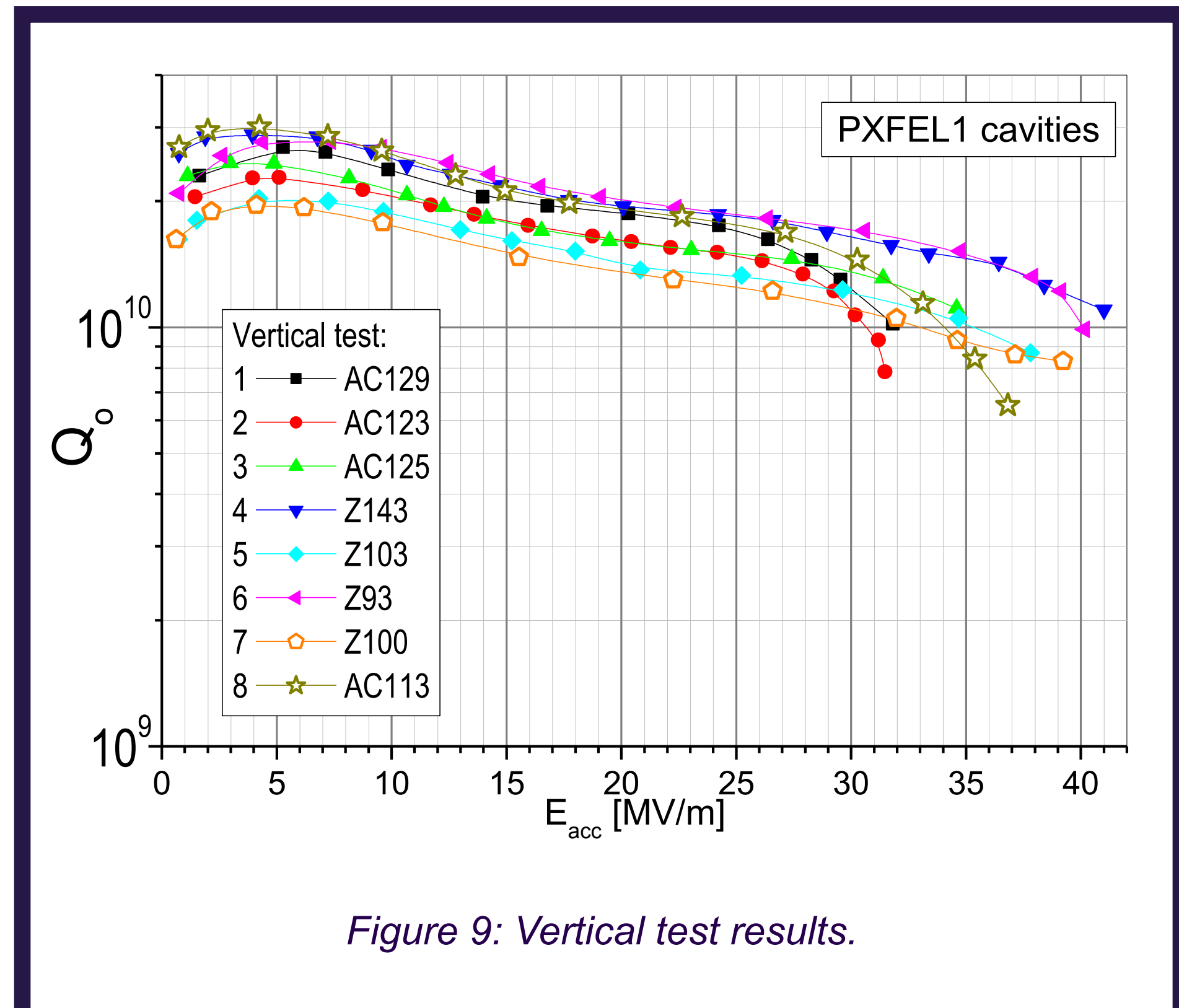


Figure 9: Vertical test results.

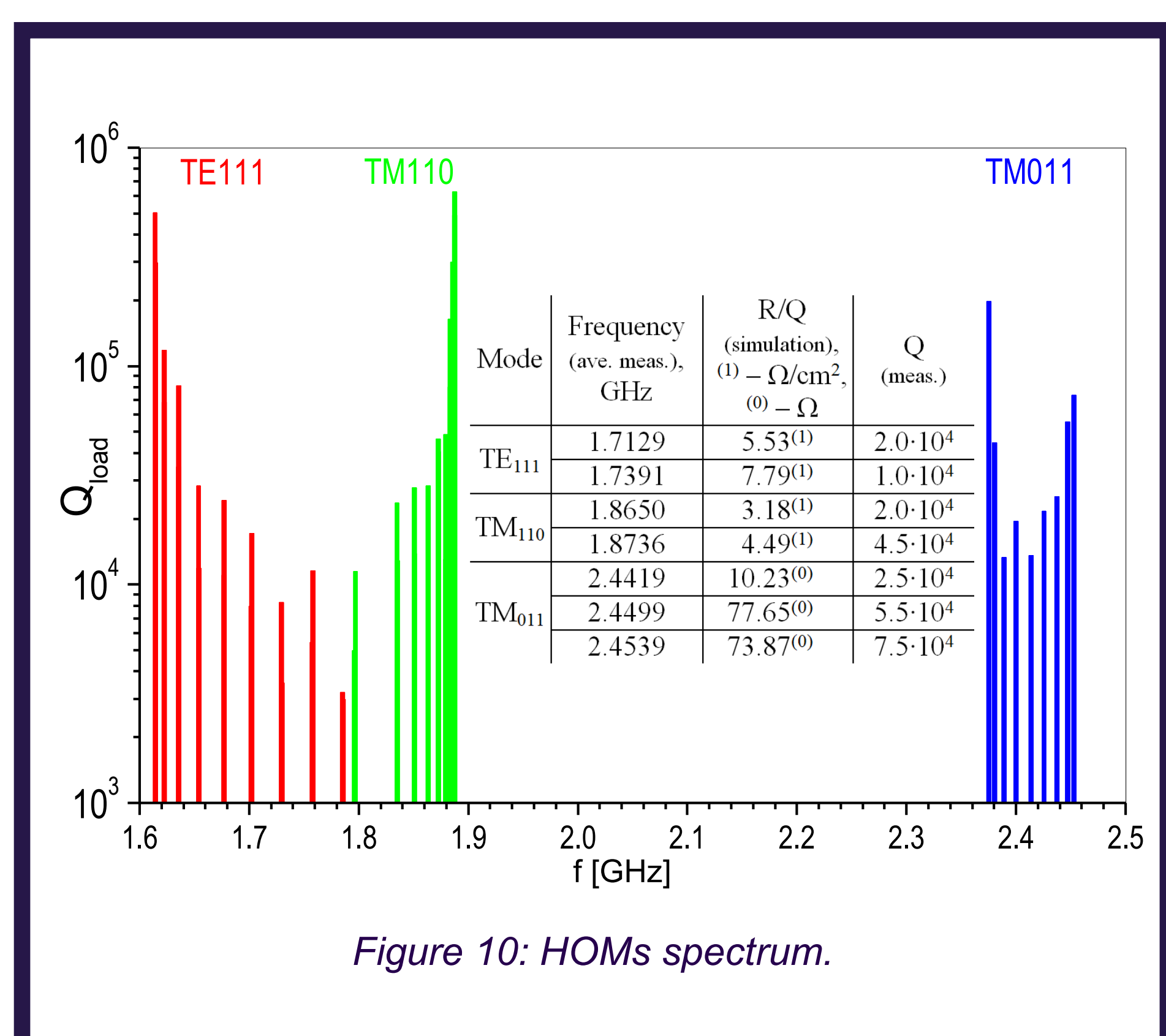


Figure 10: HOMs spectrum.

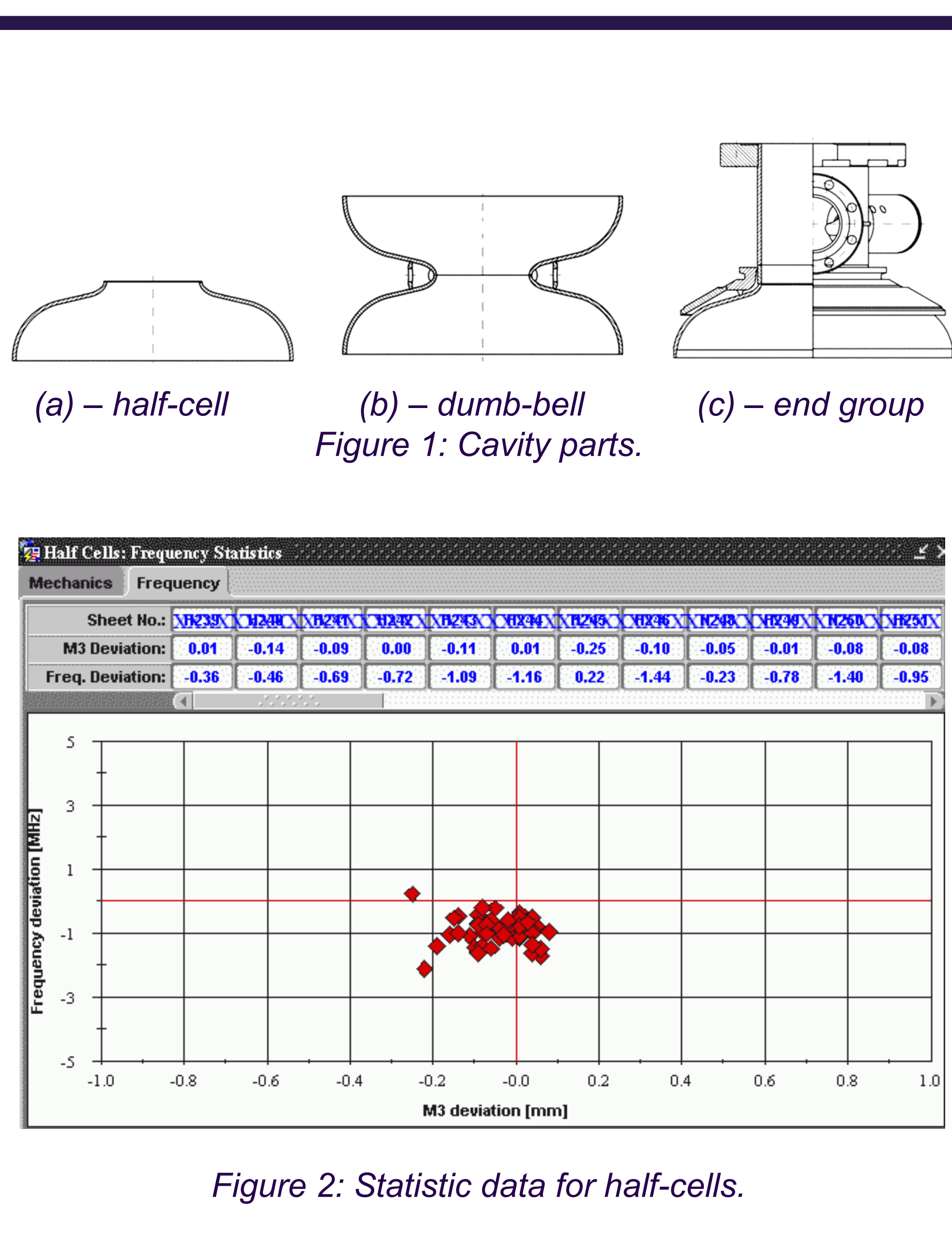


Figure 2: Statistic data for half-cells.

Table 1: RF Measurements for XFEL cavities.

Step	Measurements
Cavity	Fabrication <ul style="list-style-type: none"> <li>frequencies of half cells;</li> <li>frequencies of dumb-bells;</li> <li>frequencies of end groups;</li> <li>fundamental mode spectrum.</li> </ul>
	Treatment <ul style="list-style-type: none"> <li>fundamental mode spectrum;</li> <li>field profiles.</li> </ul>
	Cold RF Test <ul style="list-style-type: none"> <li>HOM coupler filters characteristics;</li> <li>fundamental mode spectrum;</li> <li><math>Q_0</math> vs. <math>E_{acc}</math>;</li> <li><math>Q_{ext}</math> for cavity probe antenna.</li> </ul>
Module	Assembly <ul style="list-style-type: none"> <li>fundamental mode spectrum;</li> <li>HOM coupler filters characteristics.</li> </ul>
	Test <ul style="list-style-type: none"> <li>fundamental mode spectrum;</li> <li>cable calibration;</li> <li>HOM spectrum;</li> <li><math>Q_0</math> vs. <math>E_{acc}</math>;</li> <li><math>Q_{load}</math> for main input coupler.</li> </ul>

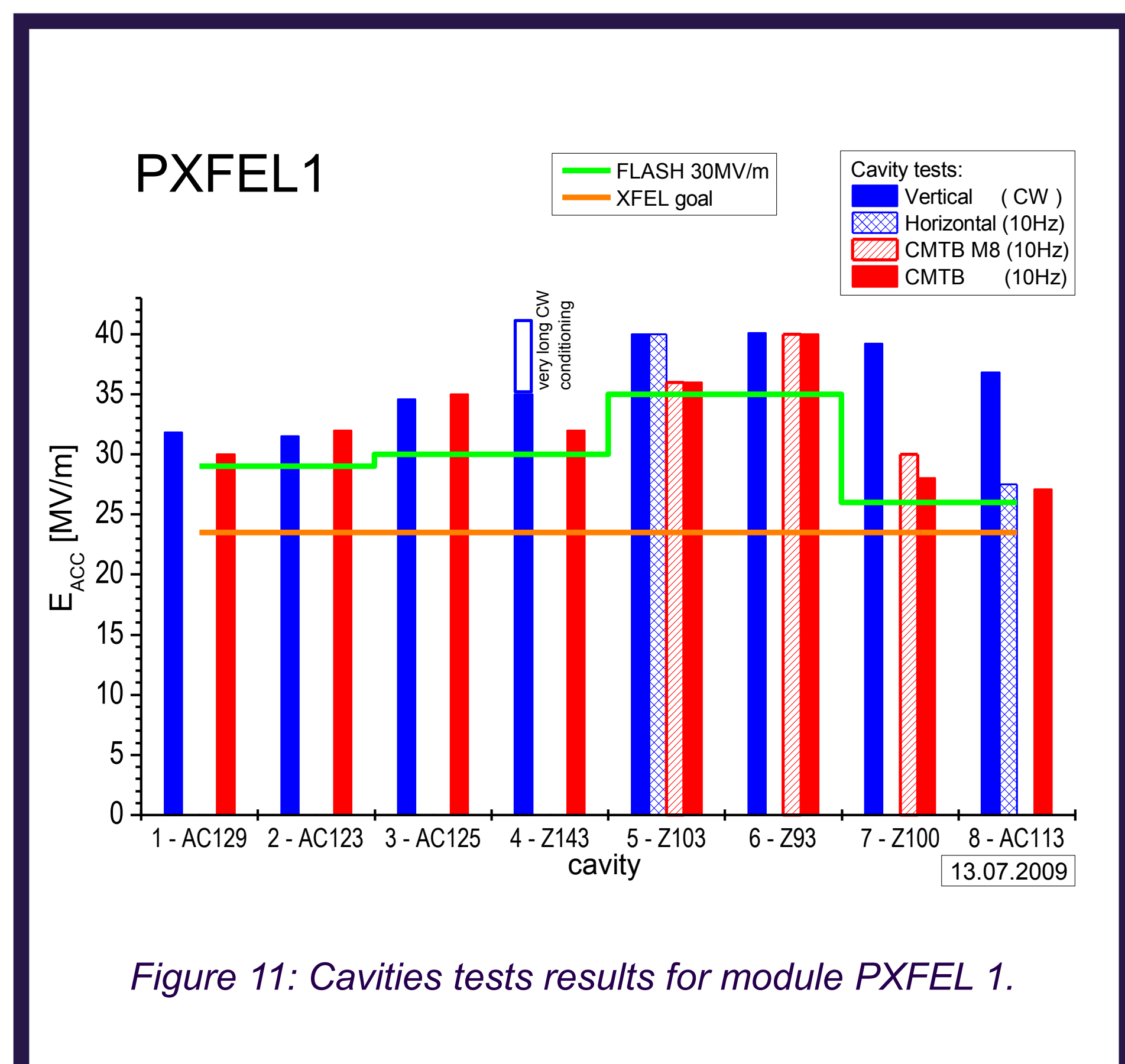


Figure 11: Cavities tests results for module PXFEL 1.

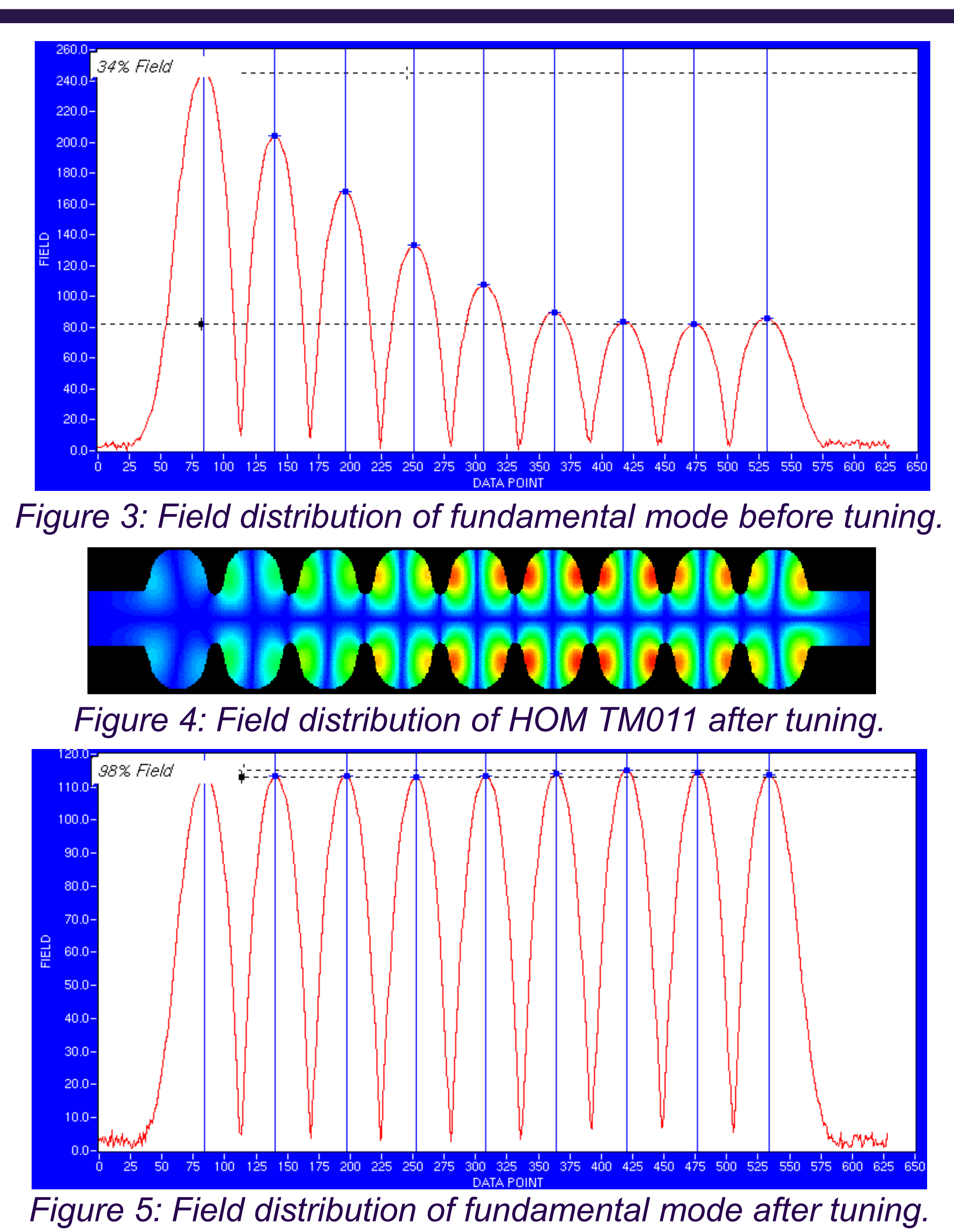


Figure 3: Field distribution of fundamental mode before tuning.

Figure 4: Field distribution of HOM TM011 after tuning.

Figure 5: Field distribution of fundamental mode after tuning.

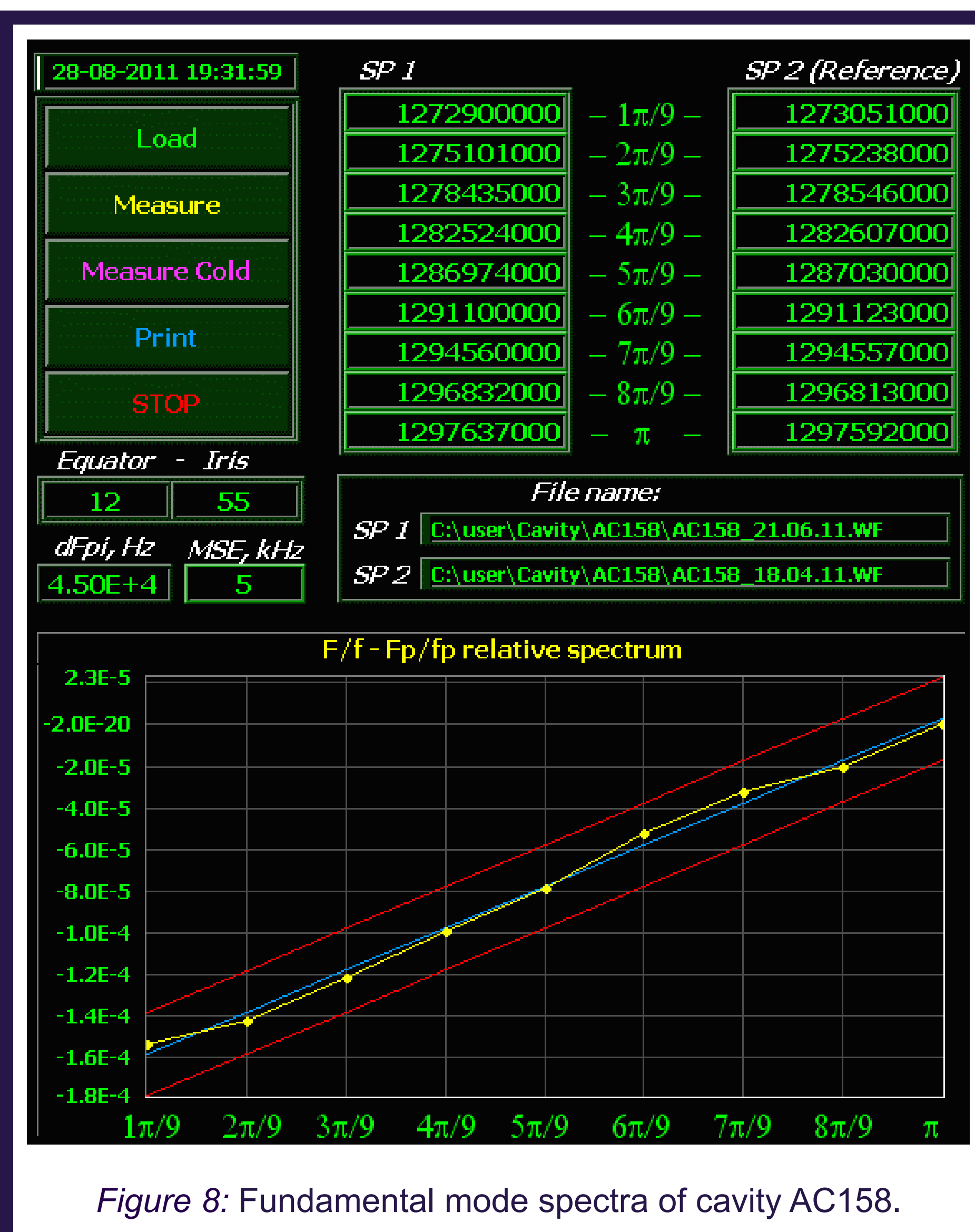


Figure 8: Fundamental mode spectra of cavity AC158.

### Summary

Series production of more than 800 9-cell TESLA type cavities for the European XFEL project not only requires high quality operation during all stages, but also maximal decrease of duration for each of step.

The new equipment such as HAZEMEMA and new Cavity Tuning Machine allow reduction of the procedures' duration for corresponding RF measurements up to 80 %.