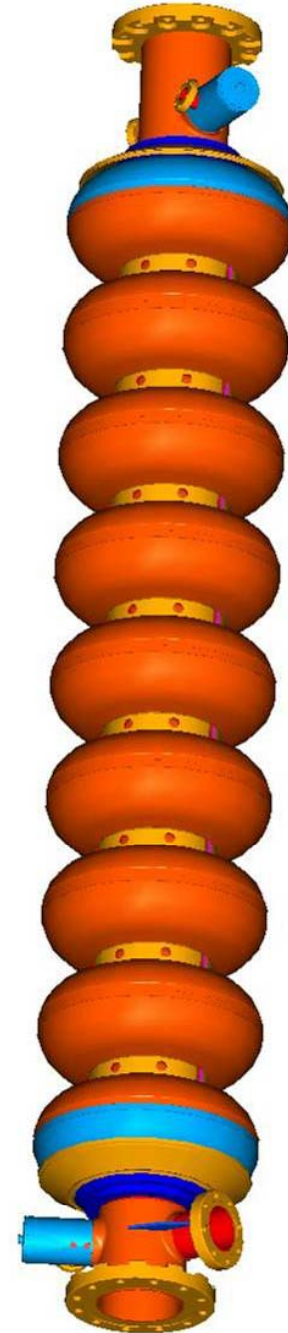


9-Cell Cavity Measurements for the XFEL

Cavity Preparation

After fabrication:

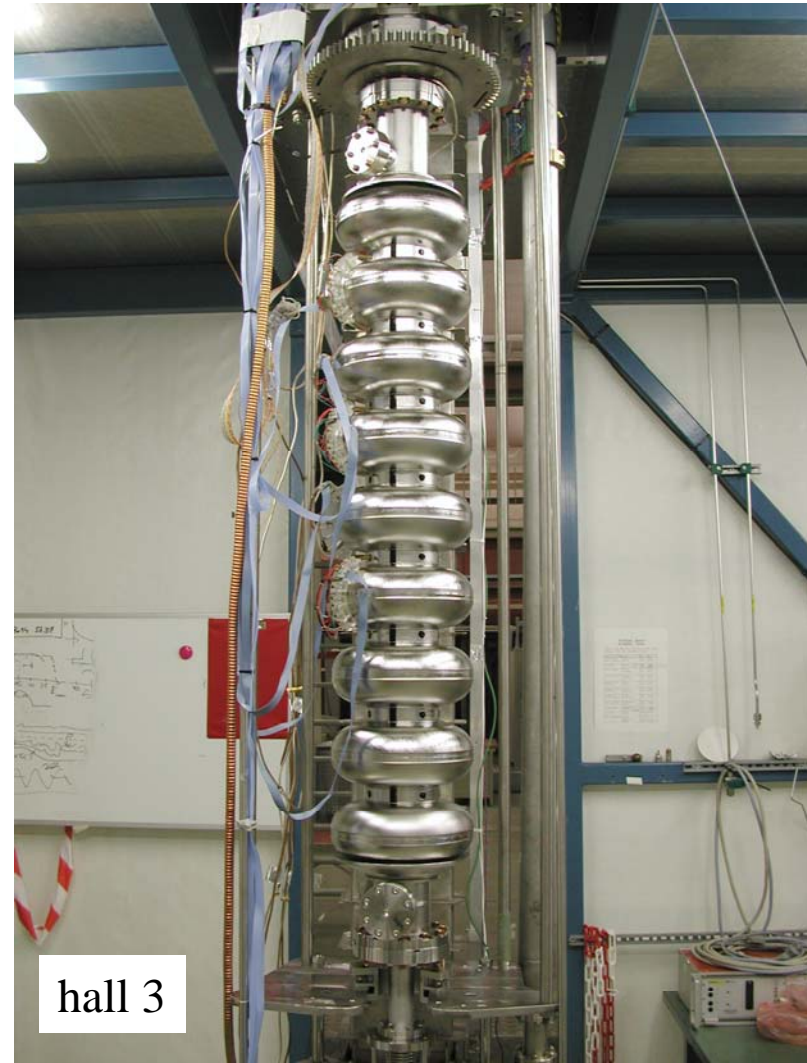
- mechanical acceptance tests
- chemical polishing (BCP) or electro polishing (EP) of the RF surface
- high pressure ultra pure water rinse (HPR)
- assembly with antennas and pump ports in dust free area (class 10)
- leak check



Vertical RF Test

first RF acceptance test at 2 K:

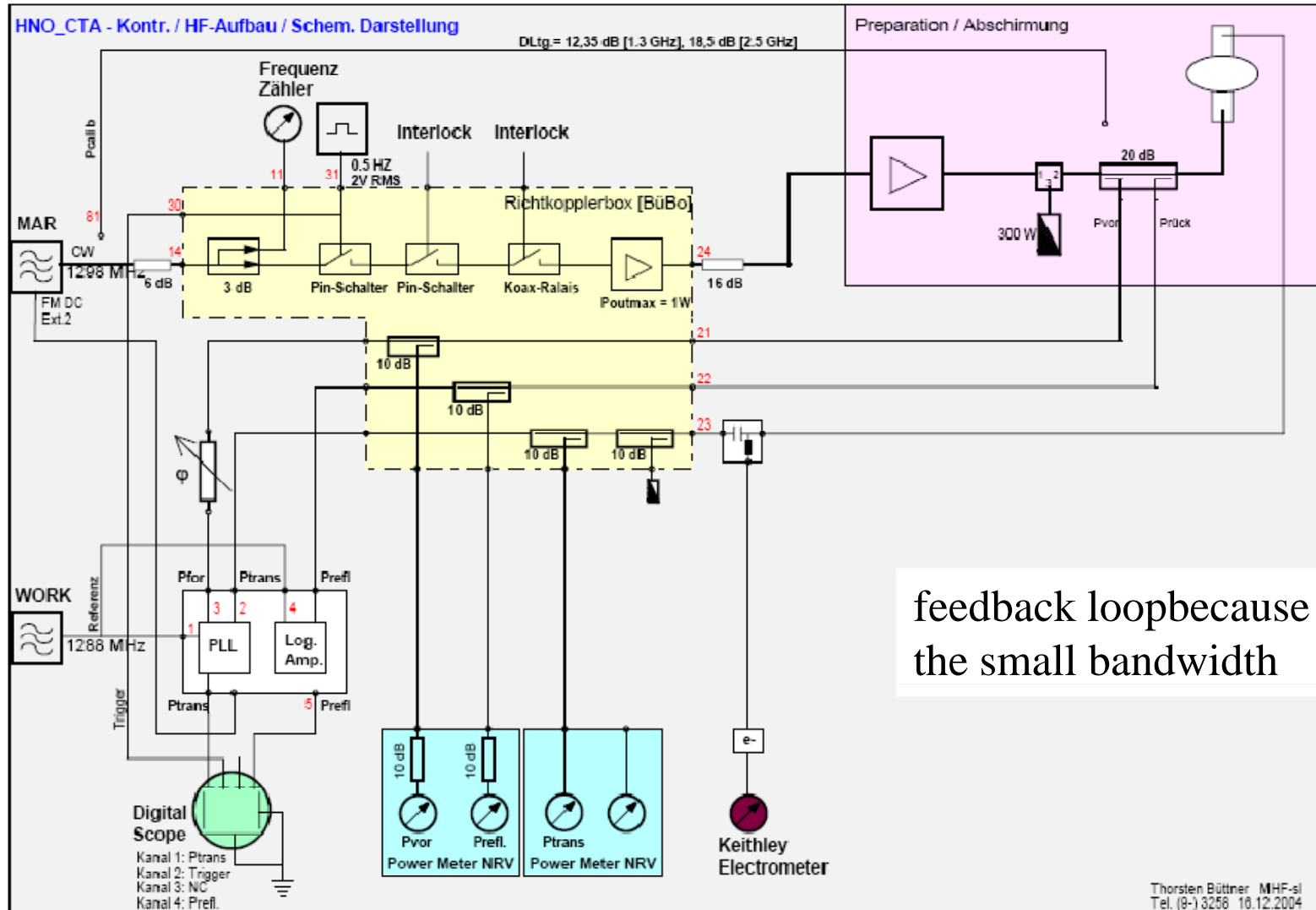
- assembly to the cryo insert
 - mechanical and vacuum
 - RF-connections
 - possibly RRR or T-map
- check of frequencies
- leak check
- transport to cryostat
- cool down



RF measurement in vertical cryostat

- cable calibration
- Q_0 vs. T (quality factor during cool down)
- RRR
- Q_0 vs. E_{acc} and field emission (quality factor vs. the accelerating field @ 2K, gamma);
→ This are the numbers for the cavity acceptance!
- optional: for the location if the field limiting defect:
 - T-map
 - Q_0 vs. E_{acc} of the fundamental passband modes

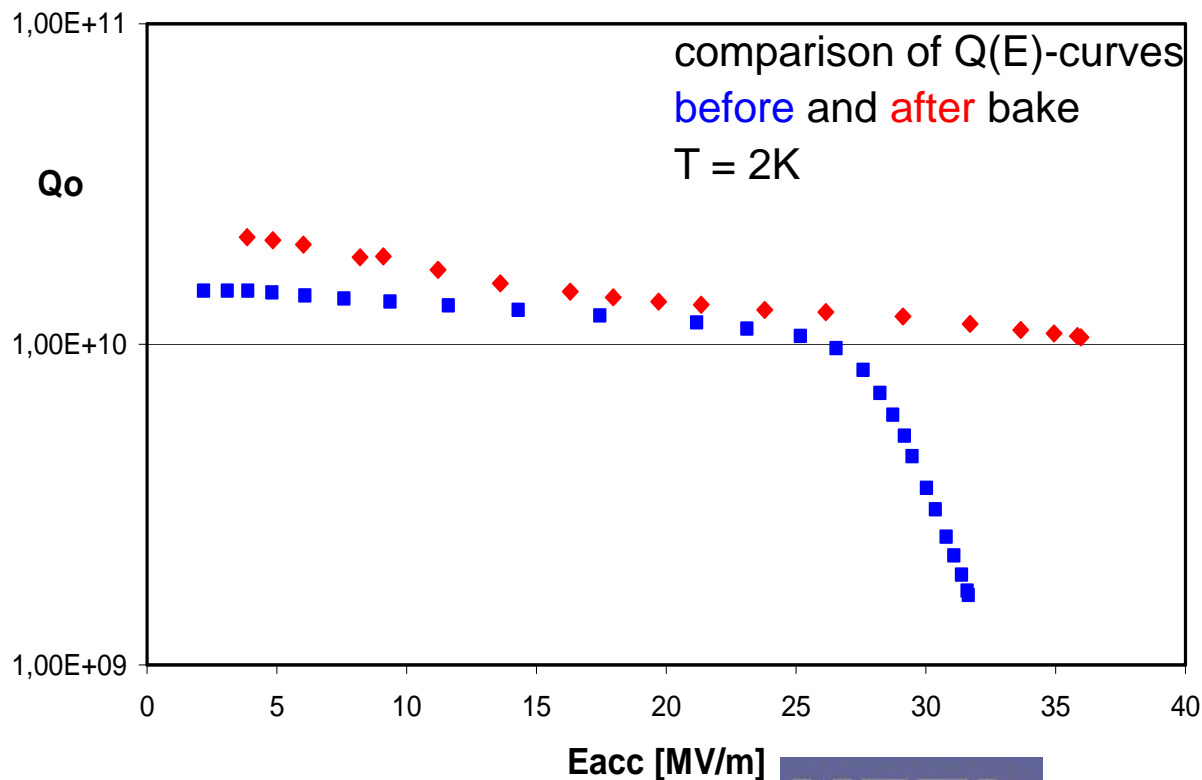
RF circuit for high Q measurement



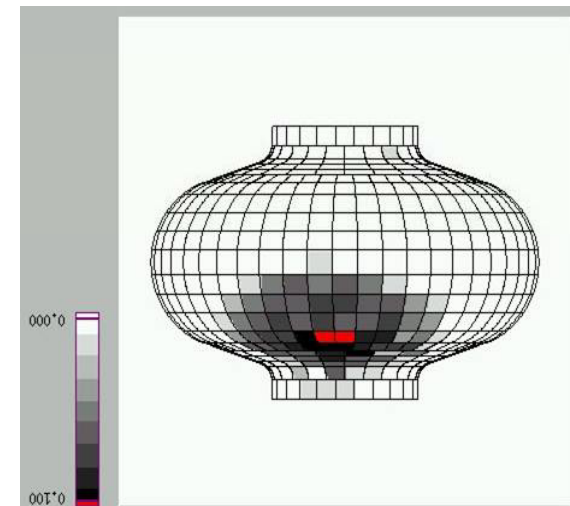
1DE1: Example of cavity test + analysis

- Nb with RRR 300 (Heraeus); deepdrawing at Zanon Co.; machining + EB welds at DESY
- 150 μm EP@Henkel, 800C, 130 μm EP@Henkel, HPR, 127C bake, HPR
(i) 130 μm EP due to grinding; ii) add. HPR after bake necessary due to field emission)

$E_{\text{acc}} = 36 \text{ MV/m}$ @ $Q_0 = 1 \cdot 10^{10}$; no field emission; limited by quench; few multipacting



temperature mapping



Quench location far off the equator

Horizontal Test

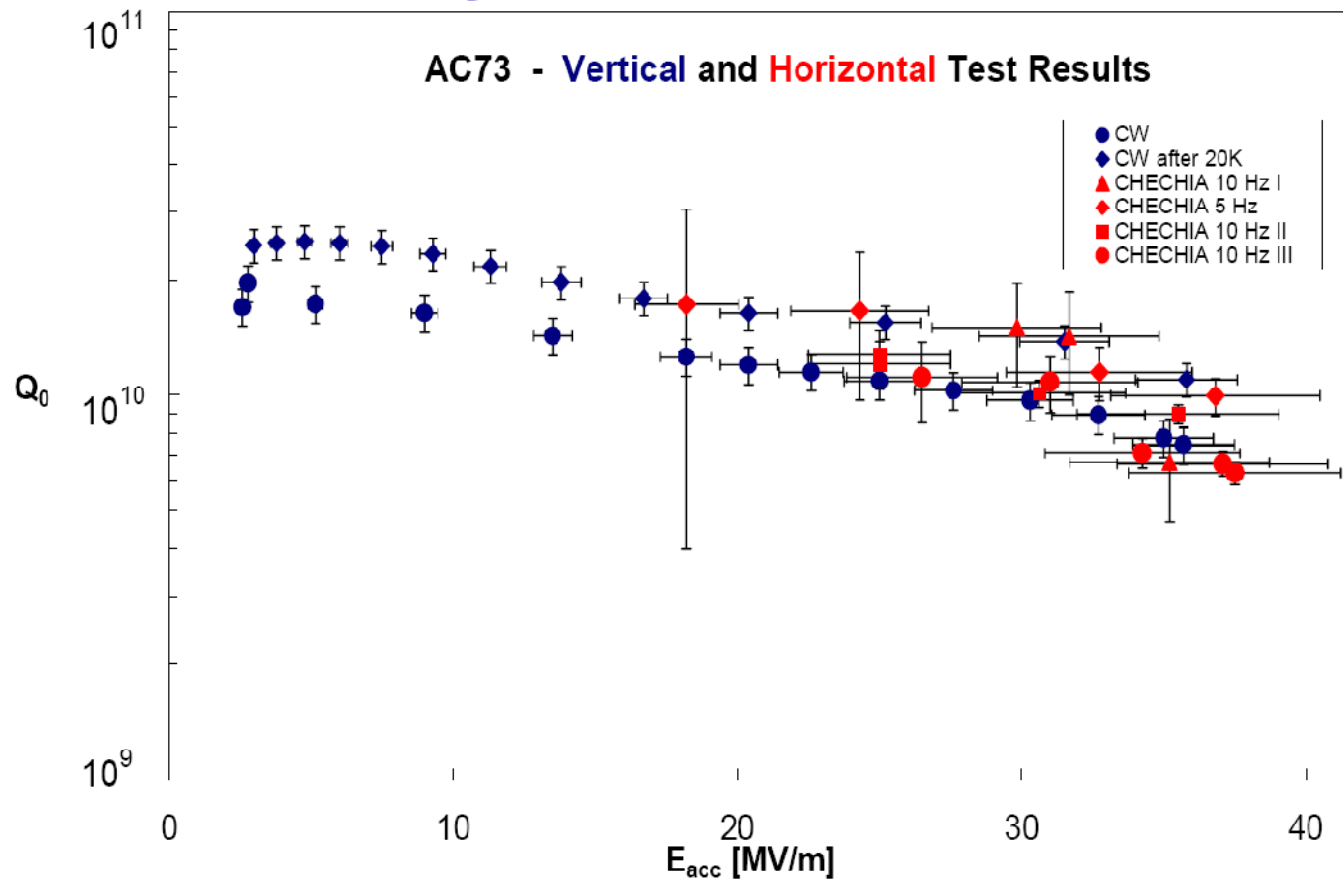
Cavity acceptance test with its fully assembled auxiliary components:

- He tank, magnetic shield
- power coupler (processing)
- HOM antennas
- tuner, slow and fast
- max. E_{acc} for RF pulse of 1.3 ms and flat top (calculated from forward power)
- Q_0 is measured by cryogenic losses @ different repetition rates (Q_{ext} is 3×10^{10})
- fieldemission
- HOM coupler functions
- tuner and piezo test
- power coupler test

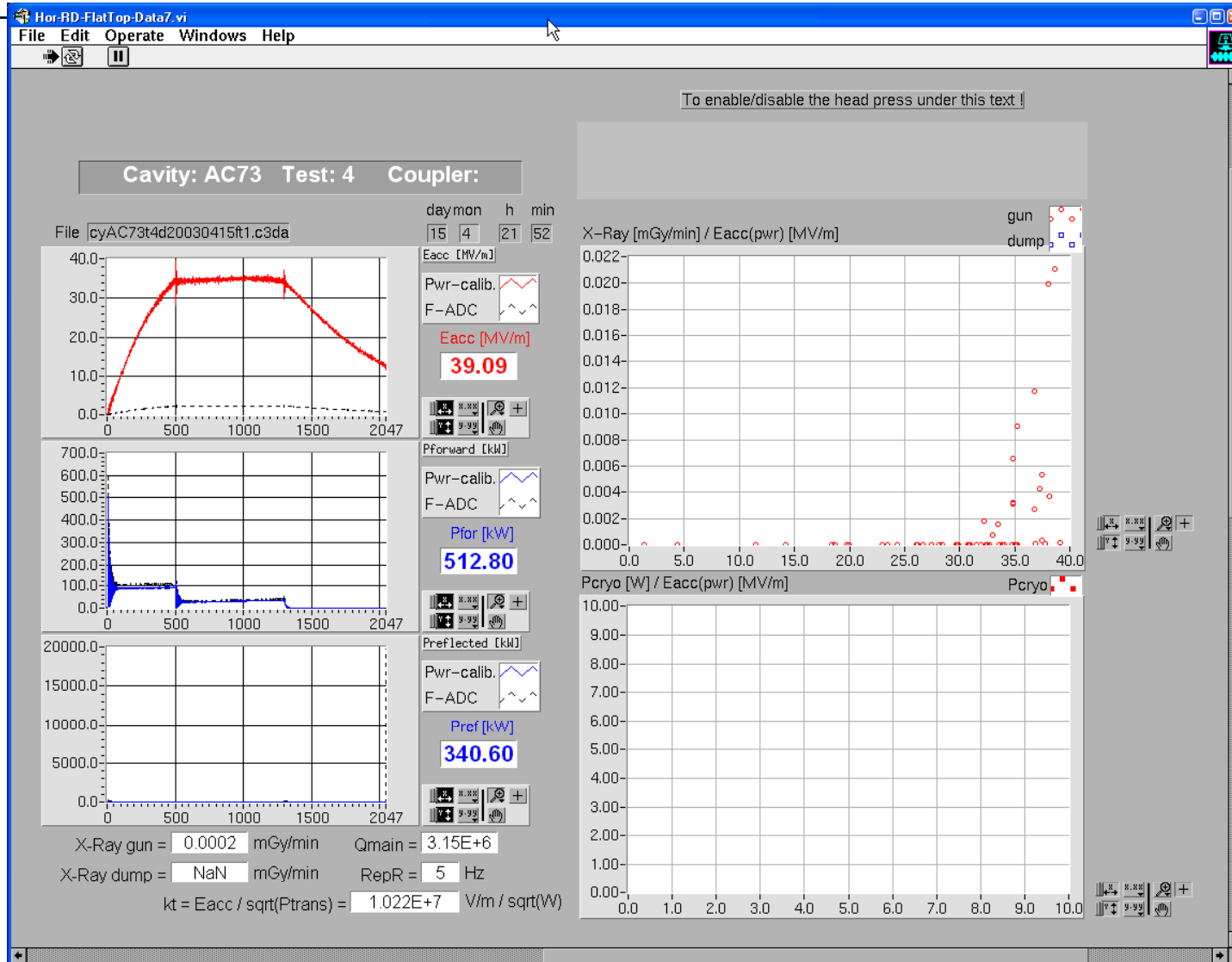


Example of horizontal test results, 1

High Power Test of AC73



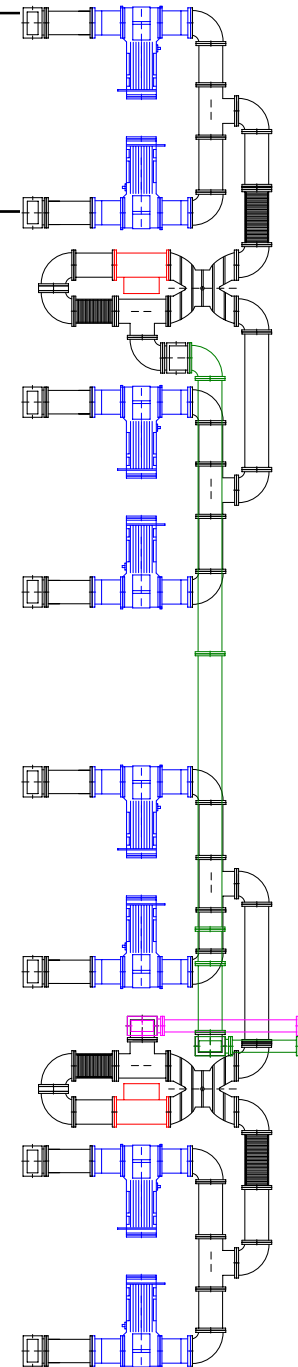
Example of horizontal test results, 2



Module cavity test

Cavity performance after complete assembly of cavity string, cold mass and module tank test of all subsystems:

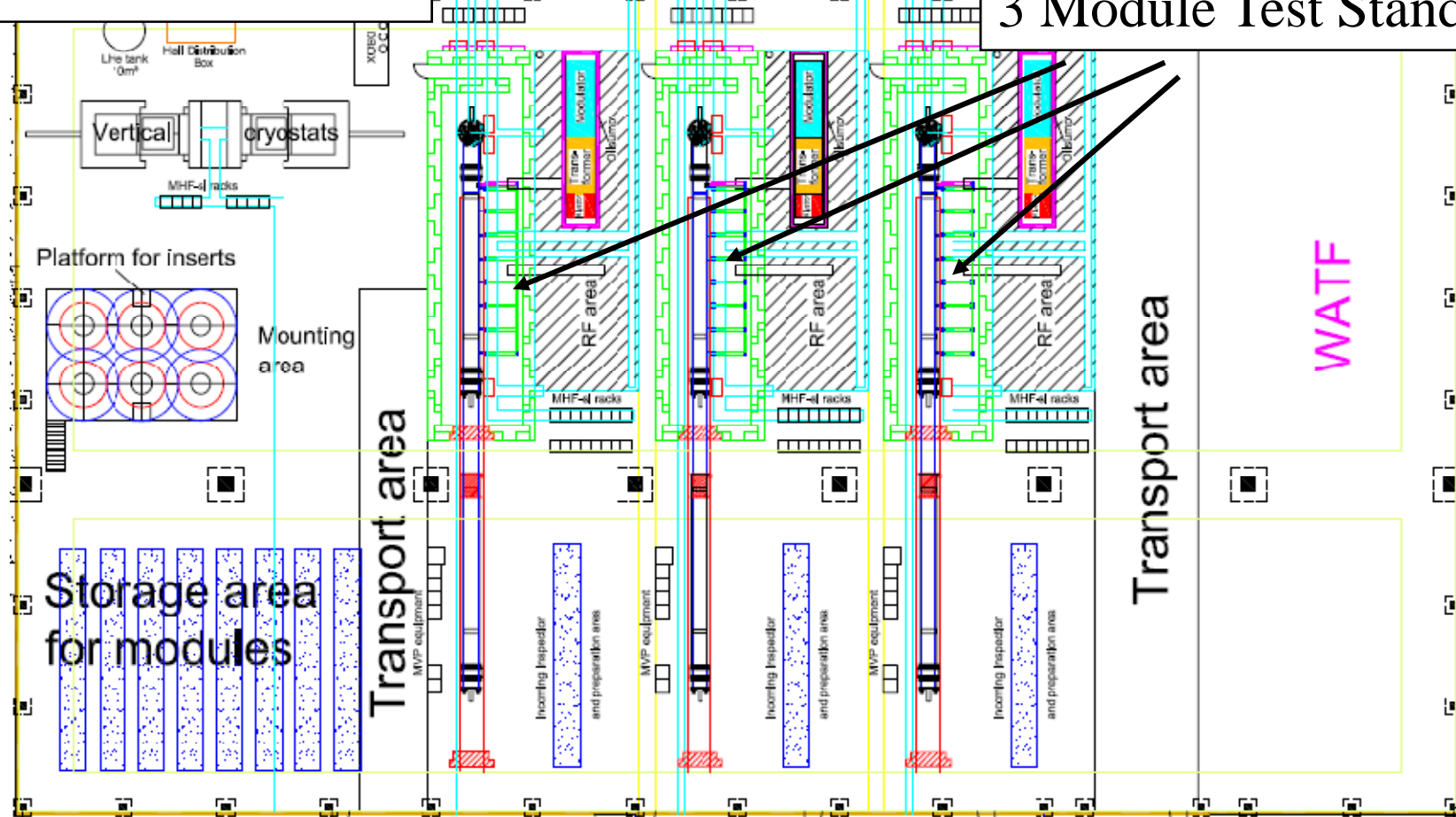
- individual cavity field limits
- ‘over all’ Q_0 for the 8 cavities (cryo losses)
- dark current
- power couplers
- quadrupole
- cryogenic losses



XFEL Test Hall: AMTF

2 vert. Test Stands

3 Module Test Stands



Test Stand, AMTF

vertical tests:

- 4 cavities at a time in one cryostat
- 1 cavity measured at a time
- no T-map
- same measurement goals

module tests:

- same as in TTF module test stand

horizontal tests:

- if necessary it takes place at one of the module test stands

