Regional Report EU

Detlef Reschke, DESY
for

- CEA Saclay (F. Eozenou et al.)
- INFN Milano (P. Pierini et al.)
- TH Darmstadt (R. Eichhorn et al.)
- DESY

Low-beta activities + Couplers

Low-beta activities

=> Actual low-beta activities will be presented by R. Laxdal !

Couplers

- Industrialization for XFEL on the way
- Specifications ready until end of this year

=> WG2: Presentation by Serge Prat !

CEA Saclay

Fabien Eozenou

- EP studies

EVALUATION OF CHLOROFORM RINSING

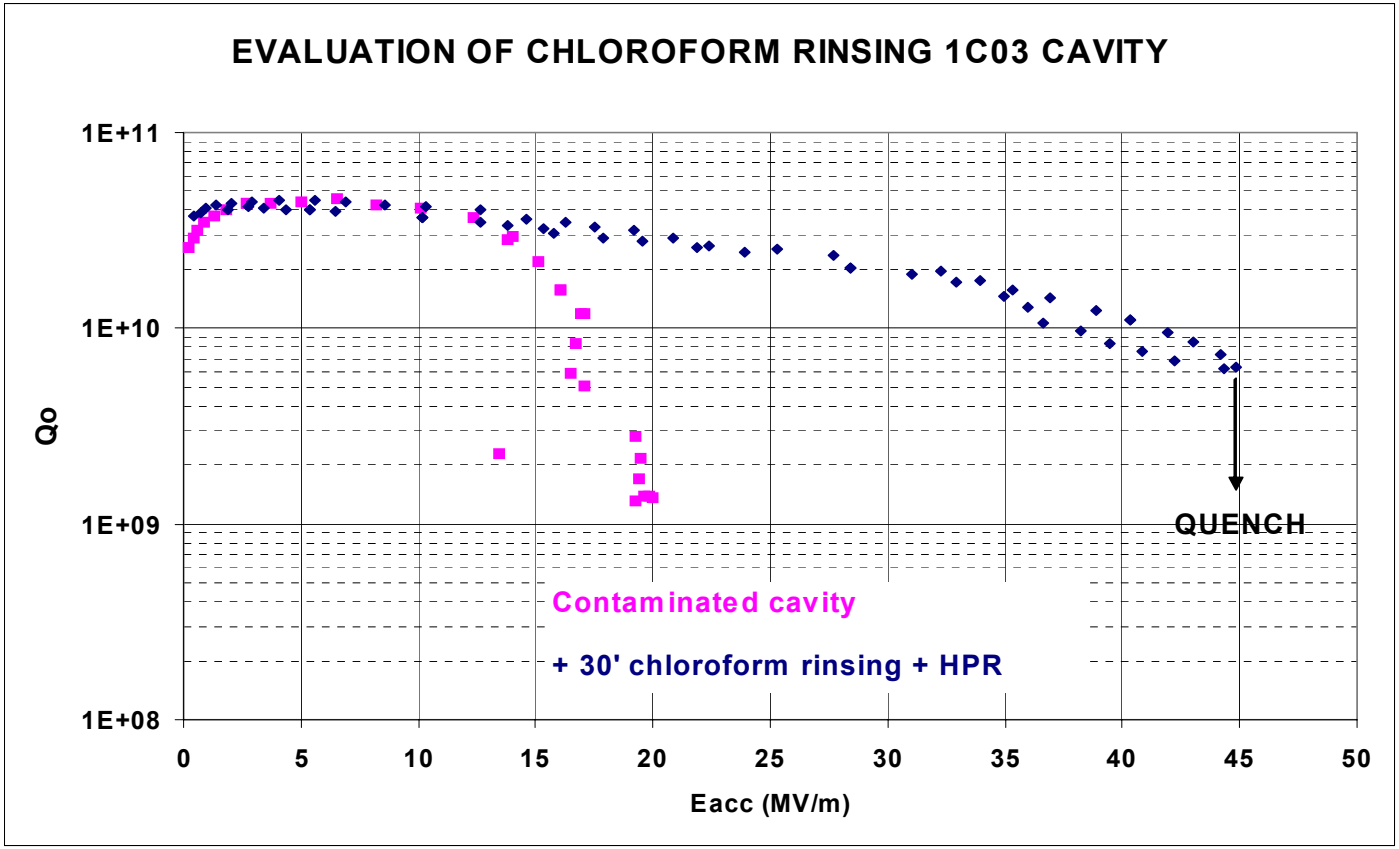
dapnia
cea
saclay

Test on 1C03 (Tesla Shape Cavity) : heavy contamination

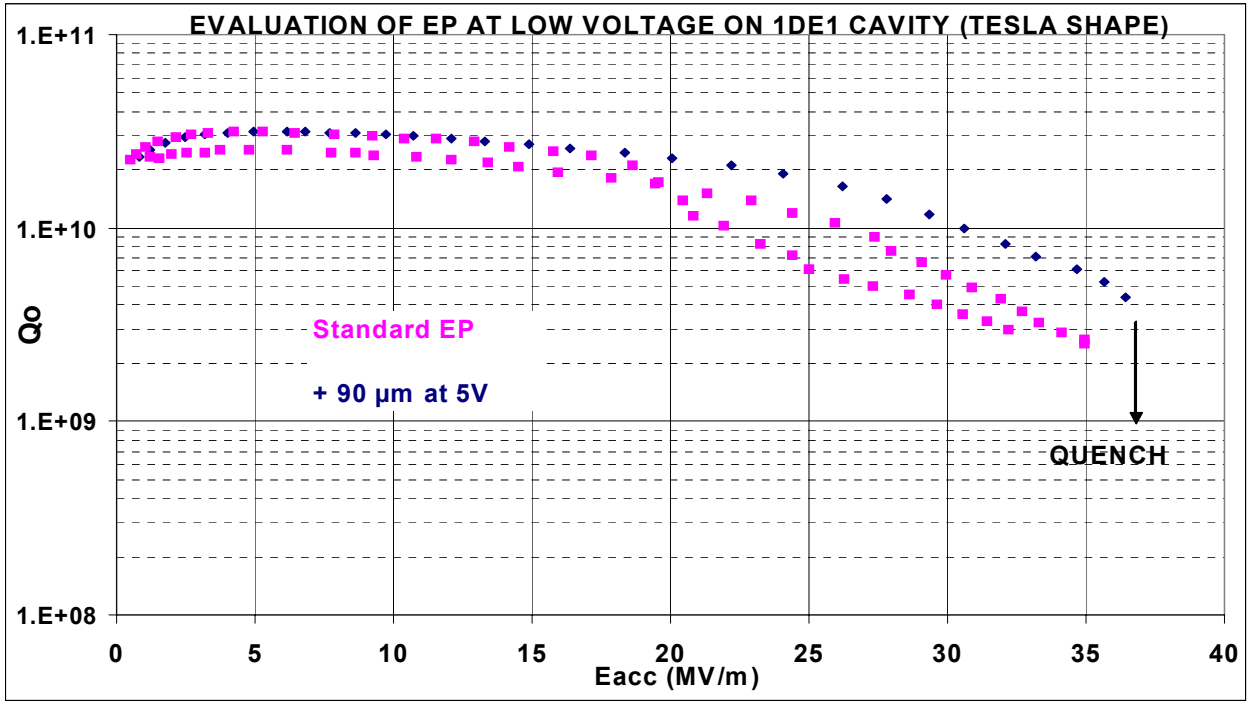
+ 30' Chloroform Rinsing + HPR: Suppression of emitters + Excellent Gradient:

Eacc ~ 45MV/m at 1.5K

Seems efficient for Rinsing of Cavity! (Sulphur highly soluble in chloroform)



ELECTRO-POLISHING AT LOWER VOLTAGE



Preliminary Result:

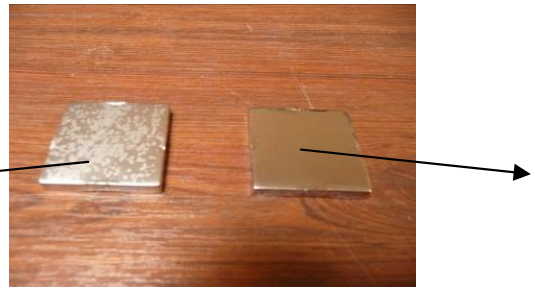
Has voltage influence on RF Results?

It questions the theory of the mandatory viscous layer during EP

= Theoretical way to reduce Sulfur Contamination (experience on going)

For the same heavy removal on two samples: less visible contamination at lower voltage

Sample electro-polished at 20V



Sample electro-polished at 5V

ON GOING R&D ON SAMPLES

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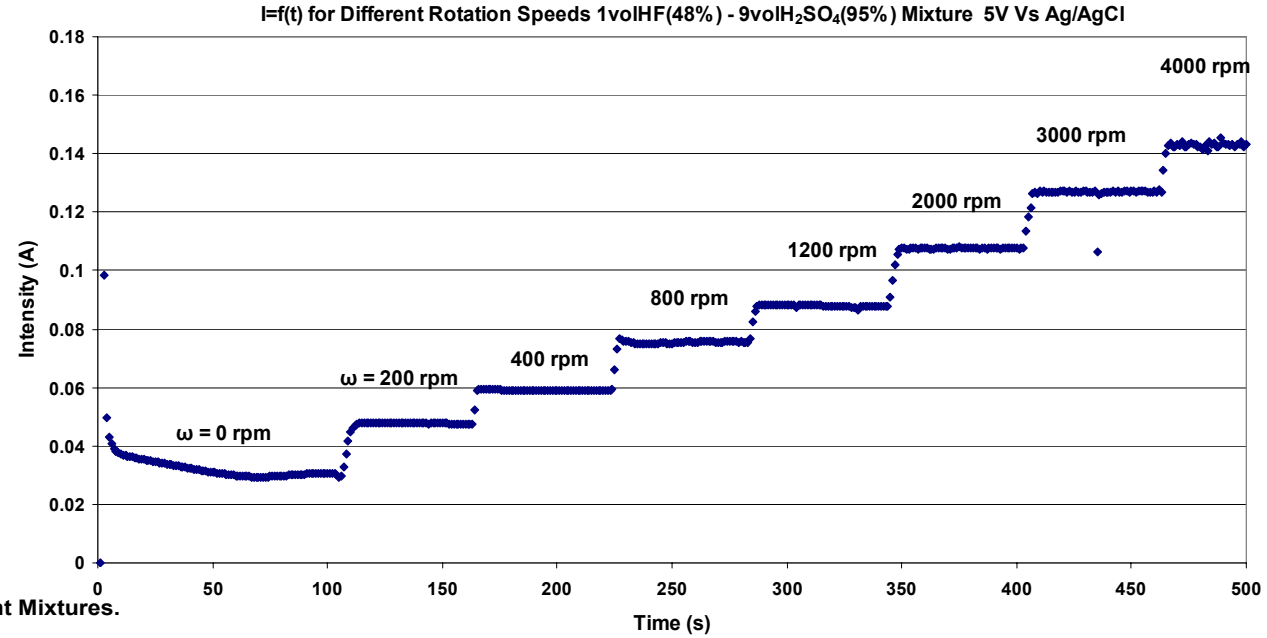
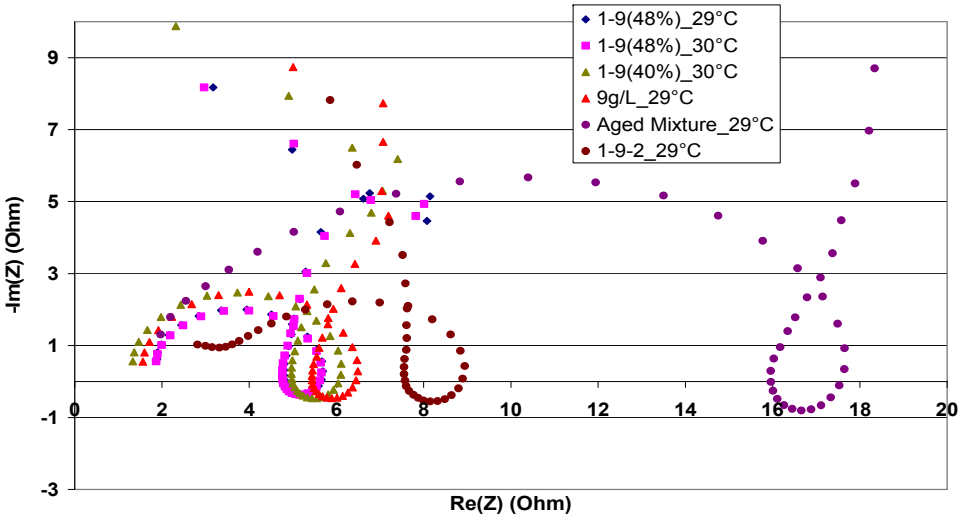
Use of rotating disc electrode to study the importance of diffusion: highlights the diffusion of HF



Intensity proportional to $\omega^{1/2}$ = signature of control by diffusion

Spectrum at 5V Vs Ag/AgCl For Different Mixtures.



Impedance Spectroscopy for varying concentrations:

- Results depend on the acid concentration
- The High Frequency limit depend on the potential for insufficient HF/H_2O ratio

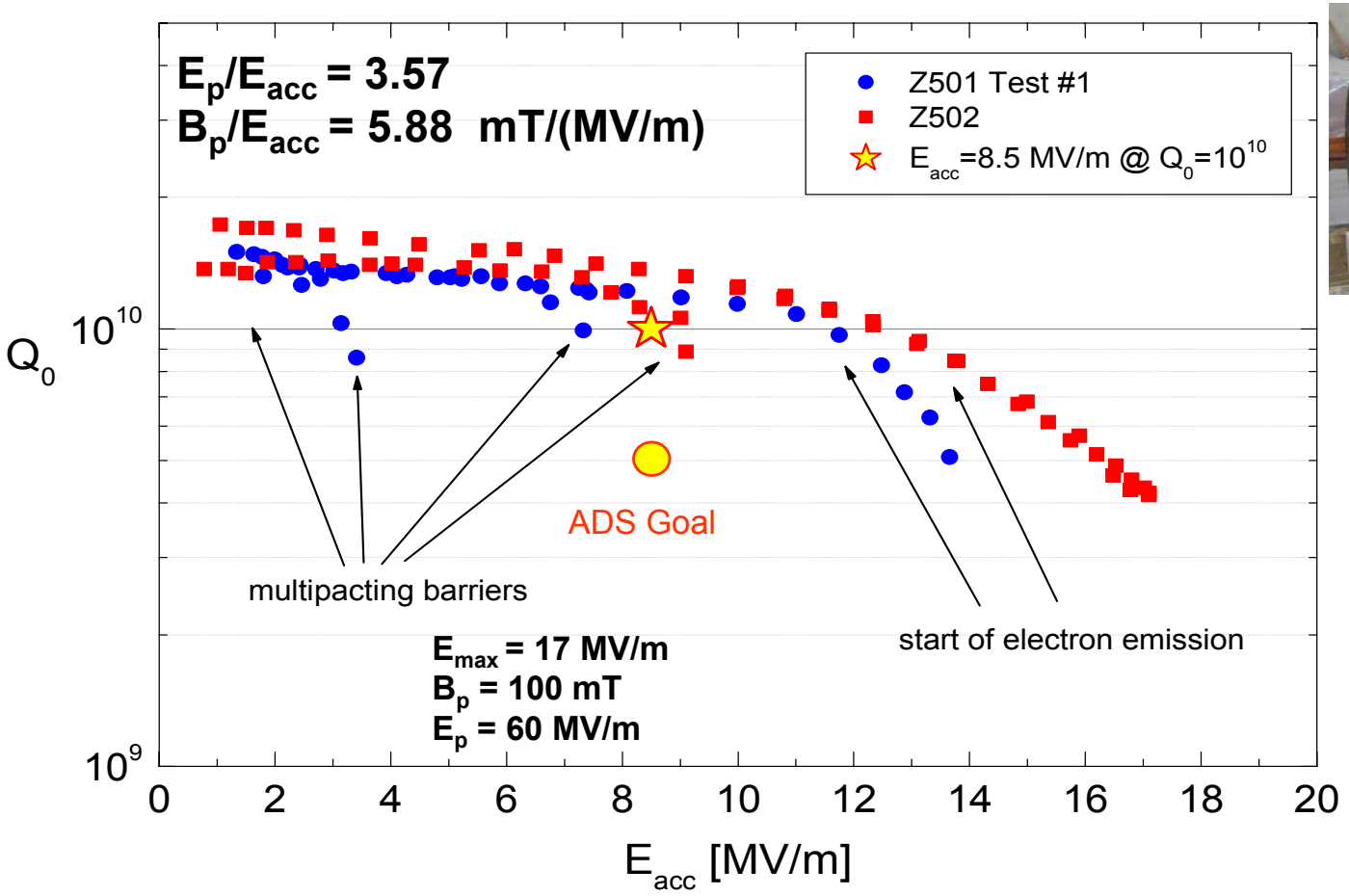
→ Possible (cheap) tool for the quality control of the acid?

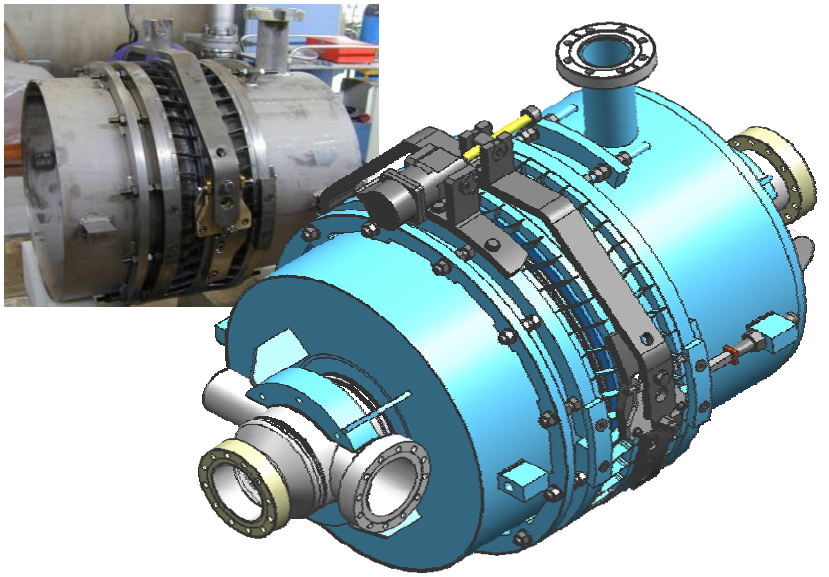
INFN Milano

Paolo Pierini

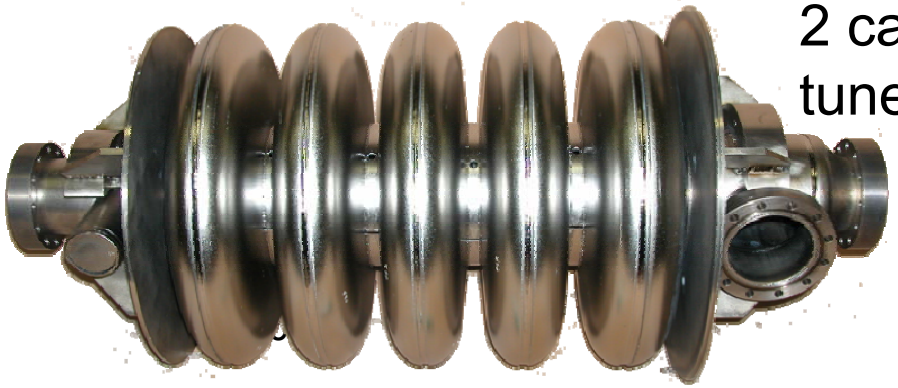
- β = 0,47 Cavity
- 3.9 GHz for XFEL
- Modified end group for 1.3 GHz nine-cells (CARE)

INFN elliptical β=0.47 cavities (ADS, SPL)





magnetic shield inside He tank

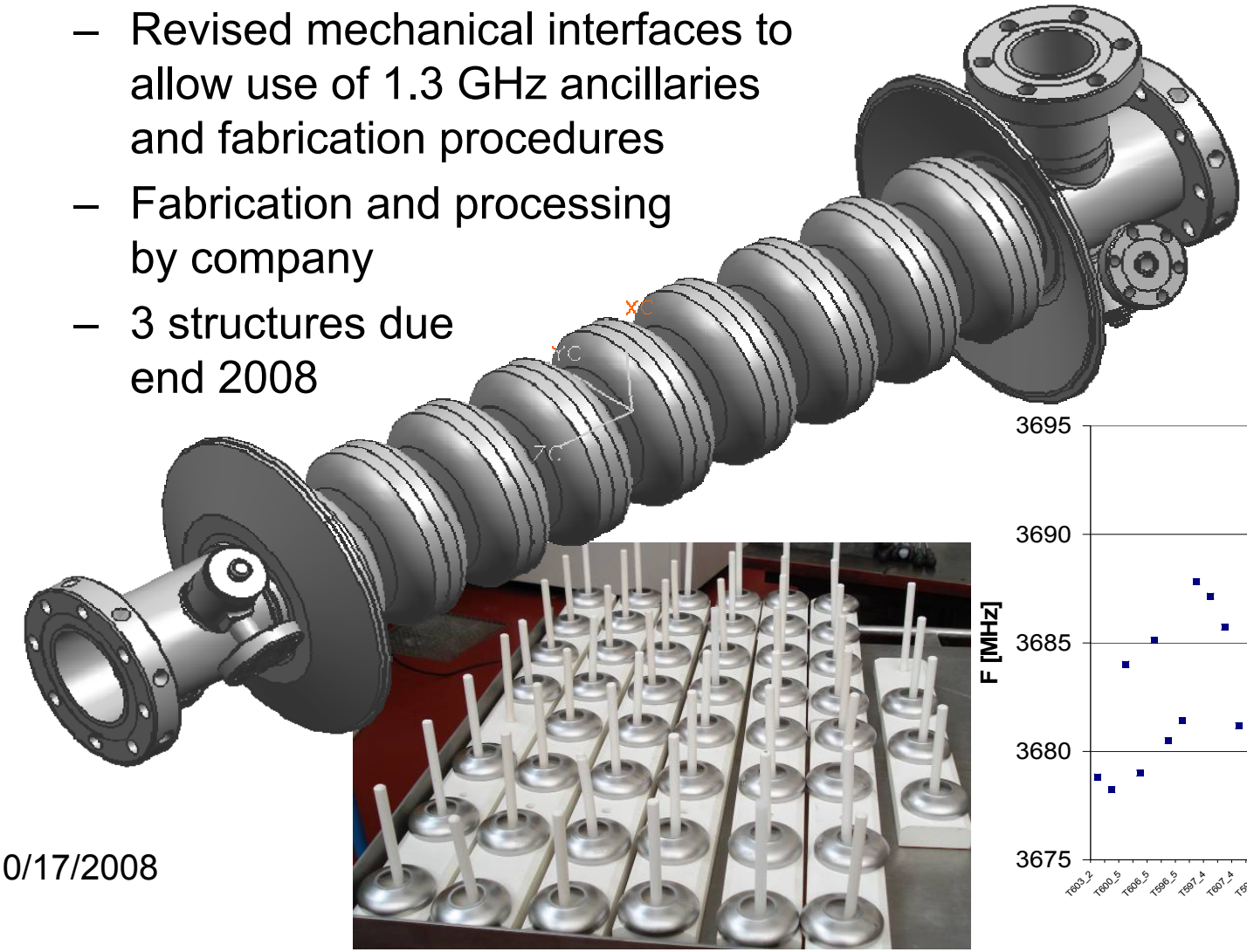


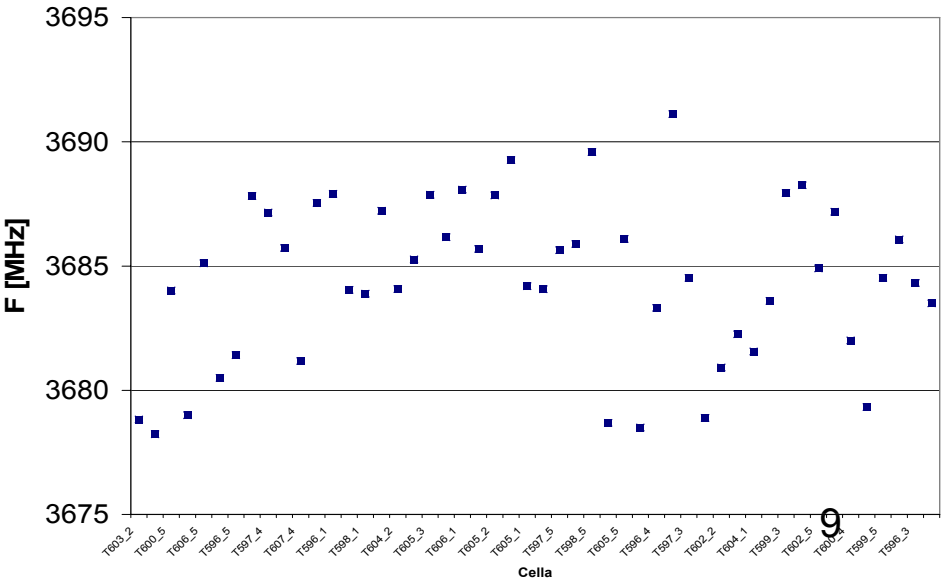
2 cavities with tank, tuner, inner mag shield

To be tested horizontally (CryHoLab & ADS Cryomodule) for LFD control at ~ 10 MV/m

XFEL 3.9 GHz (3rd Harmonic) Cavities

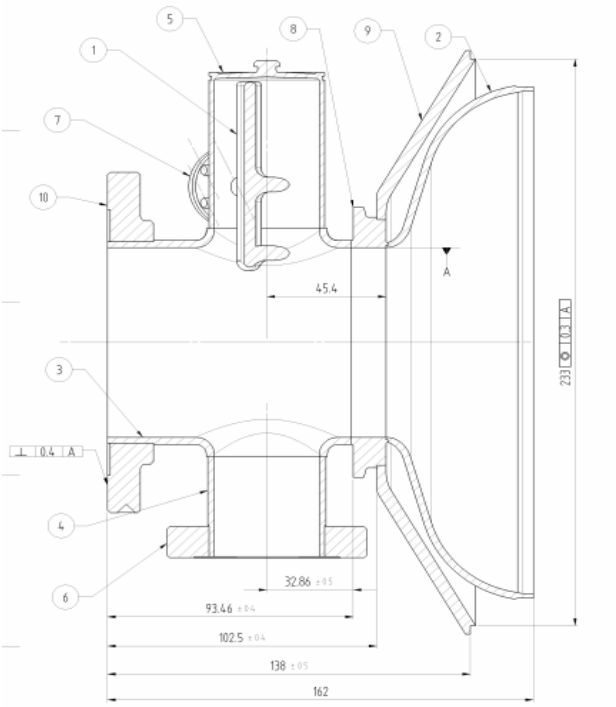
- Started the production of the structures for the XFEL 3rd Harmonic section
  - FNAL baseline design (new HOM antennas)
  - Revised mechanical interfaces to allow use of 1.3 GHz ancillaries and fabrication procedures
  - Fabrication and processing by company
  - 3 structures due end 2008

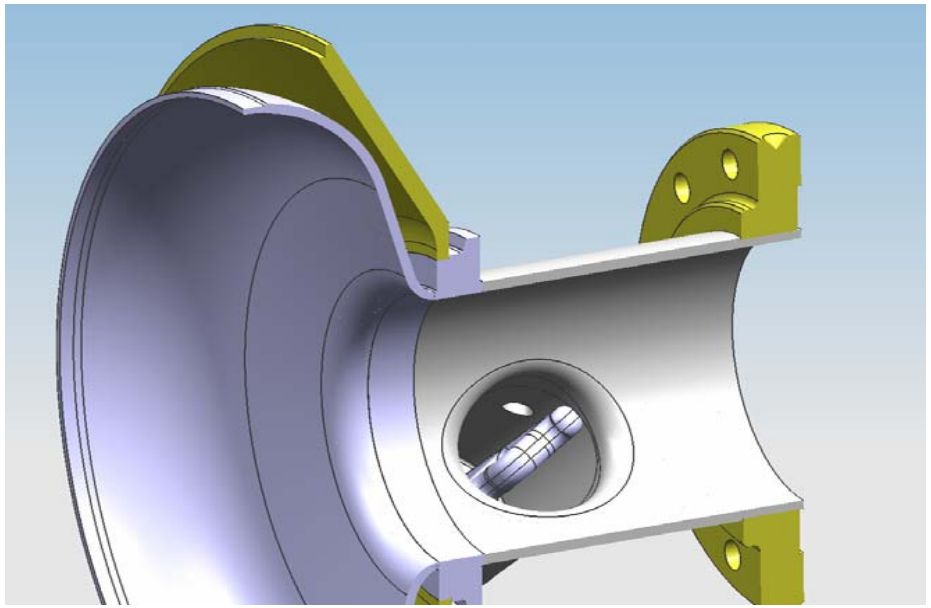


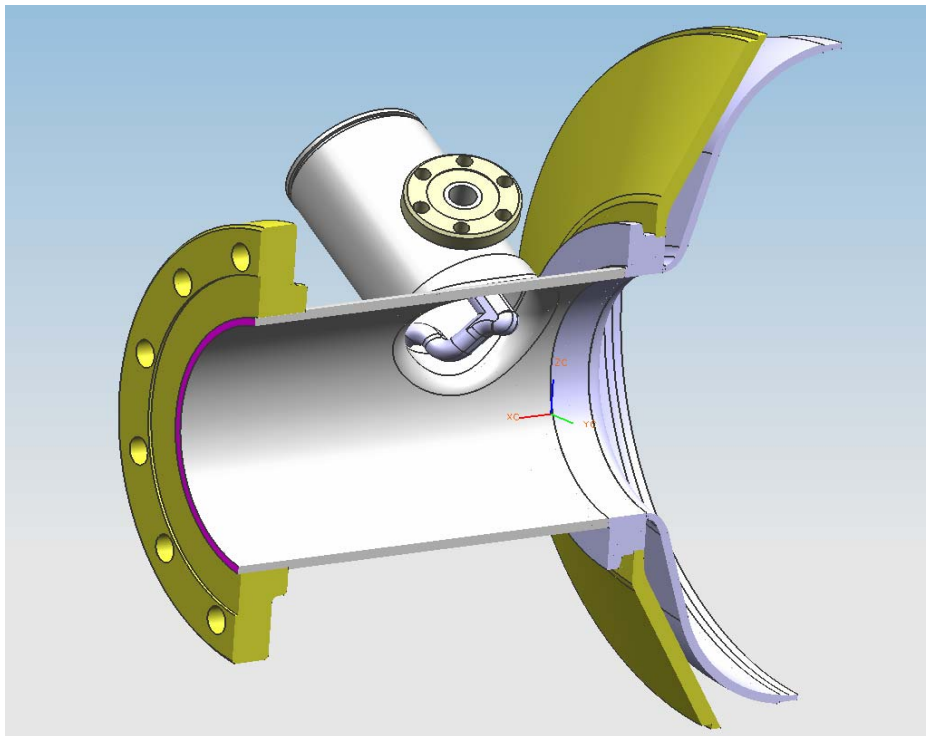


CARE: study for new endgroups

- Decrease cost of end-group parts
  - No end cell stiffening (-7% LFD)
  - Different weld procedure
  - Reduced number of EB welds
- Same axial stiffness than actual solution
- Compatible with XFEL tools
- Optimized for the coaxial tuner



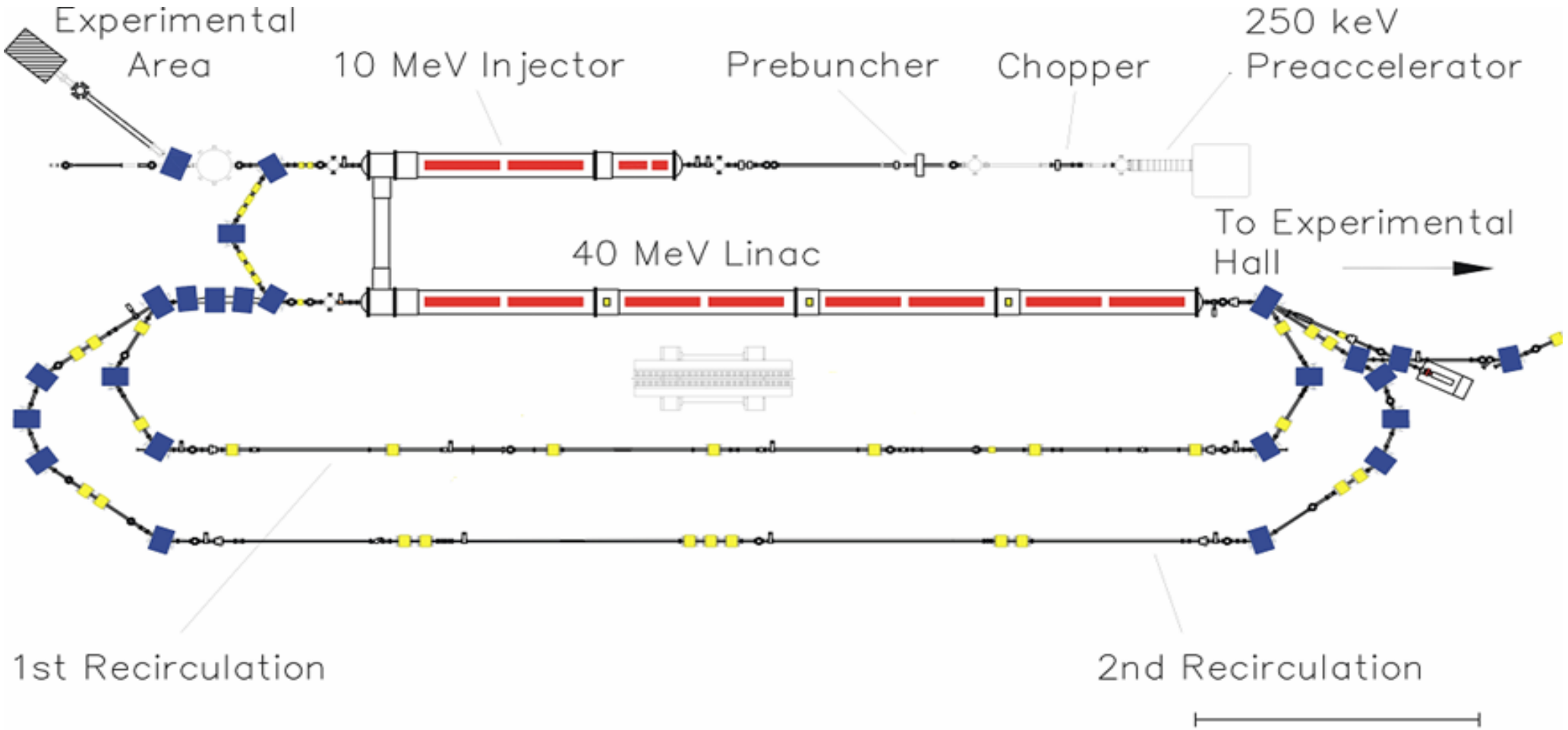




Technische Universität Darmstadt (S-Dalinac)

Ralf Eichhorn

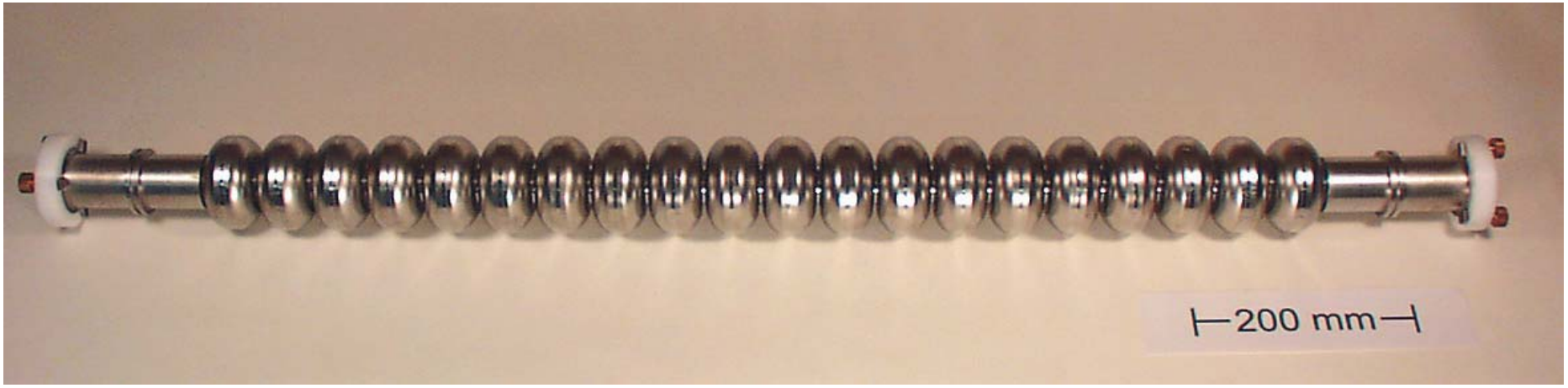
S-DALINAC



Designparameter:		
	Maximale Energie:	130 MeV
	Maximaler Strom:	60 µA
	Betriebsart:	cw
	Frequenz:	3 GHz
	Inbetriebnahme	1988

SFB 634

Accelerator structures

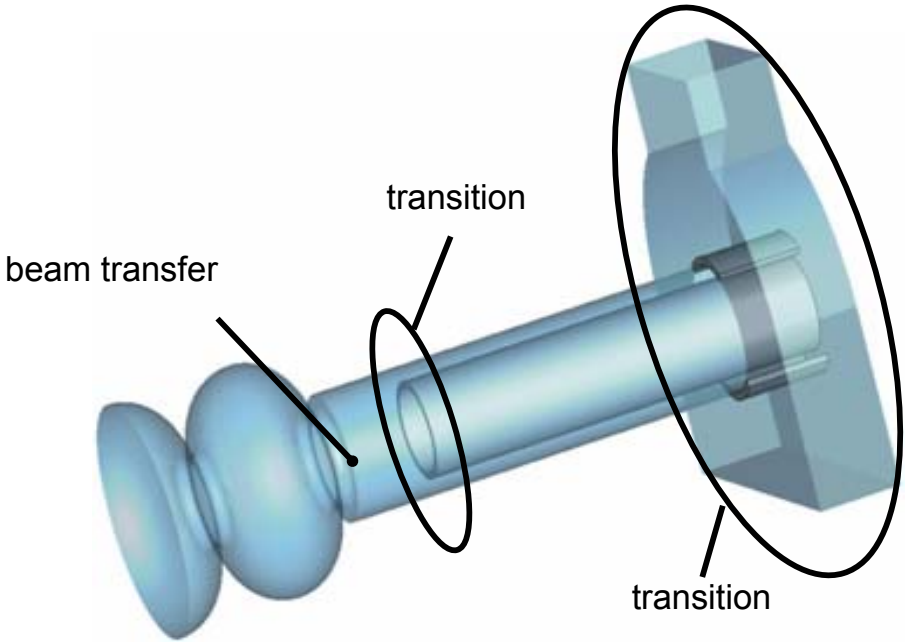


Material:	Niob (RRR=280)	Länge:	1 m
Frequenz:	2,9975 GHz	E_{acc}:	5 MV/m
Mode:	TM_{010},π	Q_0:	$3 \cdot 10^9$
Temperatur:	2 K	P_{dis}:	4,2 W

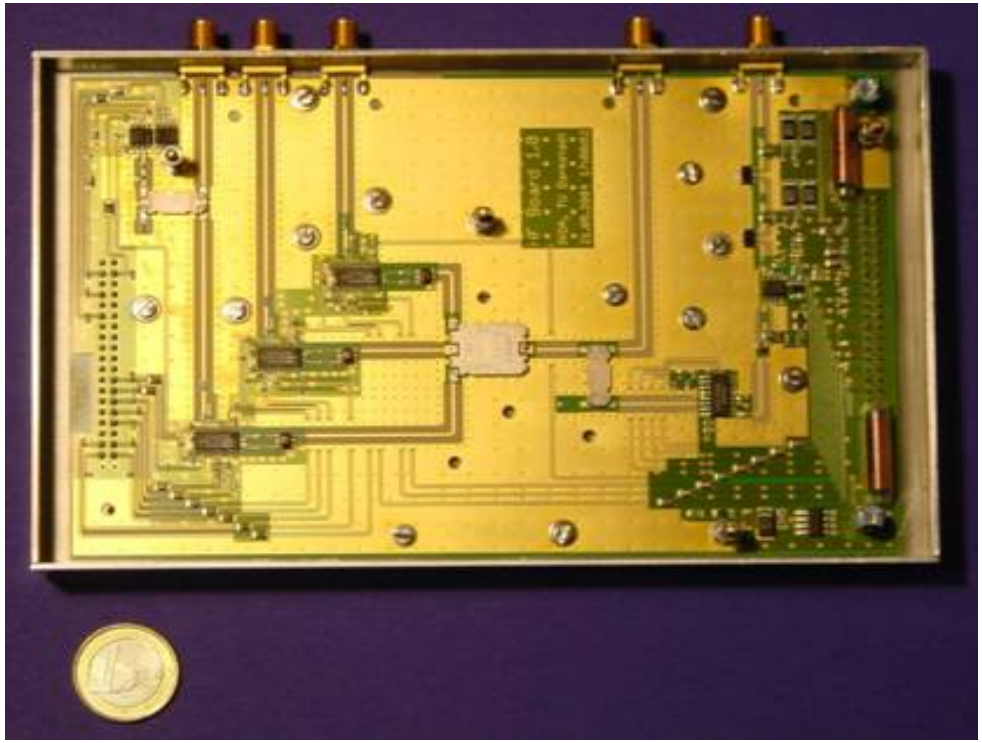
Hydrogen removal by 850 C firing: S. Sievers et. al. SRF07

Waveguide Power Couplers

Current coaxial coupler: **500 W**
Waveguide coupler: **2 kW**
Transversal kick: **< - 40 dB**

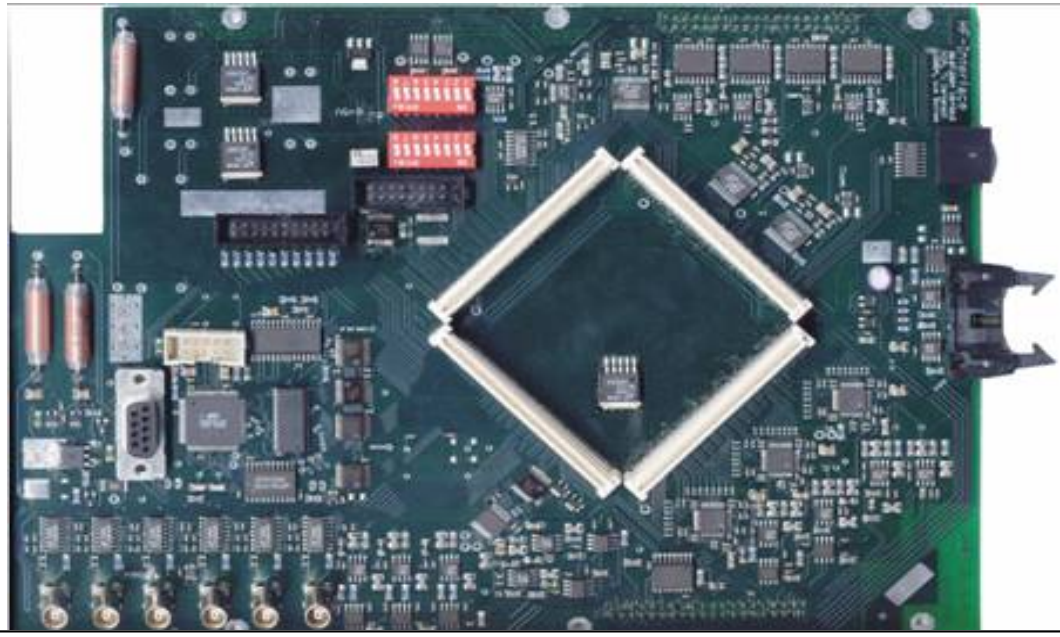


Digital RF Control @ 3 GHz

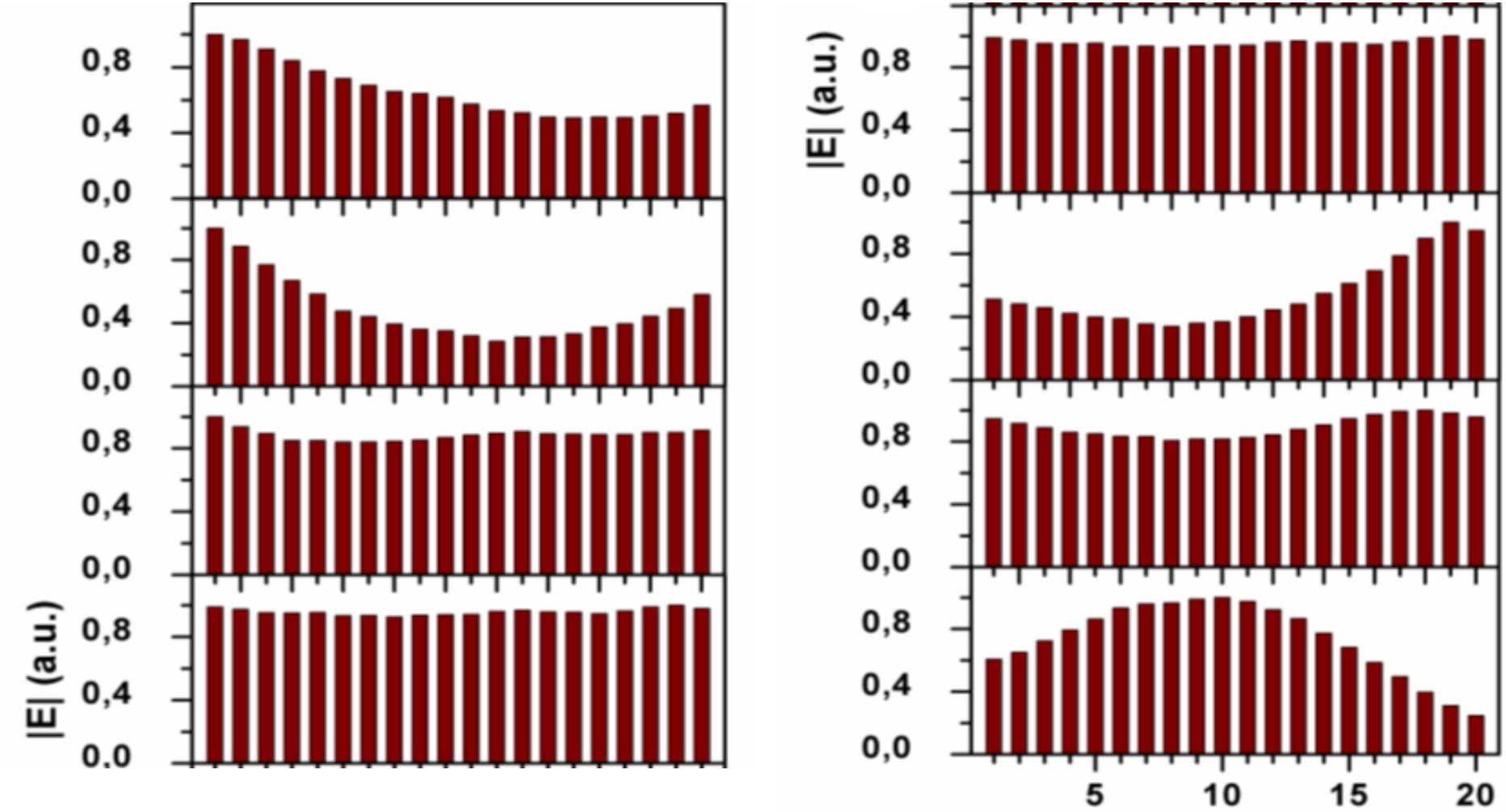


Modulation/ Demodulation to baseband using WiFi components

NF Signals process by an FPGA board, developed in-house



Operational Findings I



All cavities were tuned to flat field when installed in the 90s

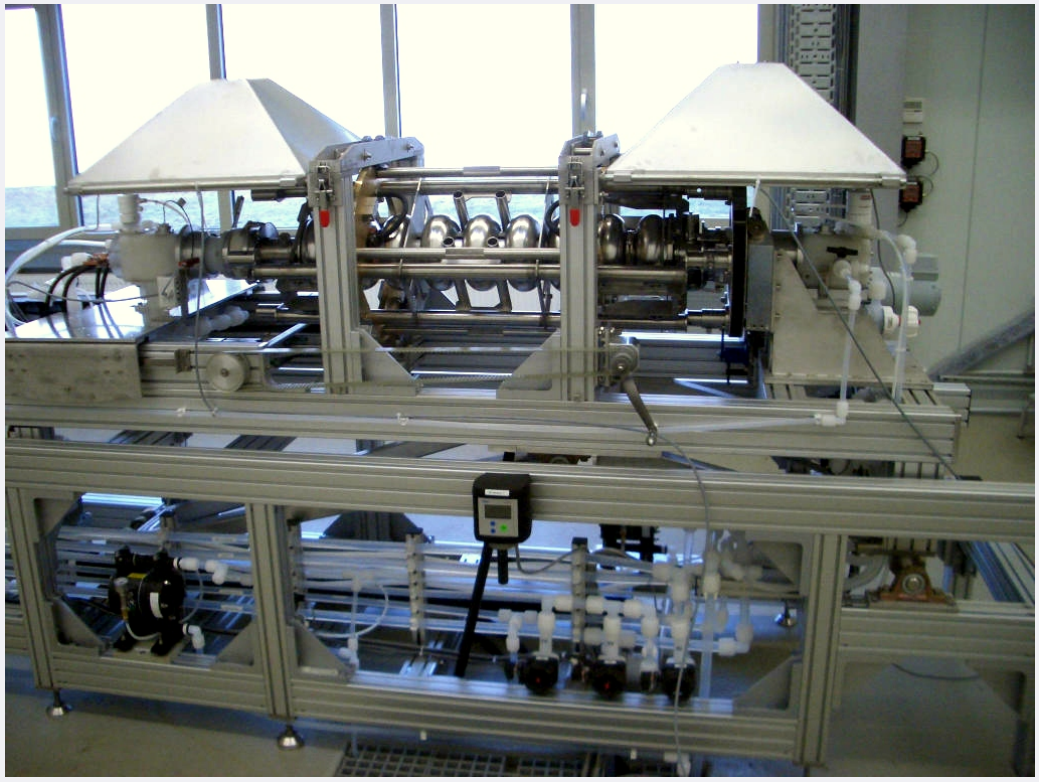
10 years later that‘s how the look like

Cavity status + results at DESY

- Industrialization of EP
- 6th 1.3 GHz nine-cell cavity production
- XFEL preparation:
  - Tuning machine
  - Cavity transportation simulation
- 3.9 GHz for FLASH
- More cavity results:
  - Open Ar bake
  - Update of Large Grain Nb results
  - Hydroformed nine-cell cavity

Industrialization of EP

- Industrial EP: 2 x 10 cavities processed => works well



Rough EP at ACCEL (courtesy of M. Pekeler)

EP system at Henkel (courtesy of. C. Hartmann)

6th cavity production: Overview (LINAC08: THP014)

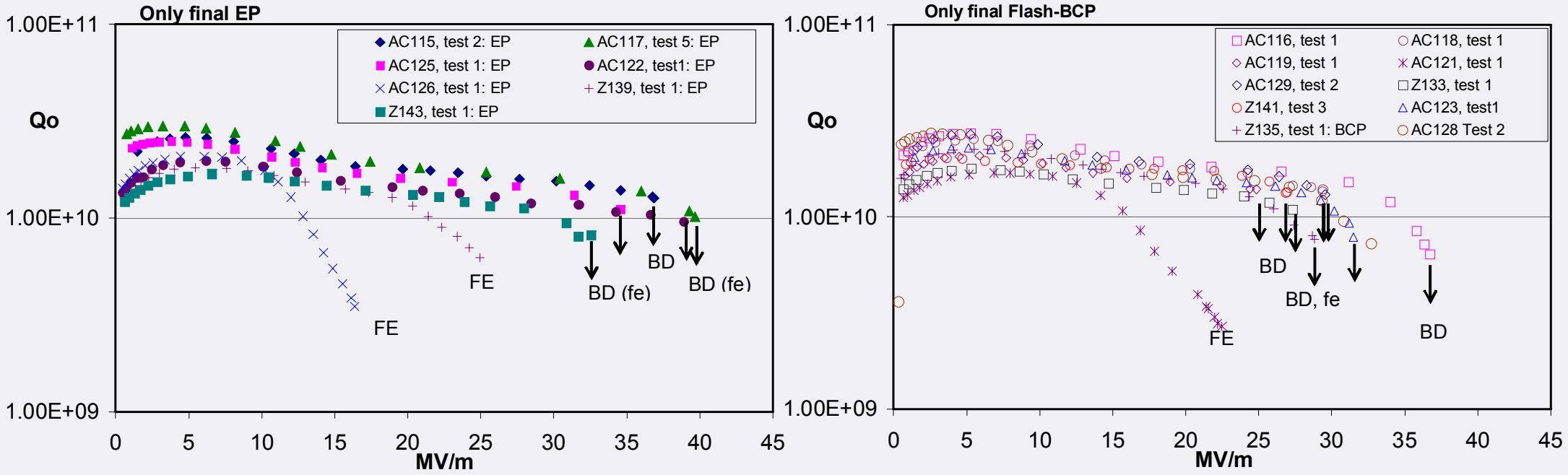
- **30 cavities fabricated by 2 vendors** (Accel + Zanon) of Tokio Denkai Nb
- final production series before XFEL

Goals:

- cavities for TTF/Flash modules
- ongoing training of manufacturing companies
- establishing **industrial EP** (Accel + Henkel)
- test of optimized, **"streamlined" preparation and test procedures** for XFEL
  - early He tank welding
  - vertical cw test with He-tank
  - vertical cw test with HOM antennas assembled
- comparison of **final preparation => EP vs. "Flash-BCP"**
  - improved statistics necessary for XFEL cavity preparation decision
  - > 10 cavities with ILC recipe

6th cavity production: Results

- Available data: 7 (of 10) final EP cavities; 10 final short BCP cavities



=> Flash BCP shows some Q-slope after bake

=> FE is still a problem !!

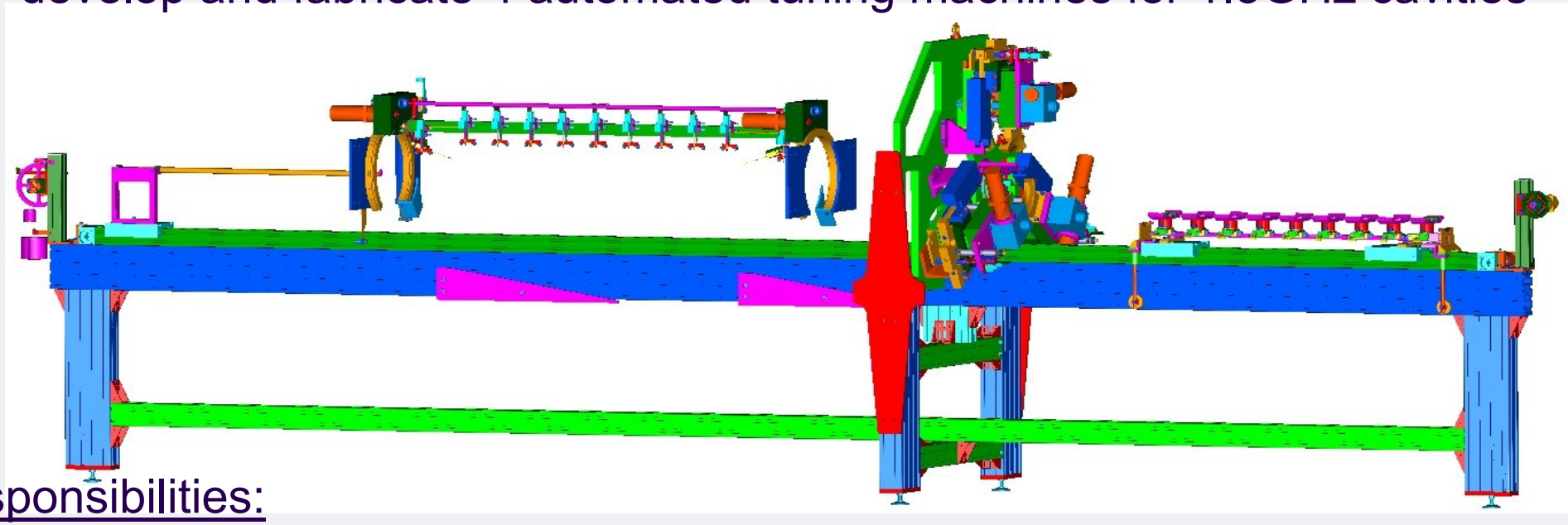
- FE loaded cavities will be HPR re-rinsed => in preparation
- 3 more EP cavities follow soon

Cavity Tuning Machine for XFEL

Based on the tuning machine design for “FLASH”

FNAL and DESY jointly

develop and fabricate 4 automated tuning machines for 1.3GHz cavities



Responsibilities:

DESY ➔ providing a complete mechanical assembly

FNAL ➔ providing the control system, consisting of a complete set of electronics and software

FNAL and DESY ➔ integrated commissioning of the machine

Cavity Tuning Machine for XFEL

Four machines will be fabricated!

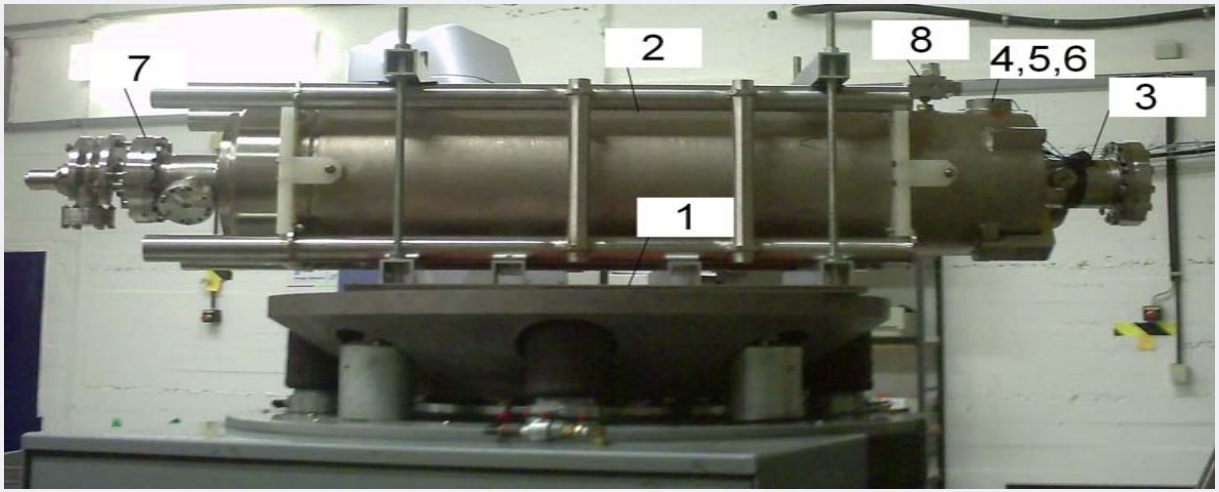
2x for DESY (XFEL), 1x for FNAL, 1x for KEK

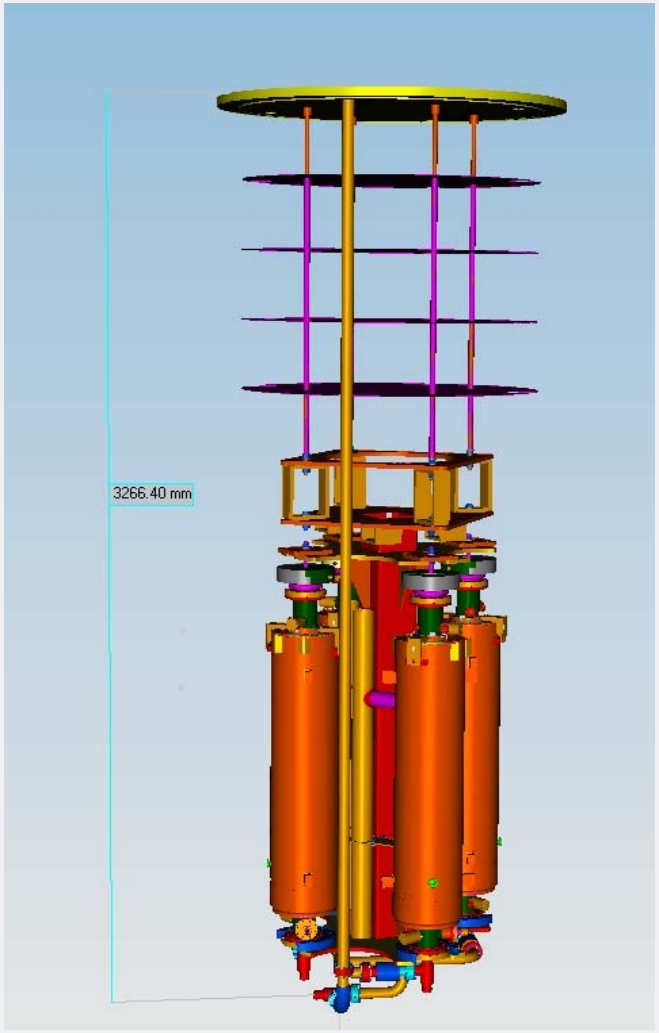
Transport Simulation: XFEL Vertical Insert

The vertical insert for testing XFEL series production is designed for 4 CV's (with and without He tank).

The lower part needs to be transported between manufacturer and test facility (AMTF) at DESY.

Transportation simulation:



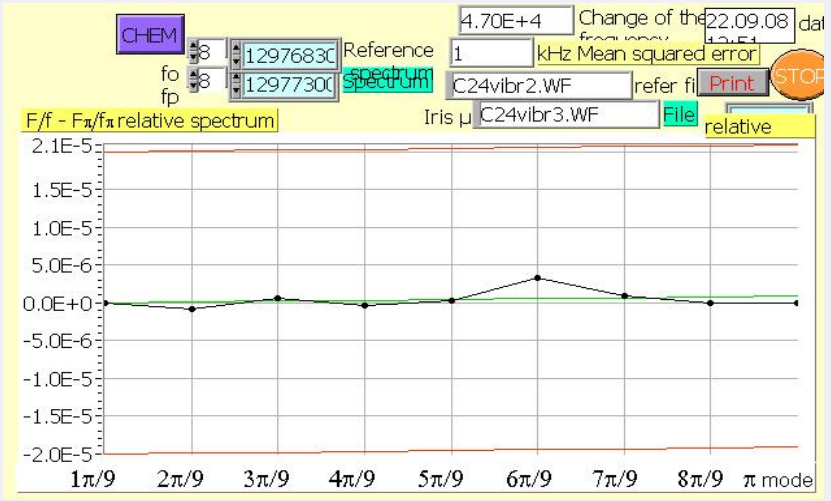


Transport simulation – Mode measurement

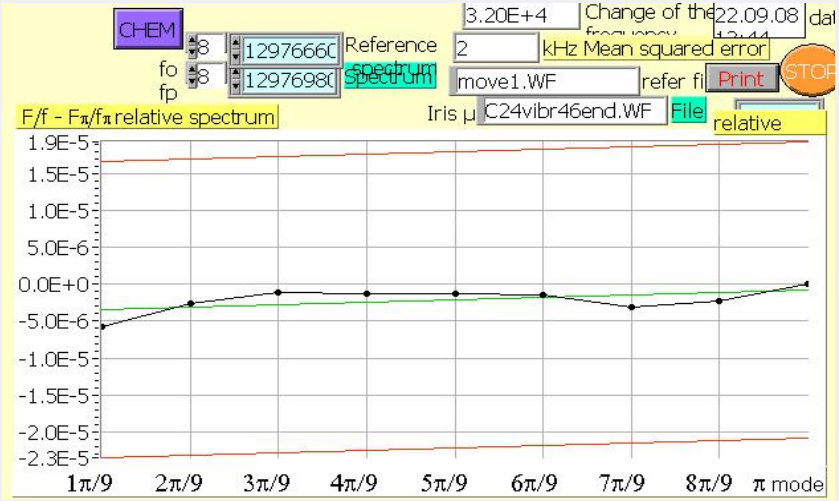
- Several mode measurements during the tests done:

=> no significant mechanical deformations of the CV

=> to be repeated with a rf tested cavity !



Startmessung



Abschlussmessung

3.9 GHz for FLASH + XFEL (LINAC08; THP019, THP028, THP029, THP030)

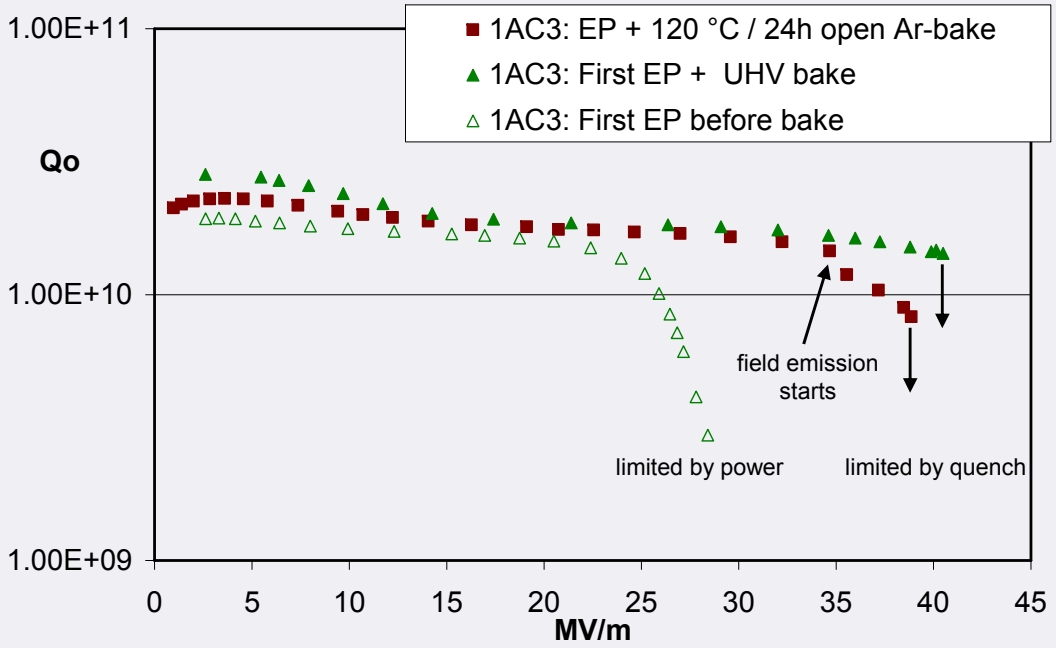
- close collaboration between FNAL, INFN Milano + DESY

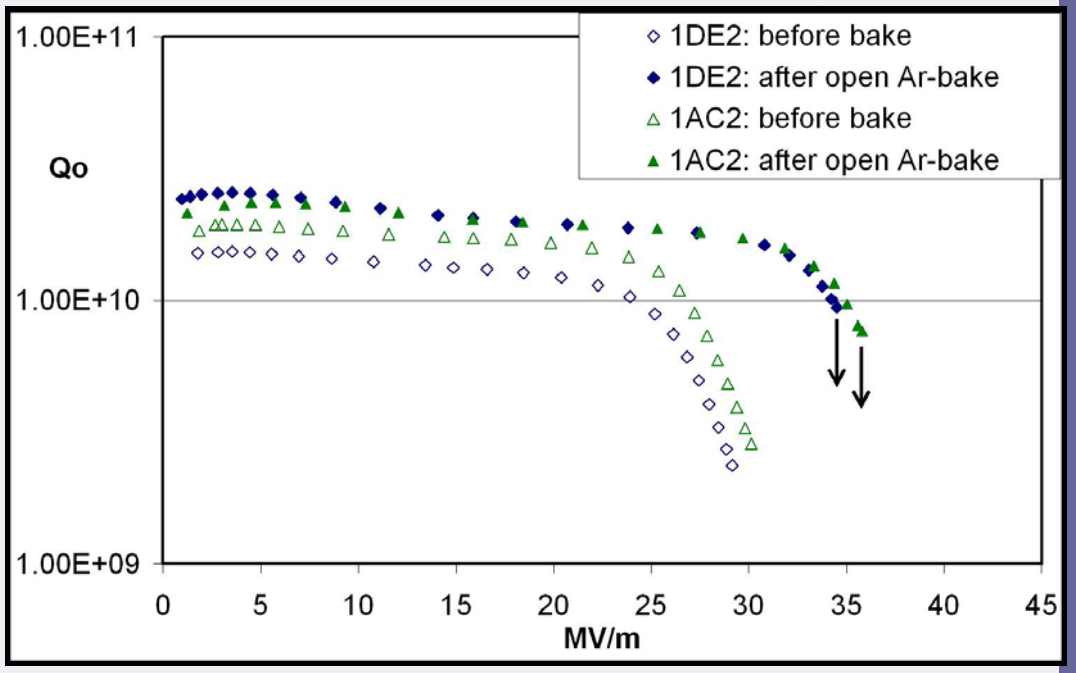
- **ACC39 for FLASH:**
- module ready at FNAL in Jan 09
- module test incl. assembly: Mar 09 – Jul 09
- assembly to FLASH: Sep 09
- beam commissioning: Dec 09

- **3.9 GHz cavities for XFEL** (=> INFN Milano)
- Simplified industrial production:
  => modified cavity + He-vessel design based on FNAL design

Open 120 °C bake in Argon atmosphere (LINAC08, THP015)

- Successful tests of open Ar-bake after final EP (left) + final short BCP (right):



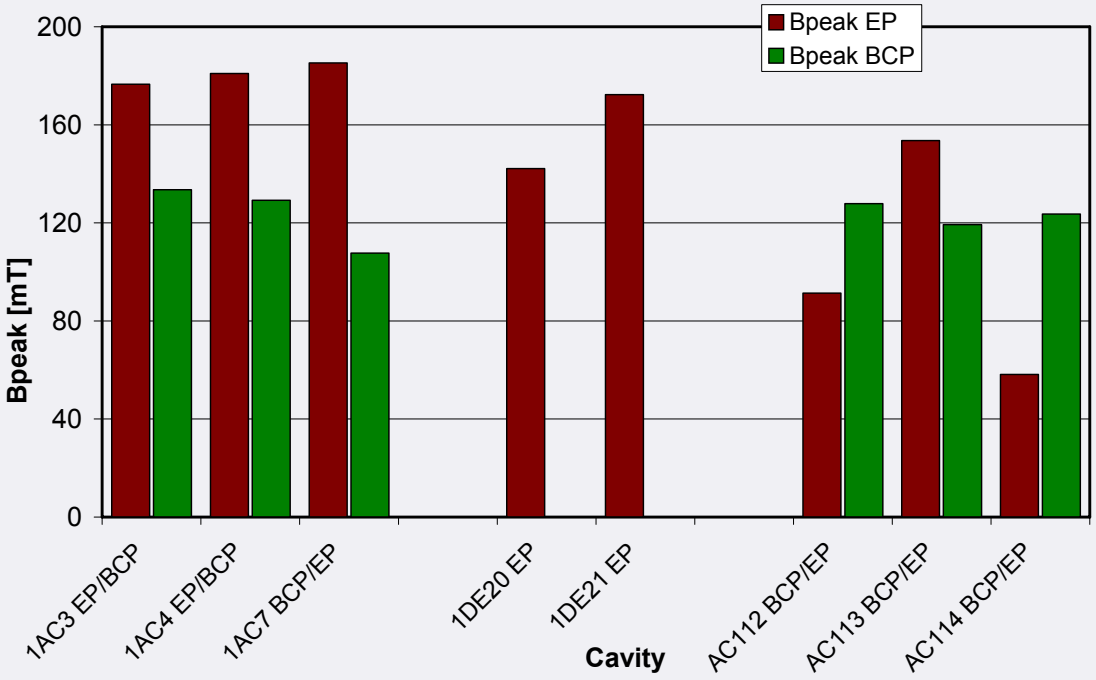


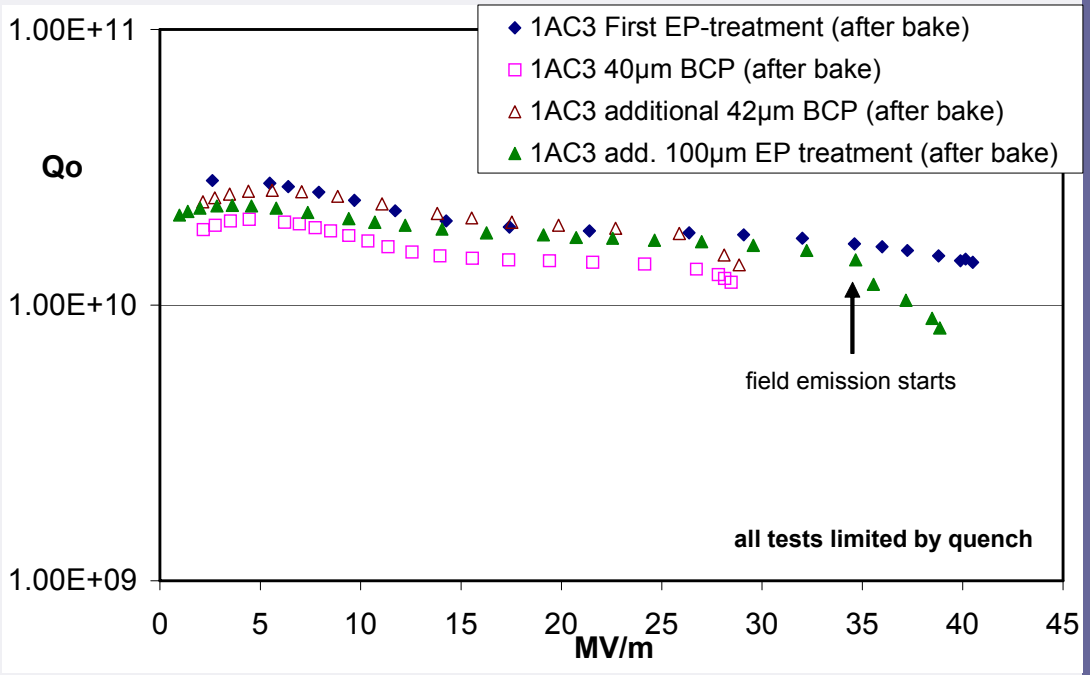
Advantages of open Ar-Bake:

- Simple implementation in the cavity preparation sequence before final HPR
- No additional vacuum handling of the fully assembled cavity + no additional thermal stress of the gaskets
- Commercial vacuum drying cabinet instead of special set-up

Large Grain Nb: EP vs. BCP

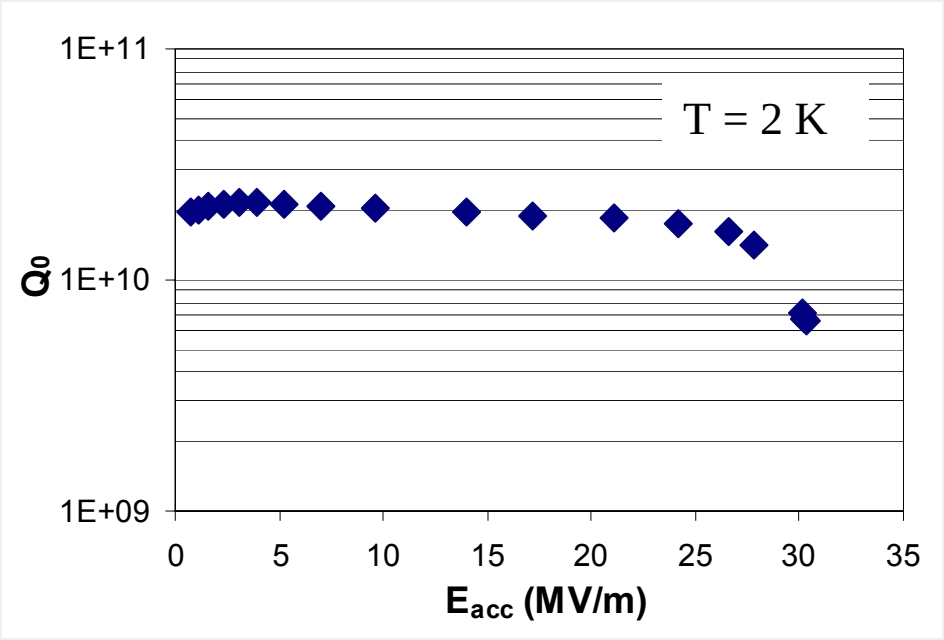
- **Final BCP** (> 40 µm removal) : reproducible gradients of **(25 – 30) MV/m**
- **Final EP** (> 40 µm removal) : gradients of **(33 – 43) MV/m in 6 of 8 cavities**
  but: two nine-cells with low gradient (1x FE; 1x BD) => new preparation
- **Full EP – BCP – EP cycles** in 2 single-cells: **gain of > 10 MV/m after EP**
- **Characteristic scrf parameters identical to fine grain !**





Hydroformed ("seamless") cavity: rf result

- Surface treatment at DESY:
  - 40 µm BCP, 800 °C heat treatment, tuning
  - 170 µm Electropolishing (EP), ethanol rinsing, 800 °C heat treatment
  - 48 µm EP, HPR, assembly and evacuation



- Status: He-tank welding done; 120 °C bake on the way

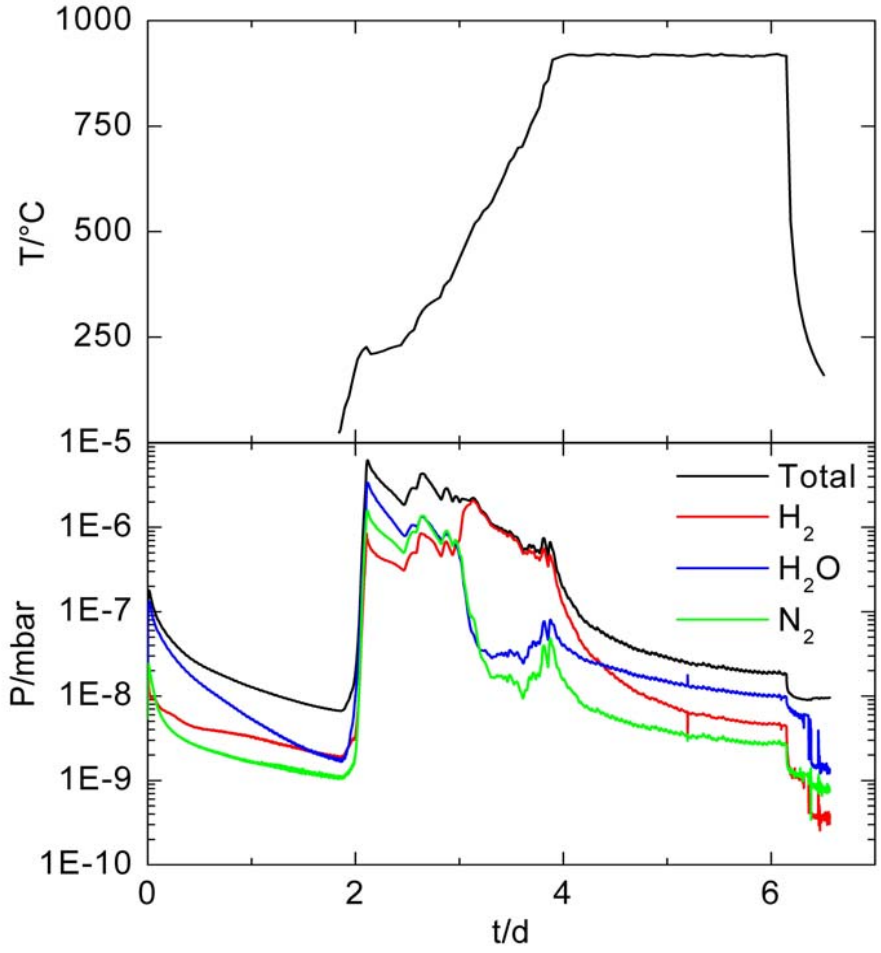
=> new rf test upcoming

Thanks!

Thanks to all external and internal colleagues, who provided me data, plots, information or any other support !!

Addendum

Cavity firing



- Heating to 850 °C
- Removing Hydrogen

Operational Findings II

Some 50 cold warm cycles and some 10 mounting dismounting procedures later: Gasket imprint on the flange, 0,16 mm deep, resulting in cold leaks

Sealing between cavity flange (Nb RRR 30) and coupler (Stainless): HELICOFLEX ®