Summary on the Parallel session LTECSC

Lutz Lilje

DESY

6.5.2004

Superconducting Linac Technology Session

- **Tuesday, May 4**
- 14:30 Introduction to LTECSC (Schedule, Deliverables) - L.Lilje
- JRA SRF Presentation
  - WP1 - Start up introduction, Management - D.Proch
  - WP2 - Planning for production reliability - P.Michelato
  - WP3 - Seamless Cavity Production - W.-D.Möller
  - WP4 - Thin Film Cavity Production - J.Langner
  - WP5 - Surface Preparation - L.Lilje
  - WP6 - Material Analysis - E.Palmieri
  - WP7 - High power coupler - M.Omeich
  - WP8 - Active tuner development - P.Sekalski
  - WP9 - Low Level RF - S.Simrock
  - WP10 - Cryostat Integration Tests - B.Visentin
  - WP11 - Beam diagnostics - C.Magne/ M. Castellano
- JRA HIPPI
  - WP3 - SC structures - S.Chel/C.Pagani Presenter: A. Bosotti

- Discussion on interconnection of JRAs and ELAN LTECSC
- Work plan discussion
  - Database setup
  - Planning of training course

- 16:00 ***Coffee Break***
- 16:15 - 18:15 ***Common session with*** LTECNC ***and*** ANAD ***on Sources of Electrons*** - Aula Touschek
  - Overview about JRS2: PHIN - A.Ghigo
  - Overview of the present status of the SRF gun design and construction - J.Teichert
  - The Eindhoven High-brightness Electron Source Programme - M.Van der Wiel
  - Electron acceleration in the Bubble regime: analytical theory and numerical simulations - S.Gordienko
  - The laser based electron beam approach : review and perspectives - V.Malka

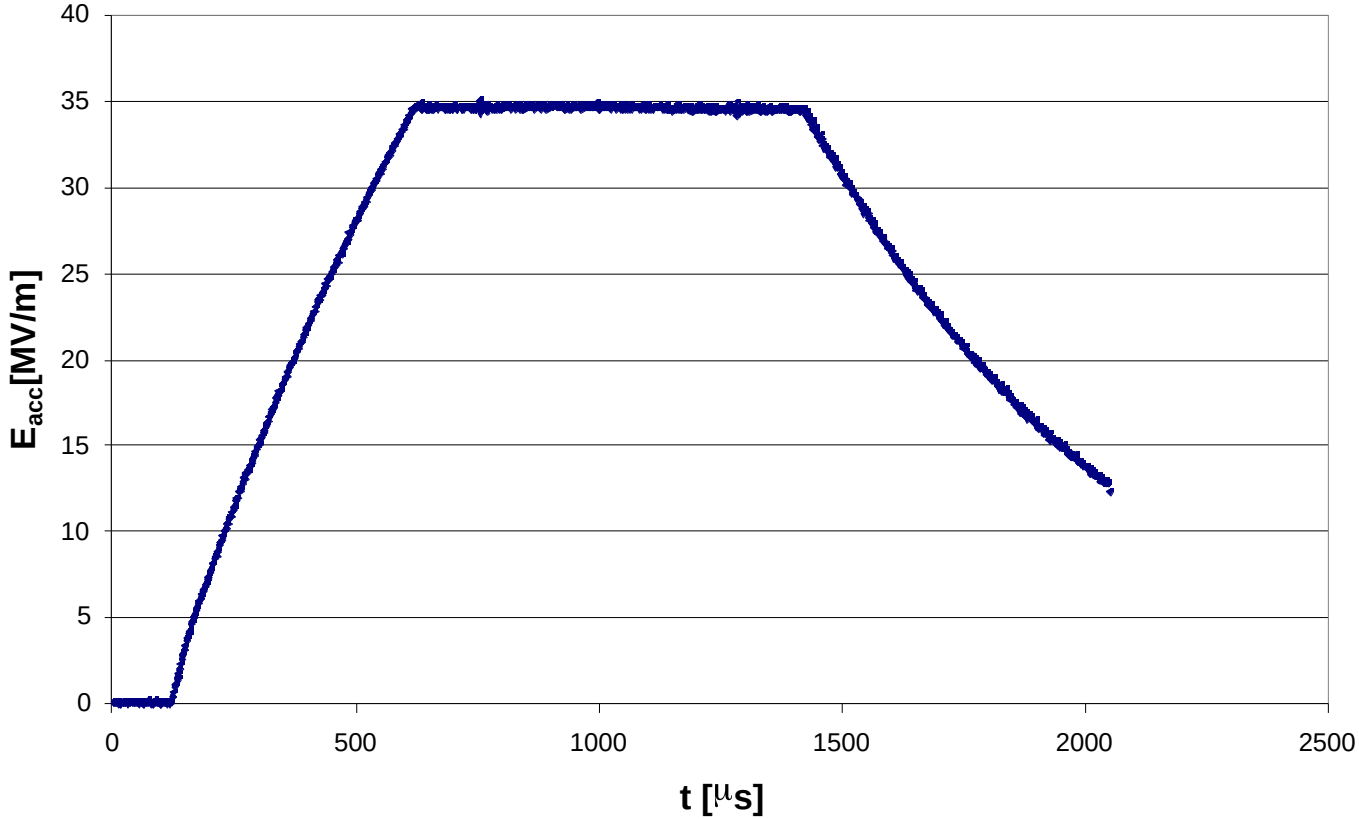
- **Wednesday, May 5**

- 09:00 Continuation of Tuesday meeting Aula A-1
- 11:00 ***Coffee Break***
- 11:30 - 13:30 ***Common session with LTECNC*** Aula Direzione
  - Stabilization of Accelerator Magnets to the Sub-nm Level - R.Assman
  - Stabilization studies from LAPP/ESIA - A.Jeremie
  - RF Deflectors for Combiner and Damping Rings - F.Marcellini
  - Mutual exchange of information between the NC-SC technologies, discussions on specific or common/critical aspects, like the two preceding topics or the possibility of combining both technologies for reaching higher energies, ...

Highlights from the JRAs

- Generally the JRA‘s are in good shape, although money arrived only very recently.
- E.g. JRA SRFCAV
  - Surface preparation
  - Dry-ice cleaning for niobium cavities
  - Improvement of test infrastructure in Saclay
  - Anti-Multipactor-Coating for couplers
  - Piezo actuators for active tuning
  - Other fabrication techniques for niobum caviites
  - Thin film techniques
- E.g. JRA HIPPI
  - Tuner

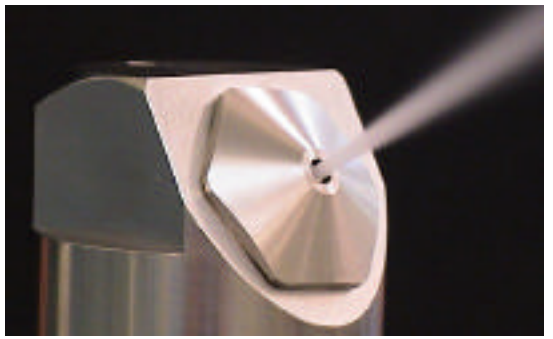
Cavity Test Inside a Module of TTF



- One of the electropolished cavities (AC72) was installed into an accelerating module for the TTF (VUV-FEL)
- Cooldown of the LINAC finished a few weeks ago
- Cavity was individually tested in the accelerator with high power RF and beam
- Result: **35 MV/m** in the accelerator!

Parameters of dry-ice cleaning

- spontaneous formation of snow/gas mixture by relaxation of liquid CO_2 (-78.9 C; ~ 50 bar)
- surrounding supersonic N_2 gas (20 C; > 12 bar)
  => acceleration + focussing
  => avoidance of condensation of humidity



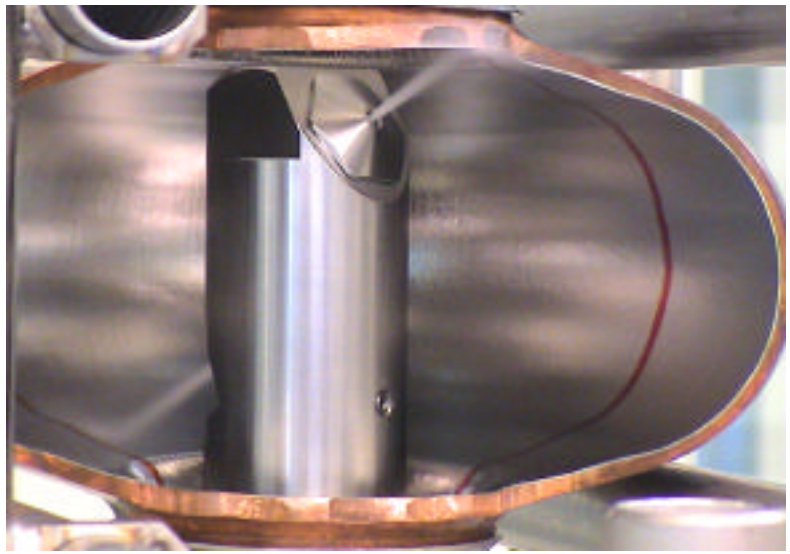
- cleaning forces:

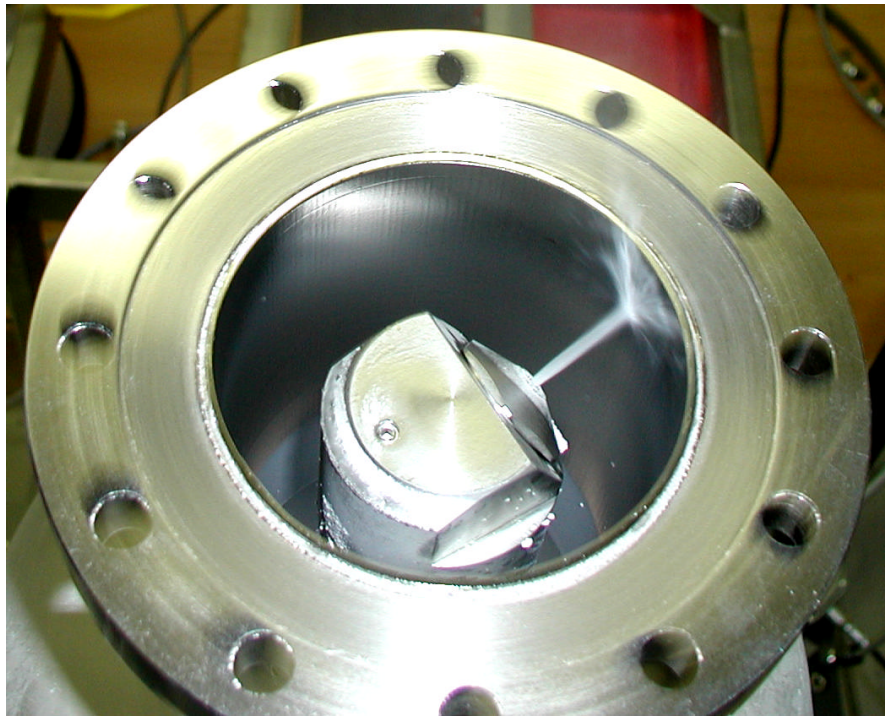
thermomechanical: i) brittling by shock-freezing
ii) pressure + shearing forces by high momentum
iii) volume increase by sublimation

chemomechanical: liquid CO_2 acts as solvent

Cavity tests on monocells

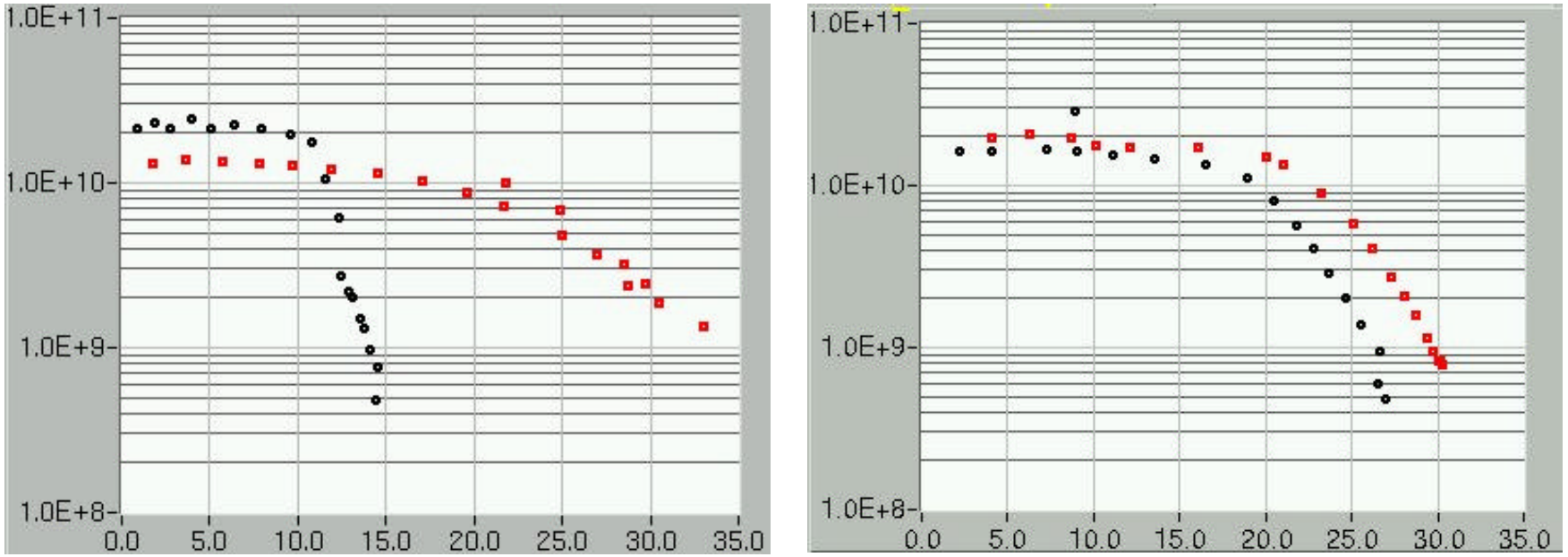
- dedicated nozzle system for cavity cleaning developed





First results of cavity tests

- Q-values up to 4,0 $\cdot 10^{10}$ at 1.8 K => no surface contamination
- gradients up to 33 MV/m => field emission is limiting effect



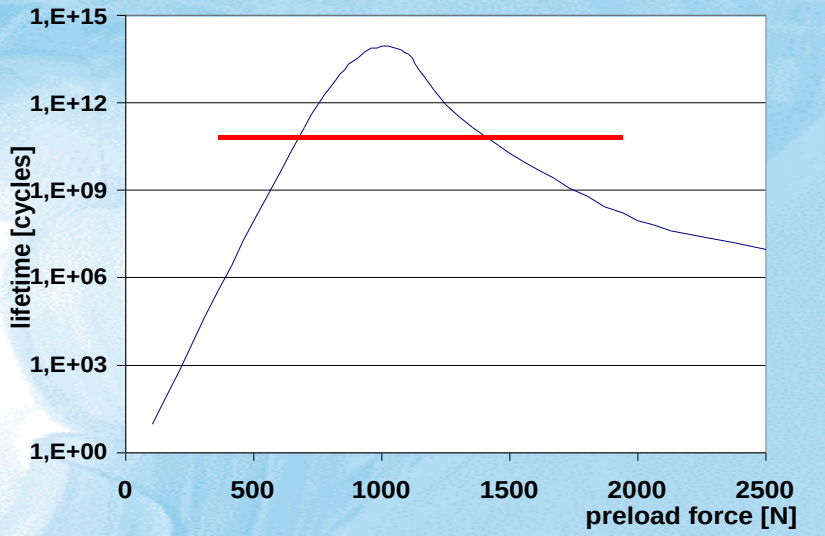
Q(E)-performance of two monocells before (black) and after (red) dry-ice cleaning

- => optimisation of process necessary
  (cleaning effect; avoidance of condensation, mass flow)

TESLA

Preload force estimation (1/2)

The lifetime of the piezo element depends on preload force



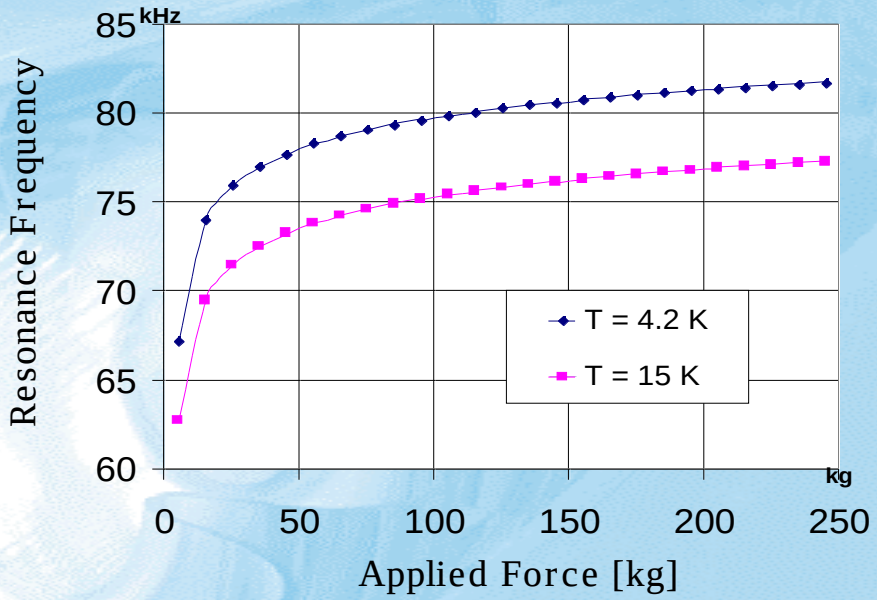
Till now, the preload force was calculated and/or assumed but never measured

Two new methods of the static force measurement at 2÷4 Kelvin is proposed:

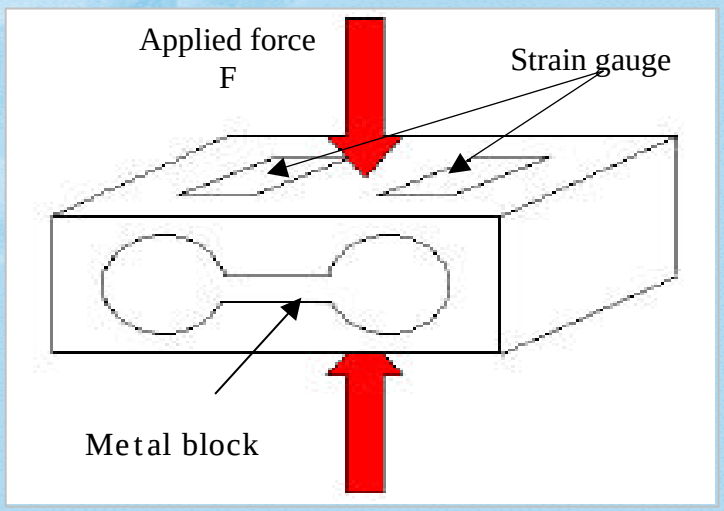
1. Resonance position on the impedance curve
2. Strain gauge sensor

Preload force estimation (2/2)

Impedance measurement



Strain gauge sensor



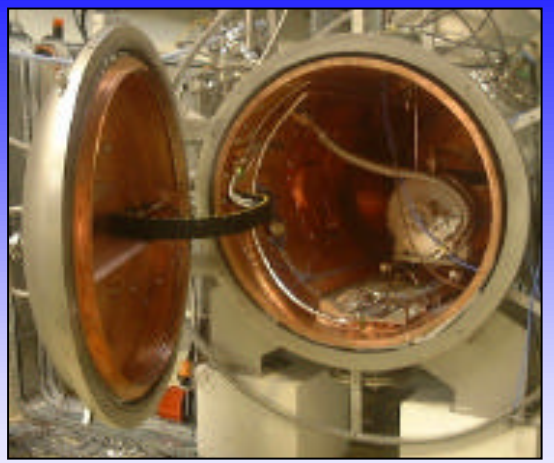
Cry-Ho-Lab (Cryostat Horizontal de Laboratoire)

Collaboration IN2P3 (IPN Orsay – LAL Orsay) / CEA Saclay

CEA site (Orme des Merisiers → Saclay)

full operation since May 2003

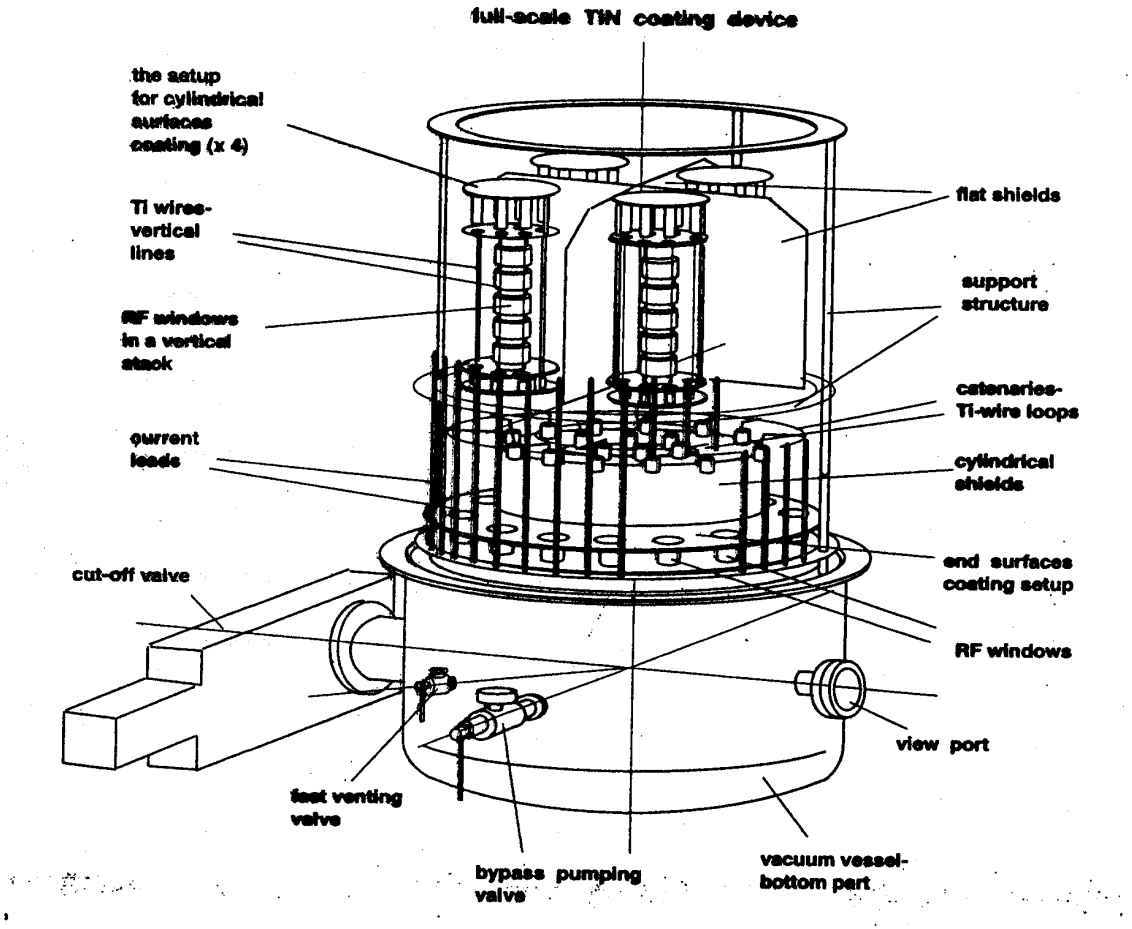
Liquefier Cold Box : 120 ℓ/h → He buffer container (2000 ℓ)



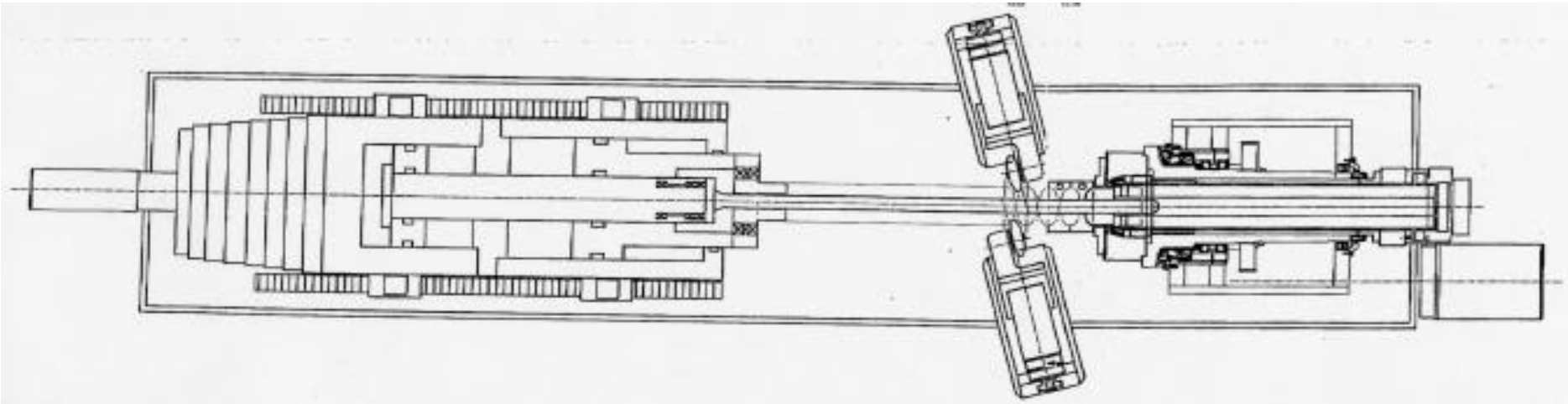
Magnetic Field Shielding → B_{res} = 20 mG

Design of TiN coating bench

- Studies are in progress
- Drawings will be ready in 2005
- Realisation will be in 2006

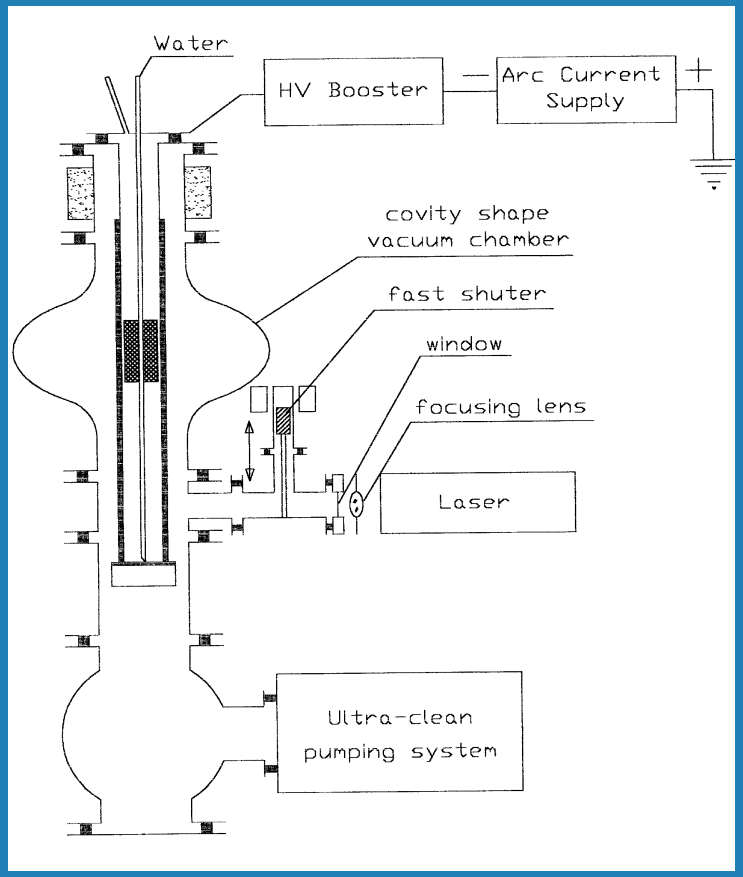


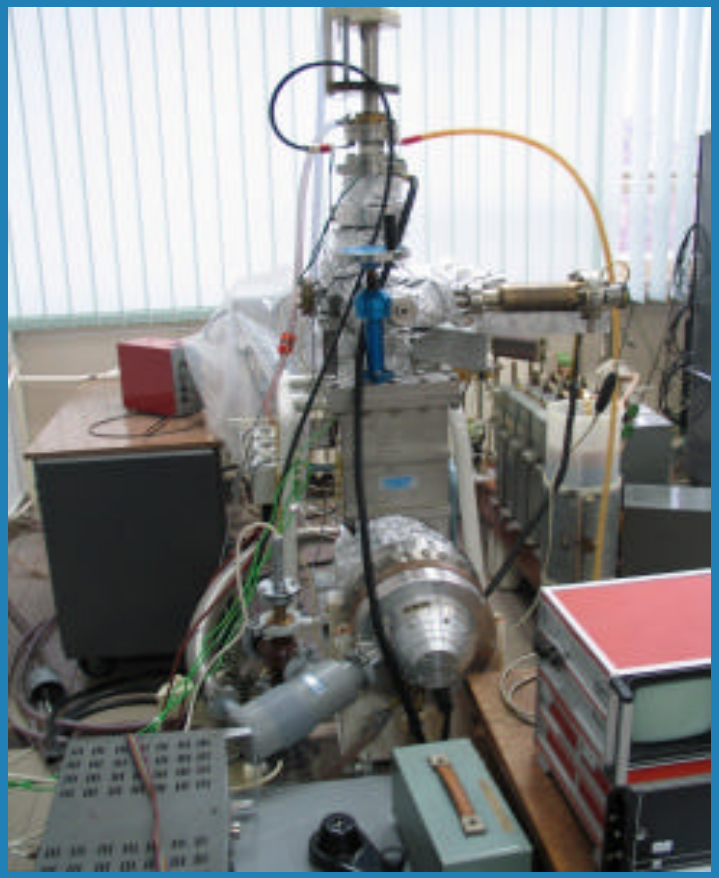
What we plan to do is to modify a standard spinning lathe in order to have a machine for 9-cell cavities



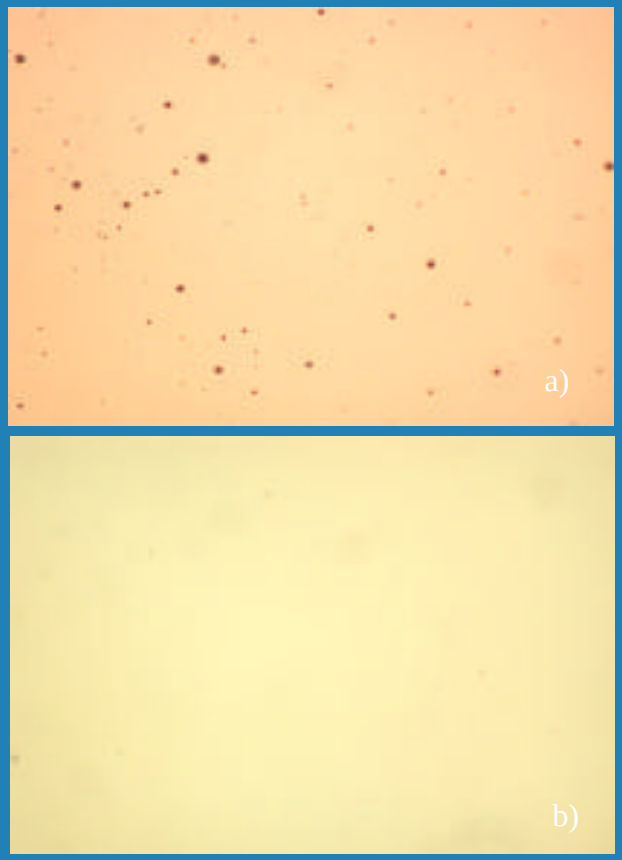
A standard machine will be adapted by increasing the pressure between headstock and tailstock; a second roller tower will be added if it will be not possible to make the roller pushing also backward

Linear arc


Water
HV Booster
Arc Current Supply
covity shape vacuum chamber
fast shuter
window
focusing lens
Laser
Ultra-clean pumping system



Sample morfology



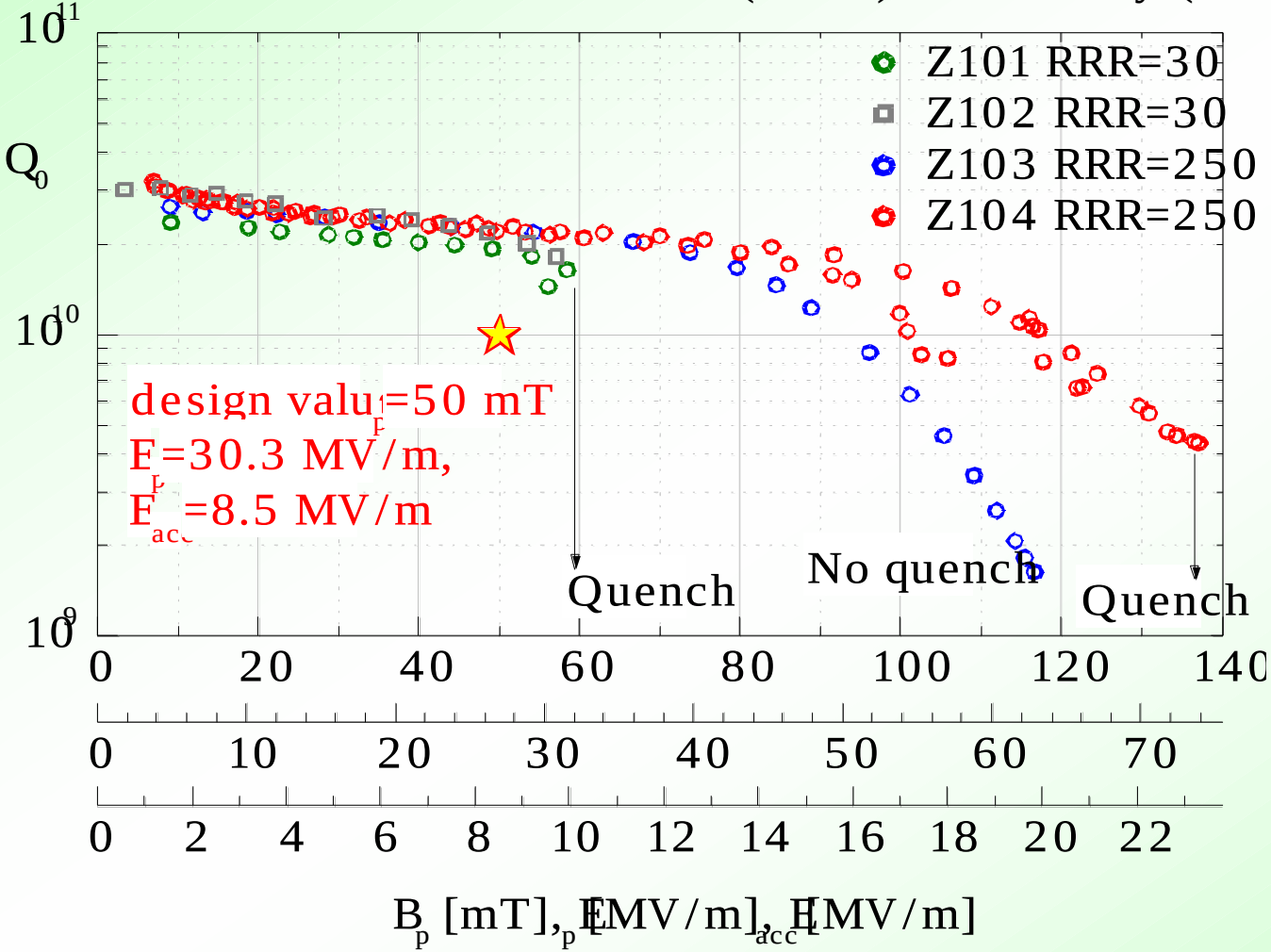
- without filter

- with filter

Summary of β=0.5 single cells

Fabricated with RRR>30 & RRR>250 Niobium at Zanon

BCP, HPR and tests at TJNAF (Z104) and Saclay (Z101-Z103)



For 1-cell:

E_p/E_{acc} = 2.90

B_p/E_{acc} = 5.38 mT/(MV/m)

For 5-cell:

E_p/E_{acc} = 3.57

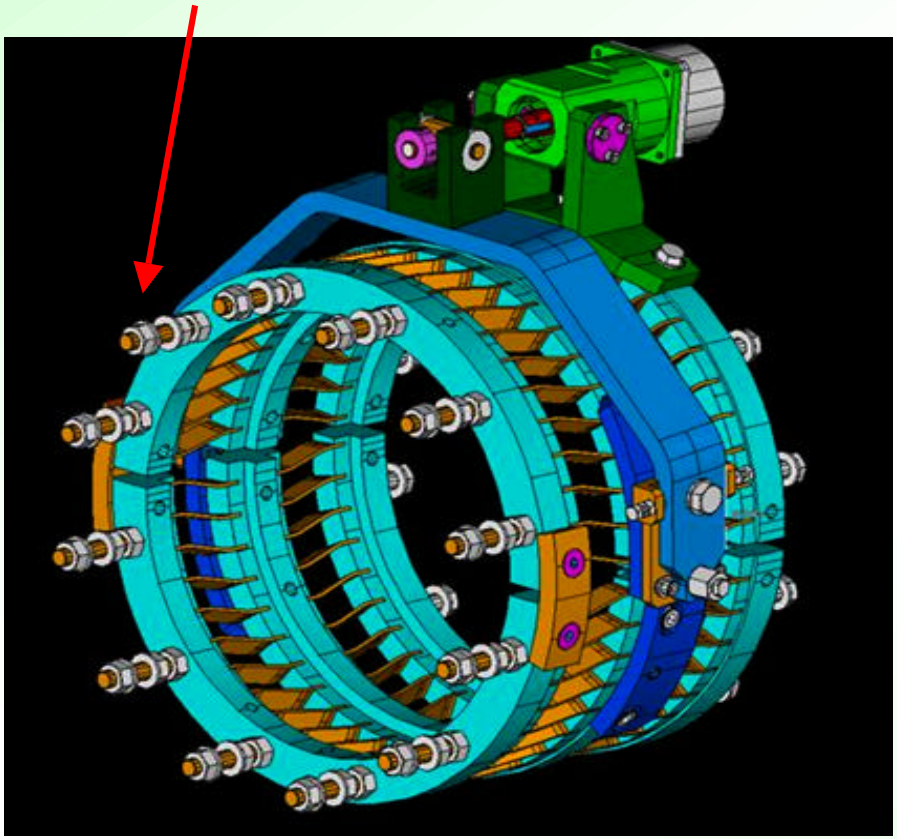
B_p/E_{acc} = 5.88 mT/(MV/m)

Max Epeak = 74 MV/m

Max Bpeak = 138 mT

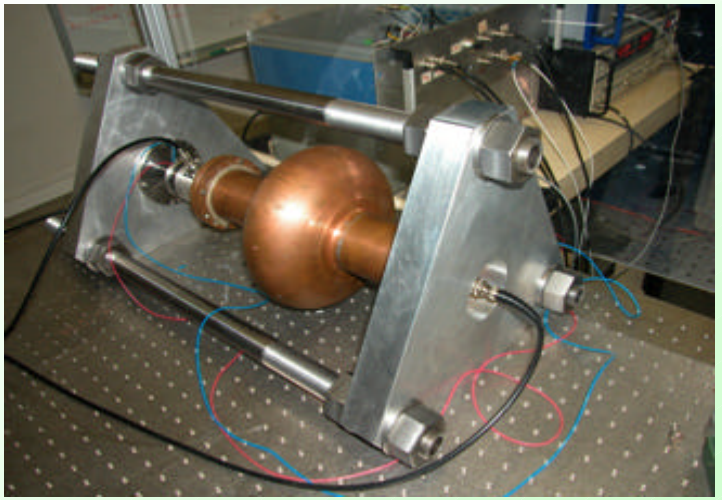
Piezoelectrics for microphonics

Piezos integration
to be design



Designing and characterizing
- Piezoelectric sensor/actuators
- Natural position is in the link between Tuner and Helium Tank

Joint development with TESLA & CARE/SRF (SRF WP8)



Deliverables of LTECSC

- Dissemination of knowledge
  - Database/ WEB site for SRF technology
    - Design of Web site: http://elan.desy.de
    - Review of status of technology
      - Links to SRF Workshops
      - Database for papers, books, etc.
      - Database on SRF projects
      - more ...
  - Course on SRF technology for newcomers and industry
    - E.g EPAC session
    - CERN Accelerator School
    - TTF Meetings
- Workshops
  - Participation at e.g. TTF (TESLA Test Facility) Meetings
  - Participation at JRA meeting (1/year)
- Review Reports (Nb sheet material, Fabrication processes, Quality control, Cleaning processes, Cavity Reliability, Roadmap of coupler reliability, Module manufacturability)

WP	Task		Year 1	Year 2	Year 3	Year 4	Year 5
LTECSC	*The work package is aimed at improving existing technology to its limits and to evaluate new materials for application in accelerators. The coordination in this work-package will allow well-defined R&D programs to share the workload between different institutes. Additionally, a comparison between the standard technology available today and possible alternatives is needed. This would allow one to increase either the performance and the reliability of the technology, or a more cost efficient approach. In this way each subsystem from the accelerating structure to the power source will be reviewed and can be optimised in this framework. The coordination will avoid duplication of developments. A database on SRF related documents will serve to ease distribution of the information. The work package will also serve to include industry into the R&D effort by introducing training courses thus allowing one to transfer knowledge from institutes to the industry. Also, new developments in technology will be reviewed for industrial manufacturability*						
	Coordination of R&D	Period	←	—	—	—	→
		MS	Workshop	Workshop	Workshop	Workshop	Workshop
		ID	Proceedings	Proceedings	Proceedings	Proceedings	Proceedings
	Dissemination of knowledge Courses on SC technology	Period		←	—	→	
		MS		Course			
		ID			Proceedings		
	Data base on SRF	Period	←	—	—	→	
		MD		**Data Base**			
		ID			Documentation		
	Strategy for R&D						
	Cavity Reliability Roadmap for coupler R&D Manufacturability of modules Machine protection	Period	←	—	→		
		MS		Workshop			
		ID		Reports			
	Surface treatments for cavities Reliable klystrons	Period	←	—	—	→	
		MS			Workshop		
		ID			Report		
	Material research on Nb sheets						
	Evaluation of quality control	Period	←	—	—	→	
		MS		Workshop			
		ID			Report		
	Evaluation of cleaning methods	Period	←	—	—	—	→
		MS		Workshop		Workshop	
		ID			Report		Report

LTECSC	**Roadmap to fabrication**						
	Evaluation of standard methods versus alternative ones	Period	←	—	—	→	
		MS	Workshop		Workshop		
		ID		Report		Report	
	Evaluate thin film methods	Period	←	—	—	—	→
		MS		Workshop		Workshop	
		ID			Report		Report
	Comparison of power sources, Cost efficiency	Period	←	—	→		
		MS		Workshop			
		ID			Report		
	Alternative cavities, feasibility study	Period	←	—	→		
		MS		Workshop			
		ID		Report			

Definitions starting during this meeting

- Contents of a database
  - What needs to be in?
    - Topics
      - Cavities
        - » Material (exists link thin films)
        - » Preparation (e.g. protocols of EP processes, Bakeout)
      - Couplers
        - » Processing times
        - » HOM damping
      - Tuners
        - » E.g. Piezo characteristics for fast tuning systems
    - Resources: Papers, Books, Ph.D. thesis, Proceedings, TTF Meetings, ‘technical‘ descriptions(TTF database, MHF-SL WWW)
    - Descriptions of projects
      - Comparison of project parameters
  - Start to accumulate information

Next steps

- Organisation:
  - Presentations of this meeting are condensed from the quarterly reports to the JRA. ELAN will point to these reports. Summary will be made (LL).
- Meetings:
  - Specialised LTECSC Meeting: SC Accelerator modules reliability discussion next TTF meeting in September 2004 in Orsay
  - CARE Meeting in November 2004: Discussion on training courses