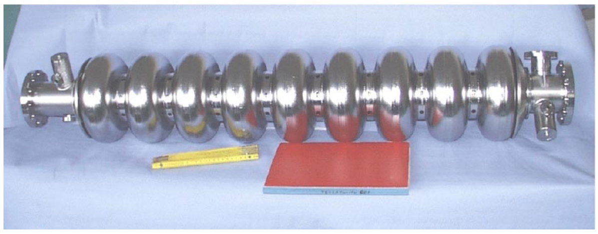
SRF



**Abstract**: This report summarises the activities of the CARE partners working within JRA1 for the first reporting period (01/01/04 – 31/12/04). MS Project charts are used to illustrate where we are with respect to the initial schedule and a list of the status of milestones/deliverables is presented. The major meetings concerning JRA1 topics are also listed along with the major conferences in which JRA1 results have been presented. Our dissemination of knowledge activities are highlighted by tabulating the technical notes, conference communications and oral presentations of our work during the last year. A brief summary of the comments and recommendations made by our International Advisory Committee is also included. Finally, the progress made within each of the ten technical work-packages is presented.

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# CARE/JRA1 Annual report 2004

## Research and Development on Superconducting Radio-Frequency Technology for Accelerator Applications

**Acronym: SRF**

**Co-Coordinators: D. Proch, DESY, T.Garvey, CNRS-Orsay**

**Participating Laboratories and Institutes:**

| **Institute** (Participating number) | **Acronym** | **Country** | **Coordinator** | **SRF Scientific Contact** | **Associated to** |
|---|---|---|---|---|---|
| DESY (6) | DESY | D | D. Proch | D. Proch | |
| CEA/DSM/DAPNIA (1) | CEA | F | O. Napoly | O. Napoly | |
| CNRS-IN2P3-Orsay (3) | CNRS-Orsay | F | T.Garvey | T.Garvey | CNRS |
| INFN Legnaro (10) | INFN-LNL | I | S. Guiducci | E. Palmieri | INFN |
| INFN Milano (10) | INFN-Mi | I | S. Guiducci | C. Pagani | INFN |
| INFN Roma2 (10) | INFN-Ro2 | I | S. Guiducci | S. Tazzari | INFN |
| INFN Frascati (10) | INFN-LNF | I | S. Guiducci | M. Castellano | INFN |
| Paul Scherrer Institute (19) | PSI | CH | V. Schlott | V. Schlott | |
| Technical University of Lodz (12) | TUL | PL | A.Napieralski | M. Grecki | |
| Warsaw University of Technology (14) | WUT-ISE | PL | R.Romaniuk | R. Romaniuk | |
| IPJ Swierk (13) | IPJ | PL | M. Sadowski | M. Sadowski | |

**Industrial Involvement:**

| **Company Name** | **Country** | **Contact Person** |
|---|---|---|
| ACCEL Instruments GmbH | D | M. Peiniger |
| WSK Mess- und Datentechnik GmbH | D | F. Schölz |
| E. ZANON SPA | I | G. Corniani |
| Henkel Lohnpoliertechnik GmbH | D | B. Henkel |

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# Summary of Research Activities JRASRF 2004

- The aim of the JRA on Superconducting RF Technology is to improve the quality and performance of the superconducting test accelerator TTF (Tesla Test Facility), a unique test facility to explore operating conditions of a high gradient superconducting accelerator, at DESY. This installation combines:

- A RF electron gun,
- superconducting accelerating units,
- beam diagnostics and
- undulators for FEL operation

The ultimate objectives of this research activity are

- to increase the accelerating gradient from 25 to 35 MV/m and
- to increase the quality factor from $5 \times 10^9$ to $2 \times 10^{10}$,
- to improve the reliability, operating performance and availability of the superconducting accelerating system,
- to achieve a cost reduction of the SRF cavities and their associated components.

An overview of the technical work packages with the various tasks is shown in the following table. Before we give a detailed description of the achieved results (milestones, deliverables) and the status and progress of the work (MS PROJECT) we make some general comments.

**Start-up, communication, financial issues, accounting**

The CARE project and thus the JRA-SRF started on 01.01.2004. After the global CARE kick off meeting in November 2003 we had our JRA-SRF kick off meeting at the end of January 2004. It was combined with the TESLA collaboration meeting at Zeuthen. This made it possible for all work-package leaders and several task leaders to be present at the workshop. The major task was to give an overview about all activities in the different work-packages of the JRA-SRF. Furthermore, organizational, financial and accounting issues were explained and discussed.

**Late arrival of EU support at participating institutes**

The EC support was transferred to many of the contracting participants around the end of May 2004. The Polish partners received the support later around June 2004. In most cases this late arrival of EC support resulted in a general delay in the spending of project money and in the hiring of non-permanent staff. In particular, subcontracts to industry were delayed. These contracts represent a considerable part of the planned early spending. This resulted in a considerable under-spending of the EC financial support and some delay in several planned activities. It is likely, however, that most of this delay can be reduced during the next reporting period.

**Status of milestones and deliverables**

As mentioned above, there is some delay in schedule mostly due to the late arrival of EC financial support. Therefore some milestones and one deliverable are delayed. At the end of December 2004 the situation is as follows ( see list):
14 milestones finished in 2004
13 milestones not finished in 2004 with an average delay of 5 month
1 deliverable not finished in 2004, delayed by 5 month

**Use and Dissemination of knowledge.**

Contributions of JRA-SRF members were given to several conferences and meetings, the major ones being as follows:
-The European Particle Accelerator Conference (EPAC 2004), Lucerne
-The International Linear Accelerator Conference (Linac 2004), Lübeck
-E-Beam 2004, Reno
-The First ILC (International Linear Collider) meeting, Tsukuba
-Workshop on pushing the limits of SRF technology, Chicago
-WILGA meeting on fast electronics, Wilga
In general, the CARE activities and especially the R&D effort for SRF technology in JRA-SRF can be considered as frontier activities in their respective fields of accelerator R&D.

There is strong interconnection between the R&D activities in JRA-SRF and the X-FEL project. The latter project is in a preparatory phase and many results of the JRA-SRF activities are of direct benefit to the X-FEL design.
Following the conclusion of the International Technical Recommendation Panel (ITRP) the planning for the organization of the International Linear Collider ILC is moving forward. The first technical meeting was held in Japan during the middle of November 2004. Members of the JRA-SRF community made essential contributions to the technical issues concerning a superconducting collider.
In addition there is growing interest of industry in the technology of SRF cavities. JRA1 members were asked to give review talks at the "International Conference on High Power Electron Beam Technology", Reno, Oct. 17-19,2004. It is the interest of industry to learn about the specific metallurgical properties of Niobium for superconducting cavities in order to prepare the production facilities for the needs of large accelerator projects like X-FEL and ILC.

**Highlights of JRA1 SRF**

Scientific investigations on coated Niobium films by the "vacuum arc method" have shown that the superconducting properties, i.e. $T_c$ and $\Delta T$, are the same as in bulk Niobium.
The technological progress with the preparation of cavities by electro-polishing and moderate bake out give hope, that this method results in high performance cavities, i.e. accelerating gradients above 30 MV/m with quality factors above $10^{10}$.
The remarkable progress in the design of a new tuner system by partners from Poland Italy, France and Germany demonstrated professional cooperation and communication in a high tech area by a European consortium.
The technology of superconducting accelerating cavities is the dominant activity in JRA1 SRF. This technology received global recognition by the International Technology Recommendation Panel with their decision in favor of superconducting technology for the ILC.

# List of Work packages, tasks and responsibilities

| | | |
|---|---|---|
| 2 Improved Standard Cavity Fabrication (ISCF) | ***P.Michelato*** | INFN Mi |
| 2.1 Reliability analysis | L. Lilje | DESY |
| 2.2 Improved component design | P.Michelato | INFN Mi |
| 2.3 EB welding | J. Tiessen | DESY |
| 3 Seamless Cavity Production (SCP) | ***W.-D. Moeller*** | DESY |
| 3.1 Seamless cavity production by spinning | E. Palmieri | INFN LNL |
| 3.2 Seamless cavity production by hydroforming | W. Singer | DESY |
| 4 Thin Film Cavity Production (TFCP) | ***M. Sadowski*** | IPJ |
| 4.1 Linear arc cathode | J. Langner | IPJ |
| 4.2 Planar arc cathode | S. Tazzari | INFN Ro2 |
| 5 Surface Preparation (SP) | ***L. Lilje*** | DESY |
| 5.1 EP on single cells | C. Antoine | CEA |
| 5.2 EP on multicells | A Matheisen | DESY |
| 5.3 Automated EP | E. Palmieri | INFN LNL |
| 5.4 Dry ice cleaning | D. Reschke | DESY |
| 6 Material Analysis (MA) | ***E. Palmieri*** | INFN LNL |
| 6.1 Squid scanning | W. Singer | DESY |
| 6.2 Flux gate magnetometry | M. Valentino | INFN LNL |
| 6.3 DC field emission studies of Nb samples | X. Singer | DESY |
| 7 Couplers (COUP) | ***M. Omeich*** | CNRS-Orsay |
| 7.1 New proto-types | L. Grandsire | CNRS-Orsay |
| 7.2 Titanium-nitride coating system | L. Grandsire | CNRS-Orsay |
| 7.3 Conditioning studies | P. Lepercq | CNRS-Orsay |
| 8 Tuners (TUN) | ***P. Sekalski*** | TUL |
| 8.1 UMI Tuner | A. Bosotti | INFN-Milano |
| 8.2 Magnetostrictive Tuner | A. Grecki | TUL |
| 8.3 CEA Tuner | P. Bosland | CEA |
| 8.4 IN2P3 activities | M. Fouaidy | CNRS-Orsay |
| 9 Low Level RF (LLRF) | ***S. Simrock*** | DESY |
| 9.1 Operability and Technical performance | S. Simrock | DESY |
| 9.2 Cost and reliabilty | M. Grecki | TUL |
| 9.3 Hardware technolgy | R. Romaniuk | WUT-ISE |
| 9.4 Software technology | Jezynski | WUT-ISE |
| 10 Cryostat Integration Tests | ***B. Visentin*** | CEA |
| 11 Beam Diagnostics (BD) | ***M. Castellano*** | INFN-LNF |
| 11.1 Beam position monitor | C. Magne | CEA |
| 11.2 Emittance monitor | M. Castellano | INFN-LNF |

CARE JRA1 SRF Technology

# Overview status of JRA1 SRF

| N° | Task Name | Milestones | Main Deliverables | Contractor | % schlo | 2004 J F M A M J J A S O N D / 2005 J F M A M J |
|---|---|---|---|---|---|---|
| **2** | **WP 2 IMPROVED STANDARD CAVITY FABRICATION** | | | | **22%** | |
| **2.1** | **Reliability Analysis** | | | **DESY** | **62%** | |
| 2.1.1 | Review of data bank: cavity fabrication | | | **DESY** | 100% | |
| 2.1.2 | Review of data bank :cavity treatment | | | **DESY** | 100% | |
| 2.1.3 | Review of data bank: cavity VT performance | | | **DESY** | 100% | |
| 2.1.4 | Review of data bank: string assembly | | | **DESY** | 100% | |
| 2.1.5 | Review of data bank: string performance | | | **DESY** | 27% | |
| 2.1.6 | Establish correlations | | | **DESY** | 10% | |
| 2.1.7 | **Final report on reliability issue** | | **Final Report** | **DESY** | 0% | 10.02. |
| **2.2** | **Improved component design** | | | **INFN-Mi** | **12%** | |
| **2.2.1** | **Documentation retrieving** | | | **INFN-Mi** | **21%** | |
| 2.2.1.1 | Start up meetings | | | **INFN-Mi** | 100% | |
| 2.2.1.2 | Access and study of Jlab, DESY, LLAN, KEK experience | | | **INFN-Mi** | 100% | |
| 2.2.1.3 | **Summary report on the status of the ar on ancillaries** | **Summary Report** | | **INFN-Mi** | 100% | 13.10. |
| 2.2.1.4 | Sealing material and shape design | | | **INFN-Mi** | 15% | |
| 2.2.1.5 | Flange preliminary design | | | **INFN-Mi** | 0% | |
| 2.2.1.6 | Material and geometric compatibility | | | **INFN-Mi** | 0% | |
| 2.2.1.7 | Final assembly design | | | **INFN-Mi** | 0% | |
| 2.2.1.8 | End plate preliminary design | | | **INFN-Mi** | 0% | |
| 2.2.1.9 | **Report about new design for compone** | **Design Report** | | **INFN-Mi** | 0% | 30.03. |
| 2.2.1.10 | Stiffness optimization | | | **INFN-Mi** | 8% | |
| 2.2.1.11 | Manufacturing procedure analysis | | | **INFN-Mi** | 0% | |
| 2.2.1.12 | Final assembly design | | | **INFN-Mi** | 0% | |
| 2.2.1.13 | Other ancillaries design | | | **INFN-Mi** | 6% | |
| 2.2.1.14 | **Final Report for new components** | **Report** | | **INFN-Mi** | 0% | |
| **2.2.2** | **Review of criticality in welding procedures** | | | **INFN-Mi** | **5%** | |
| 2.2.2.1 | Review of available parameters on vendor welding machine | | | **INFN-Mi** | 10% | |
| 2.2.2.2 | Definition of prototype requirements for tests | | | **INFN-Mi** | 0% | |
| 2.2.2.3 | Welding test on specimens | | | **INFN-Mi** | 0% | |
| 2.2.2.4 | Analysis of the results | | | **INFN-Mi** | 0% | |
| 2.2.2.5 | **Report about welding parameters** | **Report** | | **INFN-Mi** | 0% | |
| **2.2.3** | **Finalize new component design** | | | **INFN-Mi** | **0%** | |
| 2.2.3.1 | Do drawings | | | **INFN-Mi** | 0% | |
| 2.2.3.2 | **New components design finished** | **Design report** | | **INFN-Mi** | 0% | |
| **2.2.4** | **Finalize new cavity design** | | | **INFN-Mi** | **0%** | |
| 2.2.4.1 | Make drawings | | | **INFN-Mi** | 0% | |
| 2.2.4.2 | **New cavity design finished** | **Design report** | | **INFN-Mi** | 0% | |
| **2.2.5** | **Fabrication of new cavity** | | | **INFN-Mi** | **0%** | |
| 2.2.5.1 | Fabrication | | | **INFN-Mi** | 0% | |
| 2.2.5.2 | New cavity finished | | **Cavity Protot** | **INFN-Mi** | 33% | 01.01. |
| **2.3** | **EB welding** | | | **DESY** | **33%** | |
| **2.3.1** | **Design tooling** | | | **DESY** | **100%** | |
| 2.3.1.1 | Tools for flange welding | | | **DESY** | 100% | |
| 2.3.1.2 | Tools for pipe welding | | | **DESY** | 100% | |
| 2.3.1.3 | Tools for stiffening rings | | | **DESY** | 100% | |
| 2.3.1.4 | Tools for single cell welding | | | **DESY** | 100% | |
| 2.3.1.5 | Tools for 9-cells | | | **DESY** | 100% | |
| 2.3.1.6 | **Tools design finished** | **Design report** | | **DESY** | 100% | 15.12. |
| **2.3.2** | **Tools production** | | | **DESY** | **67%** | |
| 2.3.2.1 | Tools for flange welding | | | **DESY** | 100% | |
| 2.3.2.2 | Tools for pipe welding | | | **DESY** | 100% | |
| 2.3.2.3 | Tools for stiffening rings | | | **DESY** | 100% | |
| 2.3.2.4 | Tools for single cell welding | | | **DESY** | 100% | |
| 2.3.2.5 | Tools for 9-cells | | | **DESY** | 0% | |
| 2.3.2.6 | **Tools fabrication finished** | **Tools Ready** | | **DESY** | 0% | 11.03. |
| **2.3.3** | **Welding** | | | **DESY** | **13%** | |
| 2.3.3.1 | Commissioning welding machine | | | **DESY** | 100% | |
| 2.3.3.2 | Test welding | | | **DESY** | 79% | |
| 2.3.3.3 | **Start production welding of component** | **Commissioning** | | **DESY** | 0% | 11.03. |
| 2.3.3.4 | Single cell welding | | | **DESY** | 0% | |
| 2.3.3.5 | Multicell welding | | | **DESY** | 0% | |
| 2.3.3.6 | **Welding of prototypes of components f** | | **Prototypes** | **DESY** | 0% | |

Task 2.1: Delay due to late arrival of the information about TTF 2 cryomodule operating conditions (unexpected long shut down during summer 2004)

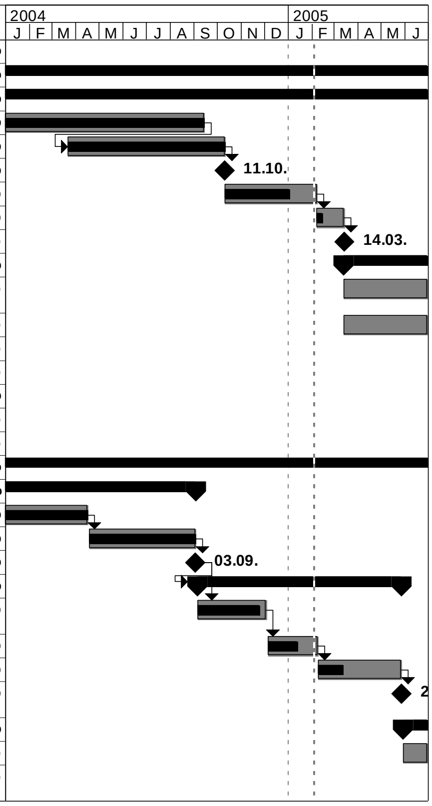
Task 2.2 : Delay due to late arraival of EC support and following late hiring of additional staff

Task 2.3. On time

| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| 3 | WP3 SEAMLESS CAVITY PRODUCTION | | | | 45% |
| 3.1 | Seamless by spinning | | | INFN-LNL | 30% |
| 3.1.1 | Design spinning machine | | | INFN-LNL | 100% |
| 3.1.1.1 | Drawings of the matrices | | | INFN-LNL | 100% |
| 3.1.1.2 | Drawings of the support system | | | INFN-LNL | 100% |
| 3.1.1.3 | Drawings of spinning machine finished | Design report | | INFN-LNL | 100% |
| 3.1.2 | Fabrication of spinning machine | | | INFN-LNL | 58% |
| 3.1.2.1 | Fabrication of machine parts | | | INFN-LNL | 100% |
| 3.1.2.2 | Software for the machine | | | INFN-LNL | 70% |
| 3.1.2.3 | Assembly of machine | | | INFN-LNL | 10% |
| 3.1.2.4 | Commissioning of the machine | | | INFN-LNL | 0% |
| 3.1.2.5 | Spinning machine ready | Commissioning | Machine read | INFN-LNL | 0% |
| 3.1.3 | Evaluation of spinning parameters | | | INFN-LNL | 1% |
| 3.1.3.1 | Drawings of the support system and turning mechanism | | | INFN-LNL | 0% |
| 3.1.3.2 | Drawings of the necking mechanism | | | INFN-LNL | 1% |
| 3.1.3.3 | Fabrication of the tube necking machine | | | INFN-LNL | 0% |
| 3.1.3.4 | Commissioning of the machine | | | INFN-LNL | 0% |
| 3.1.3.5 | Spinning parameters defined | | Design Repo | INFN-LNL | 0% |
| 3.1.4 | Spinning of 1-celll cavities | | | INFN-LNL | 0% |
| 3.1.4.1 | Material and fabrication of bulk Nb test tubes | | | INFN-LNL | 0% |
| 3.1.4.2 | Material and fabrication of bimetallic NbCu test tubes | | | INFN-LNL | 0% |
| 3.1.4.3 | 1-cell spinning parameters defined | | Design Repo | INFN-LNL | 0% |
| 3.1.5 | Extension of spinning apparatus to multicel | | | INFN-LNL | 0% |
| 3.1.5.1 | Computer simulation of the necking | | | INFN-LNL | 0% |
| 3.1.5.2 | Start of Multi-cell spinning | Start spinning | | INFN-LNL | 0% |
| 3.1.6 | Spinning of multi-cell cavities cavities | | | INFN-LNL | 0% |
| 3.1.6.1 | Computer simulation of the hydro forming | | | INFN-LNL | 0% |
| 3.1.6.2 | Hydro forming of bulk Nb 9-cell cavities | | | INFN-LNL | 0% |
| 3.1.6.3 | Parameters of multi-cell spinning defin | Design report | | INFN-LNL | 0% |
| 3.1.7 | Series production of multi-cell cavities | | | INFN-LNL | 0% |
| 3.1.7.1 | Spinning | | | INFN-LNL | 0% |
| 3.1.7.2 | Multi-cell cavities finished | | Final report, Cavity | INFN-LNL | 100% |
| 3.2 | Seamless by hydroforming | | | DESY | 52% |
| 3.2.1 | Design hydro forming machine | | | DESY | 100% |
| 3.2.1.1 | Drawings of the matrices | | | DESY | 100% |
| 3.2.1.2 | Drawings of the support system | | | DESY | 100% |
| 3.2.1.3 | Drawings matrix & support finished | Design report | | DESY | 100% |
| 3.2.2 | Construction of hydro forming machine | | | DESY | 73% |
| 3.2.2.1 | Hydraulic for machine | | | DESY | 100% |
| 3.2.2.2 | Software for the machine | | | DESY | 100% |
| 3.2.2.3 | Machine fabrication | | | DESY | 56% |
| 3.2.2.4 | Commissioning of the machine | | | DESY | 0% |
| 3.2.2.5 | Hydro forming machine ready | Commissioning | | DESY | 0% |
| 3.2.3 | Construction of tube necking machine | | | DESY | 95% |
| 3.2.3.1 | Drawings of the support system and turning mechanism | | | DESY | 100% |
| 3.2.3.2 | Drawings of the necking mechanism | | | DESY | 100% |
| 3.2.3.3 | Fabrication of the tube necking machine | | | DESY | 70% |
| 3.2.3.4 | Software for the tube necking machine | | | DESY | 100% |
| 3.2.3.5 | Construction tube necking machine fini | Design report | | DESY | 100% |
| 3.2.4 | Development of seamless tubes for 9-cell c | | | DESY | 58% |
| 3.2.4.1 | Material and fabrication of bulk Nb test tubes | | | DESY | 45% |
| 3.2.4.2 | Material and fabrication of bimetallic NbCu test tubes | | | DESY | 66% |
| 3.2.4.3 | Seamless tubes ready | Design report | | | 0% |
| 3.2.5 | Development of tube necking | | | DESY | 0% |
| 3.2.5.1 | Computer simulation of the necking | | | DESY | 0% |
| 3.2.5.2 | Experiments on tube necking at iris | | | DESY | 0% |
| 3.2.5.3 | Tube necking machine operational | Commissioning | | DESY | 0% |
| 3.2.6 | Hydro forming of seamless cavities | | | DESY | 0% |
| 3.2.6.1 | Computer simulation of the hydro forming | | | DESY | 0% |
| 3.2.6.2 | Hydro forming of bulk Nb 9-cell cavities | | | DESY | 0% |
| 3.2.6.3 | Hydro formed 9-cell cavities ready | | Cavity Protot | DESY | 0% |

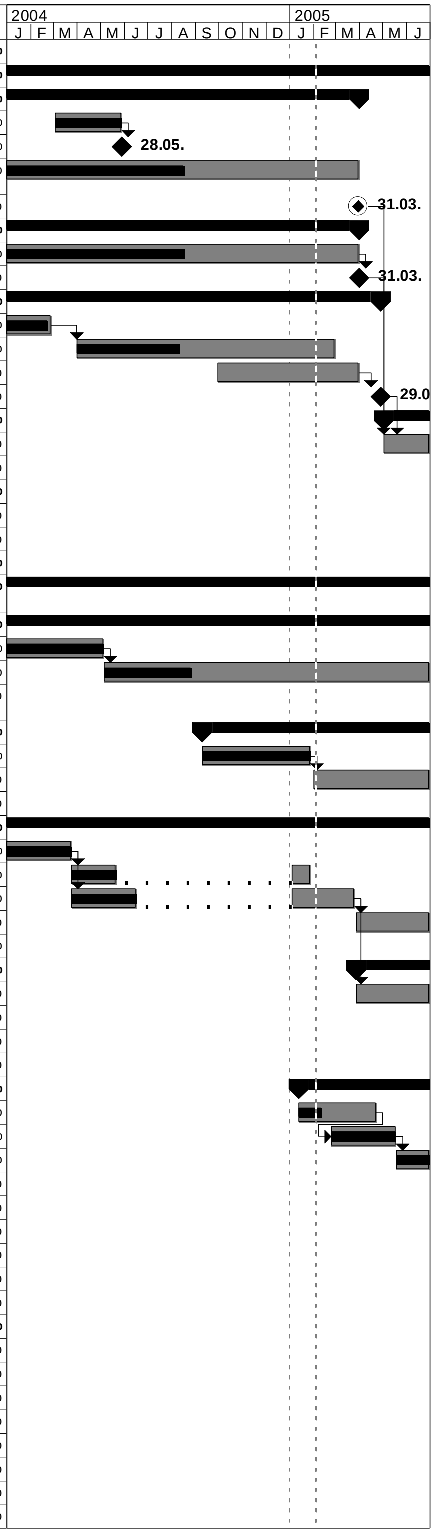
WP3: On schedule

| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **4** | **WP4 THIN FILM CAVITY PRODUCTION** | | | | **27%** |
| **4.1** | **Linear-arc cathode coating** | | | **IPJ** | **24%** |
| **4.1.1** | **Installation & commissioning of coating app** | | | **IPJ** | **32%** |
| 4.1.1.1 | Modification of a prototype facility for single c | | | **IPJ** | 100% |
| 4.1.1.2 | Optimization of a triggering system | | | **IPJ** | 100% |
| 4.1.1.3 | **Prototype facility ready** | **Commissioning** | | **IPJ** | 100% |
| 4.1.1.4 | Study of arc current reduction and stabilizatio | | | **IPJ** | 70% |
| 4.1.1.5 | Optimization of powering system | | | **IPJ** | 20% |
| 4.1.1.6 | **Coating apparatus operational** | **Apparatus ready** | | **IPJ** | 0% |
| **4.1.1.7** | **Coating single cells** | | | **IPJ** | **0%** |
| 4.1.1.7.1 | Coating of single cells without micro droplet filtering | | | **IPJ** | 0% |
| 4.1.1.7.2 | Design and construction of a micro drop | | | **IPJ** | 0% |
| 4.1.1.7.3 | **Droplet filter ready** | **Hardware ready** | | **IPJ** | 0% |
| 4.1.1.7.4 | Coating of single cell with micro droplet f | | | **IPJ** | 0% |
| **4.1.2** | **Coating multi-cell** | | | **IPJ** | **0%** |
| 4.1.2.1 | Design and commissioning | | | **IPJ** | 0% |
| 4.1.2.2 | First multicell coating | | | **IPJ** | 0% |
| **4.2** | **Planar-arc cathode coating** | | | **INFN-Ro2** | **31%** |
| **4.2.1** | **Modification of a planar-arc & trigger system** | | | **INFN-Ro2** | **100%** |
| 4.2.1.1 | Modification | | | **INFN-Ro2** | 100% |
| 4.2.1.2 | Optimization of the laser triggering system | | | **INFN-Ro2** | 100% |
| 4.2.1.3 | **Planar arc system fully tested** | **Status Report** | | **INFN-Ro2** | 100% |
| **4.2.2** | **Routine Operation of planar arc system** | | | **INFN-Ro2** | **58%** |
| 4.2.2.1 | Characterization of samples coated at different conditions | | | **INFN-Ro2** | 90% |
| 4.2.2.2 | Characterization of Nb-coated sapphire | | | **INFN-Ro2** | 60% |
| 4.2.2.3 | Characterization of Nb-coated copper sa | | | **INFN-Ro2** | 30% |
| 4.2.2.4 | **Summary report on quality of planar arc coating** | **Status Report** | | **INFN-Ro2** | 75% |
| **4.2.3** | **Studies of other HTC superconducting coati** | | | **INFN-Ro2** | **0%** |
| 4.2.3.1 | Study of superconducting properties | | | **INFN-Ro2** | 0% |
| 4.2.3.2 | **Report on quality of superconducting properties** | | **Final Report** | **INFN-Ro2** | 0% |




WP4: On schedule

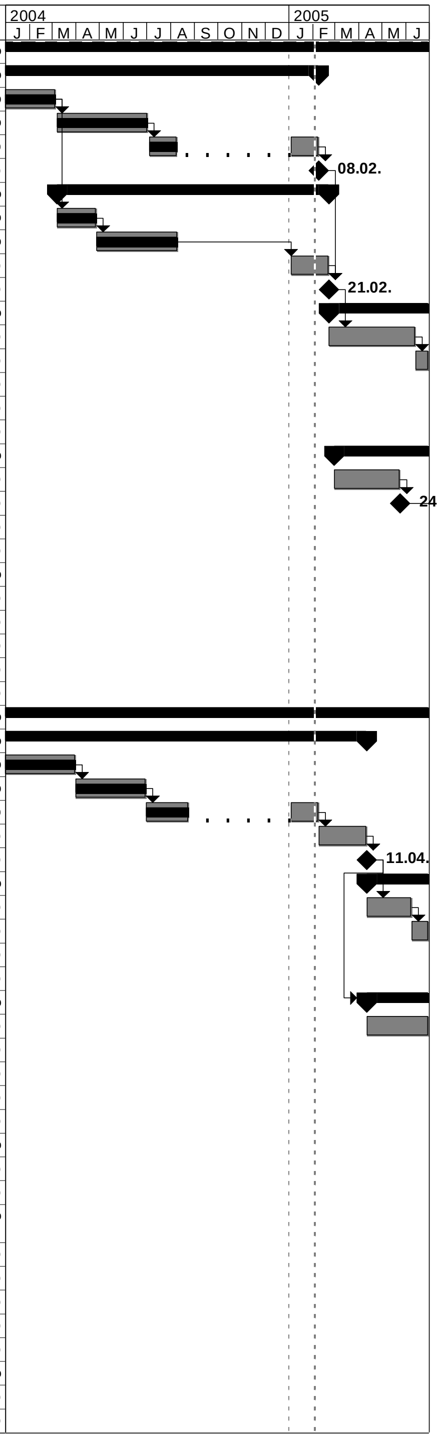
| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **5** | **WP5 SURFACE PREPARATION** | | | | **22%** |
| **5.1** | **EP on single cells** | | | **CEA** | **29%** |
| **5.1.1** | **EP on samples** | | | **CEA** | **58%** |
| 5.1.1.1 | Establishing method of surface characterizat | | | **CEA** | 100% |
| 5.1.1.2 | **Surface characterization fixed** | **Design Report** | | **CEA** | 100% |
| 5.1.1.3 | Series of EP with samples for surface investigations | | | **CEA** | 50% |
| 5.1.1.4 | **Best EP parameters** | | **Final Report** | **CEA** | 0% |
| **5.1.2** | **Single cell cavities** | | | **CEA** | **50%** |
| 5.1.2.1 | Order Nb and fabricate 3 cavities | | | **CEA** | 50% |
| 5.1.2.2 | **3 cavities fabricated** | **Cavities ready** | | **CEA** | 0% |
| **5.1.3** | **Build EP chemistry for single cells** | | | **CEA** | **32%** |
| 5.1.3.1 | Design of EP set-up | | | **CEA** | 90% |
| 5.1.3.2 | Fabrication of EP set-up | | | **CEA** | 40% |
| 5.1.3.3 | Commissioning of EP set-up | | | **CEA** | 0% |
| 5.1.3.4 | **First operation of EP set-up** | **Commissioning** | | **CEA** | 0% |
| **5.1.4** | **Operation of single cell EP** | | | **CEA** | **0%** |
| 5.1.4.1 | Continous single cell operation | | | **CEA** | 0% |
| 5.1.4.2 | **Define working parameters for single c** | **Design Report** | | **CEA** | 0% |
| **5.1.5** | **Continuous operation, search for best para** | | | **CEA** | **0%** |
| 5.1.5.1 | Parametrising EP procedure | | | **CEA** | 0% |
| 5.1.5.2 | **EP parameters fixed** | | **Final report** | **CEA** | 0% |
| **5.2** | **EP on multi-cells** | | | **DESY** | **25%** |
| **5.2.1** | **Transfer of parameters from 1 cell to multi cell equipment** | | | **DESY** | **45%** |
| **5.2.1.1** | **Finish EP setup nine-cells at DESY** | | | **DESY** | **42%** |
| 5.2.1.1.1 | Improved gas cleaning system | | | **DESY** | 100% |
| 5.2.1.1.2 | Design for hot water rinsing | | | **DESY** | 26% |
| 5.2.1.1.3 | **Proof-of-Principle experiment hot water rinsing** | **Status Report** | | **DESY** | 0% |
| **5.2.1.2** | **Optimize electrode shape** | | | **DESY** | **45%** |
| 5.2.1.2.1 | Develop computer model / Evaluate softw | | | **DESY** | 100% |
| 5.2.1.2.2 | Design improved electrode | | | **DESY** | 0% |
| 5.2.1.2.3 | **Electrode design fixed** | **Design report** | | **DESY** | 0% |
| **5.2.1.3** | **Fix process parameters/ Quality control** | | | **DESY** | **49%** |
| 5.2.1.3.1 | Setup chemical lab | | | **DESY** | 100% |
| 5.2.1.3.2 | Bath aging | | | **DESY** | 70% |
| 5.2.1.3.3 | Bath mixture | | | **DESY** | 50% |
| 5.2.1.3.4 | Alternative (salt) mixtures | | | **DESY** | 0% |
| 5.2.1.3.5 | **Process parameters fixed** | | **Final report** | **DESY** | 50% |
| **5.2.2** | **Laser roughness** | | | **DESY** | **0%** |
| 5.2.2.1 | Evaluate existing systems | | | **DESY** | 0% |
| 5.2.2.2 | Specify laser system | | | **DESY** | 0% |
| 5.2.2.3 | Built laser system | | | **DESY** | 0% |
| 5.2.2.4 | **Roughness measurement finished** | **Equipment ready** | | **DESY** | 0% |
| **5.2.3** | **Oxipolishing as final chemical cleaning** | | | **DESY** | **35%** |
| 5.2.3.1 | Laboratory studies | | | **DESY** | 30% |
| 5.2.3.2 | Design of OP system | | | **DESY** | 100% |
| 5.2.3.3 | Setup one-cell system | | | **DESY** | 90% |
| 5.2.3.4 | **Proof-of-Principle experiment Oxipolish** | **Status Report** | | **DESY** | 0% |
| 5.2.3.5 | Design OP for nine-cells | | | **DESY** | 0% |
| 5.2.3.6 | Build OP for 9-cells | | | **DESY** | 0% |
| 5.2.3.7 | **OP for 9-cells ready** | **Commissioning** | | **DESY** | 0% |
| 5.2.3.8 | Study op with 9-cell cavities | | | **DESY** | 0% |
| 5.2.3.9 | Evaluate experiments | | **Status Repor** | **DESY** | 0% |
| **5.2.4** | **Transfer Electropolishing technology to ind** | | | **DESY** | **0%** |
| 5.2.4.1 | Qualify industry with one-cells | | | **DESY** | 0% |
| 5.2.4.2 | Industrial design study on setup for multi-cel | | | **DESY** | 0% |
| 5.2.4.3 | **Report on industrial design** | **Report** | | **DESY** | 0% |
| 5.2.4.4 | Fabricate EP multi-cell industrial prototype | | | **DESY** | 0% |
| 5.2.4.5 | Commission EP multi-cell industrial prototype | | | **DESY** | 0% |
| 5.2.4.6 | **EP multi-cell industrial prototype ready** | **Commissioning** | | **DESY** | 0% |
| 5.2.4.7 | Operate EP multi-cell industrial prototype | | | **DESY** | 0% |
| 5.2.4.8 | **Final report on industrial EP** | | **Final report** | **DESY** | 0% |




WP 5.1.1 On schedule
WP 5.1.2 Slight delay in ordering material due to late arrival of EC support
WP 5.1.3: Delayed, because the installation of this chemical facility inside the lab will needs big changes, in particular reconstruction of lab hoods. Security procedures inside the lab have to be revised and accepted by the authority concerned. It will be difficult to get the functioning authorization before the end of 2004.
WP 5.2 : Operational delay of electro-chemical investigations due to component brake-downs ( leaks in chemical valves, contamination in high purity water system, enhanced heating in the electro-

chemical bath)

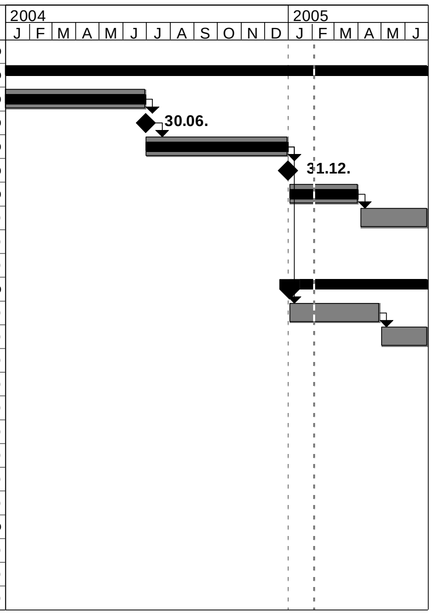
| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **5.3** | **Automated EP (AEP)** | | | **INFN-LNL** | **24%** |
| **5.3.1** | **Prototype EP installation** | | | **INFN-LNL** | **86%** |
| 5.3.1.1 | Design installation | | | **INFN-LNL** | 100% |
| 5.3.1.2 | Fabricate/ order components | | | **INFN-LNL** | 100% |
| 5.3.1.3 | Assemble EP installation | | | **INFN-LNL** | 50% |
| 5.3.1.4 | **First operation of automated EP** | **Commissioning** | | **INFN-LNL** | 0% |
| **5.3.2** | **EP computer control** | | | **INFN-LNL** | **76%** |
| 5.3.2.1 | Design control architecture | | | **INFN-LNL** | 100% |
| 5.3.2.2 | Developed software | | | **INFN-LNL** | 100% |
| 5.3.2.3 | Test of software | | | **INFN-LNL** | 0% |
| 5.3.2.4 | **Software ready** | **Status Report** | | **INFN-LNL** | 0% |
| **5.3.3** | **Operation of AEP prototype** | | | **INFN-LNL** | **0%** |
| 5.3.3.1 | Correlate surface finish/ conductance | | | **INFN-LNL** | 0% |
| 5.3.3.2 | Determine optimum conductance | | | **INFN-LNL** | 0% |
| 5.3.3.3 | Optimize automated operation | | | **INFN-LNL** | 0% |
| 5.3.3.4 | Design report on AEP | | | **INFN-LNL** | 0% |
| 5.3.3.5 | **Automated EP is defined** | | **Final Report** | **INFN-LNL** | 0% |
| **5.3.4** | **Alternative electrolytes** | | | **INFN-LNL** | **0%** |
| 5.3.4.1 | Review of EP chemistry | | | **INFN-LNL** | 0% |
| 5.3.4.2 | **Proposal for alternative electrolytes** | **Report** | | **INFN-LNL** | 0% |
| 5.3.4.3 | Experiments with alternative electrolytes | | | **INFN-LNL** | 0% |
| 5.3.4.4 | **Conclude experimental results** | **Status Report** | | **INFN-LNL** | 0% |
| **5.3.5** | **Define best AEP** | | | **INFN-LNL** | **0%** |
| 5.3.5.1 | Compare standard/new electrolyte method | | | **INFN-LNL** | 0% |
| 5.3.5.2 | Modify AEP installation for best electrolyte | | | **INFN-LNL** | 0% |
| 5.3.5.3 | Operate modified AEP | | | **INFN-LNL** | 0% |
| 5.3.5.4 | Design report on best AEP | | | **INFN-LNL** | 0% |
| 5.3.5.5 | **Conclude on best electrolyte** | | **Final Report** | **INFN-LNL** | 0% |
| **5.4** | **Dry ice cleaning** | | | **DESY** | **10%** |
| **5.4.1** | **Installation of full system for 1-3 cell cavities** | | | **DESY** | **70%** |
| 5.4.1.1 | Installation of CO2 piping | | | **DESY** | 100% |
| 5.4.1.2 | Installation of motion system | | | **DESY** | 100% |
| 5.4.1.3 | Installation of control system | | | **DESY** | 60% |
| 5.4.1.4 | Commissioning | | | **DESY** | 0% |
| 5.4.1.5 | **Installation finished** | **Commissioning** | | **DESY** | 0% |
| **5.4.2** | **Optimization of cleaning parameters** | | | **DESY** | **0%** |
| 5.4.2.1 | Sample cleaning | | | **DESY** | 0% |
| 5.4.2.2 | 1-cell cavity cleaning | | | **DESY** | 0% |
| 5.4.2.3 | Fix best cleaning parameters | | | **DESY** | 0% |
| 5.4.2.4 | **Cleaning parameters fixed** | | **Final Report** | **DESY** | 0% |
| **5.4.3** | **VT 9-cell cleaning apparatus** | | | **DESY** | **0%** |
| 5.4.3.1 | Design 9-cell apparatus VT | | | **DESY** | 0% |
| 5.4.3.2 | Fabricated 9-cell apparatus | | | **DESY** | 0% |
| 5.4.3.3 | Installation of 9-cell apparatus | | | **DESY** | 0% |
| 5.4.3.4 | Commissioning of 9-cell apparatus | | | **DESY** | 0% |
| 5.4.3.5 | **VT Cleaning Installation finished** | **Commissioning** | | **DESY** | 0% |
| **5.4.4** | **VT Cleaning of 9-cell cavities** | | | **DESY** | **0%** |
| 5.4.4.1 | Continuous cleaning | | | **DESY** | 0% |
| 5.4.4.2 | **Evaluation of experimental results** | | **Final Report** | **DESY** | 0% |
| **5.4.5** | **Design & construction of H 9-cell cleaning apparatus** | | | **DESY** | **0%** |
| 5.4.5.1 | Design 9-cell apparatus VT | | | **DESY** | 0% |
| 5.4.5.2 | Fabricated 9-cell apparatus | | | **DESY** | 0% |
| 5.4.5.3 | Installation of 9-cell apparatus | | | **DESY** | 0% |
| 5.4.5.4 | Commissioning of 9-cell apparatus | | | **DESY** | 0% |
| 5.4.5.5 | **Start H 9-cell cleaning** | **Commissionning** | | **DESY** | 0% |
| **5.4.6** | **Cleaning of horizontal nine-cell cavity** | | | **DESY** | **0%** |
| 5.4.6.1 | Continuous cleaning | | | **DESY** | 0% |
| 5.4.6.2 | **Evaluation of experimental results** | | **Final Report** | **DESY** | 0% |




WP 5.3: Some delay due to late hiring of additional technical staff.
WP 5.4: Delay of design and installation of the control system for dry ice cleaning due to mal-functioning of some sub components.

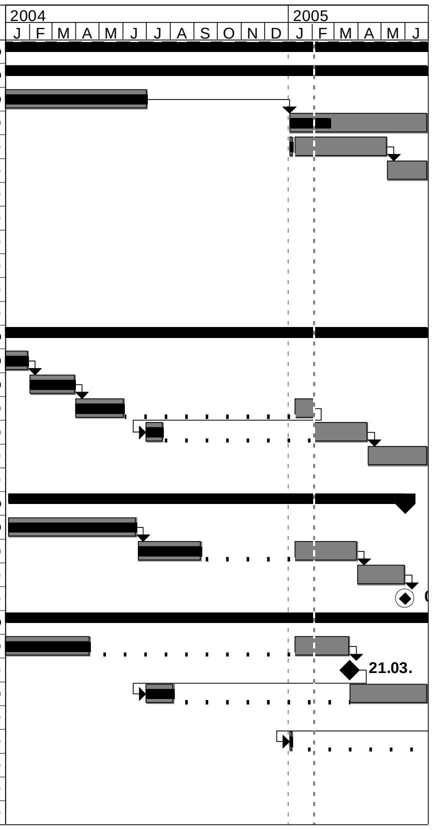
| N° | Task Name | Milestones | Main Deliverables | Contractor | % schlos |
|---|---|---|---|---|---|
| **6** | **WP6 MATERIAL ANALYSIS** | | | **DESY** | **21%** |
| **6.1** | **SQUID scanning** | | | **DESY** | **37%** |
| **6.1.1** | **Produce calibration defects** | | | **DESY** | **100%** |
| 6.1.1.1 | Production of surface defects | | | **DESY** | 100% |
| 6.1.1.2 | Production of bulk defects | | | **DESY** | 100% |
| 6.1.1.3 | **Calibration defects finished** | **Status Report** | | **DESY** | 100% |
| **6.1.2** | **Design components of Squid scanner** | | | **DESY** | **100%** |
| 6.1.2.1 | Design of the scanning table and support | | | **DESY** | 100% |
| 6.1.2.2 | Design of the SQUID cooling system | | | **DESY** | 100% |
| 6.1.2.3 | **Design Scanner finished** | **Design report** | | **DESY** | 100% |
| **6.1.3** | **Construction of scanning apparatus** | | | **DESY** | **11%** |
| 6.1.3.1 | Fabrication of the SQUID | | | **DESY** | 10% |
| 6.1.3.2 | Fabrication and purchase of components for SQUID apparatus | | | **DESY** | 15% |
| 6.1.3.3 | Softw are for the SQUID scanner | | | **DESY** | 15% |
| 6.1.3.4 | Commissioning and calibration of scanning apparatus | | | **DESY** | 0% |
| 6.1.3.5 | **Scanning apparatus operational** | **Commissioning** | | **DESY** | 0% |
| **6.1.4** | **Scanning of sheets with artificial defects** | | | **DESY** | **0%** |
| 6.1.4.1 | Scanning of sheets w ith artificial surface def | | | **DESY** | 0% |
| 6.1.4.2 | Scanning of sheets w ith artificial bulk defects | | | **DESY** | 0% |
| 6.1.4.3 | Development of algorithm for material defects classification | | | **DESY** | 0% |
| 6.1.4.4 | **Classification of defects finished** | **Status Report** | | **DESY** | 0% |
| **6.1.5** | **Scanning of production sheets** | | | **DESY** | **0%** |
| 6.1.5.1 | Scanning of sheets of different producers | | | **DESY** | 0% |
| 6.1.5.2 | Identification of defects by (EDX, SURFA etc | | | **DESY** | 0% |
| 6.1.5.3 | Conclusive comparison w ith eddy current da | | | **DESY** | 0% |
| 6.1.5.4 | **Final report on SQUID scanning** | | **Final Report** | **DESY** | 0% |
| **6.2** | **Flux gate magnetometry** | | | **INFN-LNL** | **31%** |
| **6.2.1** | **Produce calibration defects** | | | **INFN-LNL** | **74%** |
| 6.2.1.1 | Production of surface defects | | | **INFN-LNL** | 100% |
| 6.2.1.2 | Production of bulk defects | | | **INFN-LNL** | 55% |
| 6.2.1.3 | **Calibration defects finished** | **Status Report** | | **INFN-LNL** | 0% |
| **6.2.2** | **Design components of flux gate head** | | | **INFN-LNL** | **100%** |
| 6.2.2.1 | Design electronics | | | **INFN-LNL** | 100% |
| 6.2.2.2 | Design of flux gate head | | | **INFN-LNL** | 100% |
| 6.2.2.3 | Design of operations softw are | | | **INFN-LNL** | 100% |
| 6.2.2.4 | **Design flux gate head finished** | **Design report** | | **INFN-LNL** | 100% |
| **6.2.3** | **Fabrication of flux gate detector** | | | **INFN-LNL** | **7%** |
| 6.2.3.1 | Fabrication of flux gate head | | | **INFN-LNL** | 6% |
| 6.2.3.2 | Fabrication of mechanics | | | **INFN-LNL** | 12% |
| 6.2.3.3 | Implementation of softw are | | | **INFN-LNL** | 0% |
| 6.2.3.4 | Commissioning of flux gate detector | | | **INFN-LNL** | 0% |
| 6.2.3.5 | Calibration of flux gate detector | | | **INFN-LNL** | 0% |
| 6.2.3.6 | **Flux gate detector operational** | **Design report, start operation** | | **INFN-LNL** | 0% |
| **6.2.4** | **Commissioning of flux gate detector** | | | **INFN-LNL** | **0%** |
| 6.2.4.1 | Operational tets tests | | | **INFN-LNL** | 0% |
| 6.2.4.2 | Evaluation of test results | | | **INFN-LNL** | 0% |
| 6.2.4.3 | **Flux gate scanner commissioned** | **Status Report** | | **INFN-LNL** | 0% |
| **6.2.5** | **Operation of flux gate detector** | | | **INFN-LNL** | **0%** |
| 6.2.5.1 | Regular operation | | | **INFN-LNL** | 0% |
| 6.2.5.2 | Report of operation | | | **INFN-LNL** | 0% |
| 6.2.5.3 | **Conclusion of flux gate scanning operat** | **Status Report** | | **INFN-LNL** | 0% |
| **6.2.6** | **Comparison with SQUID scanner** | | | **INFN-LNL** | **0%** |
| 6.2.6.1 | Compare measurements | | | **INFN-LNL** | 0% |
| 6.2.6.2 | **Conclude SQUID scanner vs. flux gate detector** | | **Final Report** | **INFN-LNL** | 0% |
| **6.3** | **DC field emission studies of Nb samples** | | | **DESY** | **6%** |
| **6.3.1** | **Quality control scans** | | | **DESY** | **14%** |
| 6.3.1.1 | Modification of Scanning apparatus | | | **DESY** | 100% |
| 6.3.1.2 | Calibration of Scanning apparatus | | | **DESY** | 100% |
| 6.3.1.3 | **Start scanning activity** | **Start Operation** | | **DESY** | 100% |
| 6.3.1.4 | BCP and HPR samples | | | **DESY** | 30% |
| 6.3.1.5 | EP and HPR samples | | | **DESY** | 10% |
| 6.3.1.6 | BCP/EP and DIC samples | | | **DESY** | 0% |
| 6.3.1.7 | **First report on BCP/EP and DIC surface** | **Interim Report** | | **DESY** | 0% |
| 6.3.1.8 | Continue QA scanning | | | **DESY** | 0% |
| 6.3.1.9 | **Evaluation of scanning results** | | **Final Report** | **DESY** | 0% |
| **6.3.2** | **Detailed measurements on strong emitters** | | | **DESY** | **0%** |
| 6.3.2.1 | Calibrate apparatus for high current | | | **DESY** | 0% |
| 6.3.2.2 | **Start strong emitter evaluation** | **Start Measureme** | | **DESY** | 0% |
| 6.3.2.3 | I/V curves and current limits | | | **DESY** | 0% |
| 6.3.2.4 | SEM and AES | | | **DESY** | 0% |
| 6.3.2.5 | Influence of heat treatment and ion impact | | | **DESY** | |

| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **7** | **WP7 COUPLERS** | | | | **13%** |
| **7.1** | **New Prototype Coupler** | | | **CNRS-Orsay** | **50%** |
| 7.1.1 | RF Simulations of Coupler | | | **CNRS-Orsay** | 100% |
| 7.1.2 | Report on Simulation | | | **CNRS-Orsay** | 100% |
| 7.1.3 | Detailed Engineering Draw ings | | | **CNRS-Orsay** | 100% |
| 7.1.4 | Engineering complete | | | **CNRS-Orsay** | 100% |
| 7.1.5 | Call for tenders | | | **CNRS-Orsay** | 100% |
| 7.1.6 | Prototype Fabrication in Industry | | | **CNRS-Orsay** | 0% |
| 7.1.7 | Low Pow er tests | | | **CNRS-Orsay** | 0% |
| 7.1.8 | **Ready for High Power Tests** | **Coupler Prototyp** | | **CNRS-Orsay** | 0% |
| **7.2** | **Fabrication of TiN Coating System** | | | **CNRS-Orsay** | **0%** |
| 7.2.1 | Mechanical design of vacuum chamber | | | **CNRS-Orsay** | 0% |
| 7.2.2 | Fabrication draw ings | | | **CNRS-Orsay** | 0% |
| 7.2.3 | Construction of vacuum chamber | | | **CNRS-Orsay** | 0% |
| 7.2.4 | Define vacuum needs | | | **CNRS-Orsay** | 0% |
| 7.2.5 | Appropriation of vacuum equipment | | | **CNRS-Orsay** | 0% |
| 7.2.6 | Design of electronic circuitry | | | **CNRS-Orsay** | 0% |
| 7.2.7 | Fabrication of electronics in industry | | | **CNRS-Orsay** | 0% |
| 7.2.8 | Installation and Test at Orsay | | | **CNRS-Orsay** | 0% |
| 7.2.9 | **First Window Coating** | **Commissioning** | | **CNRS-Orsay** | 0% |
| **7.3** | **Conditioning Studies of Proto-type Couplers** | | | **CNRS-Orsay** | **0%** |
| 7.3.1 | Conditioning of couplers | | | **CNRS-Orsay** | 0% |
| 7.3.2 | Evaluate conditioning results | | | **CNRS-Orsay** | 0% |
| 7.3.3 | **Final report on conditioning** | | **Final report** | **CNRS-Orsay** | 0% |



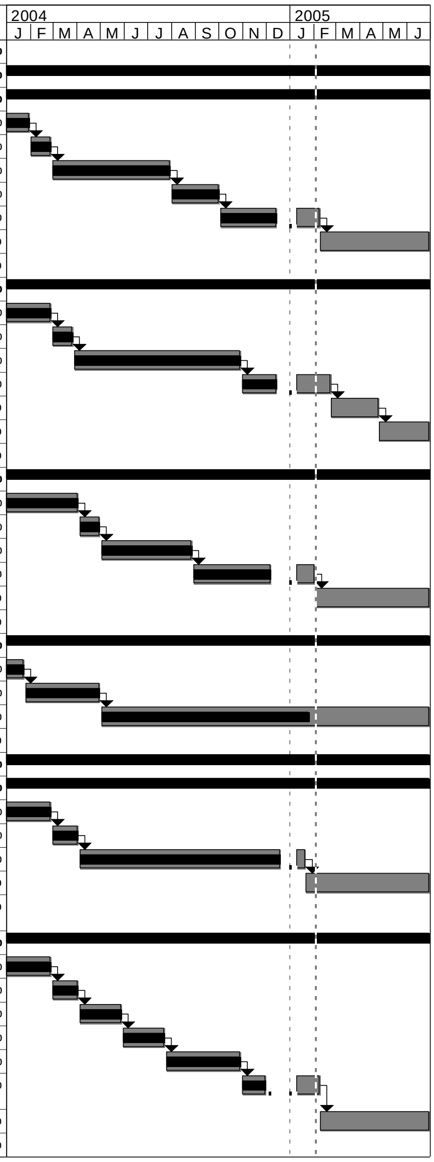

WP7: On schedule

| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **8** | **WP8 TUNERS** | | | | **23%** |
| **8.1** | **UMI TUNER** | | | **INFN-Mi** | **13%** |
| 8.1.1 | Control electronics | | | **INFN-Mi** | 100% |
| 8.1.2 | Mechanical tuner design, leverage system/motor | | | **INFN-Mi** | 20% |
| 8.1.3 | Integration piezo design | | | **INFN-Mi** | 5% |
| 8.1.4 | Choice of transducer/actuator | | | **INFN-Mi** | 0% |
| 8.1.5 | **Report UMI tuner** | **Design report** | | **INFN-Mi** | 0% |
| 8.1.6 | Tuner fabrication | | | **INFN-Mi** | 0% |
| 8.1.7 | Piezo fabrication and bench tests | | | **INFN-Mi** | 0% |
| 8.1.8 | Cavity-tuner-coupler integration | | | **INFN-Mi** | 0% |
| 8.1.9 | Pulsed RF tests | | | **INFN-Mi** | 0% |
| 8.1.10 | **Evaluation of tuner operation** | | **Final report** | **INFN-Mi** | 0% |
| **8.2** | **Magneto-strictive Tuner** | | | **TUL** | **31%** |
| 8.2.1 | Complete specification | | | **TUL** | 100% |
| 8.2.2 | Conceptual design | | | **TUL** | 100% |
| 8.2.3 | Prototype and performance evaluation | | | **TUL** | 70% |
| 8.2.4 | Finalize tuner and drive electronics design | | | **TUL** | 25% |
| 8.2.5 | Test of tuner | | | **TUL** | 0% |
| 8.2.6 | **Report on magneto-strictive Tuner** | **Status report** | | **TUL** | 0% |
| **8.3** | **CEA Tuner** | | | **CEA** | **63%** |
| 8.3.1 | Design Piezo + Tuning System | | | **CEA** | 100% |
| 8.3.2 | Fabrication | | | **CEA** | 50% |
| 8.3.3 | Installation RF | | | **CEA** | 0% |
| 8.3.4 | **Start of Integrated Experiments** | | **Tuner Protot** | **CEA** | 0% |
| **8.4** | **IN2P3 Activity** | | | **CNRS-Orsay** | **21%** |
| 8.4.1 | Characterize actuators/piezo-sensors at low temp | | | **CNRS-Orsay** | 60% |
| 8.4.2 | Report on actuator/piezo sensor | | | **CNRS-Orsay** | 0% |
| 8.4.3 | Test radiation hardness of piezo tuners | | | **CNRS-Orsay** | 20% |
| 8.4.4 | Report on radiation hardness tests | | | **CNRS-Orsay** | 0% |
| 8.4.5 | Integration of pieco and cold tuner | | | **CNRS-Orsay** | 5% |
| 8.4.6 | Cryostat tests | | | **CNRS-Orsay** | 0% |
| 8.4.7 | Tests with pulsed RF | | | **CNRS-Orsay** | 0% |
| 8.4.8 | **Report on IN2P3 tuner activities** | | **Final Report** | **CNRS-Orsay** | 0% |



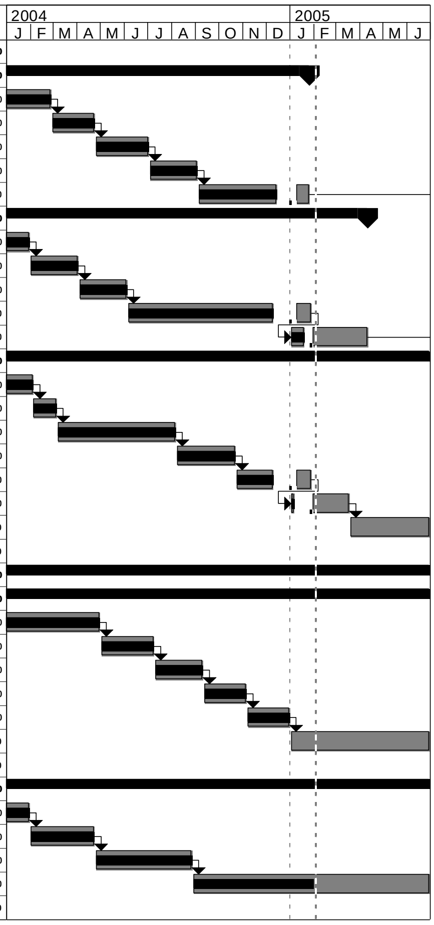

WP 8: First experiments with laboratory type of tuners revealed mechanical problems at cryogenic temperatures, e.g. piezo tuner lost the required mechanical pre-stress after cool down. This resulted in a need for a new mechanical design and subsequent shift of schedule in WP 8.2, WP 8.3 and WP 8.4. It is expected that the delay in this work package can be made up by additional engineering effort.

| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **9** | **WP9 LOW LEVEL RF (LLRF)** | | | | **57%** |
| **9.1** | **Operability and technical performance** | | | **DESY** | **51%** |
| **9.1.1** | **Transient detector** | | | **DESY** | **47%** |
| 9.1.1.1 | Define requirements | | | DESY | 100% |
| 9.1.1.2 | Electronics design | | | DESY | 100% |
| 9.1.1.3 | Build prototype and evaluate | | | DESY | 100% |
| 9.1.1.4 | Final design of detector | | | DESY | 100% |
| 9.1.1.5 | Installation and commissioning | | | DESY | 70% |
| 9.1.1.6 | Test w ith beam | | | DESY | 0% |
| 9.1.1.7 | **Report on transient detector test** | **Status Report** | | DESY | 0% |
| **9.1.2** | **LLRF Automation** | | | **DESY** | **52%** |
| 9.1.2.1 | Dialogue w ith industrial experts | | | DESY | 100% |
| 9.1.2.2 | Develop full specification | | | DESY | 100% |
| 9.1.2.3 | Implement FMS for subsystems | | | DESY | 100% |
| 9.1.2.4 | Test and evaluation | | | DESY | 50% |
| 9.1.2.5 | Implement improvements | | | DESY | 0% |
| 9.1.2.6 | Evaluation and acceptance by operators | | | DESY | 0% |
| 9.1.2.7 | **Report on LLRF atomization design** | **Status Report** | | DESY | 0% |
| **9.1.3** | **Control optimization** | | | **DESY** | **44%** |
| 9.1.3.1 | Specification of system | | | DESY | 100% |
| 9.1.3.2 | Conceptual design of controller | | | DESY | 100% |
| 9.1.3.3 | Performance simulation | | | DESY | 100% |
| 9.1.3.4 | Implementation in DSP hardw are | | | DESY | 80% |
| 9.1.3.5 | Implementation and tests on TTF | | | DESY | 0% |
| 9.1.3.6 | **Evaluation of test results** | **Status report** | | DESY | 0% |
| **9.1.4** | **Exceptional handling routines** | | | **DESY** | **64%** |
| 9.1.4.1 | Specification | | | DESY | 100% |
| 9.1.4.2 | Design of exceptional handler | | | DESY | 100% |
| 9.1.4.3 | Implementation and test on TTF | | | DESY | 55% |
| 9.1.4.4 | **Report on exceptional handler operatio** | **Status Report** | | DESY | 0% |
| **9.2** | **LLRF cost and reliability study** | | | **TUL** | **56%** |
| **9.2.1** | **Cost and reliability study** | | | **TUL** | **56%** |
| 9.2.1.1 | Identify cost drivers of present LLRF | | | TUL | 100% |
| 9.2.1.2 | Develop cost reduction ideas | | | TUL | 100% |
| 9.2.1.3 | Build prototypes and evaluate | | | TUL | 95% |
| 9.2.1.4 | Final design of LLRF system | | | TUL | 0% |
| 9.2.1.5 | **Complete design of LLRF system for reduced cost** | **Status Report** | | TUL | 0% |
| **9.2.2** | **Radiation damage study** | | | **TUL** | **56%** |
| 9.2.2.1 | Identify critical electronics issues | | | TUL | 100% |
| 9.2.2.2 | Evaluate TESLA radiation | | | TUL | 100% |
| 9.2.2.3 | Develop tests for components | | | TUL | 100% |
| 9.2.2.4 | Procure and assembles test set up | | | TUL | 100% |
| 9.2.2.5 | Data acquisition from radiation tests | | | TUL | 100% |
| 9.2.2.6 | Analyze results and develop countermeasures | | | TUL | 50% |
| 9.2.2.7 | Implement countermeasures and verify | | | TUL | 0% |
| 9.2.2.8 | **Report on radiation damage studies** | **Status Report** | | TUL | 0% |



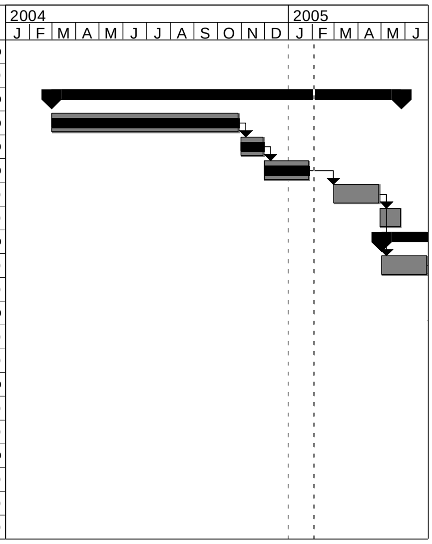

WP 9.1 and WP 9.2: On schedule

| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **9.3** | **Hardware** | | | **WUT-ISE** | **67%** |
| **9.3.1** | **Multichannel downconvertor** | | | **WUT-ISE** | **95%** |
| 9.3.1.1 | Study and compare technologies | | | **WUT-ISE** | 100% |
| 9.3.1.2 | Select optimum PCB design | | | **WUT-ISE** | 100% |
| 9.3.1.3 | Build prototype and evaluate | | | **WUT-ISE** | 100% |
| 9.3.1.4 | Finalize multichannel dow nconverter | | | **WUT-ISE** | 100% |
| 9.3.1.5 | Determine characteristics | | | **WUT-ISE** | 85% |
| **9.3.2** | **Third generation RF control** | | | **WUT-ISE** | **80%** |
| 9.3.2.1 | Integrate system generator w ith VHDL | | | **WUT-ISE** | 100% |
| 9.3.2.2 | Complete specification | | | **WUT-ISE** | 100% |
| 9.3.2.3 | Demonstrate simulator | | | **WUT-ISE** | 100% |
| 9.3.2.4 | Final design of RF electronic board | | | **WUT-ISE** | 90% |
| 9.3.2.5 | Evaluate performance | | | **WUT-ISE** | 20% |
| **9.3.3** | **Stable frequency distribution** | | | **WUT-ISE** | **45%** |
| 9.3.3.1 | Complete specification | | | **WUT-ISE** | 100% |
| 9.3.3.2 | Concept ional design of frequency | | | **WUT-ISE** | 100% |
| 9.3.3.3 | Build prototype and evaluate | | | **WUT-ISE** | 100% |
| 9.3.3.4 | Final design | | | **WUT-ISE** | 100% |
| 9.3.3.5 | Procurement and assembly of subsystems | | | **WUT-ISE** | 70% |
| 9.3.3.6 | Installation and commissioning | | | **WUT-ISE** | 10% |
| 9.3.3.7 | Performance test w ith beam | | | **WUT-ISE** | 0% |
| 9.3.3.8 | **Report on new LLRF hardware compon** | | **Final Report** | **WUT-ISE** | 0% |
| **9.4** | **Software** | | | **WUT-ISE** | **58%** |
| **9.4.1** | **Data management development** | | | **WUT-ISE** | **59%** |
| 9.4.1.1 | Specification | | | **WUT-ISE** | 100% |
| 9.4.1.2 | Conceptional design w ith DOOCS | | | **WUT-ISE** | 100% |
| 9.4.1.3 | Prototype | | | **WUT-ISE** | 100% |
| 9.4.1.4 | User evaluation | | | **WUT-ISE** | 100% |
| 9.4.1.5 | Finalize design | | | **WUT-ISE** | 100% |
| 9.4.1.6 | Implementation in TTF | | | **WUT-ISE** | 0% |
| 9.4.1.7 | **Report on data management developme** | | **Final report** | **WUT-ISE** | 0% |
| **9.4.2** | **RF gun control** | | | **WUT-ISE** | **58%** |
| 9.4.2.1 | Write specification | | | **WUT-ISE** | 100% |
| 9.4.2.2 | Design of controller | | | **WUT-ISE** | 100% |
| 9.4.2.3 | Procurement and assembly | | | **WUT-ISE** | 100% |
| 9.4.2.4 | Installation and test | | | **WUT-ISE** | 35% |
| 9.4.2.5 | **Report on RF gun control tests** | | **Final Report** | **WUT-ISE** | 0% |



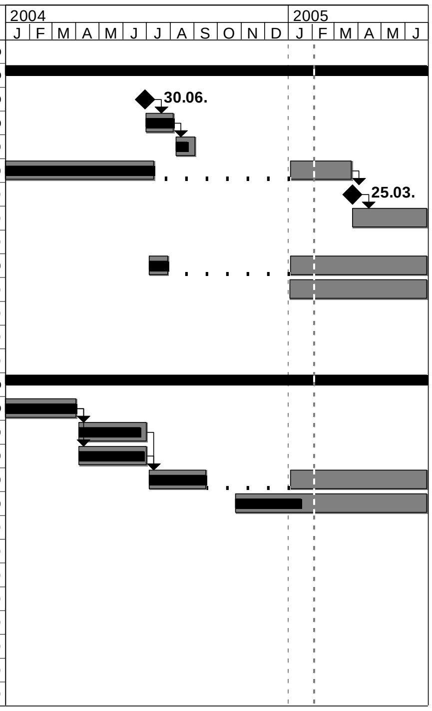

WP 9.2 and WP 9.4 : On schedule

| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **10** | **WP10 CRYOSTAT INTEGRATION TESTS** | | | | **36%** |
| 10.1 | Displace CRYHOLAB | | | **CEA** | 0% |
| **10.2** | **CRYHOLAB adaption to 9 cell** | | | **CEA** | **78%** |
| 10.2.1 | Mechanical adaption | | | **CEA** | 100% |
| 10.2.2 | Low performance cavity and coupler | | | **CEA** | 100% |
| 10.2.3 | Assembly in CRYHOLAB and cryogenic test | | | **CEA** | 100% |
| 10.2.4 | High performance coupler - High power pulsed te | | | **CEA** | 0% |
| 10.2.5 | High performance cavity transfered from DESY | | | **CEA** | 0% |
| **10.3** | **Integration tests in cryostat (1st test)** | **Status report** | | **CEA** | **0%** |
| 10.3.1 | CEA could tuning system | | | **CEA** | 0% |
| 10.3.2 | Evaluate experimental results | | | **CEA** | 0% |
| **10.4** | **Integration tests in cryostat (2nd test)** | **Status report** | | **CEA** | **0%** |
| 10.4.1 | Magnetostrictive tuner | | | **CEA** | 0% |
| 10.4.2 | Evaluate experimental results | | | **CEA** | 0% |
| **10.5** | **Integration tests in cryostat (3rd test)** | | | **CEA** | **0%** |
| 10.5.1 | Piezoelectric tuner | | | **CEA** | 0% |
| 10.5.2 | Evaluate experimental results | | | **CEA** | 0% |
| **10.6** | **Integration tests in cryostat (4th test)** | | | **CEA** | **0%** |
| 10.6.1 | New coupler from LAL | | | **CEA** | 0% |
| 10.6.2 | Evaluation of results | | | **CEA** | 0% |
| 10.6.3 | **Final evaluation** | | **Final Report** | **CEA** | 0% |




WP 10: On schedule

| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **11** | **WP 11 BEAM DIAGNOSTICS** | | | **CEA** | **19%** |
| **11.1** | **Beam position monitor** | | | **CEA** | **16%** |
| 11.1.1 | **Present BPM installed in TTF module** | **Start Measureme** | | **CEA** | 100% |
| 11.1.2 | Cryogenic measurements on BPM | | | **CEA** | 100% |
| 11.1.3 | Beam tests of BPM on TTF | | | **CEA** | 60% |
| 11.1.4 | Design of BPM Cavity | | | **CEA** | 70% |
| 11.1.5 | Design of BPM cavity ready | | | **CEA** | 0% |
| 11.1.6 | Fabrication of BPM Cavity | | | **CEA** | 0% |
| 11.1.7 | BMP cavity ready | | | **CEA** | 0% |
| 11.1.8 | Development of new hybrid coupler and electronic | | | **CEA** | 10% |
| 11.1.9 | Design of Digital Signal Processing | | | **CEA** | 0% |
| 11.1.10 | **New BPM ready for Installation** | | **BPM Prototyp** | **CEA** | 0% |
| 11.1.11 | Beam Tests with new BPM | | | **CEA** | 0% |
| 11.1.12 | **Evaluation of BPM operation** | | **Final report** | **CEA** | 0% |
| **11.2** | **Beam Emittance Monitor** | | | **INFN-LNF** | **22%** |
| 11.2.1 | Slit width simulations | | | **INFN-LNF** | 100% |
| 11.2.2 | Slit design | | | **INFN-LNF** | 90% |
| 11.2.3 | Optics simulations | | | **INFN-LNF** | 95% |
| 11.2.4 | Optics appropriations | | | **INFN-LNF** | 25% |
| 11.2.5 | System assembly and tests | | | **INFN-LNF** | 25% |
| 11.2.6 | Mechanical assembly at TTF | | | **INFN-LNF** | 0% |
| 11.2.7 | Optical assembly at TTF | | | **INFN-LNF** | 0% |
| 11.2.8 | Integration of controls into TTF | | | **INFN-LNF** | 0% |
| 11.2.9 | **Ready for beam test in TTF** | **Start Measureme** | | **INFN-LNF** | 0% |
| 11.2.10 | Beam tests at TTF | | | **INFN-LNF** | 0% |
| 11.2.11 | Evaluate first beam test result | **Status Report** | | **INFN-LNF** | 0% |
| 11.2.12 | Successive measurements | | | **INFN-LNF** | 0% |
| 11.2.13 | **Final evaluation** | | **Final Report** | **INFN-LNF** | 0% |




WP 11.1: Delay in the design of BPM cavity (Task 11.1.4) due to mechanical interface problems with the neighbouring quadrupole.

WP 11.2: On schedule

# Status of Milestones and Deliverables.

| Deliverable / Milestone No | Deliverable (D) / Milestone (M) Name | | WP / Task No | Lead Contractor | Planned (in months) | Achieved (in months) | Reference |
|---|---|---|---|---|---|---|---|
| 1 | Final report on reliability issues | D | 2.1.7 | DESY | 9 | 14 | |
| 2 | Summary report on the status of the art on ancillaries on the experience of various laboratories involved in SCRF | M | 2.2.1.3 | INFN-Mi | 7 | 10 | CARE-Note-2004-ooo-SRF |
| 3 | Report about new design for components | M | 2.2.1.9 | INFN-Mi | 12 | 15 | |
| 4 | Tools design finished | M | 2.3.1.6 | DESY | 12 | 12 | JRA1 Annual report 2004 |
| 5 | Seamless by spinning:Design finished | M | 3.1.1.3 | INFN-LNL | 9 | 9 | JRA1 Annual report 2004 |
| 6 | Seamless by hydroforming:Design finished | M | 3.2.1.3 | DESY | 9 | 9 | CARE-Note-2004-039-SRF |
| 7 | Linear-arc cathode coating: Prototype ready | M | 4.1.1.3 | IPJ | 7 | 10 | CARE-Note-2004-038-SRF |
| 8 | Linear-arc cathode coating:Start of coating | M | 4.1.1.6 | IPJ | 12 | 15 | |
| 9 | Planar-arc cathode coating: Prototype ready | M | 4.2.1.3 | INFN-Ro2 | 9 | 9 | CARE-Note-2004-038-SRF |
| 10 | Surface characterization fixed | M | 5.1.1.2 | CEA | 5 | 5 | CARE-Note-2004-032-SRF |
| 11 | EP on single cells:Best EP parameters | D | 5.1.1.4 | CEA | 12 | 15 | |
| 12 | EP on single cells:3 cavities fabricated | M | 5.1.2.2 | CEA | 12 | 15 | |
| 13 | EP on single cells:First operation of EP set up | M | 5.1.3.4 | CEA | 12 | 16 | |
| 14 | EP on multi-cells:Proof-of-Principle experiment hot water rinse | M | 5.2.1.1.3 | DESY | 9 | 19 | |
| 15 | Automated EP (AEP): EP installation ready | M | 5.3.1.4 | INFN-LNL | 9 | 14 | |
| 16 | Automated EP (AEP): Software ready | M; | 5.3.2.4 | INFN-LNL | 9 | 14 | |
| 17 | Dry ice cleaning: Installation finished | M | 5.4.1.5 | DESY | 12 | 16 | |
| 18 | SQUID scanning: Calibration defects finished | M | 6.1.1.3 | DESY | 8 | 8 | CARE-Note-2004-040-SRF |
| 19 | SQUID scanning:Design Scanner finished | M | 6.1.2.3 | DESY | 11 | 11 | CARE-Note-2004-036-SRF |
| 20 | Flux gate magnetometry:Calibration defects finished | M | 6.2.1.3 | INFN-LNL | 7 | 15 | |
| 21 | Design flux gate head finished | M | 6.2.2.4 | INFN-LNL | 9 | 12 | JRA1 Annual report 2004 |
| 22 | DC field emission: Start scanning activity | M | 6.3.1.3 | DESY | 6 | 6 | CARE-Note-2004-035-SRF |
| 23 | Report on simulation | M | 7.1.2 | CNRS-Orsay | 6 | 6 | CARE-Note-2004-037-SRF |
| 24 | Engineering completed | M | 7.1.4 | CNRS-Orsay | 12 | 12 | CARE-Note-2004-037-SRF |
| 25 | Report on actuator/piezo sensor | M | 8.4.2 | CNRS-Orsay | 7 | 15 | |
| 26 | Report on radiation hardness tests | M | 8.4.4 | CNRS-Orsay | 12 | 20 | |
| 27 | Beam position monitors: Present BPM installed in TTF | M | 11.1.1 | INFN-LNF | 6 | 6 | CARE-Note-2004-ooo-SRF |
| 28 | Design of BPM cavity ready | M | 11.1.5 | INFN-LNF | 10 | 15 | |

## Major meetings organized under JRA1

| Date | Title/Subject | Location | Number of attendees | Website address |
|---|---|---|---|---|
| 21.-23.01.04 | JRASRF kick off meeting during Tesla Meeting | DESY (Zeuthen) | 30 | http://jra-srf.desy/e24/e26/index_eng.html |
| 03.02.2004 | Meeting WP 3,5,7,8,10 | Orsay (France) | 25 | |
| 12.02.2004 | Meeting WP 5, 6 | INFN Legnaro) | 15 | |
| 12.02.2004 | Meeting WP 8 | DESY (Hamburg) | 10 | http://tesla.desy.de/~sekalski/ |
| 04.03.2004 | WP 1-11, briefing | DESY (Hamburg) | 15 | |
| 07.04.2004 | WP 1 - 11, during Tesla Meeting | DESY (Hamburg) | 20 | |
| 04.-06.05.04 | ELAN Meeting | INFN (Frascati) | 70 | http://www.lnf.infn.it/conference/elan/ |
| 05.-09.07.04 | EPAC 2004 | EPAC (Lucern) | 700 | http://www.epac04.ch/index.html |
| 16.-20.08.04 | LINAC 2004 | LINAC (Lübeck) | 350 | http://www.linac2004.de/ |
| 09.09.2004 | JRASRF, during Tesla Meeting | Orsay (France) | 21 | |
| 20.10.2004 | VITAMIB meeting | CEA (Paris) | 25 | http://pnb2004.vitamib.com/ |
| 02.-05.011.04 | Annual CARE04 Meeting | DESY (Hamburg) | 210 | http://care04.desy.de/ |

## List of overview talks of JRA1 members

| Subject | Speaker/Lab | Event | Date | Web site |
|---|---|---|---|---|
| Dry-Ice cleaning of SRF cavities | D. Reschke / DESY | ELAN, Frascati | Mai 04 | http://www.lnf.infn.it/conference/elan/ |
| Fieldemission Overview: Cleanliness and Processing | D. Reschke / DESY | Argonne 2004 | Sep 04 | http://www.aps.anl.gov/conferences/RFSC-Limits/welcome.html |
| TESLA Cavities in the VUV-FEL LINAC Modules | D. Kostine / DESY | Orsay | Sep 04 | http://tesla.desy.de/ |
| R&D activities in CARE JRASRF | D. Proch / DESY | Argonne 2004 | Sep 04 | http://www.aps.anl.gov/conferences/RFSC-Limits/welcome.html |
| Status of worldwide SRF Projects and Demands for Niobium, e-beam 2004 | D. Proch / DESY | Reno 2004 | Okt 04 | |
| Metallurgical and Technological Request for Ultra High Purity Niobium in SRF Application, e-beam 2004 | W. Singer / DESY | Reno 2004 | Okt 04 | |
| Industrial Involvement in EC supported Accelerator R&D in the 6th Framework Programme and in preparing large Scale Accelerator Projects (TESLA), EPAC 2004 | D. Proch / DESY | EPAC 2004 | Jul 04 | http://epac04.ch/index.html |

# List of papers

| CARE- pub | AUTHOR | TITLE | LOCATION / DATE |
|---|---|---|---|
| CARE-pub-04-004 | Langner, M.J. Sadowski, K. Czaus, R. Mirowski, J. Witkowski, L. Catani, A. Cianchi, R. Russo, S. Tazzari, F. Tazzioli, D. Proch, N.N. Kovaland Y.H. Akhadeev | Super-conducting niobium films produced by means of UHV arc | Czech. J. Phys. 54, Suppl. C (2004) C914-C921. |
| | | | |
| | | | |
| **CARE-Conf** | | | |
| CARE-Conf-04-001-SRF | P. Sekalski, S. Simrock, L. Lilje, C. Albrecht | Lorentz force detuning compensation system for accelerating field gradients up to 35 MV/m for superconducting XFEL and TESLA 9-cell cavities | Szczecin, 2004 |
| CARE-Conf-04-027-SRF | V. Ayvazyan, S.N. Simrock | Dynamic Lorentz Force Detuning Studies in TESLA Cavities | Luzern, 2004 |
| CARE-Conf-04-028-SRF | D. Proch,DESY | Industrial Involvement in EC supported Accelerator R&D in the 6th Framework Programme and in preparing large Scale Accelerator Projects (TESLA) | Lucerne 2004 |
| CARE-Conf-04-040-SRF | J. Langner, M.J. Sadowski, K. Czaus, R. Mirowski, J. Witkowski, L. Catani, A. Cianchi, R. Russo, S. Tazzari, F. Tazzioli, D. Proch, N.N. Kovaland Y.H. Akhadeev | Super-conducting niobium films produced by means of UHV arc | Prague, 2004 |
| CARE-Conf-04-041-SRF | J. Langner, L. Catani, A. Cianchi, K. Czaus, R. Mirowski, R. russo, M.J. Sadowski, S. Tazzari, D. Proch, Y.H. Akhmadeev, N.N. Koval | Status and Research on Deposition of Superconducting Films for RF Accelerating Cavities | Tomsk 2004 |
| CARE-Conf-04-042-SRF | D. Reschke / DESY | First Experience with Dry-Ice Cleaning on SRF cavities | Lübeck, 2004 |
| CARE-Conf-04-043-SRF | W.-D. Moeller, D.Kostine / DESY | Status and Operating Experience of the TTF Coupler | Lübeck, 2004 |

| | | | |
|---|---|---|---|
| CARE-Conf-04-044-SRF | M. Dohlus, D. Kostine, W.-D. Moeller, DESY | TESLA RF Power Coupler Thermal Calculations | Lübeck, 2004 |
| CARE-Conf-04-045-SRF | D. Kostine,DESY | New Accelerating Modules RF Test at TTF | Lübeck, 2004 |
| CARE-Conf-04-046-SRF | Krzysztof T. Pozniak, Ryszard S. Romaniuk, Tomasz Czarski, Wojciech Giergusiewicz, Wojciech Jalmuzna, Krzysztof Olowski, Karol Perkuszewski, Jerzy Zielinski -Institute of Electronic Systems, Warsaw University of Technology; Stefan Simrock - DESY | FPGA and Optical Network Based LLRF Distributed Control System for TESLA-XFEL Linear Accelerator | Wilga 2004 |
| CARE-Conf-04-047-SRF | Waldemar Koprek, Pawel Kaleta, Jaroslaw Szewinski, Krzysztof T. Pozniak, Tomasz Czarski, Ryszard S. Ronmaniuk - Institute of Electronic Systems, Warsaw University of Technology | Software Layer for FPGA-Based TESLA Cavity Control System | Wilga 2004 |
| CARE-Conf-04-048-SRF | Piotr Roszkowski, Wojciech M. Zabolotny, Krzysztof Pozniak, Ryszard Romaniuk - Institute of Electronic Systems, Warsaw University of Technology; Krzysztof Kierzkowski - Institute of Experimental Physics, Warsaw University; Stefan Simrock - DESY | Prototype Implementation of the Embedded PC Based Control and DAQ Module for TESLA Cavity SIMCON | Wilga 2004 |
| CARE-Conf-04-049-SRF | Dominik Rybka, A. Kalicki, K. Pozniak, R. Romaniuk, B. Mukherjee, S. Simrock | Irradiation Investigations for TESLA and XFEL Experiments at DESY | Wilga 2004 |
| CARE-Conf-04-050-SRF | T. Jezynski, P. Pucyk, S. Simrock, | Diagnostics for the Low Level RF Control for the European XFEL, LINAC 2004 | Lübeck, 2004 |

| | | | |
|---|---|---|---|
| CARE-Conf-04-051-SRF | A.H. Hofler, V. Ayvazyan, A. Brandt, S. Simrock, T. Czarski, J. R. Delayen, T. Matsumoto | RF Control Modelling Issues for Future Superconducting Accelerators, LINAC 2004 | Lübeck, 2004 |
| CARE-Conf-04-052-SRF | W. Cichalewski, B. Koseda, F.-R. Kaiser, S. Simrock | The Finite State Machine for Klystron Operation for TESLA and the European X-FEL Linear Accelerator | Lübeck, 2004 |
| CARE-Conf-04-053-SRF | S.N.Si 2004oc k ,DE(S)10.1 | Yceonfn (F)-0.1( )12.6(C)-10.6(o)4(n)12.6(t)-061r-o übec k | t 2004 |

| | | | |
|---|---|---|---|
| CARE-Note-2004-xxx-SRF | C.Magne | Beam position monitor | 2004 |
| | | | |
| | | | |
| **CARE Report** | | | |
| CARE Report-04-002-SRF | D.Proch, T.Garvey | Second quarterly report of the SRF collaboration | 2004 |
| CARE Report-05-002-SRF | D.Proch, T.Garvey | Annual report of the SRF collaboration | 2004 |
| | | | |
| **CARE/SRF Document** | | | |
| CARE/SRF Document-2004-001 | N. Steionhau-Kühl, A. Matheisen, B. Meyer, M. Schmökel | Investigation on the ageing process of EP-acid | 2004 |
| | | | |
| | | | |

# Report of the Review Conducted by the International Advisory Group to JRA-SRF
# R&D on Superconducting Radio-Frequency Technology for Accelerators

(Review Conducted at the Annual Care meeting in Hamburg, Germany, on Nov. 3 2004)

**Executive Summary**

The International Advisory Group reviewed the status of the JRA Program with emphasis on the technical progress over the first 10 months of the activity.

The members of the review committee are

Hasan Padamsee (Cornell, chair)
Isidoro Campisi (Oak Ridge National Lab)
Peter Kneisel (Jefferson Lab)
Jens Knobloch (BESSY)
Wolfgang Weingarten (CERN)

The charge to the committee was to:

Evaluate the Scientific content of the work.
Compare the Significance of this work as compared to related activities in other laboratories around the world
Comment on the possible synergy effects of the CARE work for other superconducting accelerator projects.
Discuss possible conflicts in reaching the scientific goals on time under the circumstances of the available resources and manpower.

Comment on possible improvements of the scientific work.

**Scope and Objectives of JRA-SRF**

Although SRF technology has reached a state of maturity, substantial improvements are required to exploit the full potential of RF superconductivity for on-going and future applications. Our JRA is a joint R&D activity for the development of improved cavity fabrication and preparation techniques to yield superconducting cavities that reliably reach high accelerating gradients (>35 MV/m) and have lower RF losses (higher quality factor). The joint effort encompasses development of cheaper, more reliable cavities together with ancillary RF components (tuners, couplers etc….) as well as low level RF control and beam diagnostics for the TTF linac. At the same time, a broader programme of R&D is being conducted on promising aspects of new and innovative SRF technology that would lower costs for large scale projects under consideration around the world. Prototype components developed from the most successful of these activities will be tested under realistic operating conditions in a horizontal cryostat, and eventually in the TTF linac. Construction and tests of prototype components will lead to the improvement of the TTF facility for accelerator R&D. In the long run it will result in an improvement in the performance of projects such as the TTF, VUV-FEL, XFEL and the ILC.

At the review, the main steps presented towards these goals were

- implementation of electro-polishing for better surface quality (roughness <1μm),
- exploration of new fabrication methods such as vacuum arc coating, and seamless cavities
- improving the methods for quality control
- developing improved input couplers
- developing improved cold tuner systems,
- improving the reliability of RF components and developing low-cost proto-types,
- performing integrated tests of the individual developments for cavities, couplers, tuners….
- Improving the performance of TTF beam via improved beam diagnostics and improved low level rf systems

The JRA program has 10 work packages and one overall management work package.

Improved Standard Cavity Fabrication
Seamless Cavity Production
Thin Film Cavity Production
Surface Preparation
Material Analysis

Couplers
Tuners
Low Level RF
Cryostat Integration Tests
Beam Diagnostics

The agenda of the one day meeting can be found in Appendix 1.

*Summary of Findings and Recommendations*

The committee was extremely pleased with the substantial progress that the team is making on the ten technical work packages which cover a broad range of important topics. This is a comprehensive effort which requires a large group of researchers from several key laboratories, bringing in much needed, new, young talent. In the short time since it has started, the project has brought 18 new FTE researchers on board.

It is also encouraging that the project is proceeding according to the planned budget and that the work packages are on schedule. The Project Management has clearly identified milestones and although the goals are ambitious, there are reasonable time scales that the various laboratories can commit to and achieve. We congratulate the team on getting this work fully underway in the short time since the start of project funding.

A strong inter-laboratory collaboration has started with good networking exchange of samples, procedures and information among the different laboratories. There is an impressive effort underway to collect and compare relevant information from laboratories within and outside the collaboration. We encourage increasing efforts to incorporate information from laboratories outside the collaboration which are conducting similar activities. We find the JRA framework presents a unique opportunity to conduct needed R&D that is normally difficult to carry out under the normal pressures associated with big construction projects. The committee expresses confidence that the results from JRA will ultimately benefit many SRF projects in the world.

The scientific and technical content of the work is excellent. The committee is pleased to see important initiatives in a wide range of directions. Many projects are at the forefront of the field. The activities underway to study the physics and chemistry of electro-polishing will be essential in order to yield a superior and reliable technique for producing smooth surfaces with improved performance. Developing new scanning and snow cleaning techniques will be important to avoid quenches and field emission. There is already a healthy record of publishing some of the work, as for example at the EPAC2004 and LINAC2004 conferences.

The work here is complementary to R&D work in progress within other programs or at other laboratories. For example, the emphasis of JRA is on improving the reliability of existing procedures (such as electro-polishing and welding) together with cost reduction of cavities and couplers. These studies will be important for effective implementation of SRF into forthcoming large scale projects. Fundamental research on the basic understanding of loss mechanisms or the fundamental critical field of superconductors is going on elsewhere.

The collaborative aspect of JRA-SRF could be enhanced by holding more frequent exchanges of information among parallel activities. In some cases, related activities whose outcome would be mutually beneficial are proceeding in parallel so that results from any activity could become of immediate value to the others. An example is the study of electro-polishing techniques, where the improvement of EP recipes with samples and the development of EP systems for single-cells, multi-cells and automation have been launched at the same time. It is important that the information from such parallel activities be fed into each other in a timely fashion.

The overall challenges for the R&D are numerous, for example extremely low RF losses at high gradients close to the theoretical limit, reliable and reproducible fabrication and treatment methods, elimination of dark currents, reliable and efficient accelerating systems and cost effective methods for fabrication in industry. The project management will need to continually exercise judgement in balancing resources and schedules of these projects with the short term and long term potential gain from the various work packages.

In particular, each cavity development project and each procedure improvement effort is likely to need a large number of cavity and component tests. The management will need to exercise careful judgment to balance available test resources with the prolific output from the large number of approaches underway.

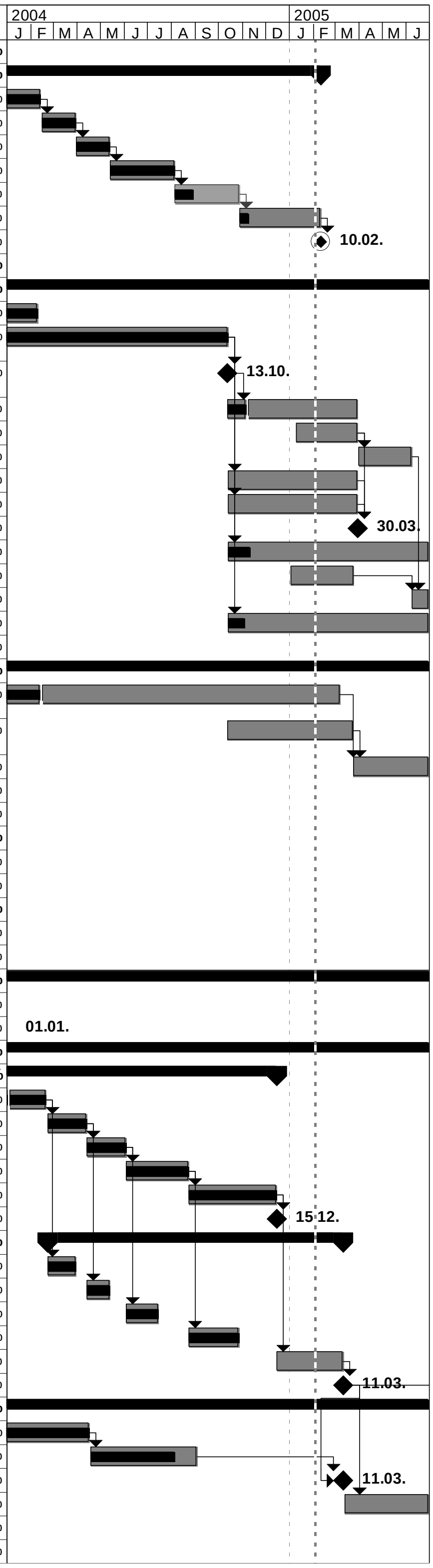
We suggest that the schedule for the next review be extended by one day so that the project and WP leaders will have sufficient time to motivate each work package and tie it in to the overall scope of the JRA. Some examples of topics that need increased motivation are addressed in detailed comments (below) by reviewers. Such a need was particularly manifest at the first review meeting.

The committee reiterates its strong support of this joint effort and we stand ready to help by providing council when needed, assistance in promoting collaborative efforts with our own laboratories, and by reviewing the technical and programmatic issues at the next meeting. We thank the JRA Team for well prepared presentations and again congratulate them on their significant progress. The energy and vitality of the JRA team is quite evident and we look forward to the next meeting on this exciting program, which is important to many SRF based projects around the world.

# Detailed description of research activities

## WP2 IMPROVED STANDARD CAVITY FABRICATION

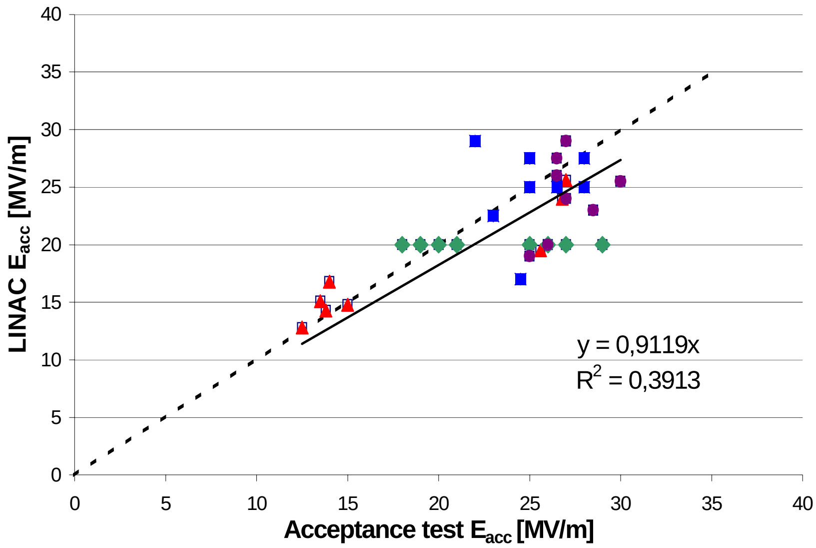
| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **2** | **WP 2 IMPROVED STANDARD CAVITY FABRICATION** | | | | **22%** |
| **2.1** | **Reliability Analysis** | | | **DESY** | **62%** |
| 2.1.1 | Review of data bank: cavity fabrication | | | **DESY** | 100% |
| 2.1.2 | Review of data bank :cavity treatment | | | **DESY** | 100% |
| 2.1.3 | Review of data bank: cavity VT performance | | | **DESY** | 100% |
| 2.1.4 | Review of data bank: string assembly | | | **DESY** | 100% |
| 2.1.5 | Review of data bank: string performance | | | **DESY** | 27% |
| 2.1.6 | Establish correlations | | | **DESY** | 10% |
| 2.1.7 | **Final report on reliability issue** | | **Final Report** | **DESY** | 0% |
| **2.2** | **Improved component design** | | | **INFN-Mi** | **12%** |
| **2.2.1** | **Documentation retrieving** | | | **INFN-Mi** | **21%** |
| 2.2.1.1 | Start up meetings | | | **INFN-Mi** | 100% |
| 2.2.1.2 | Access and study of Jlab, DESY, LLAN, KEK experience | | | **INFN-Mi** | 100% |
| 2.2.1.3 | **Summary report on the status of the ar on ancillaries** | **Summary Report** | | **INFN-Mi** | 100% |
| 2.2.1.4 | Sealing material and shape design | | | **INFN-Mi** | 15% |
| 2.2.1.5 | Flange preliminary design | | | **INFN-Mi** | 0% |
| 2.2.1.6 | Material and geometric compatibility | | | **INFN-Mi** | 0% |
| 2.2.1.7 | Final assembly design | | | **INFN-Mi** | 0% |
| 2.2.1.8 | End plate preliminary design | | | **INFN-Mi** | 0% |
| 2.2.1.9 | **Report about new design for compone** | **Design Report** | | **INFN-Mi** | 0% |
| 2.2.1.10 | Stiffness optimization | | | **INFN-Mi** | 8% |
| 2.2.1.11 | Manufacturing procedure analysis | | | **INFN-Mi** | 0% |
| 2.2.1.12 | Final assembly design | | | **INFN-Mi** | 0% |
| 2.2.1.13 | Other ancillaries design | | | **INFN-Mi** | 6% |
| 2.2.1.14 | **Final Report for new components** | **Report** | | **INFN-Mi** | 0% |
| **2.2.2** | **Review of criticality in welding procedures** | | | **INFN-Mi** | **5%** |
| 2.2.2.1 | Review of available parameters on vendor welding machine | | | **INFN-Mi** | 10% |
| 2.2.2.2 | Definition of prototype requirements for tests | | | **INFN-Mi** | 0% |
| 2.2.2.3 | Welding test on specimens | | | **INFN-Mi** | 0% |
| 2.2.2.4 | Analysis of the results | | | **INFN-Mi** | 0% |
| 2.2.2.5 | **Report about welding parameters** | **Report** | | **INFN-Mi** | 0% |
| **2.2.3** | **Finalize new component design** | | | **INFN-Mi** | **0%** |
| 2.2.3.1 | Do drawings | | | **INFN-Mi** | 0% |
| 2.2.3.2 | **New components design finished** | **Design report** | | **INFN-Mi** | 0% |
| **2.2.4** | **Finalize new cavity design** | | | **INFN-Mi** | **0%** |
| 2.2.4.1 | Make drawings | | | **INFN-Mi** | 0% |
| 2.2.4.2 | **New cavity design finished** | **Design report** | | **INFN-Mi** | 0% |
| **2.2.5** | **Fabrication of new cavity** | | | **INFN-Mi** | **0%** |
| 2.2.5.1 | Fabrication | | | **INFN-Mi** | 0% |
| 2.2.5.2 | New cavity finished | | **Cavity Protot** | **INFN-Mi** | 33% |
| **2.3** | **EB welding** | | | **DESY** | **33%** |
| **2.3.1** | **Design tooling** | | | **DESY** | **100%** |
| 2.3.1.1 | Tools for flange welding | | | **DESY** | 100% |
| 2.3.1.2 | Tools for pipe welding | | | **DESY** | 100% |
| 2.3.1.3 | Tools for stiffening rings | | | **DESY** | 100% |
| 2.3.1.4 | Tools for single cell welding | | | **DESY** | 100% |
| 2.3.1.5 | Tools for 9-cells | | | **DESY** | 100% |
| 2.3.1.6 | **Tools design finished** | **Design report** | | **DESY** | 100% |
| **2.3.2** | **Tools production** | | | **DESY** | **67%** |
| 2.3.2.1 | Tools for flange welding | | | **DESY** | 100% |
| 2.3.2.2 | Tools for pipe welding | | | **DESY** | 100% |
| 2.3.2.3 | Tools for stiffening rings | | | **DESY** | 100% |
| 2.3.2.4 | Tools for single cell welding | | | **DESY** | 100% |
| 2.3.2.5 | Tools for 9-cells | | | **DESY** | 0% |
| 2.3.2.6 | **Tools fabrication finished** | **Tools Ready** | | **DESY** | 0% |
| **2.3.3** | **Welding** | | | **DESY** | **13%** |
| 2.3.3.1 | Commissioning welding machine | | | **DESY** | 100% |
| 2.3.3.2 | Test welding | | | **DESY** | 79% |
| 2.3.3.3 | **Start production welding of component** | **Commissioning** | | **DESY** | 0% |
| 2.3.3.4 | Single cell welding | | | **DESY** | 0% |
| 2.3.3.5 | Multicell welding | | | **DESY** | 0% |
| 2.3.3.6 | **Welding of prototypes of components f** | | **Prototypes** | **DESY** | 0% |



## Status of activity:

### Task 2.1 Reliability analysis.

For what concerns the reliability task, the analysis of the data coming from the experience of the TTF modules has been started and data relative to modules 1, 2, 3, 1*, and partially for 4 and 5, have been reviewed and correlations between cavity performances and assembly procedure have been analyzed.




Frequently, cavity performances are poorer in module operation. As an example, the figure shows the differences between the cavities performances during vertical tests with respect to the those in the module. Different points, with the same colour, represent the different cavities in the same module, while different colours indicate different modules.

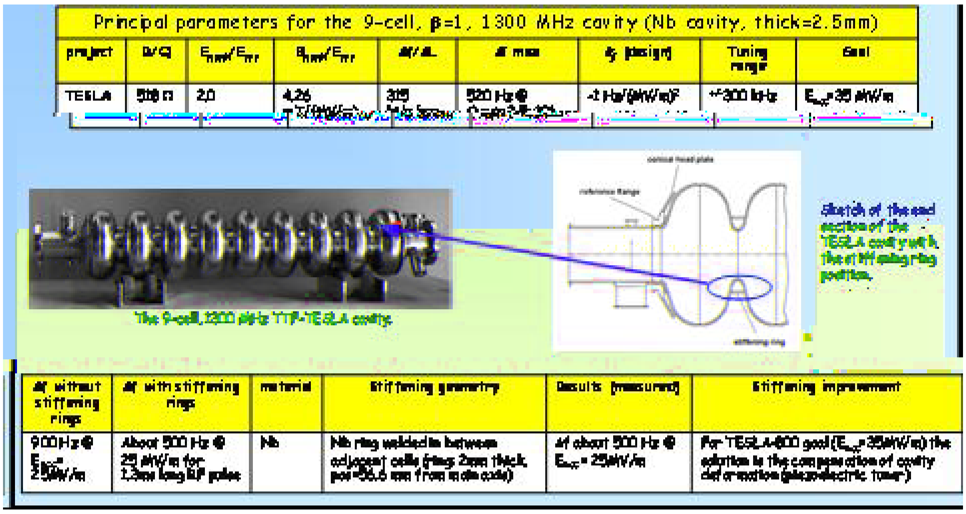
The dotted line represents the ideal behaviour for the vertical test and the module operation (same performances).

Preliminary results indicate that the reduction of the number of “difficulties” and problems during the assembly is correlated with the reduction of the difference between the cavity performances during the vertical test and the behaviour in the string.

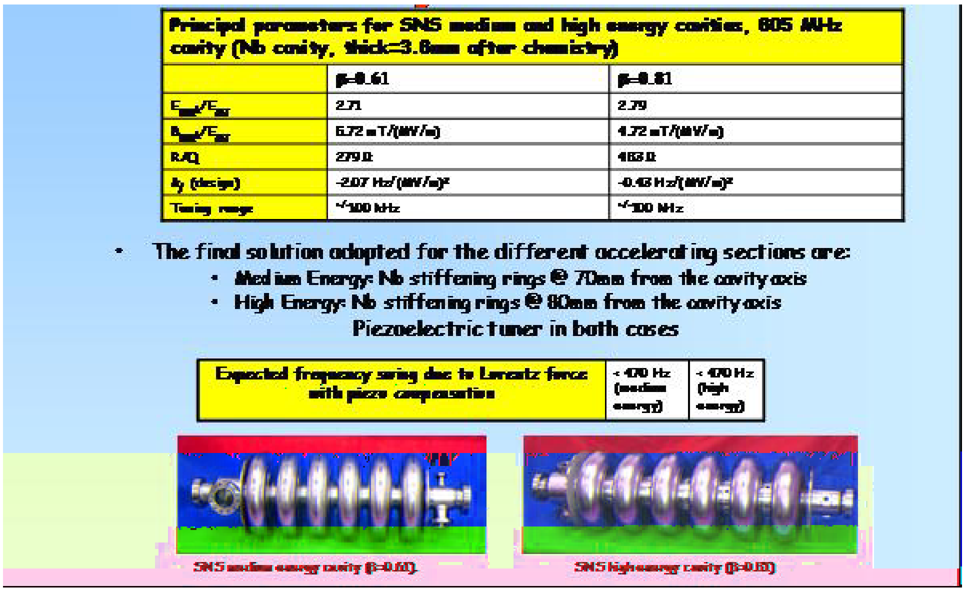
### Task 2.2 Improved component design

Bibliographic research concerning the state of the art on ancillaries and experience of various laboratories involved in SCRF is an important tool to highlight different designs and technological solutions. Information about principal ancillaries such as the He vessel, flanges, stiffening, etc., have been collected and organized in a database for systematic studies.

As an example, the next figures show the database information for TESLA and SNS relative to stiffening and fast tuners.



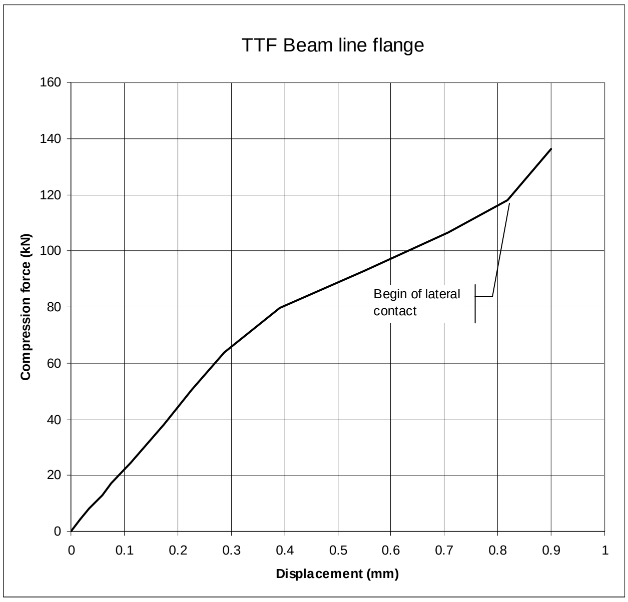

TESLA cavity stiffening and fast tuner data retrieving.



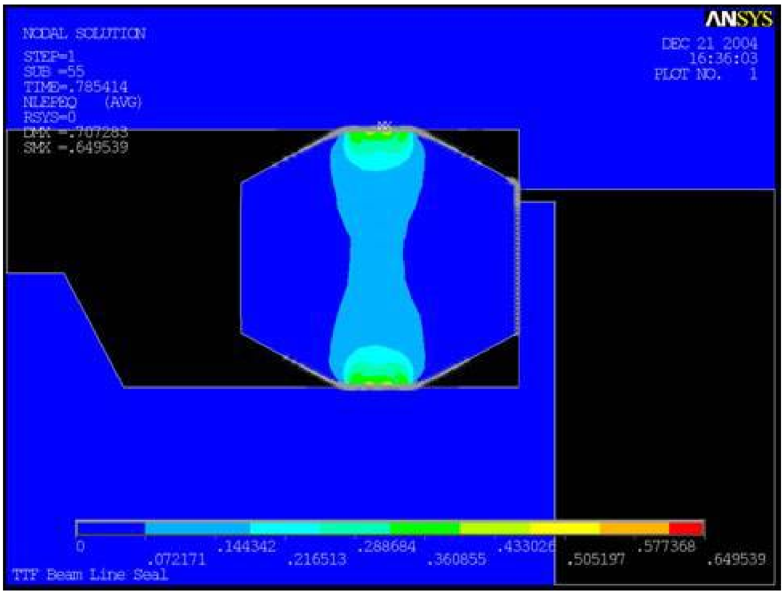

SNS cavity stiffening and fast tuner data retrieving.

Different designs of cold flanges have been compared and a preliminary analysis of the behaviour of the seal is in progress using a Finite Element Analysis (FEA) code.

The TTF cavity cold flange behaviour, calculated using the FEA code, during tightening at room temperature is shown in the following figures. The first figure is the compression curve of the aluminium seal: compression vs. displacement. The second image is the FEA analysis of the plastic deformation of the seal after tightening of the flange.




Calculated compression vs. displacement curve for the TTF cavity flange




Plastic deformation of the Al seal after tightening of the flange: displacement is 0.7 mm.

**Task 2.3: EB welding**

**Electron beam welding machine for ultra pure Niobium- and Niobium/Titanium-devices under high vacuum conditions**

*General*

Standard electron beam welding machines from industry achieve vacuum conditions up to a maximum of $10^{-5}$ mbar. These pressures can be achieved with ordinary oil diffusion pumps and in general standard vessels. They are used for example in the automobile industry for bulk production and are optimized for maximum efficiency. Cleanliness and final pressure are less important.


**Picture 1: Front side of the EB-Machine**

To investigate the influence of the residual gases on the equator and iris seams of the niobium cavities, DESY has developed, in collaboration with a manufacturer of EB-welding machines, a new machine with the highest ever performance regarding cleanliness and pressure.
This concept includes an optimised oil free pumping system, a UHV-compatible chamber and an oil free motion unit with a rotation and a linear axis.

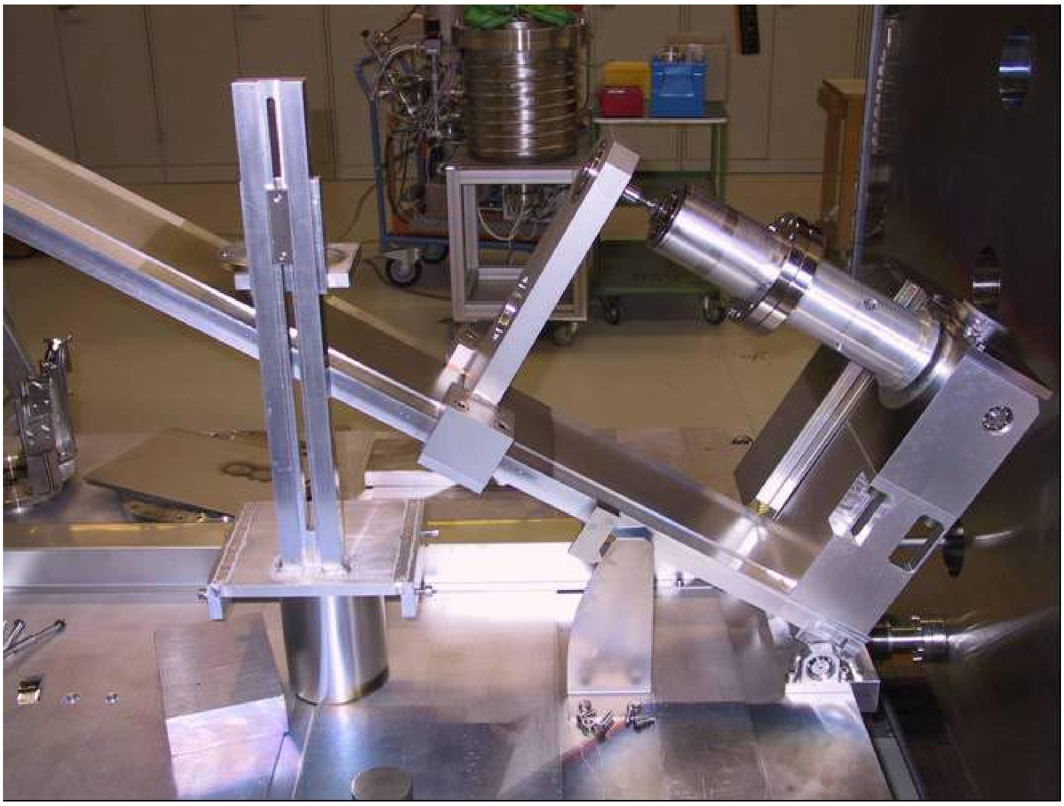
**Picture 2: Oil free vacuum pumping station**

**Picture 3: Cryogenic pumping station with 20.000 l/s**

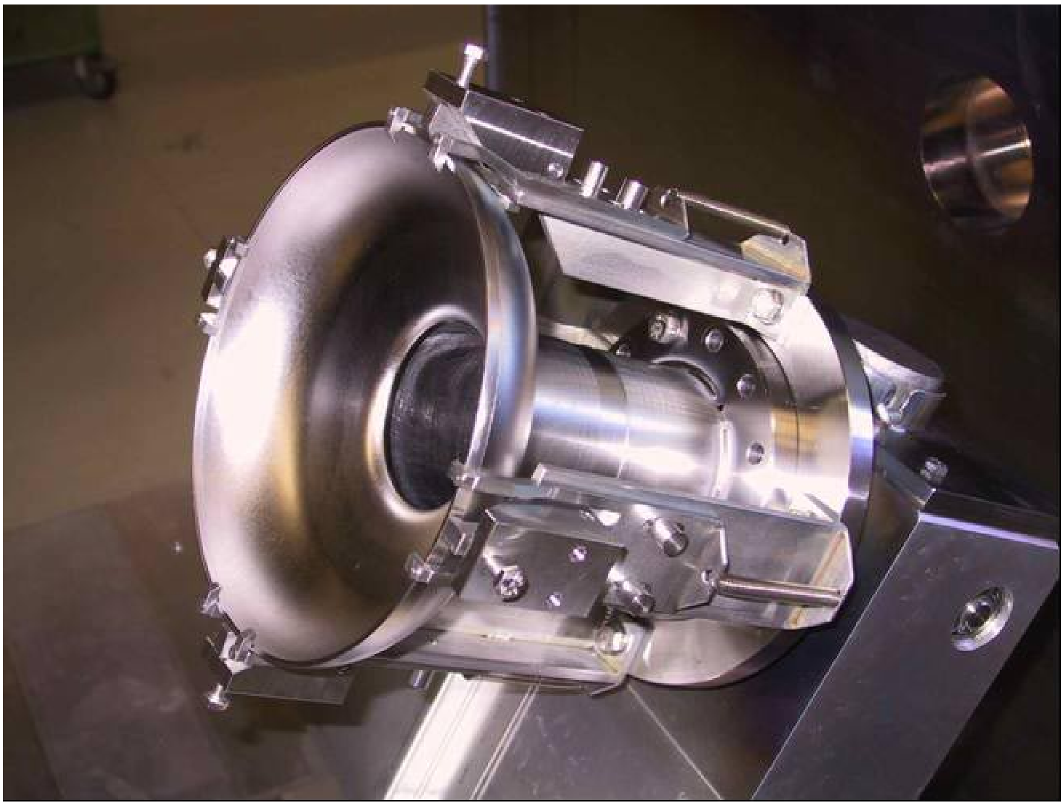
**Picture 5: Working disc**

*Status of WP 2.3*

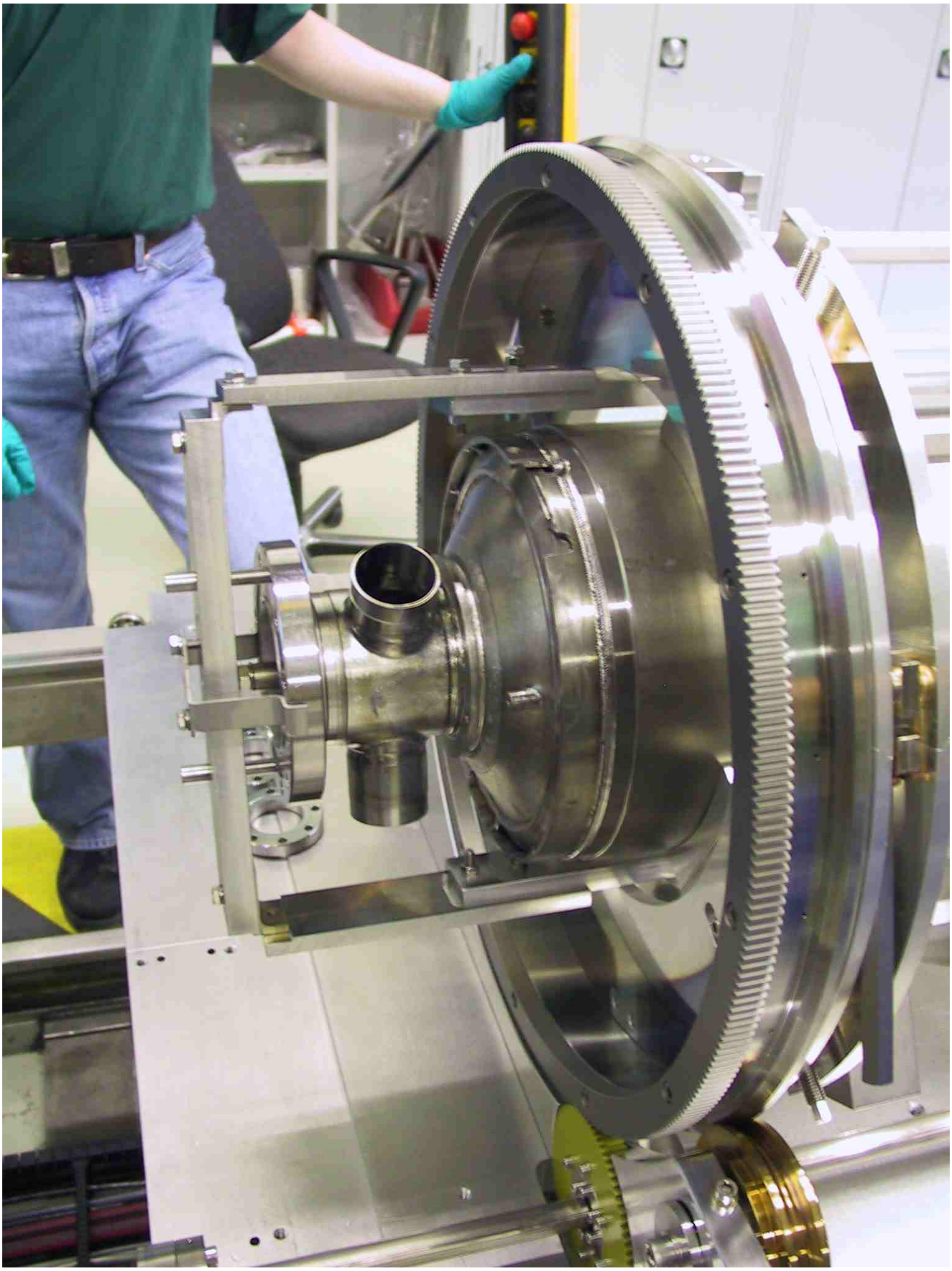
In the first design stage we have built up the requirements for preparing and welding single cell, 2-cell and spun cavities. Furthermore we are able to weld flange connections on multi-cell cavities with the titanium tank connected.



**Picture 6: Welding fixture for flange-tube connections**



**Picture 7: Welding fixture for the iris seam**



**Picture 8: Welding fixture for flanges on multicell cavities with titanium tank connected**

*Motivation for enhancing the capability of the manipulation unit.*

The basic idea of our machine as compared to standard machines is to install all electrical drives for the manipulation unit outside the chamber. This system is unfortunately not very secure because of the long mechanical transmission path. This problem raises the risk of a failure in the welding seam.

A second problem is the absence of a third axis in the manipulation unit, which significantly limits the area of operations. We plan to add a second linear transversal axis next to the existing rotation and linear longitudinal axis. The outlines of the welding seam require such a third axis in many cases. This feature was not necessary in the first machine we developed. One example of such an application is the end group of a nine cell cavity.

**1st Stage of extension**

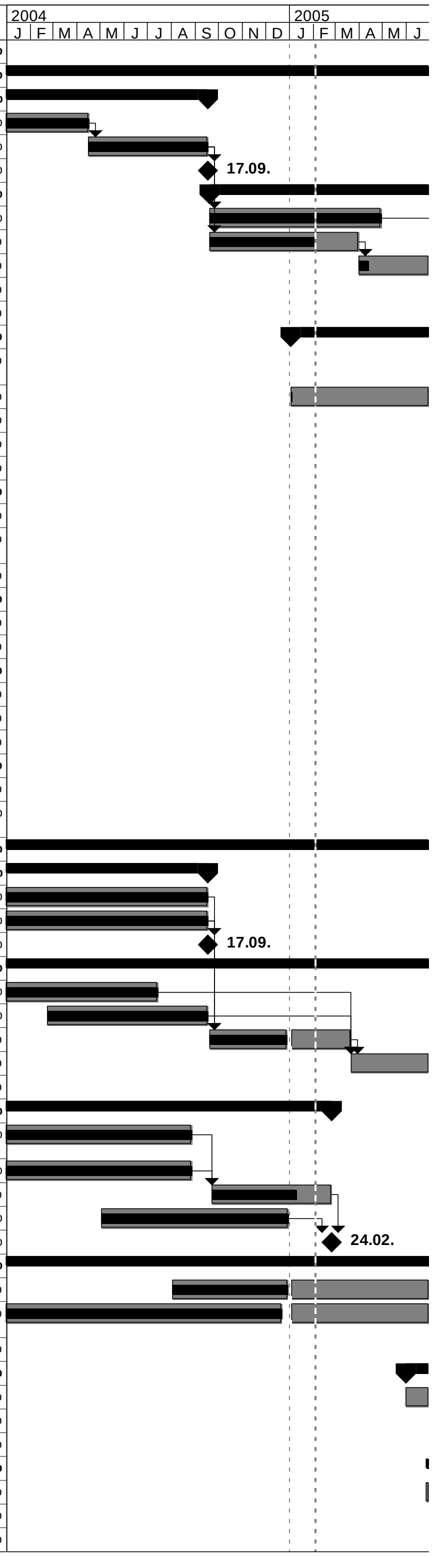
The consequence is that we have to install a motor for the rotation drive in the vacuum chamber, which accomplishes the ultra high vacuum conditions. To avoid frequent venting of the motor with the large surface during the exchange of work-pieces it will be enclosed in an evacuated housing which only contains a simple rotation feed-through.

**2nd Stage of extension**

The second linear axis drive should be fully metal sealed and located in the chamber.
The motion drive of this axis should be installed on the work table of the first linear axis.

# WP3 SEAMLESS CAVITY PRODUCTION

| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **3** | **WP3 SEAMLESS CAVITY PRODUCTION** | | | | **45%** |
| **3.1** | **Seamless by spinning** | | | **INFN-LNL** | **30%** |
| **3.1.1** | **Design spinning machine** | | | **INFN-LNL** | **100%** |
| 3.1.1.1 | Drawings of the matrices | | | **INFN-LNL** | 100% |
| 3.1.1.2 | Drawings of the support system | | | **INFN-LNL** | 100% |
| 3.1.1.3 | **Drawings of spinning machine finished** | **Design report** | | **INFN-LNL** | 100% |
| **3.1.2** | **Fabrication of spinning machine** | | | **INFN-LNL** | **58%** |
| 3.1.2.1 | Fabrication of machine parts | | | **INFN-LNL** | 100% |
| 3.1.2.2 | Software for the machine | | | **INFN-LNL** | 70% |
| 3.1.2.3 | Assembly of machine | | | **INFN-LNL** | 10% |
| 3.1.2.4 | Commissioning of the machine | | | **INFN-LNL** | 0% |
| 3.1.2.5 | **Spinning machine ready** | **Commissioning** | **Machine read** | **INFN-LNL** | 0% |
| **3.1.3** | **Evaluation of spinning parameters** | | | **INFN-LNL** | **1%** |
| 3.1.3.1 | Drawings of the support system and turning mechanism | | | **INFN-LNL** | 0% |
| 3.1.3.2 | Drawings of the necking mechanism | | | **INFN-LNL** | 1% |
| 3.1.3.3 | Fabrication of the tube necking machine | | | **INFN-LNL** | 0% |
| 3.1.3.4 | Commissioning of the machine | | | **INFN-LNL** | 0% |
| 3.1.3.5 | **Spinning parameters defined** | | **Design Repo** | **INFN-LNL** | 0% |
| **3.1.4** | **Spinning of 1-celll cavities** | | | **INFN-LNL** | **0%** |
| 3.1.4.1 | Material and fabrication of bulk Nb test tubes | | | **INFN-LNL** | 0% |
| 3.1.4.2 | Material and fabrication of bimetallic NbCu test tubes | | | **INFN-LNL** | 0% |
| 3.1.4.3 | **1-cell spinning parameters defined** | | **Design Repo** | **INFN-LNL** | 0% |
| **3.1.5** | **Extension of spinning apparatus to multicel** | | | **INFN-LNL** | **0%** |
| 3.1.5.1 | Computer simulation of the necking | | | **INFN-LNL** | 0% |
| 3.1.5.2 | **Start of Multi-cell spinning** | **Start spinning** | | **INFN-LNL** | 0% |
| **3.1.6** | **Spinning of multi-cell cavities cavities** | | | **INFN-LNL** | **0%** |
| 3.1.6.1 | Computer simulation of the hydro forming | | | **INFN-LNL** | 0% |
| 3.1.6.2 | Hydro forming of bulk Nb 9-cell cavities | | | **INFN-LNL** | 0% |
| 3.1.6.3 | **Parameters of multi-cell spinning defin** | **Design report** | | **INFN-LNL** | 0% |
| **3.1.7** | **Series production of multi-cell cavities** | | | **INFN-LNL** | **0%** |
| 3.1.7.1 | Spinning | | | **INFN-LNL** | 0% |
| 3.1.7.2 | **Multi-cell cavities finished** | | **Final report, Cavity** | **INFN-LNL** | 100% |
| **3.2** | **Seamless by hydroforming** | | | **DESY** | **52%** |
| **3.2.1** | **Design hydro forming machine** | | | **DESY** | **100%** |
| 3.2.1.1 | Drawings of the matrices | | | **DESY** | 100% |
| 3.2.1.2 | Drawings of the support system | | | **DESY** | 100% |
| 3.2.1.3 | **Drawings matrix & support finished** | **Design report** | | **DESY** | 100% |
| **3.2.2** | **Construction of hydro forming machine** | | | **DESY** | **73%** |
| 3.2.2.1 | Hydraulic for machine | | | **DESY** | 100% |
| 3.2.2.2 | Software for the machine | | | **DESY** | 100% |
| 3.2.2.3 | Machine fabrication | | | **DESY** | 56% |
| 3.2.2.4 | Commissioning of the machine | | | **DESY** | 0% |
| 3.2.2.5 | **Hydro forming machine ready** | **Commissioning** | | **DESY** | 0% |
| **3.2.3** | **Construction of tube necking machine** | | | **DESY** | **95%** |
| 3.2.3.1 | Drawings of the support system and turning mechanism | | | **DESY** | 100% |
| 3.2.3.2 | Drawings of the necking mechanism | | | **DESY** | 100% |
| 3.2.3.3 | Fabrication of the tube necking machine | | | **DESY** | 70% |
| 3.2.3.4 | Software for the tube necking machine | | | **DESY** | 100% |
| 3.2.3.5 | **Construction tube necking machine fini** | **Design report** | | **DESY** | 100% |
| **3.2.4** | **Development of seamless tubes for 9-cell c** | | | **DESY** | **58%** |
| 3.2.4.1 | Material and fabrication of bulk Nb test tubes | | | **DESY** | 45% |
| 3.2.4.2 | Material and fabrication of bimetallic NbCu test tubes | | | **DESY** | 66% |
| 3.2.4.3 | **Seamless tubes ready** | **Design report** | | | 0% |
| **3.2.5** | **Development of tube necking** | | | **DESY** | **0%** |
| 3.2.5.1 | Computer simulation of the necking | | | **DESY** | 0% |
| 3.2.5.2 | Experiments on tube necking at iris | | | **DESY** | 0% |
| 3.2.5.3 | **Tube necking machine operational** | **Commissioning** | | **DESY** | 0% |
| **3.2.6** | **Hydro forming of seamless cavities** | | | **DESY** | **0%** |
| 3.2.6.1 | Computer simulation of the hydro forming | | | **DESY** | 0% |
| 3.2.6.2 | Hydro forming of bulk Nb 9-cell cavities | | | **DESY** | 0% |
| 3.2.6.3 | **Hydro formed 9-cell cavities ready** | | **Cavity Protot** | **DESY** | 0% |



# Status of Activity

## Task 3.1: Seamless cavities by spinning

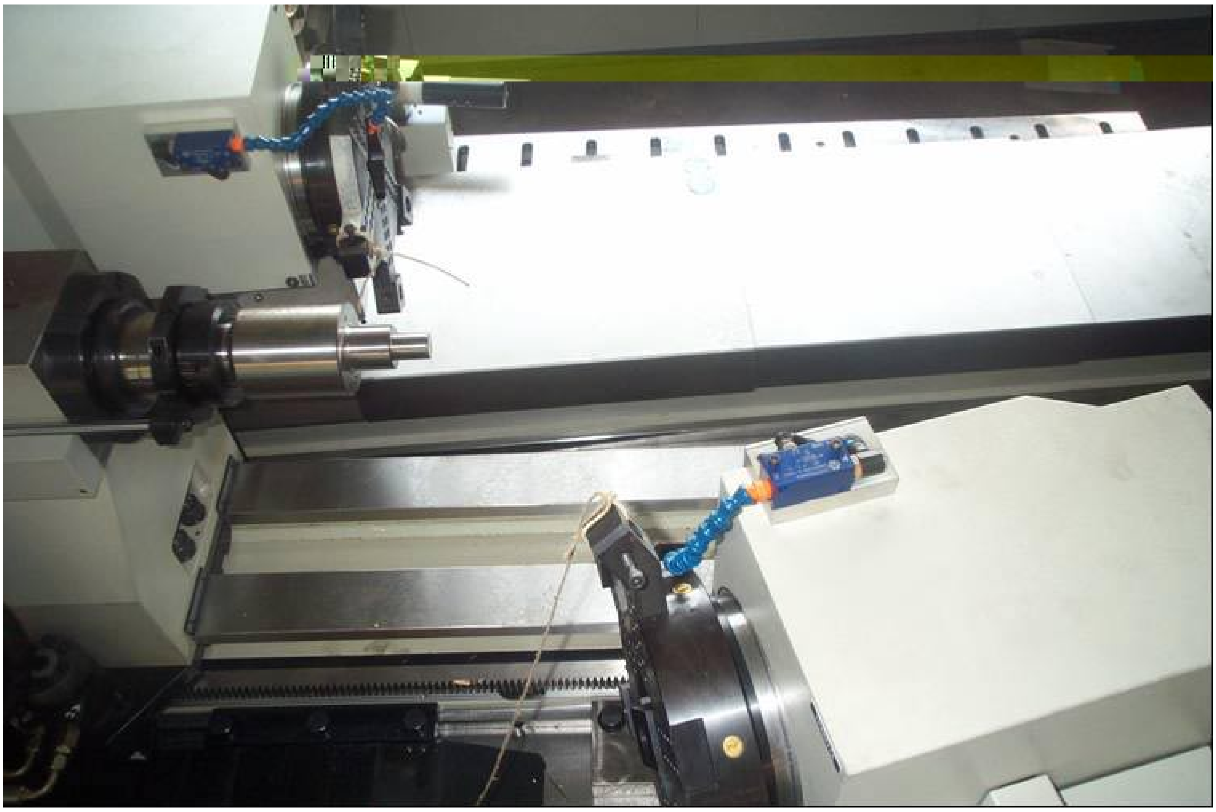
Both the design and the construction of a spinning machine for producing seamless multi-cell resonators starting from a tube have been completed. The spinning is done by an external firm that already owns a lathe currently used for spinning resonators. The actual machine has been built by upgrading an existing machine that in the original configuration was not powerful enough and not properly suitable for the spinning operation. Indeed, the main problem was the following: in all standard commercial machines the revolving turret supporting rollers would move back and forward along a direction that is approximately 45 degrees from the cavity axis. It would move forward in order to have rollers applying a radial force to the tube that must be plastically deformed. It would move backward in order to retract the roller after the deformation in order to shift from deforming one point to another . During the latter operation, the pressure is released and there would no possibility to apply any plastic deformation. Due to the peculiar shape of the cavity in each dumbbell, the standard machines could spin only the half cell that is encountered along the roller's rectilinear path. In order to spin the other half-cell, the cavity should be dismounted from the lathe together with the internal mandrel. All is then turned through 180 degrees, and the half-cell that was previously untouched by the roller then becomes the part that must be plastically deformed. This operation, which is repeated several times up to the moment when the full dumb-bell is finished, is the procedure adopted at the present time for producing spun, seamless multi-cell resonators. However, it is impractical, risky and time consuming. Not only can the piece be damaged during the operation of dismounting from lathe headstock, or during turning and remounting, but also the collapsible mandrel can move from the correct position. Furthermore, the lathe is not long enough to spin a nine cell TESLA cavity and the pressure between headstock and tailstock is insufficient.

Therefore we adapted a standard machine designing some modified parts to add to the existing machine. All the work done is reported in the following:

- As reported above, a new turret has been designed. The turret will work in the opposite direction and on the other side of the already existing one.
- The hydraulic plant will be implemented and valves will be added, in order to achieve a pressure of 120 bar.
- Since the increase in pressure will be too large for the existing headstock configuration, and since the maximum rotation speed will be of 2000 rpm, the bearings supporting the headstock will be changed adopting forced lubrication bearings with the related pump and ancillaries
- The headstock will also be consequently lengthened by 100 mm and it has been designed to be of a more robust construction.
- The lathe base and carriage appear more solid in the new design. The base will be lengthened by 200 mm.
- The lathe tailstock has been enforced also in order to support the higher pressure we need to apply between headstock and tailstock when spinning the parts.
- A new motor has been adopted. It will have 18 kW of power, with an output speed of 8000/min and a speed reducer of 1:4

**Status of milestones**

The design was finished in July 2004 and the machine has just been built and delivered, in advance of the milestone of three months. For work package 3.1 then, the milestones have been fully respected. We will invest the few months gained in building the machine in a time that will be spent for the machine commissioning, which, being a very delicate operation, is a critical phase that will certainly benefit from a few months additional time.



Picture of the new spinning machine (just delivered): the two spinning turrets work against each other.

**Task 3.2: Seamless by hydro-forming**

The fabrication by hydro-forming of a seamless niobium cavity of TESLA shape, with a ratio of equator diameter to iris diameter of about three, is a challenging task and requires a special development.
One starts with a tube of diameter intermediate between that of the iris and equator. The forming procedure includes two stages; reduction of the tube diameter in the iris area and then expansion of the tube in the equator area.
The hydro-forming experiment itself consists generally of three steps:-Determination of the strain-stress properties of the tube material, computer simulation of the forming and finally the hydro-forming test itself.
During hydro-forming experiments an internal pressure is applied to the tube and, simultaneously, an axial displacement, forming the tube into an external mould (see Fig. 1).
The experiments will be done with a machine for hydro-forming built earlier within the scope of the TESLA collaboration. In the frame of task 3.2 the machine was provided with new moulds for fabrication of multi cells and also with water hydraulic system for the internal pressure in the tube and with an oil hydraulic system for the cylinder movements. The computer control system developed for the hydro-forming allows the hydraulic expansion in stepwise as well as in a continuous regime.

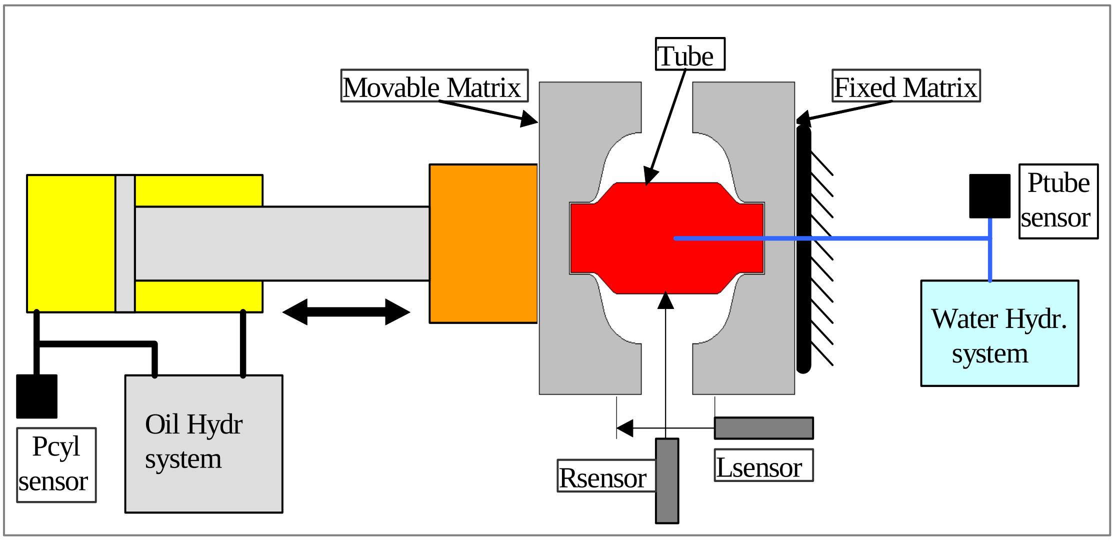



Fig. 1 Schema of the hydroforming machine

A design of the necking mechanism has been developed. It is based on a new idea using a profile ring for necking (Fig. 2). A concept for the software has been developed and is being implemented. Construction of the tube necking machine is in progress. Some components are ready. Preliminary experiments have shown that the reduction of the tube diameter can be done not only at the tube ends but also in the iris region of future cavities. This is imperative for the fabrication of multi cell cavities.

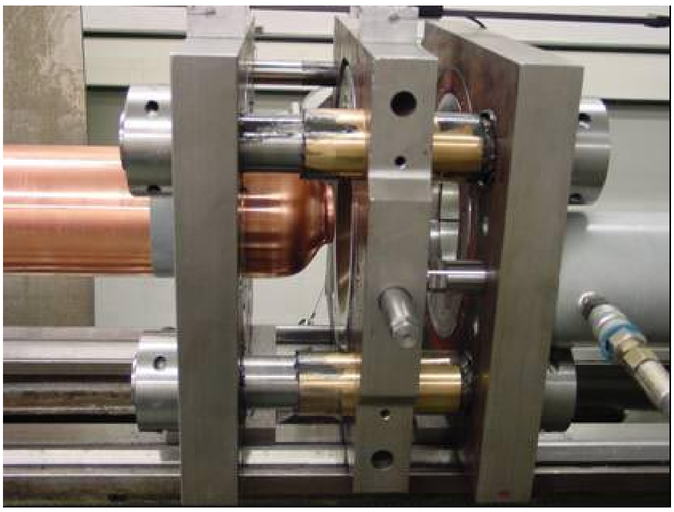


Fig.2. Necking mechanism

Fabrication of seamless tubes suitable for hydro-forming is one of main problems. The required elongation at fracture: > 30%, and achieving a small and uniform grain in the final shape is the challenge.
For the choice of the initial tube diameter two aspects should be taken into consideration. On the one hand the work hardening at the equator should be moderate and in any case remain

# WP4 THIN FILM CAVITY PRODUCTION

| N° | Task Name | Milestones | Main | Contractor | % | 2004 J F M A M J J A S O N D / 2005 J F M A M J |
|---|---|---|---|---|---|---|
| **4** | **WP4 THIN FILM CAVITY PRODUCTION** | | | | **27%** | |
| **4.1** | **Linear-arc cathode coating** | | | **IPJ** | **24%** | |
| **4.1.1** | **Installation & commissioning of coating app** | | | **IPJ** | **32%** | |
| 4.1.1.1 | Modification of a prototype facility for single c | | | **IPJ** | 100% | |
| 4.1.1.2 | Optimization of a triggering system | | | **IPJ** | 100% | |
| 4.1.1.3 | **Prototype facility ready** | **Commissioning** | | **IPJ** | 100% | **11.10.** |
| 4.1.1.4 | Study of arc current reduction and stabilizatio | | | **IPJ** | 70% | |
| 4.1.1.5 | Optimization of pow ering system | | | **IPJ** | 20% | |
| 4.1.1.6 | **Coating apparatus operational** | **Apparatus ready** | | **IPJ** | 0% | **14.03.** |
| **4.1.1.7** | **Coating single cells** | | | **IPJ** | **0%** | |
| 4.1.1.7.1 | Coating of single cells w ithout micro droplet filtering | | | **IPJ** | 0% | |
| 4.1.1.7.2 | Design and construction of a micro drop | | | **IPJ** | 0% | |
| 4.1.1.7.3 | **Droplet filter ready** | **Hardware ready** | | **IPJ** | 0% | |
| 4.1.1.7.4 | Coating of single cell w ith micro droplet f | | | **IPJ** | 0% | |
| **4.1.2** | **Coating multi-cell** | | | **IPJ** | **0%** | |
| 4.1.2.1 | Design and commissioning | | | **IPJ** | 0% | |
| 4.1.2.2 | First multicell coating | | | **IPJ** | 0% | |
| **4.2** | **Planar-arc cathode coating** | | | **INFN-Ro2** | **31%** | |
| **4.2.1** | **Modification of a planar-arc & trigger system** | | | **INFN-Ro2** | **100%** | |
| 4.2.1.1 | Modification | | | **INFN-Ro2** | 100% | |
| 4.2.1.2 | Optimization of the laser triggering system | | | **INFN-Ro2** | 100% | |
| 4.2.1.3 | **Planar arc system fully tested** | **Status Report** | | **INFN-Ro2** | 100% | **03.09.** |
| **4.2.2** | **Routine Operation of planar arc system** | | | **INFN-Ro2** | **58%** | |
| 4.2.2.1 | Characterization of samples coated at different conditions | | | **INFN-Ro2** | 90% | |
| 4.2.2.2 | Characterization of Nb-coated sapphire | | | **INFN-Ro2** | 60% | |
| 4.2.2.3 | Characterization of Nb-coated copper sa | | | **INFN-Ro2** | 30% | |
| 4.2.2.4 | **Summary report on quality of planar arc coating** | **Status Report** | | **INFN-Ro2** | 75% | **2** |
| **4.2.3** | **Studies of other HTC superconducting coati** | | | **INFN-Ro2** | **0%** | |
| 4.2.3.1 | Study of superconducting properties | | | **INFN-Ro2** | 0% | |
| 4.2.3.2 | **Report on quality of superconducting properties** | | **Final Report** | **INFN-Ro2** | 0% | |

## Status of the activity:

### Task 4.1.1: Linear arc cathode coating

Task WP4.1 is focused on the development of an UHV cathode-arc system with a linear (cylindrical) configuration. The idea of a cavity coating by means of a linear (cylindrical) arc discharge is presented in Fig.1.

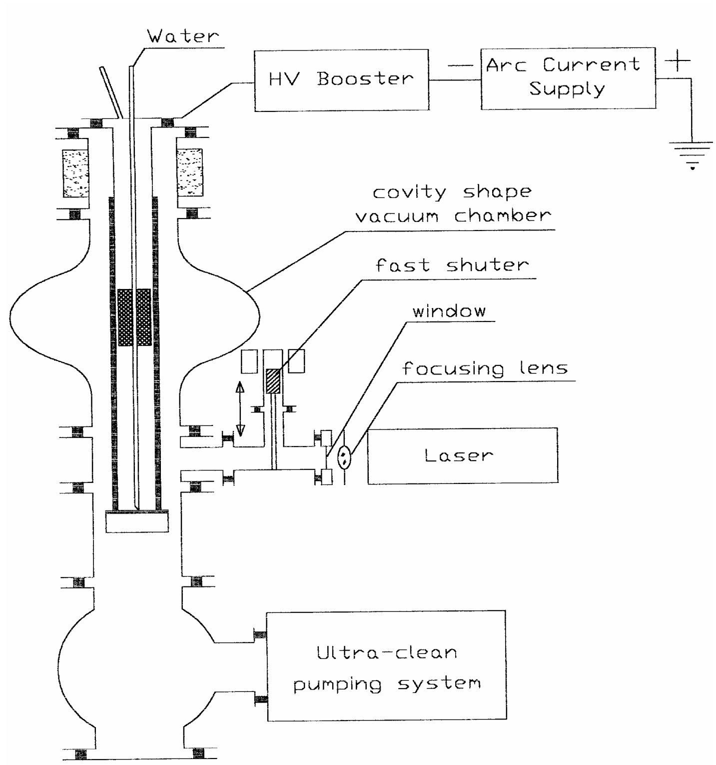



*Fig.1. Scheme of an UHV facility designed for the linear-arc cathode coating.*

Since cleanliness of the deposition process plays a crucial role during the formation of thin superconducting niobium layers, to achieve good superconducting film properties the partial pressures of water, nitrogen, oxygen, $CO_2$, hydro-carbides etc., must remain well below $10^{-9}$ hPa. Therefore, the pumping system must be totally oil-free and all parts of the deposition system must be designed and built in accordance with UHV technology requirements.

Some preliminary efforts to achieve the required UHV conditions were undertaken before starting the CARE project. A prototype set-up with a linear (cylindrical) cathode, designed especially for the deposition of niobium films, was constructed and put into operation in the mid 2003. The ultimate pressure in that system was equal to $2x10^{-8}$ mbar, i.e. it was 1 to 2 orders of magnitude higher than the value required. A thorough modernization of that set-up has been planned in a frame of CARE project, according to a scheme shown in Fig.2.

The operation of the modified prototype facility, as designed for the coating of single cells, has been delayed in a comparison with the planned time-schedule, due to a large delay in the transfer of CARE funds to Poland. It was impossible to buy and install the required durable equipment before July 2004. In order to increase the manpower committed to WP4.1 a young engineer (MScEE Pawel Strzyzewski) has been employed under a contract until September 1, 2005 .

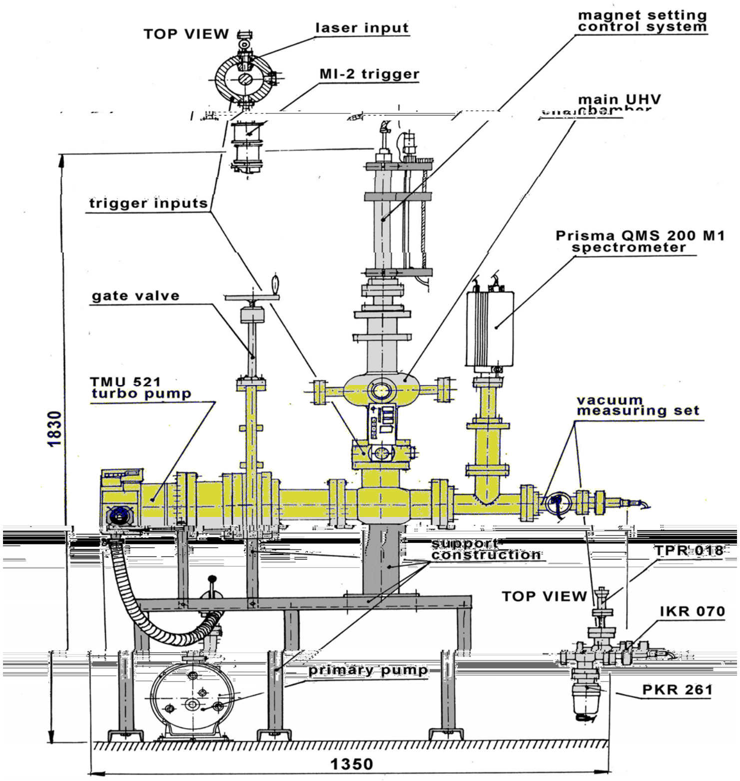



*Fig.2. Scheme of the modified UHV stand equipped with the linear-cathode arc system.*

The modification of the prototype facility included an exchange of the whole pumping system. Since September 2004

- a new turbo-molecular pump (of the TMU 521 type) has been installed;
- a new dry-piston pump (of the Xtradry.150-2 type) has been installed as a roughing-pump;
- new UHV gauges have been applied;
- a modern gas analyzer (of the QMS 200 Prisma type) has been installed;
- important improvements in the control unit have been made;
- and a new baking system has been designed and installed.

The modified system was ready for operation on October 11, 2004. Due to the modifications it was possible to improve the ultimate vacuum conditions considerably, and to reduce the final background pressure within the main experimental chamber down to values below $10^{-10}$ mbar. A typical mass spectrum of residual gasses within the chamber (after its 30-hour baking at temperature of $150^{0}$C) is shown in Fig.3.

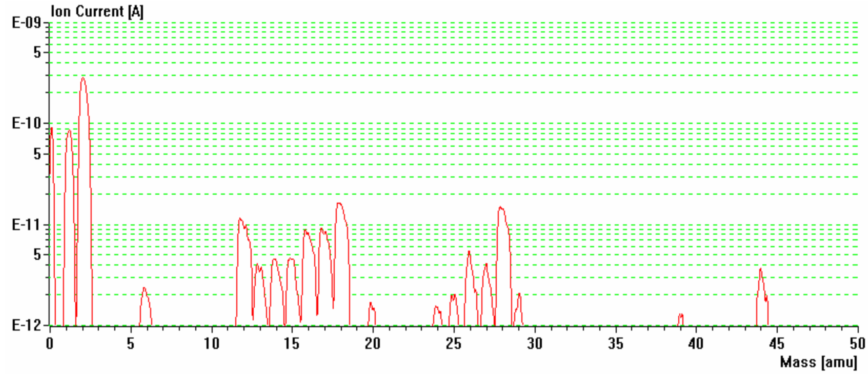



*Fig.3. Mass-spectrum of residual gases, recorded at the final pressure p = 1.5x10$^{-10}$ mbar, as achieved after 180-hour pumping and 30-hour backing at $T_b$ = 150$^o$C.*

The triggering of arc discharges often creates many problems, even in industrial arc-based devices. With UHV conditions these problems are multiplied. A triggering system for the arc deposition of superconducting Nb-films must be infallible, and it must not produce any impurities. Various ignition techniques have been tested from the point of view of their operational reliability and purity. On the basis of optimization tests three independent triggering systems have been chosen and applied in the modified set-up described above. They use:

- a Nd:YAG laser of energy 100 mJ, emitting 10-ns pulses at the repetition rate up to 20 Hz;
- a modified mechanical trigger, using a movable high-voltage (HV) electrode;
- a ruby laser of energy of 0.7 J, producing 50-ns pulses at the repetition of 1 shot/min.

These techniques ensure 100% probability of the arc ignition. The location of the triggering systems is shown in Fig.4.

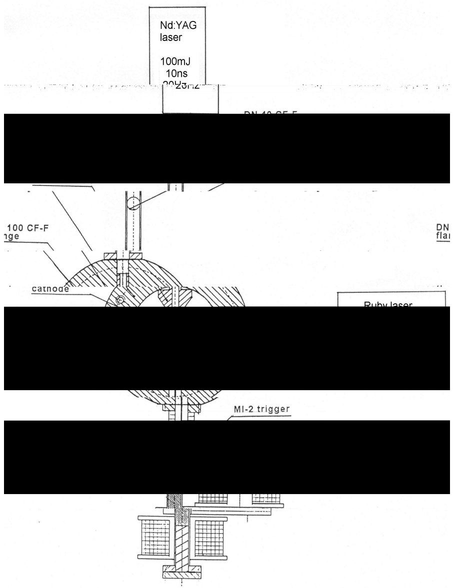



*Fig.4. Arrangement of the arc triggering systems.*

A general view of the modified mechanical trigger system, which was optimized in 2004, is shown in Fig.5.

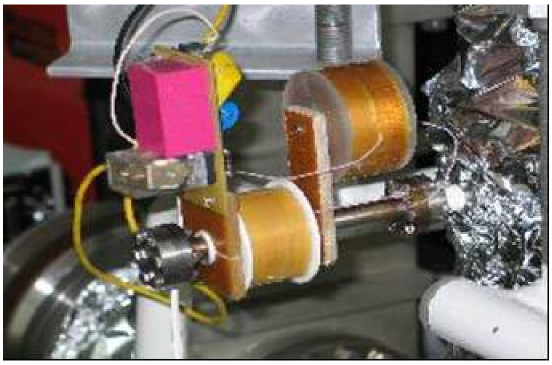


*Fig.5. Modified mechanical trigger system equipped with separate driving coils.*

The whole experimental facility, which was equipped with the linear (cylindrical) cathode, is shown in Fig.6.

*Fig.6. General view of the modified UHV system with supply and control units.*

The modified prototype facility, designed for the coating of single cells, has been tested, and an example of a stable arc discharge is shown in Fig. 7.

*Fig.7. Picture of the linear-arc discharge upon the cylindrical cathode surface), as observed at the base pressure of $4x10^{-10}$ mTorr, arc current of 40 A, the action lasting 1 minute.*

Recently, a prototype of a high-current pulse generator has been commissioned and research on the arc current reduction and stabilization has been started. The optimization of the power system is in progress, and the prototype facility should be ready for coating of a single cell by the end of February, 2005, as planned in the up-dated time-schedule.

**Task 4.2 – Planar-Arc Cathode Coating**

The task WP4.2 concerns the development of a UHV cathode-arc system with the planar configuration. In 2004 the UHV facility, which was equipped with the planar cathode, was modified on the basis of experience gained with an earlier version. That facility was built, assembled and commissioned according to the planned time-schedule. The UHV chamber has been pumped down to $10^{-10}$ Torr by means of an oil-free pumping system, consisting of a membrane backing-pump and a turbo-molecular pump. The conical cathode has been made of a high purity Nb-rod fixed to a water-cooled Cu-support. An interposed Ga-In eutectic mixture has ensured a good thermal contact between the Nb and Cu parts. A conical vacuum chamber (surrounding the Nb cathode) has been manufactured from a single stainless-steel rod. A schematic drawing of the described system is shown in Fig.8.

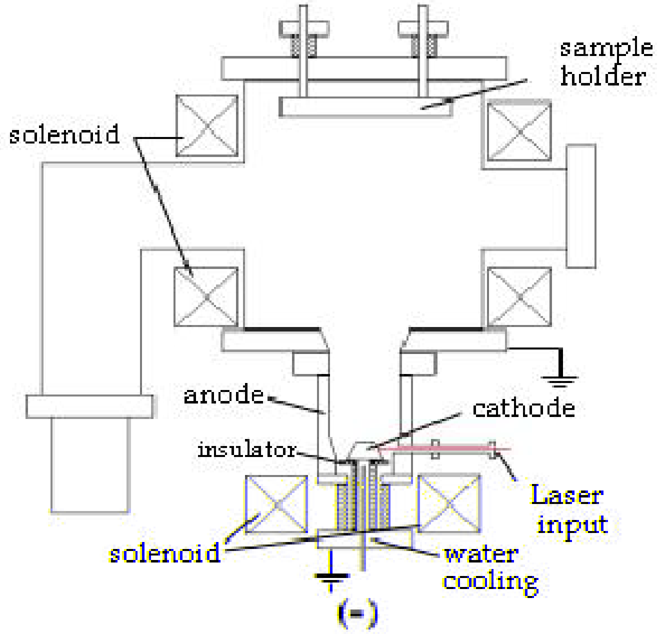



*Fig.8. Schematic of the UHV system designed for a planar-arc coating.*

A sample holder, consisting of a massive Cu flange placed at a distance of about 50 cm from the cathode, could be used to hold several samples. It has been insulated electrically, and can be biased negatively in order to avoid excessive heating of samples by plasma electrons. The holder has been equipped with a rotating shutter, which allows coating of a single sample during a chosen discharge. More details can be found in papers published this year (see the list below).

A sub-task, concerning the development and optimization of the arc triggering system, has been completed according to schedule. It has been found that the best, most reliable and completely clean method to ignite the UHV arc discharges is by laser ablation of the cathode, which might be achieved by a laser beam introduced through a vacuum window and focused onto the cathode surface.

In order to eliminate micro-particles emitted from the cathode surface, a prototype of a magnetic filtering system has been assembled and tested (somewhat earlier than it was scheduled). The system consists of an elbow-shaped vacuum channel surrounded by several coils, which produce a guiding magnetic field. Such a field guides electrons and ions through the channel, while macro-particles (moving along almost straight lines) are stopped upon the channel walls. Pictures of the facility with and without the magnetic filter are shown in Fig.9.

The obtained transition widths, which are very narrow (0.01–0.02 K), prove that the deposited films are homogeneous. The structure of the first Nb film samples has also been investigated by means of the X-ray diffraction and atomic force microscopy (AFM). The results, which indicate lower stresses and narrower widths of the diffraction peak than those observed for Nb-films sputtered onto Cu-substrates, are consistent with the $T_c$ measurements. The AFM pictures show that an average size of the Nb grains is about 200 nm. The roughness of Nb-films deposited onto Cu-substrates is comparable to that of the Cu sample itself. The roughness of Nb-films deposited on sapphire substrates is much smaller. In some cases the growth of column like structures (at the bottom and walls of a crater left by a larger micro-droplet) can be observed, as shown in Fig.11.

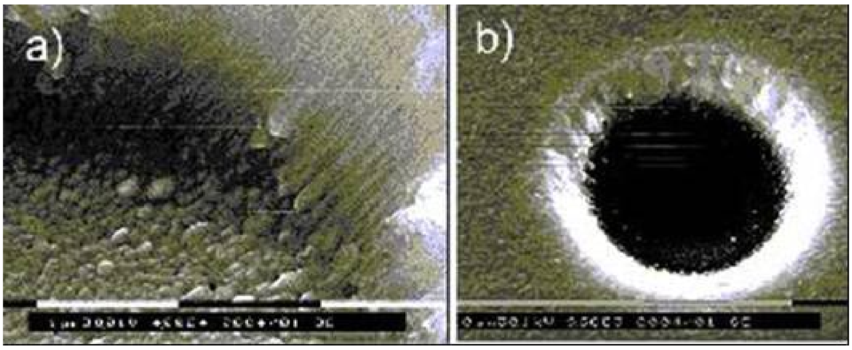



Fig.11. Germs of crystallites formed at the bottom of a crater (a), which was left after the removal of a micro-droplet from the deposited Cu-substrate (b). The column like crystallites on the crater walls are about 1.5 µm in height.

The Nb-coated samples have been investigated by means of optical and electron microscopes in order to determine the surface density and dimensions of deposited micro-droplets. The roughness of the deposited Nb-layers has also been measured as a function of the arc discharge parameters. The data collected so far have shown that, at the normal cathode temperature, the lowest number of the deposited micro-droplets can be obtained at the maximum arc current of about 130 A. The surface density and size of the micro-droplets, as measured upon the samples obtained with an unfiltered arc discharge, is shown in Fig.12.

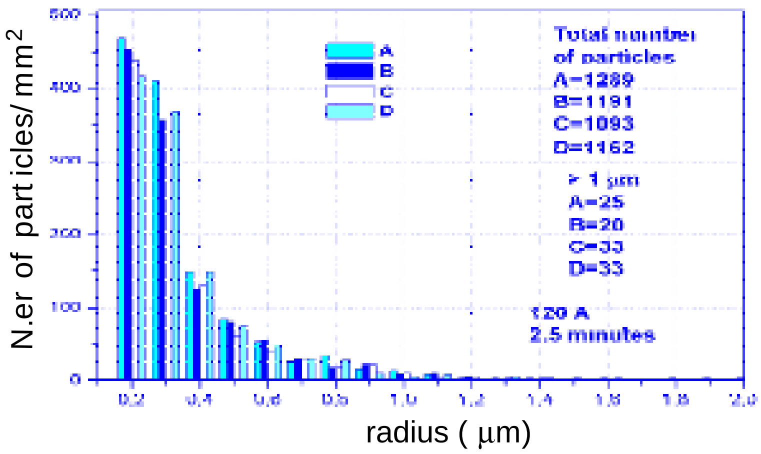



*Fig.12. Characteristics of the micro-droplets measured upon 4 different samples.*

The effectiveness of the micro-droplet filtering can be illustrated by a comparison of microscope images of the samples obtained with and without the magnetic filter, as shown in Fig.13.

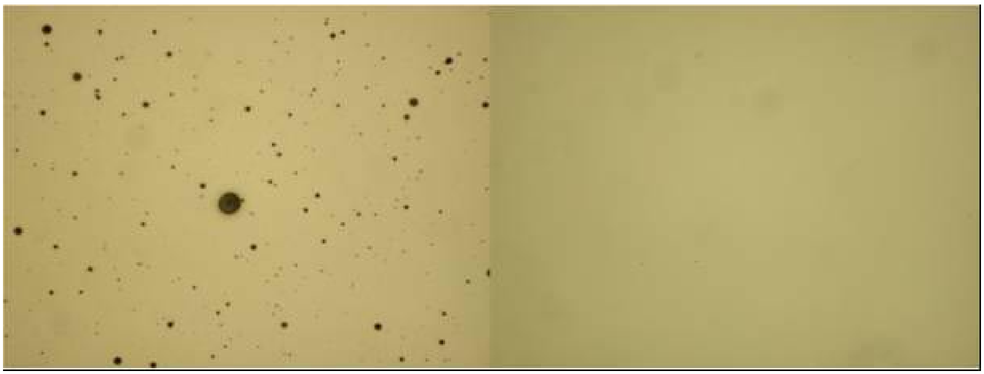


*Fig.13. Microscope pictures of the identical regions (250x190 $\mu m^2$) of the sample coated without magnetic filter (on the left) and that produced with the active filter (on the right).*

In order to characterize properties of the Nb-coated samples some preliminary RF measurements have been performed at INFN Napoli, as shown in Fig.14.

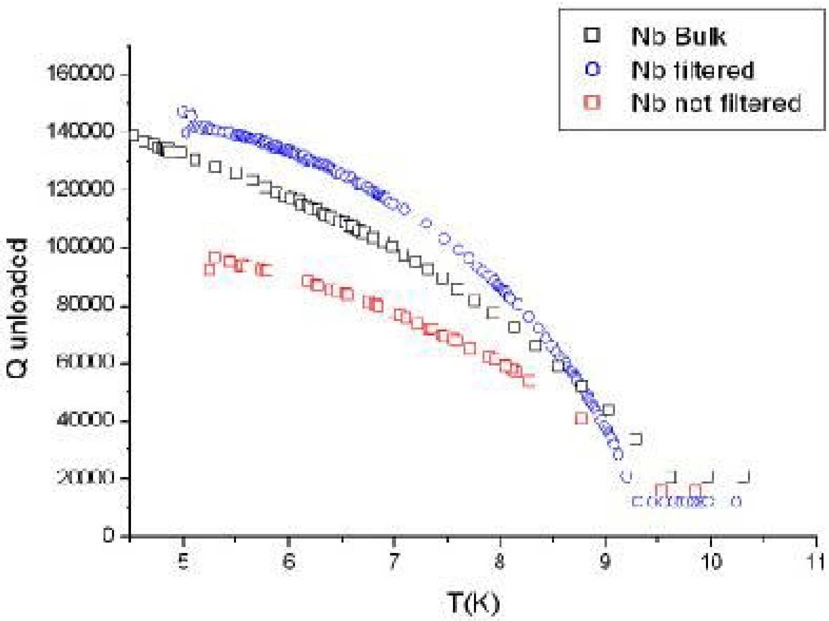
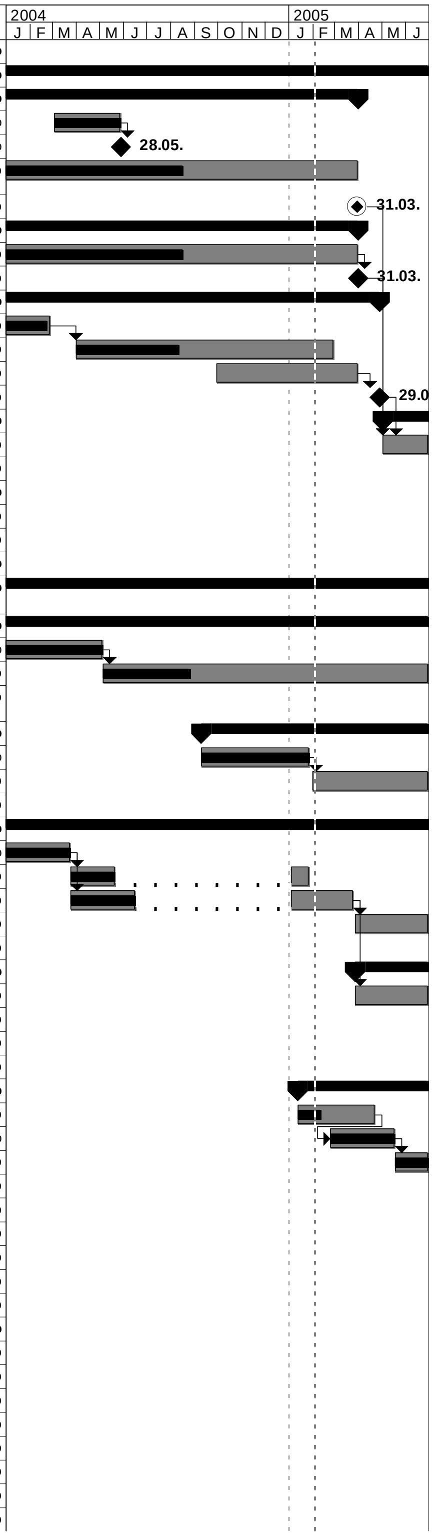



*Fig.14. Comparison between the quality factors of bulk Nb and of our Nb-film samples.*

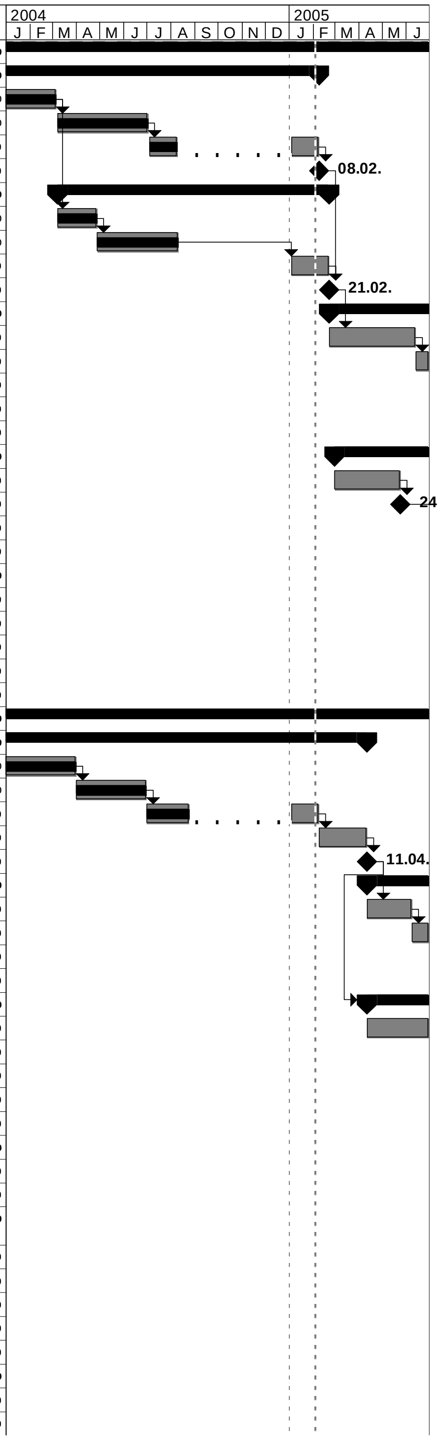
The most important result was the demonstration that the Nb-coated samples show the same behavior as the bulk Nb, and the Nb-layers obtained with the magnetic filtering appear to be the best ones.

# WP5 SURFACE PREPARATION

| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **5** | **WP5 SURFACE PREPARATION** | | | | **22%** |
| **5.1** | **EP on single cells** | | | **CEA** | **29%** |
| **5.1.1** | **EP on samples** | | | **CEA** | **58%** |
| 5.1.1.1 | Establishing method of surface characterizat | | | CEA | 100% |
| 5.1.1.2 | **Surface characterization fixed** | **Design Report** | | CEA | 100% |
| 5.1.1.3 | Series of EP with samples for surface investigations | | | CEA | 50% |
| 5.1.1.4 | **Best EP parameters** | | **Final Report** | CEA | 0% |
| **5.1.2** | **Single cell cavities** | | | **CEA** | **50%** |
| 5.1.2.1 | Order Nb and fabricate 3 cavities | | | CEA | 50% |
| 5.1.2.2 | **3 cavities fabricated** | **Cavities ready** | | CEA | 0% |
| **5.1.3** | **Build EP chemistry for single cells** | | | **CEA** | **32%** |
| 5.1.3.1 | Design of EP set-up | | | CEA | 90% |
| 5.1.3.2 | Fabrication of EP set-up | | | CEA | 40% |
| 5.1.3.3 | Commissioning of EP set-up | | | CEA | 0% |
| 5.1.3.4 | **First operation of EP set-up** | **Commissioning** | | CEA | 0% |
| **5.1.4** | **Operation of single cell EP** | | | **CEA** | **0%** |
| 5.1.4.1 | Continous single cell operation | | | CEA | 0% |
| 5.1.4.2 | **Define working parameters for single c** | **Design Report** | | CEA | 0% |
| **5.1.5** | **Continuous operation, search for best para** | | | **CEA** | **0%** |
| 5.1.5.1 | Parametrising EP procedure | | | CEA | 0% |
| 5.1.5.2 | **EP parameters fixed** | | **Final report** | CEA | 0% |
| **5.2** | **EP on multi-cells** | | | **DESY** | **25%** |
| **5.2.1** | **Transfer of parameters from 1 cell to multi cell equipment** | | | **DESY** | **45%** |
| **5.2.1.1** | **Finish EP setup nine-cells at DESY** | | | **DESY** | **42%** |
| 5.2.1.1.1 | Improved gas cleaning system | | | DESY | 100% |
| 5.2.1.1.2 | Design for hot water rinsing | | | DESY | 26% |
| 5.2.1.1.3 | **Proof-of-Principle experiment hot water rinsing** | **Status Report** | | DESY | 0% |
| **5.2.1.2** | **Optimize electrode shape** | | | **DESY** | **45%** |
| 5.2.1.2.1 | Develop computer model / Evaluate softw | | | DESY | 100% |
| 5.2.1.2.2 | Design improved electrode | | | DESY | 0% |
| 5.2.1.2.3 | **Electrode design fixed** | **Design report** | | DESY | 0% |
| **5.2.1.3** | **Fix process parameters/ Quality control** | | | **DESY** | **49%** |
| 5.2.1.3.1 | Setup chemical lab | | | DESY | 100% |
| 5.2.1.3.2 | Bath aging | | | DESY | 70% |
| 5.2.1.3.3 | Bath mixture | | | DESY | 50% |
| 5.2.1.3.4 | Alternative (salt) mixtures | | | DESY | 0% |
| 5.2.1.3.5 | **Process parameters fixed** | | **Final report** | DESY | 50% |
| **5.2.2** | **Laser roughness** | | | **DESY** | **0%** |
| 5.2.2.1 | Evaluate existing systems | | | DESY | 0% |
| 5.2.2.2 | Specify laser system | | | DESY | 0% |
| 5.2.2.3 | Built laser system | | | DESY | 0% |
| 5.2.2.4 | **Roughness measurement finished** | **Equipment ready** | | DESY | 0% |
| **5.2.3** | **Oxipolishing as final chemical cleaning** | | | **DESY** | **35%** |
| 5.2.3.1 | Laboratory studies | | | DESY | 30% |
| 5.2.3.2 | Design of OP system | | | DESY | 100% |
| 5.2.3.3 | Setup one-cell system | | | DESY | 90% |
| 5.2.3.4 | **Proof-of-Principle experiment Oxipolish** | **Status Report** | | DESY | 0% |
| 5.2.3.5 | Design OP for nine-cells | | | DESY | 0% |
| 5.2.3.6 | Build OP for 9-cells | | | DESY | 0% |
| 5.2.3.7 | **OP for 9-cells ready** | **Commissioning** | | DESY | 0% |
| 5.2.3.8 | Study op with 9-cell cavities | | | DESY | 0% |
| 5.2.3.9 | Evaluate experiments | | **Status Repor** | DESY | 0% |
| **5.2.4** | **Transfer Electropolishing technology to ind** | | | **DESY** | **0%** |
| 5.2.4.1 | Qualify industry with one-cells | | | DESY | 0% |
| 5.2.4.2 | Industrial design study on setup for multi-cel | | | DESY | 0% |
| 5.2.4.3 | **Report on industrial design** | **Report** | | DESY | 0% |
| 5.2.4.4 | Fabricate EP multi-cell industrial prototype | | | DESY | 0% |
| 5.2.4.5 | Commission EP multi-cell industrial prototype | | | DESY | 0% |
| 5.2.4.6 | **EP multi-cell industrial prototype ready** | **Commissioning** | | DESY | 0% |
| 5.2.4.7 | Operate EP multi-cell industrial prototype | | | DESY | 0% |
| 5.2.4.8 | **Final report on industrial EP** | | **Final report** | DESY | 0% |



| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **5.3** | **Automated EP (AEP)** | | | **INFN-LNL** | **24%** |
| **5.3.1** | **Prototype EP installation** | | | **INFN-LNL** | **86%** |
| 5.3.1.1 | Design installation | | | **INFN-LNL** | 100% |
| 5.3.1.2 | Fabricate/ order components | | | **INFN-LNL** | 100% |
| 5.3.1.3 | Assemble EP installation | | | **INFN-LNL** | 50% |
| 5.3.1.4 | **First operation of automated EP** | **Commissioning** | | **INFN-LNL** | 0% |
| **5.3.2** | **EP computer control** | | | **INFN-LNL** | **76%** |
| 5.3.2.1 | Design control architecture | | | **INFN-LNL** | 100% |
| 5.3.2.2 | Developed software | | | **INFN-LNL** | 100% |
| 5.3.2.3 | Test of software | | | **INFN-LNL** | 0% |
| 5.3.2.4 | **Software ready** | **Status Report** | | **INFN-LNL** | 0% |
| **5.3.3** | **Operation of AEP prototype** | | | **INFN-LNL** | **0%** |
| 5.3.3.1 | Correlate surface finish/ conductance | | | **INFN-LNL** | 0% |
| 5.3.3.2 | Determine optimum conductance | | | **INFN-LNL** | 0% |
| 5.3.3.3 | Optimize automated operation | | | **INFN-LNL** | 0% |
| 5.3.3.4 | Design report on AEP | | | **INFN-LNL** | 0% |
| 5.3.3.5 | **Automated EP is defined** | | **Final Report** | **INFN-LNL** | 0% |
| **5.3.4** | **Alternative electrolytes** | | | **INFN-LNL** | **0%** |
| 5.3.4.1 | Review of EP chemistry | | | **INFN-LNL** | 0% |
| 5.3.4.2 | **Proposal for alternative electrolytes** | **Report** | | **INFN-LNL** | 0% |
| 5.3.4.3 | Experiments with alternative electrolytes | | | **INFN-LNL** | 0% |
| 5.3.4.4 | **Conclude experimental results** | **Status Report** | | **INFN-LNL** | 0% |
| **5.3.5** | **Define best AEP** | | | **INFN-LNL** | **0%** |
| 5.3.5.1 | Compare standard/new electrolyte method | | | **INFN-LNL** | 0% |
| 5.3.5.2 | Modify AEP installation for best electrolyte | | | **INFN-LNL** | 0% |
| 5.3.5.3 | Operate modified AEP | | | **INFN-LNL** | 0% |
| 5.3.5.4 | Design report on best AEP | | | **INFN-LNL** | 0% |
| 5.3.5.5 | **Conclude on best electrolyte** | | **Final Report** | **INFN-LNL** | 0% |
| **5.4** | **Dry ice cleaning** | | | **DESY** | **10%** |
| **5.4.1** | **Installation of full system for 1-3 cell cavities** | | | **DESY** | **70%** |
| 5.4.1.1 | Installation of CO2 piping | | | **DESY** | 100% |
| 5.4.1.2 | Installation of motion system | | | **DESY** | 100% |
| 5.4.1.3 | Installation of control system | | | **DESY** | 60% |
| 5.4.1.4 | Commissioning | | | **DESY** | 0% |
| 5.4.1.5 | **Installation finished** | **Commissioning** | | **DESY** | 0% |
| **5.4.2** | **Optimization of cleaning parameters** | | | **DESY** | **0%** |
| 5.4.2.1 | Sample cleaning | | | **DESY** | 0% |
| 5.4.2.2 | 1-cell cavity cleaning | | | **DESY** | 0% |
| 5.4.2.3 | Fix best cleaning parameters | | | **DESY** | 0% |
| 5.4.2.4 | **Cleaning parameters fixed** | | **Final Report** | **DESY** | 0% |
| **5.4.3** | **VT 9-cell cleaning apparatus** | | | **DESY** | **0%** |
| 5.4.3.1 | Design 9-cell apparatus VT | | | **DESY** | 0% |
| 5.4.3.2 | Fabricated 9-cell apparatus | | | **DESY** | 0% |
| 5.4.3.3 | Installation of 9-cell apparatus | | | **DESY** | 0% |
| 5.4.3.4 | Commissioning of 9-cell apparatus | | | **DESY** | 0% |
| 5.4.3.5 | **VT Cleaning Installation finished** | **Commissioning** | | **DESY** | 0% |
| **5.4.4** | **VT Cleaning of 9-cell cavities** | | | **DESY** | **0%** |
| 5.4.4.1 | Continuous cleaning | | | **DESY** | 0% |
| 5.4.4.2 | **Evaluation of experimental results** | | **Final Report** | **DESY** | 0% |
| **5.4.5** | **Design & construction of H 9-cell cleaning apparatus** | | | **DESY** | **0%** |
| 5.4.5.1 | Design 9-cell apparatus VT | | | **DESY** | 0% |
| 5.4.5.2 | Fabricated 9-cell apparatus | | | **DESY** | 0% |
| 5.4.5.3 | Installation of 9-cell apparatus | | | **DESY** | 0% |
| 5.4.5.4 | Commissioning of 9-cell apparatus | | | **DESY** | 0% |
| 5.4.5.5 | **Start H 9-cell cleaning** | **Commissionning** | | **DESY** | 0% |
| **5.4.6** | **Cleaning of horizontal nine-cell cavity** | | | **DESY** | **0%** |
| 5.4.6.1 | Continuous cleaning | | | **DESY** | 0% |
| 5.4.6.2 | **Evaluation of experimental results** | | **Final Report** | **DESY** | 0% |




# Status of activities

## Task 5.1. EP on single cells:

A report on a method of surface characterization has been submitted. The gloss measurement of the surface turns out to be a good indication of surface characterization besides the standard roughness measurement. Due to a relocation of the group working on the activity, the activity was stopped and accumulated some delay. The EP setup is in its final design phase. The single-cell production could be started only recently.

**Task 5.2. EP on multi-cells:**

The improved gas cleaning system is installed. Due to some problems with the EP setup currently a delay of about one month has been accumulated. It was still feasible to electro-polish 10 cavities this year. The results are rather mixed. Field emission turned out to be the most crucial problem. This could not be clearly identified as a problem of the EP system. It might be caused rather by the following high pressure rinsing and the final assembly steps before the tests.

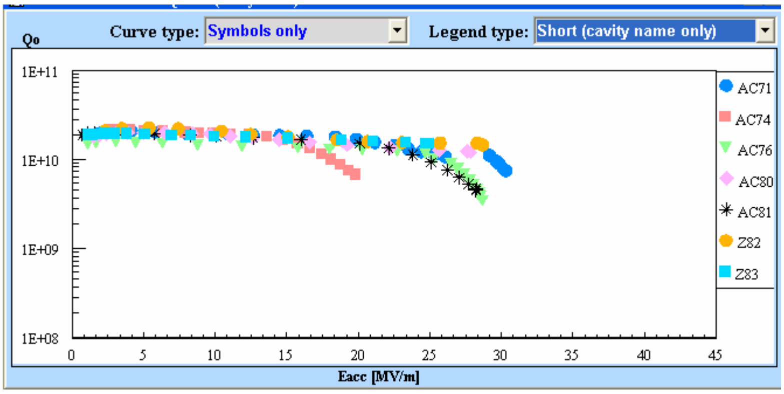



Figure: Results of the tests on cavities electro-polished at DESY. The performance is limited by field emission in most cases.

Nonetheless, one of the last cavities achieved a gradient of 38 MV/m. After maintenance of the clean room installation a consolidation of results is expected.

Elektro-polishing setup at DESY

The hot water rinsing experiment on multi-cells is on hold as single cell cavity tests give no sufficient confidence that an improvement of cavity performance can be achieved.

Preparation of the chemical lab is finished. First results confirm the assumption that the most crucial component is the content of the hydrofluoric acid that determines the process parameters. A report is under preparation.

New computer software for electrode design has been evaluated. The price is too high for the allocated money of this part of the project and a decision is needed whether this part of the project can be continued.

The laser roughness measurement is being evaluated further. There is no definite conclusion as yet.

**Task 5.3 Automated EP:**

The automated EP system is complete. The full system has been tested with copper models including the PLC and slow control software. The slow control can be logged to the optimum working point of an EP system. Several test setups for EP samples with different geometries have been built and will be evaluated. This might complement (or even replace) the computer software for electrode design referred to in the activity 5.2. Work on a high pressure rinsing system is underway.

**Activity 5.3. Dry-ice cleaning:**

Both, for carbon dioxide and for nitrogen an ultra pure gas supply system was integrated and tested in the existing clean-room. The main activity was the construction and test assembly of the moving system. First tests showed the need for further improvement of some critical components. Therefore the final assembly is delayed by 6 weeks due to the non-availability of parts. The control system is still under construction. The delay is caused by man-power problems originating from the shut-down work at the DESY accelerators in summer 2004. The CO2 purifier/cooler unit has been delivered mid of December, representing a delay of 8 weeks. Integration into the existing gas supply system started recently. Furthermore additional tests with a prototype system were performed to determine a better parameter set for the upcoming commissioning. From August, 1$^{st}$ a contract technician started to support and accelerate the installation of the system.

Figure: Nozzle system for cavity cleaning

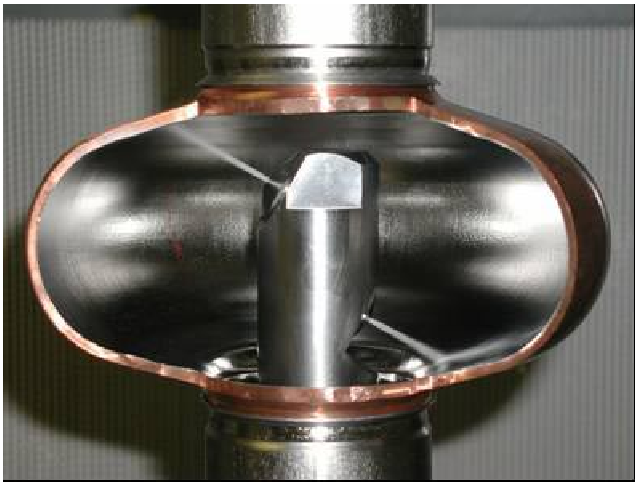


Figure: Test of the nozzle system in a cut cavity

So far, the most successful cleaning has resulted in the achievement of a gradient of more than 30 MV/m. The cavity is still limited by field emission but a significant improvement can be observed (see below).

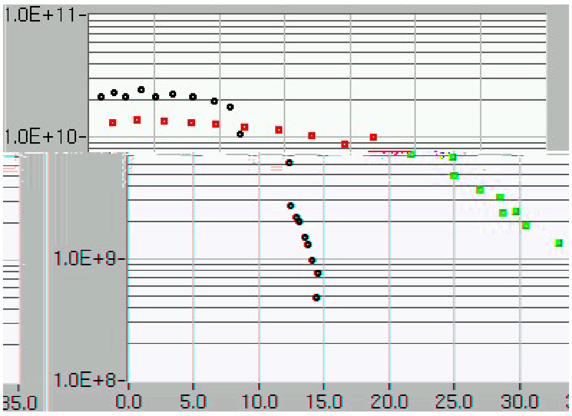
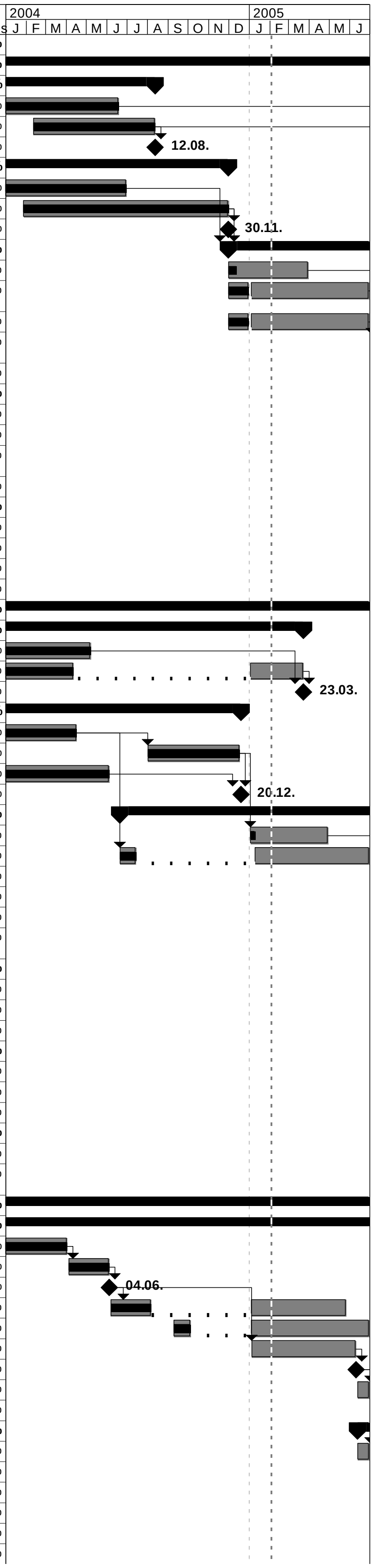



Figure: Improvement of a field emission loaded single-cell cavity (black) after dry-ice cleaning (red).

# WP6 MATERIAL ANALYSIS

| N° | Task Name | Milestones | Main Deliverables | Contractor | % schlos |
|---|---|---|---|---|---|
| **6** | **WP6 MATERIAL ANALYSIS** | | | **DESY** | **21%** |
| **6.1** | **SQUID scanning** | | | **DESY** | **37%** |
| **6.1.1** | **Produce calibration defects** | | | **DESY** | **100%** |
| 6.1.1.1 | Production of surface defects | | | **DESY** | 100% |
| 6.1.1.2 | Production of bulk defects | | | **DESY** | 100% |
| 6.1.1.3 | **Calibration defects finished** | **Status Report** | | **DESY** | 100% |
| **6.1.2** | **Design components of Squid scanner** | | | **DESY** | **100%** |
| 6.1.2.1 | Design of the scanning table and support | | | **DESY** | 100% |
| 6.1.2.2 | Design of the SQUID cooling system | | | **DESY** | 100% |
| 6.1.2.3 | **Design Scanner finished** | **Design report** | | **DESY** | 100% |
| **6.1.3** | **Construction of scanning apparatus** | | | **DESY** | **11%** |
| 6.1.3.1 | Fabrication of the SQUID | | | **DESY** | 10% |
| 6.1.3.2 | Fabrication and purchase of components for SQUID apparatus | | | **DESY** | 15% |
| 6.1.3.3 | Software for the SQUID scanner | | | **DESY** | 15% |
| 6.1.3.4 | Commissioning and calibration of scanning apparatus | | | **DESY** | 0% |
| 6.1.3.5 | **Scanning apparatus operational** | **Commissioning** | | **DESY** | 0% |
| **6.1.4** | **Scanning of sheets with artificial defects** | | | **DESY** | **0%** |
| 6.1.4.1 | Scanning of sheets with artificial surface def | | | **DESY** | 0% |
| 6.1.4.2 | Scanning of sheets with artificial bulk defects | | | **DESY** | 0% |
| 6.1.4.3 | Development of algorithm for material defects classification | | | **DESY** | 0% |
| 6.1.4.4 | **Classification of defects finished** | **Status Report** | | **DESY** | 0% |
| **6.1.5** | **Scanning of production sheets** | | | **DESY** | **0%** |
| 6.1.5.1 | Scanning of sheets of different producers | | | **DESY** | 0% |
| 6.1.5.2 | Identification of defects by (EDX, SURFA etc | | | **DESY** | 0% |
| 6.1.5.3 | Conclusive comparison with eddy current da | | | **DESY** | 0% |
| 6.1.5.4 | **Final report on SQUID scanning** | | **Final Report** | **DESY** | 0% |
| **6.2** | **Flux gate magnetometry** | | | **INFN-LNL** | **31%** |
| **6.2.1** | **Produce calibration defects** | | | **INFN-LNL** | **74%** |
| 6.2.1.1 | Production of surface defects | | | **INFN-LNL** | 100% |
| 6.2.1.2 | Production of bulk defects | | | **INFN-LNL** | 55% |
| 6.2.1.3 | **Calibration defects finished** | **Status Report** | | **INFN-LNL** | 0% |
| **6.2.2** | **Design components of flux gate head** | | | **INFN-LNL** | **100%** |
| 6.2.2.1 | Design electronics | | | **INFN-LNL** | 100% |
| 6.2.2.2 | Design of flux gate head | | | **INFN-LNL** | 100% |
| 6.2.2.3 | Design of operations software | | | **INFN-LNL** | 100% |
| 6.2.2.4 | **Design flux gate head finished** | **Design report** | | **INFN-LNL** | 100% |
| **6.2.3** | **Fabrication of flux gate detector** | | | **INFN-LNL** | **7%** |
| 6.2.3.1 | Fabrication of flux gate head | | | **INFN-LNL** | 6% |
| 6.2.3.2 | Fabrication of mechanics | | | **INFN-LNL** | 12% |
| 6.2.3.3 | Implementation of software | | | **INFN-LNL** | 0% |
| 6.2.3.4 | Commissioning of flux gate detector | | | **INFN-LNL** | 0% |
| 6.2.3.5 | Calibration of flux gate detector | | | **INFN-LNL** | 0% |
| 6.2.3.6 | **Flux gate detector operational** | **Design report, start operation** | | **INFN-LNL** | 0% |
| **6.2.4** | **Commissioning of flux gate detector** | | | **INFN-LNL** | **0%** |
| 6.2.4.1 | Operational tets tests | | | **INFN-LNL** | 0% |
| 6.2.4.2 | Evaluation of test results | | | **INFN-LNL** | 0% |
| 6.2.4.3 | **Flux gate scanner commissioned** | **Status Report** | | **INFN-LNL** | 0% |
| **6.2.5** | **Operation of flux gate detector** | | | **INFN-LNL** | **0%** |
| 6.2.5.1 | Regular operation | | | **INFN-LNL** | 0% |
| 6.2.5.2 | Report of operation | | | **INFN-LNL** | 0% |
| 6.2.5.3 | **Conclusion of flux gate scanning operat** | **Status Report** | | **INFN-LNL** | 0% |
| **6.2.6** | **Comparison with SQUID scanner** | | | **INFN-LNL** | **0%** |
| 6.2.6.1 | Compare measurements | | | **INFN-LNL** | 0% |
| 6.2.6.2 | **Conclude SQUID scanner vs. flux gate detector** | | **Final Report** | **INFN-LNL** | 0% |
| **6.3** | **DC field emission studies of Nb samples** | | | **DESY** | **6%** |
| **6.3.1** | **Quality control scans** | | | **DESY** | **14%** |
| 6.3.1.1 | Modification of Scanning apparatus | | | **DESY** | 100% |
| 6.3.1.2 | Calibration of Scanning apparatus | | | **DESY** | 100% |
| 6.3.1.3 | **Start scanning activity** | **Start Operation** | | **DESY** | 100% |
| 6.3.1.4 | BCP and HPR samples | | | **DESY** | 30% |
| 6.3.1.5 | EP and HPR samples | | | **DESY** | 10% |
| 6.3.1.6 | BCP/EP and DIC samples | | | **DESY** | 0% |
| 6.3.1.7 | **First report on BCP/EP and DIC surface** | **Interim Report** | | **DESY** | 0% |
| 6.3.1.8 | Continue QA scanning | | | **DESY** | 0% |
| 6.3.1.9 | **Evaluation of scanning results** | | **Final Report** | **DESY** | 0% |
| **6.3.2** | **Detailed measurements on strong emitters** | | | **DESY** | **0%** |
| 6.3.2.1 | Calibrate apparatus for high current | | | **DESY** | 0% |
| 6.3.2.2 | **Start strong emitter evaluation** | **Start Measureme** | | **DESY** | 0% |
| 6.3.2.3 | I/V curves and current limits | | | **DESY** | 0% |
| 6.3.2.4 | SEM and AES | | | **DESY** | 0% |
| 6.3.2.5 | Influence of heat treatment and ion impact | | | **DESY** | 0% |
| 6.3.2.6 | **Evaluate strong emitter investigations** | | **Final Report** | **DESY** | 0% |



## Status of activities

**Task 6.1 *(*Development of SQUID based equipment for detection of defects in Nb*)***

The reachable field strength in superconducting resonators is limited by surface defects or inclusions of unwanted elements. Since the manufacturing of Nb resonators is very expensive, it is reasonable to check the Nb sheets prior to fabrication of resonators.
A system is under construction for non-destructive inspection of niobium sheets, based on the eddy current effect. To receive the necessary detection sensitivity a SQUID sensor for measuring the local eddy current density is used.
Fig. 1 shows the principle of eddy current testing of niobium sheets. A circular coil, usually with a diameter of a few mm, generates eddy currents in the niobium sheet. Inhomogeneities of materials having a conductivity different from that of niobium lead to a distortion of the eddy current flow, and thus to a change in the eddy current field, which will be detected by scanning the sheet with a SQUID. In order to minimise the excitation field at the location of the SQUID, usually a gradiometric excitation coil is used, having the shape of a double D. However, since we expect the material inclusions to be only very small, a relatively small double-D coil must be used to maximize the eddy current density at the location of the inclusion. Making small double-D coils with many turns and high symmetry is not easy. Instead, one can use an electrical compensation scheme in which the field of the circular excitation coil is compensated electronically at the location of the SQUID by feeding part of the excitation current through the modulation coil used to flux lock the SQUID. By carefully adjusting the amplitude and phase of the compensation current, the excitation field at the SQUID can be compensated by a factor of 1000.
The sensitivity will be demonstrated on specially prepared niobium test sheets with tantalum inclusions of 50 - 100µm size.
The concept of the measurement system is shown in Fig. 2. It will be based on an xyz table with ca. 300mm x 300m travel area. The Nb sheets are fixed by a vacuum sample holder in order to keep them as flat as possible. The SQUID sensor is electronically controlled by a flux modulation and control loop, in order to keep the magnetic flux through the SQUID constant. Compensation current is controlled by the flux measurement. The amount of compensation current necessary to keep the SQUID's flux constant is then taken as measurement value from the control loop. This signal is then processed by a lock-in amplifier to eliminate noise with a spectral density apart from the excitation frequency. Different filters are implemented into the lock in amplifier to improve the Signal/Noise ratio. The system works in a non-shielded environment. With a sheet size of about 300x300mm² and a line width of 1mm a scan of one sheet will take about 10-15min.

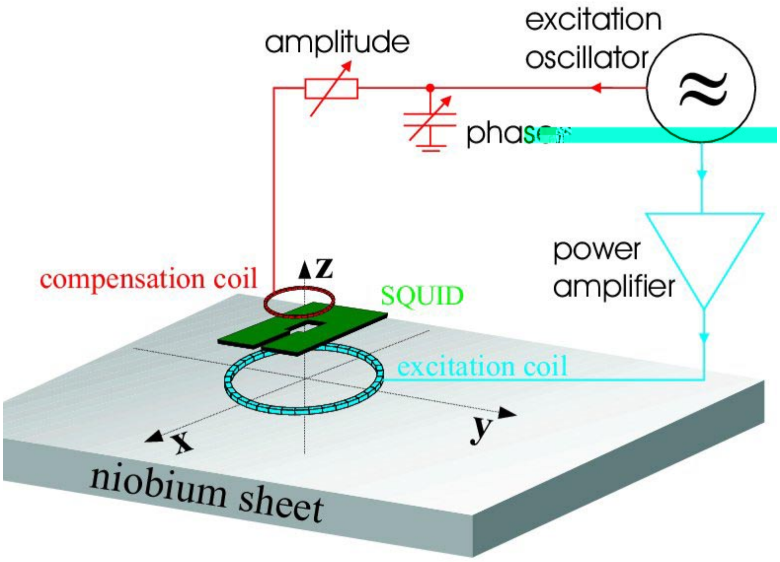



Fig. 1: Principle of the SQUID system for eddy current testing of niobium sheets
An excitation coil produces eddy currents in the sample, whose magnetic field is detected by the SQUID. A compensation coil close to the SQUID cancels the excitation field at the SQUID.

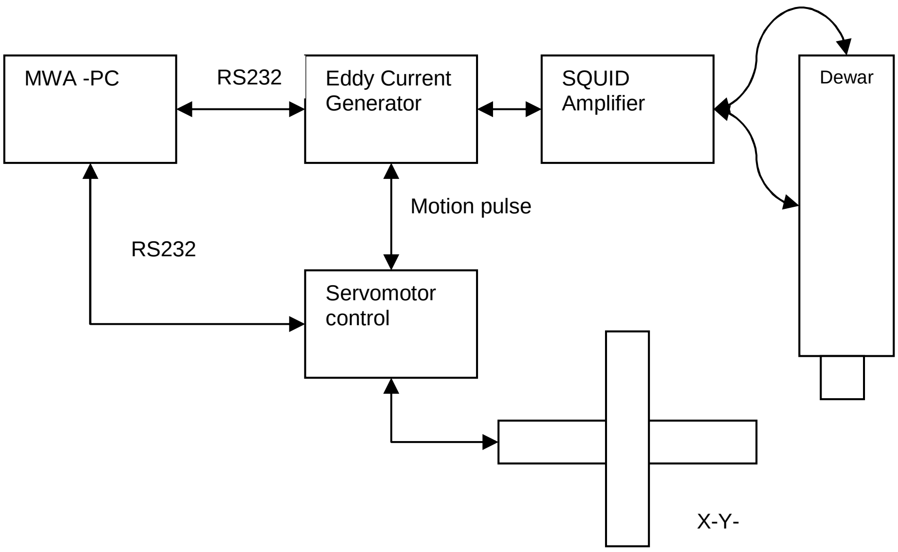
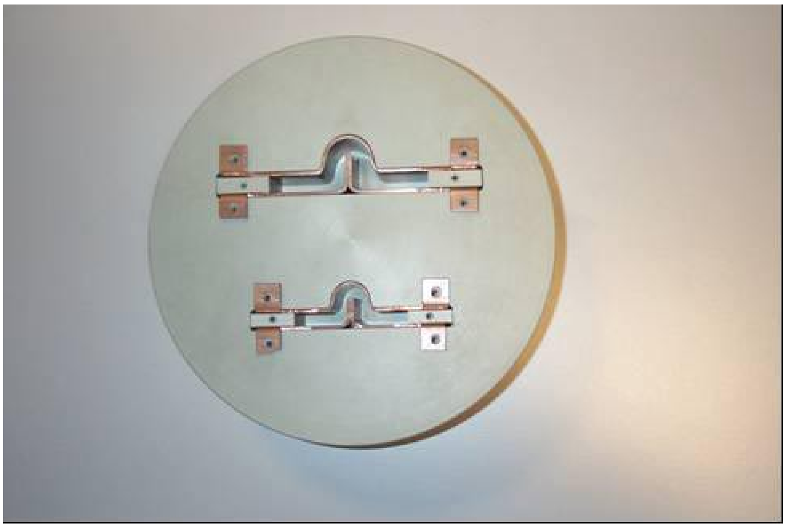



Fig. 2 Concept of a SQUID scanning system
Production of Nb sheets with artificially prepared surface defects is finished. Production of Nb sheets with artificially prepared bulk defects is in the final stage. Pure tantalum is chosen for foreign material inclusions. Some tantalum particles with smallest size of ca. 50 µm are implanted in the niobium sheet.
Design of components of the SQUID scanner is in work. One of the possible solutions for the scanning table design is finished.

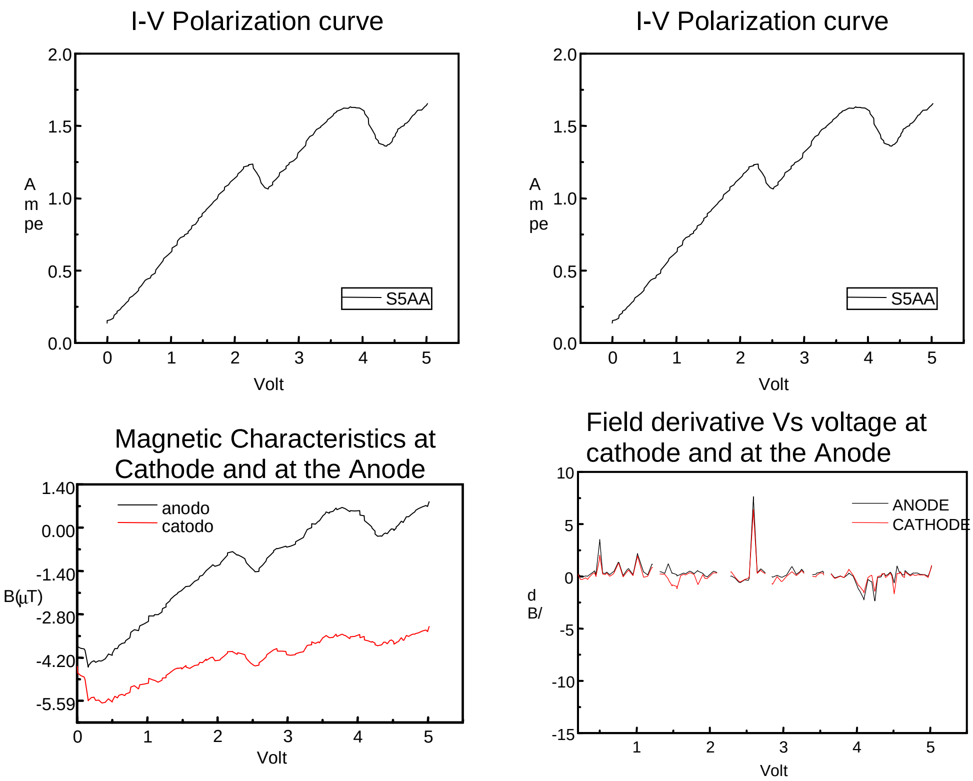
**WP 6.2 Flux gate magnetometry**

We are designing and building a flux gate scanning apparatus whose application is two-fold: (i) we will execute a tomography of the electrolytic cell, in order to configure the effect of cathode geometry on electro-polishing, (ii) we will distinguish niobium having different RRR by relative measurements of conductivity by detecting the eddy current decay.
Referring to this point we have;

- designed a cavity shaped electrolytic cell having the possibility to test different cathode shapes. The goal is as follows.
- Design the experiment to monitor two different kinds of defected samples:
    - Physical defects like surface scratches and foreign particle embedded onto niobium
    - Samples with degraded RRR to distinguish from samples with RRR 300.



Magnetometry arrangement: The picture shows a simulation of a cavity and cathode geometry for electro-polishing. Scanning by flux gate technology will deliver a tomography of the electro-polishing conditions



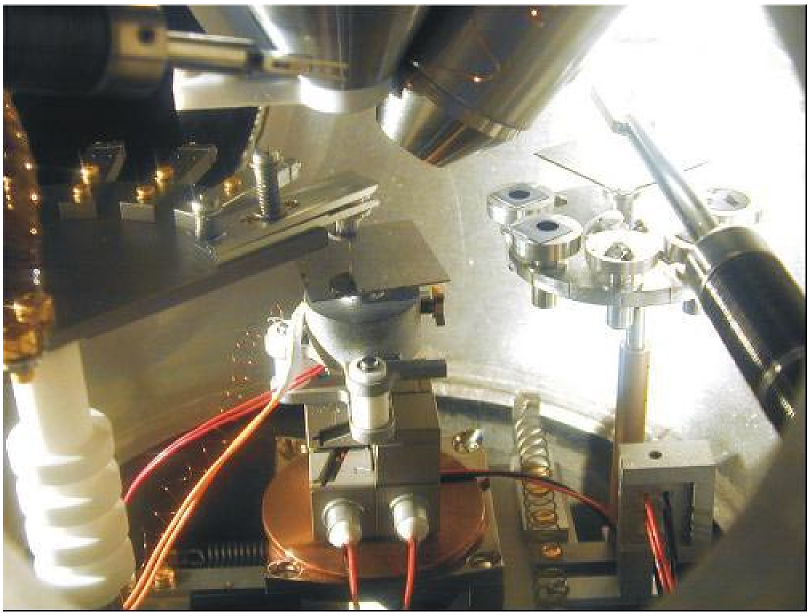

Comparison of the U/I characteristic (upper pictures) with magnetometer diagnostics (lower pictures; left direct signal, right after derivative of measured signal)

**Task 6.3 - DC field emission scanning**

A new staff member, Ms. Arti Dangwal from the Indian Inst. of Technology, has been employed on July, 1st 2004 and permanently attached to the group of Prof. Müller at the University of Wuppertal to perform the DC field emission measurements.

A series of ten high-purity Nb samples (RRR=300) of 28 mm diameter have been fabricated and mechanically polished. A dedicated specimen holder for electro-polishing, high pressure rinsing and dry-ice cleaning experiments has been constructed. The first Nb samples as well as Cu samples have been prepared for quality control scans relevant for electro-polished Nb and rf-gun cavities.

In order to increase the scanning speed for the systematic testing of numerous samples the field emission scanning microscope (FESM) has been modernized with the LabVIEW software package. The programming of the stepper-motor driven xyz-stages, Keithley Picoamperemeter and FUG high voltage power supply has been completed, and the first FE current and regulated voltage scans will be started soon. Further programming will be required for local measurements.



View into the centre of the FESM: The sample holder can be seen in the middle of the picture. Above this table the fork system of the scanning needles (with different tip size) is installed.

# WP7 COUPLERS

| N° | Task Name | Milestones | Main | Contractor | % | 2004 J F M A M J J A S O N D / 2005 J F M A M J |
|---|---|---|---|---|---|---|
| **7** | **WP7 COUPLERS** | | | | **13%** | |
| **7.1** | **New Prototype Coupler** | | | **CNRS-Orsay** | **50%** | |
| 7.1.1 | RF Simulations of Coupler | | | **CNRS-Orsay** | 100% | |
| 7.1.2 | Report on Simulation | | | **CNRS-Orsay** | 100% | 30.06. |
| 7.1.3 | Detailed Engineering Drawings | | | **CNRS-Orsay** | 100% | |
| 7.1.4 | Engineering complete | | | **CNRS-Orsay** | 100% | 31.12. |
| 7.1.5 | Call for tenders | | | **CNRS-Orsay** | 100% | |
| 7.1.6 | Prototype Fabrication in Industry | | | **CNRS-Orsay** | 0% | |
| 7.1.7 | Low Power tests | | | **CNRS-Orsay** | 0% | |
| 7.1.8 | **Ready for High Power Tests** | **Coupler Prototyp** | | **CNRS-Orsay** | 0% | |
| **7.2** | **Fabrication of TiN Coating System** | | | **CNRS-Orsay** | **0%** | |
| 7.2.1 | Mechanical design of vacuum chamber | | | **CNRS-Orsay** | 0% | |
| 7.2.2 | Fabrication drawings | | | **CNRS-Orsay** | 0% | |
| 7.2.3 | Construction of vacuum chamber | | | **CNRS-Orsay** | 0% | |
| 7.2.4 | Define vacuum needs | | | **CNRS-Orsay** | 0% | |
| 7.2.5 | Appropriation of vacuum equipment | | | **CNRS-Orsay** | 0% | |
| 7.2.6 | Design of electronic circuitry | | | **CNRS-Orsay** | 0% | |
| 7.2.7 | Fabrication of electronics in industry | | | **CNRS-Orsay** | 0% | |
| 7.2.8 | Installation and Test at Orsay | | | **CNRS-Orsay** | 0% | |
| 7.2.9 | **First Window Coating** | **Commissioning** | | **CNRS-Orsay** | 0% | |
| **7.3** | **Conditioning Studies of Proto-type Couplers** | | | **CNRS-Orsay** | **0%** | |
| 7.3.1 | Conditioning of couplers | | | **CNRS-Orsay** | 0% | |
| 7.3.2 | Evaluate conditioning results | | | **CNRS-Orsay** | 0% | |
| 7.3.3 | **Final report on conditioning** | | **Final report** | **CNRS-Orsay** | 0% | |

## Status of the activity:

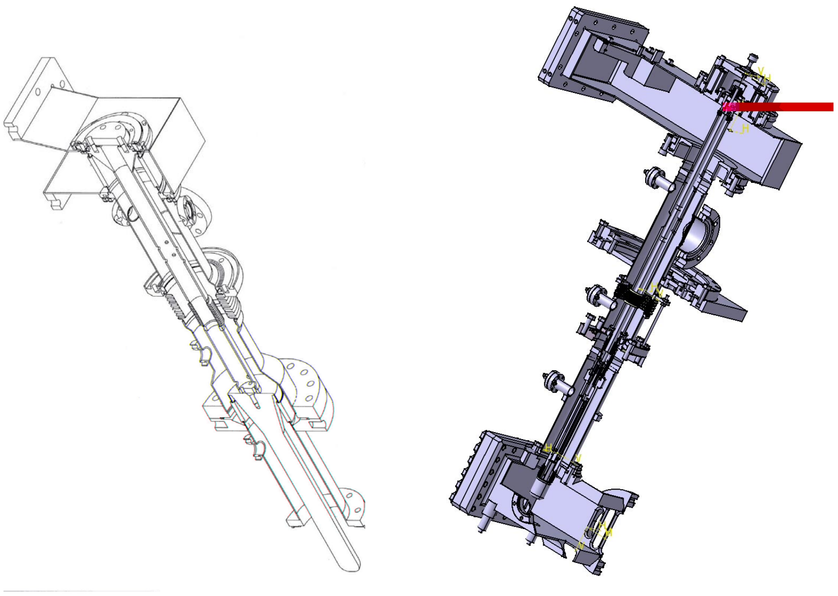
### Task 7.1: New prototype coupler
### Task 7.2: Fabrication of TiN coating system

- Work-package 7 of JRA1 concerns the development of power couplers. This WP is broken down into three main tasks:

7.1 – New proto-type couplers,
7.2 – Fabrication of a titanium-nitride coating bench for the coupler ceramic windows,
7.3 – Conditioning studies of proto-type couplers.

For task 7.1 we have designed two new-proto-types named TTF-5 and TW60 respectively. The RF design of these couplers was completed in the first part of 2004 and a description of the proto-types is available in the first quarterly report of the JRA1. The mechanical conception is now complete and a full set of engineering drawings exists for each proto-type (see figure below). The drawings are available from LAL under the references ITA0E0251-C (TTF-V) and ITE0EE002-A (TW60). These drawings will be used in tender exercises so that the couplers can be built in industry during 2005.

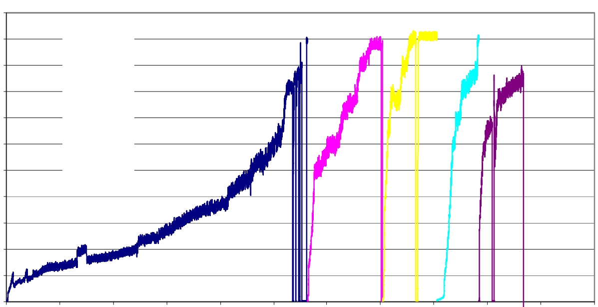
In addition to these proto-types, we have purchased two couplers from industry which, from a radio-frequency point of view, are of the type TTF-III currently used on the TESLA Test Facility. The two new couplers are manufactured, however, in a different way as certain TIG and/or electron-beam welds are replaced by brazing operations. These prototypes will allow us to perform conditioning studies (task 7.3) in 2005, ahead of the original schedule.



CAD views of the TTF-V (left) and TW60 (right) couplers.

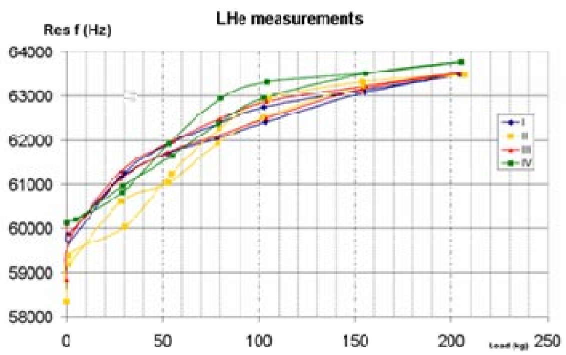
Task 7.2 should normally begin in January of 2005 however we have already begun to perform some bibliographic research on coating benches. A preliminary technical specification of the bench we wish to build is given in an internal note (Conception et fabrication d'un banc de dépôt de nitrure de titane pour traitement de surfaces de céramiques et de coupleurs – reference TESLA-COU-CDC-TiN-01).

Task 7.3 concerns conditioning studies which normally should begin in 2006. However, while awaiting the construction of the prototypes we have began to put in place many of the tools which will be required for their reception and preparation before conditioning. In particular we have been developing the control system, hardware and software, necessary for automatic conditioning of the couplers. The "loan" of TTF-III couplers from our JRA partner, DESY, has allowed us to obtain invaluable experience with this system prior to delivery of the new prototypes. An example of a conditioning cycle for a TTF-III coupler is shown in the figure below.

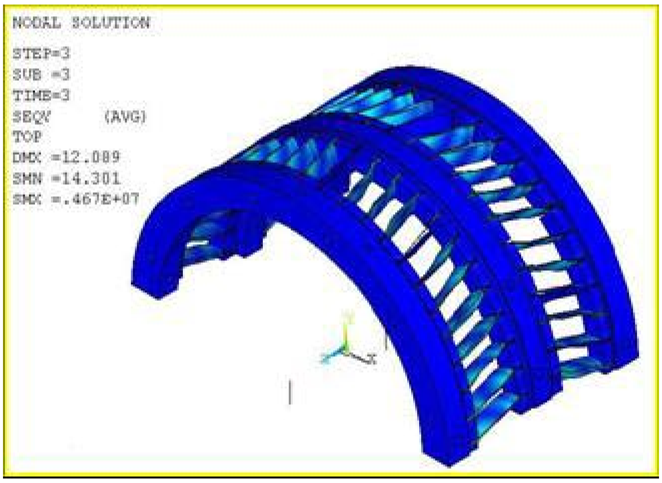


# WP 8 TUNER

| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **8** | **WP8 TUNERS** | | | | **23%** |
| **8.1** | **UMI TUNER** | | | **INFN-Mi** | **13%** |
| 8.1.1 | Control electronics | | | **INFN-Mi** | 100% |
| 8.1.2 | Mechanical tuner design, leverage system/motor | | | **INFN-Mi** | 20% |
| 8.1.3 | Integration piezo design | | | **INFN-Mi** | 5% |
| 8.1.4 | Choice of transducer/actuator | | | **INFN-Mi** | 0% |
| 8.1.5 | **Report UMI tuner** | **Design report** | | **INFN-Mi** | 0% |
| 8.1.6 | Tuner fabrication | | | **INFN-Mi** | 0% |
| 8.1.7 | Piezo fabrication and bench tes1 1 1( f)-92ption060 0 0 f(on and benc)-5((nd b37.9(on.7778 0 0 5.7679 121.6006 686.7203 Tm0 0 0 sc)Tm00659.960.7203 Tm0 c)-56.05 0 5n)]TJET1 1 1 scn33Tl scon.77796 | | | | |



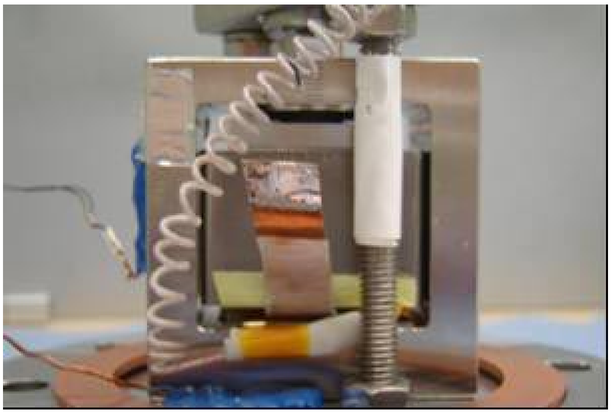
A simple structural model of the coaxial blade tuner has been done and analysed with finite elements programs (see below).




*Stress distribution (FEM simulation)*

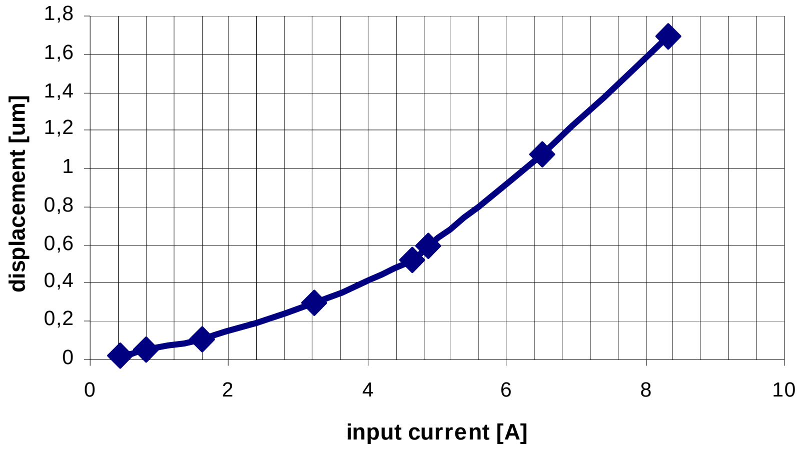
**8.2 Magneto-strictive tuner**

The technical specification and conceptional design were performed.
The sample of magneto-strictive tuner is available (see figure below). Nevertheless to reduce cost other magneto-strictive rods (made of GalFeNOL instead of KELVIN ALL®) will be investigated in future.



*Sample of magnetostrictive tuner*

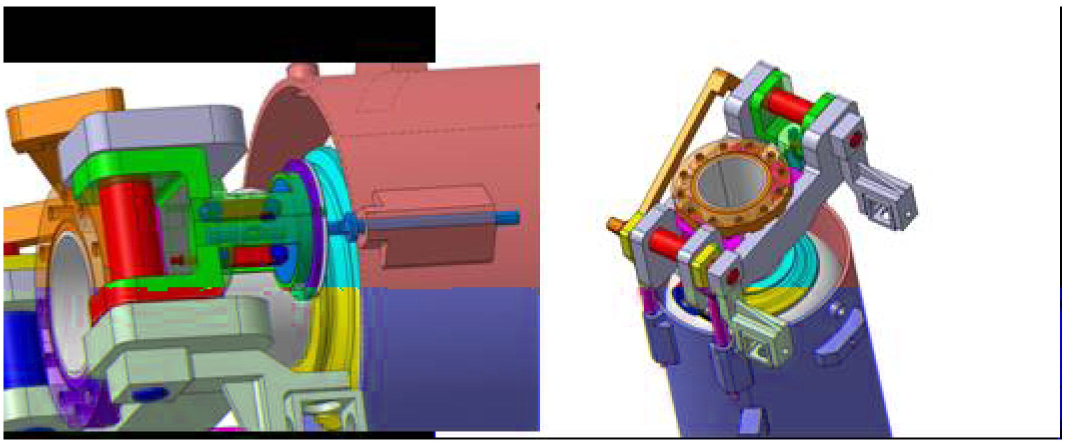
The electronic driver for the magneto-strictive element was designed and tested. The current solution is based on ca ontinuous amplifier APEX PA93. It can supply current up to 8Amps. It has a bandwidth of 2kHz. To improve amplifier parameters a PWM-based solution is currently investigated.
An experiment to validate the prototype magneto-strictive tuner was proposed. All components necessary for it were prepared and assembled. The experiment was performed at DESY. The magneto-strictive tuner was run successfully. The calculated displacement versus applies current is presented below in the figure. The data shown are imprecise because the stiffness of the system was unknown.
A detailed characterization of magneto-strictive tuner will be performed in March, 2005.




First results of displacement of magnetostrictive tuner versus applied current.

**8.3 CEA tuner**

The preliminary studies of the piezo tuner were finished and the drawings for realization were sub contracted (see figure below). During the co-operation some new ideas were developed and implemented (i.e. piezo support). As a consequence the final tuner will be more compact and robust.



Drawings of new CEA mechanical tuner

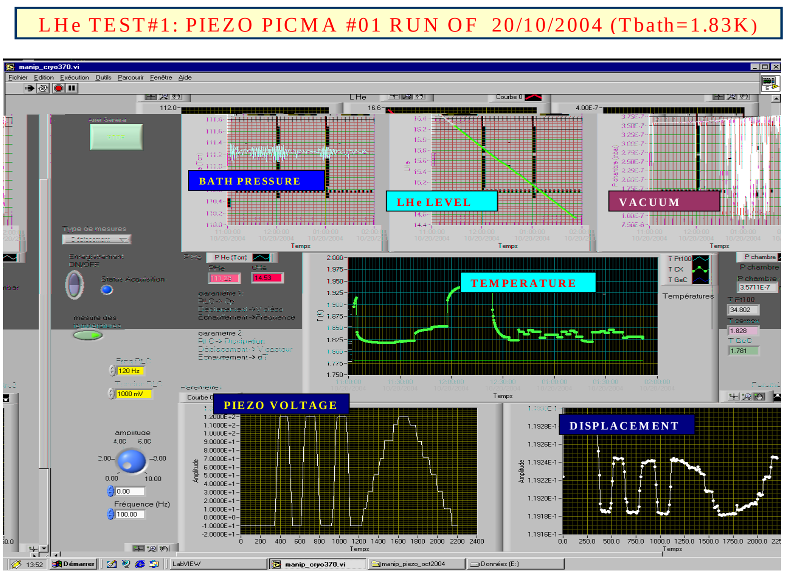
The piezo support is designed to mount two lengths of piezo: 30 and 36 mm (i.e. Noliac and PI one).
The tuner will be realized at the beginning of 2005. The final tests will take place in a new horizontal cryostat, CRYHOLAB, using the TTF cavity (obtained from DESY). The tools to install the cavity equipped in the cryostat are already investigated.
Work on the piezo electronics for the tests will begin in January 2005.

Twelve NOLIAC piezo actuators, 30mm long, and 2 stepping motors were bought.
The PI piezoelements are taken from IPN Orsay for tests. Several NOLIAC piezoelements are sent to IPN for low temperature characterization and radiation tests.

**8.4 IN2P3 activities**

The task of CNRS-IN2P3-Orsay institute is characterization of piezoelectric actuators at low temperature (i.e. 1.8 K- 300 K), perform radiation hardness tests of these components with fast neutrons at low temperature (liquid helium temperature = 4.2 K), contribute to the study of their integration in a piezo-tuner and participate to the tests of the final device inside the horizontal cryostat CRYHOLAB in close collaboration with CEA/DSM/DAPNIA institute.

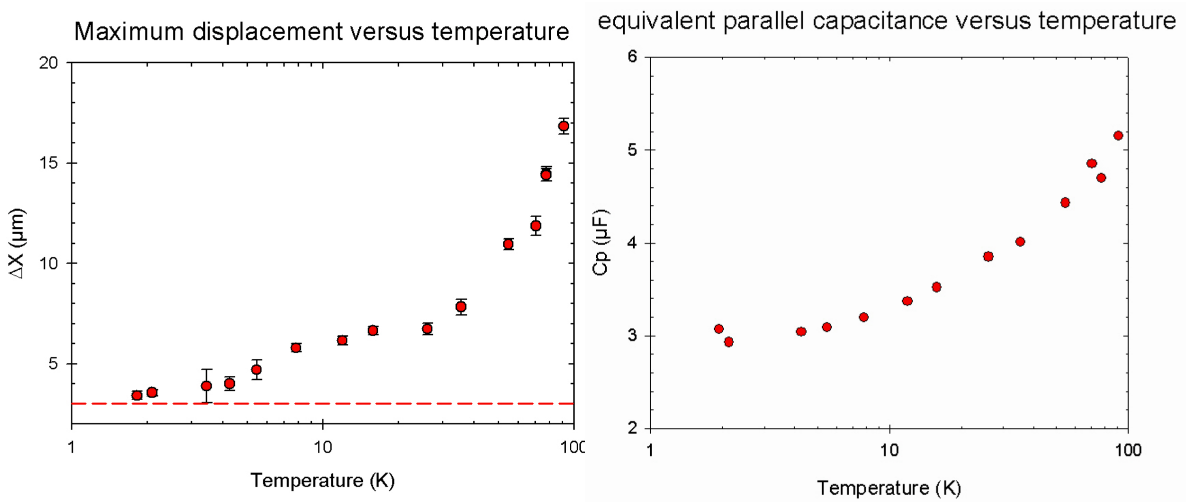
All the components needed (test-chamber, sensors and associated electronics) for piezo-element characterization at low temperature experiment were designed and ordered, were fabricated, delivered to IPN Orsay and assembled.
The thermometers for piezoelectric actuators tests were calibrated in the temperature range 1.6 K-300K at IPN Orsay.
Ten piezoelectric actuators from PI company were delivered with a delay and tested at room temperature (acceptance tests): the measured capacitances of these components are in good agreement with the expected nominal values.
The low temperature full characterization of piezo-element from PIEZOSYSTEM JENA using the first facility was continued and preliminary room temperature tests of a new experiment (piezo-element as force sensor) were successfully performed leading to very interesting results. The results were presented during the CARE Annual Meeting.
To automate the acquisition process for piezoelectric actuators tests, an new LabView application was developed (see below).




LabView application dedicated to piezo characterization tests

The new test facility developed for the actual prototypes of piezoelectric actuators (from PI and NOLIAC companies) full characterization at low temperature was successfully operated in the temperature range 1.8K-300K during October 2004 in liquid helium and liquid nitrogen.
Six NOLIAC piezostack were delivered to CEA Saclay and given to IPN Orsay for low temperature tests (two of them) and radiation hardness experiment (four of them).

First test of the piezostack from PI and NOLIAC was performed in November 2004 (sample of results are presented in figure below)
The technical report on low temperature characterization of piezo-stacks is expected for the beginning of January 2005.




Maximum displacement and equivalent parallel capacitance versus temperature for PI piezos

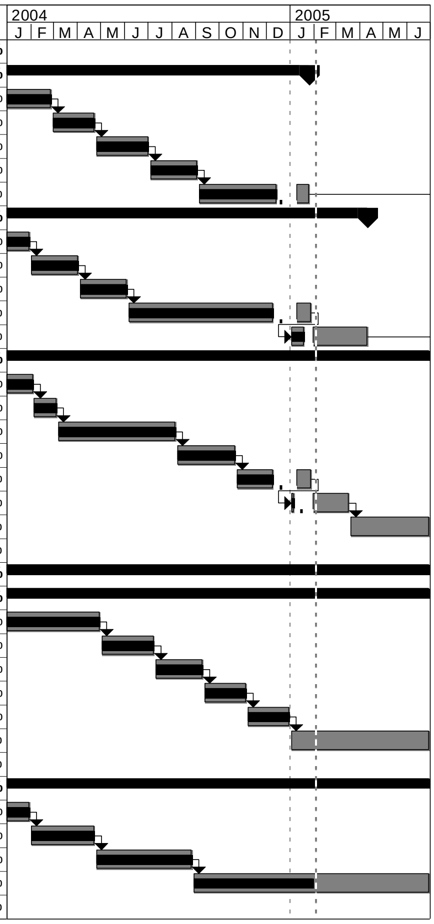
The preparation of the radiation hardness experiment is well in progress:
The experiment at CERI is already scheduled and accepted by the partner laboratory, the electronics needed for this experiment were received and successfully used in low temperature characterization tests of piezoelectric actuator from PI, the detailed drawings of the irradiation test-chamber are finished and fabricated by industry, the calculation concerning material activation and radiations hazards were performed in close collaboration with the radioprotection group at IPN Orsay, a mechanical system dedicated to handling the irradiation cryostat in front of the beam line was designed, delivered, assembled at Orsay, and will be soon installed at CERI Orléans.

A research assistant (Guillaume MARTINET, 12 months contract: September 2004-September 2005) and an engineer (Aurélia OLIVIER, 4 months contract: November 2004-February 2005) are now working at IPN Orsay in the frame of the CARE-SRF project WP8. Undergraduate and graduate students will be soon hired for working on the piezo-element characterization subject.

# WP9 LOW-LEVEL RF (LLRF)

N° Task Nam

| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **9.3** | **Hardware** | | | **WUT-ISE** | **67%** |
| **9.3.1** | **Multichannel downconvertor** | | | **WUT-ISE** | **95%** |
| 9.3.1.1 | Study and compare technologies | | | **WUT-ISE** | 100% |
| 9.3.1.2 | Select optimum PCB design | | | **WUT-ISE** | 100% |
| 9.3.1.3 | Build prototype and evaluate | | | **WUT-ISE** | 100% |
| 9.3.1.4 | Finalize multichannel downconverter | | | **WUT-ISE** | 100% |
| 9.3.1.5 | Determine characteristics | | | **WUT-ISE** | 85% |
| **9.3.2** | **Third generation RF control** | | | **WUT-ISE** | **80%** |
| 9.3.2.1 | Integrate system generator with VHDL | | | **WUT-ISE** | 100% |
| 9.3.2.2 | Complete specification | | | **WUT-ISE** | 100% |
| 9.3.2.3 | Demonstrate simulator | | | **WUT-ISE** | 100% |
| 9.3.2.4 | Final design of RF electronic board | | | **WUT-ISE** | 90% |
| 9.3.2.5 | Evaluate performance | | | **WUT-ISE** | 20% |
| **9.3.3** | **Stable frequency distribution** | | | **WUT-ISE** | **45%** |
| 9.3.3.1 | Complete specification | | | **WUT-ISE** | 100% |
| 9.3.3.2 | Conceptional design of frequency | | | **WUT-ISE** | 100% |
| 9.3.3.3 | Build prototype and evaluate | | | **WUT-ISE** | 100% |
| 9.3.3.4 | Final design | | | **WUT-ISE** | 100% |
| 9.3.3.5 | Procurement and assembly of subsystems | | | **WUT-ISE** | 70% |
| 9.3.3.6 | Installation and commissioning | | | **WUT-ISE** | 10% |
| 9.3.3.7 | Performance test with beam | | | **WUT-ISE** | 0% |
| 9.3.3.8 | **Report on new LLRF hardware compon** | **Final Report** | | **WUT-ISE** | 0% |
| **9.4** | **Software** | | | **WUT-ISE** | **58%** |
| **9.4.1** | **Data management development** | | | **WUT-ISE** | **59%** |
| 9.4.1.1 | Specification | | | **WUT-ISE** | 100% |
| 9.4.1.2 | Conceptional design with DOOCS | | | **WUT-ISE** | 100% |
| 9.4.1.3 | Prototype | | | **WUT-ISE** | 100% |
| 9.4.1.4 | User evaluation | | | **WUT-ISE** | 100% |
| 9.4.1.5 | Finalize design | | | **WUT-ISE** | 100% |
| 9.4.1.6 | Implementation in TTF | | | **WUT-ISE** | 0% |
| 9.4.1.7 | **Report on data management developme** | **Final report** | | **WUT-ISE** | 0% |
| **9.4.2** | **RF gun control** | | | **WUT-ISE** | **58%** |
| 9.4.2.1 | Write specification | | | **WUT-ISE** | 100% |
| 9.4.2.2 | Design of controller | | | **WUT-ISE** | 100% |
| 9.4.2.3 | Procurement and assembly | | | **WUT-ISE** | 100% |
| 9.4.2.4 | Installation and test | | | **WUT-ISE** | 35% |
| 9.4.2.5 | **Report on RF gun control tests** | **Final Report** | | **WUT-ISE** | 0% |

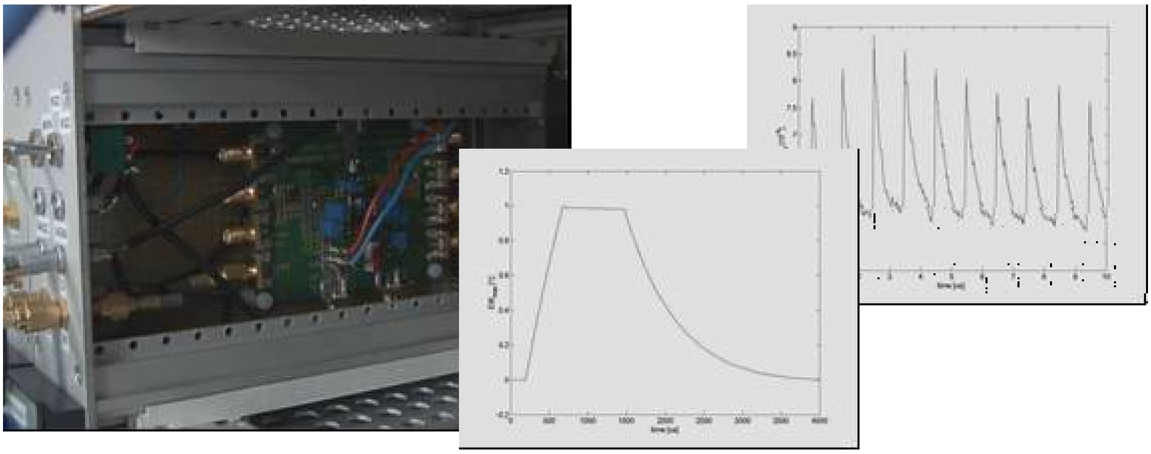



# Status of the activity

## 9.1 Operability and technical performance

### 9.1.1 Transient detector

Progress: In line with schedule.
Designed an implemented fast noise rf vector detector with low noise floor based on microwave hybrids and schottky detector diodes. With the new detector single bunch transients have been observed but interpretation of signal has been problematic due to sharp spikes induced directly by the bunch in the probe coupler. Also software with algorithms for unfolding phase and amplitude information have been written to simplify the data analysis.



*Picture of the hardware* *Measured data*

Figure1: Transient detector hardware and first measurements with beam.

Milestones and deliverables: None defined in contract for this period.

Significant achievements and impact:
Developed low noise detector suitable for single bunch measurement
Deviations from plan: Sharp spikes induced from the bunch directly in the probe coupler are not completely understood and require further studies including measurements and simulation.

9.1.2 LLRF Automation

Progress: In line with schedule.
Developed detailed specification for the klystron/modulator state machine.
Designed state machine in the state flow (matlab/simulink) environment and verified correct functionality in this environment.
Implemented klystron state machine in DOOCS which is now ready for tests in step mode.

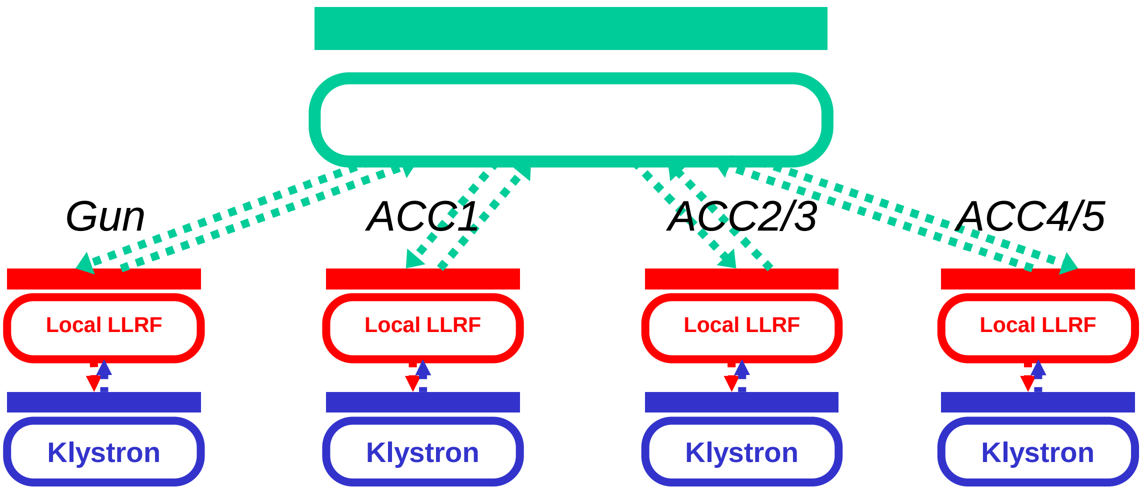



Figure 2: Hierarchy of finite state machine

Milestones and deliverables: None defined in contract for this period

Significant achievements and impact:
Klystron state machine implemented in DOOCS andready for test in accelerator

Deviations from plan: None

9.1.3 Control Optimization

Progress: In line with schedule.
Studied residual amplitude and phase errors as function of noise sources (beam, microphonics, lorentz force detuning) and errors in vector-sum calibration. Developed criteria for requirements on feedback gain and precision of feed forward. Concluded that optimal controller will use combination of feedback and feed forward

*Example: coordinated amplitude control in one RF-station, use adiabatic acceleration to minimize emittance dilution*

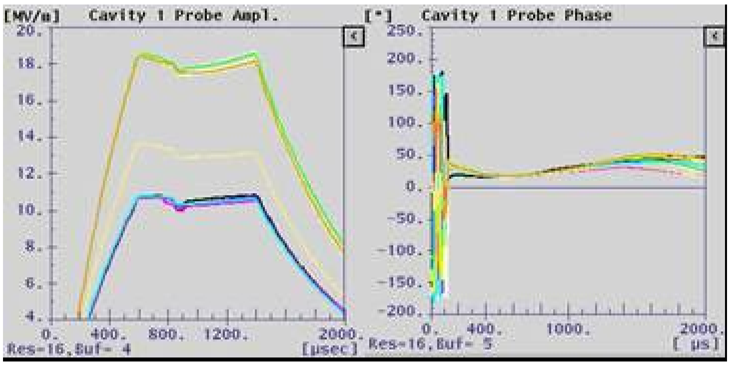



Figure 3: Example of control optimisation with time varying cavity fields

Milestones and deliverables: None defined in contract for this period.

Significant achievements and impact:
Developed understanding of error sources and control performance of feedback and feed-forward. This will lead to conceptual design of optimal controller

Deviations from plan: None

## 9.2 LLRF cost and reliability

9.2.1 Cost and reliability study

Progress: In line with schedule with reliability studies.
Accumulating data on reliability of the LLRF systems installed in VUV-FEL. Study failure modes und identifying major contributors to downtime.

- Large scale installation of XFEL and ILC (not considered as mass production by industry)
- No single cost driver identified (but: *reliability* can be consideres as a cost driver)

- Cost reduction only by conept
  - Go away from VME crates?
  - Reduce number of signals?
  - Algorithmic solutions?
  - Different sections for XFEL (before/after bunch compressor)?
- We have to develop a cost control concept rather than a cost reduction concept
- As simple as possible, as complex as necessary

Milestones and deliverables: None defined in contract for this period

Significant achievements and impact:
VUV-FEL LLRF system has been commissioned abd is in operation. First data on reliability are obtained.

Deviations from plan: None

### 9.2.2 Radiation damage study

Progress: In line with schedule.
Installed SRAM based radiation monitor closed to magnet power supplies in the VUV-FEL tunnel near the undulator to investigate why some of the power supply controllers have failed. In addition bubble dosimeters, TLDs and an ionisation chamber provide the necessary calibration of the neutron and gamma dose. Requirements for DOOCS interface for on-line readout have been developed.

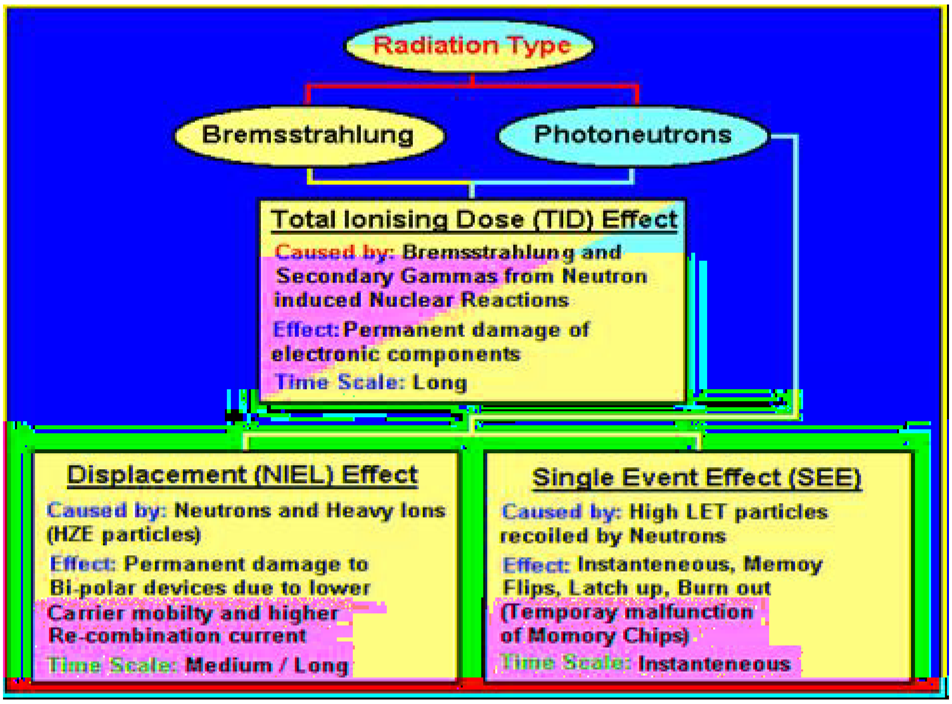



Figure 4: Various types of radiation effects on electronics

Milestones and deliverables: None defined in contract for this period

Significant achievements and impact:
SRAM based radiation monitors are installed to study degradation of power supply controllers in the VUV-FEL tunnel.

Deviations from plan: None

## 9.3 Hardware

### 9.3.1 Multichannel downconverter

Progress: In line with schedule.
Detailed noise studies on 250 kHz downconverters have been performed.
Results show that actual noise is 10-100 times higher than the specification of critical components in data sheet. Reasons are external noise sources and design flaws. Proposal for new low noise downconverter has been made.
Linearity of downconverter if used for 81 MHz IF has been measured and is of the order of $10^{-3}$. The actual requirements for the control of the vector-sum are evaluated.

Picture of 3rd generation downconverter.

- 8 in/output channels, 1 LO input
- Linearity <-50dB
- Crosstalk between channels <-50dB
- LO leakage <-50dB @ 1.3GHz
- LO stability –15dB - –5dB

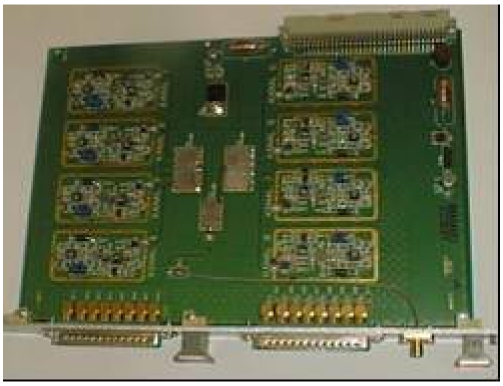


Figure 6: Downconverter design and measured parameters.

Milestones and deliverables: None defined in contract for this period.

Significant achievements and impact:
Noise sources in VUV-FEL downconverters have been analysed and are understood.

Deviations from plan: None.

### 9.3.2 Third generation rf control

Progress: In line with schedule.
Mezzanine board with 8 ADCs, 4 DACs and Virtex II FPGA has been debugged and performance has been evaluated. Noise level of 4 mV rms will be reduced further in next version of the design. Presently the controls software for 1 superconducting cavity has been developed and system has been tested with a cavity in Chechia.

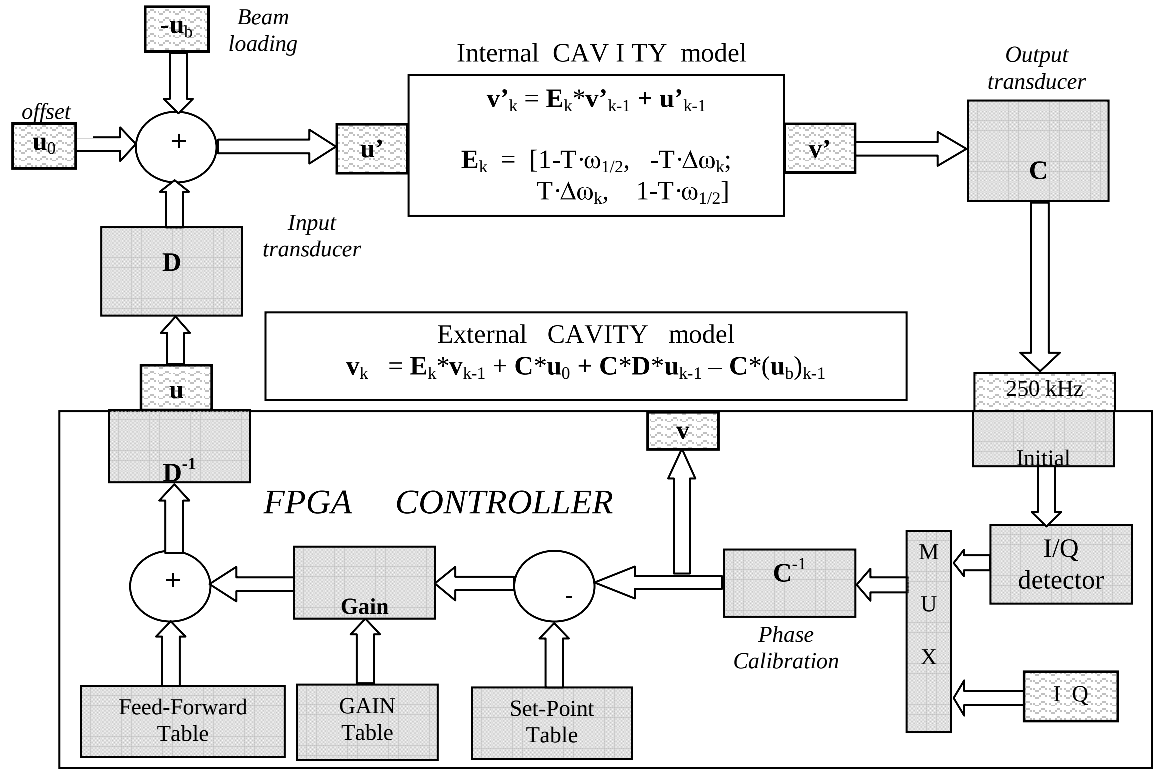
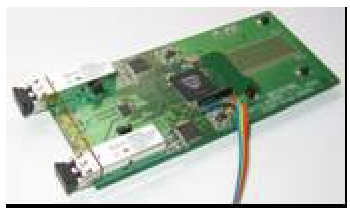
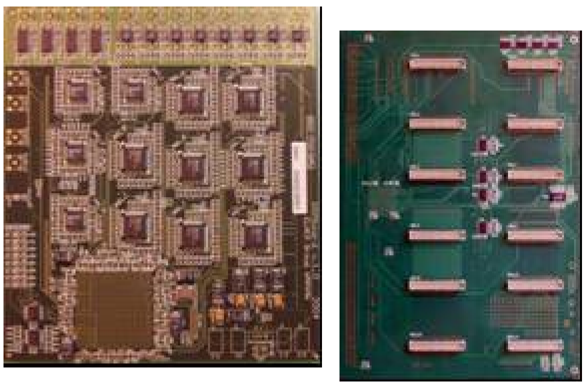



Figure 7: Functional diagram of controller used in the Chechia test.



- 8 ADCs 14 bits, 80 MHz
- 4 DACs, 14 bits, 125 MHz
- DSP Board – Virtex2 XC2V4000
- Optolink – 3.125 GHz



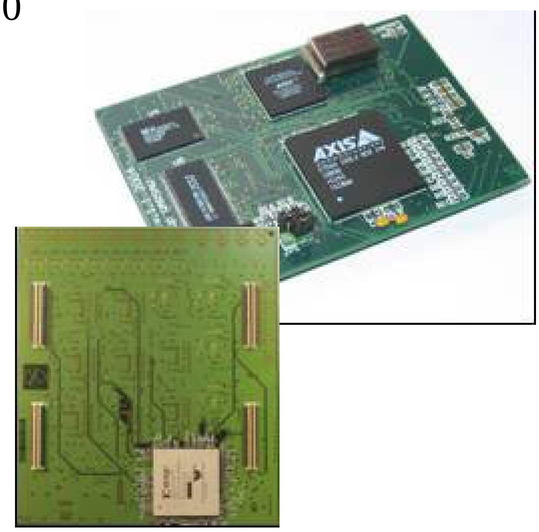


Figure 8: Third generation rf controls hardware

Milestones and deliverables: None defined in contract for this period

Significant achievements and impact:
Third generation rf system ready for testing with superconducting cavity in Chechia.

Deviations from plan: None.

9.3.3 Stable frequency distribution

Progress: In line with schedule.

Milestones and deliverables: None defined in contract for this period. Evaluated performance of fibre optic monitoring system in climate chamber. Interferometric measurement with optical phase shifter based controller guarantees system stability of better than 1 ps.
The Master Oscillator phase noise close to carrier is about 10 dB higher than specified mainly due to excessive phase noise of MTI reference oscillator which does not meet the specification in their datasheet. Will need to replace the reference oscillator with one from Wenzel.

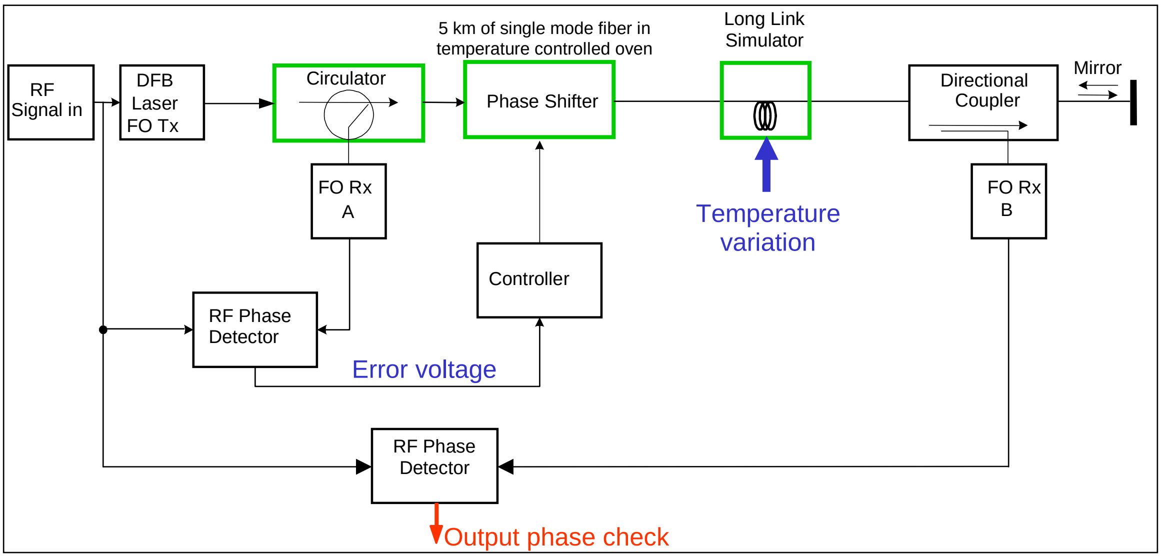



Figure 9: Schematic of fiber optic rf distribution for monitoring long term drift.

Significant achievements and impact:
Demonstrated stability of fiber optic reference distribution (for monitoring) of better than 1 ps over 5 km fiber.

Deviations from plan: None

## 9.4 Software

9.4.1 Data management development

Progress: In line with schedule.
Developed requirements document for the database and implemented most of the required features in DOOCS. Database will be ready for testing at the beginning of next year.

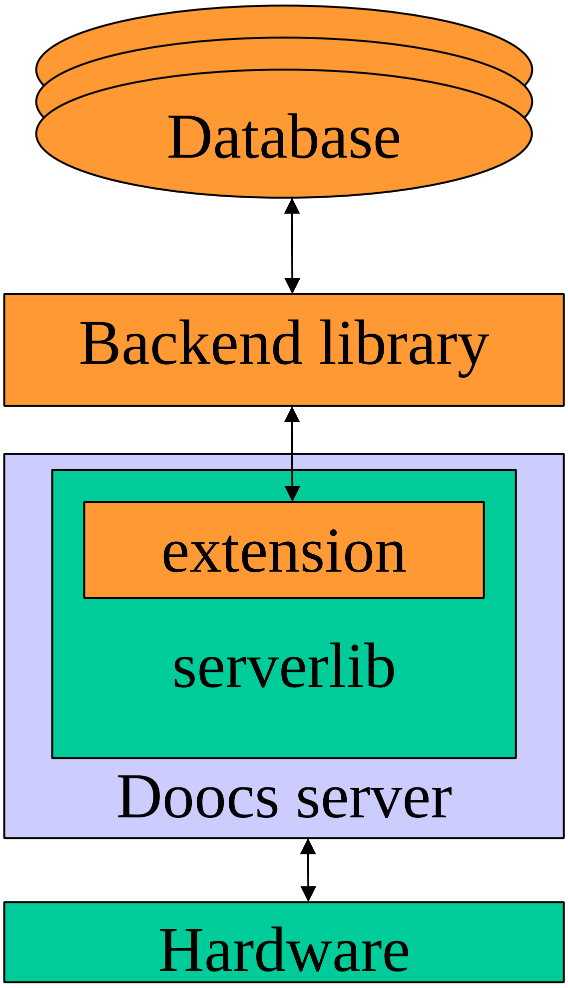



Figure 10: Concept for data management

Milestones and deliverables: None defined in contract for this period

Significant achievements and impact:
Developed requirement document for database

Deviations from plan: None

9.4.2 RF Gun control

Progress: In line with schedule.

Milestones and deliverables: None defined in contract for this period
Operated rf gun without probe with stability of better than 2 degrees in phase and 1% in amplitude with control of forward power only. Designed system which calculates filed field from forward and reflected power. Plan is to test performance of the field calculation with beam beginning of next year.

**Requirements:**

- Accelerating gradient: 40 MV/m
- Repetition rate: 1-10 Hz
- rf pulse length: 100-900 μs
- Amplitude stability: ± 0.25%

**Difficulties:**

- No probe in the gun
- Low time constant of the cavity
- High precision needed

**Solutions:**

⇒ Use forward and reflected power

⇒ Precise IQ detectors for field control

⇒ Fast logarithmic detectors with big dynamic range for measurement of decaying field

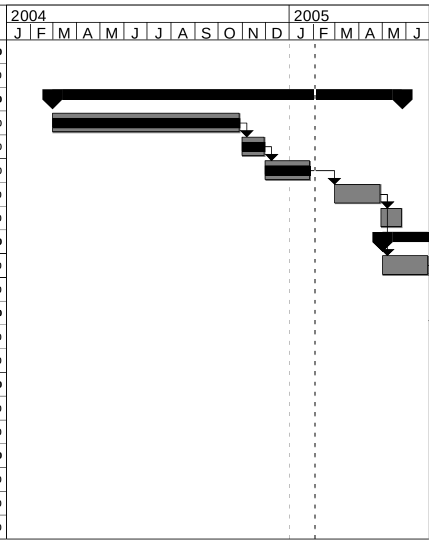

Figure 11: RF Gun Control

Significant achievements and impact:
Achieved stability of better than 2 degrees in phase and 1% in amplitude with control of forward power (no probe signal provided by gun).

Deviations from plan: None

# WP10 CRYOSTAT INTEGRATION TESTS

| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **10** | **WP10 CRYOSTAT INTEGRATION TESTS** | | | | **36%** |
| 10.1 | Displace CRYHOLAB | | | **CEA** | 0% |
| **10.2** | **CRYHOLAB adaption to 9 cell** | | | **CEA** | **78%** |
| 10.2.1 | Mechanical adaption | | | **CEA** | 100% |
| 10.2.2 | Low performance cavity and coupler | | | **CEA** | 100% |
| 10.2.3 | Assembly in CRYHOLAB and cryogenic test | | | **CEA** | 100% |
| 10.2.4 | High performance coupler - High pow er pulsed te | | | **CEA** | 0% |
| 10.2.5 | High performance cavity transfered from DESY | | | **CEA** | 0% |
| **10.3** | **Integration tests in cryostat (1st test)** | **Status report** | | **CEA** | **0%** |
| 10.3.1 | CEA could tuning system | | | **CEA** | 0% |
| 10.3.2 | Evaluate experimental results | | | **CEA** | 0% |
| **10.4** | **Integration tests in cryostat (2nd test)** | **Status report** | | **CEA** | **0%** |
| 10.4.1 | Magnetostrictive tuner | | | **CEA** | 0% |
| 10.4.2 | Evaluate experimental results | | | **CEA** | 0% |
| **10.5** | **Integration tests in cryostat (3rd test)** | | | **CEA** | **0%** |
| 10.5.1 | Piezoelectric tuner | | | **CEA** | 0% |
| 10.5.2 | Evaluate experimental results | | | **CEA** | 0% |
| **10.6** | **Integration tests in cryostat (4th test)** | | | **CEA** | **0%** |
| 10.6.1 | New coupler from LAL | | | **CEA** | 0% |
| 10.6.2 | Evaluation of results | | | **CEA** | 0% |
| 10.6.3 | **Final evaluation** | | **Final Report** | **CEA** | 0% |




## Status of activities

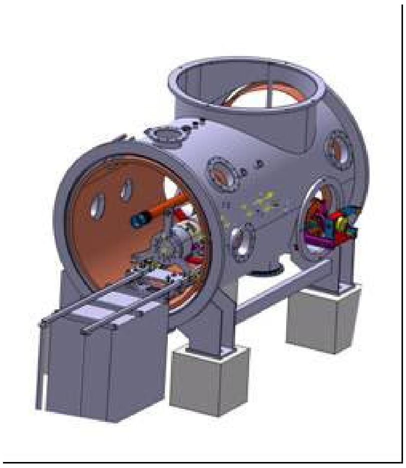
### WP (10), Integrated RF tests in a horizontal cryostat

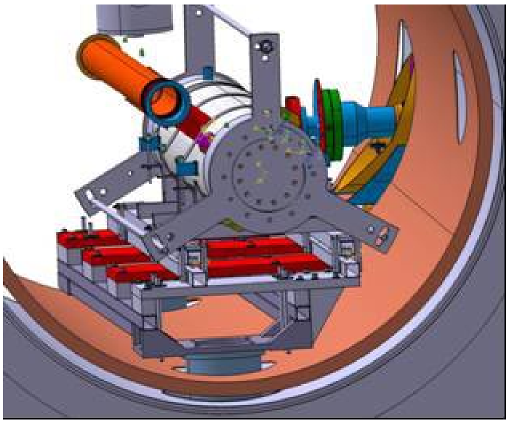
Cry-Ho-Lab, the RF test facility in a horizontal cryostat has been suggested for testing components developed within the Joint Research Activity "Superconducting RF", in parallel with other tests carried out for the JRA "HIPPI".
The different components for JRA-SRF (high power coupler, cold tuners and low level RF system) will be previously designed in work packages WP7, WP8 and WP9. These tests could be planned at full RF power (1.5 MW pulsed – 1 ms – 10 Hz) on a fully equipped 9-cell cavity (1300 MHz). Thirty weeks, with helium production, are foreseen for these tests and scheduled according to each work package agreement. The manpower required is 3.8 man-years and the estimated cost for the helium is 650 k€, based on 5 €/litre, including helium losses and operating costs for the cryogenic generator.

Before starting the tests it is necessary to ensure the 9-cell cavity is running correctly, at 2K and at full RF power. In that context, the following mechanical adaptations on the Saclay infra-structures have been necessary:

- Trolleys for cavity handling in clean room and transport to CryHoLab,
- Mechanical parts to insert and to support the cavity in the cryostat,
- Flange to connect high power coupler to CryHoLab vacuum vessel,
- Connections to the helium pipe, thermal sensors, super-insulation.
- Wave guide connection between klystron 1.3 GHz and Cryholab

For that purpose we have collected cavity and coupler drawings from DESY and we have determined the right position of the cavity inside CryHoLab. It will be necessarily shifted off the main axis of the cryostat.

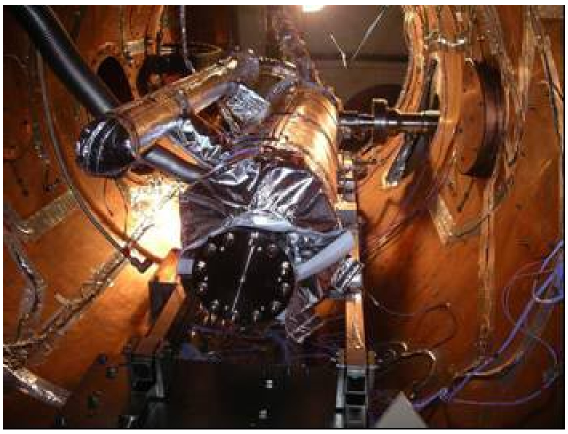




Figures 1: 3D-drawings showing the mechanical support of the cavity and the coupler connection to CryHoLab.

The mechanical adaptations were designed in June and received from manufacturers at the end of September. The 9-cell cavity (C45 - $E_{acc}$=20 MV/m) and the high power coupler (TTF-III unconditioned) have been transferred to Saclay from DESY and LAL-Orsay. These elements, although readily available, do not exhibit the best performance and are not the final tests ones. However they were satisfactory for the first feasibility test. The whole system was assembled to check for correct positioning in CryHoLab. Some finishing touches have been, nevertheless, necessary.

The definitive assembly of the cavity (equipped with thermal sensors, super-insulation), coupler and RF wave guide has been realized and the first cool down of the cryostat has taken place.



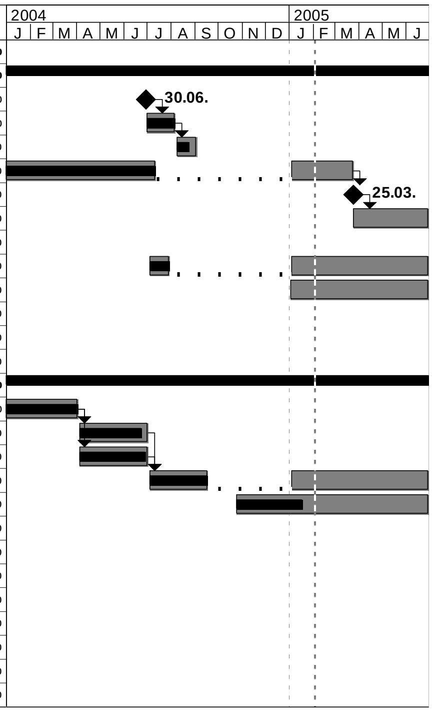
*Figures 2: Pictures showing the cavity installation in CryHoLab and the coupler connection to the RF wave guide.*

The objective of this test (first part) is to check all the potential cryogenic problems (helium tank filling, coupler cool down, temperature measurements and helium bath pumping…) and to measure the static helium consumption at 4.2 and 1.8 K. The second part of the test, planned in March 2005, will be to check the cavity running at high RF power with a conditioned coupler. The real test planed in the CARE proposal will begin only after qualification of “cavity-coupler-CryHoLab” system, probably in April 2005 with the installation and the test of the new CEA-Tuner.

In the CARE proposal, we have stated that it was necessary to displace CryHoLab from “l’Orme des Merisiers” area to the main Saclay Center and scheduled this action over a duration of 6 months. The transfer should take place before the RF tests and should have been started during the first part of 2004, and then again between November 2004 and May 2005. In fact for technical reasons this transfer will not be possible before September 2005. Nevertheless this delay for the CryHoLab displacement has no consequences for the RF tests themselves because all the preliminary actions (adaptation to 9-cell cavity, cryogenic and high power validation tests) are undertaken at the present time.

# WP11 BEAM DIAGNOSTICS

| N° | Task Name | Milestones | Main | Contractor | % |
|---|---|---|---|---|---|
| **11** | **WP 11 BEAM DIAGNOSTICS** | | | **CEA** | **19%** |
| **11.1** | **Beam position monitor** | | | **CEA** | **16%** |
| 11.1.1 | **Present BPM installed in TTF module** | **Start Measureme** | | **CEA** | 100% |
| 11.1.2 | Cryogenic measurements on BPM | | | **CEA** | 100% |
| 11.1.3 | Beam tests of BPM on TTF | | | **CEA** | 60% |
| 11.1.4 | Design of BPM Cavity | | | **CEA** | 70% |
| 11.1.5 | Design of BPM cavity ready | | | **CEA** | 0% |
| 11.1.6 | Fabrication of BPM Cavity | | | **CEA** | 0% |
| 11.1.7 | BMP cavity ready | | | **CEA** | 0% |
| 11.1.8 | Development of new hybrid coupler and electronic | | | **CEA** | 10% |
| 11.1.9 | Design of Digital Signal Processing | | | **CEA** | 0% |
| 11.1.10 | **New BPM ready for Installation** | | **BPM Prototyp** | **CEA** | 0% |
| 11.1.11 | Beam Tests with new BPM | | | **CEA** | 0% |
| 11.1.12 | **Evaluation of BPM operation** | | **Final report** | **CEA** | 0% |
| **11.2** | **Beam Emittance Monitor** | | | **INFN-LNF** | **22%** |
| 11.2.1 | Slit width simulations | | | **INFN-LNF** | 100% |
| 11.2.2 | Slit design | | | **INFN-LNF** | 90% |
| 11.2.3 | Optics simulations | | | **INFN-LNF** | 95% |
| 11.2.4 | Optics appropriations | | | **INFN-LNF** | 25% |
| 11.2.5 | System assembly and tests | | | **INFN-LNF** | 25% |
| 11.2.6 | Mechanical assembly at TTF | | | **INFN-LNF** | 0% |
| 11.2.7 | Optical assembly at TTF | | | **INFN-LNF** | 0% |
| 11.2.8 | Integration of controls into TTF | | | **INFN-LNF** | 0% |
| 11.2.9 | **Ready for beam test in TTF** | **Start Measureme** | | **INFN-LNF** | 0% |
| 11.2.10 | Beam tests at TTF | | | **INFN-LNF** | 0% |
| 11.2.11 | Evaluate first beam test result | **Status Report** | | **INFN-LNF** | 0% |
| 11.2.12 | Successive measurements | | | **INFN-LNF** | 0% |
| 11.2.13 | **Final evaluation** | | **Final Report** | **INFN-LNF** | 0% |




## Status of activities

### Task 11.1: Beam position monitor

The activity of this year has been to install one monitor (BPM) inside the ACC1 cryostat, check the behaviour under cooling at 2 K, and measure the beam-induced signals. Another part of the activity has been to start designing a new version of the monitor.

1 Monitor installed in beam line and operational

The first milestone (Present BPM installed in TTF module) has been met.

Figure 1 shows this unit before insertion into the cryomodule.

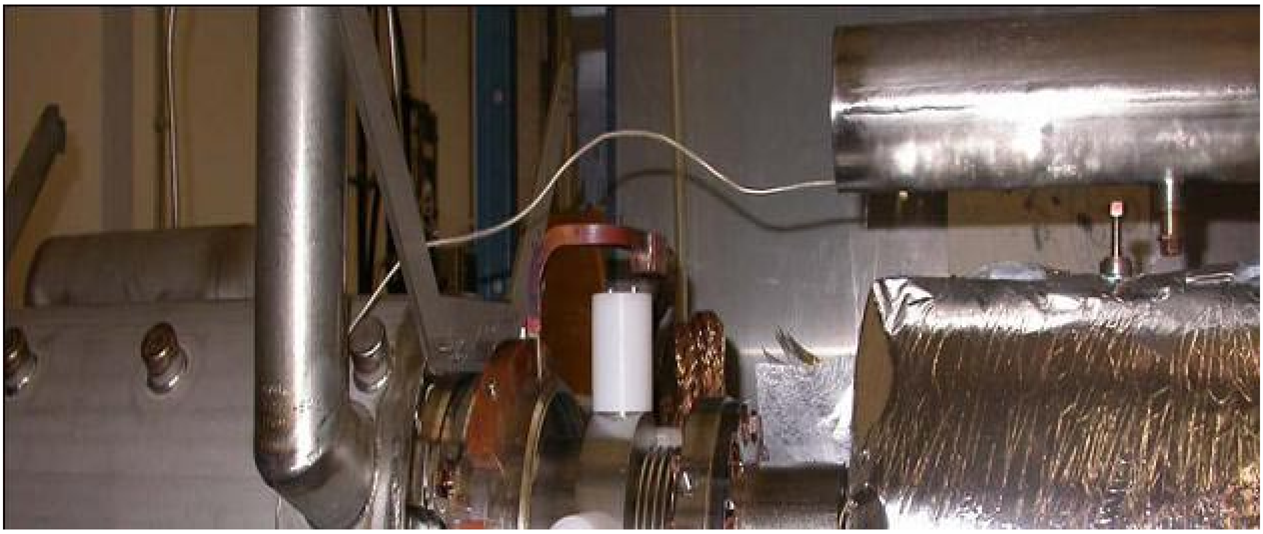


Fig.1 BPM insert before installation inside tunnel, adjacent to the accelerating cavity. Four antennas are protected by plastic cylinders during mounting.

A critical point was the feed-through fragility, 50% of the feed-throughs had to be rejected. Finally no leak or anomalous heat dissipation has been reported during cooling down and later during operation.
Another issue is the lengthy cleaning of the unit. It took several days before the dust particle counter went down to the tolerable level. Finally the cleaning has been efficient.
Both issues will be addressed for the next BPM version.
The first measurements with beam showed clean BPM signals and these are shown in fig. 1.
The connection of the diagnostic to the control system will only be operational after fixing the (re-used) processing electronics. Two people from our lab are working on this.

This causes a 3-month delay with respect to the schedule, without consequences to the rest of the planning.

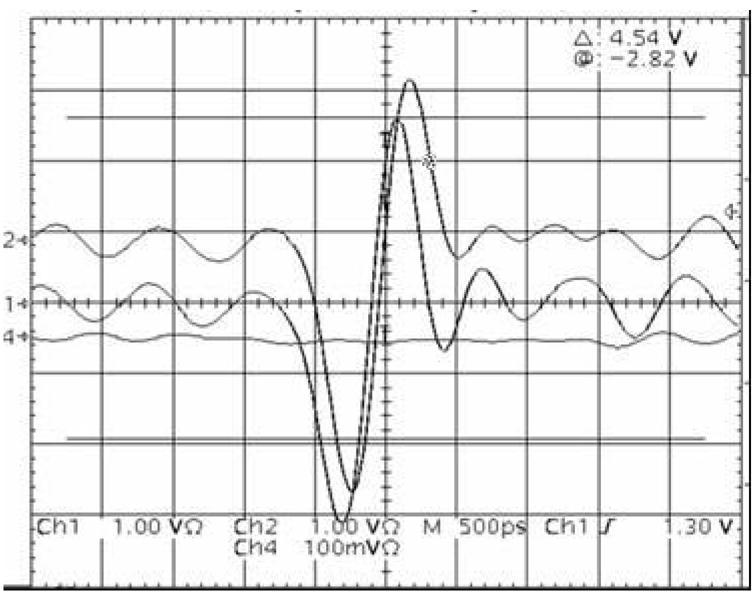



Fig.1 BPM signals (channel 1 and 2) for a 1 nC 100 MeV beam. They are measured with an oscilloscope directly connected to the antennae, without the processing electronics.

## 2 Design of a new monitor version

Studies are going on to optimize the position of the antennae with an RF simulation code. Fig. 3 is a quarter of a BPM cavity with two of the antennae, showing the RF field distribution. The main optimization parameter is the longitudinal position of the antennae. The criteria are the dipole mode sensitivity and separation from the monopole mode.

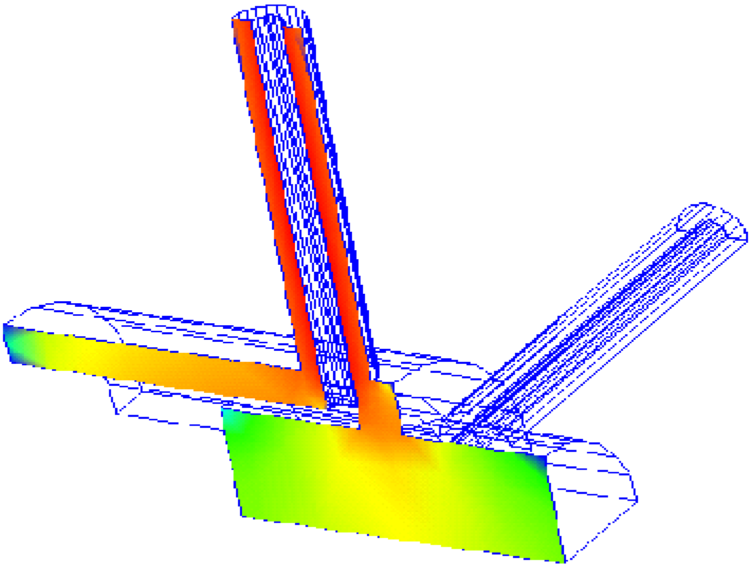


Fig 3 BPM cavity simulation showing the RF field distribution. The beam axis is the rotational symmetry axis. A quarter of the cavity and 2 antenna pickups are shown.

A new person has been hired to improve this RF design, which causes delay on the mechanical design of the next BPM unit.

More delay was caused by discussions on the mechanical interfacing to the neighbouring quadrupole. Conflat flanges will be used until the quadrupole final design is agreed. A decision was taken to have separate experiments for cryogenic tests without beam and warm beam tests.
The design of new feed-throughs is continuing after an off-the-shelf design was considered and rejected.

### Task 11_2 – Beam Emittance Monitor

The first year of activity was mostly dedicated to a simulation of the measurement, in order to define the parameters of the diffraction screen, of the optics and of the imaging device.
Due to the delay in the recruitment of the required additional personnel, we concentrated our effort in the simulation of the preliminary measurement that can be performed with the present lower TTF energy. For the nominal 1 GeV final energy, we only checked that

qualitatively the results were what we expected from approximated analytical expressions. An example is shown if Fig. 1 in which the angular distribution of Diffraction Radiation at 800 nm, produced by a 1 GeV beam with normalized emittance of 5 x10-6 m-rad and a transverse dimension of 50 µm (rms), passing through a 1 mm slit is represented.

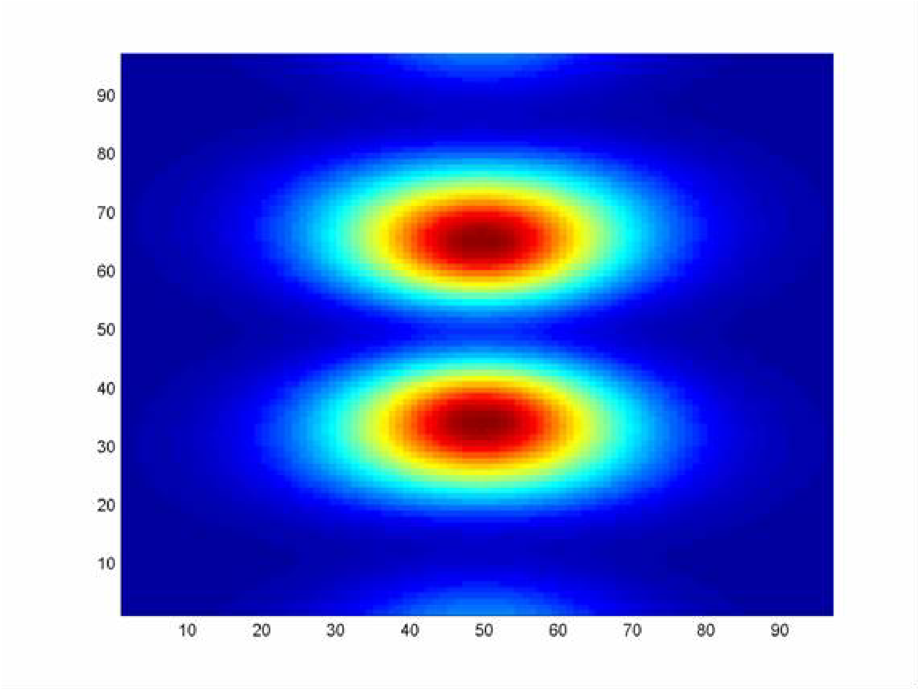



Fig. 1 – Diffraction Radiation angular distribution for a 1 GeV beam (see text)

At the lower energy of 500 MeV, there is the problem of the low level of radiation intensity, which can only be increased by decreasing the slit aperture and increasing the wavelength. In any case we are limited to 0.5 mm for the slit width by the beam size, and, for the wavelength, by the requirement to remain in the visible range. The use of a high sensitivity camera, possibly cooled to minus 30-40 degrees Celsius, should allow a first measurement.
It will be difficult, for the low S/N ratio, to obtain the required resolution of the image, but it will be sufficient for testing the hardware, verifying the principle of the measurement and, of great importance, to verify the effect of beam halo, dark current and the synchrotron radiation background.
Some of the results are shown in Figs. 2, 3 and 4. In all pictures, the beam has a normalized emittance of 5 x 10-6 m rad and the slit has 0.5 mm width. In Figs. 2 and 3 the beam size is 50 µm, with different optical magnification. In Fig. 4 the beam size is 100 µm.

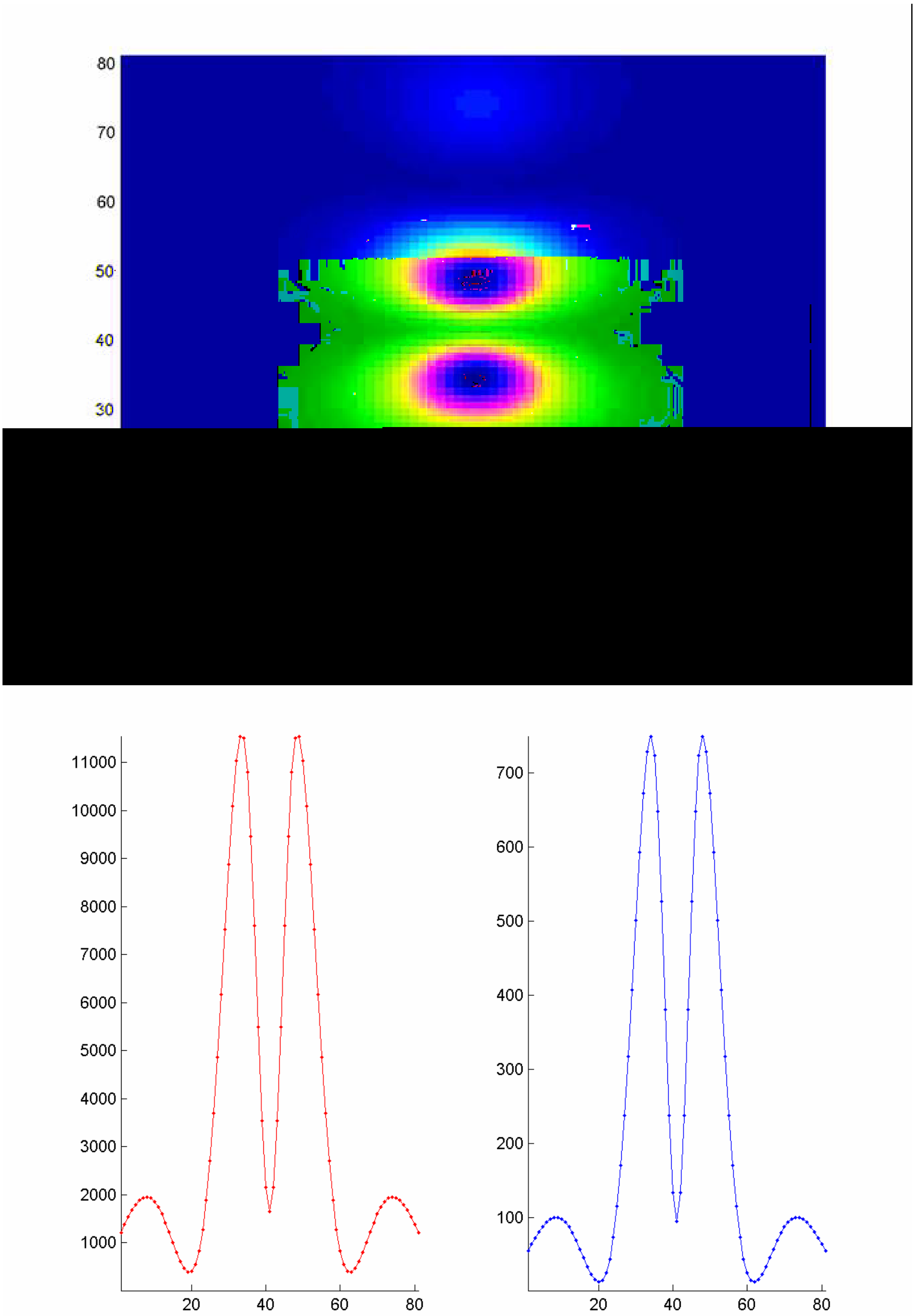



Fig. 2 – Angular distribution at 500 MeV and vertical distributions (Total vertical distribution and central line distribution). Beam size 50 µm and magnification .5

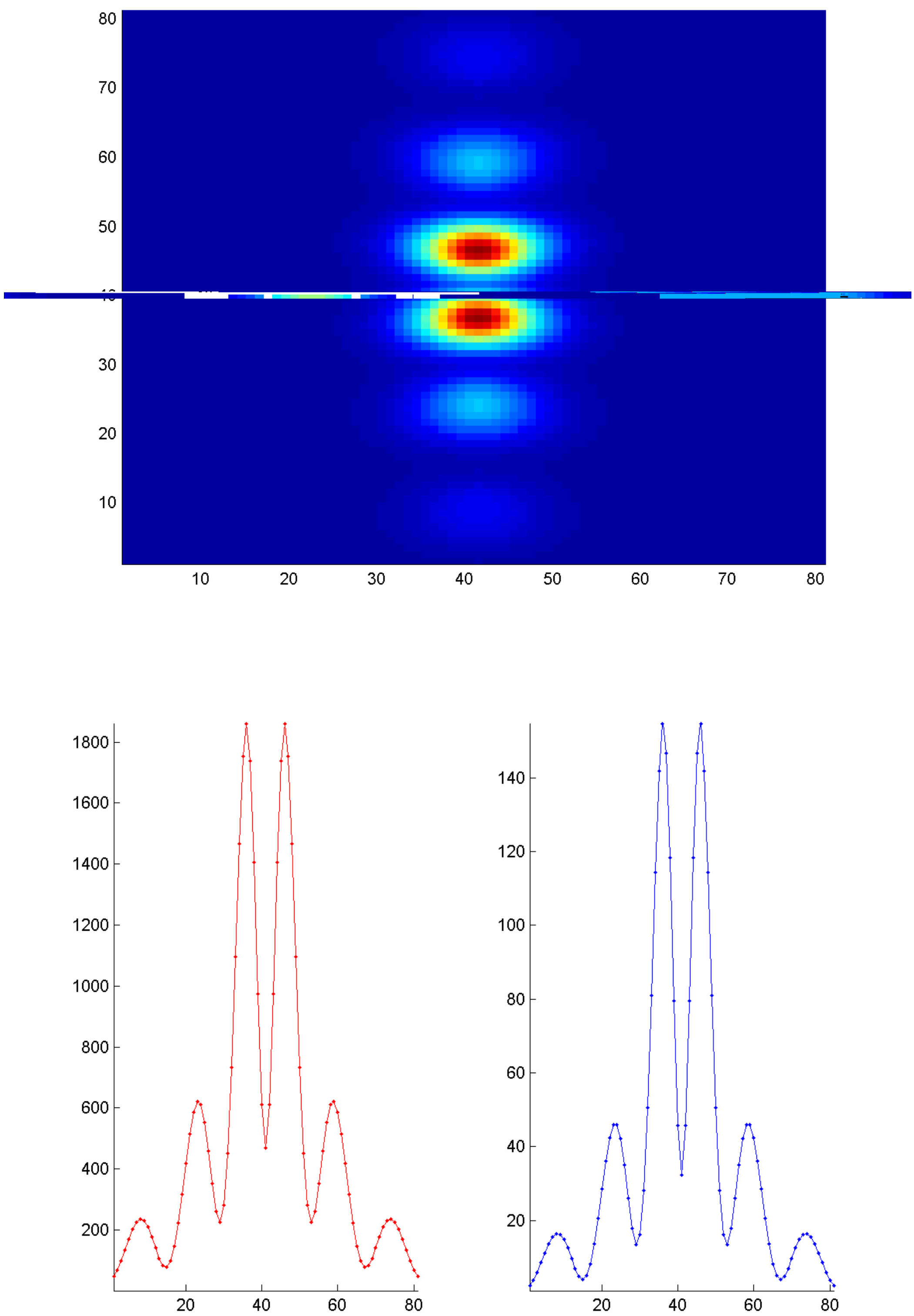



Fig. 3 – As Fig. 2, but magnification .25

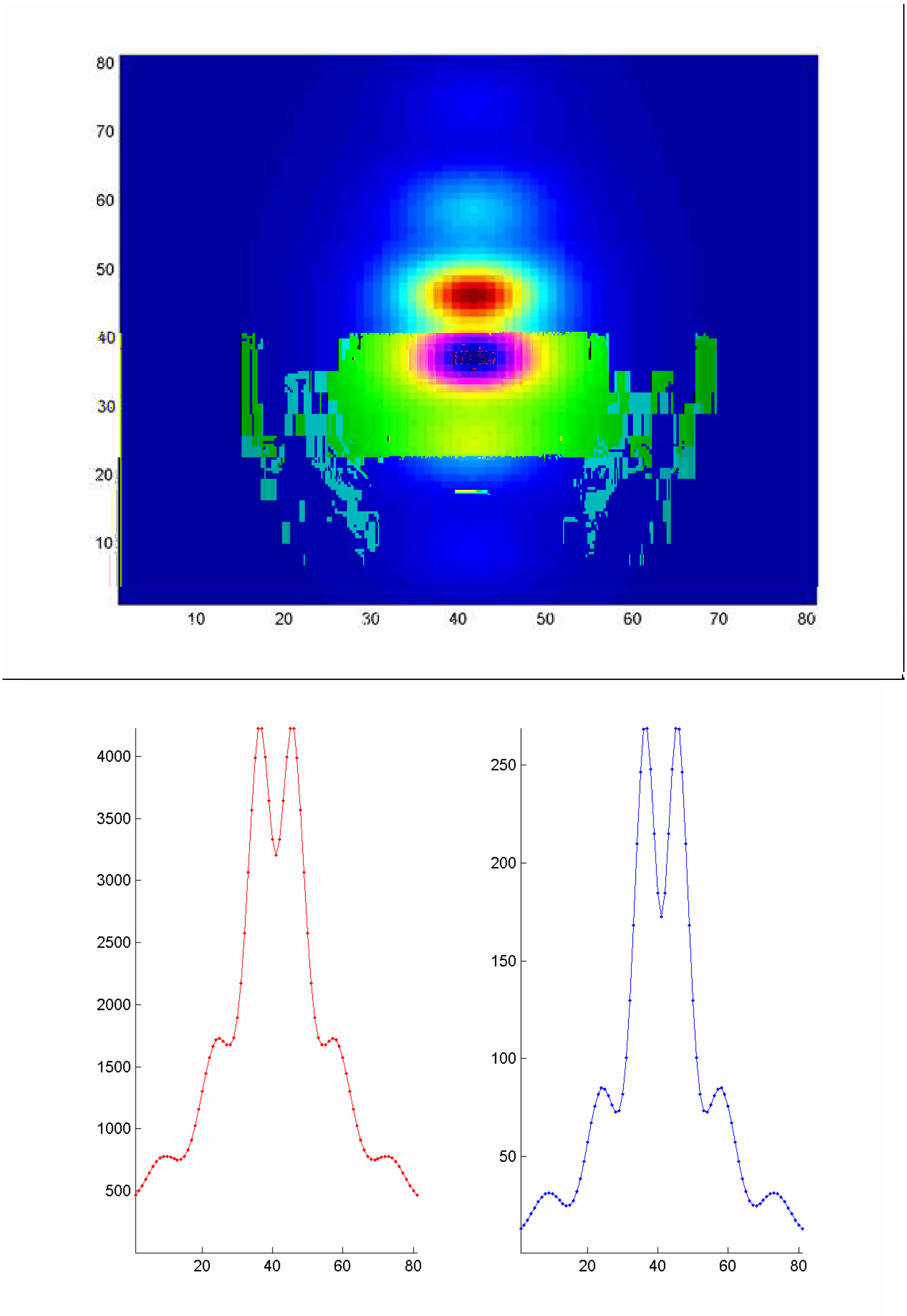
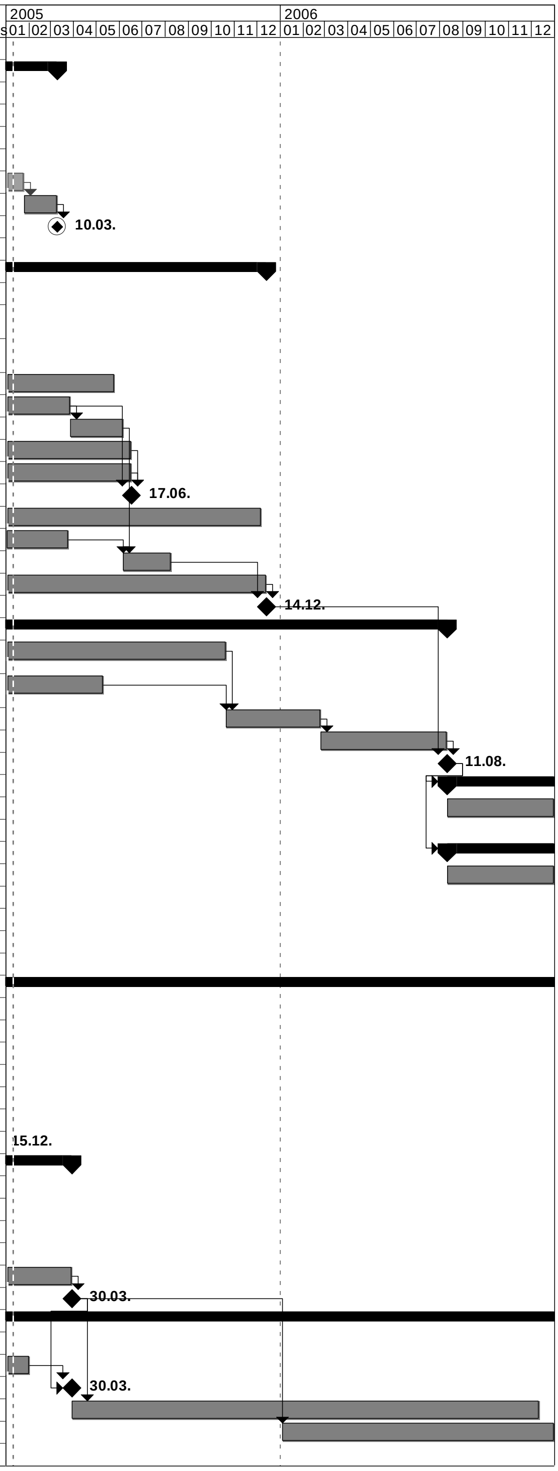



Fig. 4 – As Fig. 2, but beam size 100 µm.

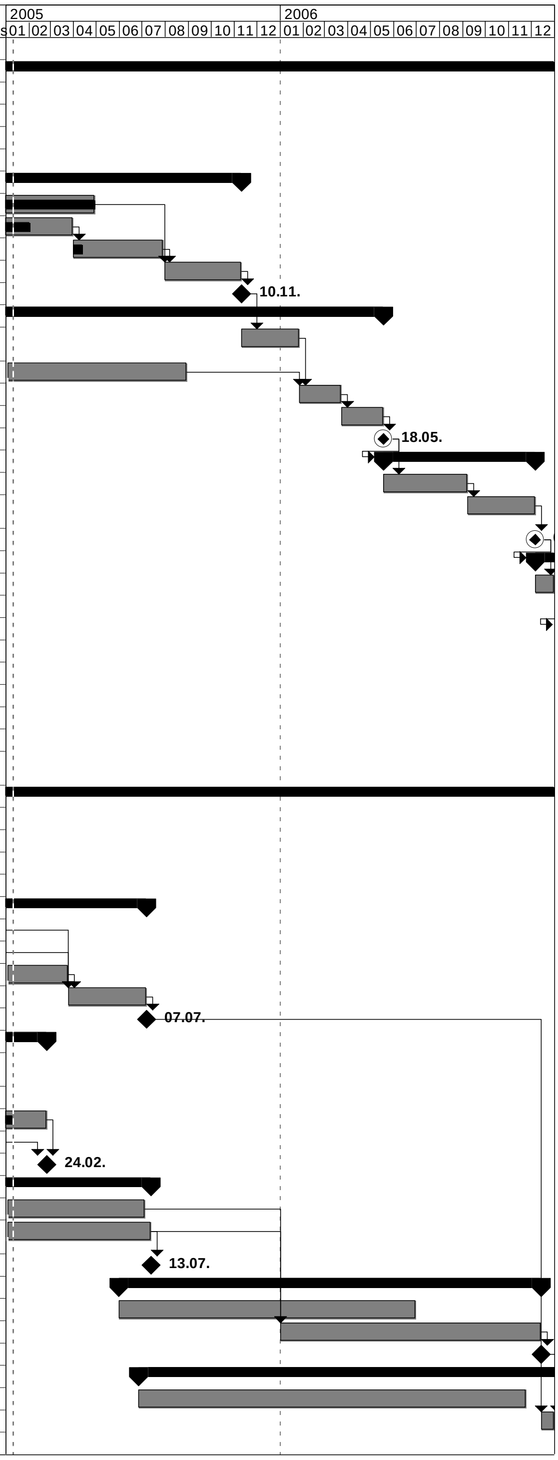
After these simulations, we have frozen the design of the diffraction screen and of the mechanical actuator, and ordered them.
We still need some time to completely define the optics and the camera.

# Next 18 month planning

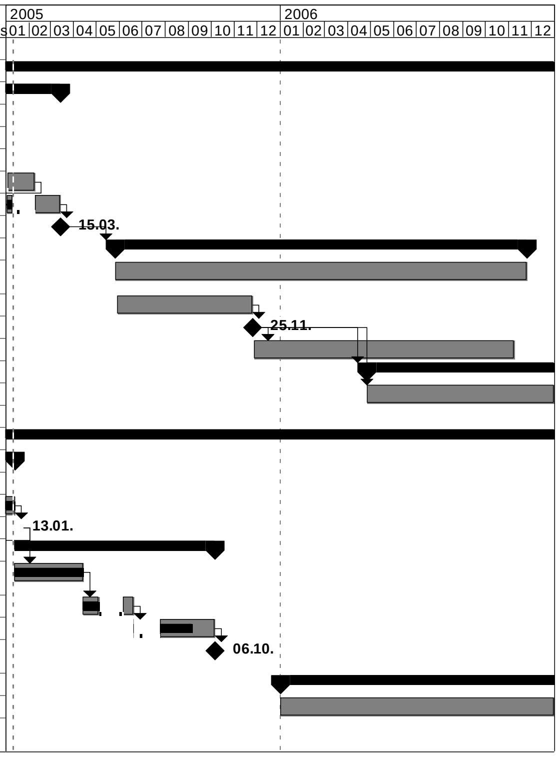
| N° | Task Name | Anfang | Ende | % schlos |
|---|---|---|---|---|
| **2** | **WP 2 IMPROVED STANDARD CAVITY FABRICATION** | **Do 01.01.04** | **Do 11.09.08** | **21%** |
| **2.1** | **Reliability Analysis** | **Do 01.01.04** | **Do 10.03.05** | **75%** |
| 2.1.1 | Review of data bank: cavity fabrication | Do 01.01.04 | Fr 13.02.04 | 100% |
| 2.1.2 | Review of data bank :cavity treatment | Mo 16.02.04 | Di 30.03.04 | 100% |
| 2.1.3 | Review of data bank: cavity VT performance | Mi 31.03.04 | Do 13.05.04 | 100% |
| 2.1.4 | Review of data bank: string assembly | Fr 14.05.04 | Mo 28.06.04 | 100% |
| 2.1.5 | Review of data bank: string performance | Di 29.06.04 | Di 25.01.05 | 50% |
| 2.1.6 | Establish correlations | Mi 26.01.05 | Do 10.03.05 | 0% |
| 2.1.7 | **Final report on reliability issue** | Do 10.03.05 | Do 10.03.05 | 0% |
| **2.2** | **Improved component design** | **Do 01.01.04** | **Do 11.09.08** | **10%** |
| **2.2.1** | **Documentation retrieving** | **Do 01.01.04** | **Mi 14.12.05** | **16%** |
| 2.2.1.1 | Start up meetings | Do 01.01.04 | Mo 09.02.04 | 100% |
| 2.2.1.2 | Access and study of Jlab, DESY, LLAN, KEK experience | Do 01.01.04 | Fr 02.07.04 | 100% |
| 2.2.1.3 | **Summary report on the status of the art on ancillaries** | Fr 02.07.04 | Fr 02.07.04 | 100% |
| 2.2.1.4 | Sealing material and shape design | Mo 05.07.04 | Mi 25.05.05 | 15% |
| 2.2.1.5 | Flange preliminary design | Fr 01.10.04 | Mo 28.03.05 | 1% |
| 2.2.1.6 | Material and geometric compatibility | Mo 28.03.05 | Mo 06.06.05 | 0% |
| 2.2.1.7 | Final assembly design | Mo 05.07.04 | Fr 17.06.05 | 1% |
| 2.2.1.8 | End plate preliminary design | Mo 05.07.04 | Fr 17.06.05 | 1% |
| 2.2.1.9 | **Report about new design for components** | Fr 17.06.05 | Fr 17.06.05 | 0% |
| 2.2.1.10 | Stiffness optimization | Mo 05.07.04 | Mi 07.12.05 | 6% |
| 2.2.1.11 | Manufacturing procedure analysis | Mo 03.01.05 | Fr 25.03.05 | 0% |
| 2.2.1.12 | Final assembly design | Mo 06.06.05 | Di 09.08.05 | 0% |
| 2.2.1.13 | Other ancillaries design | Mo 05.07.04 | Mi 14.12.05 | 6% |
| 2.2.1.14 | **Final Report for new components** | Mi 14.12.05 | Mi 14.12.05 | 0% |
| **2.2.2** | **Review of criticality in welding procedures** | **Do 01.01.04** | **Fr 11.08.06** | **11%** |
| 2.2.2.1 | Review of available parameters on vendor welding machine | Do 01.01.04 | Fr 21.10.05 | 13% |
| 2.2.2.2 | Definition of prototype requirements for tests | Do 01.07.04 | Mi 11.05.05 | 24% |
| 2.2.2.3 | Welding test on specimens | Fr 21.10.05 | Fr 24.02.06 | 0% |
| 2.2.2.4 | Analysis of the results | Fr 24.02.06 | Fr 11.08.06 | 0% |
| 2.2.2.5 | **Report about welding parameters** | Fr 11.08.06 | Fr 11.08.06 | 0% |
| **2.2.3** | **Finalize new component design** | **Fr 11.08.06** | **Mo 30.07.07** | **0%** |
| 2.2.3.1 | Do drawings | Fr 11.08.06 | Mo 30.07.07 | 0% |
| 2.2.3.2 | **New components design finished** | Mo 30.07.07 | Mo 30.07.07 | 0% |
| **2.2.4** | **Finalize new cavity design** | **Fr 11.08.06** | **Do 14.06.07** | **0%** |
| 2.2.4.1 | Make drawings | Fr 11.08.06 | Do 14.06.07 | 0% |
| 2.2.4.2 | **New cavity design finished** | Do 14.06.07 | Do 14.06.07 | 0% |
| **2.2.5** | **Fabrication of new cavity** | **Do 14.06.07** | **Do 11.09.08** | **0%** |
| 2.2.5.1 | Fabrication | Do 14.06.07 | Do 11.09.08 | 0% |
| 2.2.5.2 | New cavity finished | Do 11.09.08 | Do 11.09.08 | 0% |
| **2.3** | **EB welding** | **Do 01.01.04** | **Di 22.01.08** | **33%** |
| **2.3.1** | **Design tooling** | **Do 01.01.04** | **Mi 15.12.04** | **100%** |
| 2.3.1.1 | Tools for flange welding | Do 01.01.04 | Fr 20.02.04 | 100% |
| 2.3.1.2 | Tools for pipe welding | Mo 23.02.04 | Di 13.04.04 | 100% |
| 2.3.1.3 | Tools for stiffening rings | Mi 14.04.04 | Do 03.06.04 | 100% |
| 2.3.1.4 | Tools for single cell welding | Fr 04.06.04 | Mo 23.08.04 | 100% |
| 2.3.1.5 | Tools for 9-cells | Di 24.08.04 | Mi 15.12.04 | 100% |
| 2.3.1.6 | **Tools design finished** | Mi 15.12.04 | Mi 15.12.04 | 100% |
| **2.3.2** | **Tools production** | **Mo 23.02.04** | **Mi 30.03.05** | **67%** |
| 2.3.2.1 | Tools for flange welding | Mo 23.02.04 | Di 30.03.04 | 100% |
| 2.3.2.2 | Tools for pipe welding | Mi 14.04.04 | Do 13.05.04 | 100% |
| 2.3.2.3 | Tools for stiffening rings | Fr 04.06.04 | Do 15.07.04 | 100% |
| 2.3.2.4 | Tools for single cell welding | Di 24.08.04 | Mi 27.10.04 | 100% |
| 2.3.2.5 | Tools for 9-cells | Do 16.12.04 | Mi 30.03.05 | 1% |
| 2.3.2.6 | **Tools fabrication finished** | Mi 30.03.05 | Mi 30.03.05 | 0% |
| **2.3.3** | **Welding** | **Do 01.01.04** | **Di 22.01.08** | **13%** |
| 2.3.3.1 | Commissioning welding machine | Do 01.01.04 | Fr 16.04.04 | 100% |
| 2.3.3.2 | Test welding | Mo 19.04.04 | Di 01.02.05 | 79% |
| 2.3.3.3 | **Start production welding of components** | Mi 30.03.05 | Mi 30.03.05 | 0% |
| 2.3.3.4 | Single cell welding | Mi 30.03.05 | Di 12.12.06 | 0% |
| 2.3.3.5 | Multicell welding | Mi 04.01.06 | Di 22.01.08 | 0% |
| 2.3.3.6 | **Welding of prototypes of components finish** | Di 22.01.08 | Di 22.01.08 | 0% |



| N° | Task Name | Anfang | Ende | % schlos |
|---|---|---|---|---|
| **3** | **WP3 SEAMLESS CAVITY PRODUCTION** | **Do 01.01.04** | **Do 03.01.08** | **45%** |
| **3.1** | **Seamless by spinning** | **Do 01.01.04** | **Do 03.01.08** | **30%** |
| **3.1.1** | **Design spinning machine** | **Do 01.01.04** | **Fr 17.09.04** | **100%** |
| 3.1.1.1 | Drawings of the matrices | Do 01.01.04 | Fr 16.04.04 | 100% |
| 3.1.1.2 | Drawings of the support system | Fr 16.04.04 | Fr 17.09.04 | 100% |
| 3.1.1.3 | **Drawings of spinning machine finished** | Fr 17.09.04 | Fr 17.09.04 | 100% |
| **3.1.2** | **Fabrication of spinning machine** | **Mo 20.09.04** | **Do 10.11.05** | **58%** |
| 3.1.2.1 | Fabrication of machine parts | Mo 20.09.04 | Fr 29.04.05 | 100% |
| 3.1.2.2 | Software for the machine | Mo 20.09.04 | Do 31.03.05 | 70% |
| 3.1.2.3 | Assembly of machine | Fr 01.04.05 | Fr 29.07.05 | 10% |
| 3.1.2.4 | Commissioning of the machine | Mo 01.08.05 | Do 10.11.05 | 0% |
| 3.1.2.5 | **Spinning machine ready** | Do 10.11.05 | Do 10.11.05 | 0% |
| **3.1.3** | **Evaluation of spinning parameters** | **Mo 04.10.04** | **Do 18.05.06** | **1%** |
| 3.1.3.1 | Drawings of the support system and turning mechanism | Fr 11.11.05 | Do 26.01.06 | 0% |
| 3.1.3.2 | Drawings of the necking mechanism | Mo 04.10.04 | Di 30.08.05 | 1% |
| 3.1.3.3 | Fabrication of the tube necking machine | Fr 27.01.06 | Do 23.03.06 | 0% |
| 3.1.3.4 | Commissioning of the machine | Fr 24.03.06 | Do 18.05.06 | 0% |
| 3.1.3.5 | **Spinning parameters defined** | Do 18.05.06 | Do 18.05.06 | 0% |
| **3.1.4** | **Spinning of 1-celll cavities** | **Fr 19.05.06** | **Mi 06.12.06** | **0%** |
| 3.1.4.1 | Material and fabrication of bulk Nb test tubes | Fr 19.05.06 | Do 07.09.06 | 0% |
| 3.1.4.2 | Material and fabrication of bimetallic NbCu test tubes | Fr 08.09.06 | Mi 06.12.06 | 0% |
| 3.1.4.3 | **1-cell spinning parameters defined** | Mi 06.12.06 | Mi 06.12.06 | 0% |
| **3.1.5** | **Extension of spinning apparatus to multicells** | **Do 07.12.06** | **Mi 10.01.07** | **0%** |
| 3.1.5.1 | Computer simulation of the necking | Do 07.12.06 | Mi 10.01.07 | 0% |
| 3.1.5.2 | **Start of Multi-cell spinning** | Mi 10.01.07 | Mi 10.01.07 | 0% |
| **3.1.6** | **Spinning of multi-cell cavities cavities** | **Do 11.01.07** | **Mi 01.08.07** | **0%** |
| 3.1.6.1 | Computer simulation of the hydro forming | Do 11.01.07 | Mi 01.08.07 | 0% |
| 3.1.6.2 | Hydro forming of bulk Nb 9-cell cavities | Do 11.01.07 | Mi 11.07.07 | 0% |
| 3.1.6.3 | **Parameters of multi-cell spinning defined** | Mi 11.07.07 | Mi 11.07.07 | 0% |
| **3.1.7** | **Series production of multi-cell cavities** | **Do 12.07.07** | **Do 03.01.08** | **0%** |
| 3.1.7.1 | Spinning | Do 12.07.07 | Do 03.01.08 | 0% |
| 3.1.7.2 | **Multi-cell cavities finished** | So 30.12.07 | So 30.12.07 | 100% |
| **3.2** | **Seamless by hydro forming** | **Do 01.01.04** | **Do 15.11.07** | **52%** |
| **3.2.1** | **Design hydro forming machine** | **Do 01.01.04** | **Fr 17.09.04** | **100%** |
| 3.2.1.1 | Drawings of the matrices | Do 01.01.04 | Fr 17.09.04 | 100% |
| 3.2.1.2 | Drawings of the support system | Do 01.01.04 | Fr 17.09.04 | 100% |
| 3.2.1.3 | **Drawings matrix & support finished** | Fr 17.09.04 | Fr 17.09.04 | 100% |
| **3.2.2** | **Construction of hydro forming machine** | **Do 01.01.04** | **Do 07.07.05** | **73%** |
| 3.2.2.1 | Hydraulic for machine | Do 01.01.04 | Mi 14.07.04 | 100% |
| 3.2.2.2 | Software for the machine | Mo 23.02.04 | Fr 17.09.04 | 100% |
| 3.2.2.3 | Machine fabrication | Mo 20.09.04 | Fr 25.03.05 | 55% |
| 3.2.2.4 | Commissioning of the machine | Fr 25.03.05 | Do 07.07.05 | 0% |
| 3.2.2.5 | **Hydro forming machine ready** | Do 07.07.05 | Do 07.07.05 | 0% |
| **3.2.3** | **Construction of tube necking machine** | **Do 01.01.04** | **Do 24.02.05** | **95%** |
| 3.2.3.1 | Drawings of the support system and turning mechanism | Do 01.01.04 | Fr 27.08.04 | 100% |
| 3.2.3.2 | Drawings of the necking mechanism | Do 01.01.04 | Fr 27.08.04 | 100% |
| 3.2.3.3 | Fabrication of the tube necking machine | Do 23.09.04 | Do 24.02.05 | 70% |
| 3.2.3.4 | Software for the tube necking machine | Mo 03.05.04 | Do 30.12.04 | 100% |
| 3.2.3.5 | **Construction tube necking machine finished** | Do 24.02.05 | Do 24.02.05 | 100% |
| **3.2.4** | **Development of seamless tubes for 9-cell cavitie** | **Do 01.01.04** | **Mi 13.07.05** | **57%** |
| 3.2.4.1 | Material and fabrication of bulk Nb test tubes | Di 03.08.04 | Di 05.07.05 | 45% |
| 3.2.4.2 | Material and fabrication of bimetallic NbCu test tubes | Do 01.01.04 | Mi 13.07.05 | 65% |
| 3.2.4.3 | **Seamless tubes ready** | Mi 13.07.05 | Mi 13.07.05 | 0% |
| **3.2.5** | **Development of tube necking** | **Mi 01.06.05** | **Do 14.12.06** | **0%** |
| 3.2.5.1 | Computer simulation of the necking | Mi 01.06.05 | Fr 30.06.06 | 0% |
| 3.2.5.2 | Experiments on tube necking at iris | Mo 02.01.06 | Do 14.12.06 | 0% |
| 3.2.5.3 | **Tube necking machine operational** | Do 14.12.06 | Do 14.12.06 | 0% |
| **3.2.6** | **Hydro forming of seamless cavities** | **Mo 27.06.05** | **Do 15.11.07** | **0%** |
| 3.2.6.1 | Computer simulation of the hydro forming | Mo 27.06.05 | Fr 24.11.06 | 0% |
| 3.2.6.2 | Hydro forming of bulk Nb 9-cell cavities | Fr 15.12.06 | Do 15.11.07 | 0% |
| 3.2.6.3 | **Hydro formed 9-cell cavities ready** | Do 15.11.07 | Do 15.11.07 | 0% |

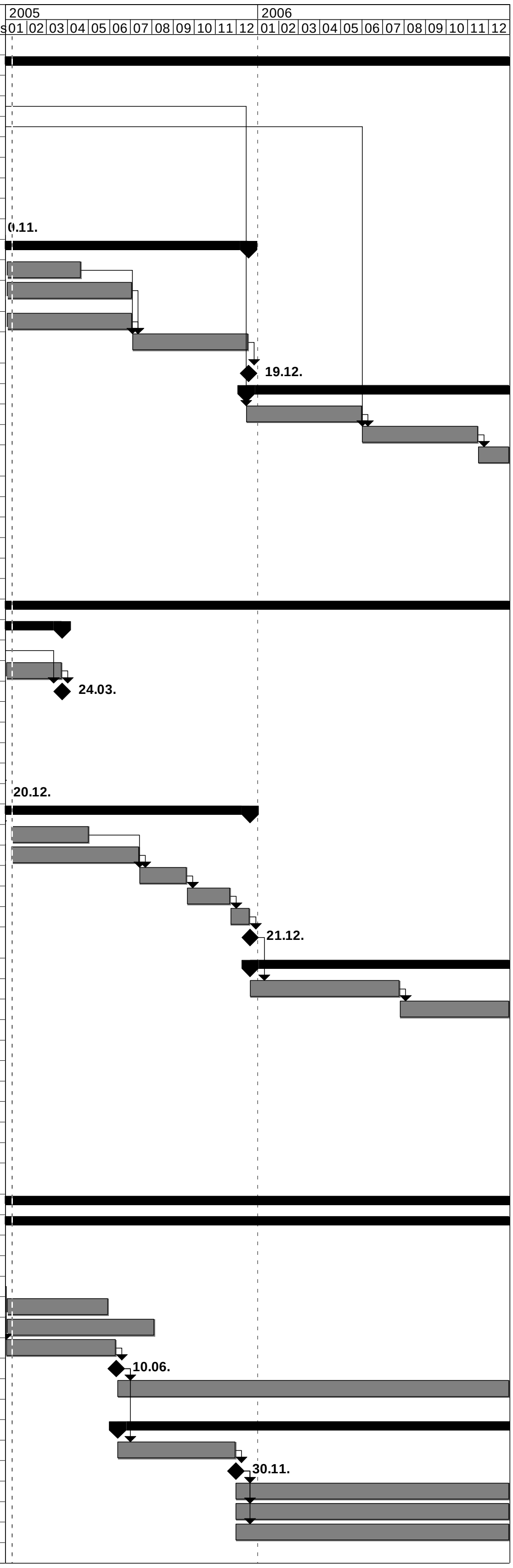


| N° | Task Name | Anfang | Ende | % schlos |
|---|---|---|---|---|
| **4** | **WP4 THIN FILM CAVITY PRODUCTION** | **Do 01.01.04** | **Do 27.12.07** | **27%** |
| **4.1** | **Linear-arc cathode coating** | **Do 01.01.04** | **Fr 27.04.07** | **17%** |
| **4.1.1** | **Installation & commissioning of coating apparatu** | **Do 01.01.04** | **Di 15.03.05** | **81%** |
| 4.1.1.1 | Modification of a prototype facility for single cells | Do 01.01.04 | Mi 31.03.04 | 100% |
| 4.1.1.2 | Optimization of a triggering system | Do 01.04.04 | Fr 30.07.04 | 100% |
| 4.1.1.3 | **Prototype facility ready** | Fr 30.07.04 | Fr 30.07.04 | 100% |
| 4.1.1.4 | Study of arc current reduction and stabilization | Do 02.09.04 | Mi 09.02.05 | 70% |
| 4.1.1.5 | Optimization of powering system | Mo 03.01.05 | Di 15.03.05 | 20% |
| 4.1.1.6 | **Coating apparatus operational** | Di 15.03.05 | Di 15.03.05 | 0% |
| **4.1.2** | **Coating single cells** | **Fr 27.05.05** | **Sa 25.11.06** | **0%** |
| 4.1.2.1 | Coating of single cells without micro droplet filtering | Fr 27.05.05 | Sa 25.11.06 | 0% |
| 4.1.2.2 | Design and construction of a micro droplet fil | Mo 30.05.05 | Fr 25.11.05 | 0% |
| 4.1.2.3 | **Droplet filter ready** | Fr 25.11.05 | Fr 25.11.05 | 0% |
| 4.1.2.4 | Coating of single cell with micro droplet filtering | Mo 28.11.05 | Mi 08.11.06 | 0% |
| **4.1.3** | **Coating multi-cell** | **Do 27.04.06** | **Fr 27.04.07** | **0%** |
| 4.1.3.1 | Design and commissioning | Do 27.04.06 | Fr 27.04.07 | 0% |
| 4.1.3.2 | First multicell coating | Fr 27.04.07 | Fr 27.04.07 | 0% |
| **4.2** | **Planar-arc cathode coating** | **Do 01.01.04** | **Do 27.12.07** | **41%** |
| **4.2.1** | **Modification of a planar-arc & trigger system** | **Do 01.01.04** | **Do 13.01.05** | **100%** |
| 4.2.1.1 | Modification | Do 01.01.04 | Fr 16.04.04 | 100% |
| 4.2.1.2 | Optimization of the laser triggering system | Mo 19.04.04 | Do 13.01.05 | 100% |
| 4.2.1.3 | **Planar arc system fully tested** | Do 13.01.05 | Do 13.01.05 | 100% |
| **4.2.2** | **Routine Operation of planar arc system** | **Do 13.01.05** | **Do 06.10.05** | **78%** |
| 4.2.2.1 | Characterization of samples coated at different conditions | Do 13.01.05 | Do 14.04.05 | 100% |
| 4.2.2.2 | Characterization of Nb-coated sapphire sam | Do 14.04.05 | Mo 20.06.05 | 60% |
| 4.2.2.3 | Characterization of Nb-coated copper sample | Mo 20.06.05 | Do 06.10.05 | 59% |
| 4.2.2.4 | **Summary report on quality of planar arc coating** | Do 06.10.05 | Do 06.10.05 | 0% |
| **4.2.3** | **Studies of other HTC superconducting coating** | **Mo 02.01.06** | **Do 27.12.07** | **0%** |
| 4.2.3.1 | Study of superconducting properties | Mo 02.01.06 | Do 27.12.07 | 0% |
| 4.2.3.2 | **Report on quality of superconducting properties** | Do 27.12.07 | Do 27.12.07 | 0% |

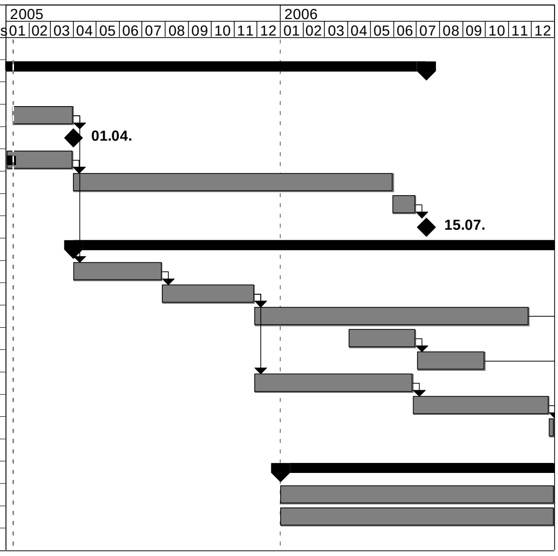


| N° | Task Name | Anfang | Ende | % schlo: |
|---|---|---|---|---|
| **5** | **WP5 SURFACE PREPARATION** | | | |

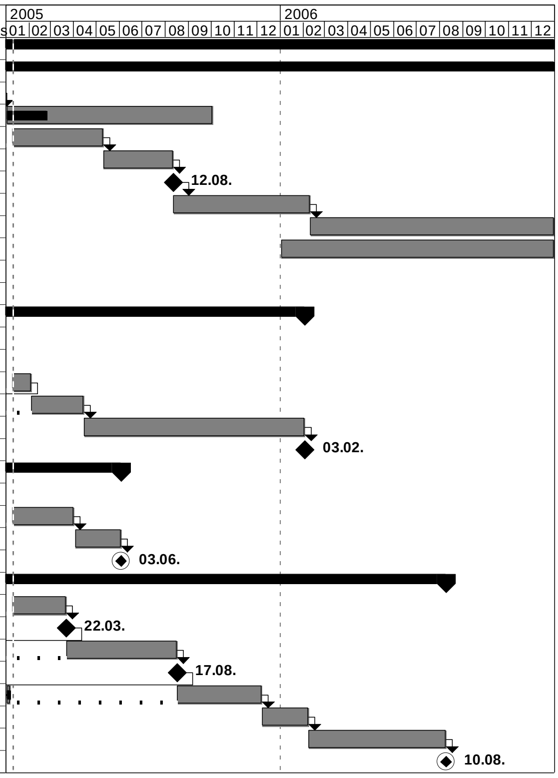
| N° | Task Name | Anfang | Ende | % schlos |
|---|---|---|---|---|
| **6** | **WP6 MATERIAL ANALYSIS** | **Mo 29.12.03** | **Di 17.06.08** | **21%** |
| **6.1** | **SQUID scanning** | **Do 01.01.04** | **Mo 31.12.07** | **37%** |
| **6.1.1** | **Produce calibration defects** | **Do 01.01.04** | **Do 12.08.04** | **100%** |
| 6.1.1.1 | Production of surface defects | Do 01.01.04 | Fr 18.06.04 | 100% |
| 6.1.1.2 | Production of bulk defects | Do 12.02.04 | Do 12.08.04 | 100% |
| 6.1.1.3 | **Calibration defects finished** | Do 12.08.04 | Do 12.08.04 | 100% |
| **6.1.2** | **Design components of Squid scanner** | **Do 01.01.04** | **Di 30.11.04** | **100%** |
| 6.1.2.1 | Design of the scanning table and support | Do 01.01.04 | Mi 30.06.04 | 100% |
| 6.1.2.2 | Design of the SQUID cooling system | Mi 28.01.04 | Di 30.11.04 | 100% |
| 6.1.2.3 | **Design Scanner finished** | Di 30.11.04 | Di 30.11.04 | 100% |
| **6.1.3** | **Construction of scanning apparatus** | **Mi 01.12.04** | **Mo 19.12.05** | **11%** |
| 6.1.3.1 | Fabrication of the SQUID | Mi 01.12.04 | Do 21.04.05 | 10% |
| 6.1.3.2 | Fabrication and purchase of components for SQUID apparatus | Mi 01.12.04 | Mo 04.07.05 | 15% |
| 6.1.3.3 | Software for the SQUID scanner | Mi 01.12.04 | Mo 04.07.05 | 15% |
| 6.1.3.4 | Commissioning and calibration of scanning apparatus | Mo 04.07.05 | Mo 19.12.05 | 0% |
| 6.1.3.5 | **Scanning apparatus operational** | Mo 19.12.05 | Mo 19.12.05 | 0% |
| **6.1.4** | **Scanning of sheets with artificial defects** | **Fr 16.12.05** | **Mi 07.02.07** | **0%** |
| 6.1.4.1 | Scanning of sheets with artificial surface defects | Fr 16.12.05 | Do 01.06.06 | 0% |
| 6.1.4.2 | Scanning of sheets with artificial bulk defects | Fr 02.06.06 | Do 16.11.06 | 0% |
| 6.1.4.3 | Development of algorithm for material defects classification | Fr 17.11.06 | Mi 07.02.07 | 0% |
| 6.1.4.4 | **Classification of defects finished** | Mi 07.02.07 | Mi 07.02.07 | 0% |
| **6.1.5** | **Scanning of production sheets** | **Fr 09.02.07** | **Mo 31.12.07** | **0%** |
| 6.1.5.1 | Scanning of sheets of different producers | Fr 09.02.07 | Do 20.09.07 | 0% |
| 6.1.5.2 | Identification of defects by (EDX, SURFA etc.) | Mo 02.04.07 | Fr 28.09.07 | 0% |
| 6.1.5.3 | Conclusive comparison with eddy current data | Fr 21.09.07 | Mo 31.12.07 | 0% |
| 6.1.5.4 | **Final report on SQUID scanning** | Mo 31.12.07 | Mo 31.12.07 | 0% |
| **6.2** | **Flux gate magnetometry** | **Mo 29.12.03** | **Di 17.06.08** | **31%** |
| **6.2.1** | **Produce calibration defects** | **Do 01.01.04** | **Do 24.03.05** | **74%** |
| 6.2.1.1 | Production of surface defects | Do 01.01.04 | Fr 07.05.04 | 100% |
| 6.2.1.2 | Production of bulk defects | Do 01.01.04 | Do 24.03.05 | 55% |
| 6.2.1.3 | **Calibration defects finished** | Do 24.03.05 | Do 24.03.05 | 0% |
| **6.2.2** | **Design components of flux gate head** | **Mo 29.12.03** | **Mo 20.12.04** | **100%** |
| 6.2.2.1 | Design electronics | Mo 29.12.03 | Di 13.04.04 | 100% |
| 6.2.2.2 | Design of flux gate head | Mo 02.08.04 | Fr 17.12.04 | 100% |
| 6.2.2.3 | Design of operations software | Do 01.01.04 | Fr 04.06.04 | 100% |
| 6.2.2.4 | **Design flux gate head finished** | Mo 20.12.04 | Mo 20.12.04 | 100% |
| **6.2.3** | **Fabrication of flux gate detector** | **Mo 21.06.04** | **Mi 21.12.05** | **7%** |
| 6.2.3.1 | Fabrication of flux gate head | Mo 13.12.04 | Mo 02.05.05 | 6% |
| 6.2.3.2 | Fabrication of mechanics | Mo 21.06.04 | Do 14.07.05 | 12% |
| 6.2.3.3 | Implementation of software | Do 14.07.05 | Mi 21.09.05 | 0% |
| 6.2.3.4 | Commissioning of flux gate detector | Mi 21.09.05 | Mi 23.11.05 | 0% |
| 6.2.3.5 | Calibration of flux gate detector | Mi 23.11.05 | Mi 21.12.05 | 0% |
| 6.2.3.6 | **Flux gate detector operational** | Mi 21.12.05 | Mi 21.12.05 | 0% |
| **6.2.4** | **Commissioning of flux gate detector** | **Mi 21.12.05** | **Di 09.01.07** | **0%** |
| 6.2.4.1 | Operational tets tests | Mi 21.12.05 | Mi 26.07.06 | 0% |
| 6.2.4.2 | Evaluation of test results | Mi 26.07.06 | Di 09.01.07 | 0% |
| 6.2.4.3 | **Flux gate scanner commissioned** | Di 09.01.07 | Di 09.01.07 | 0% |
| **6.2.5** | **Operation of flux gate detector** | **Di 09.01.07** | **Fr 21.09.07** | **0%** |
| 6.2.5.1 | Regular operation | Di 09.01.07 | Mo 11.06.07 | 0% |
| 6.2.5.2 | Report of operation | Mo 11.06.07 | Fr 21.09.07 | 0% |
| 6.2.5.3 | **Conclusion of flux gate scanning operation** | Fr 21.09.07 | Fr 21.09.07 | 0% |
| **6.2.6** | **Comparison with SQUID scanner** | **Fr 21.09.07** | **Di 17.06.08** | **0%** |
| 6.2.6.1 | Compare measurements | Fr 21.09.07 | Di 17.06.08 | 0% |
| 6.2.6.2 | **Conclude SQUID scanner vs. flux gate detector** | Di 17.06.08 | Di 17.06.08 | 0% |
| **6.3** | **DC field emission studies of Nb samples** | **Do 01.01.04** | **Fr 28.12.07** | **6%** |
| **6.3.1** | **Quality control scans** | **Do 01.01.04** | **Fr 28.12.07** | **14%** |
| 6.3.1.1 | Modification of Scanning apparatus | Do 01.01.04 | Fr 02.04.04 | 100% |
| 6.3.1.2 | Calibration of Scanning apparatus | Mo 05.04.04 | Fr 04.06.04 | 100% |
| 6.3.1.3 | **Start scanning activity** | Fr 04.06.04 | Fr 04.06.04 | 100% |
| 6.3.1.4 | BCP and HPR samples | Mo 07.06.04 | Mo 30.05.05 | 30% |
| 6.3.1.5 | EP and HPR samples | Fr 10.09.04 | Fr 05.08.05 | 10% |
| 6.3.1.6 | BCP/EP and DIC samples | Mo 03.01.05 | Fr 10.06.05 | 0% |
| 6.3.1.7 | **First report on BCP/EP and DIC surface** | Fr 10.06.05 | Fr 10.06.05 | 0% |
| 6.3.1.8 | Continue QA scanning | Mo 13.06.05 | Fr 28.12.07 | 0% |
| 6.3.1.9 | **Evaluation of scanning results** | Fr 28.12.07 | Fr 28.12.07 | 0% |
| **6.3.2** | **Detailed measurements on strong emitters** | **Mo 13.06.05** | **Fr 28.12.07** | **0%** |
| 6.3.2.1 | Calibrate apparatus for high current | Mo 13.06.05 | Mi 30.11.05 | 0% |
| 6.3.2.2 | **Start strong emitter evaluation** | Mi 30.11.05 | Mi 30.11.05 | 0% |
| 6.3.2.3 | I/V curves and current limits | Do 01.12.05 | Fr 28.12.07 | 0% |
| 6.3.2.4 | SEM and AES | Do 01.12.05 | Fr 28.12.07 | 0% |
| 6.3.2.5 | Influence of heat treatment and ion impact | Do 01.12.05 | Fr 28.12.07 | 0% |
| 6.3.2.6 | **Evaluate strong emitter investigations** | Fr 28.12.07 | Fr 28.12.07 | 0% |



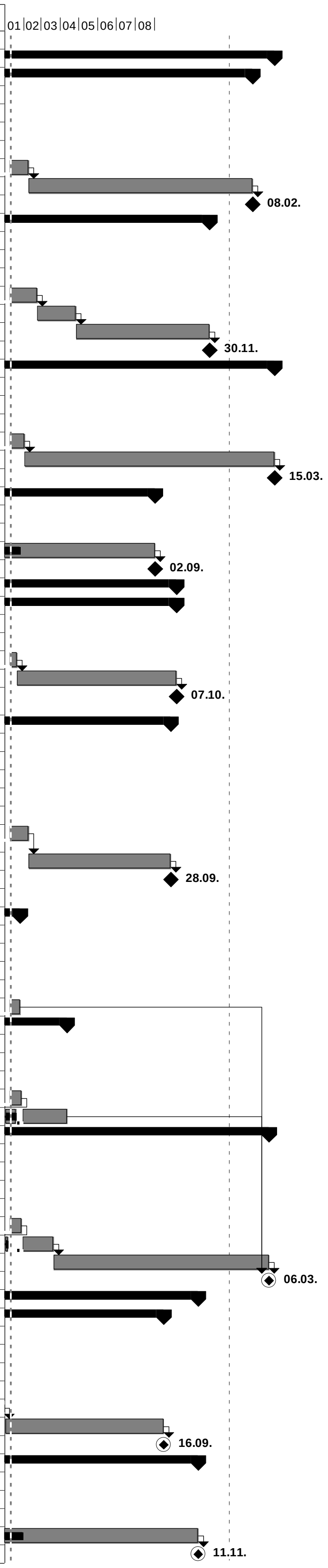
| N° | Task Name | Anfang | Ende | % schlos |
|---|---|---|---|---|
| **7** | **WP7 COUPLERS** | **Do 01.01.04** | **Do 29.11.07** | **8%** |
| **7.1** | **New Prototype Coupler** | **Do 01.01.04** | **Sa 15.07.06** | **32%** |
| 7.1.1 | RF Simulations of Coupler | Do 01.01.04 | Mi 30.06.04 | 100% |
| 7.1.2 | Detailed Engineering Drawings | Do 01.07.04 | Fr 01.04.05 | 55% |
| 7.1.3 | Engineering complete | Fr 01.04.05 | Fr 01.04.05 | 0% |
| 7.1.4 | Call for tenders | Mo 03.01.05 | Do 31.03.05 | 15% |
| 7.1.5 | Prototype Fabrication in Industry | Fr 01.04.05 | Mi 31.05.06 | 0% |
| 7.1.6 | Low Power tests | Mi 31.05.06 | Fr 30.06.06 | 0% |
| 7.1.7 | **Ready for High Power Tests** | Sa 15.07.06 | Sa 15.07.06 | 0% |
| **7.2** | **Fabrication of TiN Coating System** | **Fr 01.04.05** | **Fr 23.02.07** | **0%** |
| 7.2.1 | Mechanical design of vacuum chamber | Fr 01.04.05 | Do 28.07.05 | 0% |
| 7.2.2 | Fabrication drawings | Do 28.07.05 | Mo 28.11.05 | 0% |
| 7.2.3 | Construction of vacuum chamber | Mo 28.11.05 | Di 28.11.06 | 0% |
| 7.2.4 | Define vacuum needs | Mo 03.04.06 | Fr 30.06.06 | 0% |
| 7.2.5 | Appropriation of vacuum equipment | Mo 03.07.06 | Sa 30.09.06 | 0% |
| 7.2.6 | Design of electronic circuitry | Mo 28.11.05 | Di 27.06.06 | 0% |
| 7.2.7 | Fabrication of electronics in industry | Di 27.06.06 | Mo 25.12.06 | 0% |
| 7.2.8 | Installation and Test at Orsay | Mo 25.12.06 | Fr 23.02.07 | 0% |
| 7.2.9 | **First Window Coating** | Fr 23.02.07 | Fr 23.02.07 | 0% |
| **7.3** | **Conditioning Studies of Proto-type Couplers** | **Mo 02.01.06** | **Do 29.11.07** | **0%** |
| 7.3.1 | Conditioning of couplers | Mo 02.01.06 | Do 29.11.07 | 0% |
| 7.3.2 | Evaluate conditioning results | Mo 02.01.06 | Do 29.11.07 | 0% |
| 7.3.3 | **Final report on conditioning** | Do 29.11.07 | Do 29.11.07 | 0% |



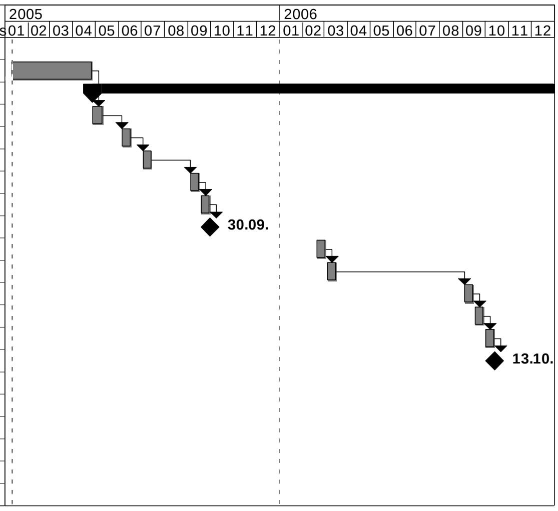
| N° | Task Name | Anfang | Ende | % schlos |
|---|---|---|---|---|
| **8** | **WP8 TUNERS** | **Do 01.01.04** | **Mo 31.12.07** | **23%** |
| **8.1** | **UMI TUNER** | **Do 01.01.04** | **Mo 31.12.07** | **13%** |
| 8.1.1 | Control electronics | Do 01.01.04 | Fr 02.07.04 | 100% |
| 8.1.2 | Mechanical tuner design, leverage system/motor | Mo 03.01.05 | Mo 03.10.05 | 20% |
| 8.1.3 | Integration piezo design | Do 05.08.04 | Mi 11.05.05 | 5% |
| 8.1.4 | Choice of transducer/actuator | Mi 11.05.05 | Fr 12.08.05 | 0% |
| 8.1.5 | **Report UMI tuner** | Fr 12.08.05 | Fr 12.08.05 | 0% |
| 8.1.6 | Tuner fabrication | Fr 12.08.05 | Fr 10.02.06 | 0% |
| 8.1.7 | Piezo fabrication and bench tests | Fr 10.02.06 | Fr 09.02.07 | 0% |
| 8.1.8 | Cavity-tuner-coupler integration | Di 03.01.06 | Sa 30.06.07 | 0% |
| 8.1.9 | Pulsed RF tests | Mo 02.07.07 | Mo 31.12.07 | 0% |
| 8.1.10 | **Evaluation of tuner operation** | Mo 31.12.07 | Mo 31.12.07 | 0% |
| **8.2** | **Magneto-strictive Tuner** | **Do 01.01.04** | **Fr 03.02.06** | **31%** |
| 8.2.1 | Complete specification | Do 01.01.04 | Fr 30.01.04 | 100% |
| 8.2.2 | Conceptual design | Mo 02.02.04 | Mi 31.03.04 | 100% |
| 8.2.3 | Prototype and performance evaluation | Do 01.04.04 | Fr 04.02.05 | 70% |
| 8.2.4 | Finalize tuner and drive electronics design | Do 01.07.04 | Fr 15.04.05 | 25% |
| 8.2.5 | Test of tuner | Fr 15.04.05 | Fr 03.02.06 | 0% |
| 8.2.6 | **Report on magneto-strictive Tuner** | Fr 03.02.06 | Fr 03.02.06 | 0% |
| **8.3** | **CEA Tuner** | **Mo 05.01.04** | **Fr 03.06.05** | **63%** |
| 8.3.1 | Design Piezo + Tuning System | Mo 05.01.04 | Fr 18.06.04 | 100% |
| 8.3.2 | Fabrication | Mo 21.06.04 | Fr 01.04.05 | 50% |
| 8.3.3 | Installation RF | Mo 04.04.05 | Fr 03.06.05 | 0% |
| 8.3.4 | **Start of Integrated Experitments** | Fr 03.06.05 | Fr 03.06.05 | 0% |
| **8.4** | **IN2P3 Activity** | **Do 01.01.04** | **Do 10.08.06** | **21%** |
| 8.4.1 | Characterize actuators/piezo-sensors at low temperatu | Do 01.01.04 | Di 22.03.05 | 60% |
| 8.4.2 | Report on actuator/piezo sensor | Di 22.03.05 | Di 22.03.05 | 0% |
| 8.4.3 | Test radiation hardness of piezo tuners | Do 01.07.04 | Mi 17.08.05 | 20% |
| 8.4.4 | Report on radiation hardness tests | Mi 17.08.05 | Mi 17.08.05 | 0% |
| 8.4.5 | Integration of pieco and cold tuner | Mo 03.01.05 | Do 08.12.05 | 5% |
| 8.4.6 | Cryostat tests | Do 08.12.05 | Mi 08.02.06 | 0% |
| 8.4.7 | Tests with pulsed RF | Mi 08.02.06 | Do 10.08.06 | 0% |
| 8.4.8 | **Report on IN2P3 tuner activities** | Do 10.08.06 | Do 10.08.06 | 0% |



| N° | Task Name | Anfang | Ende | % |
|---|---|---|---|---|
| **9** | **WP9 LOW LEVEL RF (LLRF)** | **Do 01.01.04** | **Mi 15.03.06** | **57%** |
| **9.1** | **Operability and technical performance** | **Do 01.01.04** | **Mi 15.03.06** | **51%** |
| **9.1.1** | **Transient detector** | **Do 01.01.04** | **Mi 08.02.06** | **47%** |
| 9.1.1.1 | Define requirements | Do 01.01.04 | Fr 30.01.04 | 100% |
| 9.1.1.2 | Electronics design | Mo 02.02.04 | Fr 27.02.04 | 100% |
| 9.1.1.3 | Build prototype and evaluate | Mo 01.03.04 | Fr 30.07.04 | 100% |
| 9.1.1.4 | Final design of detector | Mo 02.08.04 | Fr 01.10.04 | 100% |
| 9.1.1.5 | Installation and commissioning | Mo 04.10.04 | Mi 09.02.05 | 70% |
| 9.1.1.6 | Test with beam | Mi 09.02.05 | Mi 08.02.06 | 0% |
| 9.1.1.7 | **Report on transient detector test** | Mi 08.02.06 | Mi 08.02.06 | 0% |
| **9.1.2** | **LLRF Automation** | **Do 01.01.04** | **Mi 30.11.05** | **52%** |
| 9.1.2.1 | Dialogue with industrial experts | Do 01.01.04 | Fr 27.02.04 | 100% |
| 9.1.2.2 | Develop full specification | Mo 01.03.04 | Fr 26.03.04 | 100% |
| 9.1.2.3 | Implement FMS for subsystems | Mo 29.03.04 | Fr 29.10.04 | 100% |
| 9.1.2.4 | Test and evaluation | Mo 01.11.04 | Mi 23.02.05 | 50% |
| 9.1.2.5 | Implement improvements | Mi 23.02.05 | Mi 27.04.05 | 0% |
| 9.1.2.6 | Evaluation and acceptance by operators | Mi 27.04.05 | Mi 30.11.05 | 0% |
| 9.1.2.7 | **Report on LLRF atomization design** | Mi 30.11.05 | Mi 30.11.05 | 0% |
| **9.1.3** | **Control optimization** | **Do 01.01.04** | **Mi 15.03.06** | **44%** |
| 9.1.3.1 | Specification of system | Do 01.01.04 | Fr 02.04.04 | 100% |
| 9.1.3.2 | Conceptual design of controller | Mo 05.04.04 | Fr 30.04.04 | 100% |
| 9.1.3.3 | Performance simulation | Mo 03.05.04 | Fr 27.08.04 | 100% |
| 9.1.3.4 | Implementation in DSP hardware | Mo 30.08.04 | Mi 02.02.05 | 80% |
| 9.1.3.5 | Implementation and tests on TTF | Do 03.02.05 | Mi 15.03.06 | 0% |
| 9.1.3.6 | **Evaluation of test results** | Mi 15.03.06 | Mi 15.03.06 | 0% |
| **9.1.4** | **Exceptional handling routines** | **Do 01.01.04** | **Fr 02.09.05** | **64%** |
| 9.1.4.1 | Specification | Do 01.01.04 | Fr 23.01.04 | 100% |
| 9.1.4.2 | Design of exceptional handler | Mo 26.01.04 | Fr 30.04.04 | 100% |
| 9.1.4.3 | Implementation and test on TTF | Mo 03.05.04 | Fr 02.09.05 | 55% |
| 9.1.4.4 | **Report on exceptional handler operation** | Fr 02.09.05 | Fr 02.09.05 | 0% |
| **9.2** | **LLRF cost and reliability study** | **Do 01.01.04** | **Fr 07.10.05** | **56%** |
| **9.2.1** | **Cost and reliability study** | **Do 01.01.04** | **Fr 07.10.05** | **56%** |
| 9.2.1.1 | Identify cost drivers of present LLRF | Do 01.01.04 | Fr 27.02.04 | 100% |
| 9.2.1.2 | Develop cost reduction ideas | Mo 01.03.04 | Fr 02.04.04 | 100% |
| 9.2.1.3 | Build prototypes and evaluate | Mo 05.04.04 | Fr 21.01.05 | 95% |
| 9.2.1.4 | Final design of LLRF system | Fr 21.01.05 | Fr 07.10.05 | 0% |
| 9.2.1.5 | **Complete design of LLRF system for reduce cost** | Fr 07.10.05 | Fr 07.10.05 | 0% |
| **9.2.2** | **Radiation damage study** | **Do 01.01.04** | **Mi 28.09.05** | **56%** |
| 9.2.2.1 | Identify critical electronics issues | Do 01.01.04 | Fr 27.02.04 | 100% |
| 9.2.2.2 | Evaluate TESLA radiation | Mo 01.03.04 | Fr 02.04.04 | 100% |
| 9.2.2.3 | Develop tests for components | Mo 05.04.04 | Fr 28.05.04 | 100% |
| 9.2.2.4 | Procure and assembles test set up | Mo 31.05.04 | Fr 23.07.04 | 100% |
| 9.2.2.5 | Data acquisition from radiation tests | Mo 26.07.04 | Fr 29.10.04 | 100% |
| 9.2.2.6 | Analyze results and develop countermeasures | Mo 01.11.04 | Mi 09.02.05 | 50% |
| 9.2.2.7 | Implement countermeasures and verify | Mi 09.02.05 | Mi 28.09.05 | 0% |
| 9.2.2.8 | **Report on radiation damage studies** | Mi 28.09.05 | Mi 28.09.05 | 0% |
| **9.3** | **Hardware** | **Do 01.01.04** | **Mo 06.03.06** | **67%** |
| **9.3.1** | **Multichannel downconvertor** | **Do 01.01.04** | **Mi 26.01.05** | **95%** |
| 9.3.1.1 | Study and compare technologies | Do 01.01.04 | Fr 27.02.04 | 100% |
| 9.3.1.2 | Select optimum PCB design | Mo 01.03.04 | Fr 23.04.04 | 100% |
| 9.3.1.3 | Build prototype and evaluate | Mo 26.04.04 | Fr 02.07.04 | 100% |
| 9.3.1.4 | Finalize multichannel downconverter | Mo 05.07.04 | Fr 03.09.04 | 100% |
| 9.3.1.5 | Determine characteristics | Mo 06.09.04 | Mi 26.01.05 | 85% |
| **9.3.2** | **Third generation RF control** | **Do 01.01.04** | **Di 12.04.05** | **80%** |
| 9.3.2.1 | Integrate system generator with VHDL | Do 01.01.04 | Fr 30.01.04 | 100% |
| 9.3.2.2 | Complete specification | Mo 02.02.04 | Fr 02.04.04 | 100% |
| 9.3.2.3 | Demonstrate simulator | Mo 05.04.04 | Fr 04.06.04 | 100% |
| 9.3.2.4 | Final design of RF electronic board | Mo 07.06.04 | Fr 28.01.05 | 90% |
| 9.3.2.5 | Evaluate performance | Mo 03.01.05 | Di 12.04.05 | 20% |
| **9.3.3** | **Stable frequency distribution** | **Do 01.01.04** | **Mo 06.03.06** | **45%** |
| 9.3.3.1 | Complete specification | Do 01.01.04 | Mi 04.02.04 | 100% |
| 9.3.3.2 | Conceptional design of frequency | Do 05.02.04 | Fr 05.03.04 | 100% |
| 9.3.3.3 | Build prototype and evaluate | Mo 08.03.04 | Fr 06.08.04 | 100% |
| 9.3.3.4 | Final design | Mo 09.08.04 | Fr 22.10.04 | 100% |
| 9.3.3.5 | Procurement and assembly of subsystems | Mo 25.10.04 | Fr 28.01.05 | 70% |
| 9.3.3.6 | Installation and commissioning | Mo 03.01.05 | Mo 21.03.05 | 10% |
| 9.3.3.7 | Performance test with beam | Di 22.03.05 | Mo 06.03.06 | 0% |
| 9.3.3.8 | **Report on new LLRF hardware components** | Mo 06.03.06 | Mo 06.03.06 | 0% |
| **9.4** | **Software** | **Do 01.01.04** | **Fr 11.11.05** | **58%** |
| **9.4.1** | **Data management development** | **Do 01.01.04** | **Fr 16.09.05** | **59%** |
| 9.4.1.1 | Specification | Do 01.01.04 | Fr 30.04.04 | 100% |
| 9.4.1.2 | Conceptional design with DOOCS | Mo 03.05.04 | Fr 09.07.04 | 100% |
| 9.4.1.3 | Prototype | Mo 12.07.04 | Fr 10.09.04 | 100% |
| 9.4.1.4 | User evaluation | Mo 13.09.04 | Fr 05.11.04 | 100% |
| 9.4.1.5 | Finalize design | Mo 08.11.04 | Fr 31.12.04 | 100% |
| 9.4.1.6 | Implementation in TTF | Mo 03.01.05 | Fr 16.09.05 | 0% |
| 9.4.1.7 | **Report on data management developments** | Fr 16.09.05 | Fr 16.09.05 | 0% |
| **9.4.2** | **RF gun control** | **Do 01.01.04** | **Fr 11.11.05** | **58%** |
| 9.4.2.1 | Write specification | Do 01.01.04 | Fr 30.01.04 | 100% |
| 9.4.2.2 | Design of controller | Mo 02.02.04 | Fr 23.04.04 | 100% |
| 9.4.2.3 | Procurement and assembly | Mo 26.04.04 | Fr 27.08.04 | 100% |
| 9.4.2.4 | Installation and test | Mo 30.08.04 | Fr 11.11.05 | 35% |
| 9.4.2.5 | **Report on RF gun control tests** | Fr 11.11.05 | Fr 11.11.05 | 0% |



| N° | Task Name | Anfang | Ende | % schlos |
|---|---|---|---|---|
| **10** | **WP10 CRYOSTAT INTEGRATION TESTS** | **Do 01.01.04** | **Fr 26.10.07** | **19%** |
| 10.1 | Displace CRYHOLAB | Do 01.01.04 | Mi 27.04.05 | 40% |
| **10.2** | **Integration tests in Cryostat** | **Do 28.04.05** | **Fr 26.10.07** | **0%** |
| 10.2.1 | Test 1 | Do 28.04.05 | Mi 11.05.05 | 0% |
| 10.2.2 | Test 2 | Mo 06.06.05 | Fr 17.06.05 | 0% |
| 10.2.3 | Test 3 | Mo 04.07.05 | Fr 15.07.05 | 0% |
| 10.2.4 | Test 4 | Mo 05.09.05 | Fr 16.09.05 | 0% |
| 10.2.5 | Test 5 | Mo 19.09.05 | Fr 30.09.05 | 0% |
| 10.2.6 | **Evaluate experimental results** | Fr 30.09.05 | Fr 30.09.05 | 0% |
| 10.2.7 | Test 1 | Mo 20.02.06 | Fr 03.03.06 | 0% |
| 10.2.8 | Test 2 | Mo 06.03.06 | Fr 17.03.06 | 0% |
| 10.2.9 | Test 3 | Mo 04.09.06 | Fr 15.09.06 | 0% |
| 10.2.10 | Test 4 | Mo 18.09.06 | Fr 29.09.06 | 0% |
| 10.2.11 | Test 5 | Mo 02.10.06 | Fr 13.10.06 | 0% |
| 10.2.12 | **Evaluate experimental results** | Fr 13.10.06 | Fr 13.10.06 | 0% |
| 10.2.13 | Test 1 | Mo 02.04.07 | Fr 13.04.07 | 0% |
| 10.2.14 | Test 2 | Mo 23.04.07 | Fr 04.05.07 | 0% |
| 10.2.15 | Test 3 | Mo 03.09.07 | Fr 14.09.07 | 0% |
| 10.2.16 | Test 4 | Mo 24.09.07 | Fr 05.10.07 | 0% |
| 10.2.17 | Test 5 | Mo 15.10.07 | Fr 26.10.07 | 0% |
| 10.2.18 | **Final evaluation** | Fr 26.10.07 | Fr 26.10.07 | 0% |



| N° | Task Name | Anfang | Ende | % schlos |
|---|---|---|---|---|
| **11** | **WP 11 BEAM DIAGNOSTICS** | **Do 01.01.04** | **Di 18.03.08** | **14%** |
| **11.1** | **Beam position monitor** | **Do 01.01.04** | **Mo 17.12.07** | **9%** |
| 11.1.1 | **Present BPM installed in TTF module** | Mi 30.06.04 | Mi 30.06.04 | 100% |
| 11.1.2 | Cryogenic measurements on BPM | Do 01.07.04 | Do 15.07.04 | 100% |
| 11.1.3 | Beam tests of BPM on TTF | Mi 01.09.04 | Do 27.01.05 | 40% |
| 11.1.4 | Design of BPM Cavity | Do 01.01.04 | Do 03.03.05 | 70% |
| 11.1.5 | Fabrication of BPM Cavity | Fr 04.03.05 | Mo 05.09.05 | 0% |
| 11.1.6 | Development of new hybrid coupler and electronics | Do 01.07.04 | Mo 02.01.06 | 1% |
| 11.1.7 | Design of Digital Signal Processing | Di 30.11.04 | Di 03.01.06 | 1% |
| 11.1.8 | **New BPM ready for Installation** | Di 03.01.06 | Di 03.01.06 | 0% |
| 11.1.9 | Beam Tests with new BPM | Di 03.01.06 | Mo 17.12.07 | 0% |
| 11.1.10 | **Evaluation of BPM operation** | Mo 17.12.07 | Mo 17.12.07 | 0% |
| **11.2** | **Beam Emittance Monitor** | **Do 01.01.04** | **Di 18.03.08** | **21%** |
| 11.2.1 | Slit width simulations | Do 01.01.04 | Mi 31.03.04 | 100% |
| 11.2.2 | Slit design | Do 01.04.04 | Di 18.01.05 | 90% |
| 11.2.3 | Optics simulations | Do 01.04.04 | Do 13.01.05 | 95% |
| 11.2.4 | Optics appropriations | Do 01.07.04 | Di 19.04.05 | 25% |
| 11.2.5 | System assembly and tests | Mo 01.11.04 | Di 19.07.05 | 25% |
| 11.2.6 | Mechanical assembly at TTF | Di 19.07.05 | Fr 19.08.05 | 0% |
| 11.2.7 | Optical assembly at TTF | Fr 19.08.05 | Mo 19.09.05 | 0% |
| 11.2.8 | Integration of controls into TTF | Mo 19.09.05 | Mi 19.10.05 | 0% |
| 11.2.9 | **Ready for beam test in TTF** | Mi 19.10.05 | Mi 19.10.05 | 0% |
| 11.2.10 | Beam tests at TTF | Mi 19.10.05 | Mi 22.03.06 | 0% |
| 11.2.11 | Evaluate first beam test result | Mi 22.03.06 | Mi 22.03.06 | 0% |
| 11.2.12 | Successive measurements | Mi 22.03.06 | Di 18.03.08 | 0% |
| 11.2.13 | **Final evaluation** | Di 18.03.08 | Di 18.03.08 | 0% |