JRA1 SRF partner meeting
Zeuthen Jan. 22, 2004

Paolo Michelato,
INFN Milano LASA

WP2 task and objectives

WP2 (Improved Standard Cavity Fabrication, ISCF) aims at improving the present cavity fabrication technology.

It is based on the operating experience with superconducting cavities in the test linac TTF.

There is an obvious need to modify at least partially the cavity design and the preparation procedures to improve the performance and reliability of the SRF accelerating system.

WP2

WP 2	Improved Standard Cavity Fabrication
Task 2.1	Reliability analysis
	The performance of cavities and auxiliary components in TTF will be analysed. A correlation between obvious degradation of performance (*e.g.*, reduction of the usable accelerating gradient, enhanced dark current) and unusual steps in fabrication and treatment procedures will be investigated
	Deliverables: reports, proposals for design and treatment changes
Task 2.2	Improved component design.
	Based on the findings of task 2.1 design and treatment of components will be revised
	Deliverables: Modified design of components, new methods of cavity treatment, reports, drawings, work plans
Task 2.3	EB welding
	New components will be fabricated for exploring the improved performance
	Deliverables: fabrication of prototypes (cavities, auxiliary components)

SRF- leaders D. Proch, T. Garvey, deputy H. Mais		
Work package/Task	**Work package/ task leader**	**Laboratory**
1 Management and Communication (M&C)	***D. Proch***	DESY
2 Improved Standard Cavity Fabrication (ISCF)	***C. Pagani***	INFN Mi
2.1 Reliability analysis	L. Lilje	DESY
2.2 Improved component design	D. Barni	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***	IN2P3-Orsay
7.1 New proto-types	L. Grandsire	IN2P3-Orsay

+ WP8: See P. Sekalsky talk

WP2 strategy, partially under way

- Analysis of the performances of the TTF cavities
- Analysis of auxiliary components
- Identification of critical components
- Identification of procedures and use for instance check list
- Identification of week components or critical procedures
- Correlation test (i.e. degradation vs. production procedure)
- Identification of non foreseen or unusual steps in components production procedure

How?

Look carefully on the log books

Database use and data archival procedures

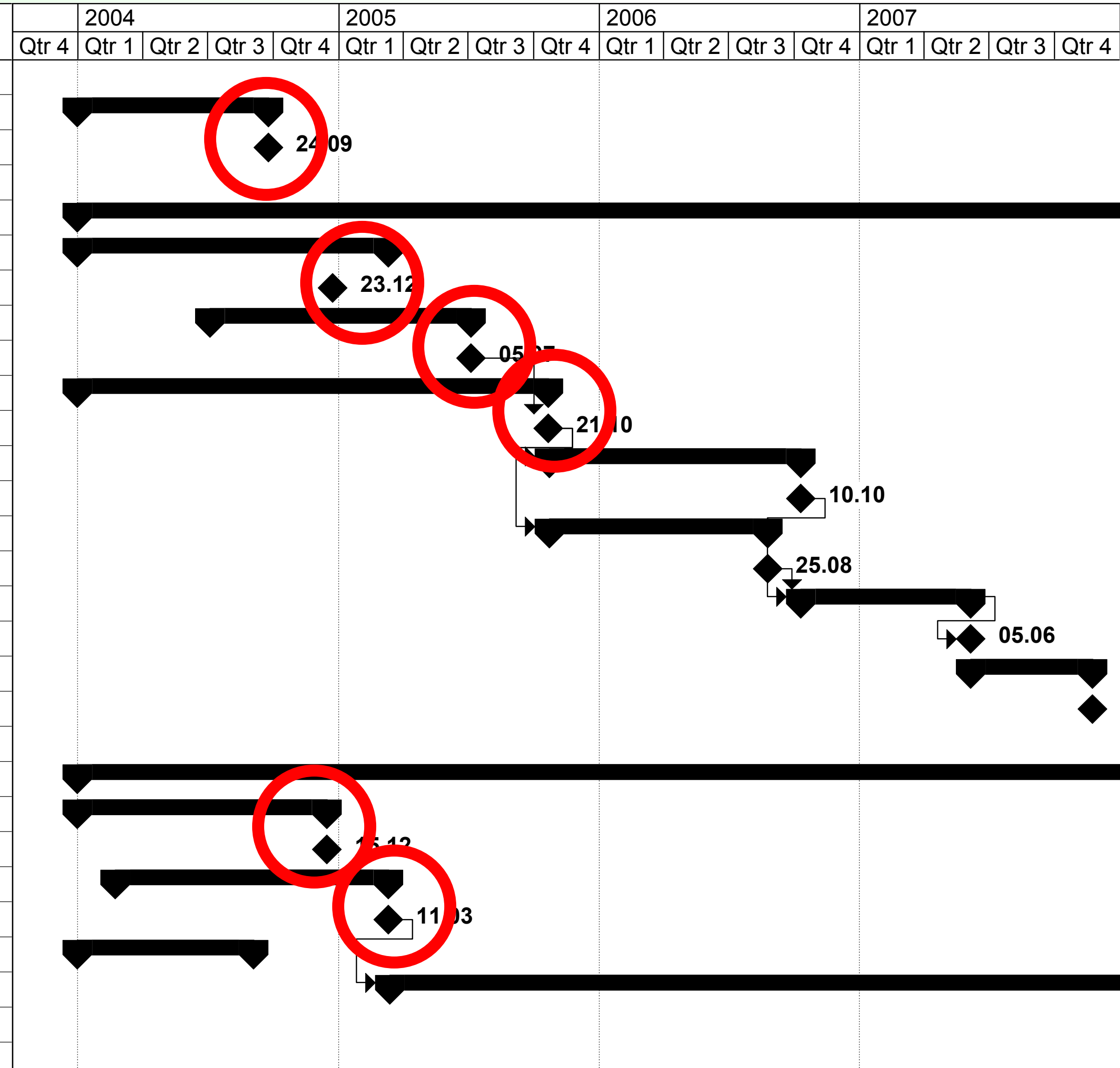
...

→

Improve Standard cavity fabrication with ACCEL AND ZANON

WP2 important dates

ID	Task Name
1	**2. Improved standard cavity fabrication**
2	**2.1 Reliability Analysis**
9	2.1.7 MS Final report on reliability issue
10	
11	**2.2 Improved component design**
12	**2.2.1Documentation retrieving**
20	2.2.1.9 MS Report about new design for components
21	**2.2.1.10 Stiffness optimazation**
25	2.2.1.14 MS Final Report for new components
26	**2.2.2 Review of criticality in welding procedures**
31	2.2.2.5 MS Report about welding parameters
32	**2.2.3 Finalise new component design**
34	2.2.3.2 MS New components design finished
35	**2.2.4 Finalise new cavity design**
37	2.2.4.2 MS New cavity design finished
38	**2.2.5 New design of complete cavity**
40	2.2.5.2 MS New complete cavity design finished
41	**2.2.6 Fabricate cavity of new design**
43	2.2.6.2 MS Cavity of new design finished
44	
45	**2.3 EB welding**
46	**2.3.1 Design tooling**
52	2.3.1.6 MS Tools design finished
53	**2.3.2 Tools production**
59	2.3.2.6 MS Tools fabrication finished
60	**2.3.3 Welding**
63	**2.3.3.3 MS start production welding**
66	
67	



As an example: cold flange development
Different strategies in different laboratories

ITEMS

Flange Material
- NbTi55
- Stainless Stell 316L

Gasket Material
- Copper
- Aluminium
- Elicoflex

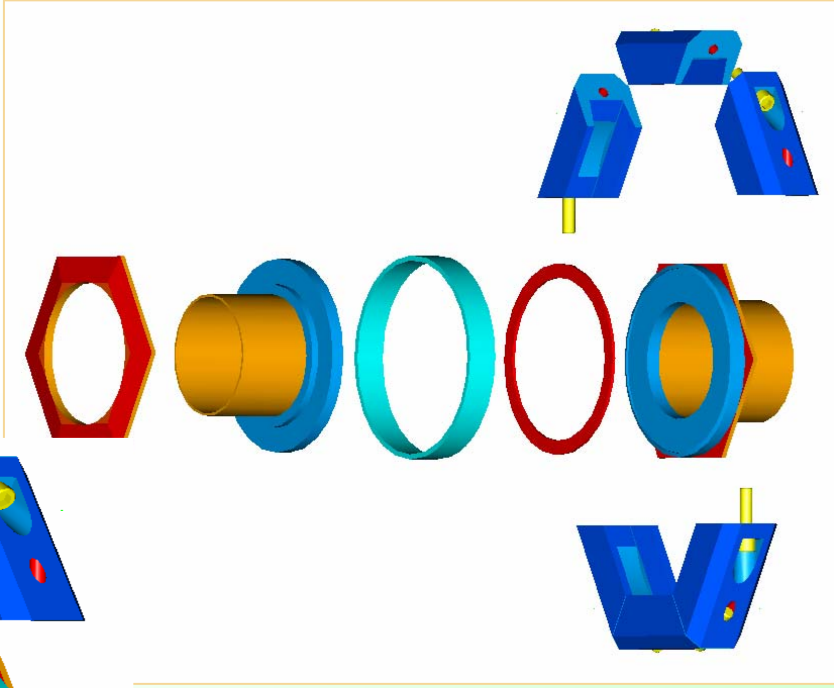
Pipe connection
- Welding
  - EB
  - Friction, explosive bonded, …
- Brazing
- HIP

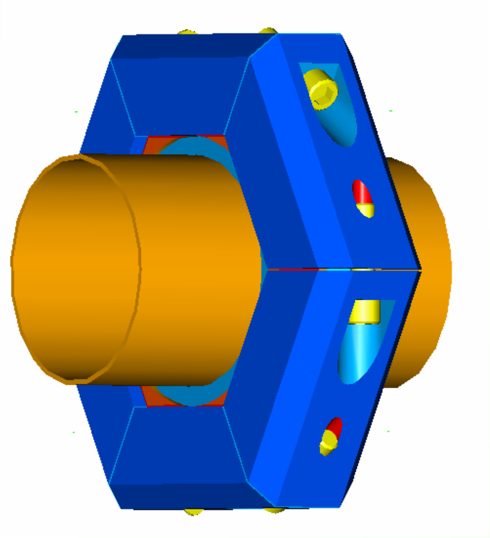
Sealing
- Bolts and Nuts
- Clamp
- Chain

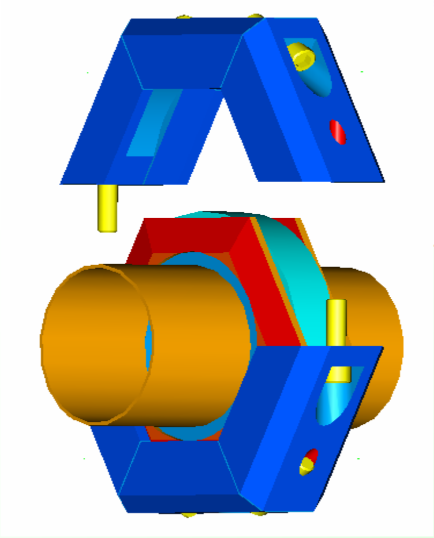
Lab	TTF II	Saclay	KEK	SNS
Flange material	NbTi55	SS CF	SS	NbTi55
Gasket	Al diam shape	Cu	Al square	Al diam shape
Pipe connection	EB	Brazing (Au/Ag)	HIP (Cu interlayer)	EB
Sealing	Cu ni sil bolts	Bolts and nuts	Bolts and nuts	Special clamps
BCP comp	Yes	Yes	yes	Yes
EP comp	yes	yes	yes	yes
1400°C	yes	no	no	Yes (?)
…				

Development of components for large scale and high reliability cryomodule production
e.g.: Cold Joint SS NbTi flanges

- Study
- Development
- Optical microscope inspection
- Prototype production
- Warm and cold test (4 and 2K)
- Leak test







Courtesy of Jlab

WP8

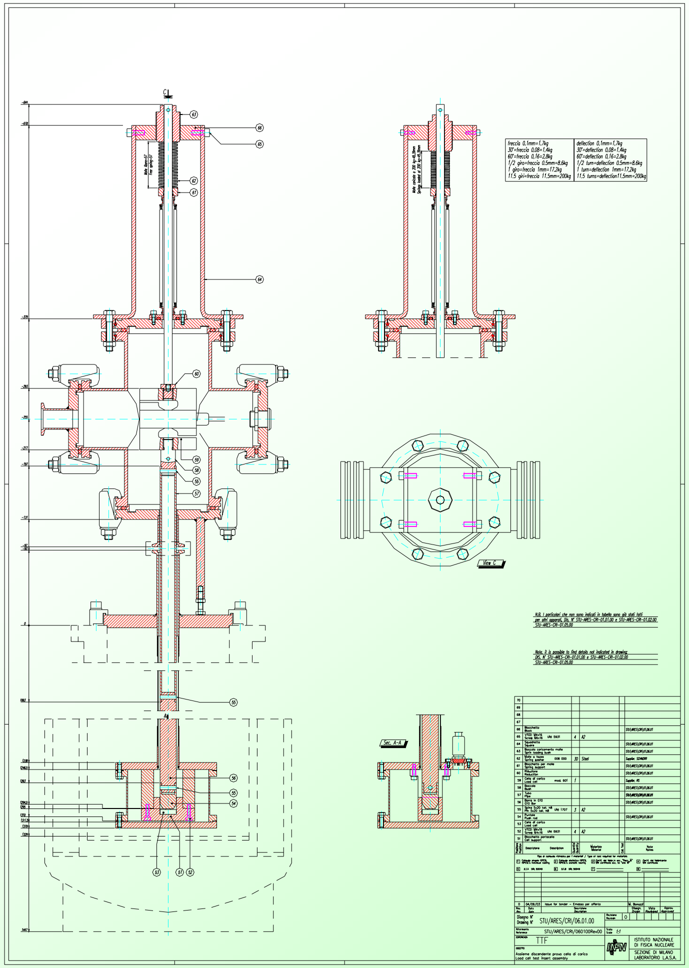
INFN Milano is also involved in WP8: See P. Sekalsky talk

WP8 (Tuners) The development of active tuner systems is imperative for operation of SC cavities at high gradient. Four of the participating laboratories are investigating innovative tuner systems as well as developing the electronic drive circuitry necessary for them. These tuners are the deliverables of this WP. Especially innovative will be the development of tuners based on piezo-electric and magneto-strictive effects. Tuners are required to counteract the so-called Lorentz de-tuning effect when the cavities are pulsed at high field so as to maintain the phase and amplitude constant during the RF pulse, whilst minimising additional RF power needed for field control. We aim to develop tuners capable of correcting 1 kHz of de-tune so allowing the cavities to operate stably at 35 MV/m. This should be compared with existing tuners on TTF which correct for fields of ~ 15 – 20 MV/m. Long life-time is also a major issue and we aim to develop tuners allowing for 20 years of operation.

Characterization of the load cell

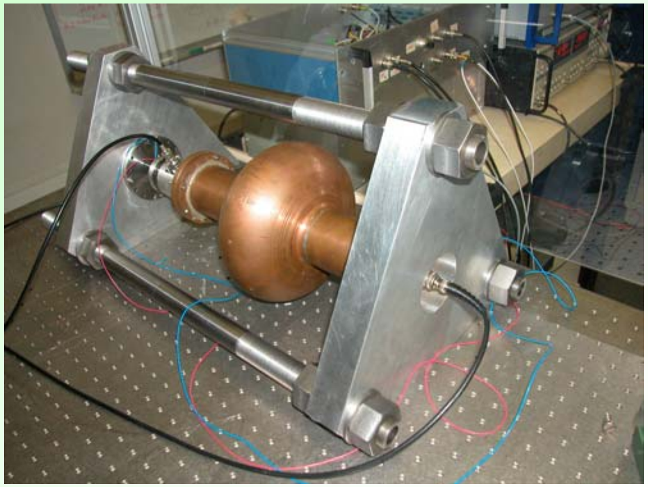
A new insert was designed to host different load cells and the load generating device. Our goal is the characterization of the sensor at 4 K up to 2kN.

A load cell under test – from Burster

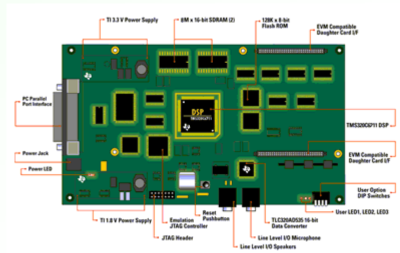


- The button on the cell is **pushed** by stainless steel rod, 20 mm diameter.
- The loading force is **generated** by a screwing device provided with washer springs at the top of the insert.
- The loading force is **measured** by a calibrated load cell placed in the cross junction, working at room temperature.

Microphonics feedback control loop facility

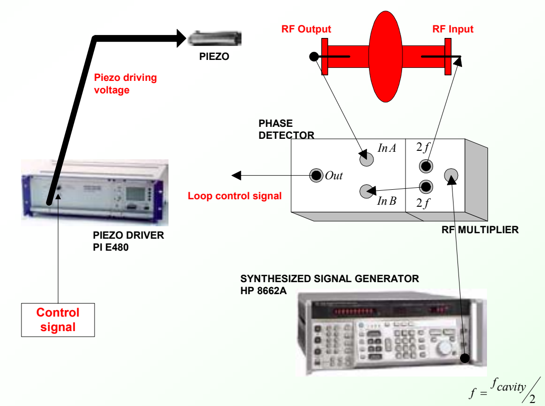


The single cell cavity and its high-stiffness environment, hosting the piezoelectric actuator

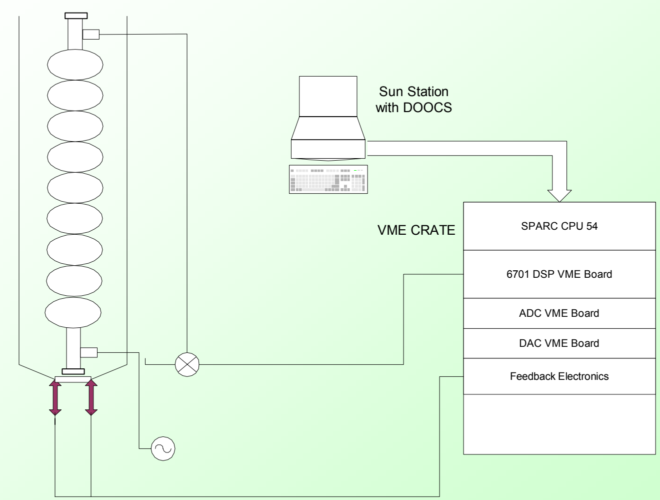


C6711 DSP board for digital filtering

Control electronics

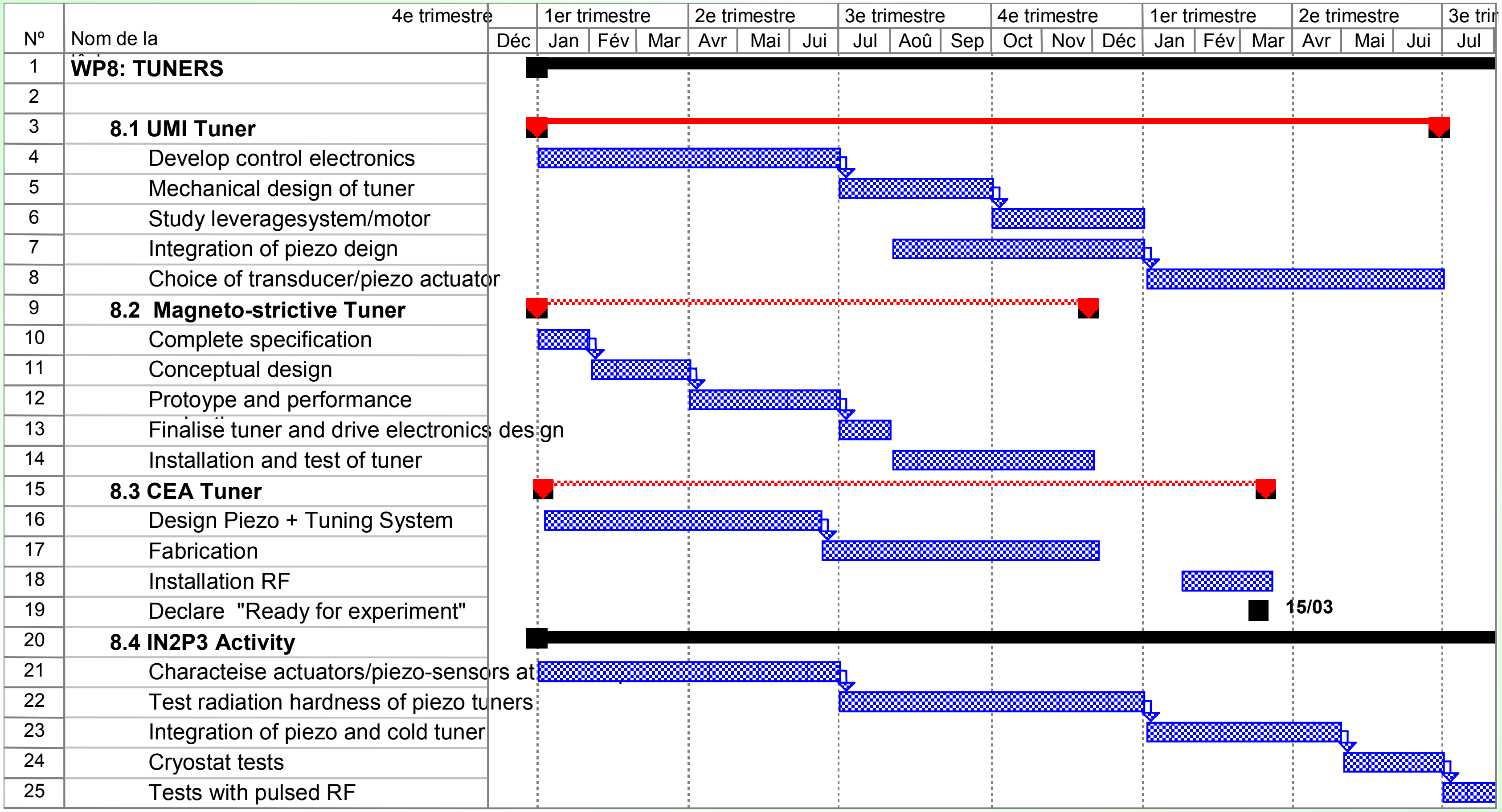


Our Goal



A feedback loop will be implemented for the compensation of microphonics

WP8


4e trimestre
1er trimestre
2e trimestre
3e trimestre
4e trimestre
1er trimestre
2e trimestre
Nº
Nom de la
Déc Jan Fév Mar Avr Mai Jui Jul Aoû Sep Oct Nov Déc Jan Fév Mar Avr Mai Jui Jul
1 WP8: TUNERS
2
3 8.1 UMI Tuner
4 Develop control electronics
5 Mechanical design of tuner
6 Study leveragesystem/motor
7 Integration of piezo deign
8 Choice of transducer/piezo actuator
9 8.2 Magneto-strictive Tuner
10 Complete specification
11 Conceptual design
12 Protoype and performance
13 Finalise tuner and drive electronics design
14 Installation and test of tuner
15 8.3 CEA Tuner
16 Design Piezo + Tuning System
17 Fabrication
18 Installation RF
19 Declare "Ready for experiment"
15/03
20 8.4 IN2P3 Activity
21 Characteise actuators/piezo-sensors at
22 Test radiation hardness of piezo tuners
23 Integration of piezo and cold tuner
24 Cryostat tests
25 Tests with pulsed RF

INFN-Mi

LASA is involved in the design of superconducting linacs (for example for a high intensity cw proton linac for waste transmutation) and in manufacturing components. Single cell and five-cell, superconducting, low beta elliptical cavities (704 MHz, beta 0.5) have been designed and produced. They will be tested in a vertical test facility after high pressure rinsing (HPR) in a class 10-100 clean room.

The Laboratory has designed and upgraded the TTF cryostats, which have been manufactured under LASA's supervision in industry and have been assembled at DESY with the collaboration of DESY experts.

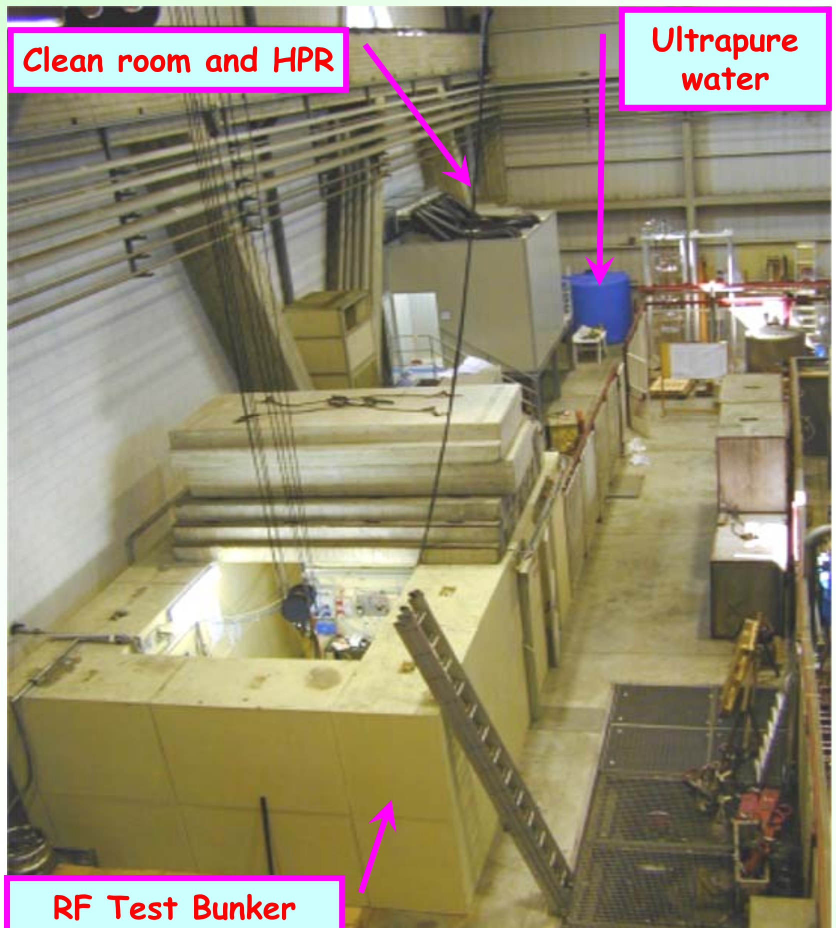
Large expertise also exists in topics relevant to JRA PHIN . For example, photo cathodes are routinely produced at LASA and new materials and analyzing techniques are studied for an improved performance of the cathode production.

Infrastructures available at LASA

- Class 10-100 Clean Room
- Ultra Pure Water and HPR (High Pressure Rinsing)
- Cryostats and RF for cold tests
  - RF tests possible from 450-820 MHz (1.3 GHz soon)
  - Tests limited by helium and technical support
- Instrumentation

Cavity test infrastructure in Milano

- Clean Room, HPR station & vertical cryostat
  - –HPR station in a class 100 clean room
  - –RF test bunker with a vertical cryostat



HPR mechanics and filter before mounting in the clean room

Field Flatness tooling

Z502 is on the tool for the field flatness

- (before end of 2003)
- Small fix, remachine flanges