TESLA 1993-35

TESLA - COLLABORATION

TTF Collaboration Meeting
June 1 - 2, 1993
DESY, Hamburg

Editor: H. Edwards

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TTF Collaboration Meeting - Final Report
June 1 - 2, 1993, DESY, Hamburg

Contents

TTF AGENDA, JUNE 1-2, 1993
HAMBURG

Session I. 10:00-15:00, (lunch break at 1300) Rm 4b (in Lab. 1b)
Welcome (M.Tigner)
Reports from the Labs. status and schedule

a) TTF Infrastructure (DESY)
   1. Chemistry, etc. (S.Wolff) (10)
   2. Cryogenics, (B.Petersen) (10)
   3. RF Power, (A.Gamp) (10)

b) Status of first two industrial cavities (DESY) (H.Kaiser) (5)
c) TTF cavity design and tender (DESY), (H.Kaiser) (15)
d) TTF module cryostat design and tender (Frascati),(S.Tazzari) (15)
e) Horizontal Test Cryostat and Cold Tuner (Saclay), (J.Gastebois) (15)
f) Vertical Cryostat Collection Box, Heater (FNAL) (T.Peterson) (15)
g) RF Insert, Power Coupler, Modulator (FNAL) (H.Edwards) (15)
h) Power Coupler (DESY) (B.Dwersteg) (10)
i) HPP coupler results (D.Proch) (10)
j) Beam Position Monitor(TU Berlin) (R.Lorenz) (10)
k) HOM Coupler (DESY) (J.Sekutowicz) (10)
l) HOM Coupler (Saclay) (A.Mosnier) (10)
m) Injector w. Saclay Meeting Report (INP, LAL, Saclay) (T.Garvey)(15)
n) TTF Revised Layout (DESY) (M.Leenen) (15)
o) **Activities at Frankfurt (TBA) (10)**
p) Other Lab Reports as Desired (10 ea.)

Session II. TTF Miniworkshop Begins 15:00

15:00-16:00 Open Questions from Saclay Injector Meeting (T.Garvey) (list questions and interface information needed from DESY and report on vibration experiments w. MACSE) (Room. 4b)

16:00-18:30 A. Experimental Program for Injector and Linac (B.Aune, H.Edwards) Room 292 (1d)

a) Treatment and Test of 1st two cavities (Wed. AM)
b) RF control tests at MACSE
c) new thoughts about beam experiments
d) Review current instrumentation list and discuss procedure for developing the complete list and detailed specifications
e) Implications of experimental program for controls
f) Report on Emittance 93 (A.Mosnier)

B. Cryogenic Discussion Group concerning the cryomodule details and outfitting of TTF and Injector and Control needs thereof (D. Trines) Room 4b

C. Controls Discussion Group (M.Clausen/K.Rehlich) (1d Open Area)
Meet with Experimental Program and Cryogenics groups as needed.

D. Cavity Discussion Group (D.Proch) Room 3 conference area
Discussion of cavity and coupler design issues.

19:00 June 1, Refreshments

09:00-12:30, June 2, continue TTF Miniworkshop Groups A, B and C
(Same room assignments)
12:30-13:30 Lunch

<u>Session III</u> 13:30 (4b) (H.Edwards)
Summary Group A (B.Aune/H.Edwards) (45)
Summary Group B (D. Trines) (20)
Summary Group C (M.Clausen/K.Rehlich) (20)
Summary Group D (D.Proch) (20)
Summary Discussion concerning TTF layout (M.Leenen) (20)
Summary Discussion on the Schedule (M.Tigner) (15)

1993-1994 Schedule of TTF Meetings (B.H.Wiik) (15)

Closing Remarks (B.H. Wiik)

M. Leenen 6.7.1993

TESLA-Test-Facility Meetings

1993	13. September		DESY
	14./15. December		DESY
1994	7. March	)	
	7./8. June	)	tentative
	6./7. September	)	
	21./22. November	)	

TESLA 500 Meetings

1993	14./15./16. September		DESY
	(LC '93 13.-21. October (SLAC))		
1994	8./9./10. March	}	tentative

12.Mai 1993
Borchardt
- HERAP -

TESLA - Milestones		
1	Delivery of 2 Nb cavities	1. 8.93
2	Release cavity production 1-10	1.10.93
3	1st cavity rf test	1.11.93
4	1st cavity HPP test	1. 2.94
5	Treatment,test cavities 1-10	1. 3.94
6	1st cavity horizontal test	1. 5.94
7	1st module assembly	1.11.94
8	Test module 1 without beam	1. 4.95
9	Release cavity production 11-40	1. 6.95
10	Release module cryo. product.2-4	1. 6.95
11	Ready to test mod.1 & injector I	1. 8.95
12	Treatment,test cavities 11-40	1.12.95
13	Assembly module 2-4	1. 5.96
14	Test TTF LINAC	1. 4.97

TTF LINAC
PROVISIONAL PARAMETER LIST
VERSION 31.05.93MT
corrections requested h edwards

GENERAL
Energy 480 MeV nominal at 15 MV/m average gradient
Four Cryomodules at 12.2m ea, 48.8 m total length
Beam Height from floor 1.23 m
Bunch Energy Spread # (10-3)
Energy Stability # (0.5 x10-2)
Beam Current 8 mA in macro pulse, 0.064 mA average
Beam Pulse Length 800 micro sec.
Repetition Rate 10 Hz
Bunch Length 1mm rms
Emittance 45 mm mrad, normalized, max.
Acceleration Frequency, fo= (1300.00 MHz)

INJECTOR(Stage I)
Capture Cavity Freq. (1300.00 MHz)
Energy 14.5 MeV (nom)
Bunch Length 1mm rms
Beam Current 8 mA in macropulse
Repetition Rate 10 Hz
Beam Pulse Length 800 micro sec.
Emittance 10 mm mrad, normalized, nominal
Static Heat Load 5 W
Energy Spread # 1%
Beam Position Jitter # 50 micrometer
Microbunch Structure ‖ 6 x 108 e/bun. at 73 MHz (or 1 MHz)
Gun Voltage 250 kV nominal
Subharmonic Buncher(SHB) Freq. fo/6, 216.667 MHz
Length (rear wall to 1st iris cryomodule 1) 12 m (nom)

INJECTOR(Stage II)
nominally same as St. I but
Microbunch Structure 5 x 1010 e/bun. at 1 MHz

INJECTOR RF SYSTEM
RF Power at Capture Cavity Input (120 kW) nominal
RF Pulse Length at fo 1300 micro sec.
Power Pulse Flatness ▒ (1%)
RF Power Regulation ▒ (0.5%)
__ kW nom. at fo/6 at prebuncher input
RF Pulse Length at fo/6 1.4 ms

CRYOMODULE
Length 12.2 m
Eight 9 Cell Cavities each
R/Q, 103 ohm per 9 cells
klong, 10 V/pC per 9 cells
ktrans, 20 V/pC/m per 9 cells
Unloaded Q, 3 x 109
Loaded Q for beam power match,(3 x 106), [@ 25MV/m gradient]

Peak Input power (120) kW beam, (1000) kW HPP[per 9 cells]
Tuning Range 600 kHz
Operating Temp. 1.8-2 K
Static Losses at 2 K, 0.4 W/m [design goal]
Static Losses 15 W/module at 4.5 K, 55 W/mod. at 70 K
Active Losses at 2K, 1.1 W/m average [10 Hz, 15 MV/m, beam off]
Active Losses at 2K, 1.6 W/m average* [10 Hz, 15 MV/m, beam on
at 5 x 1010 e/ bunch, 800 bunches/pulse]
Active Losses at 70K HOM absorber, ‡4.3 W/m avg.á [40 W/
absorber] for full beam at 5 x 1010 e per bunch
F and D Quadrupoles, 3T max integrated gradient
Two pair corr. dipoles, integ. str. 10-3 Tm each
V and H Beam Position Monitor 15 micrometer resolution
HOM Absorber- in line stainless steel at 70K nom.
Cavity Axis Alignment 0.5 mm rms
Quadrupole Axis Alignment 0.1 mm rms
Quadrupole Vibration 0.1 micrometer rms
Axial Alignments, (1mm)

ACCELERATOR RF SYSTEM
Two klystron/modulator units
Autotune system keeps cavity in 16 Hz band
RF Power at Cryomodule Input (4500 kW) nominal
RF Pulse Length at fo 1300 micro sec.
Power Pulse Flatness ± (1%)
Amplitude Feedback keeps module voltage ± (0.7%)

* Estimated assming 10% of total HOM power deposited at 2K.
á Estimated assuming remaining 90% HOM at 70K

SUMMARY OF INJECTOR DISCUSSIONS (TTF meeting, Hamburg, June 1/2 93)

A summary of the discussions from the injector meeting held at Saclay on the 28th and 29th April was presented. This meeting was divided into three main topics;
1. Choice of injector approach (chopper vs. sub-harmonic)
2. Open questions on Capture cryostat
3. Discussions on controls issues

Capture cryostat and controls issues were mainly covered in the CRYOGENICS and CONTROLS discussion groups respectively and will be summarised there. Consequently, we report here on remaining injector issues.

SIMULATION STUDIES of the INJECTOR
At the Saclay meeting a list of beam parameters, calculated with PARMELA, for the sub-harmonic buncher approach was presented. It was immediately clear that the expected performance was inferior to that which one could expect from the 1.3 GHz chopper approach (particularly with respect to the emittance). Nevertheless, the SHB approach was adopted in view of its ability to provide variable pulse repetition frequency operation with the consequent hope of being able to test beam break up issues.

Since the saclay meeting further calculations had been performed in which the mean current had been reduced to 5.4 mA (sufficient to test full beam loading at 15 MV/m) and in which the repetition frequency had been increased from 72.2 MHz to 216.7 Mhz. In this approach the total charge is now spread over three times as many bunches greatly reducing detrimentalspace-charge effects. The output parameters are much more attractive. The two possible operating parameters are summarised below;

e's/bunch	1.0e9	1.6e8
Rep freq (MHz)	72.2	216.7
average current (mA)	12	5.4
rms phase-width(deg.)	1.67	0.46
total phase-width(deg.)	9.4	2.2
rms energy spread(MeV)	0.23	0.07
total energy spread(MeV)	1.2	0.32
Energy	14.4	14.6
sigma-e / E	1.6%	0.5%
rms norm. emitt. (mm-mrad)	43	3.7

The second set of parameters have emittance, phase-width and energy spread close to that of the chopper approach and are perfectly acceptable for TTF requirements.

ACTION ITEMS from the SACLAY MEETING

At the Saclay meeting it was agrred that the LAL group would make a proposal for a timing scheme for TTF operation and a make an initial design of the low level RF distriburion system. In addition, it was suggested that a study of the required diagnostics and their associated accuracies and sensitivities should be carried out. The timing, RF distribution scheme and proposed diagnostics were presented and received some critical review within the 'Experiments' group.
Briefly, the conclusions were as follows;
(i) The low level RF distribution schemes had the approval of A. Gamp with perhaps minor modifications in the feedback loops to the accelerating cavities being required.
(ii) It was agreed that the FNAL people should study the timing lay-out before it is finally approved.
(iii) The list of suggested diagnostics was found to be largely that required to measure all the parameters of interest at all the locations of interest. Some minor modifications, based on experience at the MACSE and S-DALINAC linacs were suggested and have since been incorporated into the diagnostic layout. The final diagnostic proposal will be distributed as a TESLA note in order to generate further comments or suggestions.

MISCELLANEOUS

In addition to the above topics some remarks were made concerning work in progress on the calculation of higher-order modes of the SHB cavity, measurements of beam current on an existing Saclay (ALS) gun (which is planned for use in the injector) and E-GUN calculations which are being made determine the final gun geometry to be adopted.

Space / Infrastructure

The latest injector layout shows an overall length of 15 m as this is what was thought to be available at the time of the Saclay meeting. The length actually available has to be decided in conjunction with the reqiurements of the full linac. A request for additional 'transveres' rather than 'longitudinal' space was left as an issue to be discussed.
It was agreed that DESY would provide LAL with a list of DESY 'standards' concerning, connections, adaptors, oil regulations, interlocks, solder materials, hose gauges etc.

TTF MEETING APRIL 28-29 1993 AT SACLAY

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1 - GENERAL SURVEY

INTRODUCTION

The IPN/LAL/SACLAY collaboration propose to construct the injector for TTF according to the attached schematic. It is forseen to make the first tests of the injector at Saclay and to aim at delivery of the injector to DESY early in 1996.

The cavity and couplers must be supplied during the first quarter of 1994.
All the components will be mounted into the cryostat in a clean room at Saclay (end 94).
The tests with beam in the MACSE tunnel are planned starting early 1995. (see attached schedule).

CAPTURE CAVITY

Two options were discussed :

a) The capture cavity (one of the 10 first cavities) will be supplied by DESY after commissioning (mechanical, dimensions, frequency, field level ...).Chemical treatment and test in a vertical cryostat at Saclay, heat treatment and final decision on mounting in the cryostat if $E_{acc} \geq 10$ MeV/m.

Welding of the helium tank and new test in vertical cryostat (eventually high power RF processing).

b) DESY proposes to prepare and test the cavity in vertical and horizontal cryostats and to send it to Saclay closed and equipped with its helium tank. The beam tubes could be supplied by DESY, or sent to DESY by ORSAY, and mounted at DESY.

MODULATOR AND KLYSTRON

DESY to furnish 350 kW klystron and associated RF circuitry (including circulator) for the capture cavity. The exact inventory of the RF circuitry to be furnished by DESY will be known in June. Saclay will fabricate the modulator.

COUPLERS

- HOM coupler : the choice of the final design (DESY or Saclay) will be adopted in 3 months.
- Main coupler will be supplied by Fermilab.

TTF BUILDING AND SPACE REQUIREMENTS

- A drawing of the TTF injector was presented by LAL with a total length of ~ 12 m. The HV insulation of the gun assembly could require + 2 m.
- The drawing of the hall 3 at DESY presented by B. PETERSEN allows ~ 15 m overall length available for the injector.
- The transfer line between the feed box and the capture cryostat is not necessarily level with the helium bath. It is possible to install the analysis line on the same side (left side with respect to the beam axis) as the feed box. The maximum height of the components of the beam line must be defined.
- Height of the beam : 1.23 m. This proposal gives compatibility with the MACSE beam line at Saclay.

BEAM ANALYSING LINE

For the tests forseen at Saclay existing equipment will be used for beam analysis. Work on the analysis line to be furnished to DESY will begin in 1995.

PUMPS/COOLING WATER

DESY will provide turbo-molecular pumps for injector in Hamburg. However ionic pumps are considered suitable for tests at Saclay if they are properly mounted. Saclay will perform tests on turbo pumps to assess vibration effects. Valves and gauges to be furnished by Saclay.
All water systems should be able to handle 16 bars inlet pressure.

LOW LEVEL RF - TIMING

LAL will begin work on injector timing system i.e. defining master oscillator frequency and specification of the required frequency multipliers, amplifiers etc needed to provide signals to cavities and pulses to gun. A first draft of the low level RF distribution system will be drawn up.

INJECTOR SCHEMATIC (Figure 3)

The following changes to the proposed layout of the injector were agreed :

i) beam analysis line to be placed towards outside wall of hall,
ii) addition of view-screen at exit of gun column,
iii) reversal of collimator and view-screen before capture cavity,
iv) beam loss monitors (x-ray diodes) to be installed for tuning low power beam. Associated interlock to inhibit gun pulse,
v) a "no-go" high voltage area to be defined around gun.

MISCELLANEOUS

- Saclay will prepare a list of available hardware for use on the high-energy beam-line.
- There may be a possibility of using a Cornell diagnostic for coherent synchrotron radiation to measure the bunch length.
- LAL will prepare a list of all diagnostic instrumentation required for injector with associated resolution and sensivity.
- Check on HOM'S of sub-harmonic buncher.

Simulation studies of the Injector

T. Garvey gave a short presentation on the status of the PARMELA calculations for the sub-harmonic buncher approach to the injector.

For the following input parameters;

Gun voltage	250 kV
current pulse	400 mA during 0.77 ns
Horizontal / vertical beam size	2.5 mm
Horizontal / vertical emittance	15 mm-mrad
SHB frequency	216.7 MHz
SHB gap voltage	53.2 kV
capture cavity field	30 MV/m

We obtain the following output parameters;

Total phase extension	9.4°
RMS phase-width	1.67° (1 mm)
Total energy spread	1.2 MeV
RMS energy spread	0.23 MeV
Mean energy	14.4 MeV
fractional energy spread	1.6%
Particle transmission	100%
normalised RMS emittance	45 mm-mrad (x-plane) - 43 mm-mrad (y-plane)

In the discussion which followed it was agreed that, for the experimental programme forseen on TTF, the parameters were acceptable although the emittance should not be larger. It was pointed out that the input current in the code is three times that required and so the space-charge is larger than forseen. Further runs with reduced space-charge and employing improved magnetic focusing may help to improve the calculated emittance. A shematic of the proposed injector layout was distributed (figure 3).

2. CRYOCAP DESIGN

S. BUHLER presents a first conceptual design of the cryostat (→ Fig. 1). The design and the open questions of his memorandum (20.4.93) are discussed as follows:

VACUUM TANK

General agreement on the basic design of the cryostat showing a horizontal vacuum tank which integrates

- a 80 K radiation shield
- two cryogenic valves located on the opposite end of the main coupler and permanently connected to a vertical feed reservoir
- a cryogenic feed thru and vacuum barrier
- two horizontal pumping ports (Pneurop NW 100) on <u>each</u> side of the vessel): one for actual connection with a gate valve, the other for convenience
- connections for vaccum gauges, safety valve, electric feed thru for measurements (→ avoid such items on the top of the vessel, keep it clear for survey marks for alignement purposes)

- Autonomous vacuum for CRYOCAP, produced dynamically with a turbomolecular pump during start-up; with cryopumping from the helium tank under steady-state conditions (the turbomolecular pump then is stopped in order to avoid transmission of vibrations).

80 K RADIATION SHIELD

- Active He cooling of the cylindrical part of the copper radiation shield that fits with a relatively small clearance into the vacuum tank. Carefully baffled openings for good vacuum communication are provided in the medium plane.

- Two removable end caps are conduction cooled from the central part

- The radiation shield acts also as a heat sink for the 80 K thermal intercepts to couplers and beam tubes

- The proposed suspension system of the LHe tank (2 x 4 glass fiber rods for transverse position + fixation point for longitudinal position) differs from the cryomodule design, but no problems should arrise with the standard He tank, since no permanent fixtures are provided anyway on the tank itself and the proposed fixtures may be clamped easily onto the vessel.

4 K HEAT INTERCEPTS

Basically there is no need for a 4 K radiation shield, since superinsulation is widely used and all access ports thru the 80 K radiation shield should be carefully masked

However, since there is a need for thermal intercepts at 4 K on the couplers (heat loads to be defined: TBD) and, presumably (TBD) on both beam tubes, the 4.5 K line, conveniently arranged, will support suitable copper braids for this purpose.

Two particular problems have to be thorougly examined:

- Estimate of the temperature profile on the beam tube: conduction and radiation thru successively the stainless steel and Nb sections (→ IPN)
- Necessity, definition and process management of a 4.5 cold spot on each beam tube in order to avoid hydrogen contamination of the cavity (→ DESY).

HELIUM TANK

The final design of the LHe tank and its associated tuning system will be available within few weeks (→ DESY, Saclay, Italy)

For the moment a recent and complete set of assembly drawings from the cryomodule design (INFN, Italy) is dispatched.

Cavity and LHe tank for CRYOCAP should be as standard as possible. The associated beam tubes might be designed individually (MACSE design ?), but the consequences for the cavity supply should be examined.

The vertical feed reservoir is connected with a standard flange (Ø 100) to the LHe tank. A second connection (~ Ø 12), still to provide on the lowest part of the vessel, will ensure correct LHe level measuring. S.BUHLER suggests that such communication might also prove useful for each cavity in a first experimental cryomodule set-up (→ Fig. 2).

SUSPENSION SYSTEM

The proposed suspension system (2 x 4 glass fiber rods + 1 longitudinal fixation point) differs from the standard cryomodule design, but its adaption seems possible with a splitted ring clamped tightly on the bare LHe tank. For more details S.BUHLER will directely contact Mr. TAZZARI.

A basic alignement of the cavity axis is done in a early state under atmospheric conditions by adjustment of the GF-rods. There is no need for adjusting the rods under cold conditions, but the final alignement asks for slight displacements of the entire cryostat; so provide some flexibility in the transfer line.

COUPLERS

S. BUHLER would appreciate a thermal budget estimate for the heat influxes at the several temperature levels for main coupler and HOM.

CRYOGENIC COMPONENTS

CRYOGENIC VALVES

DESY has no preference for a particular supplier (they are already using WEKA and KAEMMER products). Desired equipment:

- pneumatic actuator (3.5 bar air pressure) and positioner
- 4/20 mA interface and limit switches for process control
- Direct reading of the opening position, no potentiometric transmission
- Preliminary flow calibration before installation might be considered

TEMPERATUR SENSORS

The equipped sensors (RIVAC type as proposed by U.KNOPF) will be supplied from DESY with electronics and interface to the control system

Type of connectors and feed-thru to be installed in the cryostat are still TBD (JAEGER, BENDIX ?)

LHE LEVEL CONTROL

Continuous level meter with superconducting sensors: ~ 700 Ω/m, 70 mA (50 mA in France) are available from DESY or from ARTEC (France). Suitable probe Ø for superfluid LHe : 6 mm. Preliminary tests in a glass cryostat are suggested.

Installation of a second sensor (spare) is advisable, as of 2 carbon resistors at a given position for in situ calibration

PRESSURE CONTROL

T.JUNQUERA recommends MKS Baratron equipment (sensor, control unit and associated valve) in service in Orsay which achieves temperature stability at 1,8 K (steady state conditions) better than ∓ 1 mK

VACUUM EQUIPMENT

Vacuum pumps will be supplied by DESY in final installation

Vaccum gauges and valves are supplied with the cryostat

FEED BOX AND TRANSFER LINE

Feed box and transfer line are presently in project at FERMILAB, but no design is yet available.

General agreement on a separate vacuum for CRYOCAP, but a common vacuum for transfer line and feed box

Cryogenic connections CRYOCAP/transfer line should all be welded in a final assembly (TBD: suitable procedure and space requirements) . If removable connections are used for preliminary tests in France then provide sufficient tube length to cut them off.

Provide and define ($\mp$ x or y mm) flexibility of the transfer line for final positioning of CRYOCAP

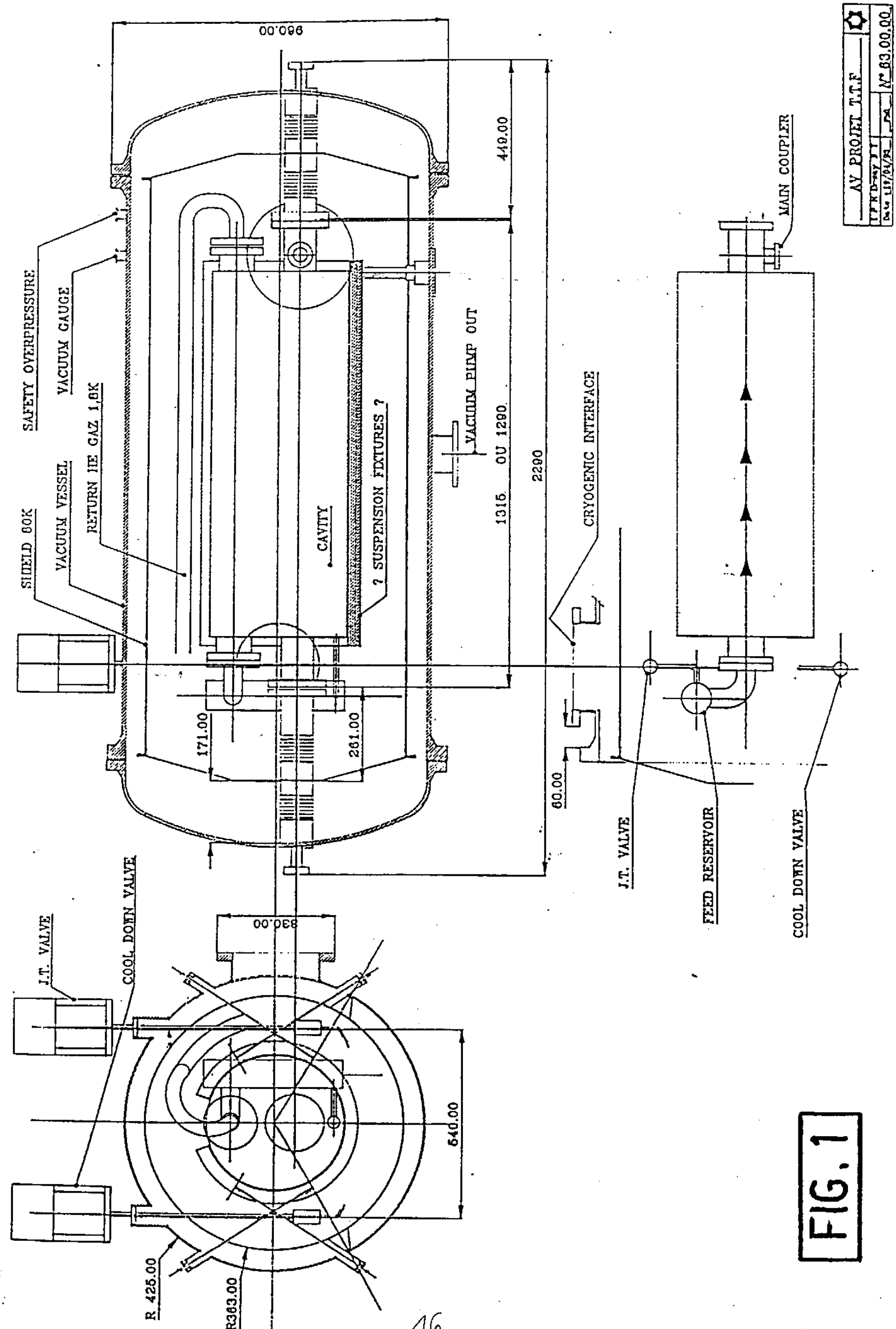

AV PROJET T.T.F
N° 63.00.00
980.00
440.00
1316 OU 1290
2290
171.00
261.00
60.00
830.00
540.00
R 425.00
R363.00
SAFETY OVERPRESSURE
VACUUM GAUGE
SHIELD 80K
VACUUM VESSEL
RETURN HE GAZ 1,8K
CAVITY
? SUSPENSION FIXTURES ?
VACUUM PUMP OUT
CRYOGENIC INTERFACE
MAIN COUPLER
J.T. VALVE
FEED RESERVOIR
COOL DOWN VALVE
J.T. VALVE
COOL DOWN VALVE

FIG. 1

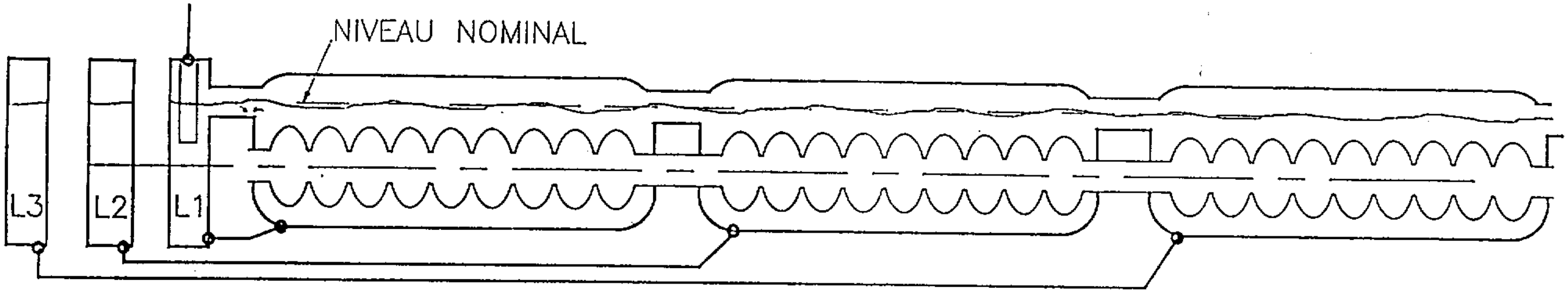


FIG. 2 : Individual level gauges for each cavity.

If the overflow LHe feed is interrupted, LHe level will fall below nominal and thus communication between the different cavities will be interrupted. Further decrease of the LHe level of each cavity will folllow its own pace and thus allows location of a faulty device by calorimetric considerations from the individual level gauges.

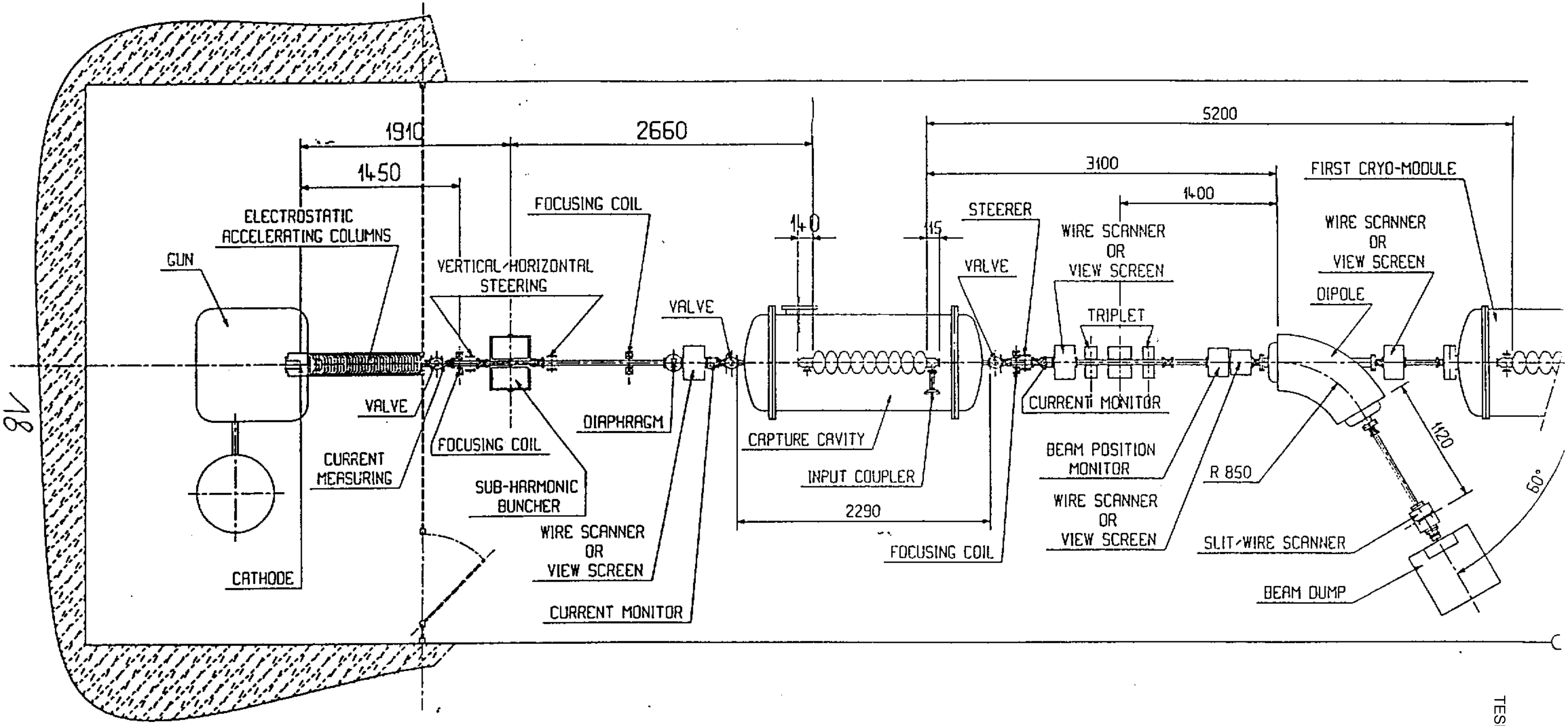
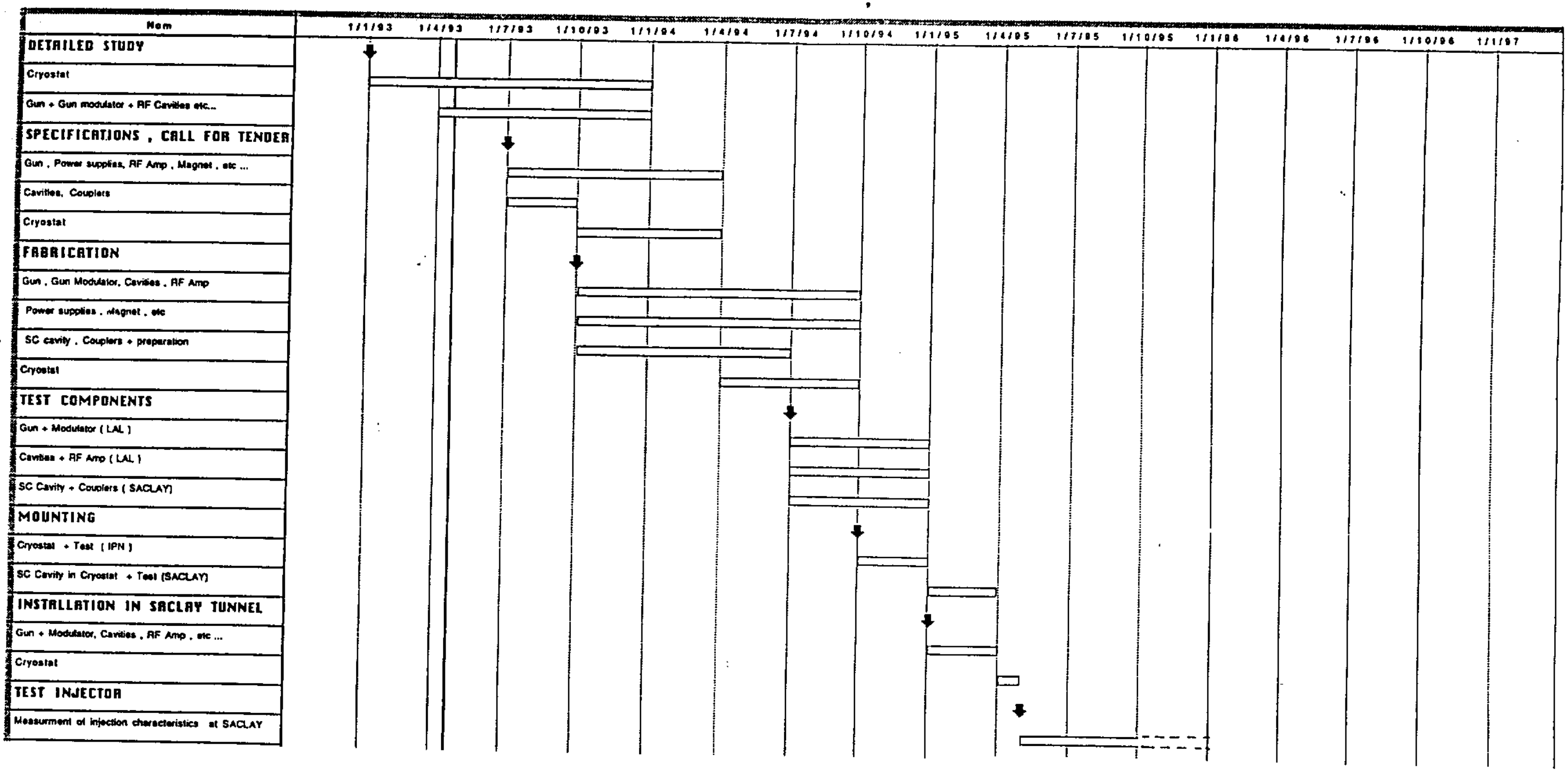


FIGURE 3. SCHEMATIC OF TTF INJECTOR (27/4/93)


Nom
1/1/93
1/4/93
1/7/93
1/10/93
1/1/94
1/4/94
1/7/94
1/10/94
1/1/95
1/4/95
1/7/95
1/10/95
1/1/96
1/4/96
1/7/96
1/10/96
1/1/97
DETAILED STUDY
Cryostat
Gun + Gun modulator + RF Cavities etc...
SPECIFICATIONS , CALL FOR TENDER
Gun , Power supplies, RF Amp , Magnet , etc ...
Cavities, Couplers
Cryostat
FABRICATION
Gun , Gun Modulator, Cavities , RF Amp
Power supplies , Magnet , etc
SC cavity , Couplers + preparation
Cryostat
TEST COMPONENTS
Gun + Modulator (LAL)
Cavities + RF Amp (LAL)
SC Cavity + Couplers (SACLAY)
MOUNTING
Cryostat + Test (IPN)
SC Cavity in Cryostat + Test (SACLAY)
INSTALLATION IN SACLAY TUNNEL
Gun + Modulator, Cavities , RF Amp , etc ...
Cryostat
TEST INJECTOR
Measurment of injection characteristics at SACLAY

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TTF
22/4/93

INJECTOR OPERATING SCENARIOS

# e's/bunch	7×10^9		1.6×10^8	
Repetition FREQ (MHz)	72.2	~ 12 mA	216.7	~ 5.4 mA
RMS phase-width	1.67°	(σ_z = 1.1 mm)	0.46°	(σ_z = 0.3 mm)
Total phase width	9.4°		2.2°	
RMS ENERGY SPREAD (MeV)	0.23		0.07	
Total Energy Spread (MeV)	1.2		0.32	
ENERGY (MeV)	14.4		14.6	
σ_E/E	1.6%		0.5%	
RMS Emittance (norm).	43		3.7	

INJECTOR MEETING - SACLAY 28/29 April

AIM - (i) Address list of open questions from TTF workshop (DESY, Feb. 93).

(ii) Identify new open questions.

QUESTIONS - (i) Technical

(ii) Clarify institutional responsibilit

3 MAIN TOPICS

- Decide on approach to injector { chopper / SHB
- CAPTURE CAVITY - Cryogenic issues
- Controls / Software - compatibility issues
  - agenda items for June m

\+ miscellaneous items

Question of overall schedule left open.

TTF MEETING APRIL 28-29 1993 AT SACLAY

1 - GENERAL SURVEY

INTRODUCTION

The IPN/LAL/SACLAY collaboration propose to construct the injector for TTF according to the attached schematic. It is forseen to make the first tests of the injector at Saclay and to aim at delivery of the injector to DESY early in 1996.

The cavity and couplers must be supplied during the first quarter of 1994.
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INJECTOR SCHEMATIC ~~(Figure 3)~~

The following changes to the proposed layout of the injector were agreed :

i) beam analysis line to be placed towards outside wall of hall,
ii) addition of view-screen at exit of gun column,
iii) reversal of collimator and view-screen before capture cavity,
iv) beam loss monitors (x-ray diodes) to be installed for tuning low power beam. Associated interlock to inhibit gun pulse,
v) a "no-go" high voltage area to be defined around gun.

TTF BUILDING AND SPACE REQUIREMENTS

- A drawing of the TTF injector was presented by LAL with a total length of ~ 12 m. The HV insulation of the gun assembly could require + 2 m.

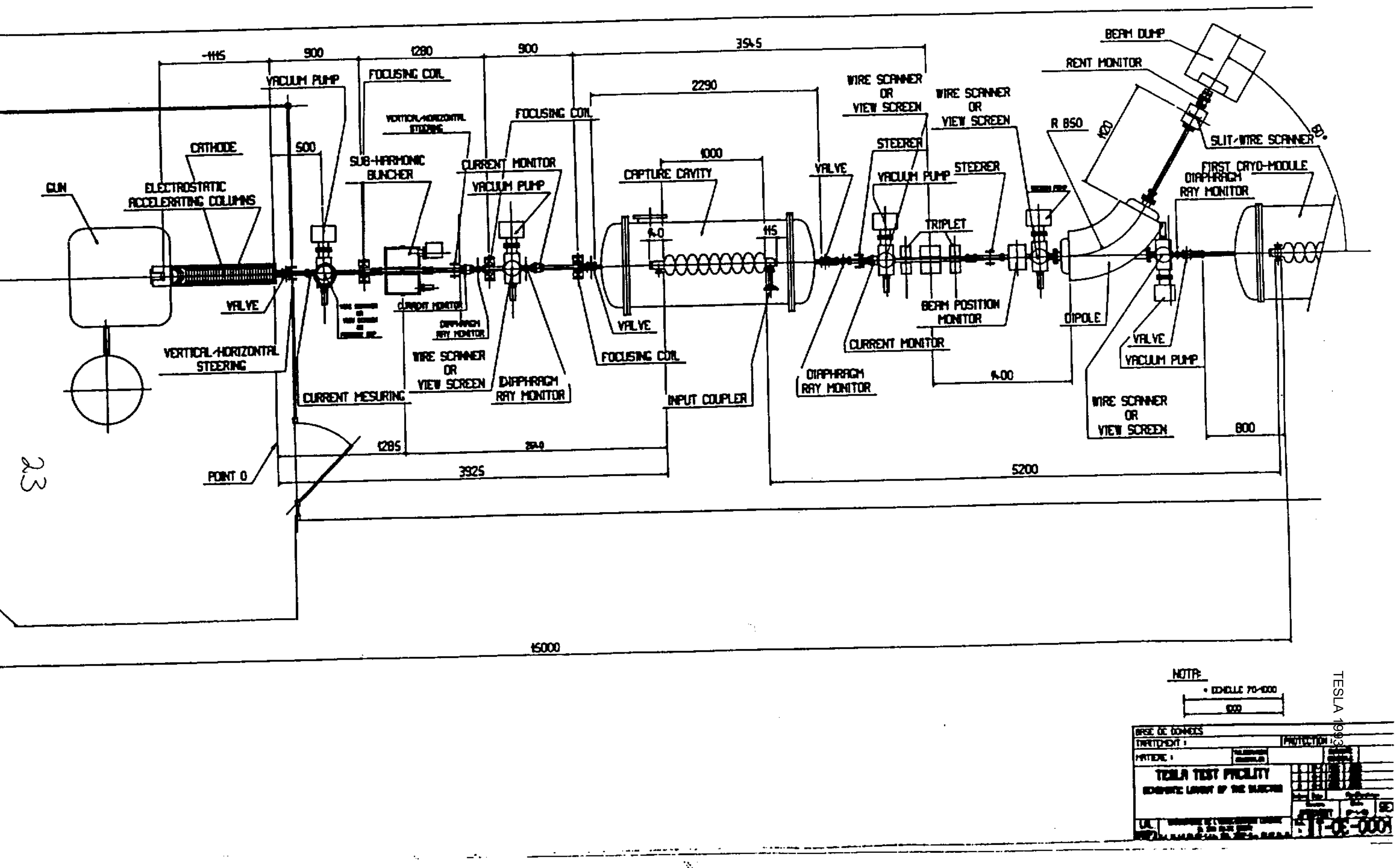
- The drawing of the hall 3 at DESY presented by B. PETERSEN allows ~ 15 m overall length available for the injector.

- The transfer line between the feed box and the capture cryostat is not necessarily level with the helium bath. It is possible to install the analysis line on the same side (left side with respect to the beam axis) as the feed box. The maximum height of the components of the beam line must be defined.

- Height of the beam : 1.23 m. This proposal gives compatibility with the MACSE beam line at Saclay.

LOW LEVEL RF - TIMING

LAL will begin work on injector timing system i.e. defining master oscillator frequency and specification of the required frequency multipliers, amplifiers etc needed to provide signals to cavities and pulses to gun. A first draft of the low level RF distribution system will be drawn up.


GUN
CATHODE
ELECTROSTATIC ACCELERATING COLUMNS
VALVE
VERTICAL-HORIZONTAL STEERING
POINT 0
VACUUM PUMP
500
CURRENT MESURING
FOCUSING COIL
SUB-HARMONIC BUNCHER
VERTICAL-HORIZONTAL STEERING
CURRENT MONITOR
DIAPHRAGM RAY MONITOR
WIRE SCANNER OR VIEW SCREEN
CURRENT MONITOR
VACUUM PUMP
FOCUSING COIL
DIAPHRAGM RAY MONITOR
CAPTURE CAVITY
1000
40
115
VALVE
FOCUSING COIL
INPUT COUPLER
VALVE
DIAPHRAGM RAY MONITOR
WIRE SCANNER OR VIEW SCREEN
STEERER
VACUUM PUMP
WIRE SCANNER OR VIEW SCREEN
STEERER
TRIPLET
BEAM POSITION MONITOR
CURRENT MONITOR
400
DIPOLE
R 850
1120
BEAM DUMP
RENT MONITOR
SLIT-WIRE SCANNER
60°
FIRST CRYO-MODULE
DIAPHRAGM RAY MONITOR
VALVE
VACUUM PUMP
WIRE SCANNER OR VIEW SCREEN
800
-1115
900
1280
900
3545
2290
1285
2840
3925
5200
15000
NOTA:
• ECHELLE 70-1000
1000
BASE DE DONNEES
TRAITEMENT :
PROTECTION :
MATIERE :
TESLA TEST FACILITY
SCHEMATIC LAYOUT OF THE INJECTOR
TT-0E-0001

Simulation studies of the Injector

T. Garvey gave a short presentation on the status of the PARMELA calculations for the sub-harmonic buncher approach to the injector.
For the following input parameters;

Gun voltage	250 kV
current pulse	200 ~~400~~ mA during 0.77 ns
Horizontal / vertical beam size	2.5 mm
Horizontal / vertical emittance	15 mm-mrad
SHB frequency	216.7 MHz
SHB gap voltage	53.2 kV
capture cavity field	30 MV/m

We obtain the following output parameters;

Total phase extension	9.4°
RMS phase-width	1.67° (1 mm)
Total energy spread	1.2 MeV
RMS energy spread	0.23 MeV
Mean energy	14.4 MeV
fractional energy spread	1.6%
Particle transmission	100%
normalised RMS emittance	45 mm-mrad (x-plane) - 43 mm-mrad (y-plane)

In the discussion which followed it was agreed that, for the experimental programme forseen on TTF, the parameters were acceptable although the emittance should not be larger. It was pointed out that the input current in the code is three times that required and so the space-charge is larger than forseen. Further runs with reduced space-charge and employing improved magnetic focusing may help to improve the calculated emittance. A shematic of the proposed injector layout was distributed (figure 3).

→ Proceed with SHB approach

MODULATOR AND KLYSTRON

DESY to furnish 350 kW klystron and associated RF circuitry (including circulator) for the capture cavity. The exact inventory of the RF circuitry to be furnished by DESY will be known in June. Saclay will fabricate the modulator.

BEAM ANALYSING LINE

For the tests forseen at Saclay existing equipment will be used for beam analysis. Work on the analysis line to be furnished to DESY will begin in 1995.

PUMPS/COOLING WATER

DESY will provide turbo-molecular pumps for injector in Hamburg. However ionic pumps are considered suitable for tests at Saclay if they are properly mounted. Saclay will perform tests on turbo pumps to assess vibration effects. Valves and gauges to be furnished by Saclay.
All water systems should be able to handle 16 bars inlet pressure.

CAPTURE CAVITY

Two options were discussed :

a) The capture cavity (one of the 10 first cavities) will be supplied by DESY after commissioning (mechanical, dimensions, frequency, field level ...).Chemical treatment and test in a vertical cryostat at Saclay, heat treatment and final decision on mounting in the cryostat if $E_{acc} \geq 10$ MeV/m.

   Welding of the helium tank and new test in vertical cryostat (eventually high power RF processing).

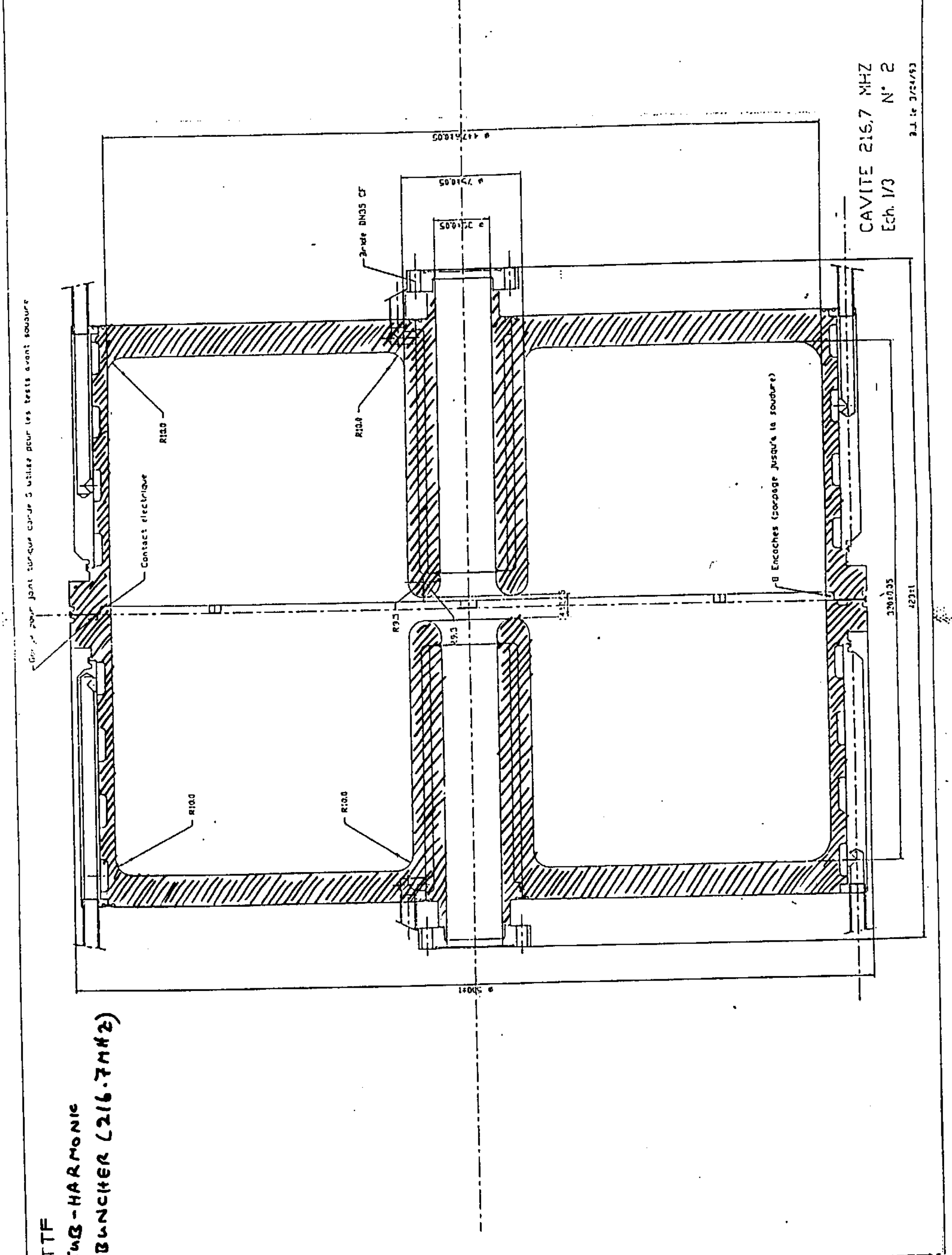
b) DESY proposes to prepare and test the cavity in vertical and horizontal cryostats and to send it to Saclay closed and equipped with its helium tank. The beam tubes could be supplied by DESY, or sent to DESY by ORSAY, and mounted at DESY.

COUPLERS

- HOM coupler : the choice of the final design (DESY or Saclay) will be adopted in 3 months.
- Main coupler will be supplied by Fermilab.

MISCELLANEOUS

- Saclay will prepare a list of available hardware for use on the high-energy beam-line.
- There may be a possibility of using a Cornell diagnostic for coherent synchrotron radiation to measure the bunch length.
- LAL will prepare a list of all diagnostic instrumentation required for injector with associated resolution and sensivity.
- Check on HOM'S of sub-harmonic buncher.
- Design of 250 kV Gun – Use electrostatic post-acceleration column (c.f. S-DALINAC)
  Cathode will be existing SACLAY source (modified)


CAVITE 216,7 MHZ
N° 2
Ech. 1/3
Bride DN35 CF
Contact électrique
TTF
SUB-HARMONIC
BUNCHER (216.7MHz)

Calculs faits avec URMEL

V. MASQUELIER (LAL

MODES LONGITUDINAUX

MODE TYPE	FREQUENCY / MHZ	(R/Q)/OHM AT R0	ACCURACY	CONTAMINATION
TM0-EE- 1	216.004	152.717	6.4E-02	0.366715
TM0-EE- 2	814.602	1.605	6.6E-03	0.119620
TM0-EE- 3	986.379	5.077	5.5E-03	0.192755
TM0-EE- 4	1267.02	3.166	2.4E-03	0.067101
TM0-EE- 5	1638.74	0.532	1.7E-03	0.053775
TM0-EE- 6	1870.71	0.102	1.6E-03	0.378964
TM0-EE- 7	1906.31	1.607	2.5E-03	0.693995
TM0-EE- 8	2049.05	1.479	1.5E-03	0.122975
TM0-EE- 9	2459.46	0.285	2.7E-02	3.233414
TM0-EE-10	2553.36	******	1.6E-01	10.000000
TM0-EE-11	2640.50	0.535	6.3E-02	9.990112
TM0-EE-12	2814.96	1.197	6.5E-02	5.418941
TM0-EE-13	3005.98	******	1.3E-01	10.000000
TM0-EE-14	3211.25	******	1.3E-01	10.000000
TM0-EE-15	3392.88	0.866	7.6E-02	6.869097

MODES DIPOLAIRES

MODE TYPE	FREQUENCY (MHZ)	(R/Q) (OHM AT R0)	(R/Q)/(K*R0)**2M (OHM)	ACCURACY	CONTAMINATION
1-EE- 1	888.503	0.328	3.093	2.4E-02	1.136665
1-EE- 2	990.000	0.448	3.396	2.4E-03	0.138548
1-EE- 3	1261.61	1.618	7.558	7.0E-03	0.272451
1-EE- 4	1408.28	0.893	3.348	1.9E-03	0.101582
1-EE- 5	1620.18	7.179	20.332	1.1E-03	0.057919
1-EE- 6	1758.41	4.920	11.827	1.3E-03	0.090468
1-EE- 7	1927.40	0.089	0.177	3.0E-02	5.113550
1-EE- 8	1981.81	1.408	2.665	6.2E-03	1.304896
1-EE- 9	2028.11	0.232	0.419	5.5E-03	1.274760
1-EE-10	2193.84	6.509	10.053	2.1E-03	0.155546
1-EE-11	2560.84	******	******	1.2E-01	10.000000
1-EE-12	2560.84	0.396	0.449	5.1E-02	10.000000
1-EE-13	2743.69	0.024	0.023	7.5E-02	5.906027
1-EE-14	2977.39	0.911	0.764	2.4E-02	1.629168
1-EE-15	3280.00	0.284	0.196	2.4E-02	1.246837

INJECTOR DIAGNOSTIC REQUIREMENTS STUDY

TESLA 1993-35

R. Chehab (LAL)

— ss —

- What needs to be measured and with what sensitivity + precision? (Report in preparation)

POSITION - BPM's (Button type - ESRF) (Resonant Cavity)

INTENSITY - Toroids

PROFILE - View Screens
Wire Scanners
Optical Transition Radiation.

BUNCH LENGTH - OTR + Streak Camera

ENERGY SPREAD - SEM - grid (as used at LAL)

LOSS MONITOR - distributed ionisation chamber
(discrete - X ray diodes)

J. M. JOLY (SACLAY)
+ M. OMEICH (LAL)

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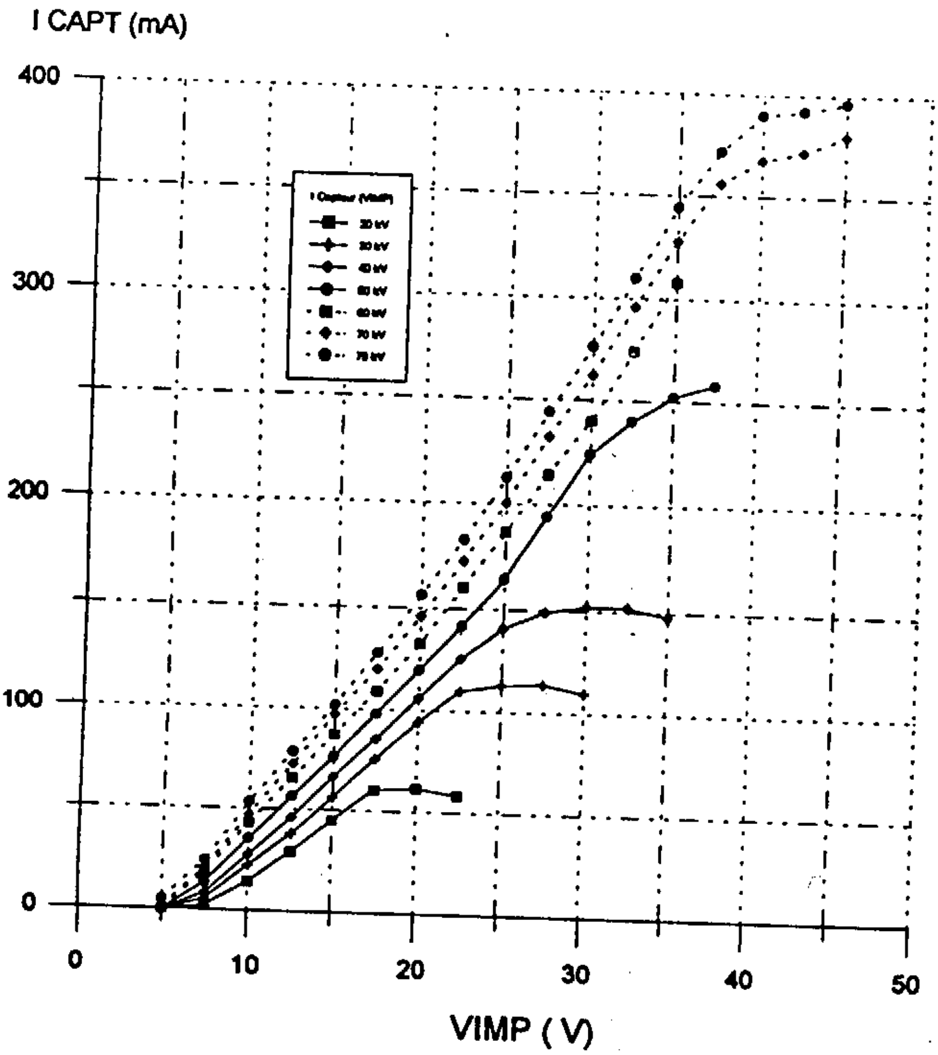
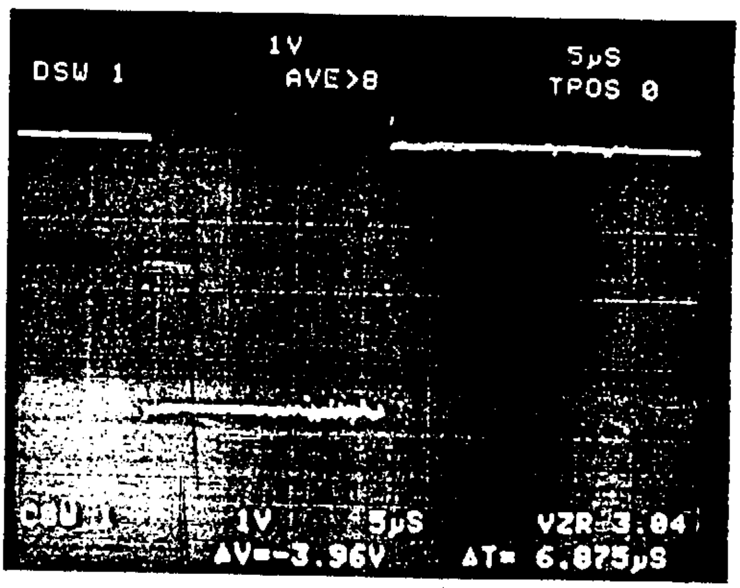
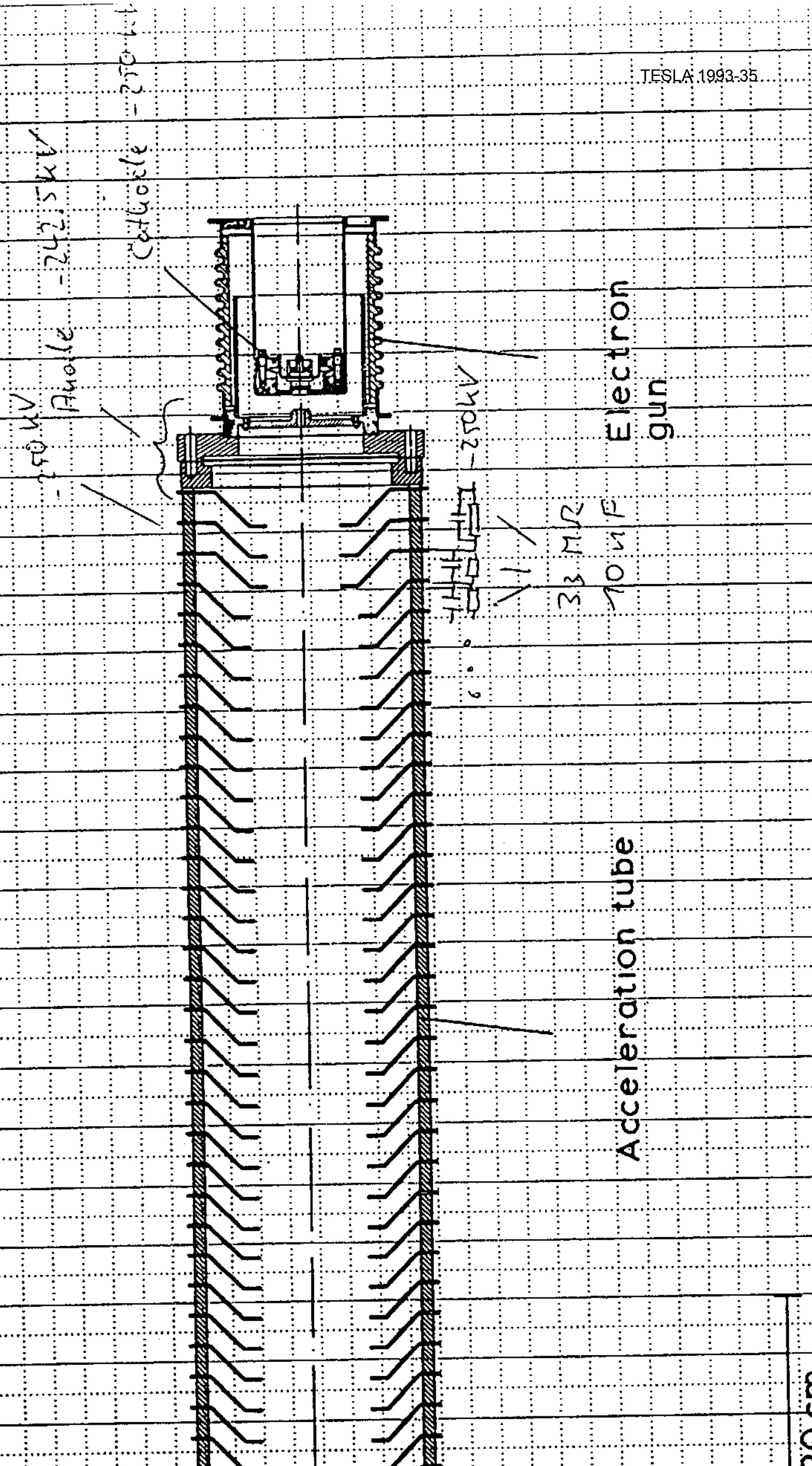


Chauffage: I=1,35A V=6,5V

28/5/93: FIRST TTF ELECTRONS

I=400mA

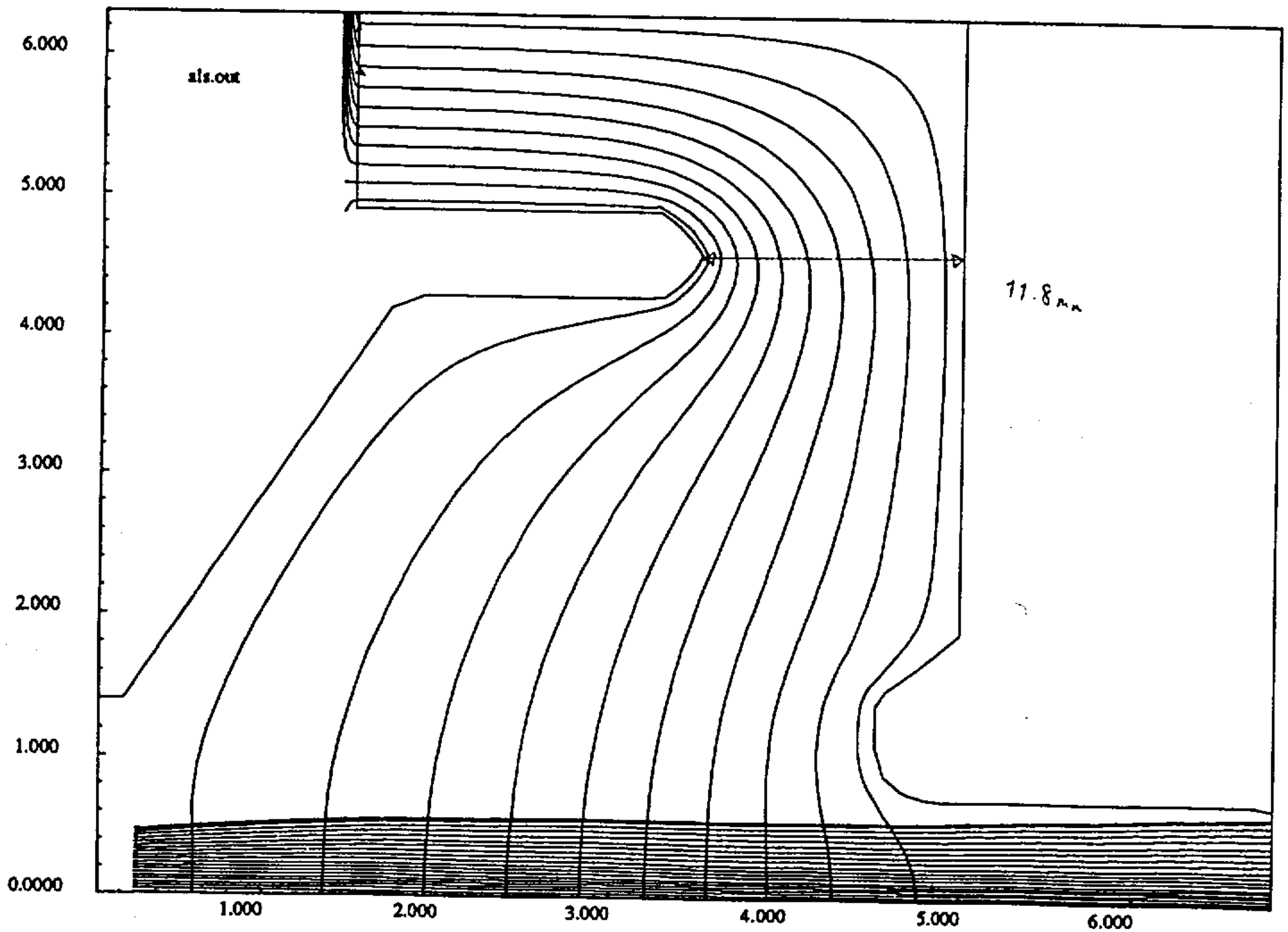



Electron gun
Acceleration tube
20cm
Anode
Cathode
-250kV

E-GUN SIMULATION OF
MODIFIED SACLAY GUN.

400 mA, 31 kV

$4\pi\gamma\beta\varepsilon_{rms}$ = 10.1 π mm mrad.



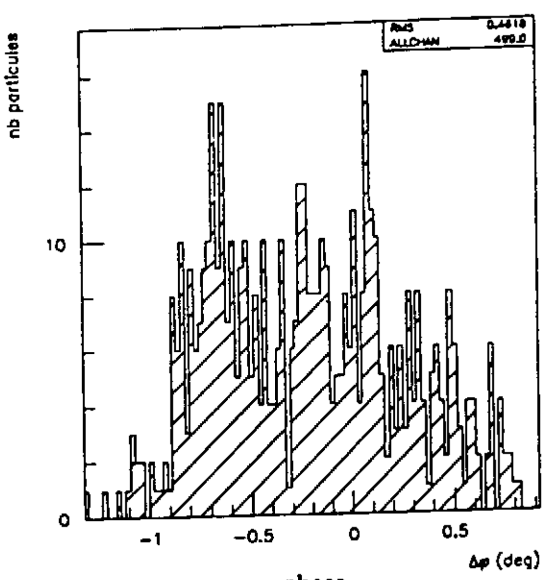
INJECTOR OPERATING SCENARIOS

# e's / bunch	1×10^9 ~ 12 mA	1.6×10^8 ~ 3.4 mA
Repetition Freq (MHz)	72.2	216.7
RMS phase-width	$1.67°$ (σ_z = 1.1 mm)	$0.46°$ (σ_z = 0.3 mm)
Total phase width	$9.4°$	$2.2°$
RMS Energy Spread (MeV)	0.23	0.07
Total Energy Spread (MeV)	1.2	0.32
Energy (MeV)	14.4	14.6
σ_E/E	1.6%	0.5%
RMS Emittance (norm).	43	37

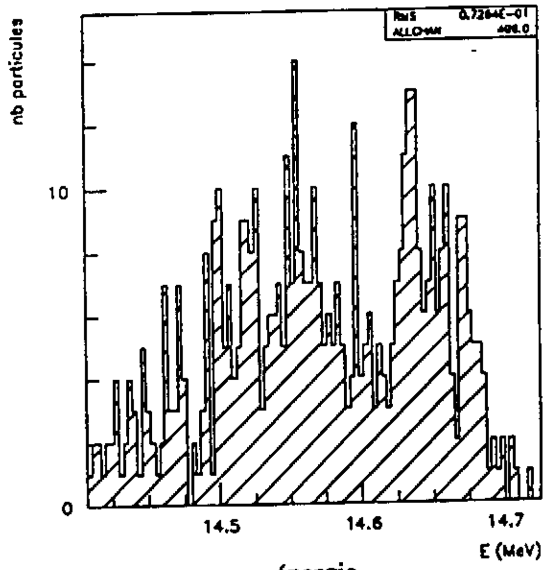
TTF201

element no 25

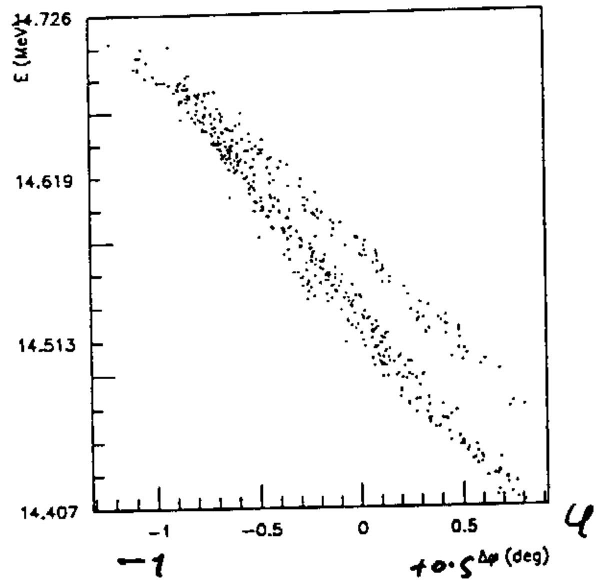
- sortie cavité de capture -

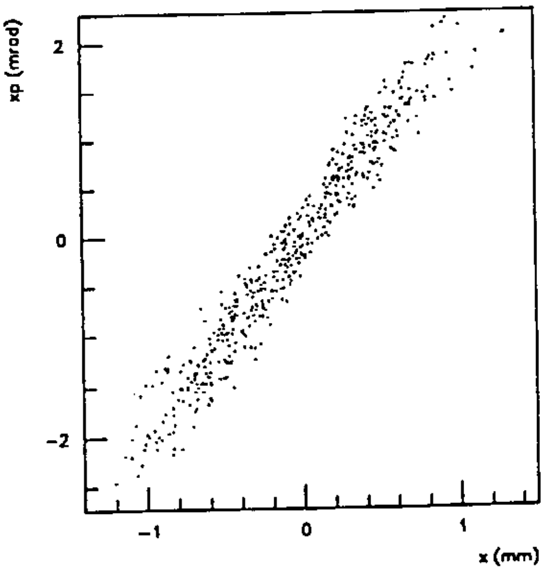


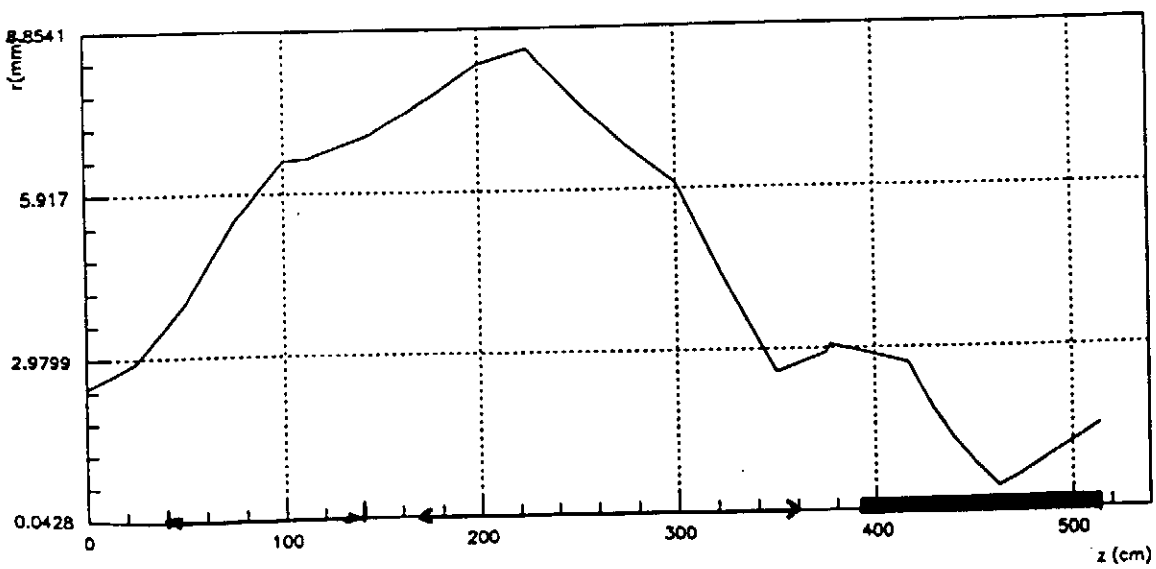
phase



énergie







enveloppe: 100%

Open Questions from Injector Group

(i) List of items concerning capture cryostat (TRINES)

(ii) Is timing system acceptable?

(iii) Is low level RF distribution acceptable?

(iv) Beam Diagnostics - Have we covered everything? - Injector Layout?

(v) Injector Space Requirements - Excessive?

(vi) Controls - (esp. vacuum) compatibility

ANSWERS

(i) CRYOCAP — Some answers

(ii)
(iii) } A. GAMP Seal of approval

(iv) Beam Diagnostics — Additional BPM
" Steerers
phase measuring device (H. WEISE)
Displace FC

{ INTENS
PROFILE
EMITTA
POSITIO
BUNCH L
ENERGY S

+ Optical diagnostics — OTR + s.c.
coherent synch. radiation (IR)
short pulse laser + auto-correlati

Materials ?

- Eckoldt list → in preparation.

Water, Quality
Special Solders
Oil tanks - Security
Pipe Materials
Plugs | Adapters
Interlocks — Hard Wired rather than computer controlled

EXPERIMENTAL PROGRAM

Introduction

It is suggested that all proposed experiments be classed in several chapters as, for example, Cryogenics, Alignment, RF, Cavity performance, Beam, Operation.

It has been proposed that a volunteer person be designated to chair each of these experimental groups.

Each experiment proposal should provide a form indicating informations like : Objective, Group, Procedure, Requirements, Instrumentation, Controls, Analysis.

Beam analysing line

In addition to the beam energy and the beam energy spread, the beam analysing line must permit to measure the energy variation with time within the beam pulse. The complete design of this line remains to be done.

Timing system

A schematic of the timing system has been proposed by Orsay and is being discussed with FERMILAB and DESY people.

Experiments on MACSE

Experiments on MACSE for testing RF control have been discussed : TTF conditions can be simulated with MACSE cavities and 2 RF control schemes proposed by DESY and SACLAY will be tested starting fall '93 . The powering of the cavities can be made by individual klystrons or in feeding up to four cavities with one klystron.

Beam loading will be simulated by direct RF pertubation or in accelerating a beam after modification of the injection line to permit a maximum current up to 1 mA.

Wakefield studies

Some experiments using a non accelerated beam injected off axis to study the transverse wakefields have been proposed .

a) *multibunch effect*

The goal is to measure the damping of the dipole modes . The variation of the bunch positions will be monitored with the linac BPMs. To increase the sensitivity of the method, the modes will be excited resonantly by tuning the cavities to an harmonic of the bunch frequency. This implies a bunch frequency of 1 MHz. For example, with 5.10^{10} electrons and an initial beam offset of 1 cm, a large displacement is obtained when only one cavity is tuned for one of the first dipole modes. With a lower bunch population, several cavities have to be tuned to get a measurable effect : When the 8 cavities of 1 cryomodule are tuned, bunches of 5.10^9 electrons will produce a 3 mm displacement.

Another method is to measure the RF power from the HOM couplers. It is a very sensitive method but the calibration seems difficult. It can be used to determine the cavity axis by finding the beam position which gives zero signal.

b) *single bunch effect*

A non accelerated bunch of 5.10^{10} electrons moving at 1 cm from the axis in the first cryomodule will have its tail displaced by about 1.5 cm. This "banana effect" could be observed on a viewscreen and more accurately if a streak camera is available.

Beam line monitors

Principles and locations of beam monitors have been discussed.

Intensity and profile monitors (for emittance measurements) have to be provided before and after the capture cavity.

A bunch length monitor using infra-red coherent synchrotron radiation, as devised by BNL, has been suggested and could be installed after the capture cavity.

It was recommended to study a beam loss monitoring all along the linac. It could be a long cable used as an ionisation chamber.

Test of the first 2 Niobium cavities

The cavities will be delivered mid August.

After room temperature measurements performed at DESY, one will be sent to Saclay (1st of September) for chemical treatment and RF tests in vertical cryostat.

The second one will be used for the commissioning of the TTF cleaning and chemical processing installation.

TESLA 1993-35

```
cryo.instr      hte
july 16  draft 2
notes from Bacher june 1, 2 93 tesla meeting
and table from Tazzari
        * indicates items found in Tazzari Table 4.6.1T


Each cavity
        stepping motor
                *control
                pos read back?
        HOM coupler 1 (step mot end)
                *1 power ext cable, pickup, coax
                *1 thermometer (2-4K)
        on cavity- helium vessel ( step mot end?, what about other end?)
                *1 pickup for RF field (& elect emission?) coax
                *2 thermometers (2K) middle of cavity, top & bottom of He ves
                *2 vibration det (h,v) accelerometer, coax
                ?! 1 heater !? (I thought heater in feed or end can)
        HOM coupler 2 (input coupler end)
                *1 power ext cable, pickup, coax
                *1 thermometer (2-4K)
        Input power coupler
                *2 RF pickups (& electron emission) where?, coax
                *2 thermometers- outer cond (4K, 40-70K)
                1 thermometer- inner cond (~70K)
                2? spark det (photo diodes?) where?-either side 70K window?
                Additional instrumentation outside cryostat????

Each cryomodule - Quad assembly
        Magnets
                Quad doublet (powered in series, 2 leads)
                Horiz & Vert steering - 2 pairs (Why do we need both? The
                        dog leg could be set up at begining & end of string.
                        Still would need strong enough steering to compensate
                        for quad steering of 1 cm offset beam.)
                        (2x3 leads)
                *4 thermometers-2 @4K(TSC4.5),2 @70K-shield?(PT1000)
                *2 vibration det- accelerometer, coax
        HOM absorber
                monitor cable?
                temp measurement, and/or calorimetry?

Each cryomodule - other

        Thermometers- Shield, pipes, & support structure
                        (tot 38-TSC4.5, 31-PT1000)
                *28 thermometers on 2? cavity shields @4K
                *28 thermometers on 2? cavity shields @70K
                *1 @4K, 1 @70K on each of 3 posts (tot 3 @4K, 3 @70K)
                *1 @4K beam pipe
                *6 @4K on He Gas Ret Pipe (HeGRP)
        Thermometers- in gas lines (total 4-TSC4.5, 2 PT1000)
                *1 @2K in 100mm pipe
                *1 @2K in 2.2K pipe?(HeGRP?)
                *2 @4K in 4K supply/return
```

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```
        *2 @70K in 70K supply/return

Beam pos monitor (h,v) *4 coax
Beam current monitor? (to measure dark current also)
        (could bpm be used?)
Beam loss monitor (outside of cryostat)
He level monitor(? is this in each cryomodule or just at either end
        of string?)
```

3.5.2. Acceptance tests

3.5.2.1- All interconnection piping shall be factory leak tested: there shall be no measurable leak, against 20 atm of He gas, at a sensitivity of 10^{-10} torr·l/s. Appropriate documentation of the test results shall be submitted to INFN, for acceptance.

3.5.2.2 - Mechanical conformity to the drawings shall be demonstrated, at the factory, to INFN-designated inspectors .

3.6 DIAGNOSTICS, WIRING AND CABLING

3.6.1. Description of work

3.6.1.1- Materials to be supplied for on-site assembly: specification *Document 4.6. L1*

3.6.1.2 - Feedthrough flanges : specification Dwg. 06.01.00

3.6.1.3 - A list of wires and cables according to type of sensor and including the indication of the corresponding feedthrough flanges is supplied in Table 4.6.1.T.
The location of thermosensors and accelerometers on the cavities, the support posts and each of the 4 °K and thermal shields is schematically shown in figures 3.6.1, 3.6.2.a) and 3.6.2.b). The location of the accelerometers on the quadrupole are schematically shown in fig.3.6.2.c).
Thermosensors on pipes other than the HeGR one, are located near the end of the module, quadrupole side. Those on the HeGR pipe will be evenly distributed along the lenght of the pipe and around its diameter
Thermosensor location on the main coupler is schematically shown in Dwg. 2.4.
The quadrupole thermosensors are imbedded in the coils.

3.6.1.4 - Wire and cable pulling and electrical connections for the prototype will be done on the DESY site by INFN authorised personnel.

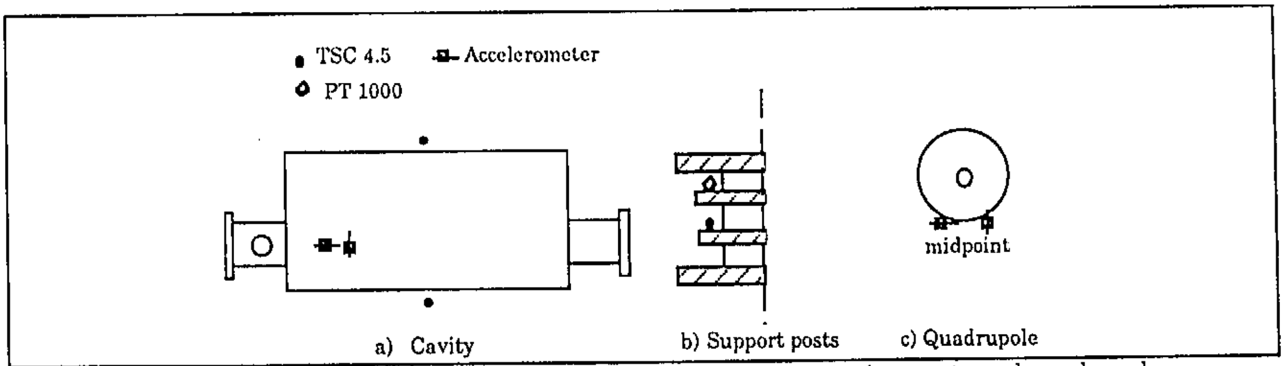


Fig.3.6.1 - Location of thermosensors and accelerometers on cavity, posts and quadrupole.

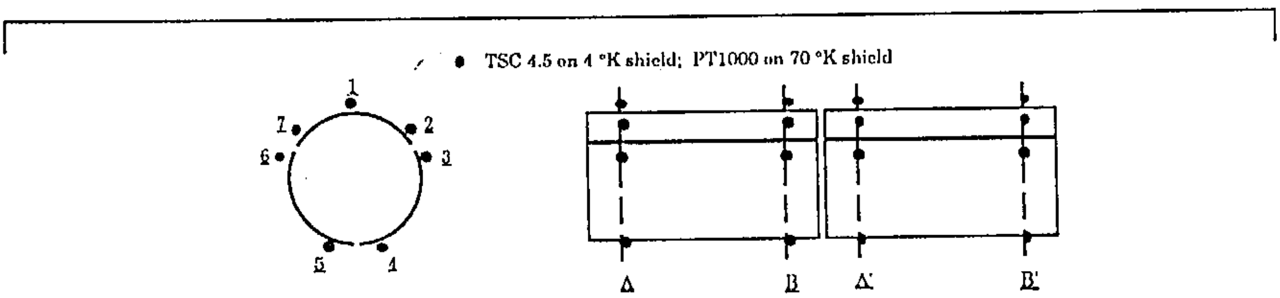


Fig.3.6.2- Location of thermosensors and accelerometers on the shields

TABLE 4.6.1.T - LIST OF DIAGNOSTIC WIRES AND COAXIAL CABLES

Diagnostic Wires

Item	Position	items per pos.	# of pos.	Tot. # of items	wires per item	wires per pos.	Tot. # of wires	#12-p. conn. per pos	Tot. # of conn	Feedthrough flange(s)
TSC 4.5	M. coupler	1	8	48	4	24	192	2	16	Main Coupler
PT 1000	M. coupler	1								
TSC 4.5	HOM Abs	2								
TSC 4.5	Cavity He v.	2								
TSC 4.5	Quadrupole	2	1	2	4	8	32	1	1	Q.Pole/Small
TSC 4.5	4 °K Sh.Sect	14	2	28	4		112		26	End Diagnostic
PT 1000	70°K Sh.Sect	14	2	28	4		112			
PT 1000	Quadrupole	2	1	2	4		8			
TSC 4.5	Support posts	1	3	3	4		12			
PT 1000	Support posts	1	3	3	4		12			
TSC 4.5	Beam pipe	1	1	1	4		4			
TSC 4.5	HeGRP	6	1	6			24			
In Gas										
TSC 4.5	Ø 100 pipe	1	1	1	4		24			
TSC 4.5	2.2 °K pipe	1	1	1						
TSC 4.5	4.5 °K pipe,frw	1	1	1						
TSC 4.5	4.5 °K pipe,ret	1	1	1						
PT 1000	70 °K pipe,frw	1	1	1						
PT 1000	70 °K pipe,ret	1	1	1						
Running in metallic conduit ; 5 A rating										
Motors	Cavity	1	8	8	5		40		4	
							572		47	

Coaxial cables

Item	Position	# items p.pos.	# of pos.	Tot. # of items		# Conn. p. Pos.	Tot. # of conn.	Feedthrough flange(s)
RF p/ups	MC	2	8	16		7	56	Main Coupler
RF p/ups	Cavity	1		8				
RF p/ups	HOM	2		16				
Accel.		2		16				
P/ups	BPM	4	1	4			6	End Diagnostic
Accel.	Quadrupole	2	1	2				
							62	

fall.outline

june14,93 h edwards revised july 18 (`new dates)

OUTLINE OF HALLE 3 ACTIVITIES FOR COMMISSIONING CAVITY PREPARATION & PROCESSING

Schedule Mile Stone Overview- for two test cavities (#1t,#2t)

*( ) indicate the test cycle of a cavity at Desy eg 1st, 2nd etc
TTF tesla milestones distributed by Tigner indicated by initial numbers and dates (x.x.xx)

1.two test cavities #1t,2t	arrive	Aug 15(1.8.93)	
Cavity room temp measure-2weeks Desy	complete	Sept 1	
Saclay treat&test cav#1t-2weeks	complete	Sept 21	
" cav#2t- 2weeks	complete	Oct 1`	
Commission clean room, chemistry,	start	Sept 27`	
water w cav#2t	finish	Oct 22`	
Vert Dewar	arrive	Sept 1	Note 1
Helium Heater	arrive	Sept 15	1
4K Refrigeration	available	Oct 1	
RF Insert (top hat)	arrive	Oct 1	1
RF test 200watt4K cav#1t (1)* without desy treatment`	start	Oct 7	2,3
Valve Box	arrive	Oct 15	1
2K Refrigeration	available	Nov 1	
(could at this time measure #1t @ 2K, treat/test sched below would slip 2 week)`			
3.RF Test 200w2K cav#2t (1) & RF insert	start	Nov 1 (1.11.93)	
(cav#2t will have had desy treat`)			
Process(chem treat)cav#1t@ Desy	start	Nov 1	4
Retest cav#1t 200w2K (2)	start	Nov15	
Reprocess(chem) cav#2t	start	Nov 15	
Retest cav#2t 200w2K (2)	start	Dec 1	
Modulator	arrive	Nov 15	1
Modulator installation	complete	Dec 1	
" check out	complete	Jan 7	
Furnace commissioning	start	Dec 15	
Reprocess/retest cav#1,2t (3)	as needed	Dec 1, 15, Jan 1	5
Furnace cleanroom	available	Jan 15	
4.HPP processing 2K (4)	start	Jan 15 (1.2.94)	
2nd RF insert for vert dewar	arrive	~March	
5.Production cav #1p-11p	start deliv	April 1 (1.3.94)	
Horiz test cryostat	arrive	~April	
6.1st Horiz test	start	May 1 (1.5.94)	

Notes
1) assumes 2weeks packing and shipping time for all components from FNAL.
2) Saclay will see if they have a top plate suitable for low power tests.

It seems unlikely that a suitable low power tp insert will be available. If the FNAL hi power RF insert arrives on time it will be better to go ahead with it.

3) 4K test with 200 watts, Q expected~ 5E8, should get ~4-5 MV/m.
4) cavity 1t will not have been tested at 2K at Desy under this schedule.
5) This assumes a 2 week turnaround for cavities. There may be reasons to cycle only one cavity and do more long term tests on the other. This can be worked out later.

Fall 93

Alternate Proposals: for 1st two test cavities, depending on schedules and delivery changes. (other varients also possible- of course)

a) Send both cavities to Saclay for certification. This now looks like the most sensible plan, because of cleanroom schedule.

Cav#1t: Saclay treat, test- measure; Desy test- measure @ 4K & 2K
Cav#2t: Saclay t,t-measure; Desy treat,test- measure @2K

This plan provides for a redundent measurement of #1t without chemical treatment between the saclay and desy measurements. It certifies the desy steps associated with measurement. However it is likely this 1st measurement will be at 4K.

b) Heat treatment - if the Q is bad at Saclay.Then send cavity to Cern for heat treatment. (2 weeks) This should be done only if it will not slow up the infrastructure commissioning at DESY.

c) Mechanical and vibration analysis.
Send a cavity to Stanford for mechanical analysis, when it becomes available, some time in the spring.

ttf.expobj
hte july 18,93

TTF Expermental Objectives- By Group Classification

This is a reorganization of Tigner TTF Objectives(rev 08.02.93) with minor changes & additions.
[x] numbers refer to that list.
* best with full bunch charge.

Alignment-Vibration

A1. [2] Measure cryomodule alignment stability during cool dn/ warm up.
A2. [3] Measure vibration properties, ie vibration transfer function for cavities and quadrupoles (and coupler). Note: are accelerometers on cavities or helium vessel?

Cryo

K1. [1] Measure heat leak with and w/o beam and RF.
[10]*Measure HOM power deposited in He and to beam tube absorber[11].
Measure Qo vs Eacc [4,9] calorimetrically if possible or at miinimum be able to detect low Q (leading to ~1/4 watt in a cavity) and quenches.
K2. [15] Measure temperature profile for each cell and coupler on at least one cavity. (At present detailed measurements of cells are not planned as far as I can tell). Still might want some cavity temp measurement.
K3. Measure operation as function of temperature.

Cavity preformance (overlap with cryo)

C1. [4,9],see also K1. Measure QvsE with time , with and without beam, calorimetrically and electrically.(Don't believe can do elect measurement because insufficient coupler adjustment.)
C2. [5] Try to do HPP in situ.
C3. [6]* Transfer full pulse power to beam at full pulse length.
C4. [10,11,17]*, see also K1. Measure HOM power:
deposited in liq helium
coming out beam pipe, absorbed at HOM absorber
coming out HOM couplers
C5. [12]* Look for transverse mode excitation as function of beam position. Try to measure module/cavity alignment by looking for beam position that yields minimum transverse mode excitation.
C6. [16] Measure dark current. Measure radiation patterns & spectrum without beam for field emission and captured dark current. See also O4.

RF System

R1. Develop cavity, coupler- freq, voltage, phase, coupling, tune up proceedure. With cavity tuning and radiation pressure compensation.
R2. Develop beam loading compensation, and be able to switch from no beam to beam conditions.
R3. Develop quench, arc protection.
R4. [8] Measure E(t), Phi(t) in each cavity w&w/o beam.

R5. [3] Look for microphonics including radiation pressure effects. Look for coupler vib effects. See also A3.

Beam

B1. [7]* Measure E,deltaE, & energy and positional path stability, bunch by bunch. (or at least for sellected bunches)

B2. [13]* Measure bunch length. Needed at least at injector end. to assure injected beam not leading to excessive deltaE.

B3. [14]* Measure wakefields- single and multi bunch. Must determine if want a witness bunch- off energy. Wake field measurements coupled to emittance(head tail) and mode excitation measurements also.

B4. [18] Measure emittance. *Measure emittance blowup off axis,off momentum.

B4. [12]* Look for transverse mode excitation. See also C5.

Operation

O1. [19] Develop tuneup procedures. See also R1.
[20] Practice beam alignment, focusing, and energy optimization.

O2. [22] Check BPM system operation for sensitivity, linearity, off center line, etc.

O3. [21] Make precision beam transmittion measurements.

O4. Measure radiation pattern with beam. Determine amount of radiation coming from poor quality injected beam. See also C6.

O5. [23] Simulate fault conditions of subsystems. (like cavity RF trips, magnet trips, etc)

TTF OBJECTIVES(rev.08.02.93)
(tentative)

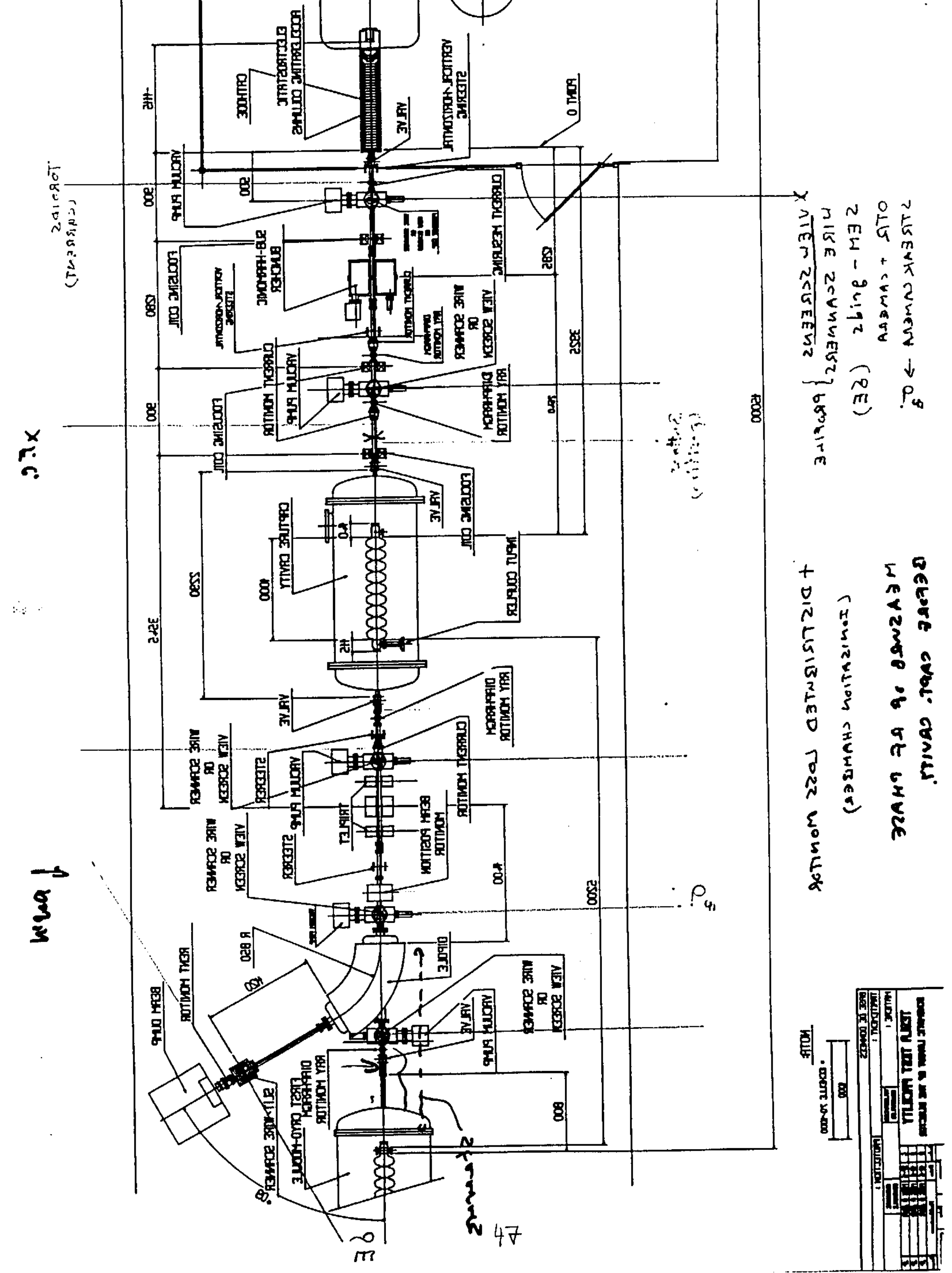
1. Measure cryomodule heat leak with and without beam/rf.
2. Measure cryomodule alignment stabili.y during cooldown and warm-up.
3. Measure cryomodule vibration properties, i.e. vibration transfer function for both cavities and quadrupole while cold. Look at microphonics with rf on including the radiation pressure effects.
4. Investigate Q vs E_{acc} with time and with and without beam.
5. Explore utility of in-situ HPP.
6. *Transfer full pulse power to beam at full pulse length.
7. *Measure E, $\Delta E/E$, energy stability and beam path stability bunch by bunch.
8. Measure $E(t)$ and $\Phi(t)$ in each cavity unit.
9. Measure Q_0 both calorimetrically and electrically if variable coupler is available.
10. *Measure HOM power deposited in LHe.
11. *Measure HOM power coming out beam pipe.
12. Measure module/cavity alignment by looking for beam position that yields minimum transverse mode excitation.
13. *Measure bunch length.
14. *Measure wakefields with single and multiple bunches followed by a witness bunch.
15. Measure temperature profile for each cell and coupler on at least one cavity.
16. Measure typical radiation patterns w.o beam for both FE and captured dark current.
17. *Measure HOM output of HOM couplers.
18. Emittance measurement /off axis/off momentum Emitt blowups.
19. Develop tune-up procedures.
20. Practice beam alignment and focusing.
21. Make precision beam transmission measurement.
22. Check BPM system operation for sensitivity, linearity, etc.
23. Simulation of fault conditions for important subsystems (list needed).

* Best made with full bunch charge

Develop cavity/coupler Voltage, Φ, coupling tune up procedures

Measure operat as func/temp -
measure beam loading compensation, cavity tune, phase
Measure radiation, dark current, measure mechanical vib.

Detect low Q/Quench -
look for propagating modes -



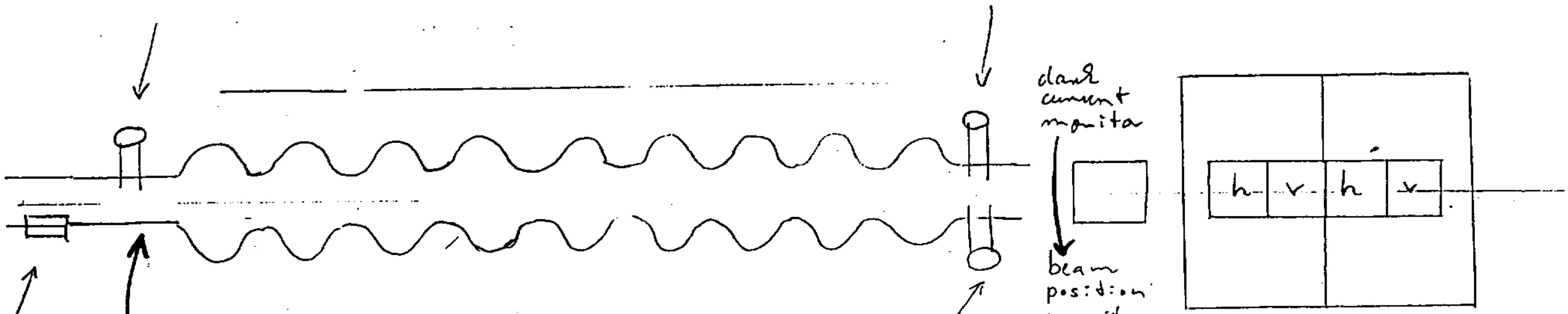
Cryomodule

8 x 9-cell cavity
1 x quadr. module
24 thermometers (shield, structure)

He-level monitor not in each cryomodule

HOM coupler 1
- 1 pickup (power extraction)
- 1 thermometer

HOM coupler 2
- 1 pickup
- 1 thermometer



stepping motor (tuning)

9-cell cavity / He-vessel
- 1 [?] pickups (rf-field measur.)
- 2 thermometers (1.8 °K)
- 2 vibration det. (horiz. vert.)
- 1 heater (?)

main coupler
- 2 pickups (electron/rf-field)
- 2 thermometers (4.0 °K, 40 °K)
- spark detectors

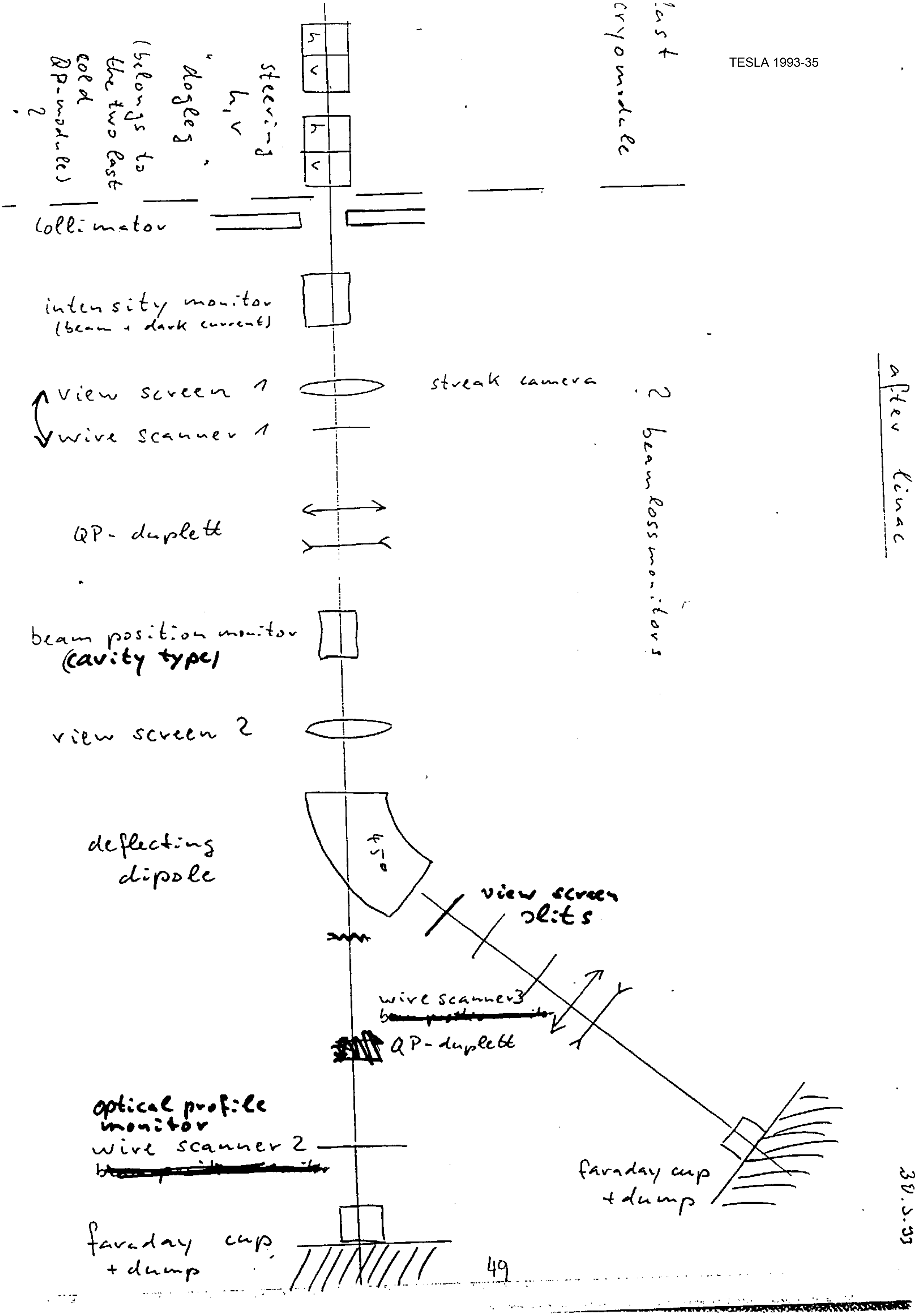
! 1 thermometer at inner conductor 70 °K !

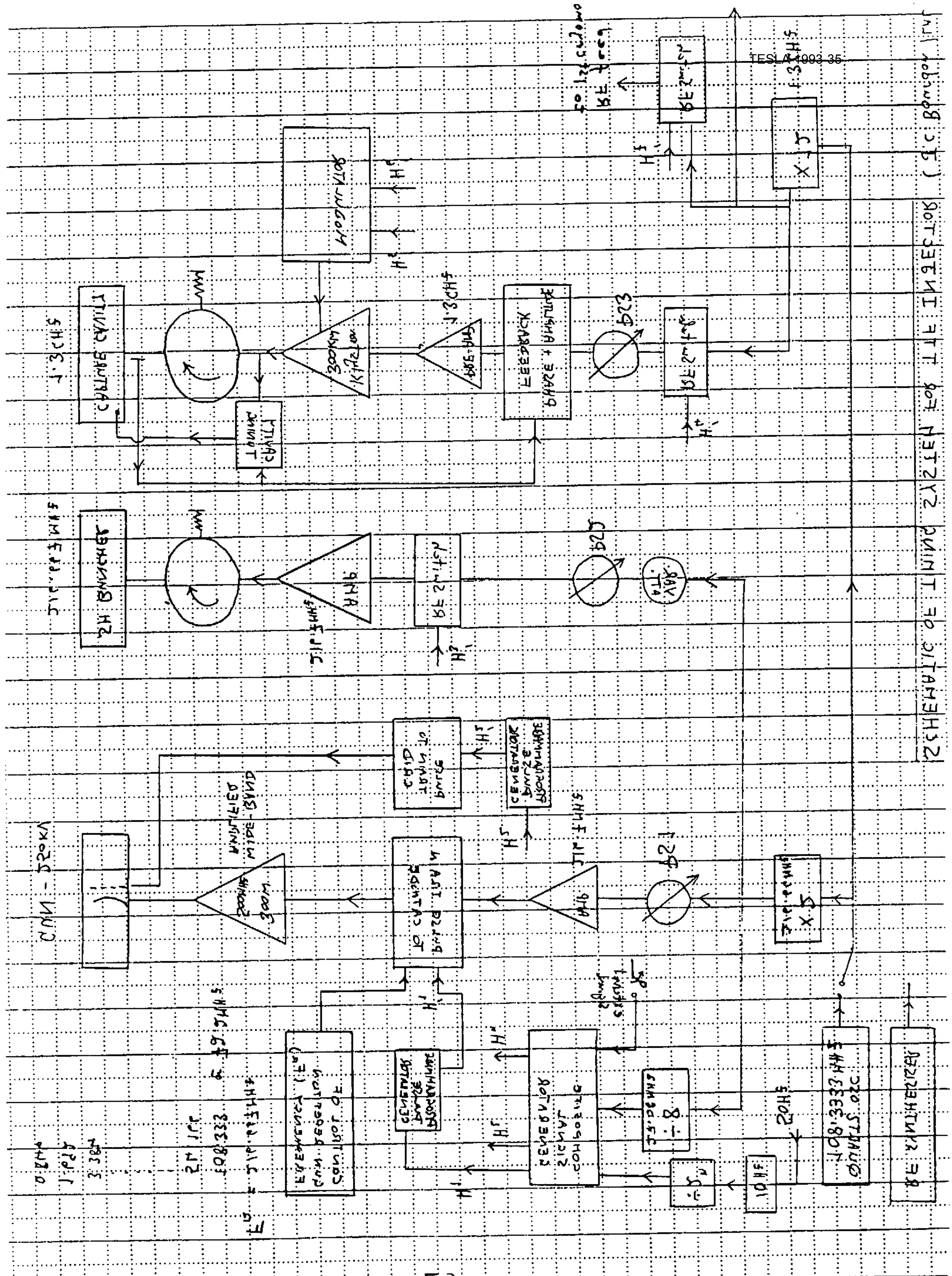
dark current monitor

beam position monitor (pill-box)

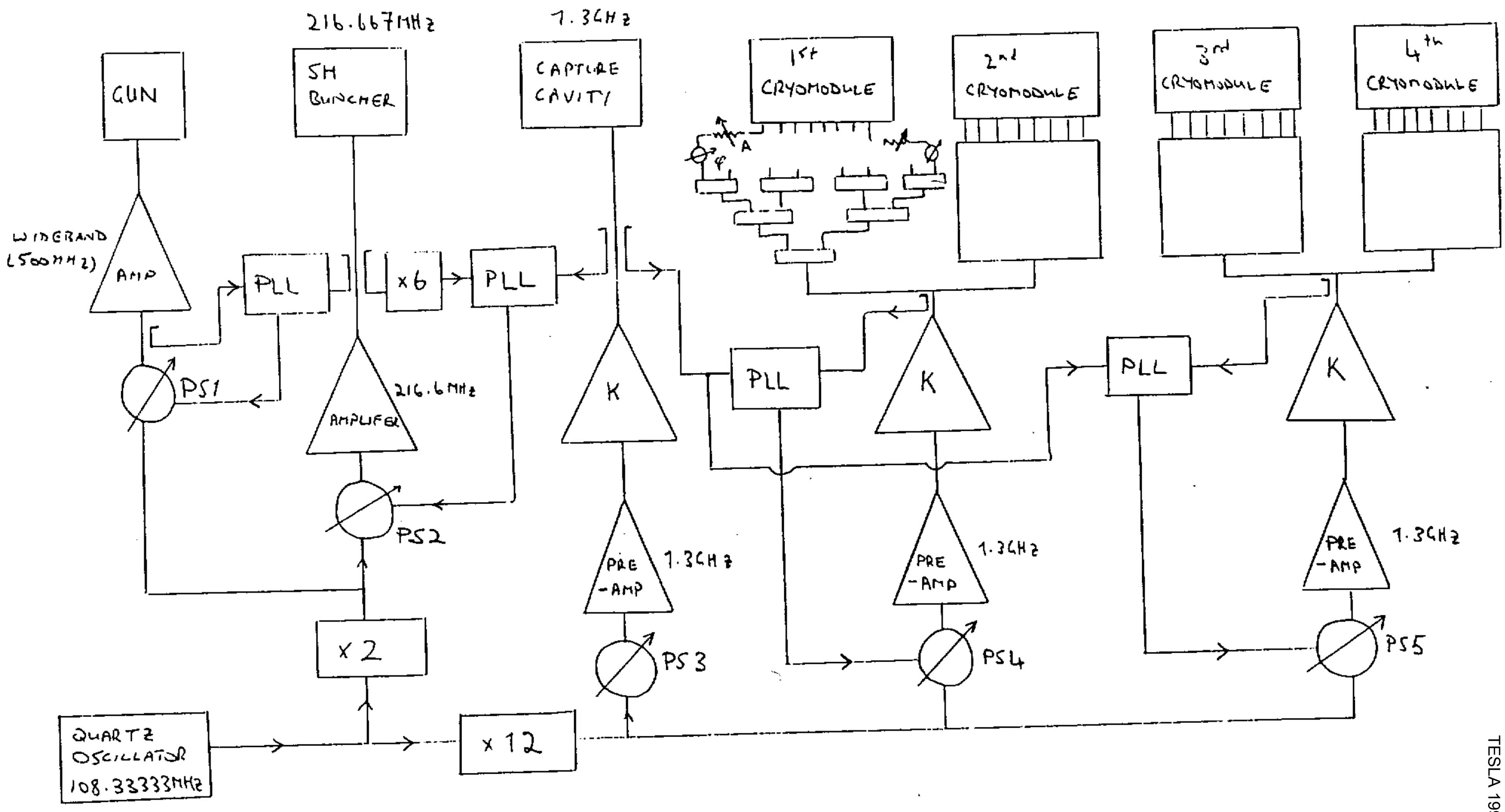
quadrupole-duplett
horiz. and vertical correction dipol duplet
(shifting quad. axis; 1cm, dogleg offset)
- 4 thermometers (PT1000, 4 °K)
- 2 vibration detect.
- 2 leads in series for quad. dupl.
- 2 x 3 leads in series for dipol pairs
- HOM-absorber (calorimeter?)

beam loss monitors


last cryomodule
steering h, v
„doglegs"
(belongs to the two last cold QP-modules) ?
h
v
h
v
collimator
intensity monitor (beam + dark current)
view screen 1
wire scanner 1
streak camera
2 beamloss monitors
after linac
QP-duplett
beam position monitor (cavity type)
view screen 2
deflecting dipole
45°
view screen
slits
wire scanner 3
QP-duplett
optical profile monitor
wire scanner 2
faraday cup + dump
faraday cup + dump
30.3.93


TESLA 1993-35
SCHEMATIC OF TIMING SYSTEM FOR THE INJECTOR
RF SYNTHESIZER
108.3333 MHz QUARTZ OSC.
10 HF
20Hz
COMPOSITE SIGNAL GENERATOR
PULSE TRAIN TO CATHODE
AMP
GUN - 250kV
WIDE-BAND AMPLIFIER
SH BUNCHER
CAPTURE CAVITY
MODULATOR
PHASE + AMPLITUDE FEEDBACK
RF SWITCH
x 2
x 12
216.66 MHz
1.3GHz

DISTRIBUTION and REGULATION of RF POWER (J.C. Bourdon/LAL)



EXPERIMENTS on MACSE.

- MACSE running for accel. develop^{ts} until installation of TTF injector (end '94)

- RF Control Developments:

Same detuning effect as in TTF:

	MACSE	TTF	
$\Delta f / \Delta E^2$	4.5	0.6 – 1.6	
Eacc	5-10	15	$\Rightarrow \approx$ Same Δf.

(1) { • One Klystron / cavity
• One K for 4 cavities

beam simulated by RF perturbation

(2) With beam

$Q_{ex} = 1\text{-}2\,10^7$

$\Rightarrow$ $E_a \simeq 10$ MeV/m, $I \simeq 1$ mA } $\Rightarrow$ 100% beam loading

With slight modification of the injector starting in September:

2 RF control system will be tested:

- → Frequency jump method (DESY)
- → Self excited loop. (Saclay)

With a 1mA pulsed beam, MACSE can be used to test RF and beam behavior of TTF.

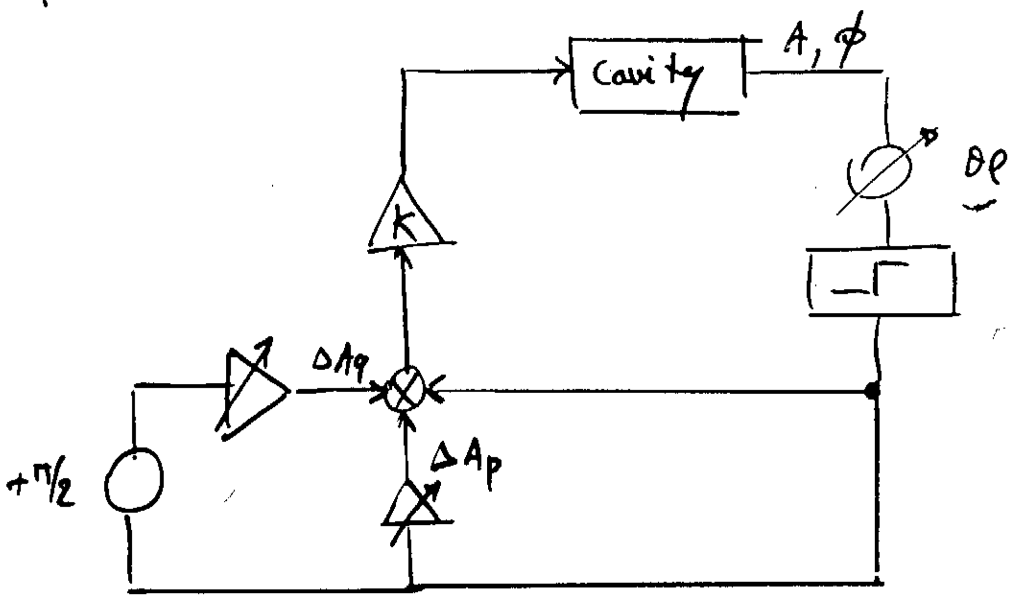
Measurements of E, ΔE available, with a beam from injector well defined ($\delta E \simeq 10$ keV)

Final Stabilization with feedback loops. Darmstadt.

Goal = the control system must stabilize the phase without amplitude perturbation

→ Complex Phase Modulator
a "in quadrature" signal is added up for phase rotation → the amplitude is constant.

Example for the self-excited loop:



Feedback loop: "in phase" $\Delta A_p = k_a (A_{ref} - A)$

"in quadrature" $\Delta A_q = k_q (\phi_{ref} - \phi)$

self-excited loop. (Saclay development)

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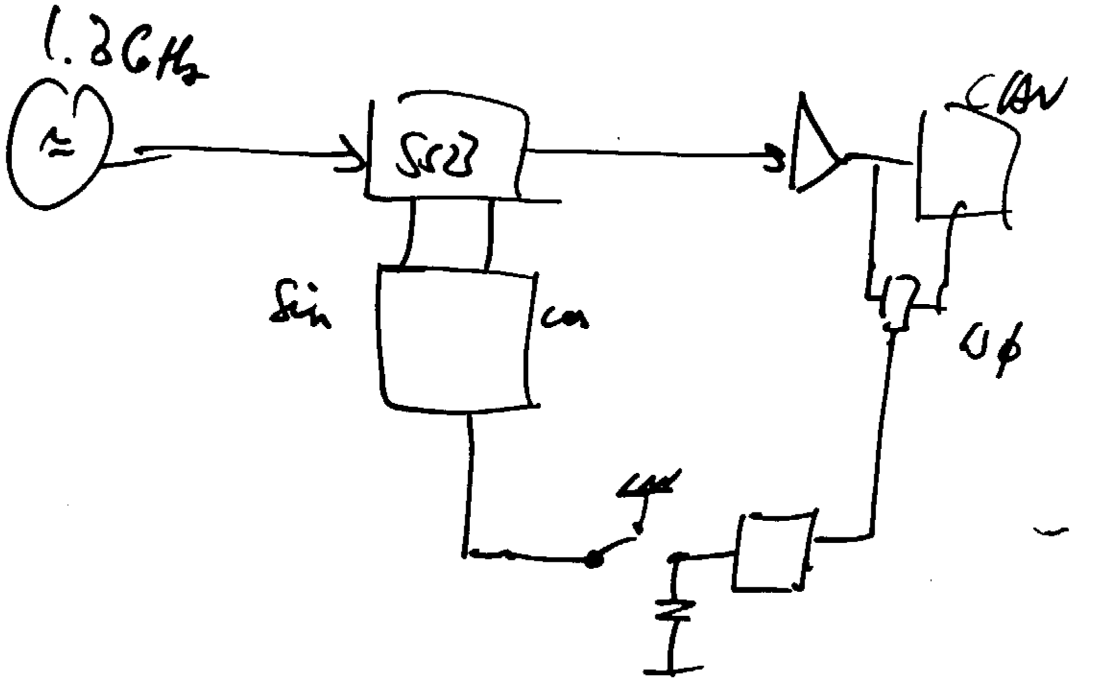
Frequency Jump Method.

(DESY development)



CAV tuned to 1.3GHz+Δf at high field

WAKE FIELD STUDIES W. BEAM

- **Multibunch**
  - Inject beam off axis - Non accelerated. Look at deflection after 1 module
  - . bunch frequency = 1 MHz
    - Tuning of one dipole mode at $F = F_{rep}(1 \pm \frac{1}{2R})$

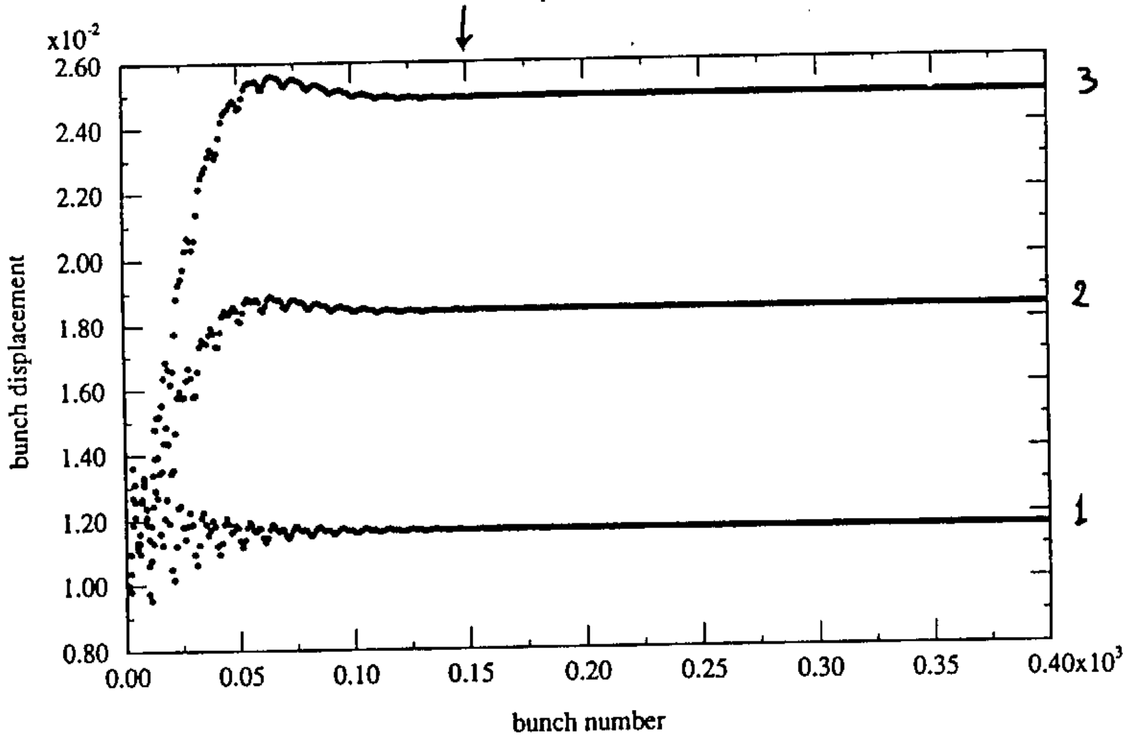
  ⇒ Measurement of the damping of individual modes!

  - Needs $N \gtrsim 10^{10}$ e^-/bunch -

- **Single bunch**
  - Inject at 1 cm from axis
  - Meas^t of deflection of the tail after one module

Multi bunch

steady state



Multibunch Instability. bunch spacing = 1 μs

TempleGraph 2.5, Origin: mosnier@seas63 - Fri Apr 16 15:16:45 1993 (data file was res9)

same offset 10 mm 10 deflecting modes

frequency spread = 1 MHz

cavity scatter = 500 μm

observe at the BPM located at the end of 1st module

1) with the natural mode frequencies

2) To study each mode individually.

Tune the 1st cavity to the resonant excitation

$F_{res} = n F_{rep.} (1 \pm 1/2Q)$ tuning range ± 1 MHz (HOMs)

→ measurement of the damping of the mode.

Example F = 1874 MHz $Q \simeq 10^5$ $R/Q = 8.6\ 10^4\ \Omega/m^2$

→ ≃ 8 mm displacement

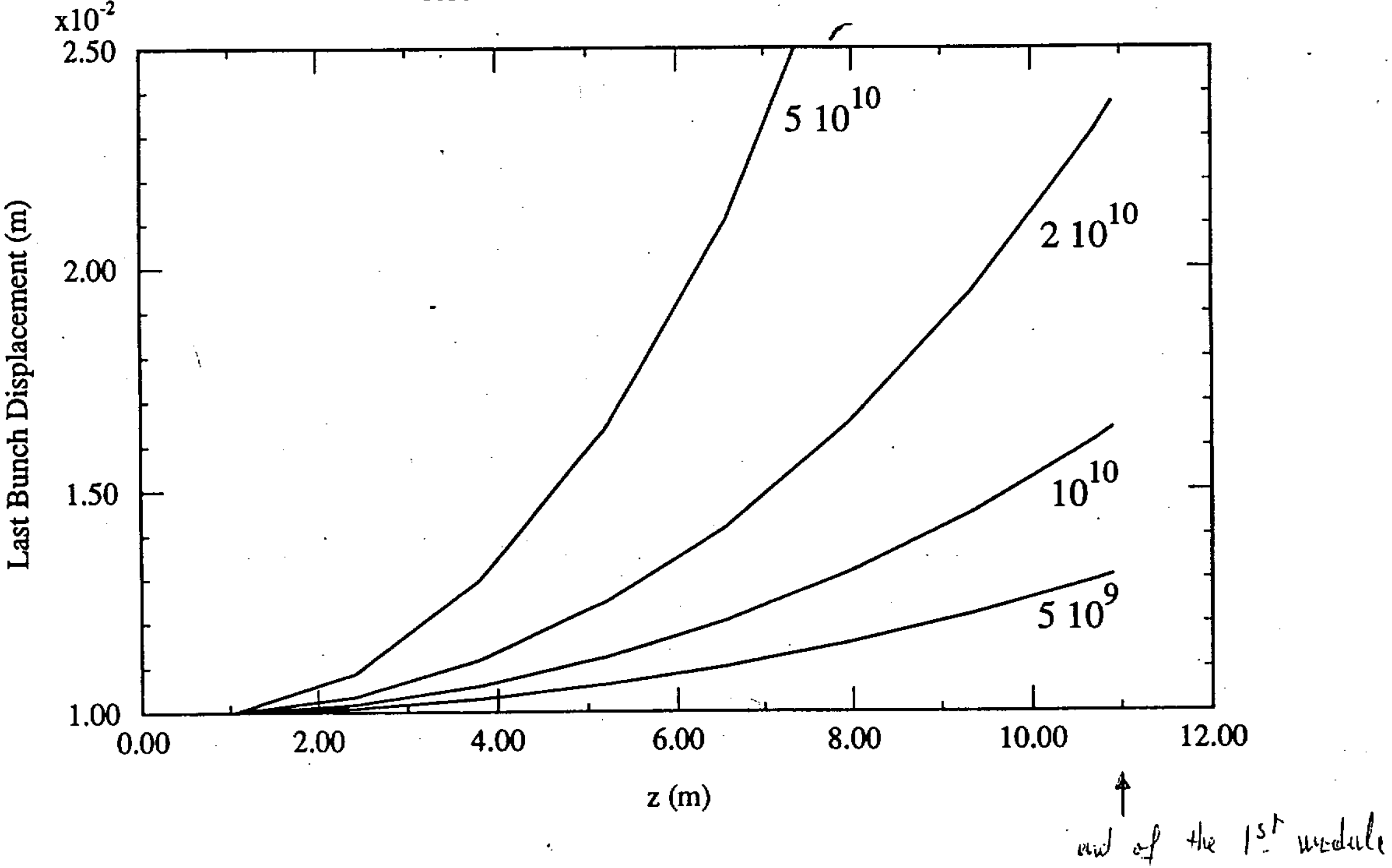
3) Tune the 1st and the 2d cavities.

→ ≃ 15 mm displacement

Resonant condition for the 8 cavities of 1st module

→ $N > 10^{10}$

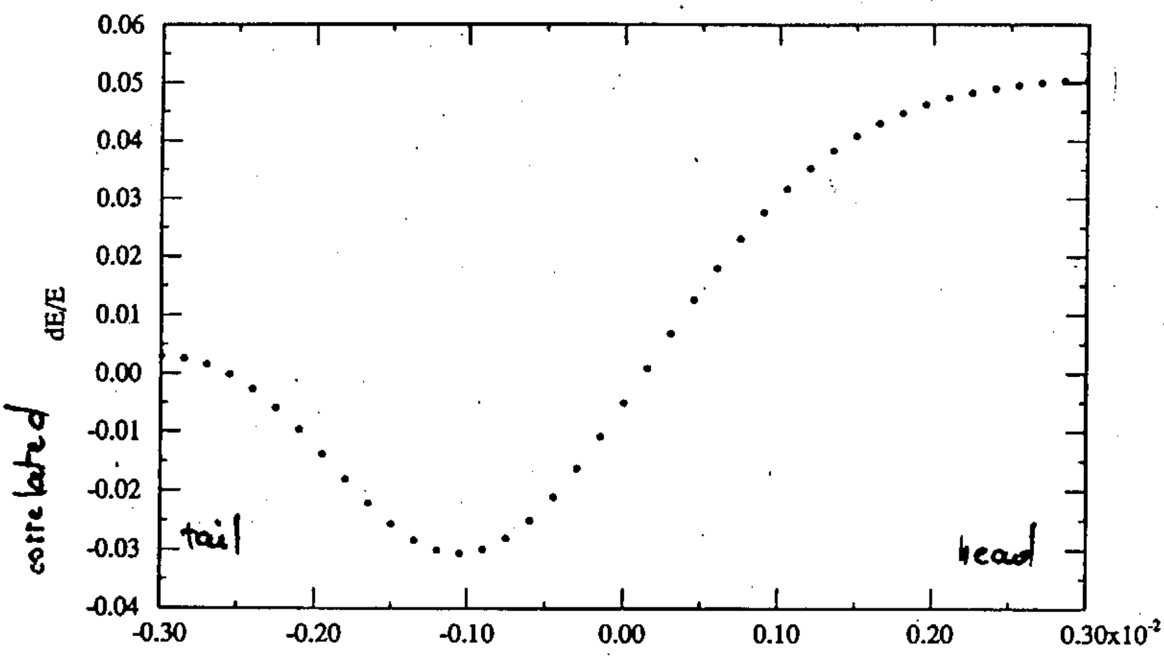
Frep = 1 MHz



TempleGraph 2.5, Origin: magne@seas65 - Mon May 24 18:34:00 1993 (data file was /usr/tmp/TG.AAAa05241)

Example of wakefields study in TTF

Single Bunch



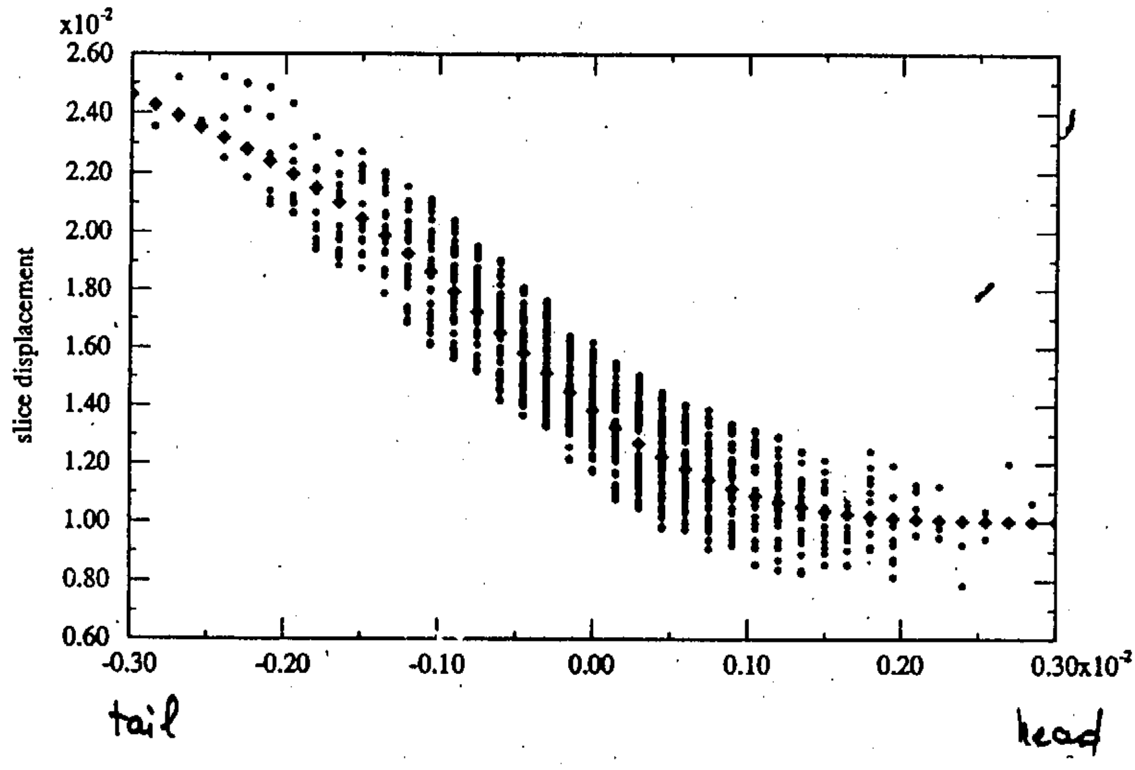
Inject a beam ($N = 5\,10^{10}$) in one module (8 cavities)

Energy = 14 MeV without acceleration beam offset = 10 mm

TempleGraph 2.5, Origin: moenier@seas63 - Fri Apr 16 18:15:56 1993 (data file was res1)

longitudinal wakes → σ_E/E = 2.5 %

Transverse wakes → tail displacement = 15 mm



TempleGraph 2.5, Origin: moenier@seas63 - Fri Apr 16 18:27:35 1993 (data file was res3)

Two test Cavities

Delivery 2 cavities Aug 15

room temp measuments Sept 1
Desy - 2 weeks

Cavity 1
treatment + test
Saclay - 2 weeks Sept 21

Cavity 2 - Desy Sept 17
commission - clean room, ↓
chemistry, water.
Oct 1

Refrig + RF Desy
vert dewar deliv Sept 1
4 deg Refrig Oct 1
2 deg " Nov 1

RF Desy test 200W - Cav1 Oct 1
(Saclay top plate?)

4 deg test - 200W
$Q \sim 5 \times 10^8$
$\sim$ 4-5 MV/m

Alternative proposals -

depending on schedules
+ delivery charges -

A) Send both cavities to Saclay for certification

Cav 1 → Saclay T+T measure. → DESY T+T measure (2nd)

Cav 2 → Saclay T+T measure. → DESY measure (1st)

B) Heat treatment. -
if Q bad (at Saclay)
then send to Cern for
heat treatment (2 weeks)

Also - send one to Stanford
for mechanical + vibration analysis
in spring when can free it up.

D. Trines -MKV-

Hamburg, 5.7.93

Summary from CRYOGENICS GROUP
on TESLA Workshop 1 -2 June 1993

Participants:

CEBAF	C. Rode
DESY	Horlitz, Knopf, Lierl, Renken, Petersen, Sellmann, Wolff
FNAL	T. Peterson
INFN	Allesandria, Castagna, Tazzari
ORSAY	Buehler, Junquerra
SACLAY	J. Gastebois

Topics Addressed:

1.) Capture Cavity
2.) Modefication Input Coupler
3.) Number, Type and Position of Sensors in Cryomodule
4.) Specification Cryomodule

1.) <u>Capture Cavity</u>

It was agreed on the cryogenic connection of the Capture Cavity Cryostat to the feedbox. There will be a vacuumbarrier at the C.C.C. to the transferline to the feedbox.
The necessity to align the C.C.C. after installation was discussed. It was agreed that an alignment of the cavity in the cryostat in situ is not necessary.
An additional helium connection at the cavity to the level container, as proposed by Orsay, was discussed. We reached agreement, that this connection was not necessary.

The problems with the pressure code - due to the fact that the cavity vessel will not be an accepted pressure vessel - were discussed. The vacuum vessel has to fulfill pressure code regulations. The problem is similar as for CHECHIA and the cryomodule. The main task is to verify and convince authorities that the steel vacuum tank does not get colder than - 50° C in case of a break in the helium vessel. Tom Peterson will investigate the problem for all three cryostats.

The design goal for the static heat load of the C.C.C. remains to be specified.

The layout of the transferline between C.C.C. and the feed has to be specified especially the distance between tubes, to allow for an easy welding connection.

2.) <u>Modification of the Input Coupler</u>

In the older layout of the cryomodule the distance between the outer radiation shield and the connection flange for the input coupler was felt to be too small. The layout has been changed and is already incorporated in the latest drawings.

3.) Number, type and position of thermo sensors

A new table was made up, which has been distributed already, for the number and type of thermometers. The main change occured in the number of sensors on the radiation shields for the first cryomodule. There will be 28 thermo sensors per shield to measure the temperature distribution sufficiently.

4.) Specification of cryomodule

A first draft for the specification of the cryomodule was distributed by S. Tazzari. Due to lack of time it was not discussed in detail. It was agreed that on an extra meeting beginning of July the text of the specification and the drawings should be finalized.

Some smaller items were discussed (see transparencies).

Ø H. Edwards

TESLA 1993-35

CENTRE D'ETUDES DE SACLAY

DEPARTEMENT D'ASTROPHYSIQUE, DE LA PHYSIQUE DES PARTICULES, DE LA PHYSIQUE NUCLEAIRE ET DE L'INSTRUMENTATION ASSOCIEE

TELEFAX

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DESY

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For any trouble concerning this transmission, please call : (33) 1 69 08 21 01.

Number of pages (including cover sheet) : ______

BRIEF FAX NOTE :

Here are very late meeting notes of our meeting of may 19.

Sincerely

date : 16 june 1993

P. TOTAL 06

CEN SACLAY
DAPNIA/SGPI
Ph. Leconte

TESLA TEST FACILITY
19/5/93 MEETING AT DESY
on helium tank, cold tuning system and cavity design

Participants : D. Trines, H. Kaiser (DESY)
M. Maurier, Ph. Leconte (Saclay)

Copies : Participants + B.Aune, J. Gastebois, A. Mosnier

1) Safety

Niobium (or Titanium) as part of the helium Vessel create a safety problem as none of these material are certified in the pressure vessels safety regulations.

32 connected vessels must be considered as a unique vessel => safety regulations to be applied.

Proposed solution : the vacuum vessel must stop any projected part following an explosive event. It should be calculated to support the notch impacts even though the loss of coolant has modified the mechanical properties of the vacuum tank wall. As a result stainless steel should be used instead of soft magnetic perm iron which becomes fragile under - 50°C.

2) Flexible part of the helium vessel required for cold tuning.

DESY proposes to use a commercial bellow from Calorstat (or to derive from this design a titanium bellow in order to avoid the Nb/SS transition.

3) Important stress is supported by the Nb part of the vessel which is welded to the cavity. DESY has tried many designs and calculated the corresponding maximum stress. Conical designs provide less stress but require more material and more machining. A flat design is preferred.

4) Making the complete helium Vessel from titanium may be simpler (no transitions) and provide almost zero differential shrinking. The cost per volume is the same between SS an Ti. However, the Young modulus is twice lower, thus requiring twice as much material. for an equivalent rigidity.

5) The mechanical stability of the helium Vessel is important because, it is a part of the cold tuning system. It should resist to variations of the helium pressure. T. Peterson has made a calculation showing that when the RF is fired with full power into the whole set of 32 cavities, the helium pressure will vary by as much as 0.22 mB per minute.

6) Beam pipe bellow between cavities.

Flexibility range evaluation considering that the cavity helium vessels are fixed at one end on the Ø 300 mm return pipe :

Relative thermal shrinking	dx	
	Ti Vessel mm	SS Vessel mm
1) Ret. Pipe at 300 K Cavity at 300 K	0	0
2) Ret. Pipe at 300 K Cavity at 2K	1,5	3
3) Ret. Pipe at 2 K Cavity at 2 K	1,5	0
4) Ret. Pipe at 2 K Cavity at 300 K	-3	-3

As the cavity is produced with a ± 5 mm tolerance on the length after field flattening and tuning, the total range of the bellow must be ± 8 mm.

Existing data from Calorstat give for a bellow with internal Ø 84,2 :

Waves	length	flexibility
#	mm	mm
5	33	7,5
15	95	25
10	66	15
7	50	10

7) Axial tolerances on cavity position

will be set by optical alignment, so that these tolerances apply only for relative displacement during cold tuning

$$\Delta r = \pm 0.2 \text{ mm}$$

8) The design of the helium tank and of the cold tuning system would be greatly simplified if a decision is made between the two HOM design (F or G)

A possible change of the angular position by 15° of the G. HOM can still occur.

9) Cold tuning system design

DESY will make a shoe shaped piece to distribute the stress between the CTS and the cavity. It will be made out of Titanium.

Saclay will connect the CTS on this shoe by the help of two screws.

10) Design of the end of the helium vessel.

A thick plate (20mm) will close both ends of the helium tank. The CTS will be fastened by adjustable screws to the end plate.

11) Distance between cavities. A. Mosnier should say which distance he wants.

12) Required information for studies of the CTS

- distances between helium vessel and plates and iris
- distance between shoe shape piece reference place and iris

These information will be given by H. Kaiser as soon as possible.

DEUTSCHES ELEKTRONEN – SYNCHROTRON DESY TESLA 1993-35

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TO/AN:	00331 69088138	Saclay	Dr. Ph. Lecomte	1

	Sender / Phone / Dept. / Absender / Telefon / Abt.	When replying please use: Fax No. / Bei Antwort wählen Sie bitte Fax-Nr.:	Date / Datum
FROM/ VON:	DESY 040/8998-3284 H. Kaiser, MPL	40 8994 4305	7.7.93

Dear Dr. Lecomte,

thank you for your meeting notes, Trines and I have the following comments:

Concerning 1) Stainless steel would only be necessery if the temperature of the vacuum vessel should drop below 50°C. Our estimates indicate, this is not the case.

Concerning 5) The 0.22 mbar/min rate would occur only if no counter-measures, like activating a heater, were taken

Concerning 6) In the table for 3), Ti vessel it must be −1.5.

Missing points:

- The tuning mechanism would guide the cavity end – since the bellow cannot.

68

- Between iris and beam tube flange 114 mm are reserved for the tuner.

Best regards H. Kaiser

D. TRINES

CRYOGENICS DISCUSSION GROUP

[1-2 JUNE 93]

PARTICIPANTS :

CEBAF	C. RODE
DESY	HORLITZ KNOPF LIERL RENKIN PETERSEN SELLMANN WOLFF
FNAL	T. PETERSON
INFN	ALLESANDRIA CASTAGNA TAZZARI
ORSAY	BUEHLER JUNQUERA ~~BOURDON~~ ~~GARVEY~~
SACLAY	GASTEBOIS

TOPICS

- CAPTURE CAVITY
- MODIFICATION INPUT COUPLER
- NUMBER + TYPE OF SENSORS + POSITION, CABLES, FEEDTHROUGHS
- SPECIFICATION CRYOMODULE

CAPTURE CAVITY

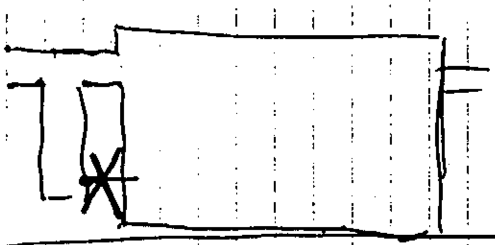
- CRYOGENIC CONNECTION AGREED ON

[IF FEED BOX NOT AT CRYOMODULE AND PROBLEMS WITH PATH OF TRANSFER LINE → PUT JT - VALVE INTO FEED CAN OF CRYO MODULE]

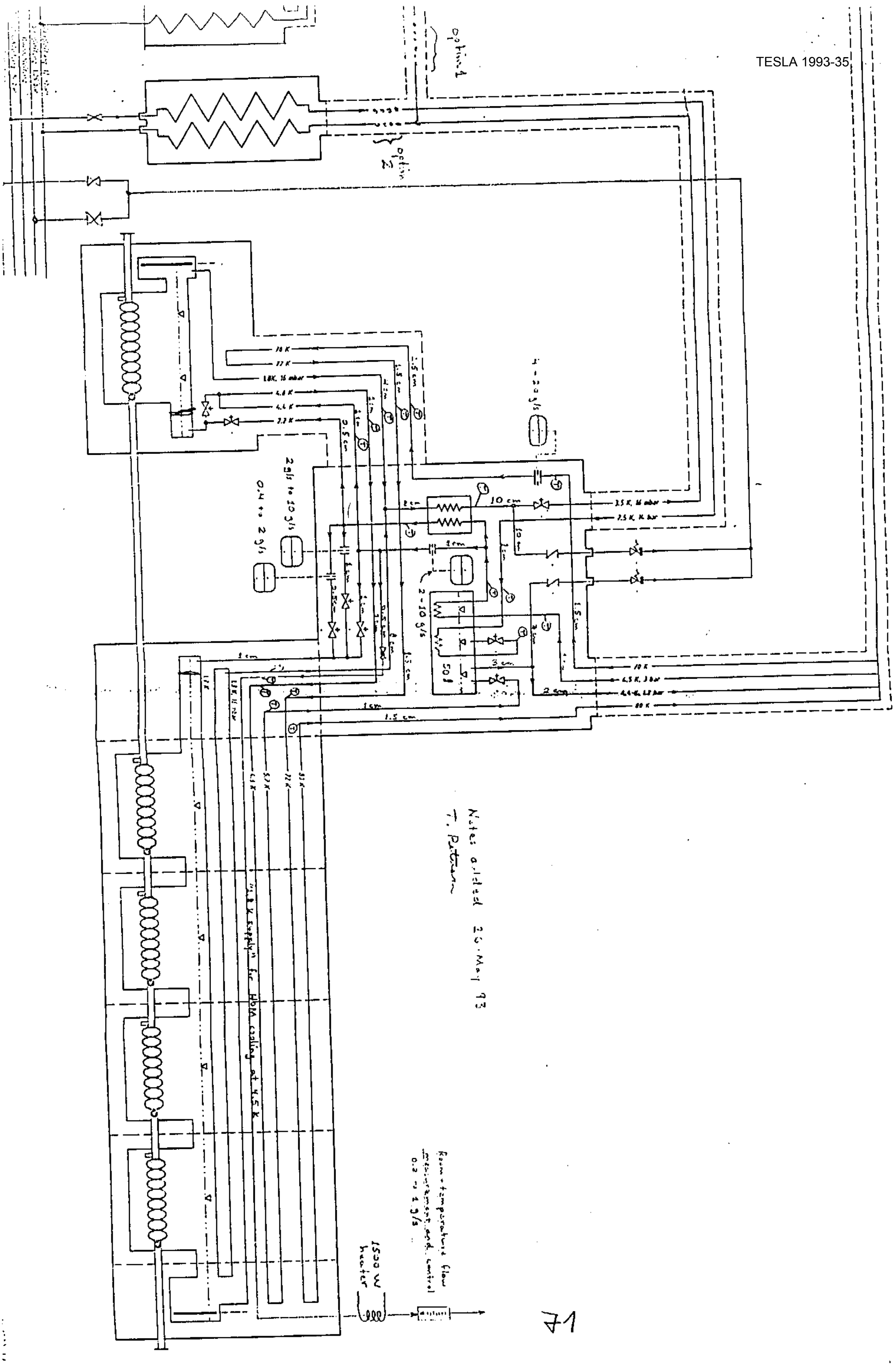
ADJUSTMENT OF COLD CAVITY IN CAPTURE CAVITY CRYOSTAT NOT NECESSARY

THERE WILL BE A VACUUM BARRIER AT C.C.C.

ADDITIONAL HELIUM PIPE BETWEEN CAVITY - HELIUM VESSEL AND LEVEL CONTAINER NOT NECESSARY



PROBLEMS WITH PRESSURE CODE WILL BE CHECKED


option 1
option 2
10 cm
3 cm
50 l
2-10 g/s
2 g/s to 20 g/s
0.4 to 2 g/s
1.5 cm
70 K
80 K
1500 W heater
Notes added 26. May 93 T. Peterson

DESIGN GOAL ON STATIC HEAT LOAD OF CAPTURE CAVITY HAS TO BE SPECIFIED

TO MAKE WELDING CONNECTION OF TRANSFER-LINE TO C.C. DISTANCE BETWEEN ADJACENT TUBES HAS TO BE SPECIFIED.

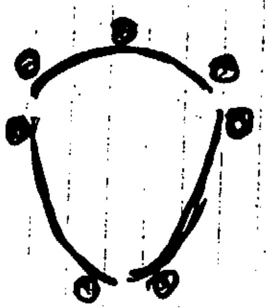
MODIFICATION OF INPUT COUPLER

HAVE BEEN INCORPORATED. IN DESY-DESIGN THERE IS A NEW DRAWING.

NUMBER AND TYPE OF THERMO SENSORS

NEW TABLE.

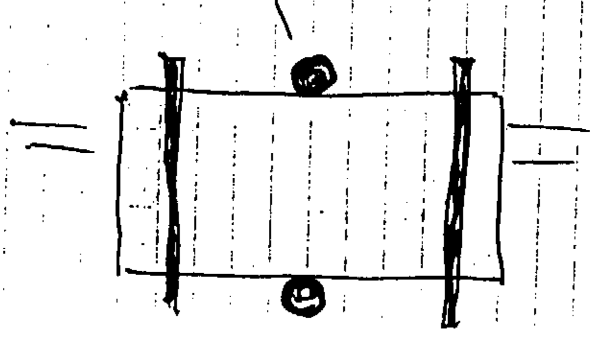
MAIN CHANGE ON SHIELDS



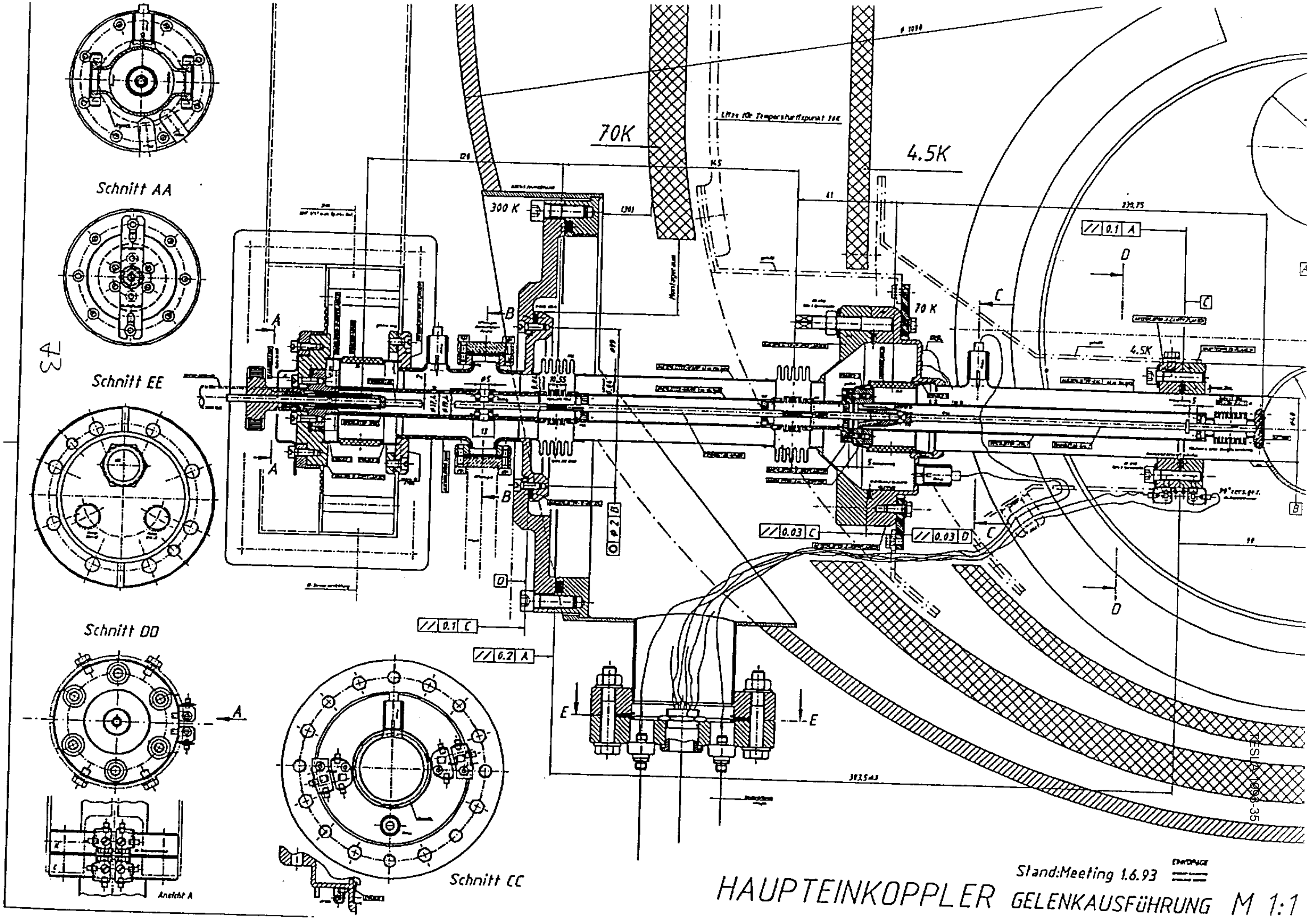
$7 \times 4 = 28$ / SHIELD

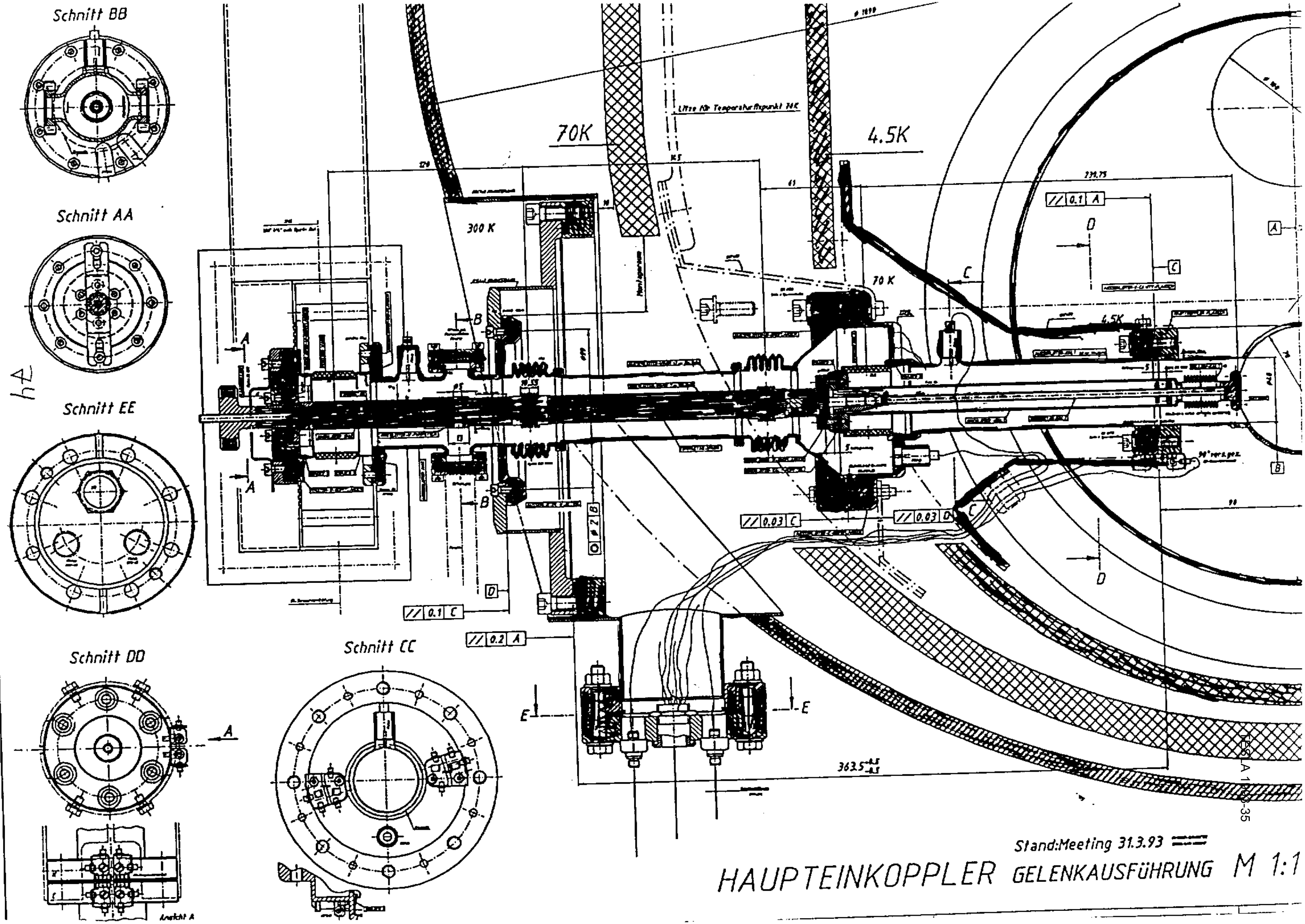
FOR FIRST MODULE.

POSITION



MOUNTED ONTO CAVITY BEFORE HANGING CAVITIES FROM SUPPORT TUBE


70K
4.5K
300 K
70 K
Schnitt AA
Schnitt EE
Schnitt DD
Schnitt CC
Ansicht A
Stand:Meeting 1.6.93
HAUPTEINKOPPLER GELENKAUSFÜHRUNG M 1:1


Schnitt BB
Schnitt AA
Schnitt EE
Schnitt DD
Schnitt CC
70K
4.5K
300 K
70 K
4.5K
Litze für Temperaturfixpunkt 70 K
// 0.1 A
// 0.1 C
// 0.2 A
// 0.03 C
// 0.03 D
363.5
Stand:Meeting 31.3.93
HAUPTEINKOPPLER GELENKAUSFÜHRUNG M 1:1

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FIRST MODULE

Tabelle

ORT	TYP	Stückzahl/Cavity	Stückzahl/Modul
Cavity Heliumbehälter	TSC 1.8	2	16
HOM-Coupler	TSC 1.8	2	16
Input Coupler	TSC 4.5 PT 1000	1 1	8 8
300 mm Ø Tragerohr	TSC 1.8		6
100 mm Ø Verbindungsleitung	TSC 1.8		1 im Gas
2.2 K Vorlauf	TSC 4.5		1 im Gas
4.5 K Vorlauf Rücklauf	TSC 4.5 TSC 4.5		1 im Gas 1 im Gas
70 K Vorlauf Rücklauf	PT 1000 PT 1000		1 im Gas 1 im Gas
4.5 K Schild	TSC 4.5		~~12~~ 8 28 7x
70 K Schild	PT 1000		~~12~~ 8 28
(QUADR.)	(TSC 4.5)		~~4~~ (2)
ABSORBER	~~TS~~ PT1000	~~TSC 4.5~~	2
SUPPORT POSTE		~~PT1000~~	3
			3

~~PT 1000 16 Stück ≅ 300 DM) ohne~~

~~TSC 4.5 ~~17~~ 20 Stück ≅ 6800 DM) Elek-~~

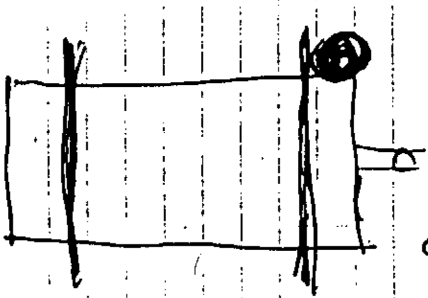
~~TSC 1.8 ~~38~~ 39 Stück ≅ 15200 DM) tronik~~

~ 22000 DM

BEAM TUBE TSC 1.8 1

VIBRATION DETECTOR

1/CAVITY



PATH OF CABLES AND MECHANICAL, THERMAL FIXPOINT
WILL BE DESIGNED BY INFN

FEEDTHROUGH

12 PIN FAECER

LARCER FEEDTHROUGH ARE NOT LEAKTIGHT

HEATERS

THERE WILL BE NO HEATERS ON
THE CAVITIES

COAX CABLES

SMA

TABLE 4.6.1.T - LIST OF DIAGNOSTIC WIRES AND COAXIAL CABLES

Diagnostic Wires

Item	Position	# of items per pos.	# of pos.	Overall # of items	# of wires per item	Overall # of wires	# of 12-pin connectors	Feedthr. flange
Thermoresist.	Cavity	14	8	112	4	448	40	MC
Thermoresist.	Shield sect.	3	12	36	4	144	16	Qp/ L
Thermoresist.	Gas Ret.Pipe	8	1	8	4	32		
Thermoresist.	Reserve	4	1	4	4	16		
Thermoresist.	Quadrupole	2	1	2	4	8	1	Qp/ S
Thermoresist.	Quadrupole	2	1	2	4	8	1	Qp/ L
Heater	Cavity	1	8	8	2	16		
Motors	Cavity	1	8	8	5	40 (*)	5	Qp/ L
				180		672	63	

(*) : Running in metallic conduit

Coaxial cables

Item	Position	# of items per pos.	# of pos.	# of coax connectors	Feedthr. flange
RF p/ups	MC	2			MC
RF p/ups	Cavity	1	8	40	
RF p/ups	HOM	2			
RF p/ups	BPM	4	1	4	Qp/ L
Accelerometers	Cavity	2	8	16	MC
Accelerometers	Quadrupole	2	1	2	Qp/ L
				78	

Legenda :
- Qp/ L : Large diagnostic feedthrough flange next to Quadrupole
- Qp/ S : Small diagnostic feedthrough flange next to Quadrupole
- MC : Main Coupler feedthrough flanges

- Thermoresitor wires shall be type : QL-32 man. by Lake Shore Cryotronics Inc.,
- Coaxial cables shall be type : BN50085, man. by Coaxitube Corp.
- Multipin connectors shall be type : Jaeger 25-pin ? 12 bu
- Coaxial connectors shall be type :
- Motor wires shall be type :
- Heater wires shall be type :

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END CAP OF CRYOMODULE STRING

SUPPLIED BY INFN

RELIEF VALVE FOR VACUUM VESSEL

IN „SCHIEBEMUFFE"

DIAMETER WILL BE SPECIFIED BY T. PETERSON
TO KEEP PRESSURE IN VESSEL
BELOW 1.2 bar

TEST PRESSURE IN CIRCUITS

≤ 3 bar 1.8 K — 300 mm ∅, 100 mm ∅, CAVITY VESSEL

20 bar ALL SHIELD TUBES

SURVEY REFERENCE PLATES (S. WOLFF)

TWO PRECISE PLATES
ON TOP OF VACUUM VESSEL
FOR MOUNTING OF SURVEY EQUIP.

Summary: Workshop @ DESY 1Z2 June '93
Tesla Test Facility Working-Group 3
Instrumentation, Control, Safety and Interlock

Due to the short time to prepare this workshop, not all labs could be represented in this working group. Therefore we skipped the discussion on communication protocols and concentrated on the following topics:

- review of action lists
- from last workshop - DESY
- from workshop -SACLAY
- status reports from the individual subsystems
- discussion on the drafted paper from Fermilab

Since not all colleagues could attend the meeting on the 28-29 at SACLAY, here is a short summary: We agreed on the principals of a complete system layout. The main points are: X-Window for display, TCP/IP for communication, Ethernet as transport media, VME as front-end bus, VxWorks as real-time operating system. SACLAY will evaluate EPICS as application software. In addition it was agreed that all signals should be computer readable and ready for display on a screen. It will need further discussion whether those signals normally displayed on a scope should also be computer-ready. It was pointed out that all devices should have status bits which will be read by the computer and can be used to generate alarms. Last not least: Jean Francois Gournay was nominated for the coordinator of the injector controls.

Summary of action points.

A2: Vacuum
The vacuum pumps of MACSE are currently controlled by a different type of local controller (PLC), compared with those used at DESY. DESY and SACLAY should try to agree on a common controller and a common protocol to avoid unnecessary overhead.

A5: Beam Equipment
Reinhard Bacher has been nominated to coordinate the work on beam equipment for DESY.

A7: Clean Room
To be able to read-out the data from the particle measurement in the clean room, a special protocol to the local hardware has to be implemented.
M. Clausen takes this action.

A8: Timing
A. Gamp will coordinate the work on this point.

A9: Power Supplies
The magnets of the injector will initially be driven by the MACSE controllers. The final design will taken place in '94. To take the chance to use these controllers also for the rest of the Linac it is evident to know the requirements for the accuracy of the measurement and settings.

A10: Interlock
It is obvious that this work has to be coordinated and that we need someone ...DESY to be assigned.

A12: Several colleagues agreed to contribute to the paper. The final version shall be presented at the next workshop.

Review of status reports

SACLAY
The time until the MACSE operation finishes will be used to test equipment -specially the EPICS software will be tested. It will be also tested whether it will be possible to read-out a view screen directly into a SUN workstation.

Vacuum/DESY
The software development is in progress. Some problems occurred when interfacing to Profibus. K. Rehlich is confident to receive the proper hard and software in time. The colleagues in the working group encouraged him to acquire external help from a company to meet the time schedule.

RF
The development of the Lab-View software is on the way. There was a misunderstanding about the current status of the work. Not the whole programming had started two weeks ago but the work on the simulation part of it.
It still has to be worked out how the additional analog and digital signals - not covered by Lab-View - will be read into the TTF control system.

Cryogenics
While the controls are under way the preparation of the cryogenic plant and its subsystems for control still takes a lot of effort.

Next workshop
One important topic shall be 'communication protocols'. We hope that all interested colleagues will have the chance to join the meeting.

TESLA 1993-35

Action-List
June '93

1.RF / Cavity
-> A. Gamp / D. Proch (DESY)

a. additional channels
b. tuner control
c. closed tuning loops
d. coupler signals
e. diagnostic

2.Vacuum
-> K. Rehlich (DESY)
-> C. Henriot (SACLAY)
a. coordination on PLCs and communication protocols

3.Cryogenics
-> M. Clausen (DESY)
4.Injector
-> SACLAY

5.Beam equipment
-> R. Bacher (DESY)
a. what is already available

6.General Supply
-> J-P Jensen (DESY)
a. access to measured data

7.Clean Room
-> M. Leenen (DESY)

a. readout of particle measurement
-> M. Clausen

8.Timing
coordination:
-> A. Gamp (DESY)
a. master time clock
-> M. Shea (FNAL)
-> M. Gormley (FNAL)
b. 2nd time source requirements
c. timing @ DESY
-> M. Clausen (DESY)

9.Power Supplies

```
    a.  CERN protocol for power supplies
        -> J.F. Gournay (SACLAY)
    b.  power supplies @ DESY                                    done
        -> A. Millhouse (DESY)

    c. requirements for TTF magnets
        - accuracy
        -> S. Wolff (DESY)

  10Safety / Interlock
    a. interfaces between different systems

    b. requirements at DESY
        -> ?
  11Database (Off-line)
    a.  define requirements / kick off a meeting
        -> D. Gall (DESY)


  12 Paper on "Suggestions, Recommendations ..."
    -> all
```

Summary Group C
Controls

review of action-list

- timing → Alex Gamp
- Power supplies
  - resolution 12/16 bit?
- safety / interlock
  - responsible person @ DESY

Status Reports

- injector
- vacuum
  - VME/Profibus
    problem with drivers
    external software development?
  - VME/SEDAC
    in test
- RF
  - LabView
    - work started 2 weeks ago
    - usage of CEBAF code?
  - other signals
    - how to connect
- cryogenics
  - getting the existing system automated

M. Clausen

Proposed Agenda for the TTF working group on **Instrumentation, Control Safety and Interlock**

1%2 June 1993 @ DESY

1. Review of actions from last workshop @ DESY

2. Review of open questions from workshop @ SACLAY

3. Discussion on drafted paper from FNAL
   "SUGGESTIONS, RECOMMENDATIONS AND GUIDELINES FOR THE DEVELOPMENT OF TTF/TESLA CONTROL SYSTEM FACILITIES"

4. Communication protocols
   a. status
   b. demonstration

5. Timing
   a. requirements from other working groups
   b. available systems

6. Safety / Interlock
   a. requirements from other working groups
   b. who does the work?

7. Status Reports

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TTF Meeting April 28-29 at SACLAY

Meeting Notes on Instrumentation, Control, Safety and Interlock

by M. Clausen (DESY)

Cryogenic Instrumentation

1. Temperature Sensors

The temperature sensors will be of the RIVAC type a proposed by U. Knopf. The electronics to read out the sensors will be provided by DESY. This electronics will be based on SEDAC- the DESY in-house standard also used at HERA. To be able to read out the measurement from these SEDAC modules DESY will provide the software on a PC and the necessary interface to SEDAC. The software will be written in 'C'. The informations on the raw data and the converted data (in [K]) will be prepared in a table. SACLAY will adapt this code to communicate with their PLC .
SACLAY prefers the 'Borland-C' compiler. DESY will supply the software until beginning of June with the compiler currently used for SEDAC communication.

2. LHe Level

The LHe level will be read out by another SEDAC cassette. The measured data will also be available by the above mentioned program.

3. LHe Heater

The heater controls for the test at SACLAY will be supplied by SACLAY.

(additional minutes will be written by Mr. Pailler)

General Discussion on Controls

1. Compatibility

A list of suggested compatibility items was presented.(s. App.I)
There was a common agreement that the communication has to be provided through Ethernet and that standard communication software based on TCP/IP should be used. The resulting layout of such a system was presented (s. App. II) and discussed as a desirable solution.

2. Control Coordinator at SACLAY

Jean Francois Gournay was introduced to be the coordinator and responsible contact for the injector controls.

3. Availability of EPICS Software

The EPICS(Experimental Physics and Industrial Control System) application package will be used for the cryogenic controls at TTF. SACLAY is interested to evaluate this software. This would lead to a situation, where the software prepared at SACLAY could be directly used at DESY without any further modifications. Los Alamos Labs have already agreed that SACLAY might use the software in conjunction with their work for TTF. M. Clausen will contact LANL to make the software available to SACLAY.

4. Open questions from the controls discussion:

a. **Vacuum**
SACLAY uses PLCs based on GBUS running the MODBUS protocol.
At DESY both types are unusual. To be able to interface to the DESY vacuum system, it has to be discussed what the easiest way to interface will be.
If any DESY vacuum controls will be used at SACLAY, the interfaces and connectors will have to be specified.

b. **Interlock**
Interlocks at SACLAY are purely based on PLCs. This is in conflict with the DESY rules how signals related to personal safety have to be handled. Further discussions are needed.

c. **Cryogenics**
DESY will supply support for temperature read-out and level control for the tests at SACLAY

d. **Beam Instrumentation**
SACLAY will supply all the beam instrumentation for the injector. A complete list of these instruments will be made available. Further discussions are needed to find out whether this instrumentation might be used also for the high energy end of TTF.
It was agreed that all signals should be displayed on 'a' screen whenever possible. It is desired that signals normally displayed on a scope should be displayed on the workstation screen - when possible-.

e. **Timing**
The requirements for the TTF timing system need to be defined.

f. **RF**
What are the requirements for a control loop injector/TTF?
Is the cavity tuning system of MACSE usable for TTF controls?

g. **Space Requirements**
What are the space requirements for the injector controls?

h. **Requirements for General Supply**
- electric power (UPS?)
- water
- air

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App. I

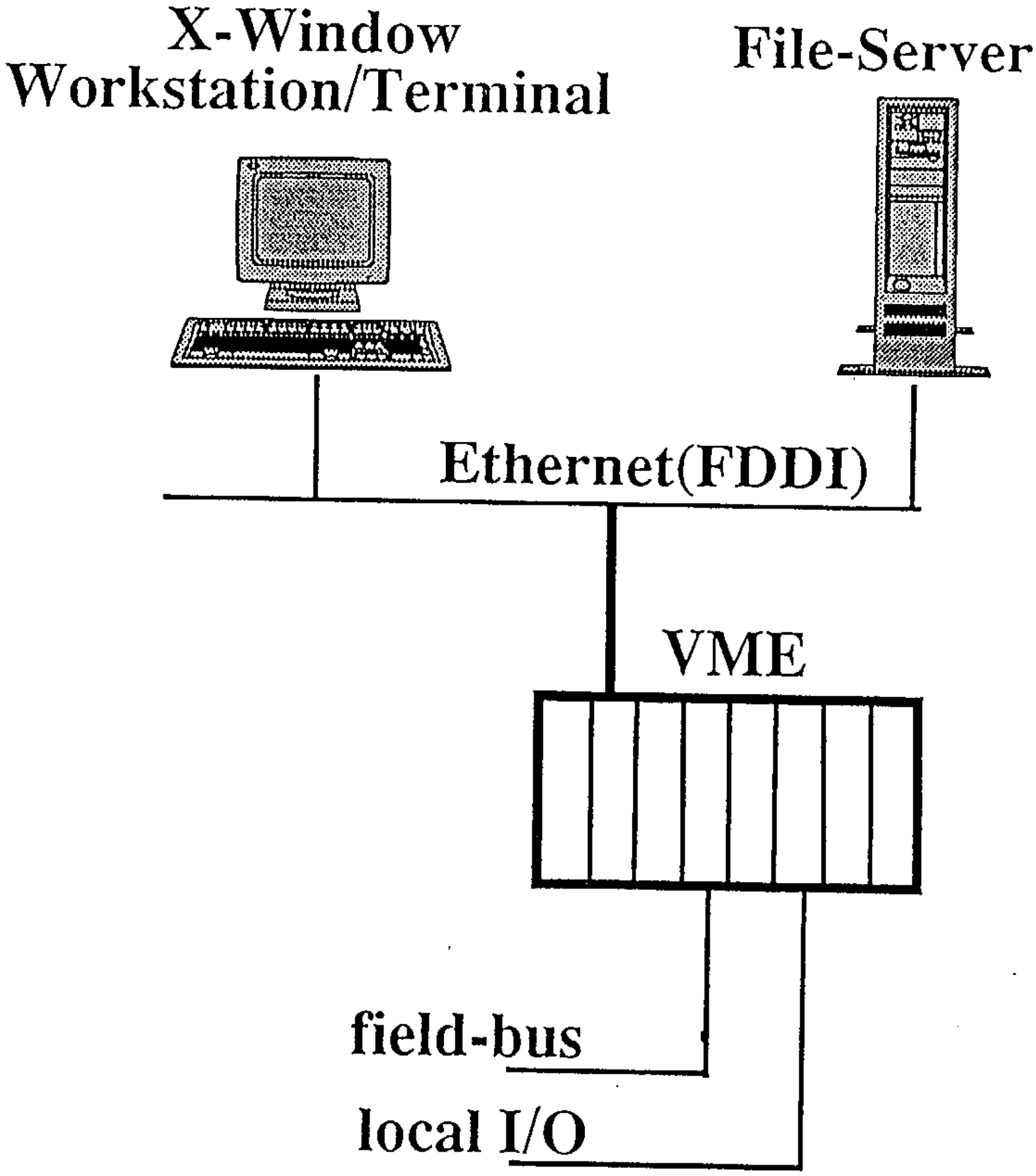
Installed equipment for TTF controls

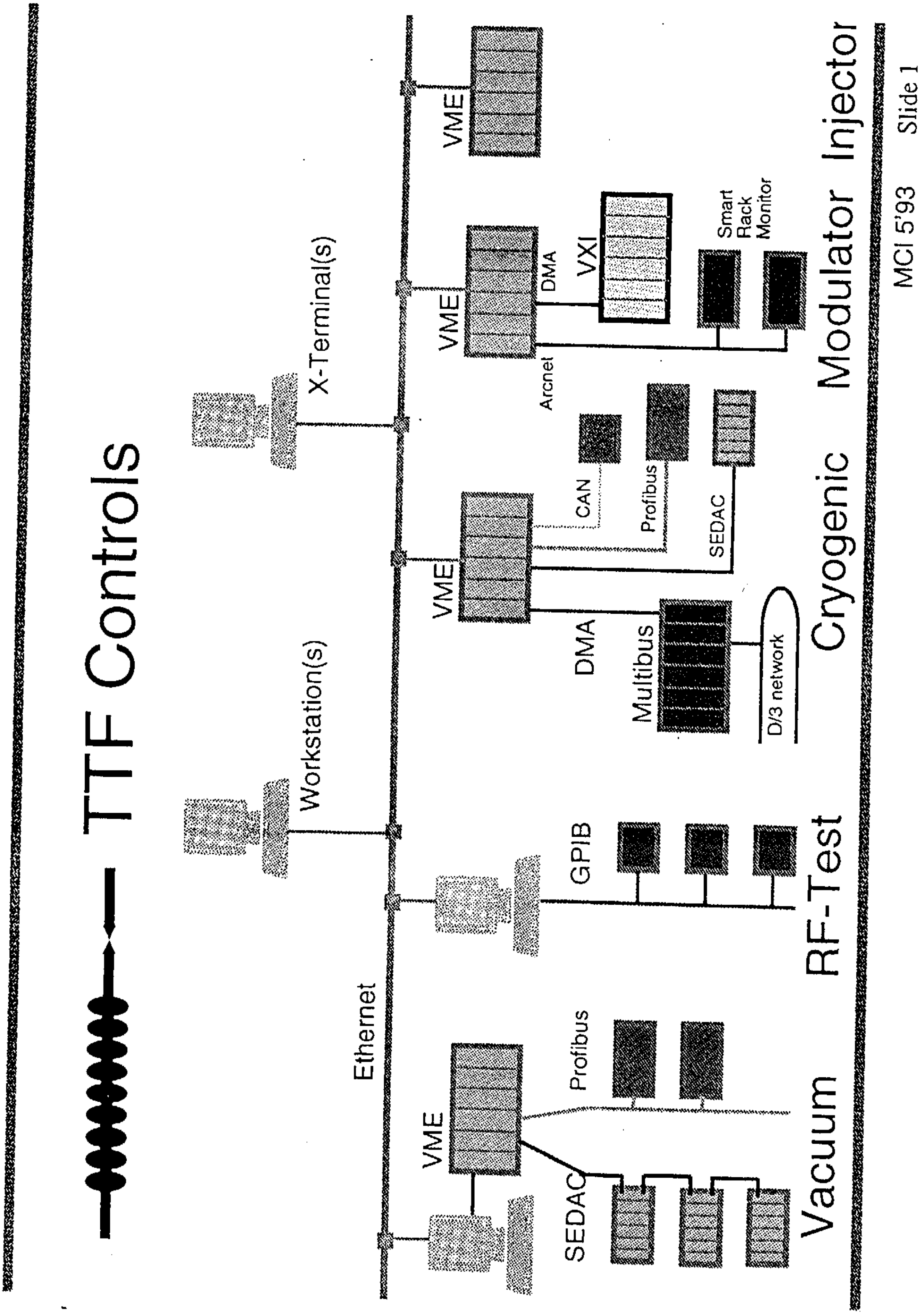
preferred equipment is **bolded**

- workstations and development systems
  SUN (SUN-OS)
  DEC-ALPHA (OSF1)
  VAX (VMS)
- front-end systems
  —based on VME
  SUN-WS (SUN-OS)
  68040 (VxWorks/DECelx)
  ALPHA-AXP (DECelx)
  68040 (PSOS)
  —based on VXI
  68040 (?)
- fieldbus systems
  SEDAC (vacuum/cryogenic)
  Profibus (PLCs)
  CAN (intelligent I/O)
  Arcnet (remote I/O)
  Interbus-S (fast I/O)
  GPIB
  RS232/V24 (several protocols)
- local I/O (in VME)
  A/D
  GPIB
  stepping motor
  power supply control
  timing

- special hardware
  low temperature measurement
  (based on SEDAC and CAN/Interbus-S)
  helium level and heater control (SEDAC)
  vacuum leak test (SEDAC)
  ... more
- LAN
  Ethernet
  FDDI
- network protocols
  TCP/IP
  TCP/UDP
  DECnet-OSI
  LAT
- network applications
  RPCs
  TCP/IP sockets
  COBRA (object oriented protocols based on RPCs)
- control applications
  vacuum (DESY-PVAC)
  cryogenics (EPICS cooperation)
  RF modulator (FNAL 'Goodwin system')
  cavity controls (LabView)
- graphics (based on X-Windows)
  vacuum (DESY-PVAC)
  cryogenics (EPICS cooperation)
  cavity controls (LabView)
- archiver
  vacuum (DESY-PVAC)
  cryogenics (EPICS cooperation)

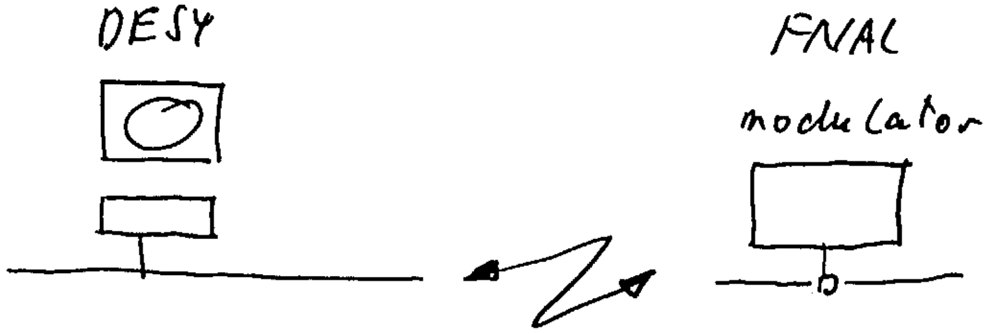
TTF controls: new structures




TTF Controls
Workstation(s)
X-Terminal(s)
Ethernet
VME
SEDAC
Profibus
Vacuum
GPIB
RF-Test
DMA
Multibus
D/3 network
CAN
SEDAC
Cryogenic
Arcnet
DMA
VXI
Smart
Rack
Monitor
Modulator
Injector
MCI 5'93
Slide 1

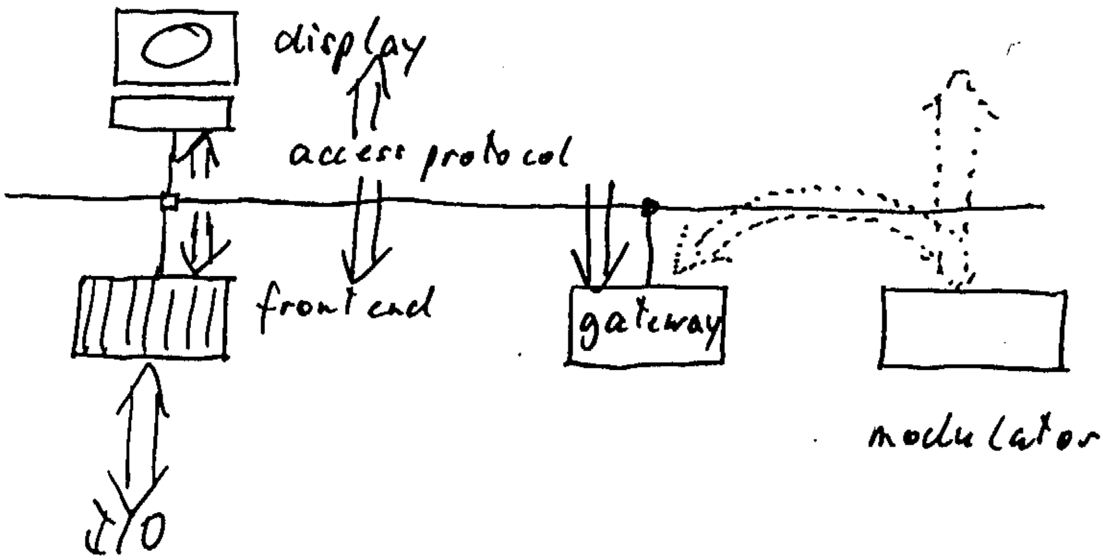
communication

1.)



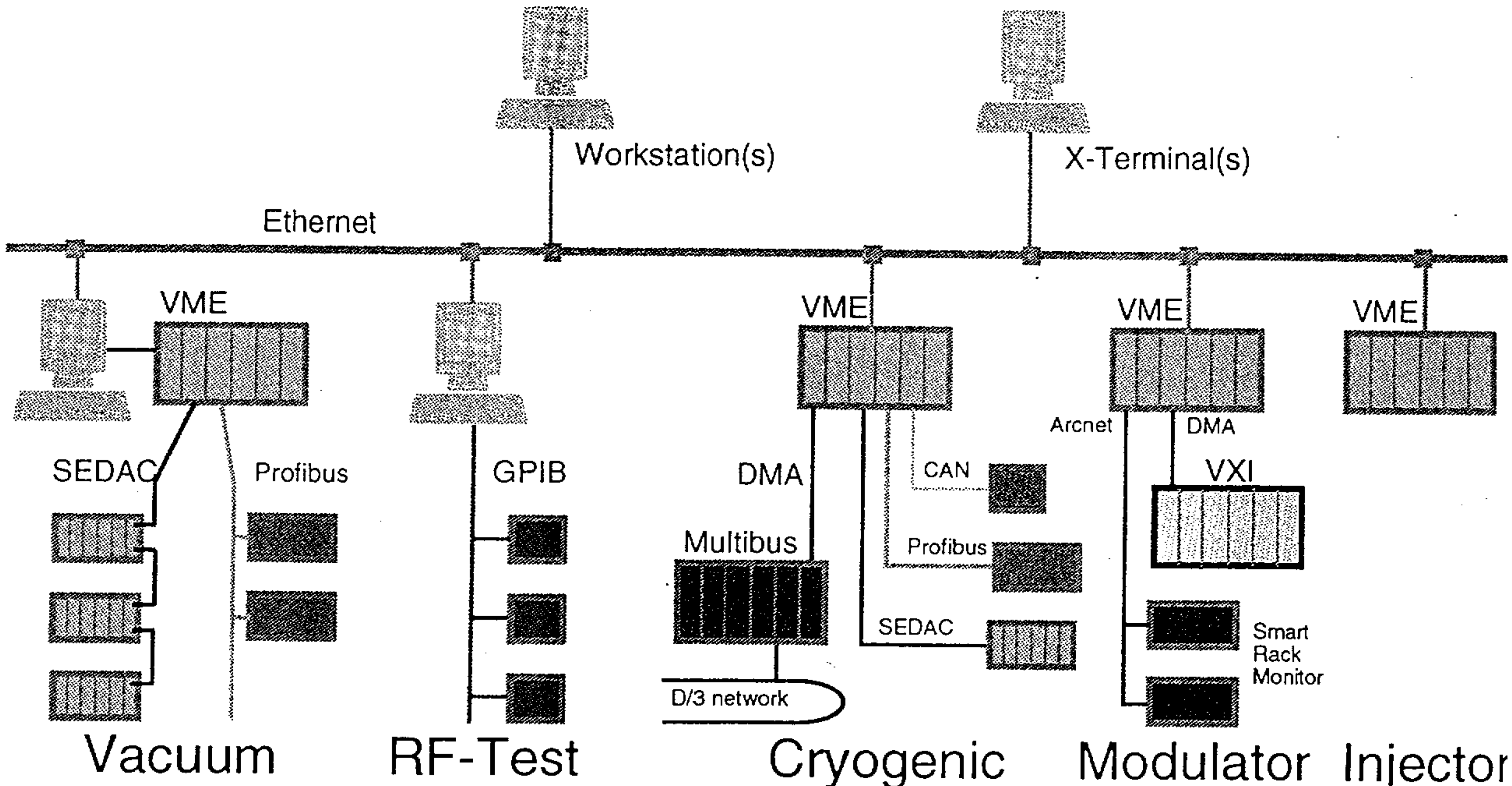
read data from modulator @ FNAL

2.)



shown: gateway EPICS/cryogenic (DI3)

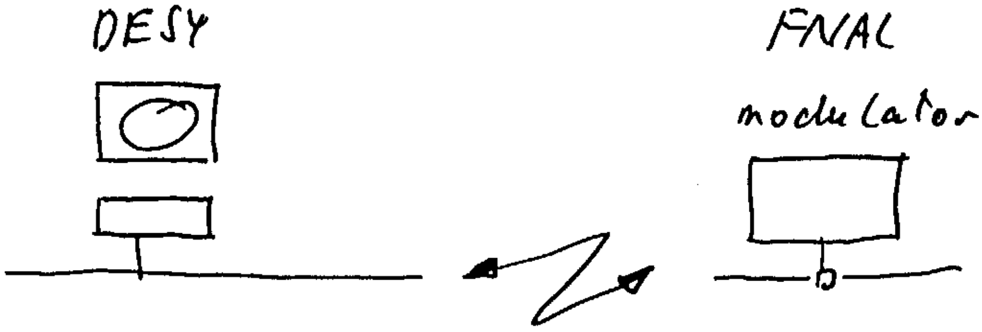
TTF Controls



MCI 5'93 Slide 1

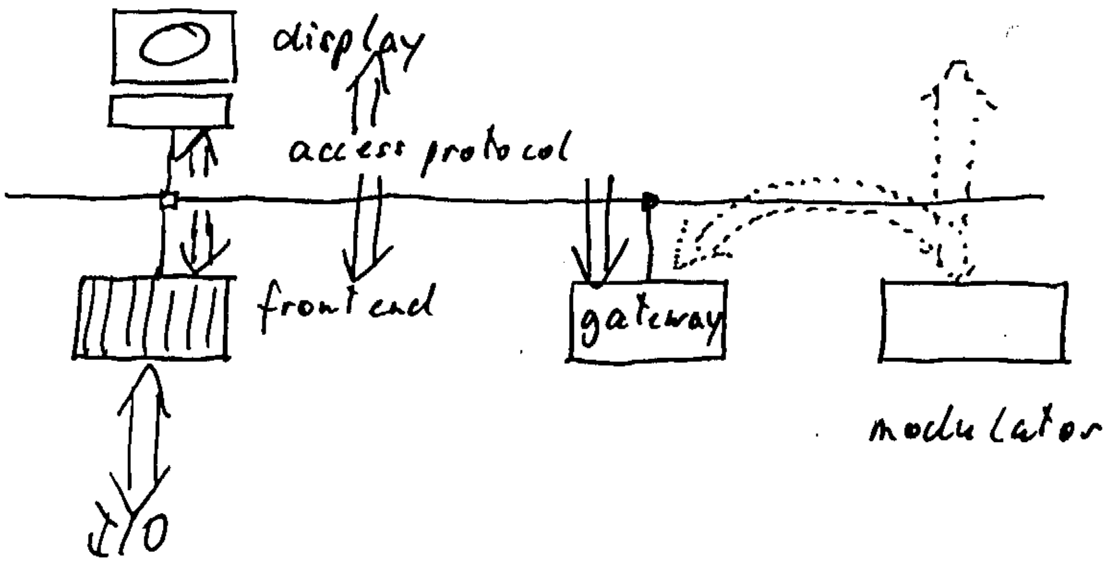
communication

1.)



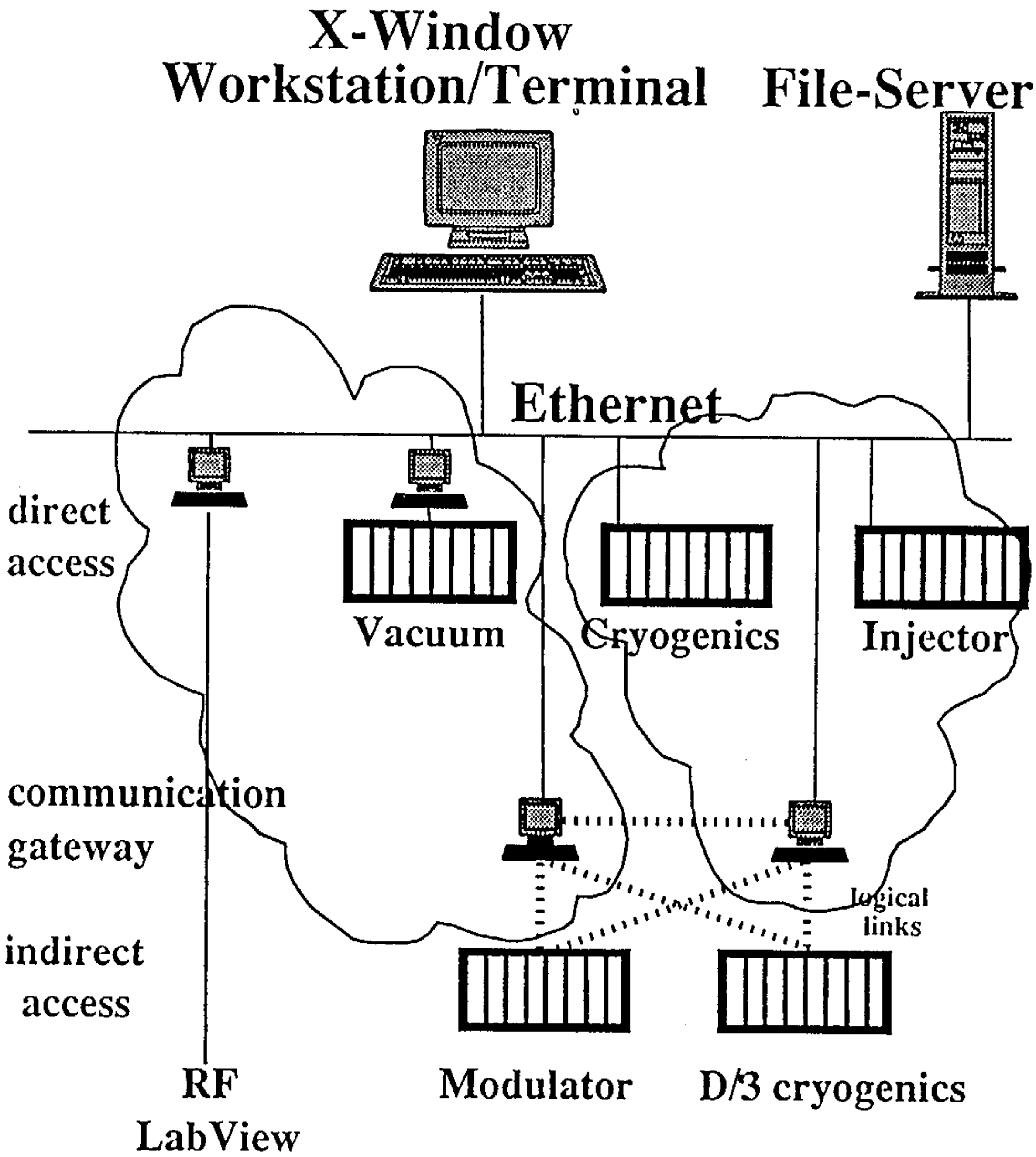
read data from modulator @ FNAL

2.)



shown: gateway EPICS/cryogenic (D13)

TTF controls: communication layer



TESLA Meeting, June 1 & 2, 1993
Cavity Group, D. Proch

The following items have been discussed in the cavity group:

A) Report on latest results with HPP at Cornell

B) Do we need polarised cavities for TESLA?

C) Discussion of latest HFSS coupler calculations

D) Problems with cavity vibrations

E) HOM propagation between cavities

F) Impedance of LOM (Lower Order Mode) resonances

G) What to do with the two first Nb cavities (also discussed in the TTF physics group)

H) Not discussed because of lack of time:
- new HOM measurements
- magnetic shielding

A) Latest HPP Results at Cornell

At Cornell the vertical test stand for 1.3 GHz has been put to operation. There is a TEFLON window at the 300 K part of the waveguide, a cold window at the doorknow-transition and a bellow at the coaxial part to adjust the coupling for HPP processing. The vertical height in the cryostat allows to assemble cavities (1.3 GHz) up to 5 cells.
Two major failure modes have been observed during processing at 2 K. It turned out that both problems also occured when the test stand was completely at room temperature. This made trouble hunting easier.

<u>Failure mode 1:</u> "Stair case mode":
1 The signal at the pick up probe shows steps in amplitude, the "Cavity" decay time changes (see Fig. 1).
2 The problem starts at rather low forward power (some 10 kW),
3 but it can be processed up to the highest power levels (after some hours of processing).

<u>Failure mode 2:</u> "Dead mode"
4 Sudden complete breakdown of pick up signal.
5 High e^- current at pick up probe (cavity RF-pick up).
6 Light signal at doorknob (generator side; detected with view port at upper cavity cut off tube).
7 The breakdown level depends on the length of the inner coaxial line.

The "stair case mode" is thought to be due to partial reflection of forward RF power along the rectangular waveguide section. Also problems at the TEFLON window cannot be excluded. The fact that this failure mode can be processed (after some time) stopped further investigation.
The "dead mode" is thought to be due to discharge phenomena at or near to the cold window. Deposition of Ag at the ceramic, darkened areas on the ceramic and sputter marks at the coaxial part (near the bellow section) have been detected. HFSS calculations indicated that for an unfavourable length of the (open) coaxial line a maximum of the electric field is established at the window area. Experiments with different lengths of this coaxial part resulted in raising the level of the breakdown above 700 kW forward power. HFSS calculations confirmed that this is caused by shifting the E field maximum of the standing wave pattern away from the cold window region. At this stage cavity processing by HPP was started again. It is concluded, however, that modelling the doorknob region and the ceramic geometry by HFSS is a need to develop a more reliable HPP window. This is especially true for the present TTF input coupler which uses the same doorknob transition at the 300 K region. Also the difference of half height (Cornell HPP test stand) and full height waveguide system (TTF design) have to be investigated.

B) Do We Need Polarised Cavities for TESLA?

The Higher Order Modes (HOM) will be damped by couplers at the beam pipe of the cavity. At present one coupler on each side of the cavity is foreseen. The relative angle of both couplers is 150° (DESY coupler) and 115° (Saclay coupler). Sufficient coupling was measured for monopole HOMs with both type of couplers. For dipole HOMs (and quadrupole, ..) it is important to supply sufficient coupling to all polarisations. This can be done by:

- two or more couplers at each end of the cavity: excluded because of cost reasons;
- artificially polarising the cavities, thus placing the one HOM coupler at a region with field of all polarised resonances.

The second possibility has been investigated at Cornell. In the deepdrawing process the cavities are deformed in the sense that the cross section at the equator is elliptical but changes to a circle along a line to the iris. The disadvantage of this method is the lack of symmetry of the cups and thus complexity during handling and welding, thus increasing fabrication costs.

There is hope to reach enough HOM coupling with only one coupler at each side to all polarisations because

- coupling is magnetic <u>and</u> electric,
- the coupler integrates the field over an azimuthal angle of 30° (out of 360°).

Detailed measurements have been done to investigate this problem. The results fit into two categories:

- HOMs below cut off in the beam pipe (of the appropriate mode pattern),
- HOMs above cut off.

Strictly speaking only HOMs of the first category might need polarised cavities. Above cut off the HOM-coupler of the adjacent cavities act as "polarised" couplers because they are rotated by 150° with respect to their neighbouring couplers. Measured damping values (see Table 1a - c) present "worst case" results in the sense that the HOM couplers are rotated in respect to the cavity and the weakest coupling is shown. In all cases the "specified" damping (see A. Mosnier, LC92) could be reached. The HOM frequency spread of the Cu cavities is only 0.5 MHz, whereas a value of 1 MHz (= 1 μs bunch spacing) is optimum for smearing out cumulative effects. On purpose detuning of only one end cell (worst case of simulating larger spread in fabrication tolerance) only showed a minor effect to the HOM field profile and thus to the damping. This is due to the high cell to cell coupling of about 5 % for the HOMs under investigation.

The measured damping of the HOMs above cut off is sufficient for a non polarised cavity (see Table 1a - c). Here the fields in the beam pipe propagate to both neighbouring couplers. The coupling is mainly determined by the cavity to beam pipe coupling. This is not influenced by a polarisation of the cavity.

It was therefore concluded that there is no need to polarise the cavities.

C) HFSS Calculation

The HFSS (High Frequency Structure Simulation, HP) programme has been installed on a Sparc station and first production runs have been started at DESY. It is planned to calculate the (half height) waveguide to coax transition (DESY design) for the TTF. If the "no doorknob" transition shows low E_p enhancement, it might be used also for the HPP installation in the vertical deware. The waveguide design can be seen in Fig. 2 (HFSS calculation).

D) Vibration of the Cavity

Hammering a 9-cell cavity (Nb, Cu) at 300 K showed resonances around 300 Hz with a decay time constant of 50 ms (Cu) and 120 ms (Nb) (see Fig. 3a, b). After firing and after cooldown the Q of the mechanical resonance is expected to increase considerably. Measurements at CEBAF on a 5-cell cavity at 2 K (inserted into LHe) concluded a Q of about 10,000 (see Fig. 4) at about 65 Hz. At the room temperature experiment the individual cells are deformed half way between iris and equator. The lowest transverse mode of the whole cavity should resonate around several tens of Hz. At HEPL there is a test stand to measure mechanical resonances by read out a bunch of accelerometers. It is foreseen to ship a complete Nb cavity (with stiffening rings, head plate) to HEPL and analyse the spectrum of mechanical modes. The exitation and damping mechanism of a high Q mechanical resonance need further studies.
Each cavity will have a different resonant frequency for its mechanical modes. It was questioned whether the incoherent oscillation of several cavities might only result in a neglectible integral effect to the beam (like the wanted spread of HOM resonances).

E) HOM Propagation between Cavities

BCI calculate the (longitudinal) loss factor of a cavity K_{tot}. This is a measure of the total HOM power transferred from the beam to the cavity. The calculation assumes the single passage limit, i.e. it does not include resonant enhancement. A comparison of this value with the "individual loss factors" of the dominant HOM longitudinal modes ($K_\omega = \frac{\omega}{4} \cdot \frac{r}{Q}$) concludes that the majority ($\approx$ 70 %) of the total HOM power is contained in the frequency range above 5 GHz. These modes shall be damped at the stainless beam pipe every 8 cavities. The individual HOM couplers at each cavity are designed to have damping at very high frequencies, too. A measurement of the damping up to 100 GHz is very difficult so that a broad band steel absorber is foreseen.

Measurements and calculations on a cavity-beam pipe-cavity system indicate that under certain circumstances the RF power of the left cavity is not propagating through the right cavity, i.e. the stainless steel absorber every eight cavities will not be active. There seems to be field in the beam pipe under any circumstances. The beam pipe itself might resonate, depending on its length and boundary conditions. Thus a broad band HOM coupler at the beam pipe might supply sufficient damping.

The propagation in the cavity-beam pipe-cavity system can be analysed, if the cavity and beam pipe field pattern (both are known) and the coupling fields at the cavity-beam pipe transition are given. The later ones are not known but can be experimentally determined by measuring the S-parameters in an appropriate frequency range ("Chipman method"). Investigation will be started in this area.

F) LOM Impedance

The 9-cell TESLA cavity has nine modes in the fundamental TM_{010} passband. In an ideally tuned cavity all modes but the accelerating π-mode show zero impedance. In case of a slightly unflat field profile the π-mode impedance is nearly uneffected but the other modes (especially the π-1 mode) will have non zero impedances. Measurements on the Cu-cavities with a realistic field profile resulted in a r/Q value of 2 Ω for the (π-1) mode. The resulting impedances will be 8 MΩ (assuming a Q_{ext} of 4 x 10^6). This will not be a problem in respect to induced power because of the heavy damping by the input coupler. In respect to beam instability calculations, however, the value of 8 MΩ is comparable to the contribution of the major longitudinal HOMs. This might result in a more stringent condition for field flatness tuning in the accelerating mode.

G) What To Do with the First Two Nb Cavities?

There was a lively discussion about this subject in a joined session of the cavity and the accelerator physics group. Both cavities will arrive at DESY on August 12, 1993. They are designed very near to the TTF cavities. Nb wall thickness, cavity shape, asymmetric end cells, stiffening rings and Nb flanging technology are identical to the final design. The head plate differs in design but allows to adopt a LHe container, too. There was consensus that:

- at least one cavity will be shipped to Saclay. This cavity should be treated and measured at Saclay. After having reached satisfactory superconducting properties the measurement should be repeated at DESY.
- The second cavity will be used to commission the infrastructure at DESY (chemistry, clean room handling, furnace treatment, vertical measurement).
- After commissioning the DESY infrastructure the first cavity (Saclay treatment) will be reprocessed and measured at DESY.

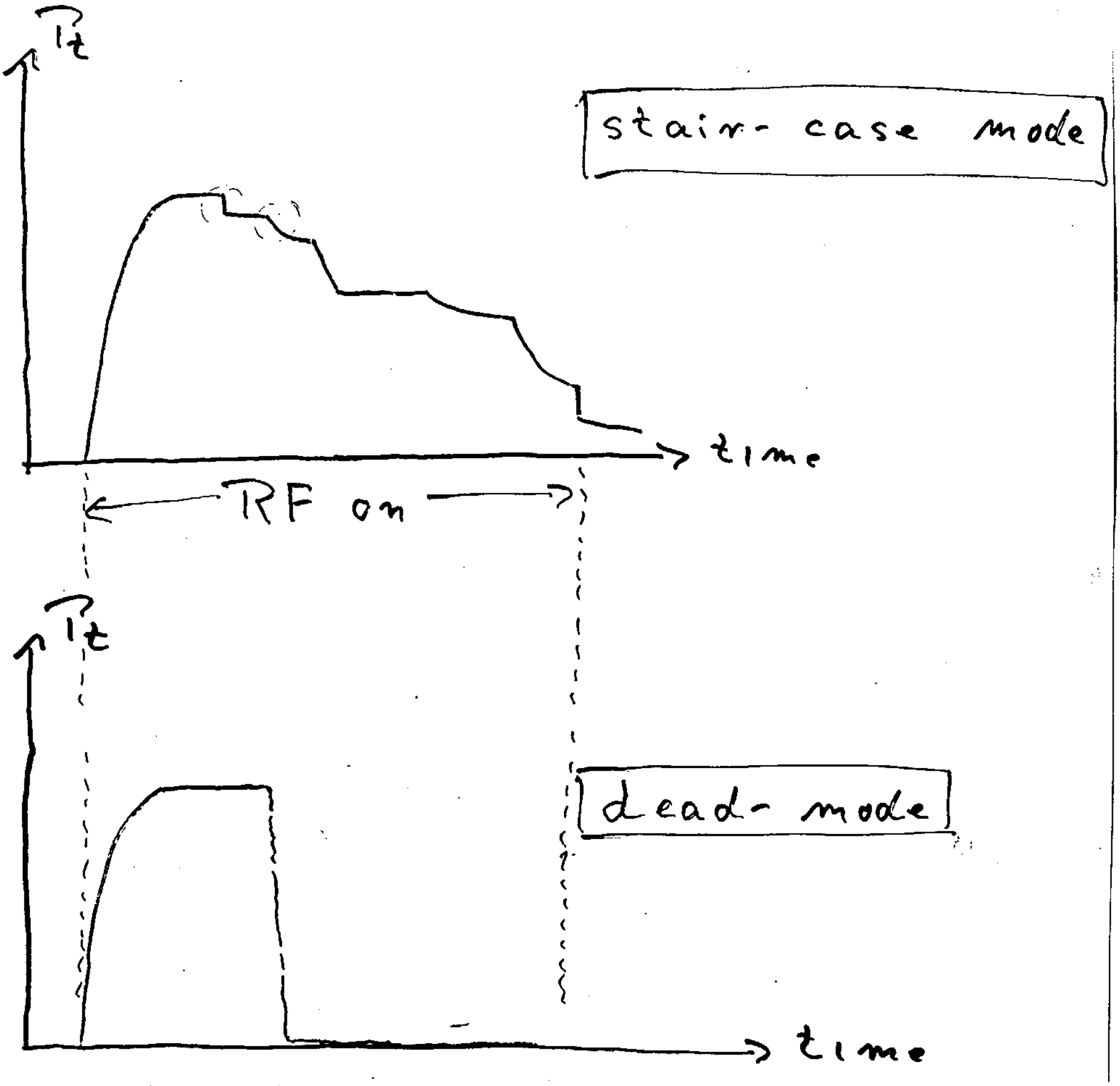


Fig. 1: Failure modes of HPP test stand

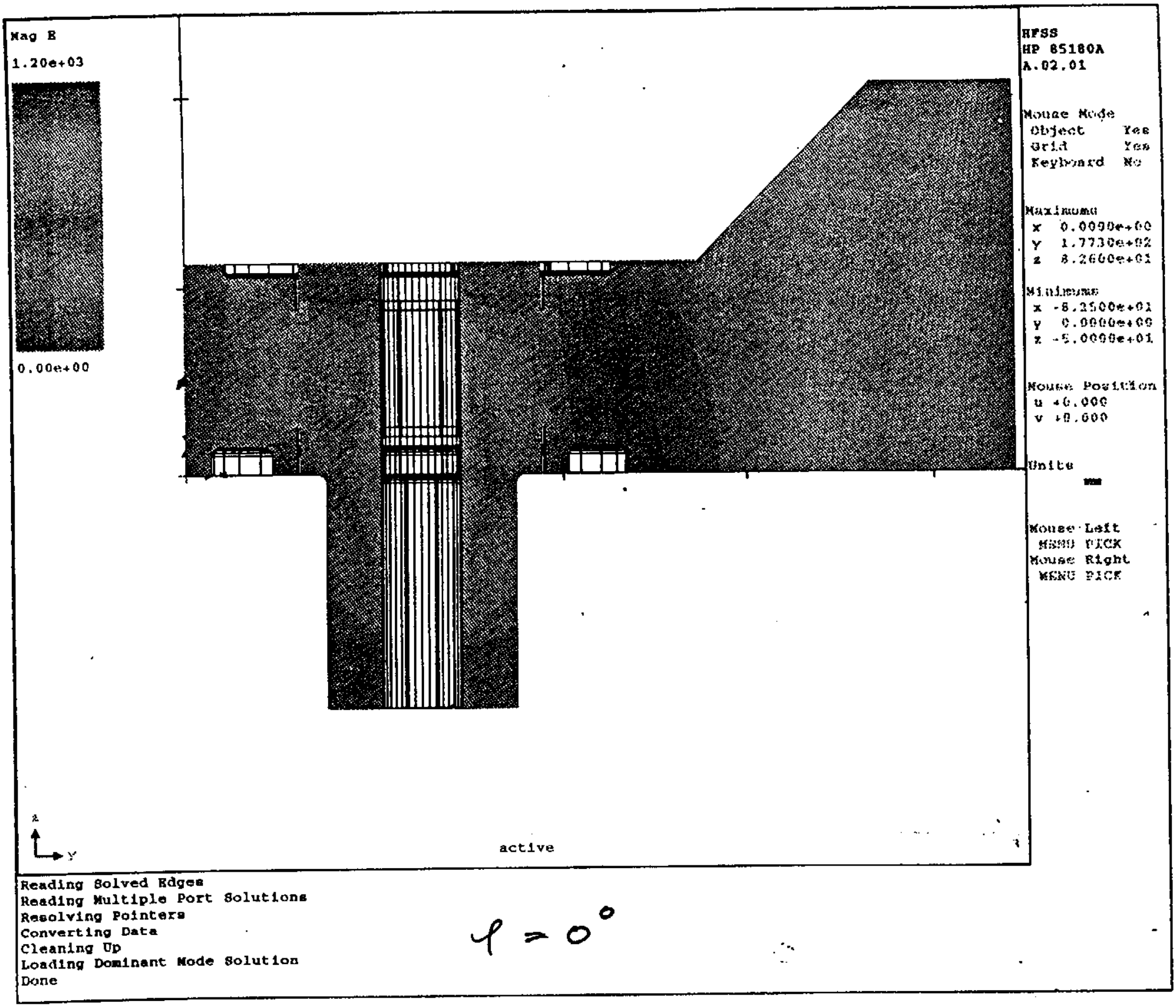
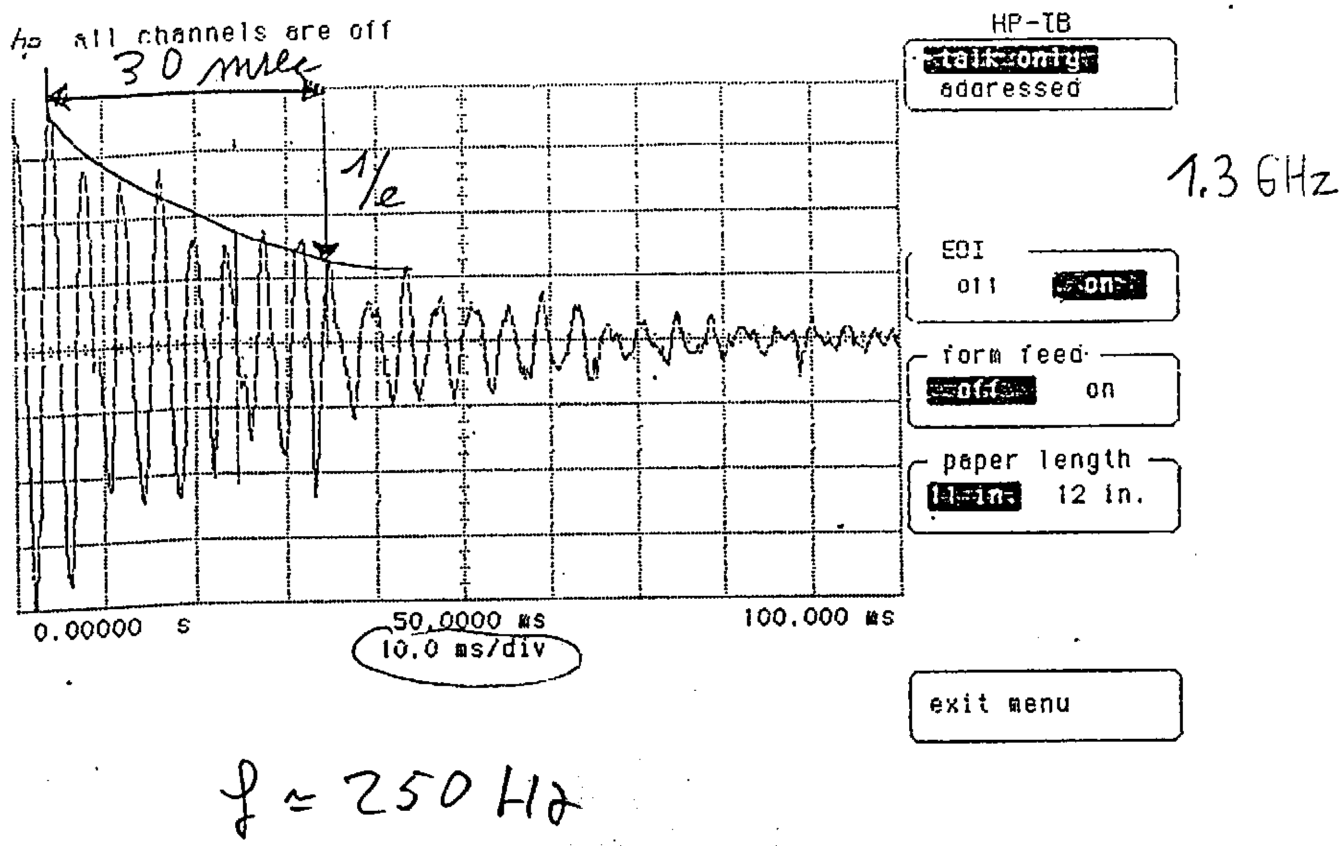


Fig. 2: HFSS calculation of a waveguide to coax transition



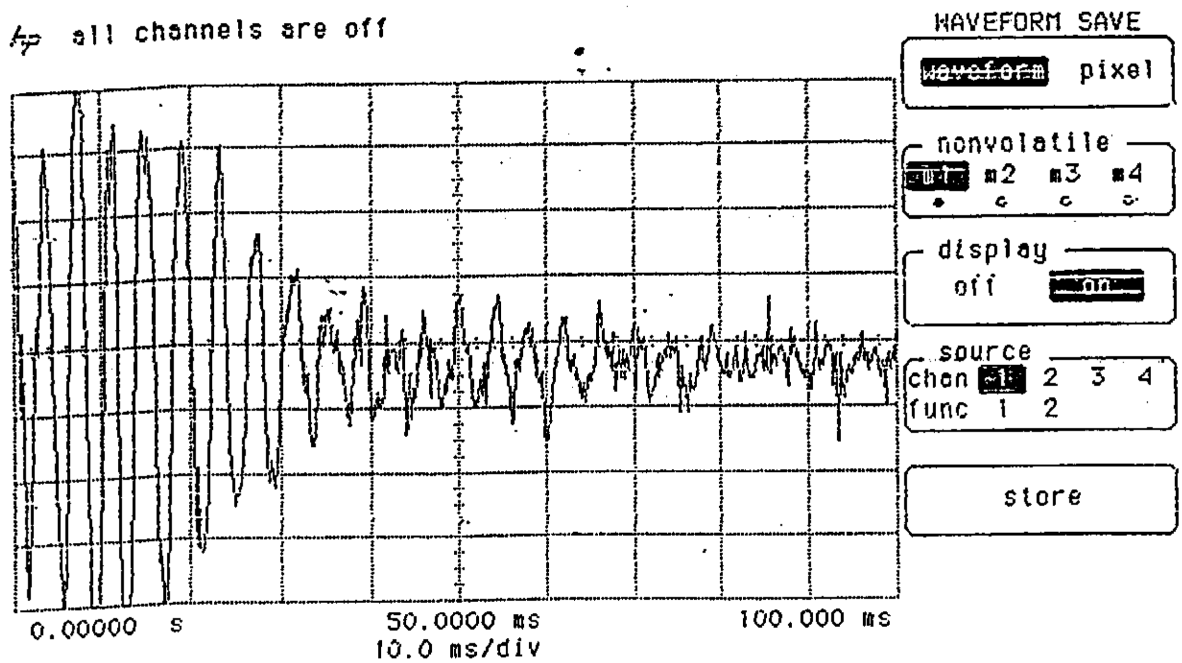
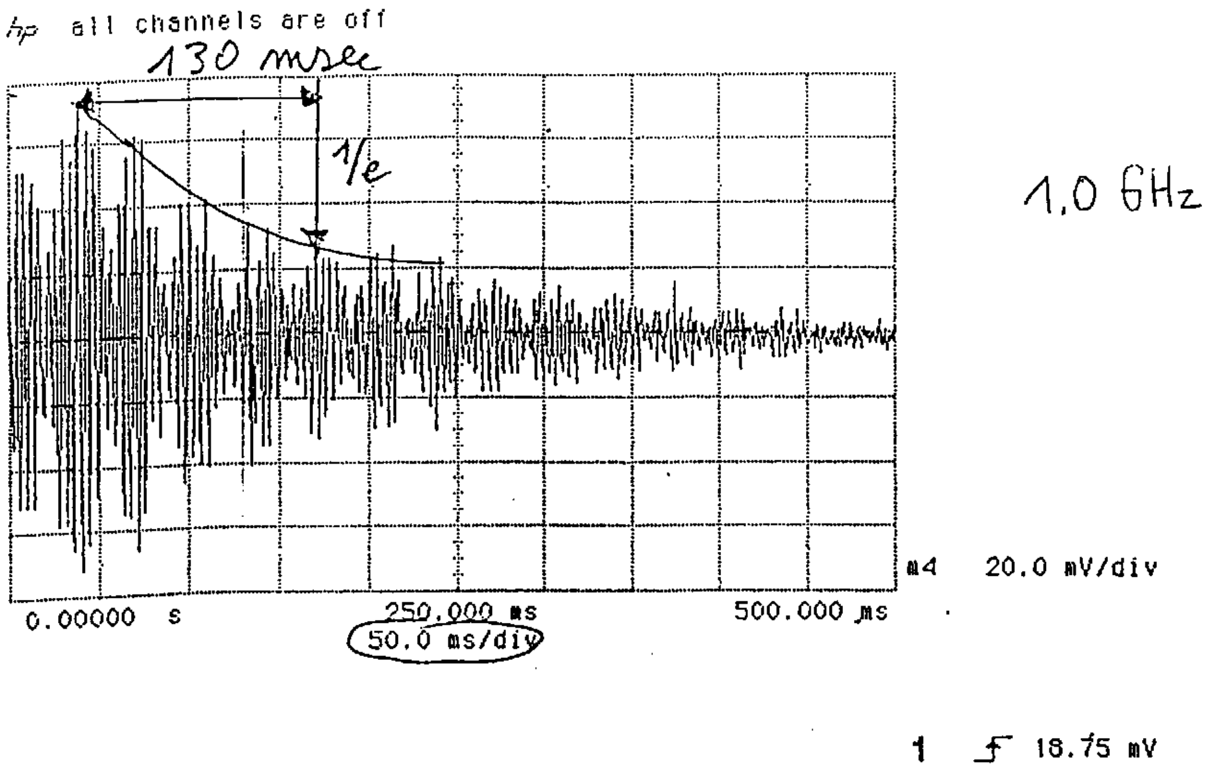


Fig. 3a: Mechanical resonance of a 9-cell Cu cavity



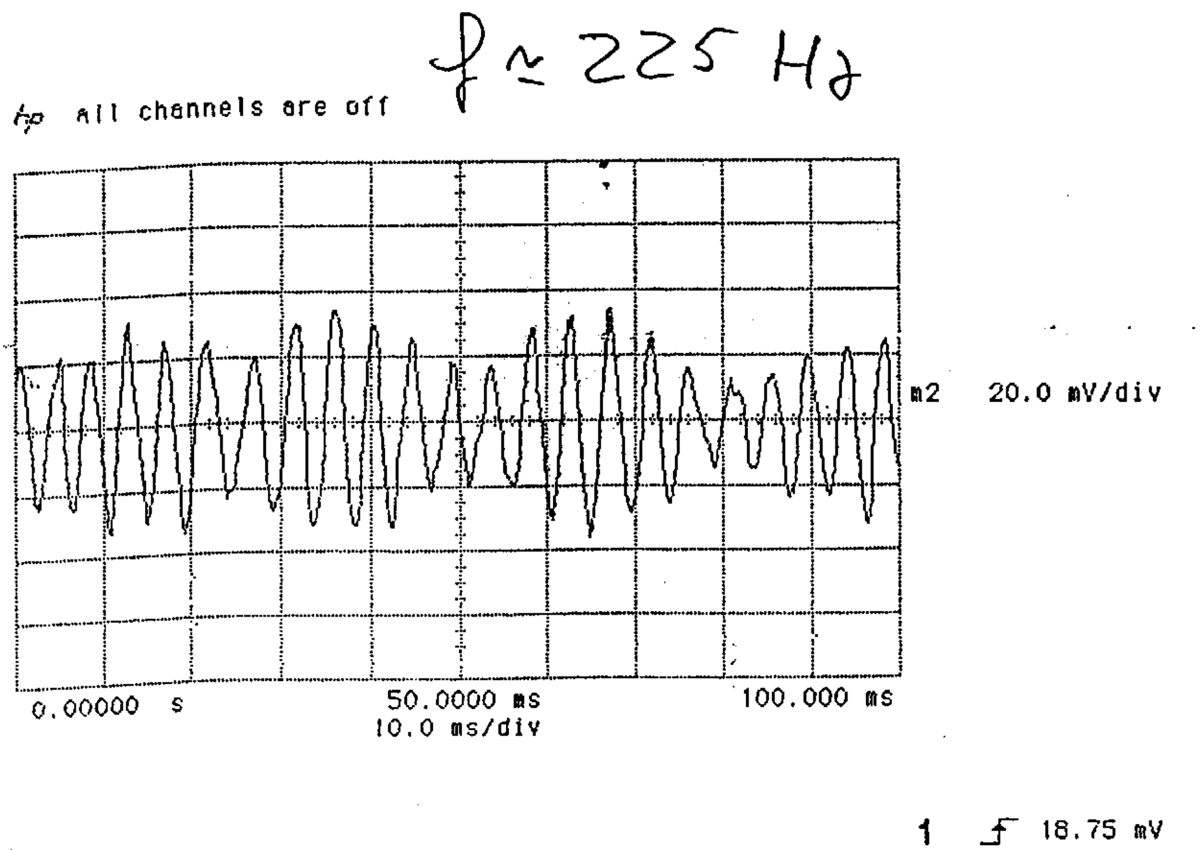


Fig. 3b: Mechanical resonance of a 9-cell Nb cavity

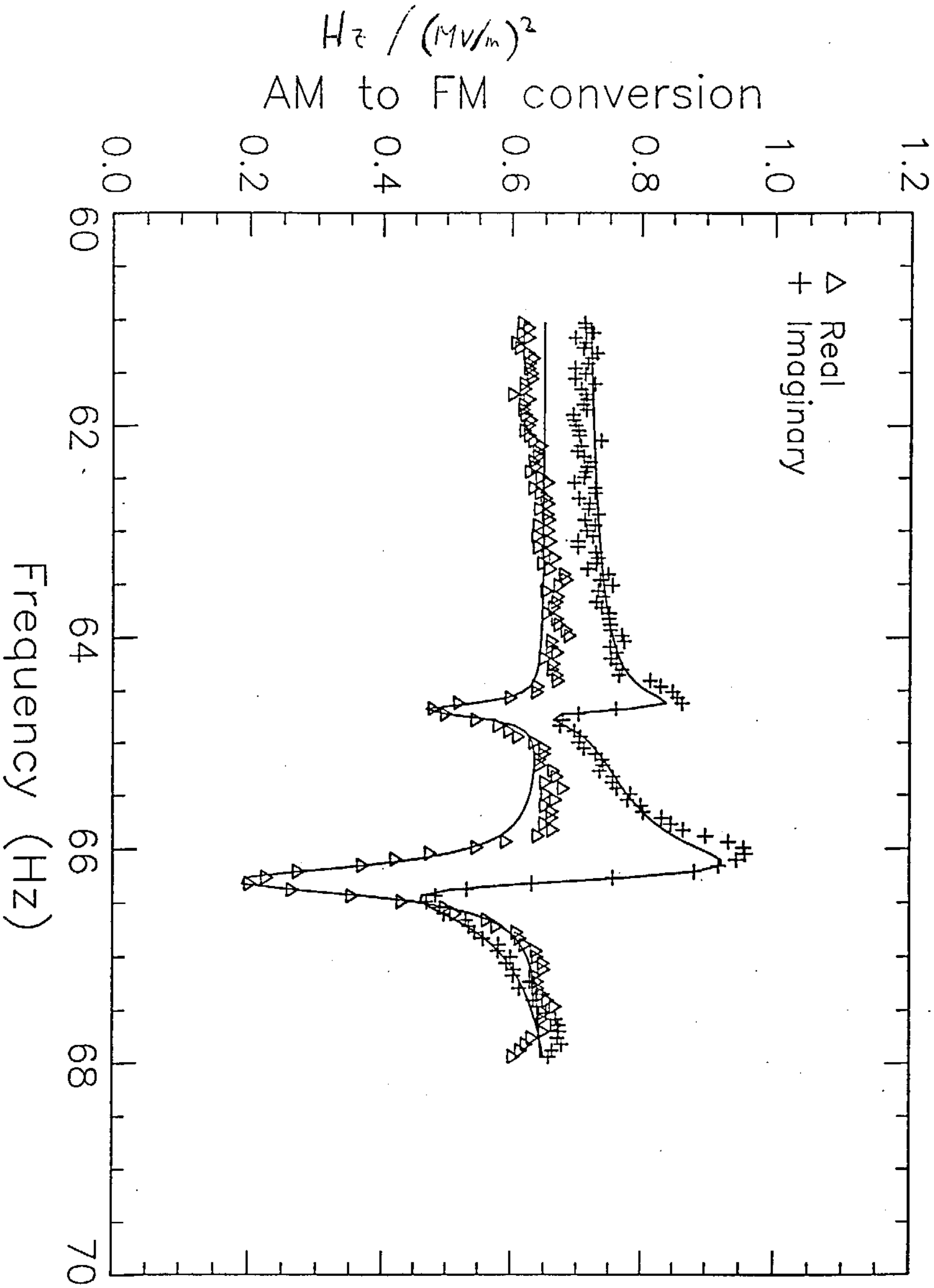


Fig. 4: Measured mechanical resonance of a CEBAF cavity at 2 K

PROPAGATING MODES

TE121
(propagating mode, F_{cutoff} = 2.25 GHz , λ = 144 mm)

N	F [Hz]	(R/Q) [Ω/cm²]	Qext	(R/Q)*Qext [Ω/cm²]
1	3.0757E+09	0.113	1.71E+05	1.93E+04
2	3.0760E+09		2.29E+05	2.59E+04
3	3.0765E+09	0.013	4.08E+05	5.30E+03
4	3.0767E+09		1.21E+05	1.57E+03
5	3.0775E+09	0.020	5.69E+05	1.14E+04
6	3.0776E+09		7.95E+04	1.59E+04
7	3.0790E+09	0.135	2.48E+05	3.35E+04
8	3.0791E+09		3.50E+04	4.73E+04
9	3.0819E+09	0.915	9.43E+04	8.63E+04
10	3.0821E+09		4.45E+04	4.07E+04
11	3.0874E+09	1.265	4.37E+04	5.53E+04
12	3.0877E+09		7.59E+04	6.94E+04
13	3.0970E+09	0.156	3.30E+04	5.15E+03
14	3.0972E+09		1.02E+05	1.59E+04
15	3.1133E+09	0.016	1.68E+04	2.69E+02
16	3.1135E+09		9.89E+04	1.58E+03

(R/Q) as computed by A. Mosnier
Comment : distance between two couplers = $2\lambda - \lambda/4$

Table 1a: HOM measurements

TM110
(non propagating mode, F_{cutoff} = 4.69 GHz)

N	F [Hz]	(R/Q) [Ω/cm²]	Qext	(R/Q)*Qext [Ω/cm²]
1	1.7999E+09	0.714	5.19E+03	3.71E+03
2	1.8009E+09		4.22E+03	3.01E+03
3	1.8370E+09	0.453	1.98E+04	8.97E+03
4	1.8357E+09		1.89E+04	8.56E+03
5	1.8527E+09	0.330	2.77E+04	9.14E+03
6	1.8532E+09		2.09E+04	6.89E+03
7	1.8653E+09	6.470	5.06E+04	3.27E+05
8	1.8655E+09		2.65E+04	1.71E+05
9	1.8744E+09	8.75	5.02E+04	4.39E+05
10	1.8748E+09		5.11E+04	4.47E+05
11	1.8808E+09	1.83	9.51E+04	1.74E+05
12	1.8812E+09		8.55E+04	1.56E+05
13	1.8852E+09	0.096	1.81E+05	1.73E+04
14	1.8854E+09		7.52E+04	7.22E+03
15	1.8874E+09	0.176	6.33E+05	1.11E+05
16	1.8878E+09		2.51E+05	4.42E+04
17	1.8891E+09	0.005	1.80E+06	9.00E+03
18	1.8894E+09		1.50E+06	7.50E+03

(R/Q) as computed by A. Mosnier

TM011
(non propagating mode, F_{cutoff} = 2.94 GHz)

N	F [Hz]	(R/Q) [Ω]	Qext	(R/Q)*Qext [Ω]
1	2.3796E+09	0.000	3.50E+05	0.00E+00
2	2.3844E+09	0.165	7.24E+04	1.19E+04
3	2.3923E+09	0.654	4.95E+04	3.24E+04
4	2.4020E+09	0.646	8.40E+04	5.43E+04
5	2.4144E+09	2.053	3.20E+04	6.57E+04
6	2.4271E+09	2.933	2.91E+04	8.54E+04
7	2.4387E+09	6.930	2.04E+04	1.41E+05
8	2.4484E+09	67.04	1.74E+04	1.17E+06
9	2.4541E+09	79.50	3.86E+04	3.07E+06

(R/Q) as computed by A. Mosnier

Table 1b: HOM measurements

HOM measurements on asymmetric cavity
(status at June 1,1993)

G.Kreps J.Sekutowicz
DESY - MHF

Non propagating modes

TE111
(non propagating mode, F_{cutoff} = 2.25 GHz)

N	F [Hz]	(R/Q) [Ω/cm²]	Qext	(R/Q)*Qext [Ω/cm²]
1	1.6222E+09	0.009	1.93E+05	1.74E+03
2	1.6223E+09		3.66E+05	3.29E+03
3	1.6298E+09	0.138	4.76E+04	6.57E+03
4	1.6299E+09		7.72E+04	1.07E+04
5	1.6423E+09	0.025	2.52E+04	6.30E+02
6	1.6422E+09		3.70E+04	9.25E+02
7	1.6591E+09	0.754	4.22E+04	3.18E+04
8	1.6603E+09		2.19E+04	1.65E+04
9	1.6812E+09	0.041	1.07E+04	4.39E+02
10	1.6822E+09		2.31E+04	9.47E+02
11	1.7067E+09	10.0	4.76E+03	4.76E+04
12	1.7078E+09		5.48E+03	5.48E+04
13	1.7340E+09	15.4	3.43E+03	5.28E+04
14	1.7343E+09		4.55E+03	7.01E+04
15	1.7605E+09	2.23	2.68E+03	5.98E+03
16	1.7622E+09		3.18E+03	7.09E+03
17	1.7865E+09	1.4	2.09E+03	2.93E+03
18	1.7894E+09		2.82E+03	3.95E+03

(R/Q) as computed by A. Mosnier

Table 1c: HOM measurements

Cavity group

A- do we need polarized cavities?

B- HFSS calculations

C- vibrations

D- HOM propagation

E- ZOM impedance

(- new HOM measurements)

(- magnetic shielding)

A: measurements indicate good coupling
with round cavity + 2 (+2) couplers
→ but spread of f_{HOM} <u>smaller</u> 1 MHz → ??
↳ determine HOM - cell resonance
measure effect of field flatness
measure resulting damping

B: first HFSS results at Desy
↳ for calibration:
- calculate single cell
- calculate HPP, Cornell

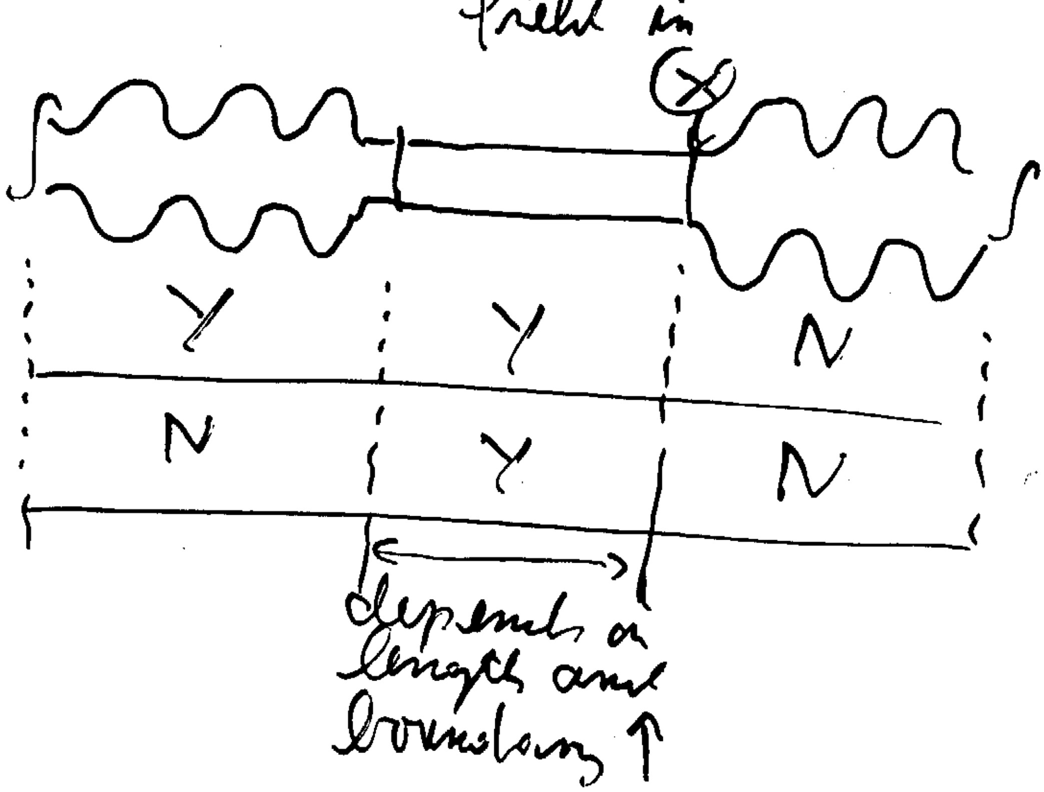
→ • calculate "no detuned" transition

C : calculate mechan. resonance (FEM, HEPZ)
measure mechan. resonance (HEPZ)

question: does a vibrating HOM-f_0 harm the beam?

• measured $Q = 10.002$, 6 GHz, in 2 He!!

D measurement / calculation shows:



make "CHIPMAN" measurement for impedance at "x",
↔ calculate propagation of chain (cavity, pipe, cavity, ...

E (π-1) mode of 1.3 GHz:

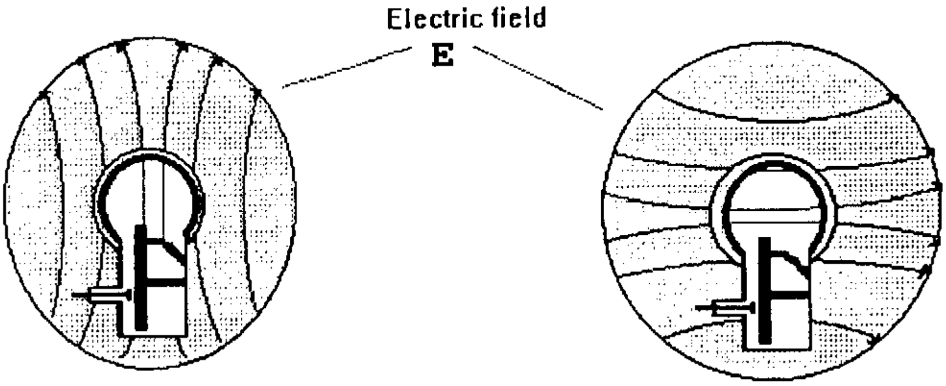
$Z = \frac{r}{Q} \cdot Q_{ext}$

$= 2 \cdot 4 \cdot 10^6 = \boxed{8\ M\Omega}!$ no power problem ↔ beam impedance

Polarized or unpolarized ???

All modes which are not rotational symmetric have two polarization due to the perturbation of the symmetry of the cavity.

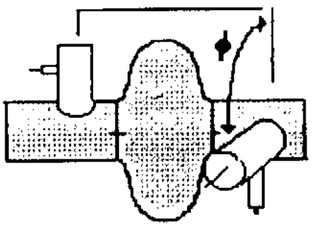
1-cell structure



Very good coupling
E parallel to the antenna tip

Very bad coupling
E vertical to the antenna tip

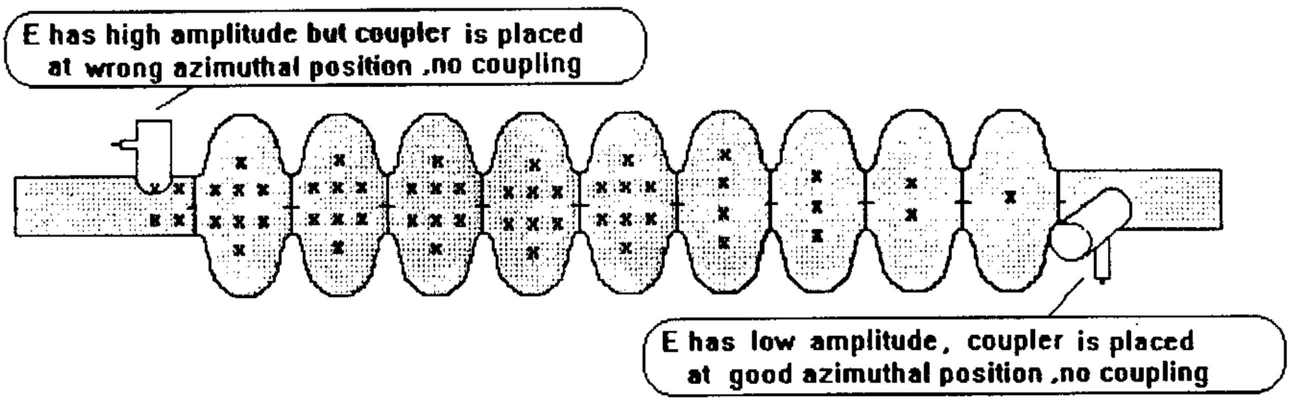
2 HOM couplers shifted with angel $\phi = Pi/(2*m)$ provide always coupling.



m=1 for dipoles
m=2 for quadrupoles
m=3 for sextupoles

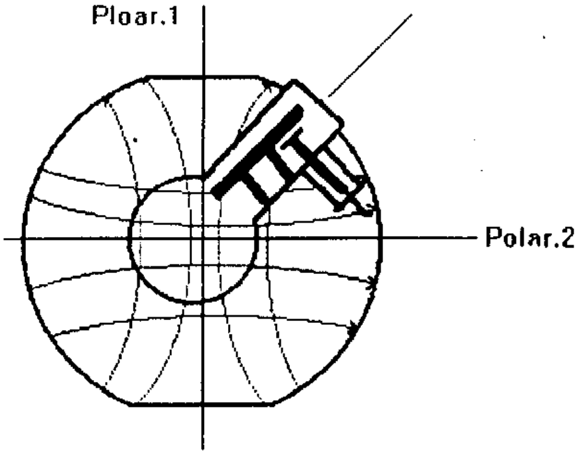
N-cell structure

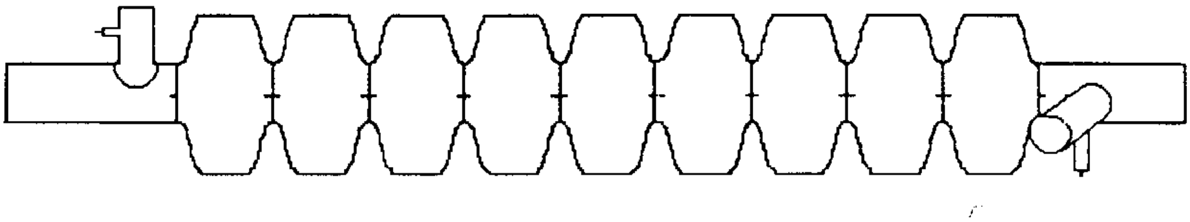
Not only polarization but also field unflatness makes coupling more difficult.



Here we need 4 HOM couplers (2 at each side)

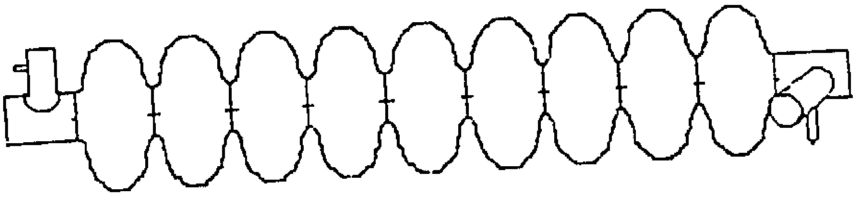
Instead of 4 HOM couplers one can fix polarization of the modes and place 2 couplers at such a position that each coupler couples to both polarization. (Cornell)





What is more expensive : 2 additonal HOM couplers or polarized cavity ???

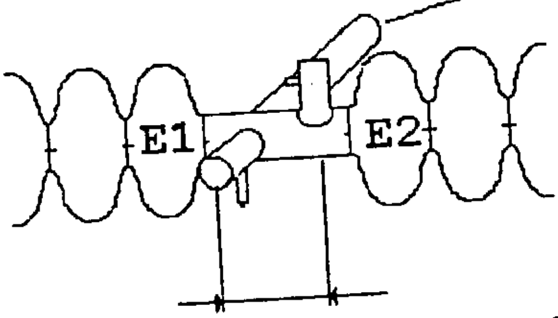
1) Non propagating dipole modes:
TE111 and TM110



All 5 copper models did not show any field unflatness:

- cells are well manufactured
- cell to cell coupling is big:
  $k_{TE111} = 10\%$ and $k_{TM110} = 4.8\%$

2) Propagating dipole modes: TE121



$\lambda_{TE121} = 144\,\mathrm{mm}$ $2\lambda_{TE121} - \lambda_{TE121}/4 \cong 256\,\mathrm{mm}$

Lower frequencies (6 untrapped modes):
- Qext 3 orders of mag. below required values.

Higher frequencies:
- all propagating modes which have stored energy in the beam tubes are damped by 4 HOM couplers and couplers change polarization of the modes.

HOM measurements on asymmetric cavity
(status at June 1,1993)

G.Kreps J.Sekutowicz
DESY - MHF

Non propagating modes

TE111
(non propagating mode, F_{cutoff} = 2.25 GHz)

N	F [Hz]	(R/Q) [Ω/cm²]	Qext	(R/Q)*Qext [Ω/cm²]
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4	1.6299E+09		7.72E+04	1.07E+04
5	1.6423E+09	0.025	2.52E+04	6.30E+02
6	1.6422E+09		3.70E+04	9.25E+02
7	1.6591E+09	0.754	4.22E+04	3.18E+04
8	1.6603E+09		2.19E+04	1.65E+04
9	1.6812E+09	0.041	1.07E+04	4.39E+02
10	1.6822E+09		2.31E+04	9.47E+02
11	1.7067E+09	10.0	4.76E+03	4.76E+04
12	1.7078E+09		5.48E+03	5.48E+04
13	1.7340E+09	15.4	3.43E+03	5.28E+04
14	1.7343E+09		4.55E+03	7.01E+04
15	1.7605E+09	2.23	2.68E+03	5.98E+03
16	1.7622E+09		3.18E+03	7.09E+03
17	1.7865E+09	1.4	2.09E+03	2.93E+03
18	1.7894E+09		2.82E+03	3.95E+03

(R/Q) as computed by A. Mosnier

TM110
(non propagating mode, F_{cutoff} = 4.69 GHz)

N	F [Hz]	(R/Q) [Ω/cm²]	Qext	(R/Q)*Qext [Ω/cm²]
1	1.7999E+09	0.714	5.19E+03	3.71E+03
2	1.8009E+09		4.22E+03	3.01E+03
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9	1.8744E+09	8.75	5.02E+04	4.39E+05
10	1.8748E+09		5.11E+04	4.47E+05
11	1.8808E+09	1.83	9.51E+04	1.74E+05
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16	1.8878E+09		2.51E+05	4.42E+04
17	1.8891E+09	0.005	1.80E+06	9.00E+03
18	1.8894E+09		1.50E+06	7.50E+03

(R/Q) as computed by A. Mosnier

TM011
(non propagating mode, F_{cutoff} = 2.94 GHz)

N	F [Hz]	(R/Q) [Ω]	Qext	(R/Q)*Qext [Ω]
1	2.3796E+09	0.000	3.50E+05	0.00E+00
2	2.3844E+09	0.165	7.24E+04	1.19E+04
3	2.3923E+09	0.654	4.95E+04	3.24E+04
4	2.4020E+09	0.646	8.40E+04	5.43E+04
5	2.4144E+09	2.053	3.20E+04	6.57E+04
6	2.4271E+09	2.933	2.91E+04	8.54E+04
7	2.4387E+09	6.930	2.04E+04	1.41E+05
8	2.4484E+09	67.04	1.74E+04	1.17E+06
9	2.4541E+09	79.50	3.86E+04	3.07E+06

(R/Q) as computed by A. Mosnier

PROPAGATING MODES

TE121

(propagating mode, F_{cutoff} = 2.25 GHz , λ = 144 mm)

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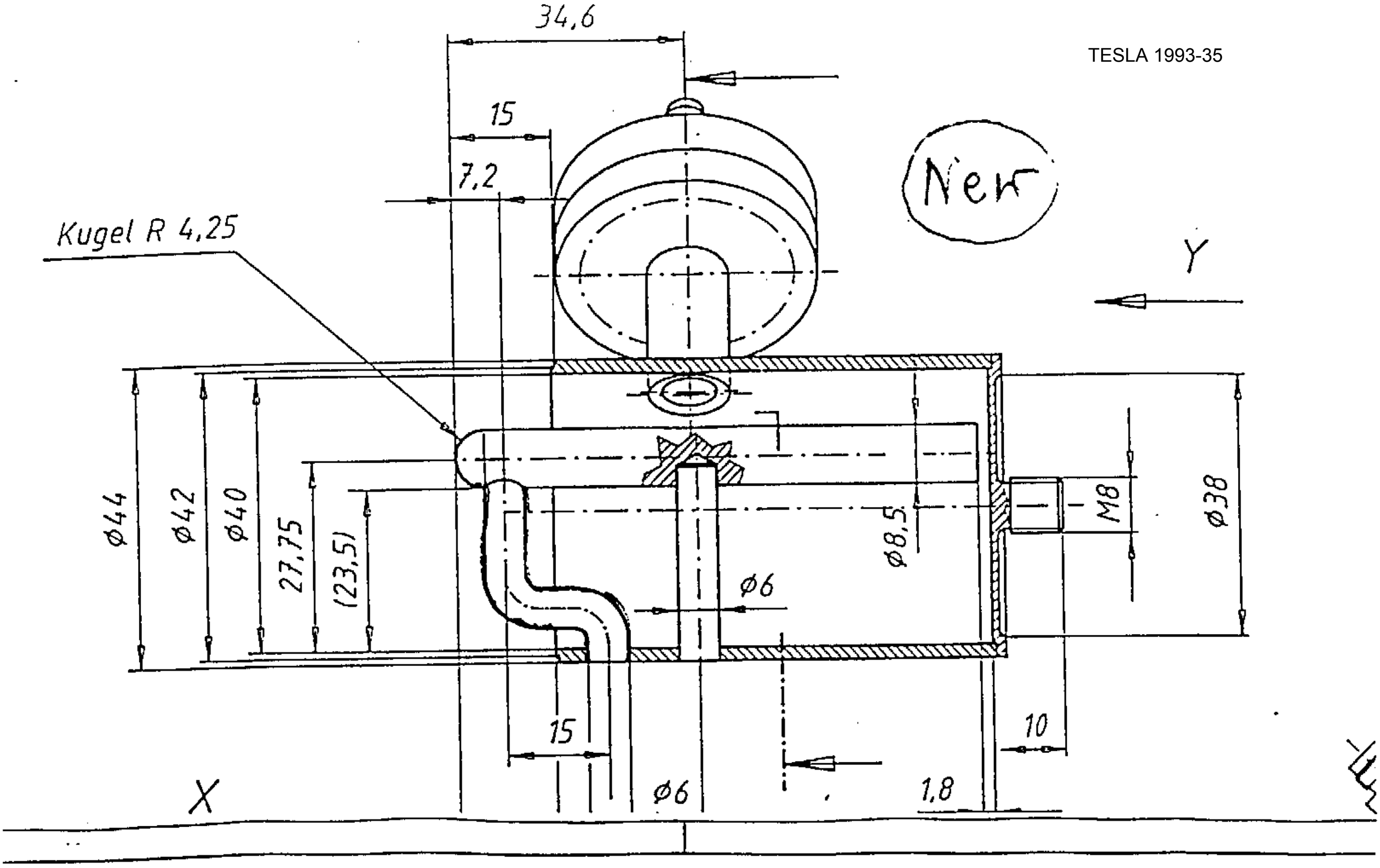
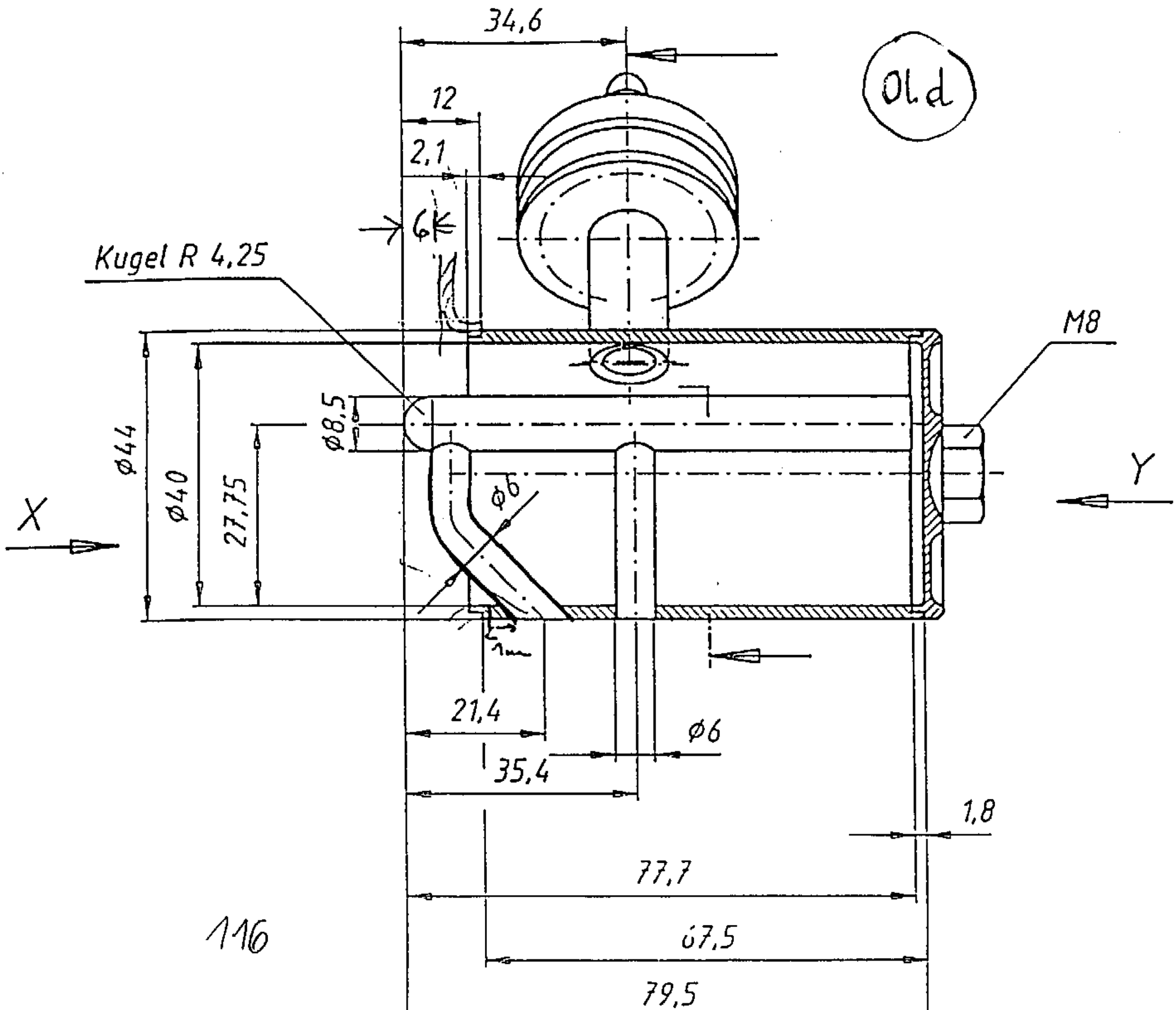
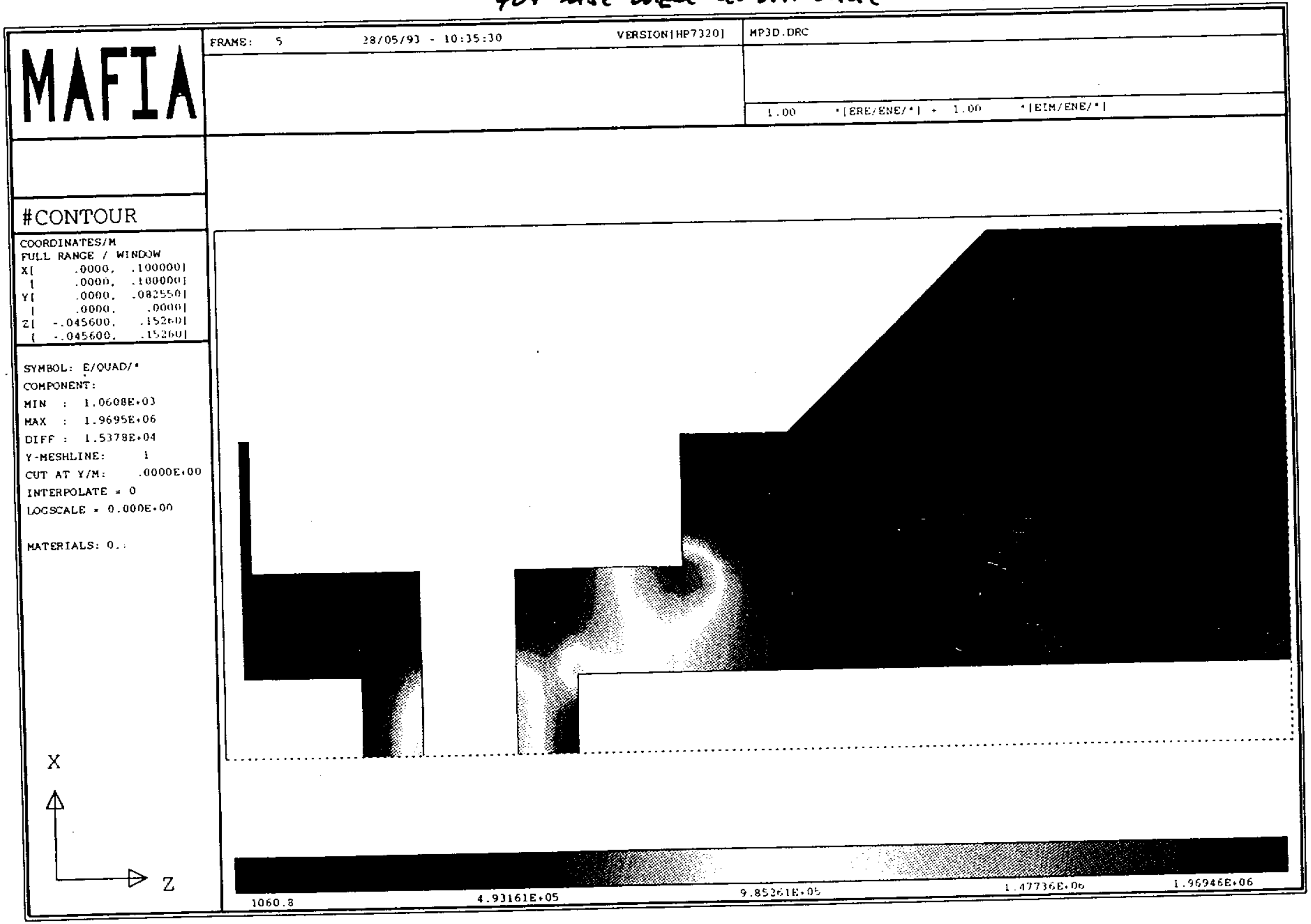
5	3.0775E+09	0.020	5.69E+05	1.14E+04
6	3.0776E+09		7.95E+04	1.59E+04
7	3.0790E+09	0.135	2.48E+05	3.35E+04
8	3.0791E+09		3.50E+04	4.73E+04
9	3.0819E+09	0.915	9.43E+04	8.63E+04
10	3.0821E+09		4.45E+04	4.07E+04
11	3.0874E+09	1.265	4.37E+04	5.53E+04
12	3.0877E+09		7.59E+04	6.94E+04
13	3.0970E+09	0.156	3.30E+04	5.15E+03
14	3.0972E+09		1.02E+05	1.59E+04
15	3.1133E+09	0.016	1.68E+04	2.69E+02
16	3.1135E+09		9.89E+04	1.58E+03

(R/Q) as computed by A. Mosnier
Comment : distance between two couplers = 2λ − λ/4


34,6
15
7,2
Kugel R 4,25
New
Y
ø44
ø42
ø40
27,75
(23,5)
ø8,5
M8
ø38
ø6
15
10
X
ø6
1,8


34,6
Old
12
2,1
6
Kugel R 4,25
M8
ø8,5
ø44
ø40
27,75
ø6
X
Y
1mm
21,4
ø6
35,4
1,8
77,7
67,5
79,5

Matched Waveguide to Coax transition without ceramic window for use with additional WG Pill Box window



FRAME: 16 22/10/92 - 09:12:22 VERSION(HP731D) MP3D.DRC

FREQUENCY/HZ 1.3000000000000E+09

Fix mitstab !

ELECTRIC FIELD IN V/M

P--:3.10

#ARROW

COORDINATES/M
FULL RANGE / WINDOW
X(.0000, .100000)
(.0000, .100000)
Y(.0000, .082550)
(.0000, .0000)
Z(-.066400, .15260)
(-.066400, .15260)

SYMBOL = EIM/*/*

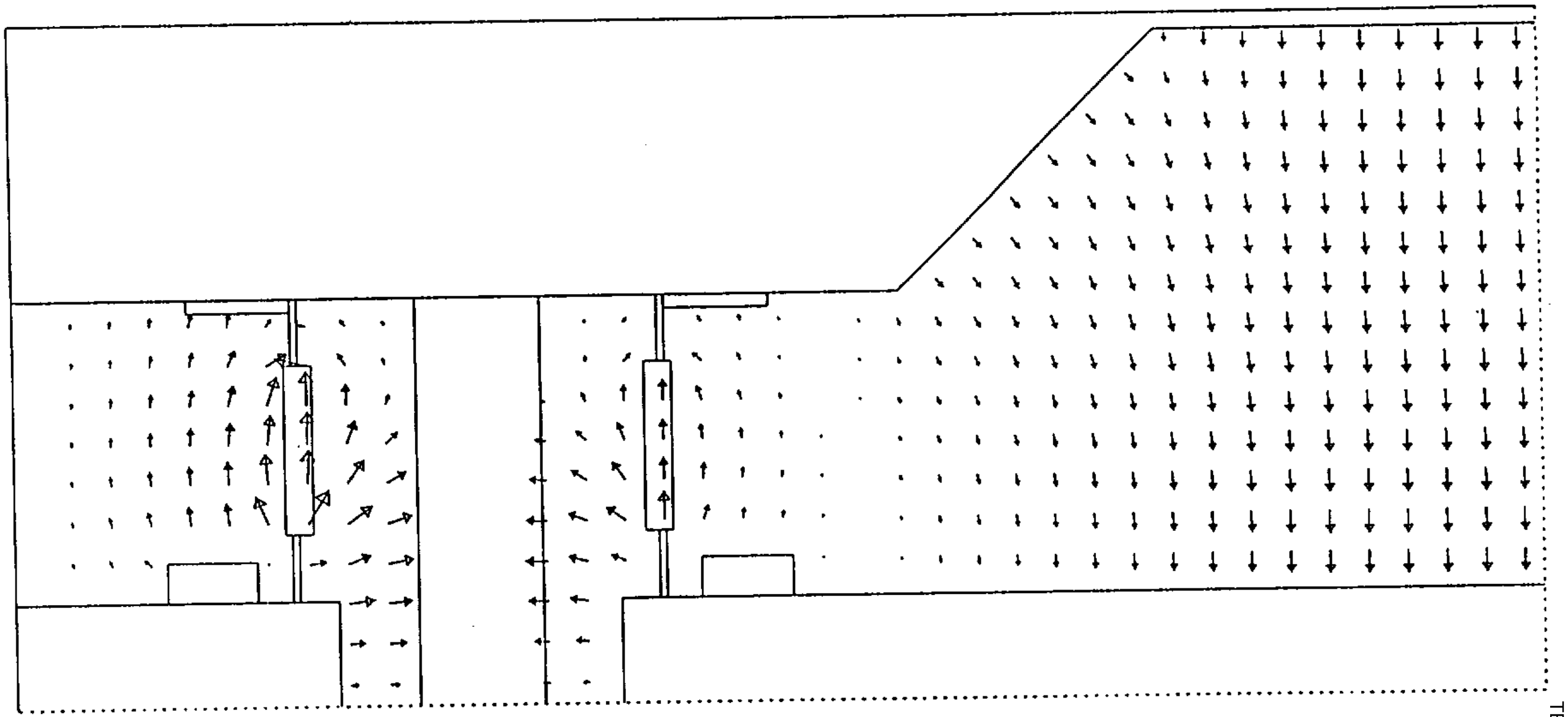
MAX ARROW = 663.76

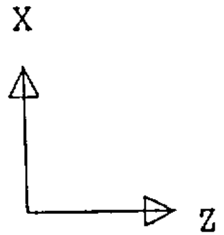
Y-MESHLINE: 1

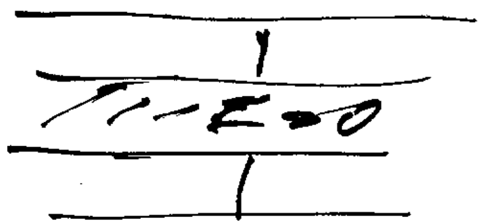
CUT AT Y/M: .0000E+00

INTERPOLATE = 1

ITIME = 17253







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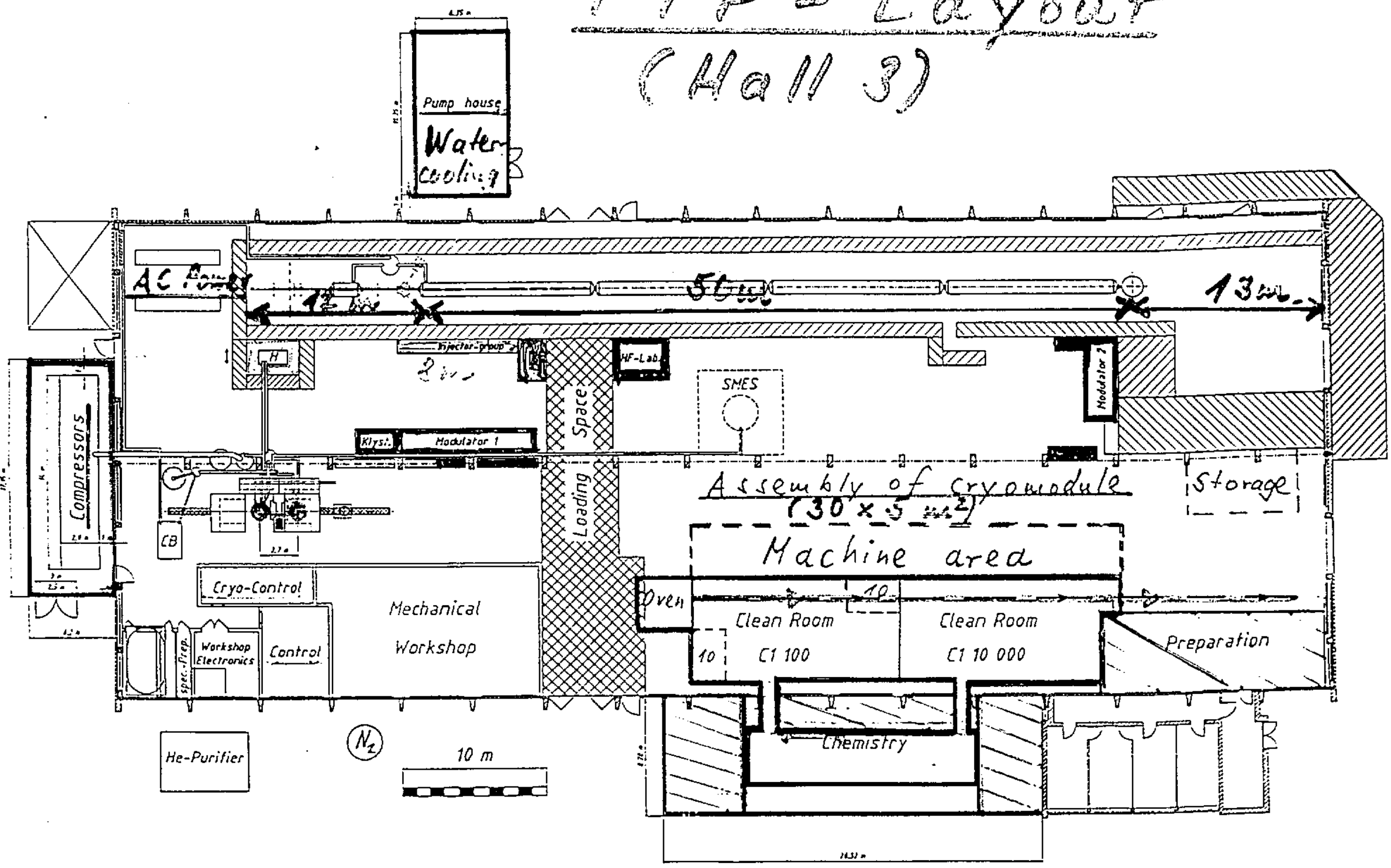
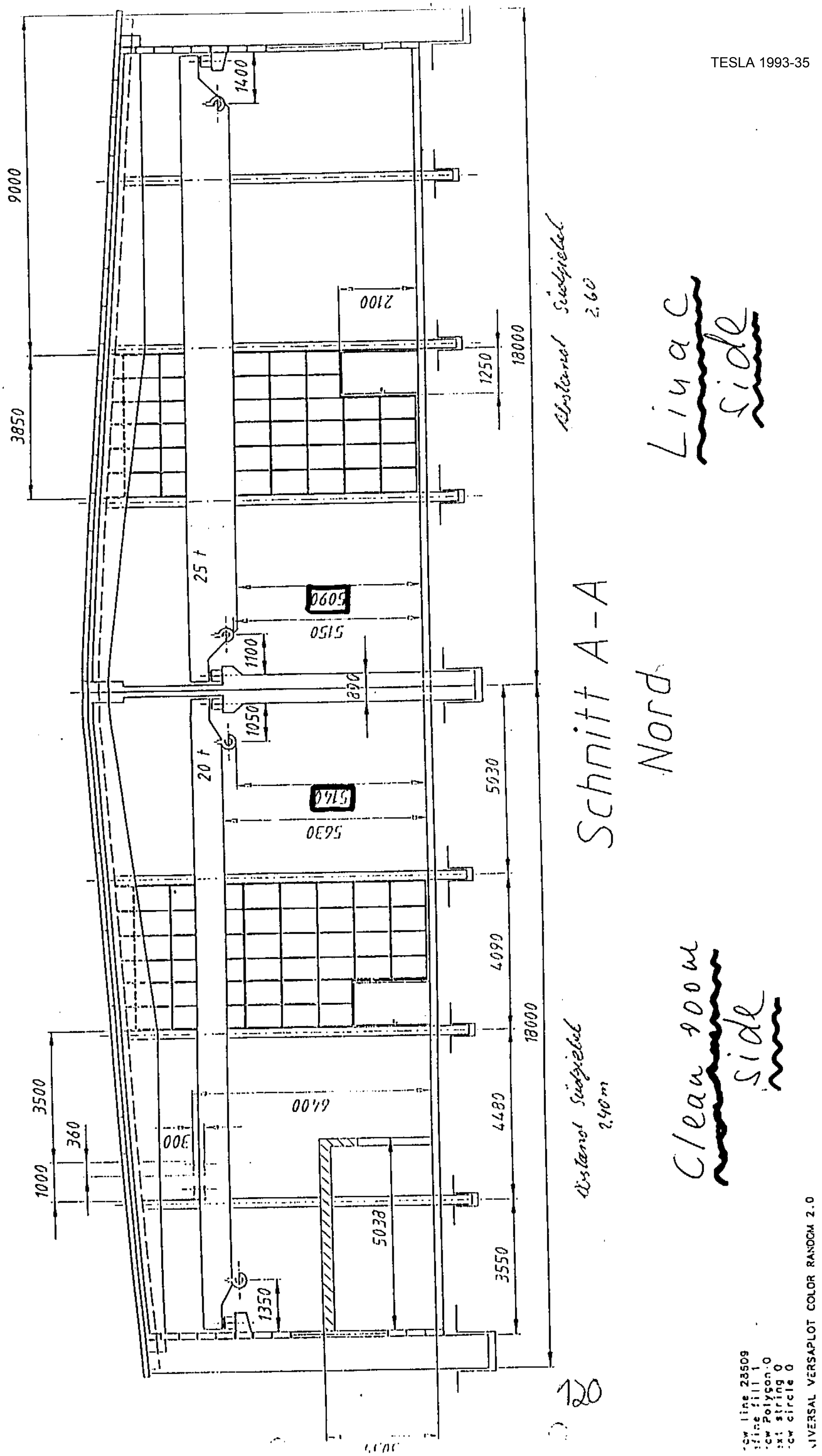
TTF - Layout (Hall 3)

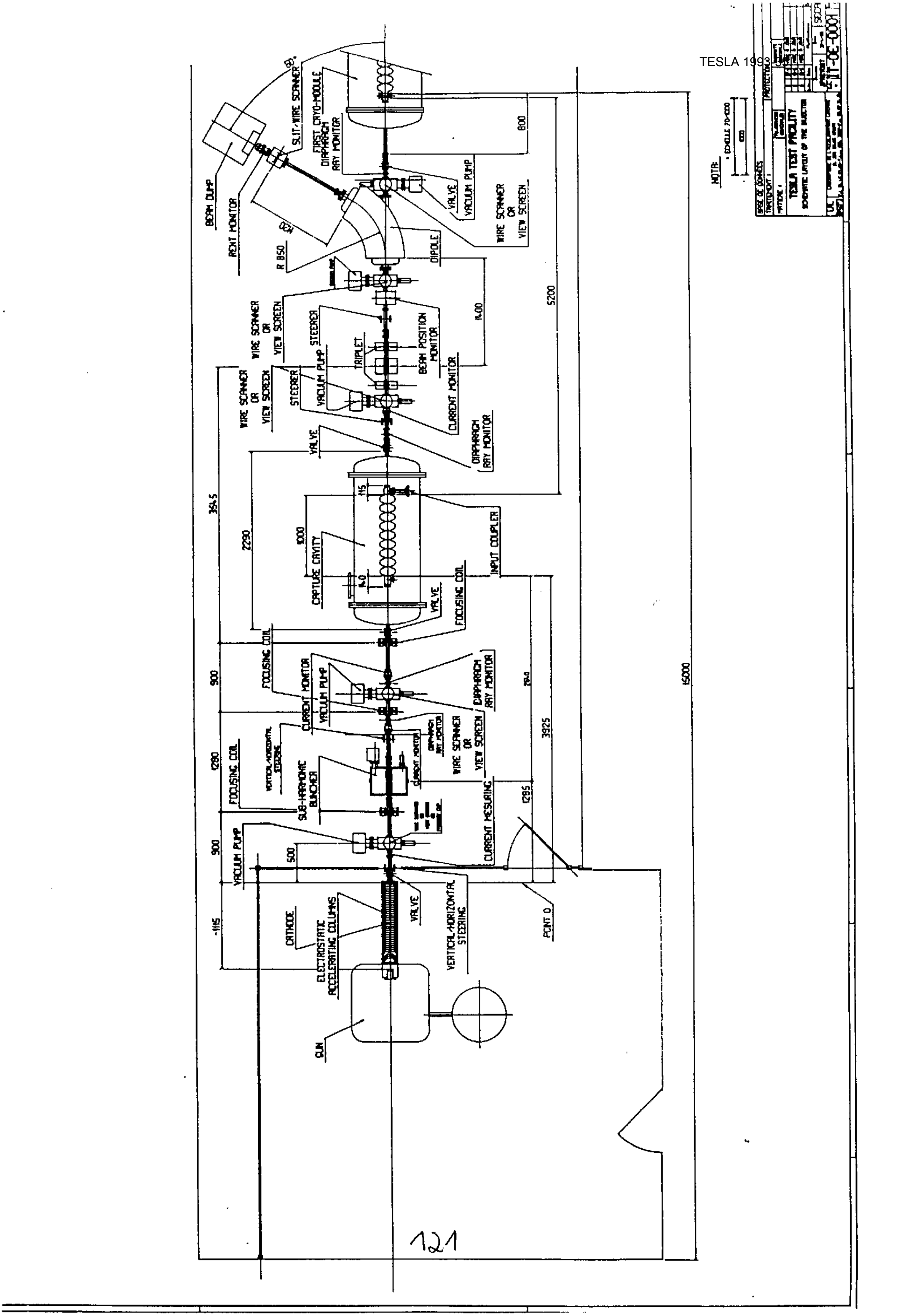
1/6/93
HLE



Halle 3 (Gebäude 28)

M=1:100

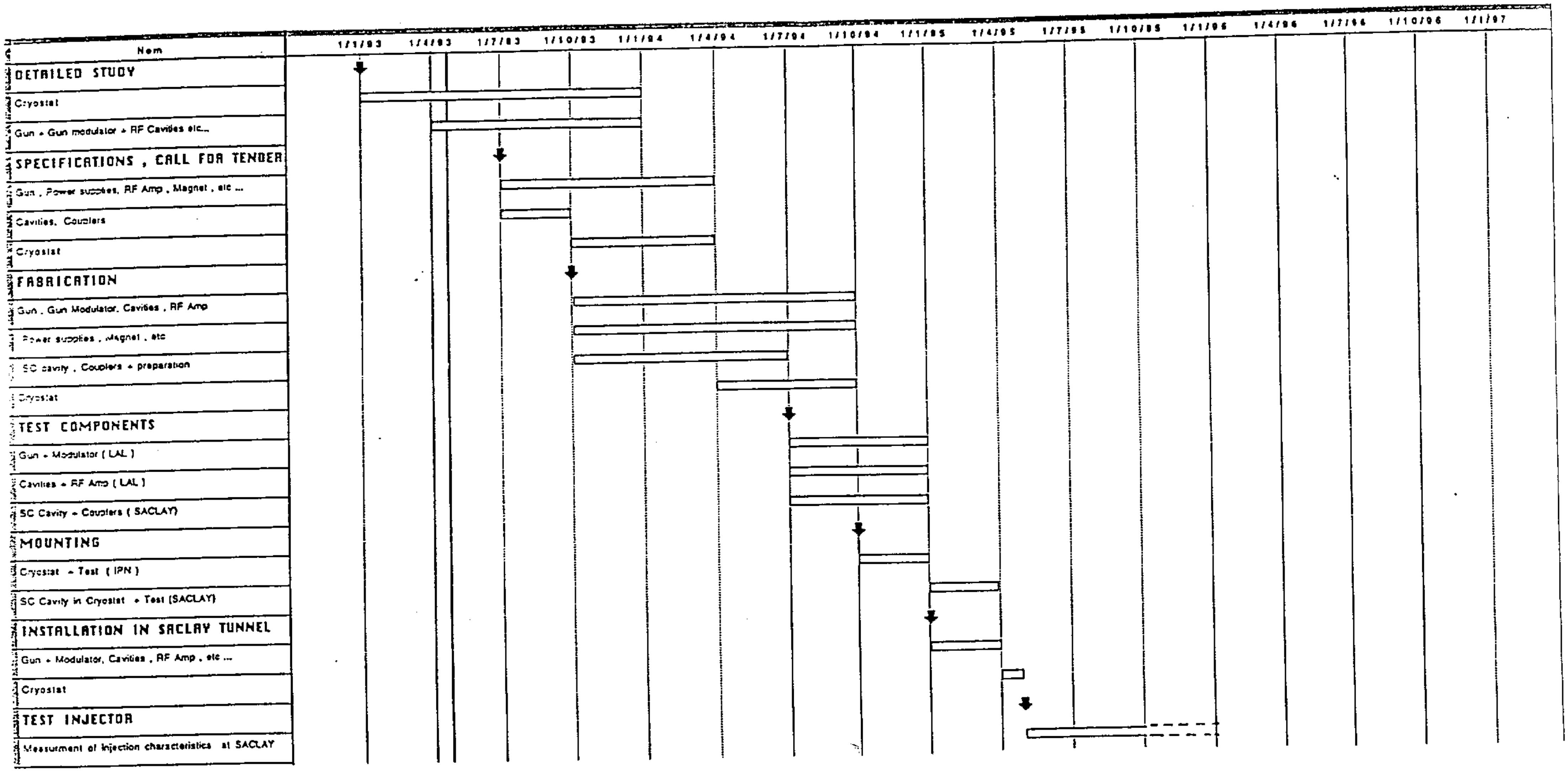

Schnitt A-A
Nord
Linac
side
Clean room
side
25 t
20 t
9000
3850
3500
360
1000
1400
2100
1250
18000
5090
5150
1100
890
1050
5030
5140
5630
4090
18000
6400
300
4480
5038
3550
1350
Abstand Südgiebel 2,60
Abstand Südgiebel 2,40 m
120
UNIVERSAL VERSAPLOT COLOR RANDOM 2.0


BEAM DUMP
RENT MONITOR
SLIT-WIRE SCANNER
FIRST CRYO-MODULE
DIAPHRAGM
RAY MONITOR
VALVE
VACUUM PUMP
WIRE SCANNER
OR
VIEW SCREEN
DIPOLE
R 850
STEERER
TRIPLET
BEAM POSITION
MONITOR
CURRENT MONITOR
CAPTURE CAVITY
INPUT COUPLER
FOCUSING COIL
SUB-HARMONIC
BUNCHER
CURRENT MESURING
VERTICAL-HORIZONTAL
STEERING
CATHODE
ELECTROSTATIC
ACCELERATING COLUMNS
GUN
POINT 0
800
5200
1400
3545
2290
1000
115
140
900
1280
500
-1115
3925
1285
15000
NOTA:
TESLA TEST FACILITY
SCHEMATIC LAYOUT OF THE INJECTOR

12.Mai 1993
Borchardt
- HERAP -

TESLA - Milestones

1	Delivery of 2 Nb cavities	1. 8.93
2	Release cavity production 1-10	1.10.93
3	1st cavity rf test	1.11.93
4	1st cavity HPP test	1. 2.94
5	Treatment,test cavities 1-10	1. 3.94
6	1st cavity horizontal test	1. 5.94
7	1st module assembly	1.11.94
8	Test module 1 without beam	1. 4.95
9	Release cavity production 11-40	1. 6.95
10	Release module cryo. product.2-4	1. 6.95
11	Ready to test mod.1 & injector I	1. 8.95
12	Treatment,test cavities 11-40	1.12.95
13	Assembly module 2-4	1. 5.96
14	Test TTF LINAC	1. 4.97



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TTF
22/4/93

DRAFT•DRAFT•DRAFT

TTF LINAC(TTFL) CONCEPTUAL DESIGN REPORT

Possible Table of Contents

Possible Expansion of T of C

I. INTRODUCTION. Broader picture of Linear Collider development with some remarks about the physics goals and time scale.

II. PURPOSE Specific technical goals for the TTFL, e.g. as in TTF Workshop of Feb. 1993.

III. OVERALL DESCRIPTION. Layout with dimensions and words describing the facility technical features using following chapter names as terms of reference. Beam optics and principal analysis equipment discussion.

IV. INJECTOR
- a) Overall description
- b) Technical Design w. simulation results
- c) Component Details
- d) Interfaces
- e) Controls and interlocks
- f) Test Objectives and Program

V. CRYOMODULE
- a) Overall description
- b) Cryostat
  - i) overall description incl. layout w. dimensions
  - ii) heat loads
  - iii) cryocomponents
  - iv) control features and instrumentation
  - v) insulation vacuum
  - vi) interlocks and safety requirements
- c) Cavities
  - i) overall description w. dimensions and mechanical features and specifications an safety requirements
  - ii) rf properties, fundamental and HOM
  - iii) lorenz and mechanical tuning
  - iv) HOM couplers
  - v) power coupler
- d) Focus, steering and BPM unit
  - i) overall description with dimensions and functions
  - ii) magnetic component details
  - iii) cryomodule beam position monitor details

e) Beam line vacuum
- i) overall considerations
- ii) injector
- iii) cryomodules w. details of bellow sections and HOM absorbers
- iv) beam analysis stations
- v) valving and interlocks

VI. RF SYSTEM
- a) overall discussion of scheme
- b) low level rf system
- c) high power rf system
- d) distribution
- e) control
- f) safety and interlocks

VII. CRYOGENICS AND REFRIGERATION
- a) overall description of system
- b) cryosupply
- c) distribution system
- d) operating scenarios (injector alone, cryomodule alone, all together)
  - i) cooldown
  - ii) operation under varying or steady load conditions
  - iii) warmup
- e) control and instrumentation
- f) interlocks and safety

VIII. CONTROLS
- a) overall description of scheme
- b) protocols to be used
- c) software
- d) hardware
- e) operating scenarios

IX. BEAM ANALYSIS EQUIPMENT AND INSTRUMENTATION
- a) overall description
- b) catalog and details of the instrumentation to be provided with its specifications, utility and power supply needs and control requirements

X. UTILITIES AND POWER SUPPLIES
- a) overall description
- b) water needs and supplies
- c) electric power needs and supplies
- d) gas needs and supplies

e) catalog of power supplies to be furnished and their control and regulation requirements

XI. PERSONNEL INTERLOCKS AND SAFETY

a) principles to be followed
b) overall description of the system
b) scenario for checkout and conduct of operations

XII. EXPERIMENTAL AND DEMONSTRATION PROGRAM

a) overall objectives
b) index of experiments and measurements
c) scenario and instrumentation for each of the measurements and experiments with instrumentation specification implied by measurement or experiment need
  i) mechanical
  ii) thermostatic and dynamic
  iii) microwave
  iv) beam
  v) upset conditions and safety
d) utility and power supply needs for experimental and analysis equipment

XIII. SCHEDULE

schedule and milestones for principal subsystems of TTFL

- Given the financial constraints and the political boundary conditions it is likely that a new e^+e^- linear collider facility will be constructed as an interregional project

↦ need to build a broad support in each region

↦ need to agree on a common technology

⬇

requires a new broadly based international "organization"

this "organization" must recognize the "cultural differences" that exist between the regions.

DESY, KEK, SLAC.

TESLA 1993-35

INTERLABORATORY MEMORANDUM OF UNDERSTANDING OF RESEARCH AND DEVELOPMENT TOWARDS TeV LINEAR e^+e^- COLLIDERS

INTRODUCTION

Colliding beam machines, both hadron colliders and electron-positron colliders, have played the leading role in high-energy particle physics for the past decade. The success of physics programs at the SLC and LEP demonstrates the continuing contribution of e^+e^- interactions to the advancement of particle physics. The physics of high-energy electron-positron collisions has been the subject of a number of extensive studies by the American, European, Japanese, and Former Soviet Union communities of particle physicists, and has been comprehensivly reviewed at a recent international workshops (Finland, September 1991 and Hawaii, April 1993).

A consensus has emerged that an electron-positron collider with initial center-of-mass energy 300-500 GeV and luminosity $5 \times 10^{33} cm^{-2} s^{-1}$, built so that its energy can be increased to 1 TeV and beyond, is the proper and natural next step in the evolution of electron-positron colliders. Studies of electron-positron annihilation with this collider will be complimentery to studies being carried out at hadron colliders at the beginning of the next century, and will be essential to the development of a complete understanding of particle physics beyond the Standard Model.

Linear colliders have emerged as the tools that will carry the e^+e^- energy frontier beyond LEP II. It is therefore essential that the accelerator physics and technology necessary for the continued development of these machines be pursued in a timely fashion. This work has been pursued up to now by an unstructured and informal international collaboration of interested institutions. The signatories of this Memorandum of Understanding believe that the work has reached the stage where a more structured collaboration will facilitate the effort.

Purpose and Guidelines

This Memorandum of Understanding (MoU) describes the Collaboration formed by the Signatory Institutions for the following purpose:

- To coordinate international Research and Development (R & D) efforts towards e^+e^- linear colliders.
- To review and monitor the status and progress of technical approaches towards linear colliders.
- To facilitate the exchange of personnel among the participating Institutions, and to promote the sharing of research facilities among the Participating Institutions.

This Collaboration will carry out its business according to the following guiding principles:

- The Collaboration is open to any Institution which agrees to make significant Contributions toward the development of linear colliders.
- This Collaboration is not intended to displace or supercede any existing organization.
- The Collaboration recognizes the requirement that R & D towards future linear colliders be conducted without prejudice to potential sites of construction.
- The Collaboration anticipates that future linear colliders will be constructed by international coalitions.

1. Organization

The elements of the Organization of this Collaboration are shown in the attached Figure.

1a. A Collaboration Council will be established to coordinate the business of the Collaboration.

1b. A Regional Council will be established to provide coordination of Collaboration business among Global Regions.

1c. A Technical Review Group will be established to provide expertise in the accelerator physics and technology of linear colliders. This Technical Review Group will be responsible for review of the technical status and progress of the world wide R & D effort towards future e^+e^- linear colliders.

2. Methods

The Collaboration recognizes the following Methods of Contribution towards its Objectives.

2a. Development of theoretical ideas and understandings that form the basis for high-energy linear colliders and the interface between experiment and accelerators.

2b. Development of the accelerator technologies required to realize high energy linear colliders.

2c. Participation in the construction or utilization of experimental facilities intended to demonstrate the feasibility of high-energy linear colliders.

3. The Collaboration Council:

Each Participating Institution shall appoint one Institutional Representative to membership in the Collaboration Council. The Institutional Representative serves at the pleasure of their Institution..

The Collaboration Council shall establish from its membership a Chair, a Vice-Chair, a Secretary, and a Deputy Secretary, each to serve for a term of duration one year. Upon completion of each term the Vice-Chair and Deputy Secretary shall become respectively the Chair and Secretary for the succeeding term, and the Collaboration Council shall elect a new Vice-Chair and Deputy Secretary.

All activities of the Collaboration Council are to be carried out by approval of a majority of its members.

The tasks of the Collaboration Council are as follows:

3a. The Collaboration Council shall consider the goals of Elementary Particle Physics established for future linear colliders at meetings such as the Workshops on Physics and Experiments with Linear e^+e^- Colliders (Finland 1991, Hawaii 1993 etc.).

3b. The Collaboration Council shall yearly nominate members for the Technical Review Group and draft a charge for the Technical Review Group. These members and charge are to be approved by the Regional Council..

3c. The Collaboration Council shall consider and comment on Technical Reviews submitted to it by the Technical Review Group.

3d. The Collaboration Council shall make its Comments known to all Participating Institutions and to the Regional Council.

3e. The Collaboration Council shall record its deliberations (and votes) in the form of minutes of its meetings and those of its subcommittees.

These minutes shall be made available to all members of the Collaboration Council and the Regional Council.

4. The Regional Council:

A Regional Council will be established with membership consisting of three Regional Representatives of each of the Global Regions (i) The Far East, (ii) The Former Soviet Union, (iii) Europe, and (iv) The Americas. The Regional Representatives shall be determined by majority vote of the Institutional Representatives of the Collaboration Council grouped according to their home Region. Members of the Regional Council need not be members of the Collaboration Council.

In addition, the Chair of the Collaboration Concil and the Chair of ICFA shall participate as *ex officio* members of the Regional Council.

The Regional Council shall establish from its membership a Chair, Vice-Chair, and Secretary, who shall serve for a term of duration one year. Upon completion of each term the Vice-Chair shall become the Chair for the succeeding term, and the Regional Council shall elect new Officers as Vice-Chair and Secretary.

All activities of the Regional Council are to be carried out by consensus of its members.

The tasks of the Regional Council are to consider the Comments of the Collaboration Council, and to discuss ways and means to further development of linear colliders.

5. The Technical Review Group:

The members of the Technical Review Group shall be nominated by the Collaboration Council and approved by the Regional Council. The membership of the Technical Review Group shall be sufficient in number and expertise to be able to review the accelerator physics and design strategies based on all technological approaches to e^+e^- linear colliders.

The duties of the Technical Review Group are:

5a. To consider the status and progress of the development of e^+e^- linear colliders reviewed in meetings such as the Linear Collider Workshop (LCXX).

5b. To identify issues that have been successfully addressed and areas where further work is required, and to discuss issues specified in the Charge from the Collaboration and Regional Councils.

5c. To submit a written Technical Review to the Collaboration Council.

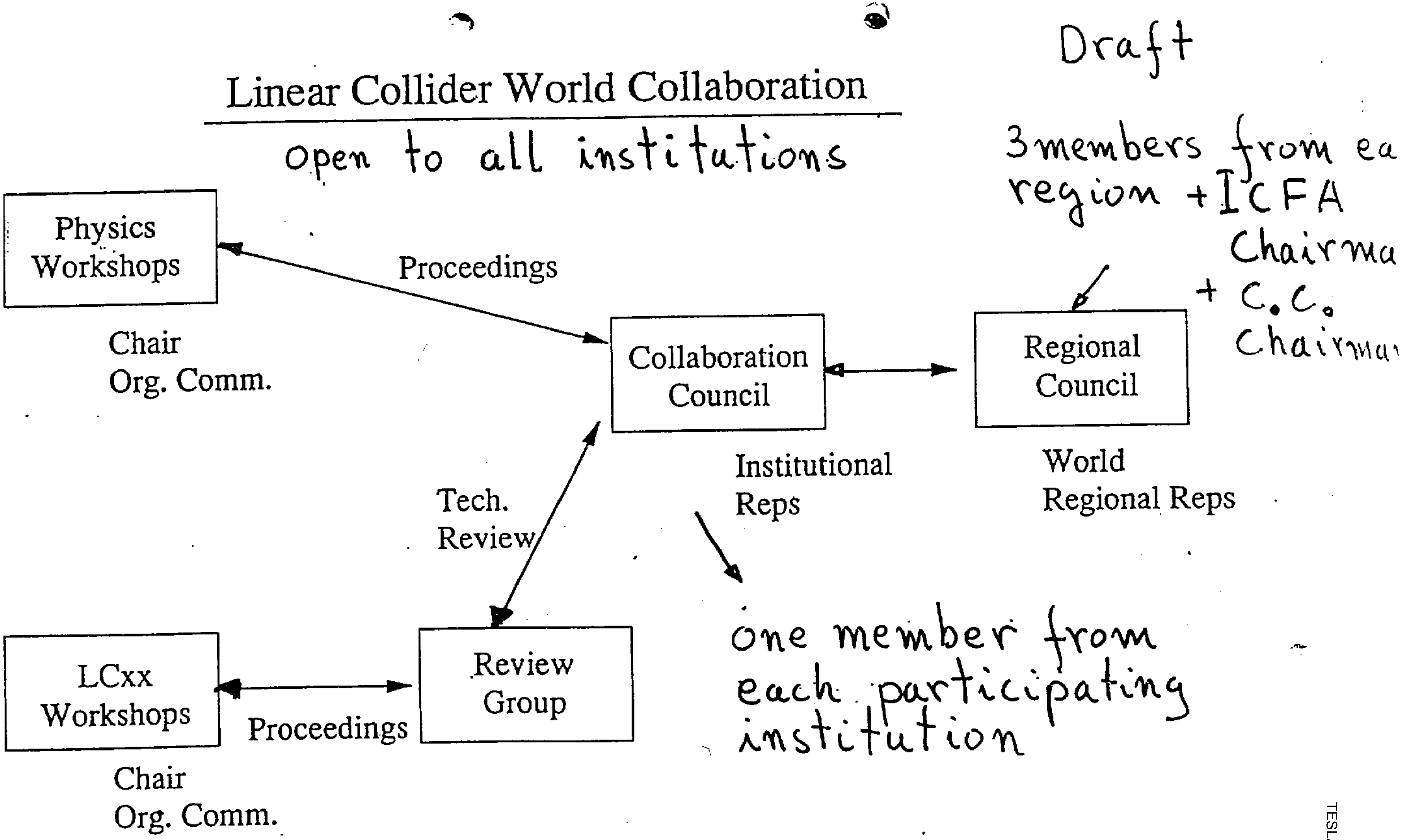
The Technical Review Group shall be disbanded upon submission of its Review to the Collaboration Council.

6 Amendments

Amendments to this MoU may be recommended to the Regional Council by agreement of two-thirds of the Institutional Representatives in the Collaboration Council.

7. Termination:

A Signatory Institution of this MoU may terminante its participation in this Collaboration by written statement to the Chair of the Collaboration Council.


Draft
Linear Collider World Collaboration
open to all institutions
3 members from ea
region + ICFA
Chairma
+ C.C.
Chairma
Physics Workshops
Chair
Org. Comm.
Proceedings
Collaboration Council
Institutional Reps
Regional Council
World Regional Reps
Tech. Review
one member from each participating institution
LCxx Workshops
Chair
Org. Comm.
Proceedings
Review Group

ICFA

International Committee for Future Accelerators
Sponsored by the Particles and Fields Commission of IUPAP

Also ECFA supportive

6 May 1993

A consensus has emerged that an electron-positron collider with an initial center of mass energy of 300 to 500 GeV and a luminosity of order 10^{33} cm^{-2} s^{-1} or more is the natural choice for the next collider needed to explore the high energy e^+e^- frontier.

A broad set of technological alternatives which all have the potential of meeting these design goals are presently being explored at various laboratories. Given the breadth and diversity of the program and the fact that at present work is only being pursued at few laboratories, there is a need to:

- Facilitate a critical evaluation and comparison of the various approaches with the aim of reaching a consensus on a favored design.
- Coordinate the worldwide R&D effort towards this goal.
- Broaden the basis of linear collider R&D by providing a mechanism by which smaller and medium size institutions can join in the R&D effort.

These questions have been addressed in a memorandum titled:

> "Interlaboratory Memorandum of Understanding of Research and Development towards TeV Linear e^+e^- Colliders."

which has been submitted jointly by DESY, KEK, and SLAC to ICFA.

The memorandum describes the structure of a collaboration designed to meet the objectives listed above. A copy was submitted to the meeting of ICFA held at DESY on 6 May 1993.

The proposed collaboration is based on the following principles:

- The collaboration recognizes the desirability to coordinate on a worldwide basis R&D of linear colliders.
- The collaboration is open to any institution which wishes to contribute to the development of linear colliders.

- The collaboration recognizes the importance of the exchange of personnel and information between participating institutions.
- The collaboration anticipates that future linear colliders will be constructed by international coalitions.
- The collaboration recognizes the requirement that R&D towards future linear colliders be conducted without prejudice to potential sites of construction.

ICFA welcomes and supports the initiative taken by DESY, KEK, and SLAC and endorses the guiding principles of the collaboration agreement as outlined above.

ICFA wishes to be kept informed at regular intervals by the Chairman of the Regional Council.

ICFA concurs with the proposal that its Chairman should be an ex-officio member of the Regional Council.

Upon approval of the project, ICFA assumes that there will be a call for proposals of the experimental use of the facility and that the experiments will be examined and recommended by an International Advisory board without prejudice towards institutions and persons which have participated in the R&D phase of the accelerator.

Meetings

TTF ~ 4 review meetings / year
+ many topical meetings organized as needed.

Schedule Review meetings:

- 1993:

September	13	at DESY
Dezember	14 / 15	

- 1994:

March	7	monday	
June	7 / 8	"	"
September	6 / 7	-"-	-"-
November	21 / 22	-"-	-"-

Dates for 1994 tentativ, to be fixed at Dezember meeting.

We should also try to fix the locations at the September / December meeting.

TESLA 500 GeV.

TESLA 1993-35

- 1993:
  September 14/15/16 at DESY
  LC-93
  Stanford October 13-23.

  first technical review.

- 1994:
  March 8/9/10

  September ?
  depends on the schedule of
  LC-94. Need one week

  first draft outline of the
  Report.

Layout Interaction Region and Canonical Detector

- Should be a broadly based effort including some experimental Physicists.
- Layout interaction region
  - magnets } incl. tolerances
  - collimators } and support
- Backgroud
  - muons created upstream
  - synchrotron radiation
  - resolved photon events
- Detector
  - design (define comp. performance
  - simulation of background + physics events
- We would like to have the first meeting of this kind in the autumn.

TTF

- Rapid progress
  - ↦ coordination / communic
  - ↦ design changes

  drawings on CAD / Data bank.
- Placing large orders / inviting bids.

  ↦ final review

- Should we order all the Nb at once?

- After we have gained expriencewith the first module
  - → design update
    (1 - 1½ year)

Break after one module or after 2 modules