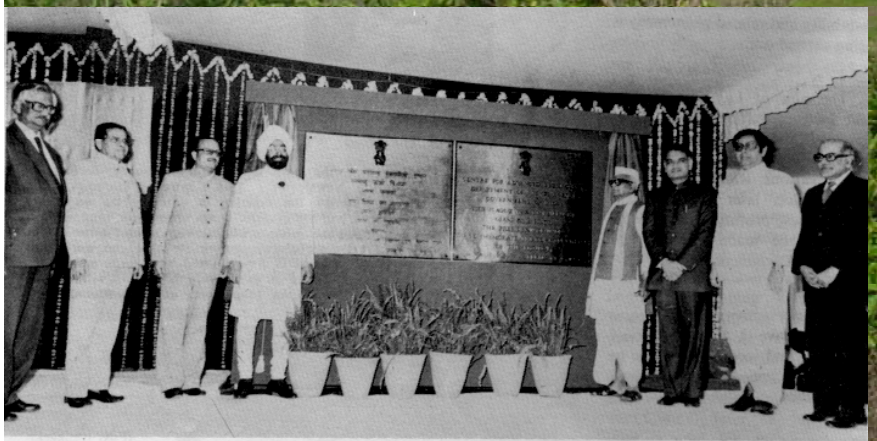
Raja Ramanna Centre for Advanced Technology, Indore

A Warm Welcome from the Entire Staff of RRCAT on the Visit of Dr. K. Kasturirangan, Hon'ble MP & Director, NIAS

Scientific Accomplishments of the Last Year

FOUNDATION DAY FUNCTION

February 19, 2008

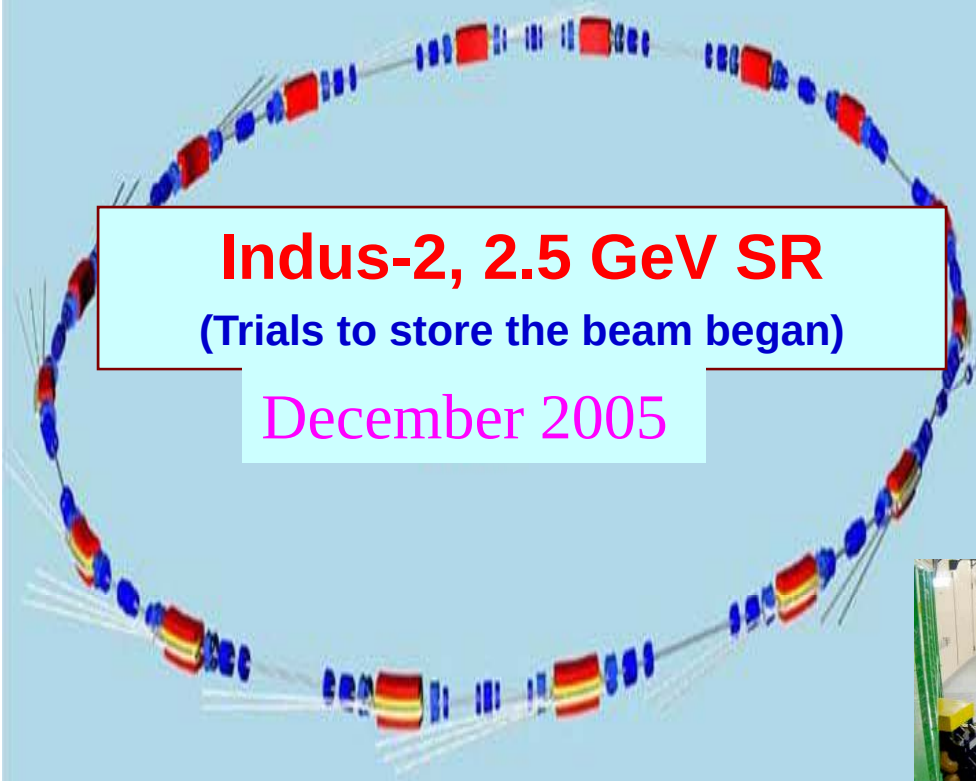


Inauguration of CAT by President Giani Zail Singh. Seen along with him (L to R) are—Dr. R. Ramanna, Chairman, Atomic Energy Commission: Shri P.C. Sethi, Union Home Minister; Shri Arjun Singh, Chief Minister of M.P.; Shri Bhagawat Dayal Sharma, Governor of M.P.; Shri Shivraj Patil, Union Minister for Energy; Shri Rajendra Dharkar, Mayor, Indore Municipal Corporation & Shri C. Ambasankaran, Chairman, P&IC, CAT.

Photograph at the Function, when our Centre's Foundation Stone was laid on 19th February 1984, by the then President of India

SCHEMATIC OF INDUS COMPLEX & SOME PICTURES

Have progressed well in 2007-08.
Are now poised to operate both Indus-1 & Indus-2 for long hours for users and are making headway.



Indus-2, 2.5 GeV SR
(Trials to store the beam began)
December 2005

Booster Synchrotron (700 MeV)

Microtron (20 MeV)

TL-1

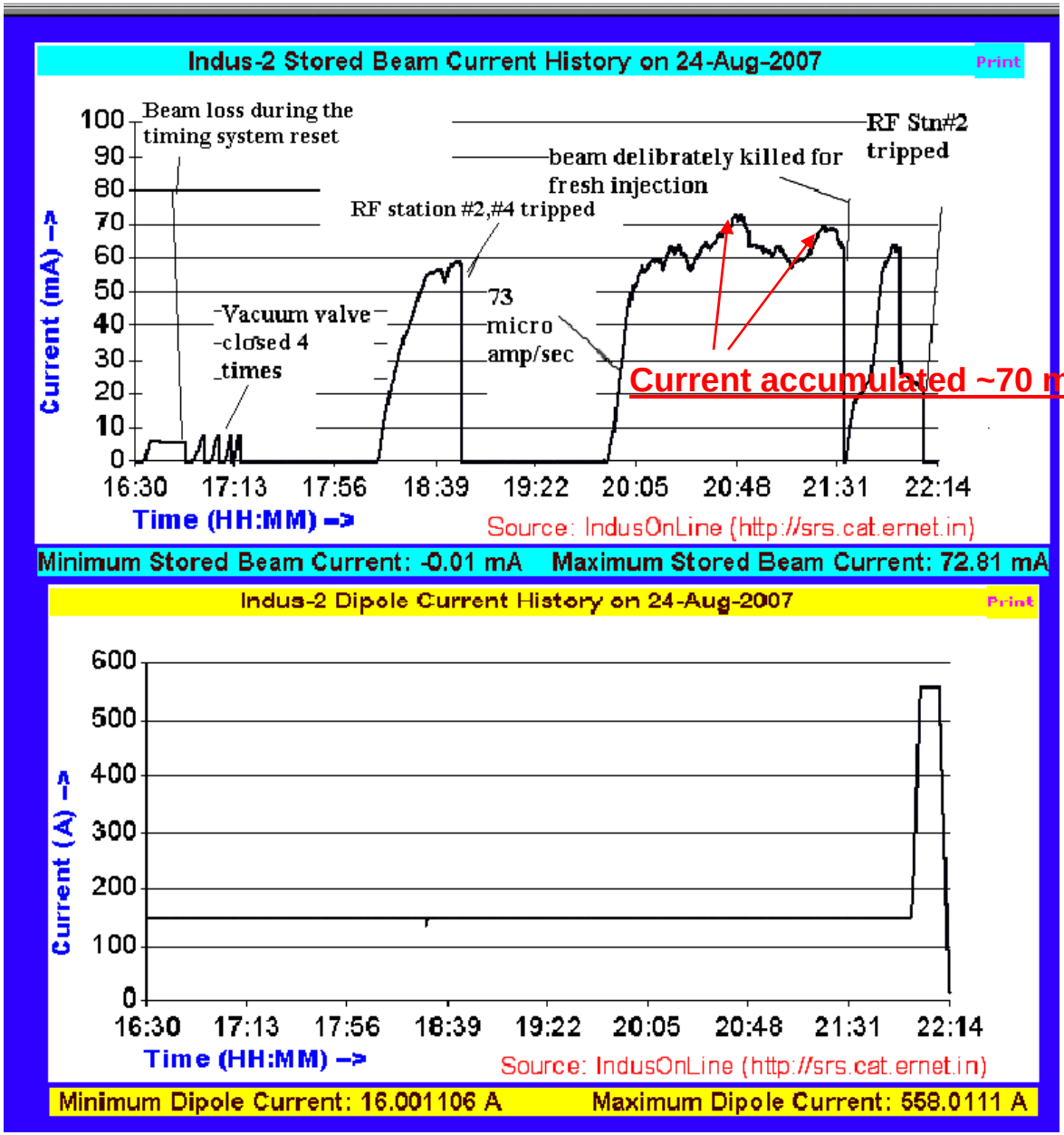
TL-2

TL-3

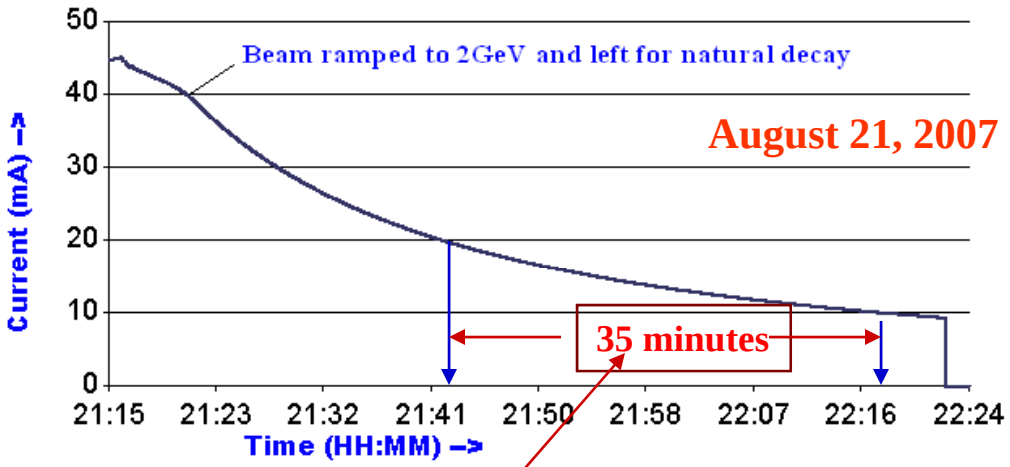
Indus-1 (450 MeV, 100 mA)

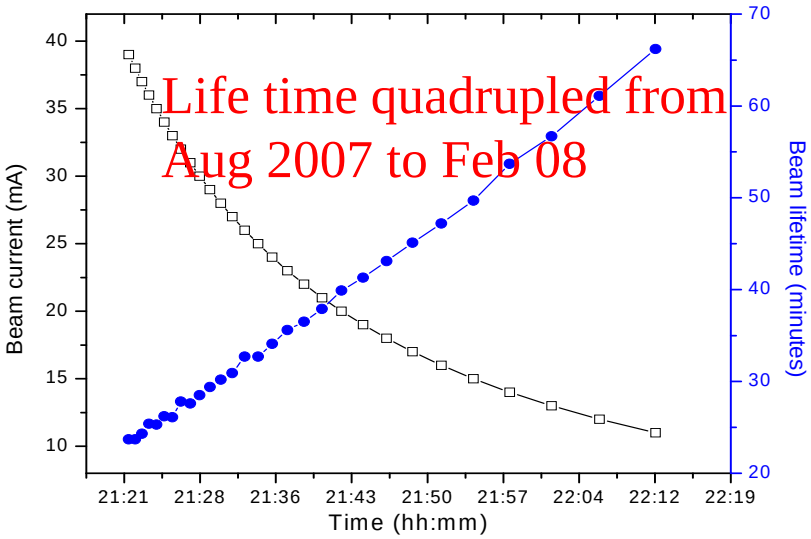
Indus-2 Status: ~70mA accumulated@ injection energy ~550MeV.
Now being operated @2GeV.(Max energy reached so far 2.4 GeV.)

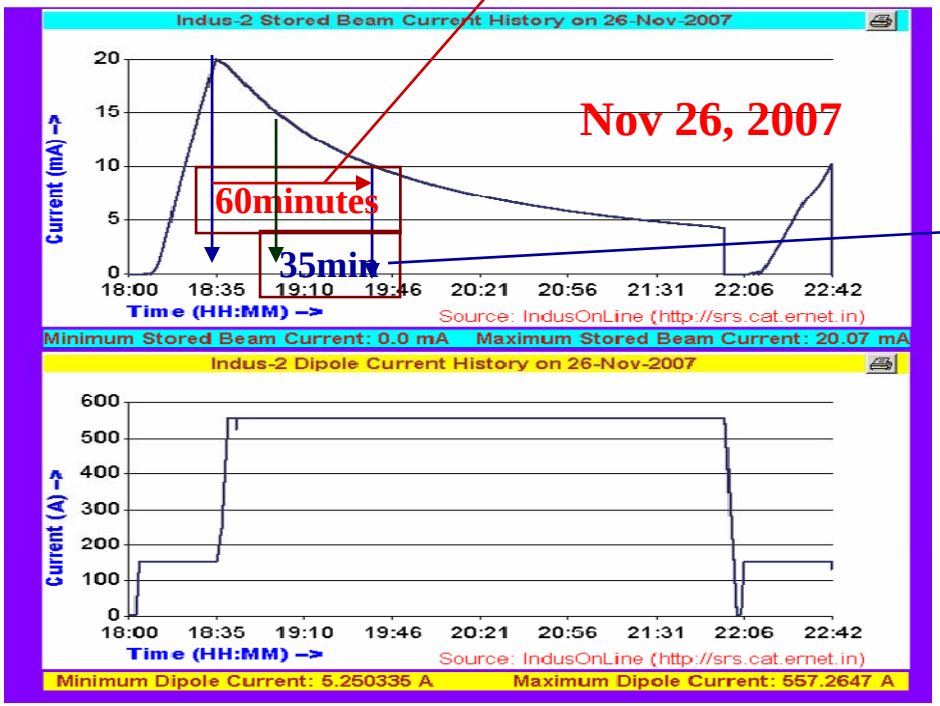
Accumulated current of ~70 mA has been reached in Indus-2

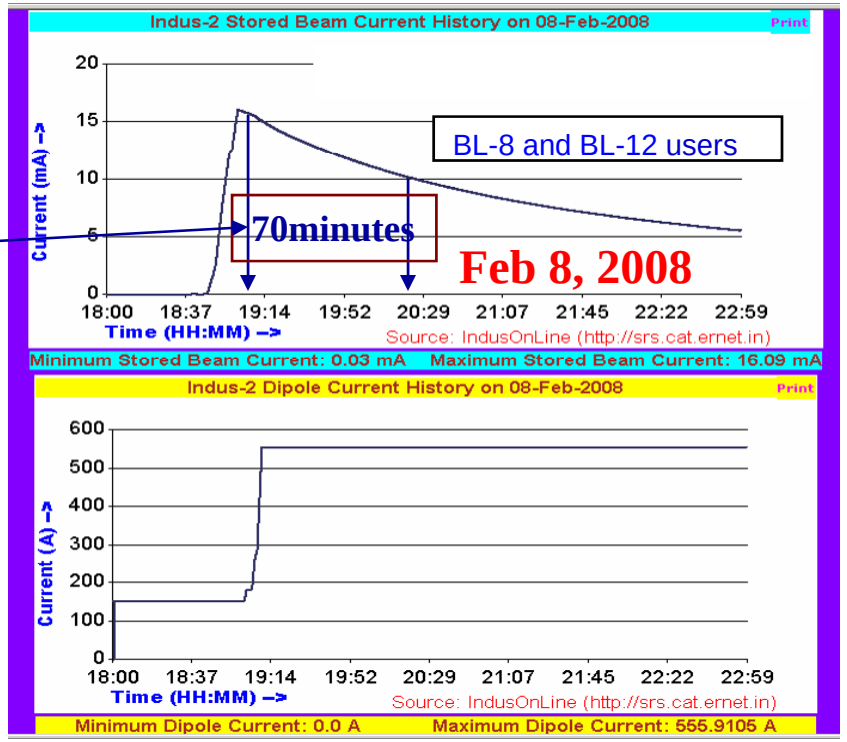


Progress in the beam lifetime for 2GeV operation

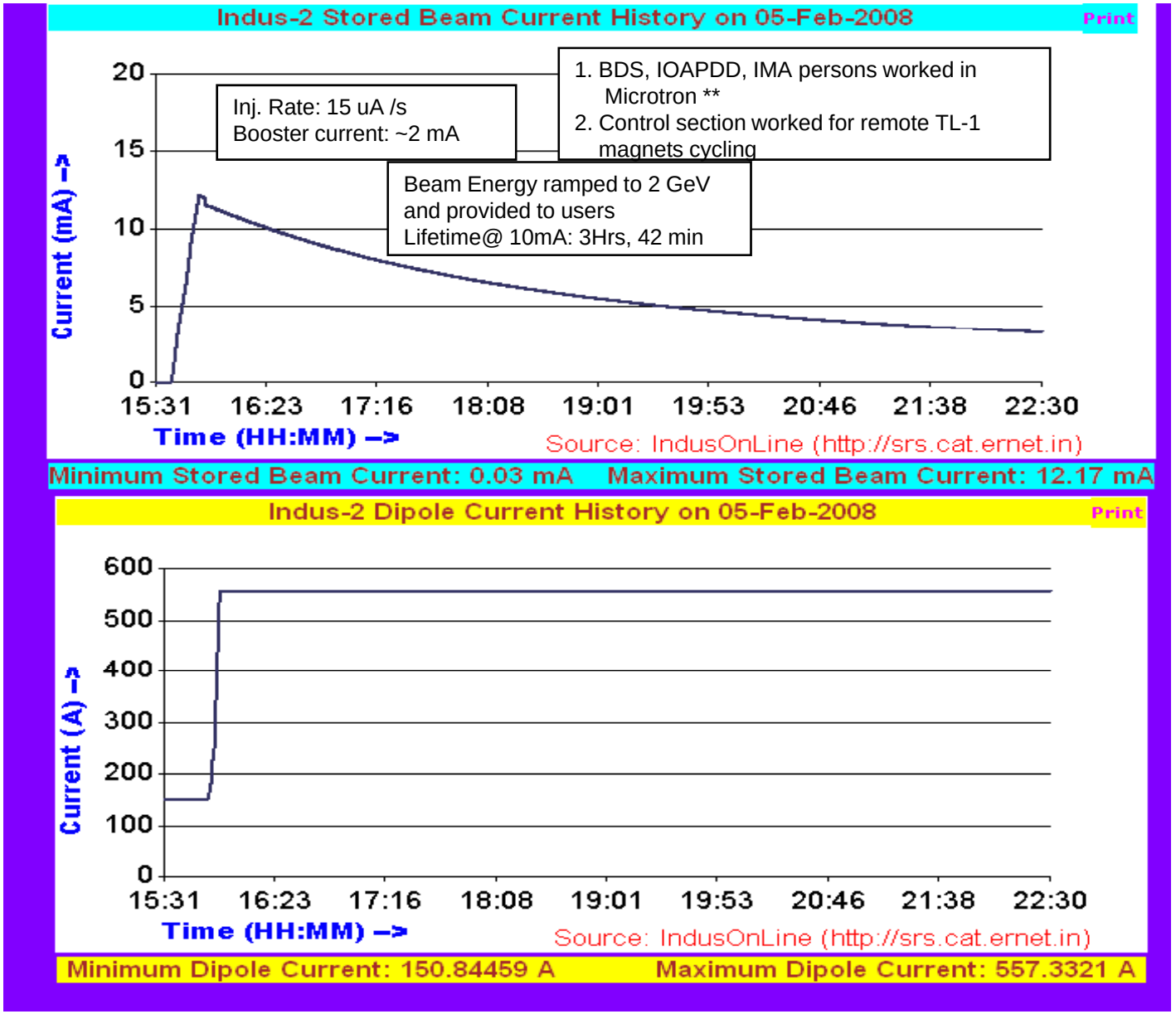








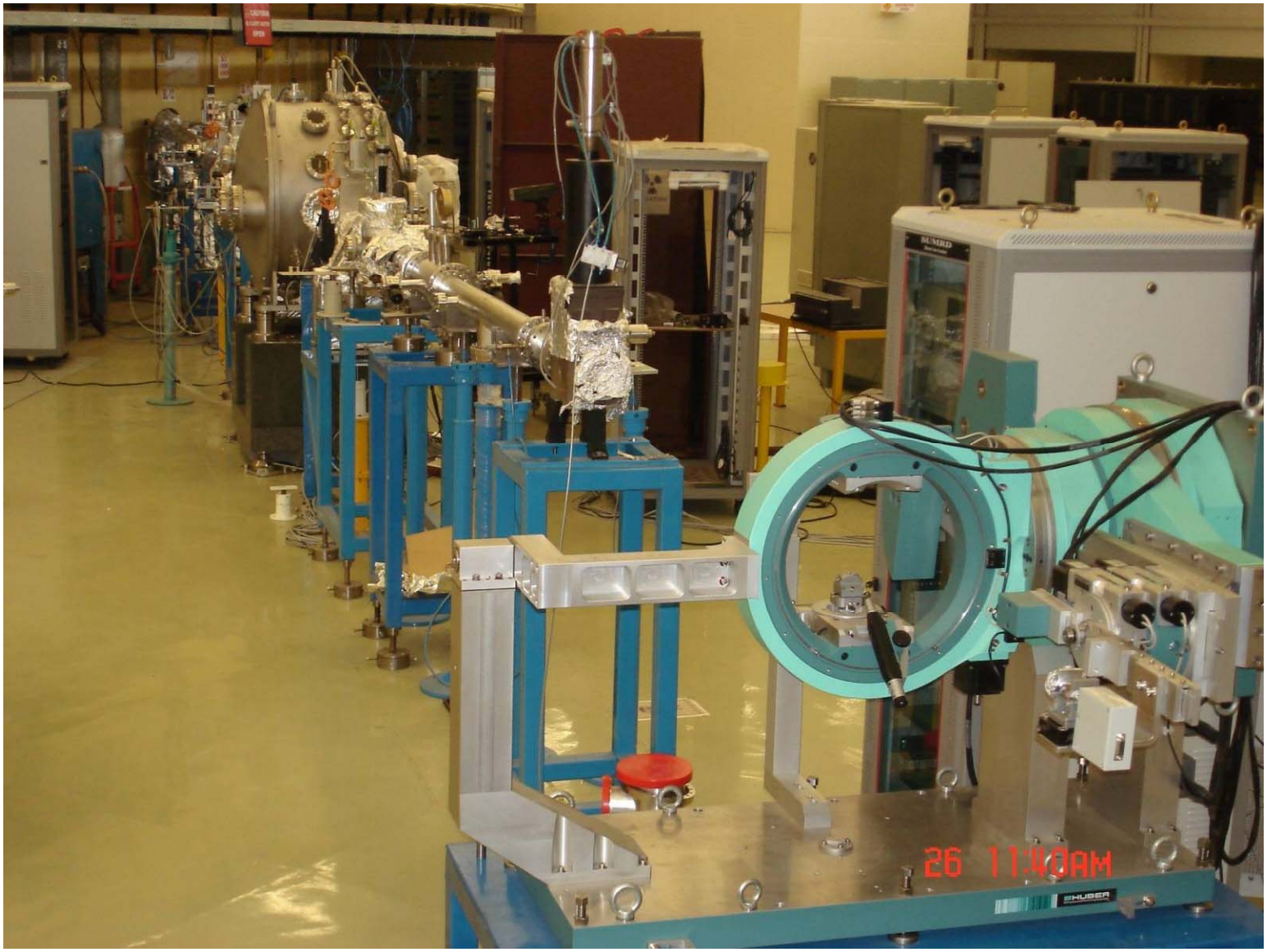
Indus-2 can now run for long hours at ~10 - 20 mA @ 2 GeV. So user program could commence in right earnest.



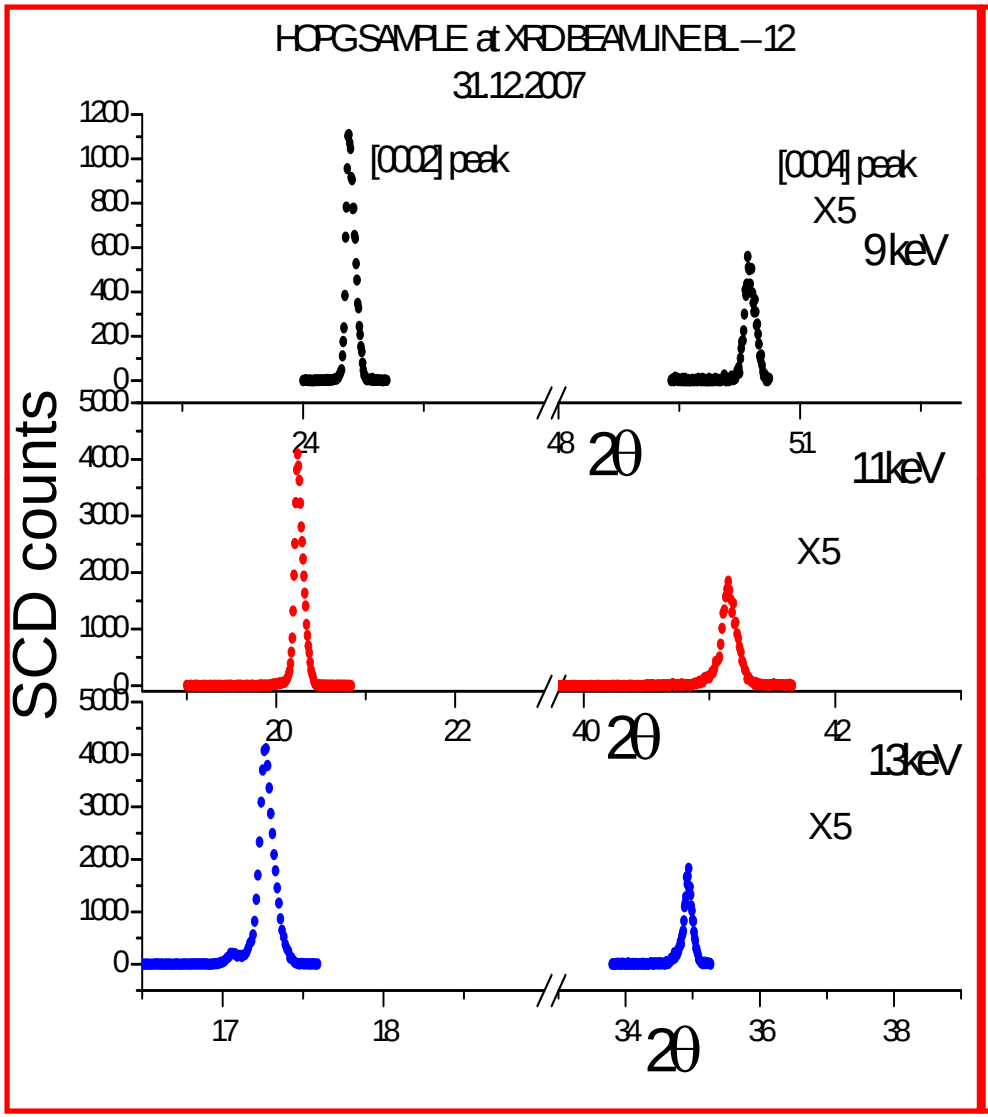
Beam-lines being built/designed/planned

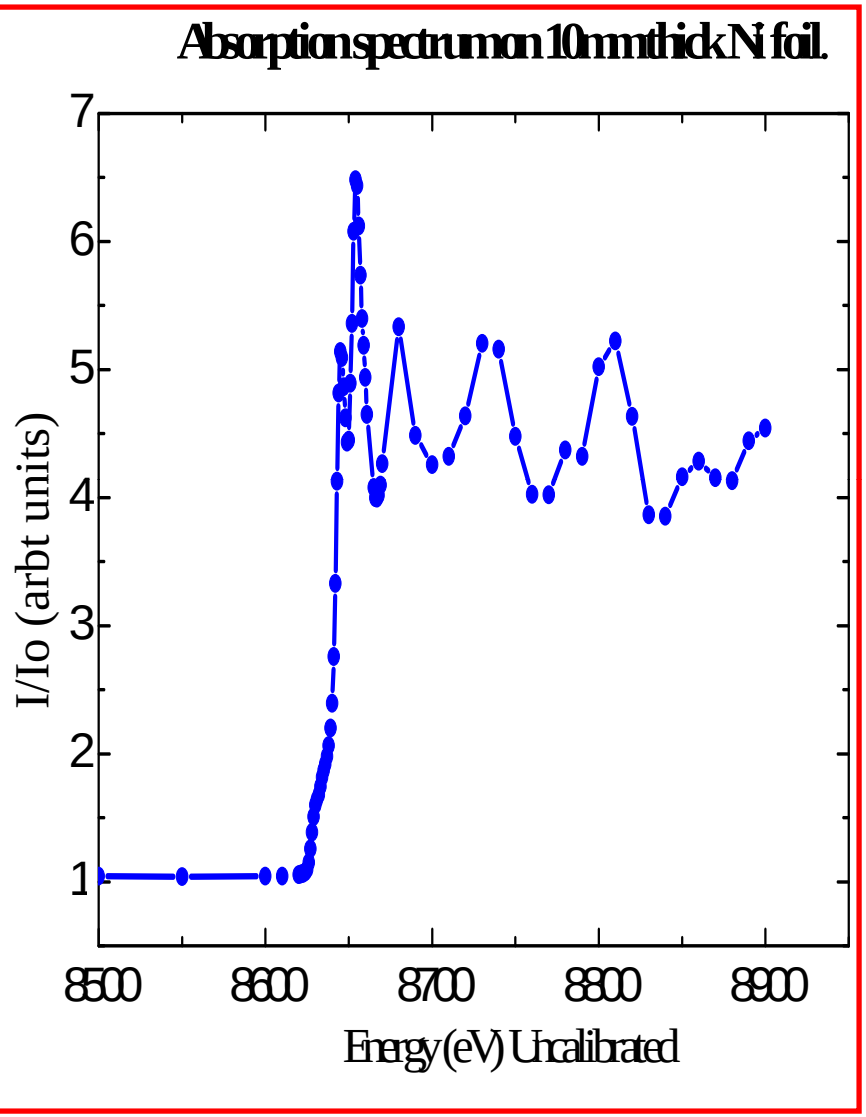
	Range (KeV)	Groups
Being built		
High resolution XRD (Mostly Installed)	5 – 25	RRAT
XRF-microprobe	2 – 20	RRCAT
Energy Dispersive – XRD (Installed)	10 – 70	BARC
EXAFS (Installed)	5 – 20	BARC
Grazing incidence mag scattering (#)	5 – 15	SINP, Kolkata
PES (With high resolution at ~6keV) (#)	.8 - 15	BARC
Small angle X-ray scattering (SAXS)	8 - 16	BARC + IGCAR
Being designed		
Protein Crystallography	6 – 25	BARC + UGC-DAE-CSR
White-beam lithography	1 – 10	RRCAT
MCD/PES on bending magnet	0.03 – 4	UGC-DAE-CSR
Medical imaging beam-line	10 – 35	BARC + UGC-DAE-CSR
Planned		
IR-beam-line	2 – 100 μm	BARC
Undulator-MCD	0.1 – 1.5	RRCAT
X-ray beam diagnostics	6.2	RRCAT
Visible beam diagnostics	Visible	RRCAT

(# Action towards beam line installation in experimental hall has started)



XRD beamline BL-12


HOPG SAMPLE at XRD BEAMLINE BL – 12
31.12.2007
SCD counts
[0002] peak
[0004] peak
X5
9keV
11keV
X5
13keV
X5
2θ
2θ
2θ

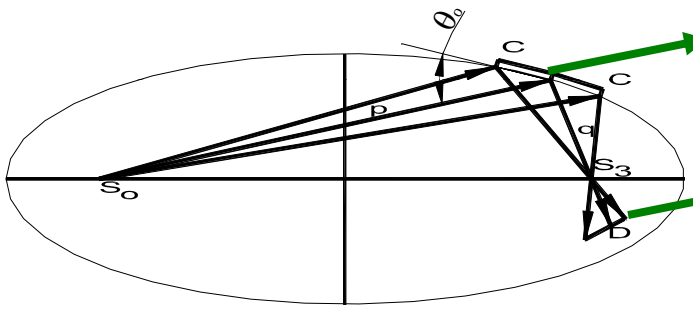

Absorption spectrum on 10 mm thick Ni foil.
I/Io (arbt units)
Energy (eV) Uncalibrated

Multi Channel EXAFS Beamline for INDUS-2 Synchrotron Source

Built by Spectroscopy Division, B.A.R.C.

It involves measuring the x-ray attenuation coefficient in a material just above the absorption edge of a particular atom using Energy Dispersive Mode

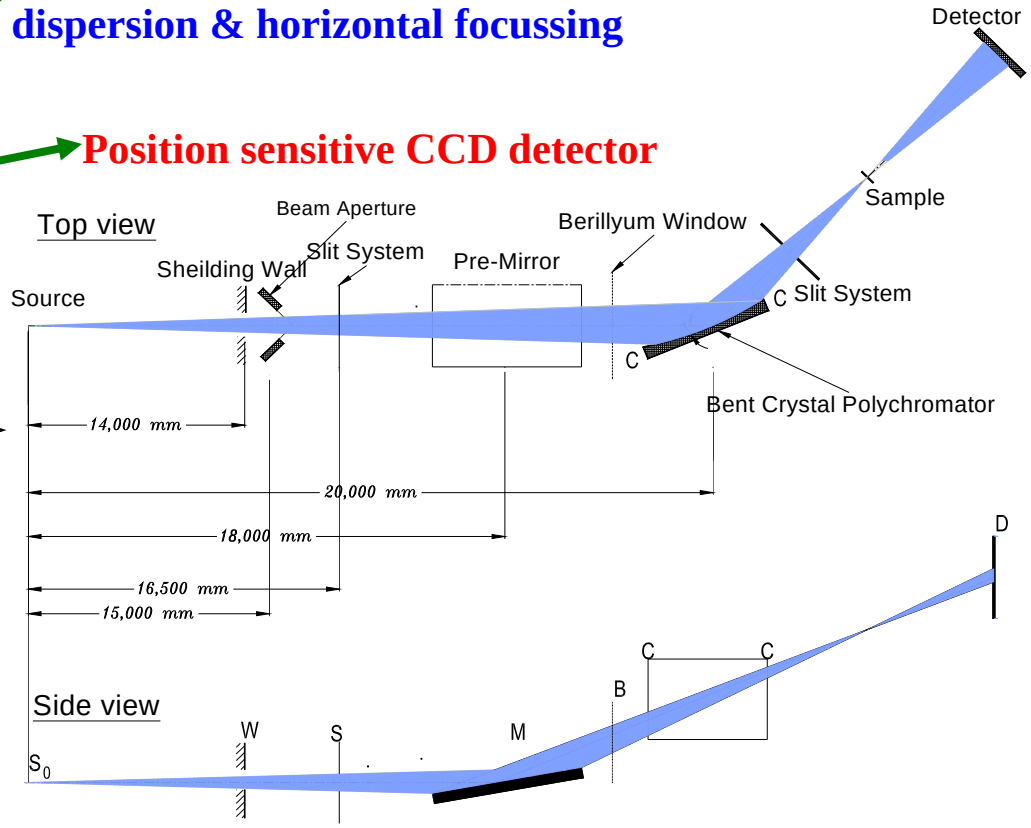
Fast Technique → **Average data acquisition time : 300 msec**
Suitable for in-situ, fast and time-resolved processes



Elliptically bent Si (111) crystal for dispersion & horizontal focussing

Position sensitive CCD detector

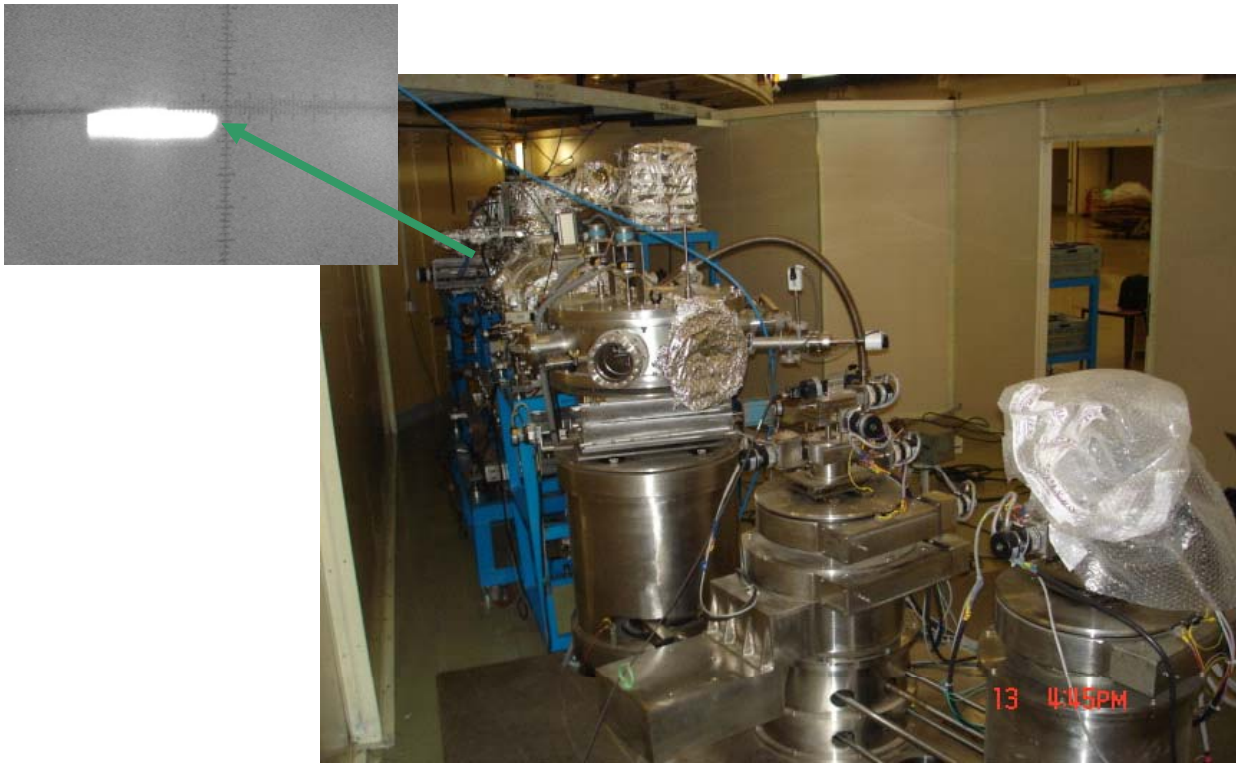
Optical Layout →



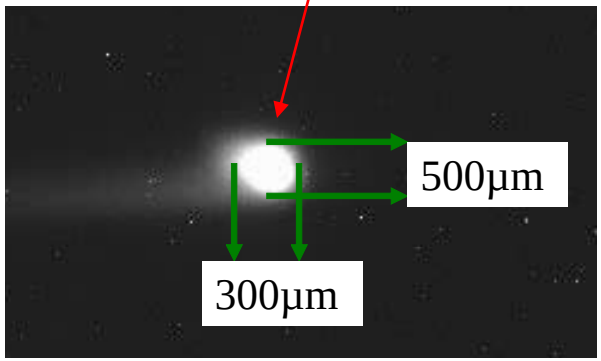
Specifications

Energy Range: 5-20 keV
Bandwidth : 1 keV @ 10keV
Resolution (E/ΔE): 10^4

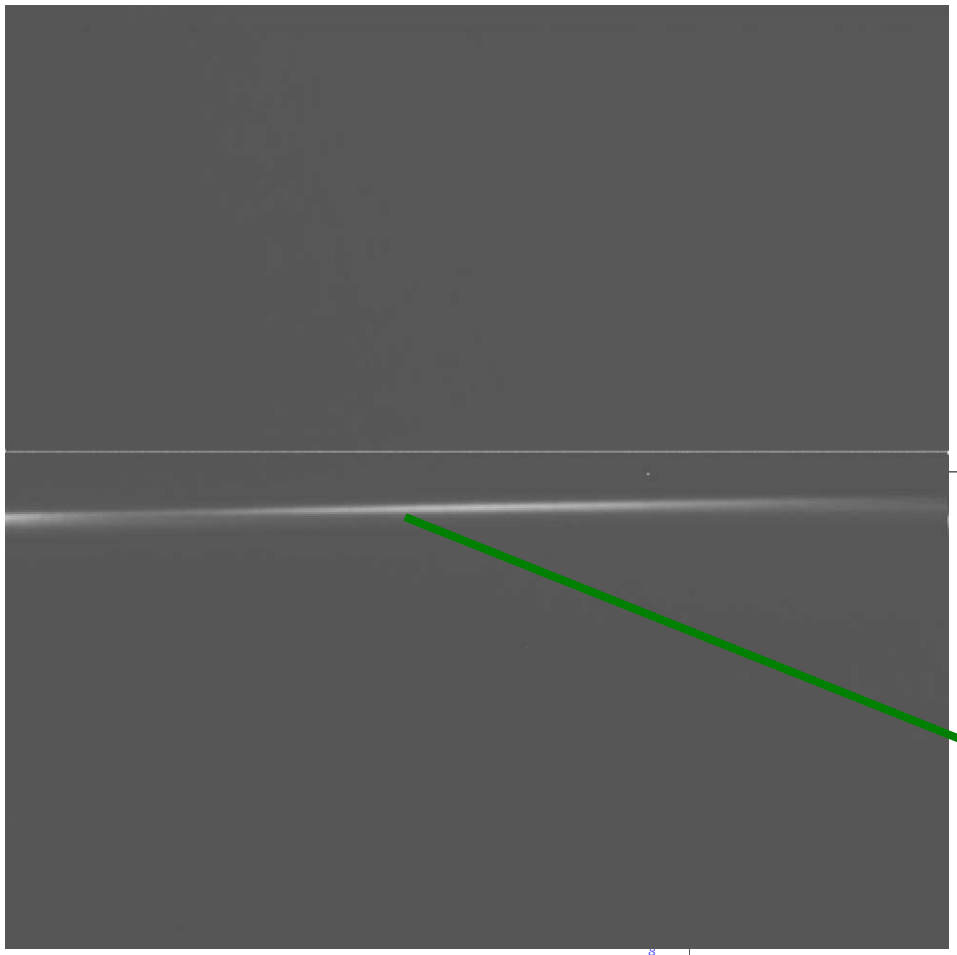
SR Beam footprint at Beam Viewer-1 (before pre-mirror) of BL-8, EXAFS beam line obtained on 22.11.2007 @5mA/2 GeV beam from Indus-2



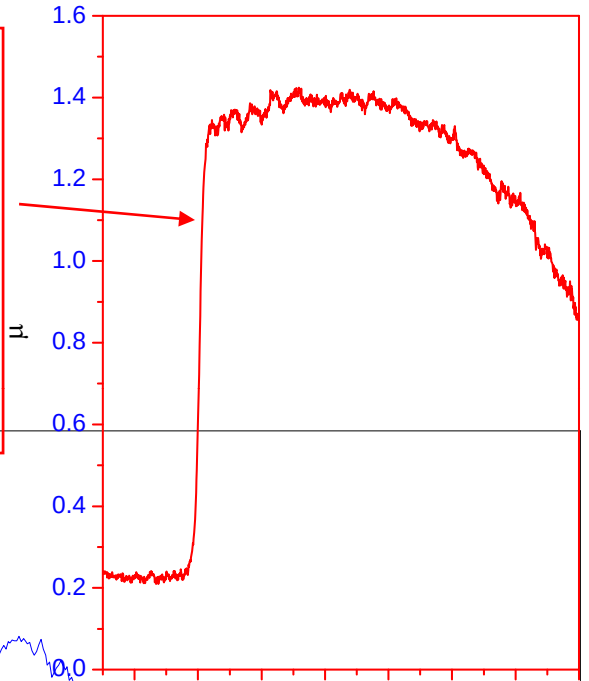
Focussed beam at the sample position after horizontal focusing by bent Si(111) crystal & vertical focusing by Rh–coated mirror recorded with 7mA@2 GeV beam on 8-2-08 at BL-8 on Indus-2

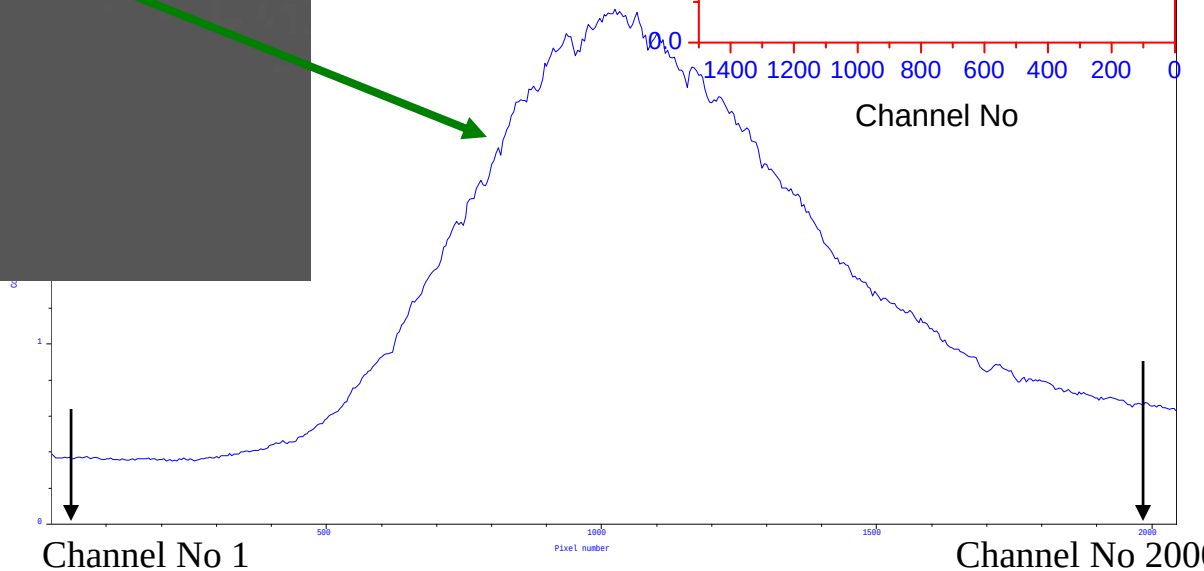


SR beam footprint on the CCD detector at 900 mm behind the focal point recorded with 7mA@2 GeV beam on 8-2-08 at BL-8 on Indus-2

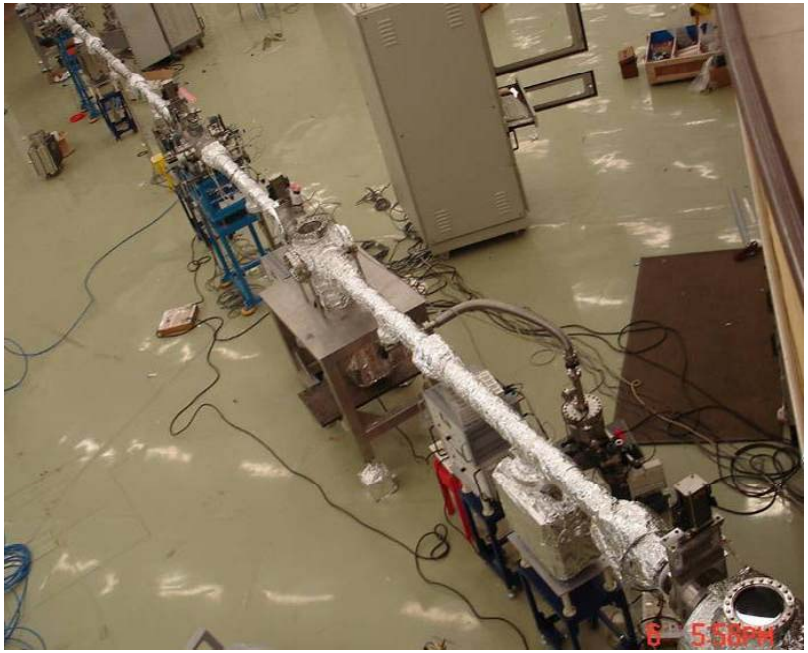


Nb k-edge studied with 19 keV setting & 4 mA@2 GeV beam on 13-2-08





Tasks on other BLs in 2007 - Work on PES & GIMS Started



Main parameters of PES beam line

Energy range : 0.85 keV to 15 keV,

Resolution : ~ 10^{-4}

Overall Pressure : < $5x10^{-10}$ mbar

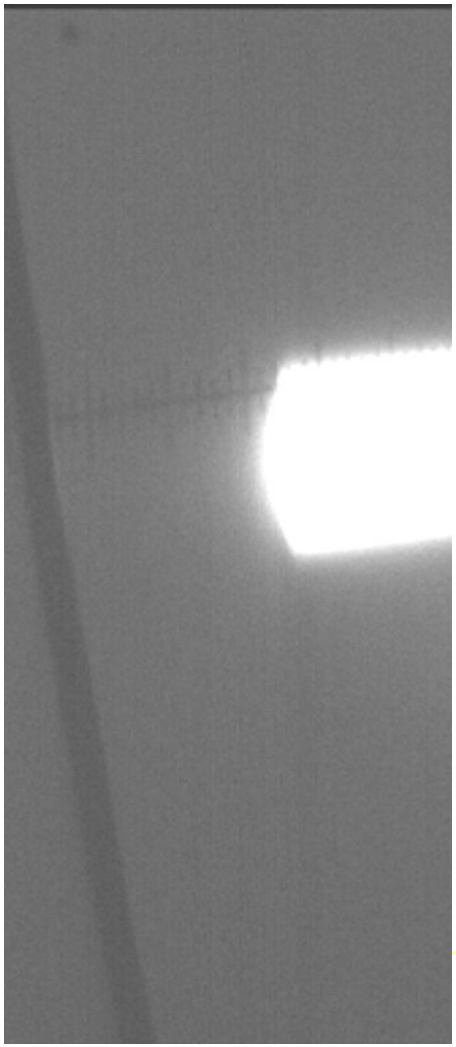
Crystals : (1) Si (111), 2d = 6.271 Å ,

(2) Beryl (1010), 2d = 15.954 Å

Spot on Sample :~ 250 μm x 250 μm

Salient Features:

- Home built DCM, slit assemblies & HSA for electron-energy analysis.
- All subsystems computer controlled.
- Sample temperature 10 - 1100 K.
- Insitu thin film preparation facility.
- Pre-characterization by LEED/ AUGER
- Arrangement for depth profiling.
- Software developed for data acquisition and analysis.

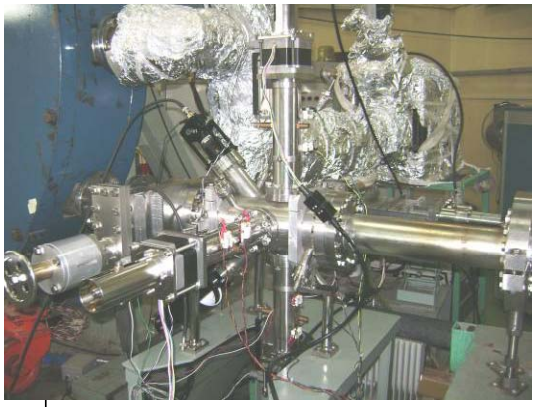


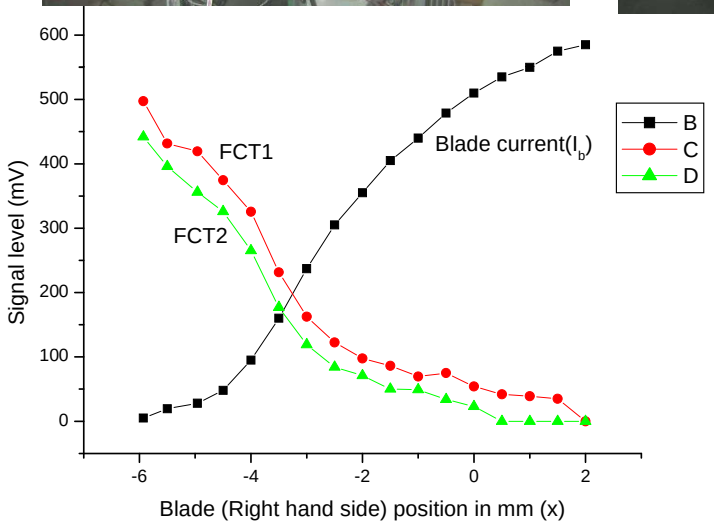
SR as seen on the E
the EDXRD beam lir
Picture taken on 27

User efforts are now well under way on three beam lines (XRD, EXAFS & EDXRD) and work is also on to build two more beam lines (PES & GIMS) so that we should be able to produce some data in the coming months, **even as capability of beam lines & machine are being improved.**

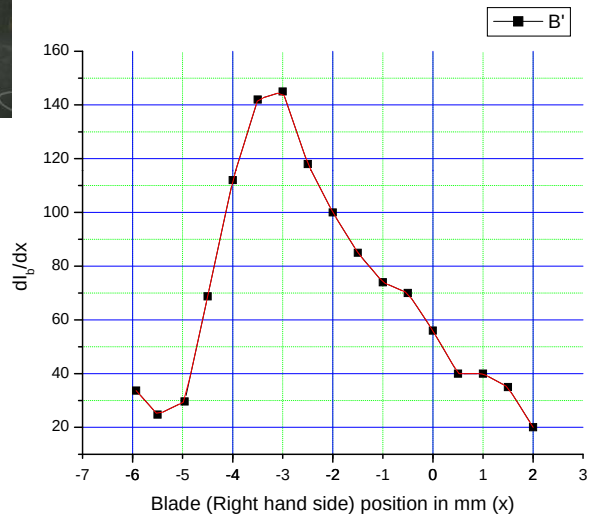
We have started a project on the core technology ("SCRF") required for light sources of next generation.

Improving the diagnostics in the injector system





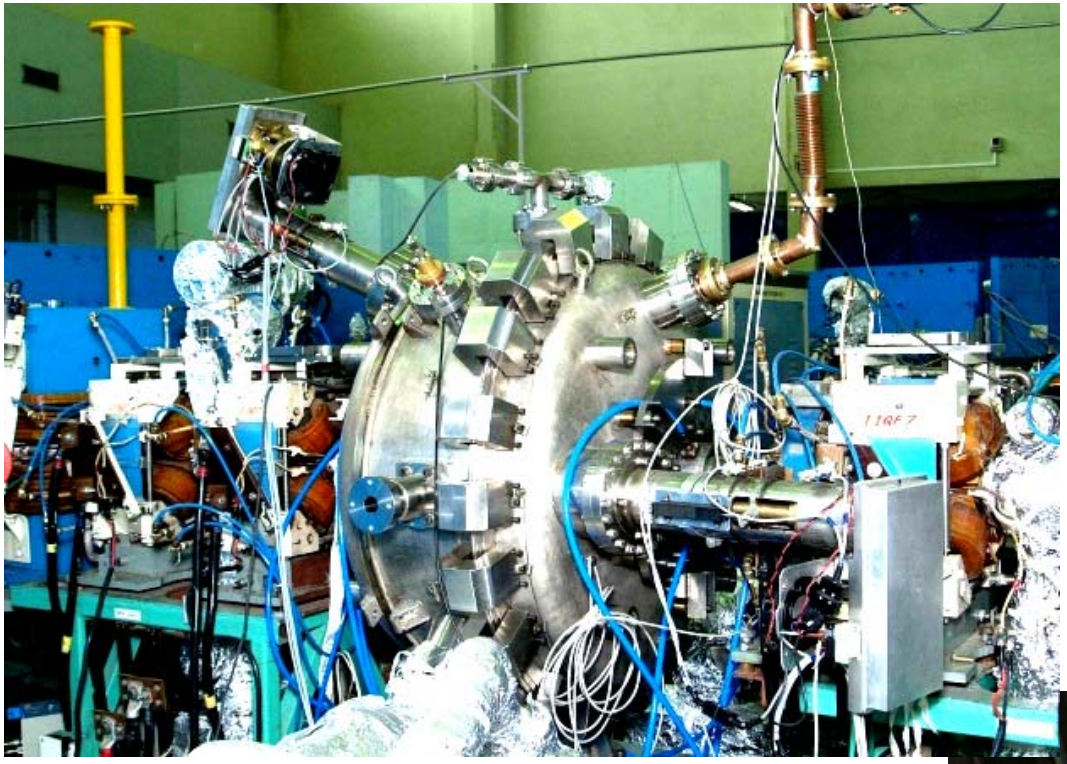
Optical slit type set up for beam monitoring



Above graph was obtained by differentiating blade signal with respect to x, which gives the horizontal beam profile. (FWHM ~ 3.6 mm, x pos ~ -3.1 mm)

Optical slit type system mounted on TL-1

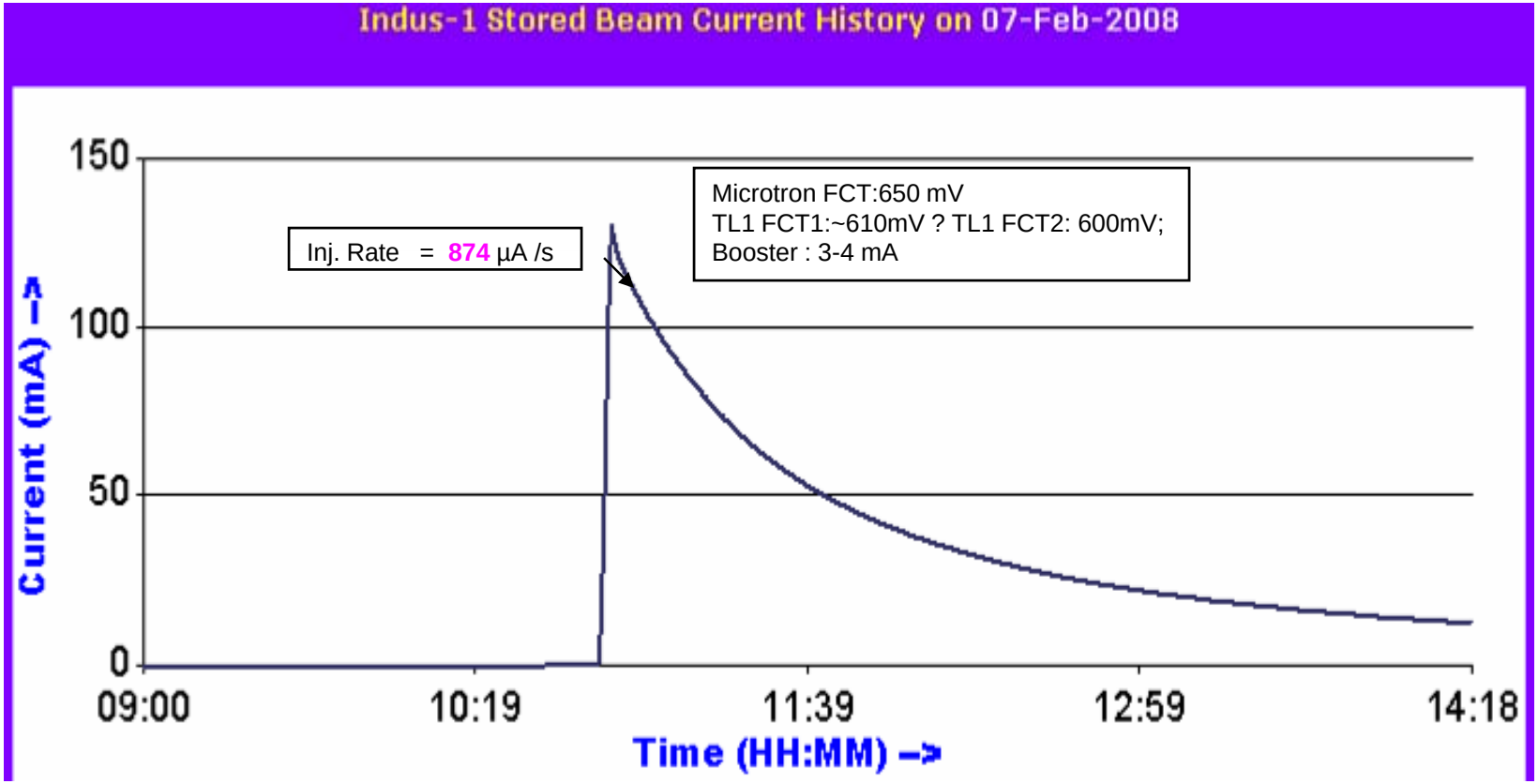
Right hand side blade of slit was moved towards beam keeping other 3 blades in OUT position. At each step, blade current (voltage across 50 Ω), FCT1 and FCT2 signals were recorded.



Picture shows the new RF cavity for Indus-1 during fabrication. Interior of the cavity chamber that was electroplated with copper is shown.

New RF cavity for Indus-1 after installation in the storage ring.

Performance of Indus-1 ~ 8 months after new cavity was installed



Activities Related to XI Plan Project of RRCAT on Development of Superconducting Cavities and Associated Technologies for High Energy Accelerators & their Applications

Major objectives of this project are

- Build infrastructure & develop **technology of Nb SCRF cavities** & join **R&D efforts for International programs, like ILC, X-FEL etc.**
- Upgrade **cryogenic infrastructure**.
- Create base for **next generation** light sources: **$\lambda \approx 30\mu$ THz source**.
- R&D in bulk/thin film superconducting materials (Nb & others).

Collaboration focus is on S&T partnership in

SCRF technology relevant for High Current Proton Driver/SNS/ADS.

Partners: FNAL, SLAC, Jlab, Cornell Univ –USA; KEK-Japan

RRCAT, BARC, VECC, TIFR, IUAC &Delhi Univ - INDIA

Memorandum of Understanding
between
US Universities & Accelerator Laboratories
and
Indian Universities & Accelerator Laboratories
concerning
Collaboration on R&D for Various Accelerator Physics and High Energy Physics Projects

January 9, 2006

1. Introduction

1.1 General Description

This Memorandum of Understanding (MOU) establishes a collaboration framework between various US and Indian Accelerator Laboratories and

4.2 Approvals

The following concur in the terms of this Memorandum of Understanding:

Piermaria Oddone, Director, FNAL	Vinod C. Sahni, Director, RRCAT
1/9/05	March 8, 2006
Date	Date
Jonathon Dorfan, Director, SLAC	Bikash Sinha, Director, VECC
1/23/06	March 9, 2006
Date	Date
Christoph Leemann, Director, TJNAJ	Amit Roy, Director, IUAC
1/18/06	March 9, 2006.
Date	Date
Maury Tigner, Director, Newman Lab	S. Bhattacharya, Director, TIFR
Date	April 17, 2006
	Date
	S. Banerjee, Director, BARC
Date	March 14, 2006
	Date
	Deepak Pental, Vice Chancellor, DU
Date	April 10, 2006
	Date

ADDENDUM
to the
Memorandum of Understanding
between
US Universities & Accelerator Laboratories
and
Indian Universities & Accelerator Laboratories
concerning
Collaboration on R&D for Accelerator Physics and High Energy Physics Projects

Addendum I: "Fermilab, RRCAT, BARC, IUAC and VECC Collaboration on ILC Main Linac SRF Accelerator Technology R&D"

October 2, 2007

1. Introduction

The work detailed in this document falls within the scope of the Memorandum of Understanding (MOU) between US and Indian Institutions dated January 9, 2006. It

7 Management and Approval:

The work under this MOU will be jointly managed by Dr. Shekhar Mishra, Fermilab and Dr. Vinod C. Sahni, India. They represent the institutions in the respective countries and serve as a single point of contact.

The following concur on the terms of this Memorandum of Understanding:

Dr Vinod C. Sahni, Director, RRCAT	Dr. Piermaria Oddone Director, FNAL
Oct 2, 2007	10/2/07
Date	Date
	Dr. Shekhar Mishra Deputy ILC Program Director, FNAL
	10/2/07
	Date

Trials for making 1.3 GHz cavity forming dies/machining fixtures

Loading arrangement of dies on the 200 Ton Hydraulic Press at RRCAT

Blank Loading for Forming

Half cups of finally formed parts of cavity

Frequency & E-Field Measurement on Trial 1.3 GHz Cu Cavity

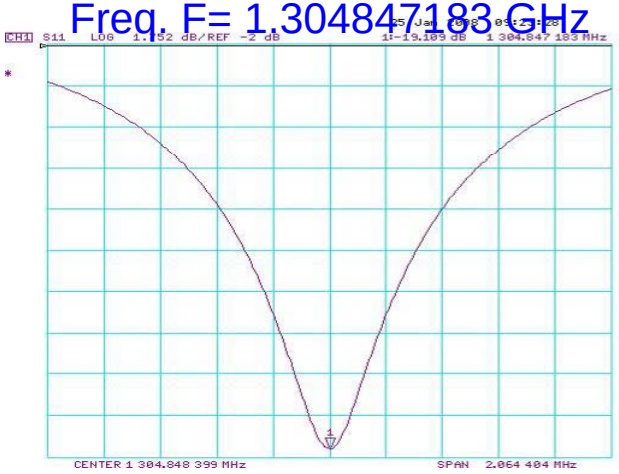
Trial Prototype Elliptical Cavity Made of Two Cu Half Cells

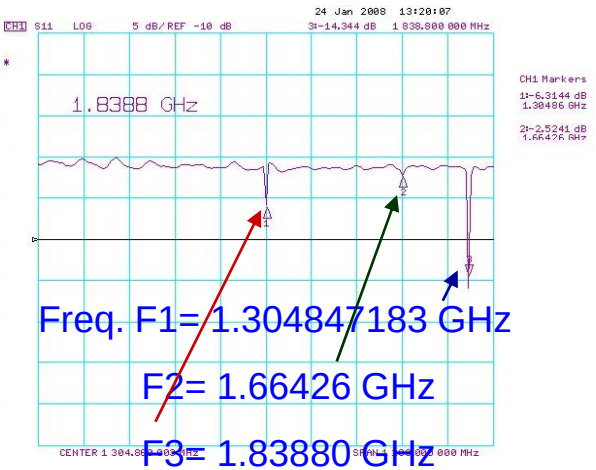
2 Half Cells+ beam pipe & Flanges

Bead Pull Measurement Setup
for Assembled Cavity

Assembled Cavity with
beam pipe & Flanges

Freq. F= 1.304847183 GHz



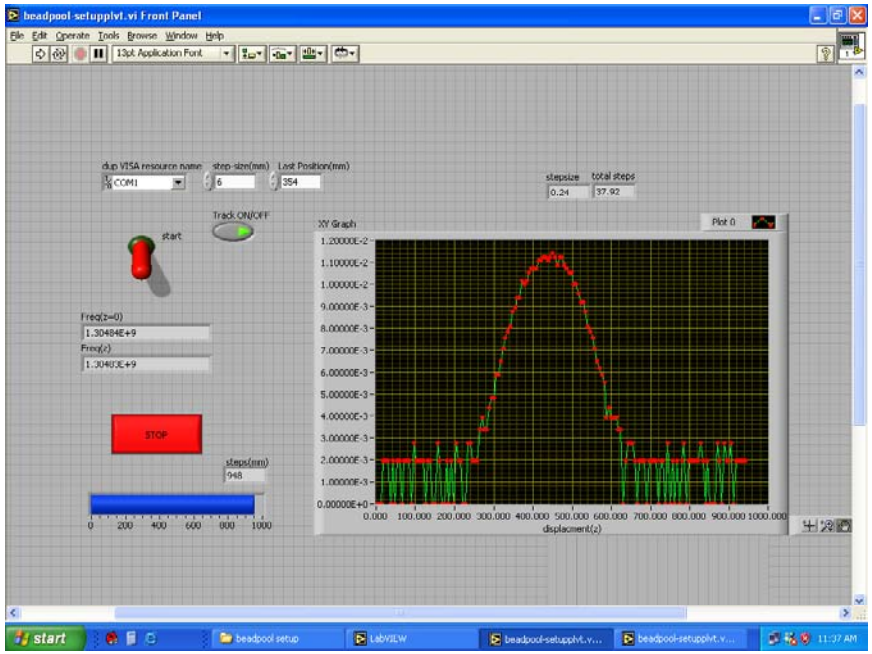


Freq. F1= 1.304847183 GHz

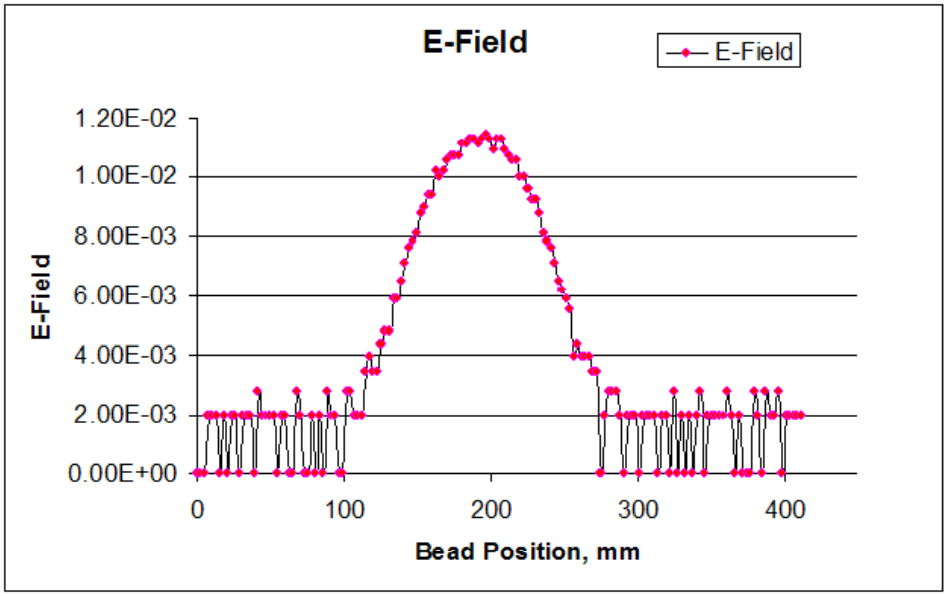
F2= 1.66426 GHz

F3= 1.83880 GHz

Screen Shot of Bead Pull Measurement Program



Plot of Measured E-Field Distribution in the Cavity Using Bead Pull Measurement



Frequency: Computed ANSYS - 1302.0228 MHz

SUPERFISH - 1301.3937 MHz

CST (MWS) - 1299.4400 MHz

Measured using VNA - **1304.847183 MHz**

Q Value **Computed**: ANSYS - 30136

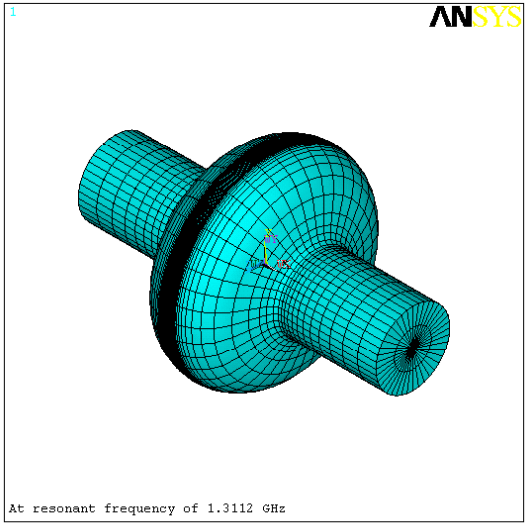
SUPERFISH - 29520.8

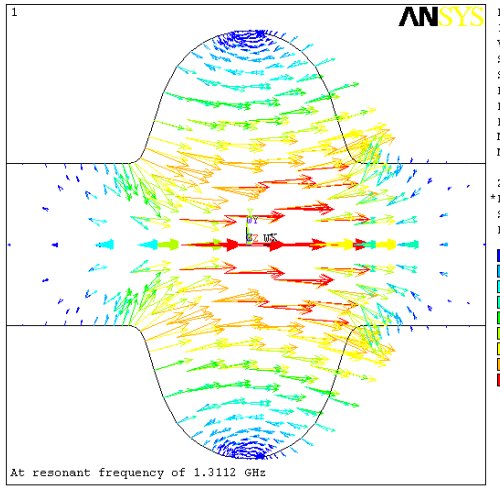
CST MWS - 25621.2102

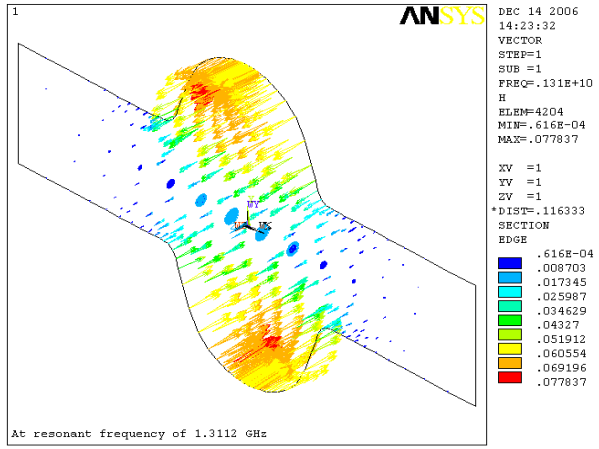
Measured Q Value - 6990 (Low because of poor contact)

Simulation of Fields in RF Cavities

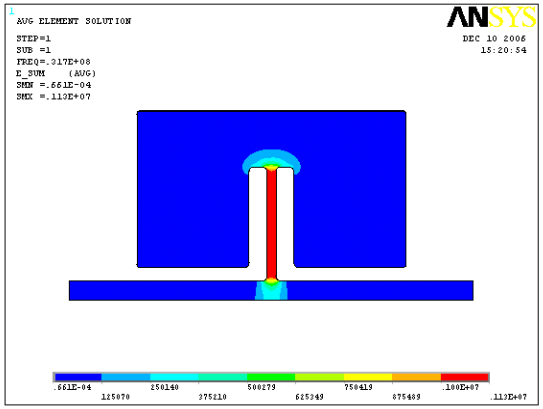
1.3 GHz Cavity

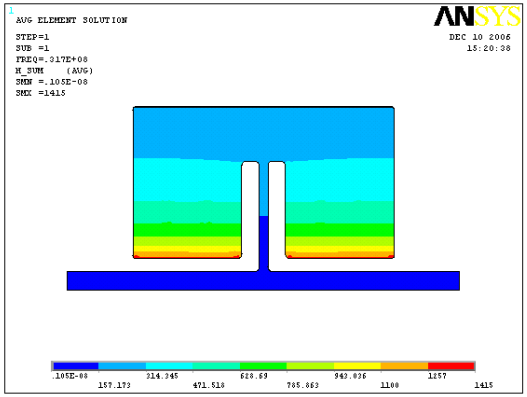


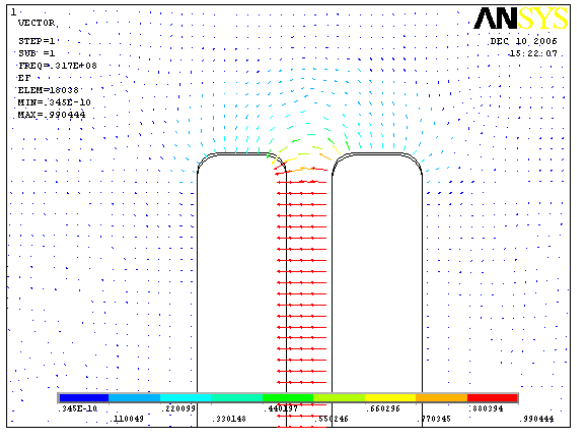




31.6 MHz Indus-1 Cavity





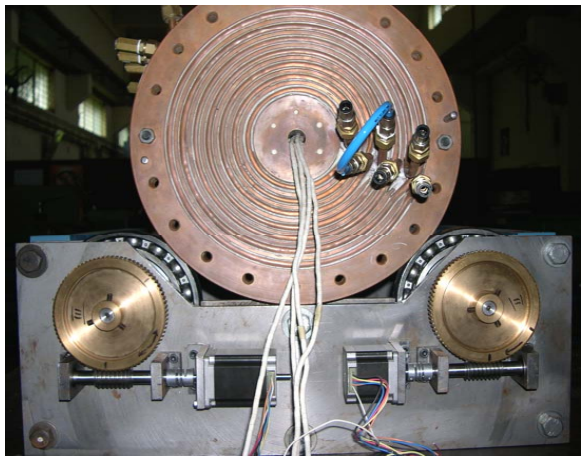


Amongst the final aims : Develop module of a Nb SC cavity for a Linac

In the first phase we will develop the infrastructure to build single cell cavities, eventually make a multi cell cavity as shown

Development of other components for upcoming accelerator programs

Cut view of 6-channeled efficiently cooled drift-tubes for High-energy SFDTL RF cavities



Eccentric wheel based alignment system, supporting a typical accelerator cavity

DAE- CERN Collaboration in Particle Accelerators

DAE-CERN Collaboration : LHC & Beyond

(RRCAT is the Nodal DAE Institute for this Collaboration)

DAE has given subsystems & skilled manpower support of 44 MCHF for LHC @ CERN; ***India is an Observer State.***

We continued to help in LHC commissioning and

Participated in CERN's Novel Accelerator Projects :

*** Compact Linear Collider (CLIC)Test Facility CTF3.**

***Linac-4, front end of Superconducting Proton Linac.**

Reciprocally CERN has given hardware for our projects:
R&D for Spallation Neutron Source (SNS) at RRCAT
Injector for Accelerator Driven System (ADS) at BARC.

 # We have made good progress on the new collaborative programs during 2007-08.

Indian Participation in LHC Commissioning

Cryogenic experts from RRCAT, participated in **analysis of performance data** generated during commissioning of LHC cryo-systems to help debug the deficiencies.

For example:
a) Source of excessive frosting on the Distribution Feed Boxes.

b) Re-evaluation of safety valve size to withstand different accidental conditions

P074/LHC

PROTOCOL

to

THE 1991 CO-OPERATION AGREEMENT

between

THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (CERN)

and

THE DEPARTMENT OF ATOMIC ENERGY OF THE GOVERNMENT OF INDIA (DAE)

concerning

THE FURTHER DEVELOPMENT OF NOVEL ACCELERATOR TECHNOLOGIES

2005

This Protocol shall form an integral part of the Co-operation Agreement dated 28 March 1991 and shall cancel the Statement of Intent signed on 25 May, 2005 by the Parties.

Done at Mumbai/Geneva on 15th February 2006 in two copies in the English language

For the European Organization for Nuclear Research (CERN)

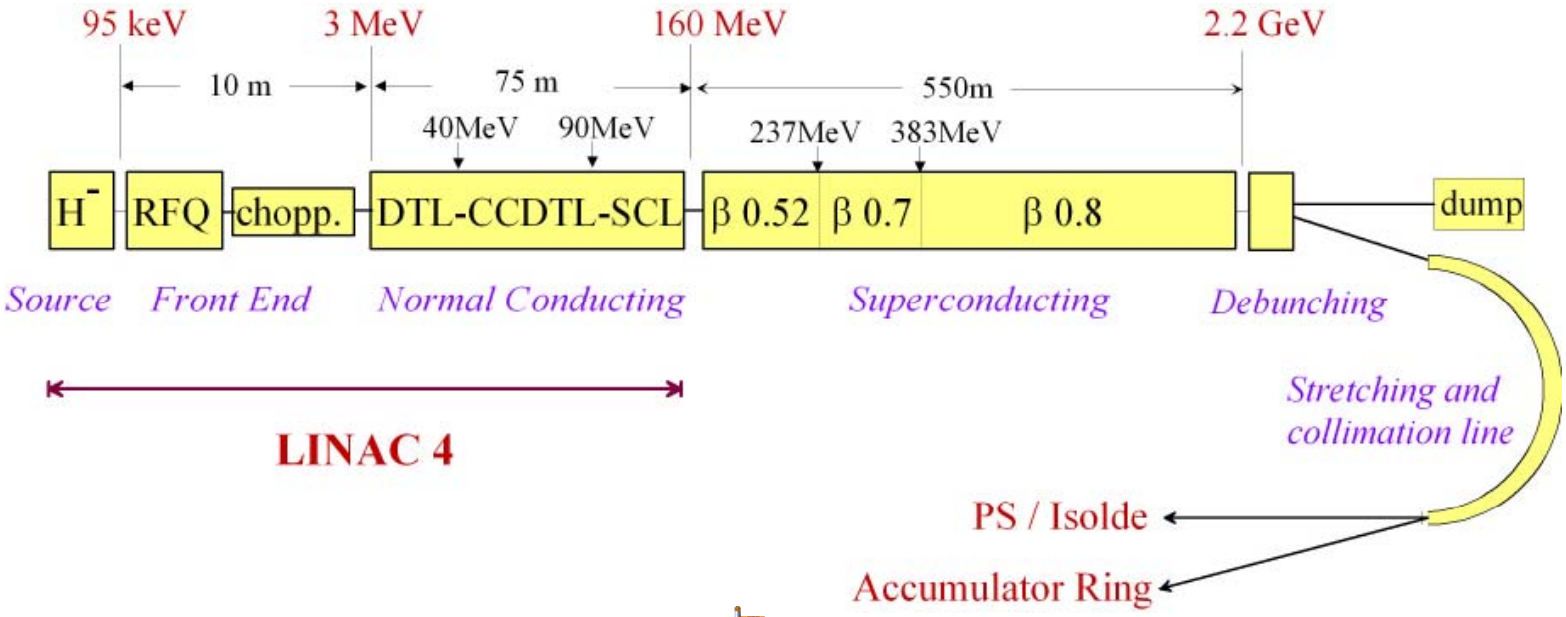
Robert Aymar
Director-General

For the Department of Atomic Energy of the Government of India (DAE)

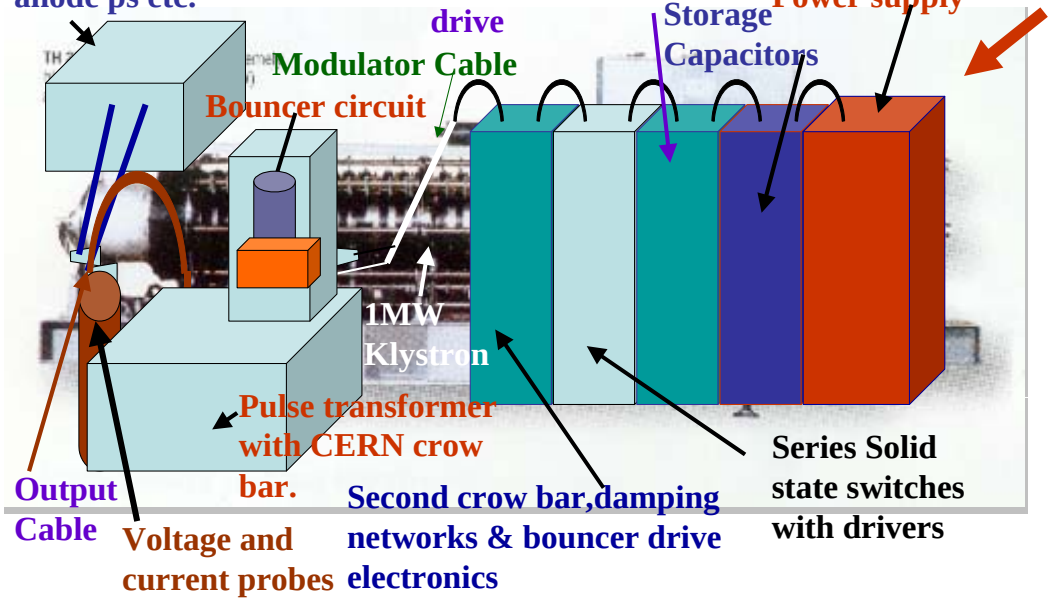
Anil Kakodkar
Chairman, Atomic Energy Commission

NAT envisions DAE's participation in CERN's LINAC-4 & CLIC Test Facility-3 projects & CERN's contribution to DAE's programs by way of delivering hardware.

Schematic of Superconducting Proton Linac Project at CERN

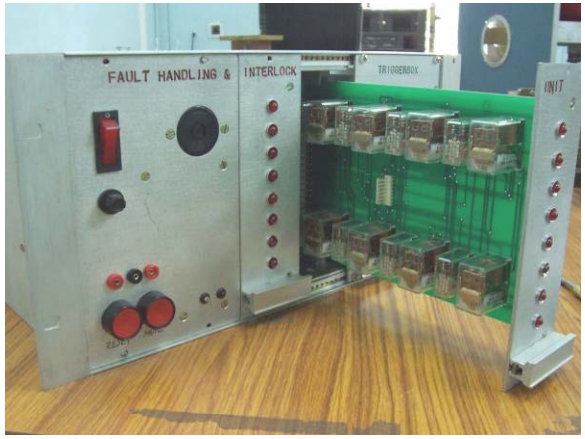


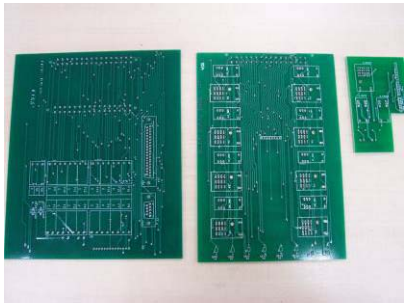
Layout of klystron modulator for 3MeV RFQ- LINAC 4

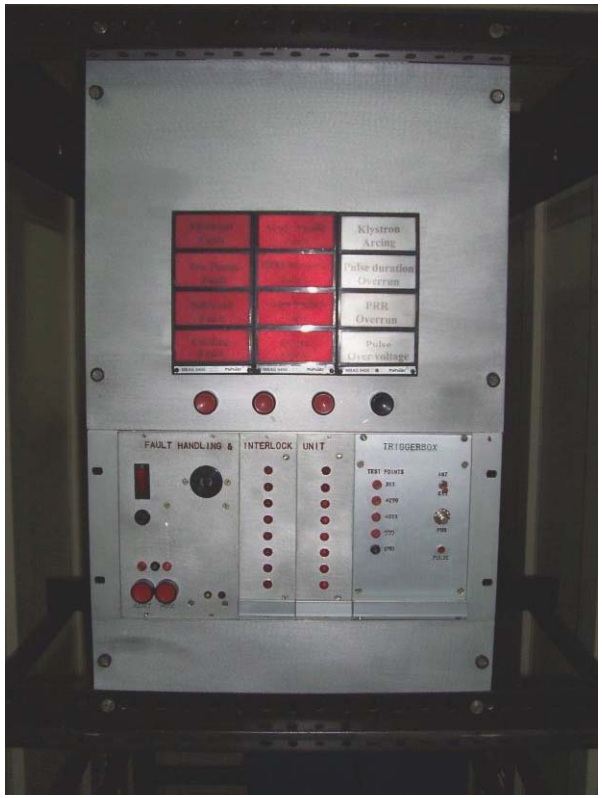


RRCAT has designed an state of the art long pulse modulator for 1MW klystron for RFQ of LINAC 4. One modulator has been assembled and tested at CERN based on the common design, another modulator is in advanced stage of development at RRCAT.

CERN has supplied LEP waveguide components and Super conducting cavities with cryomodule for DAE's ADS/SNS projects.







SOLID STATE MODULATOR SUBSYSTEMS INTEGRATION

Concept behind CLIC TEST FACILITY3 (CTF3) at CERN & its layout

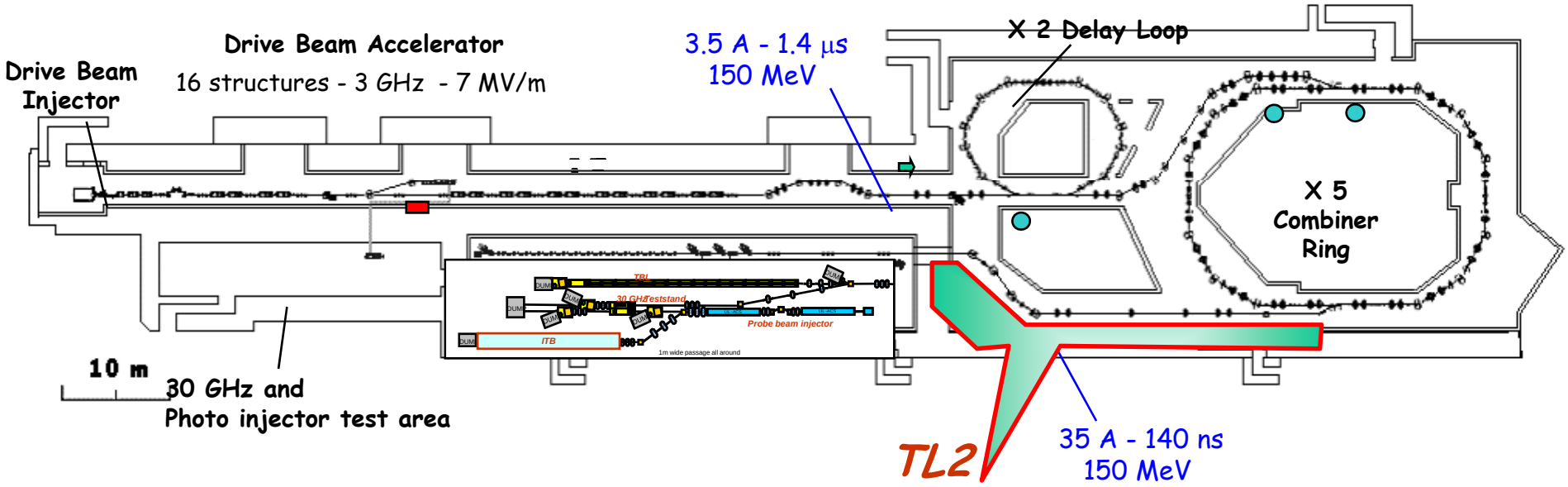
Aim of CLIC: Establish the principle of a 3-5 TeV e^+-e^- Collider using the idea of

(1) A "drive beam" creating an "in situ 12 GHz RF source",

(2) Extracting RF power via PETS (Power Extraction & Transport System)&

(3) Using this RF power to accelerate electron & positron beams that will collide.

RRCAT is involved in the Design & Fabrication of TL2 (Transfer Line-2).

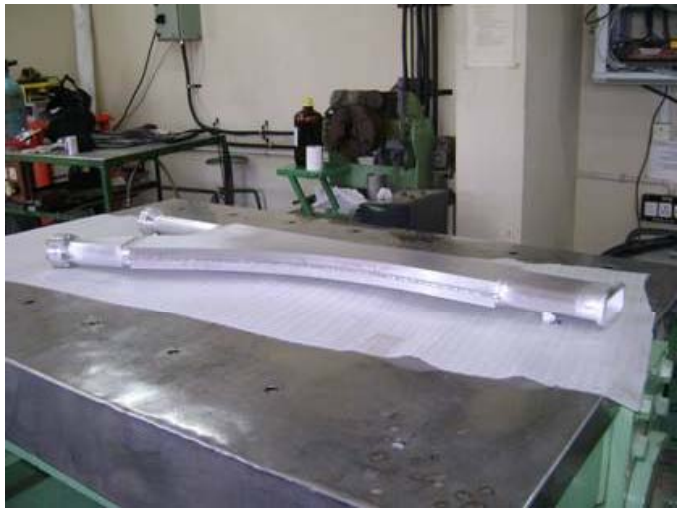


RRCAT has provided the final design of Transfer Line–2 of CTF-3. Fabrication of vacuum components and dipole chambers for the above line is under way and we are giving help for CTF-3 commissioning.

Circular vacuum chamber parts

Race track vacuum chamber parts

Assembly of vacuum chambers



Prototype dipole vacuum chamber

Dipole magnet core fabrication and assembly

Dipole magnet complete

Stages of fabrication & packing for shipment for first dipole magnet at RRCAT

Application software developed for CTF 3 controls

Magnet Degaussing

Automatically degausses the magnets.

Combiner Ring Beam Orbit Display

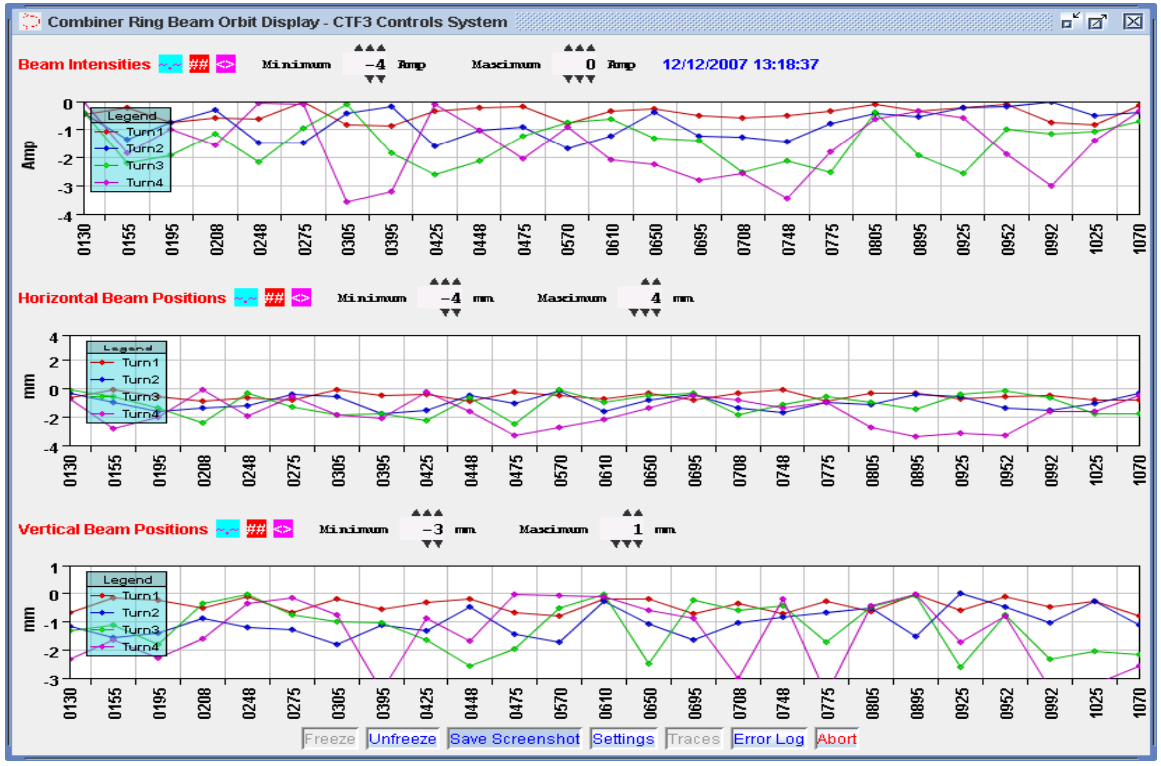
Graphic display of multi turn beam orbits in combiner ring.

R. F. Pulse Shifter

Shifts the pulse delays of R. F. devices.

Interlock Display

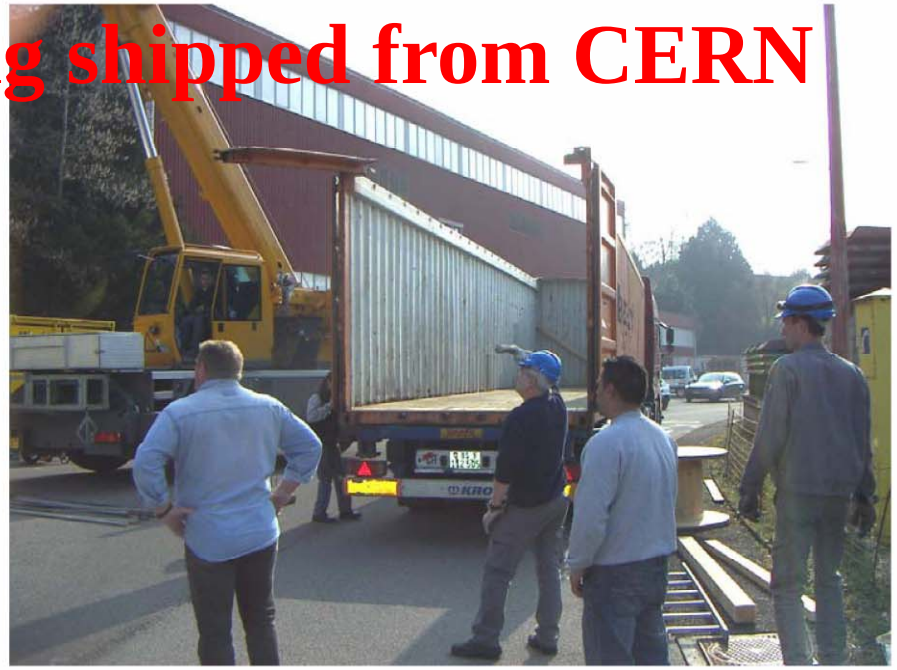
Displays interlock status details in CTF3 Control System.



Screenshot*: Combiner Ring Beam Orbit Display

* In simulation mode

LEP cryomodule being shipped from CERN



Preparation to bring Cryomodule to BARC

Unloading at CDM

What can be done with cryomodule?

Use for electron acceleration upto ~ 50 MeV

Beam can be used for photo production of neutrons via bremstrahulng. (KAERI has done it).

Will need major cyrogenic facility.

CTD, BARC to look into it.

Prototype WR 2300 waveguide components developed at RRCAT

Preparation and welding of WR 2300 **half height** W/G structure

Preparation of WR 2300 **full height** W/G structure

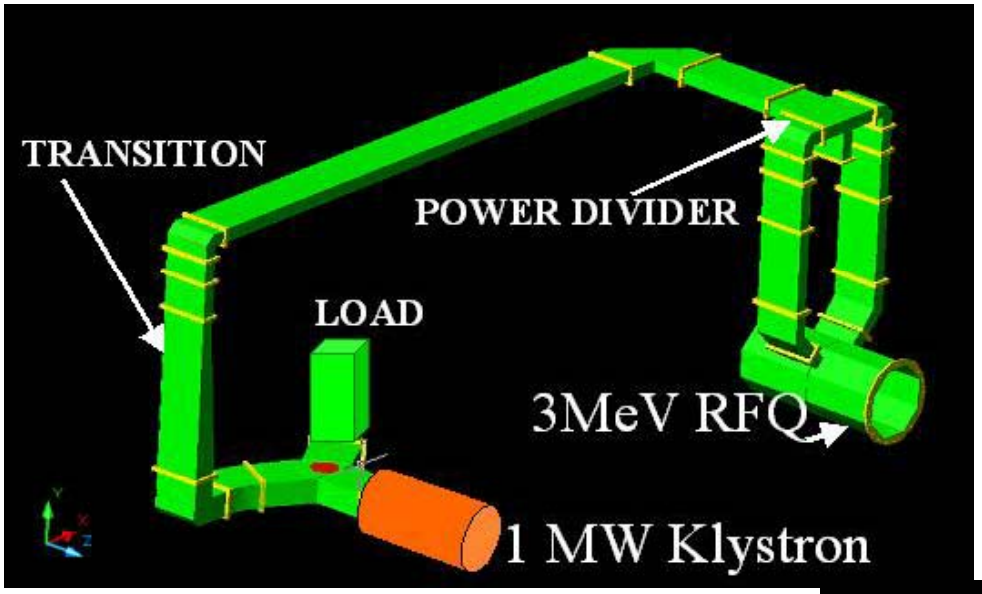
CALIBRATION SET UP

WR 2300 FLEXBILE WAVEGUIDE TESTS

WR 2300 H PLANE BEND TESTS

TEST SET UP FOR WR 2300 WAVEGUIDE COMPONENTS

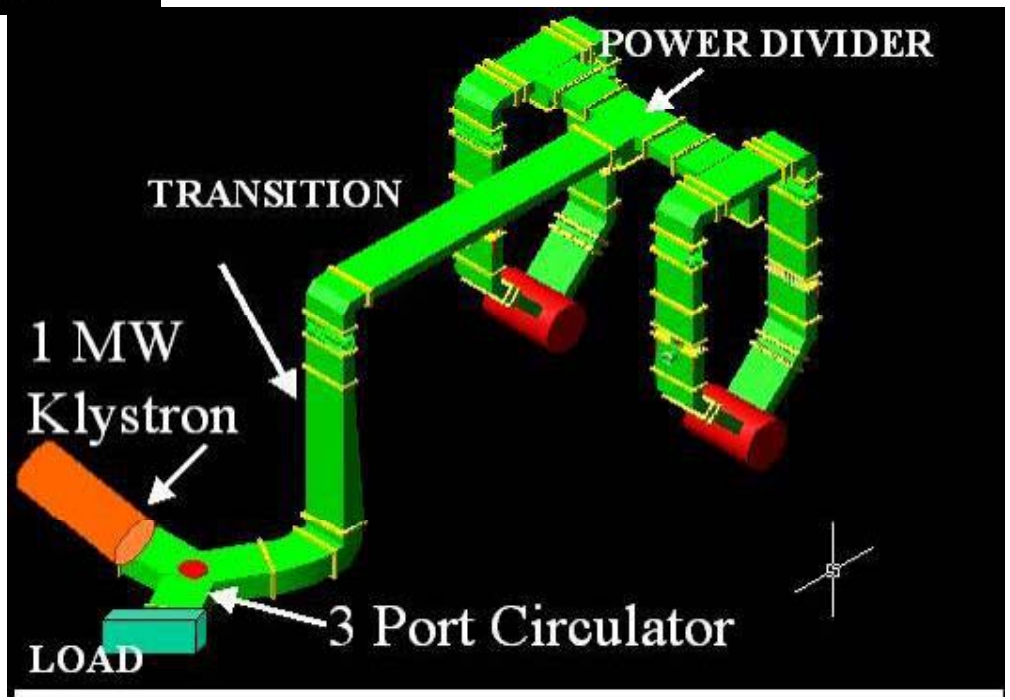
WG Design for LEHIPA@BARC



WAVEGUIDE FEED BASE LINE LAYOUT DESIGN FOR PROTON ACCELERATOR WITHCERN LEP

W/G COMPONENTS

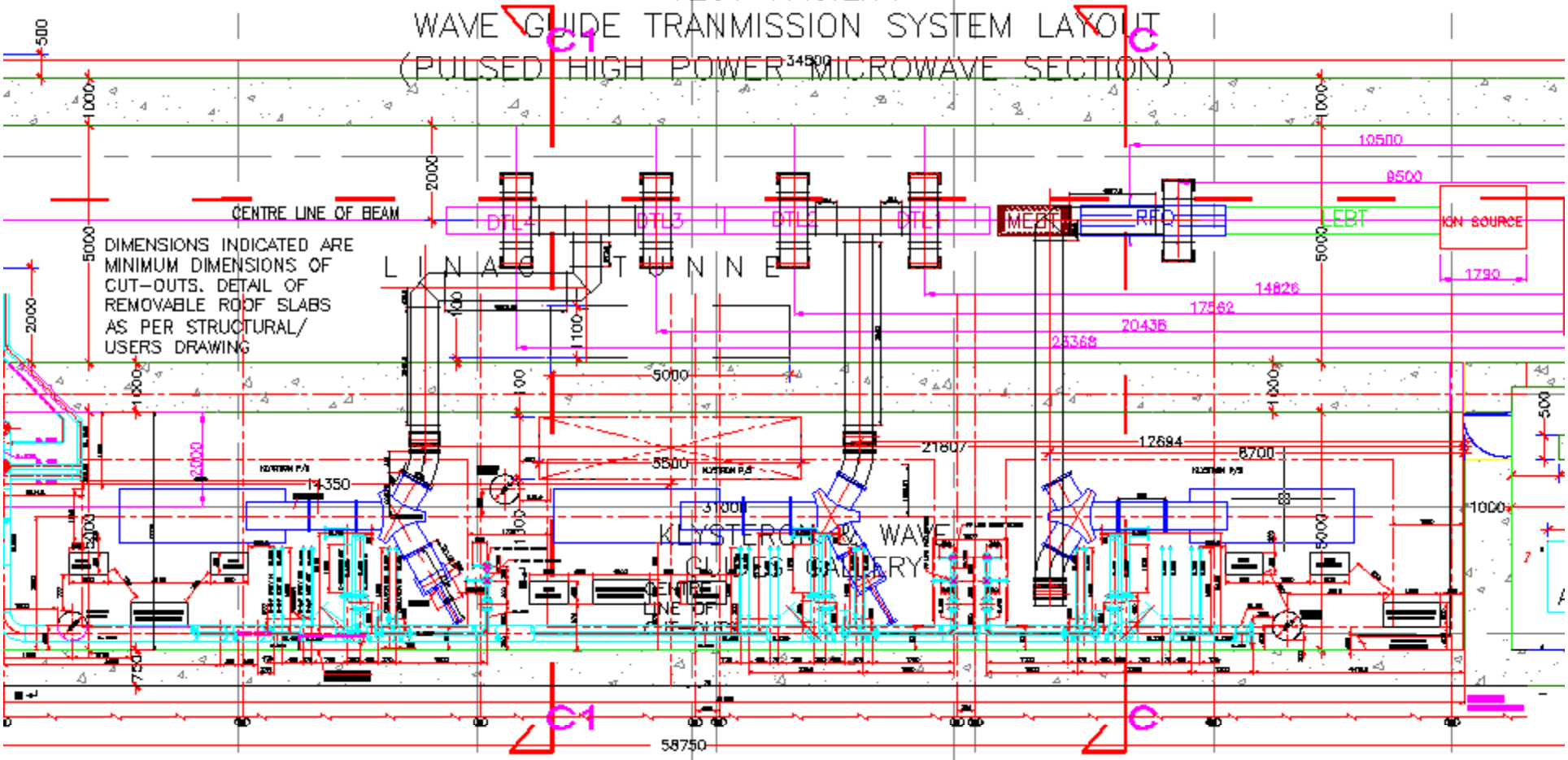
WR 2300 WAVEGUIDE FEED TO **RFQ**



WR 2300 WAVEGUIDE FEED TO **DTLS**

LOW ENERGY HIGH INTENSITY PROTON ACCELERATOR TEST FACILITY

WAVE GUIDE TRANMISSION SYSTEM LAYOUT (PULSED HIGH POWER MICROWAVE SECTION)



BASEMENT FLOOR PLA

RRCAT's request to join TTC was approved in April 2007

Our XI plan program envisions a major role in national and international accelerator projects.

We have substantial expertise in accelerator technology

- Indus and other accelerators
- LHC, Linac-4 and CLIC
- SRF material and Cavity and Cryomodule R&D.

We would add significant SRF infrastructure in XI plan.

TTC approved in April 07, RRCAT's membership for advanced R&D for a project, like, ILC.

ADDENDUM

to the

Memorandum of Understanding

between

US Universities & Accelerator Laboratories

and

Indian Universities & Accelerator Laboratories

concerning

Collaboration on R&D for Accelerator Physics and High Energy Physics Projects

Addendum II: "SLAC, RRCAT, BARC, IUAC and VECC Collaboration on ILC RF Power Sources and Beam Dump Design R&D"

December 3, 2007

1. Introduction

The work detailed in this document falls within the scope of the Memorandum of Understanding (MOU) between US and Indian Institutions dated January 9, 2006. It addresses in some detail three key areas of collaboration: (i) Accelerator for the International Linear Collider (ILC), (ii) Radio Frequency Power (RFP) Acceleration Science and Technology, (iii) Development of Beam dump design and technology for high power beam for ILC. All terms and conditions under which the work will be carried out are found within the main MOU.

This Addendum to the MOU outlines the collaborative accelerator technology R&D that Stanford Linear Accelerator Center (SLAC) and Raja Ramanna Center of Advanced Technologies (RRCAT), Bhabha Atomic Research Center (BARC), Variable Energy Cyclotron Center (VECC) and Inter University Accelerator Center (IUAC) (referred as the Indian Institutions in this document) plan to carry out for the development of RFP for the ILC Main Linac, high intensity proton accelerator, and any other accelerator using similar SRF technology. It also outlines collaborative accelerator technology R&D between SLAC and the Indian Institutions on beam dump design.

7 Management and Approval:

The work under this MOU will be jointly managed by Dr. Shekhar Mishra, Fermilab, USA and Dr. Vinod C. Sahni, RRCAT, DAE, India, who will coordinate on behalf of all MoU partner institutions in their respective countries and serve as a single point of contact.

The following concur on the terms of this Memorandum of Understanding:

Dr Vinod C. Sahni,
Director, RRCAT

Dec 12, 2007
Date

Prof. Persis Drell
Director, SLAC

Dec 10, 2007
Date

Prof. Tor Raubenheimer
Accelerator Research Division Head, SLAC

Dec 10 2007
Date

Dr. Shekhar Mishra
Deputy ILC Program Director, FNAL

Dec 10 2007
Date

Scheme for Qualifying Niobium & Other Materials for Reproducible Production of Superconducting RF-Cavities Giving High Accelerating Gradients (New Patent was filed in Oct 07 by S. B. Roy & V. C. Sahni, RRCAT, Indore)

*Current approach to material qualification for SC-RF cavities mainly relies on improving the residual resistivity ratio (RRR) of the SC. Involves expensive Niobium refinement process.

*With high RRR Nb + right cavity shape + BCP/EP treatment $\Rightarrow$ Extrinsic (+ surface) defects are low & so multipacting reduces.

*But high RRR does not say how good are the SC properties of Nb & at best gives indirect information on thermal conductivity.

***All cavities fabricated in the same way don't give high gradients.**

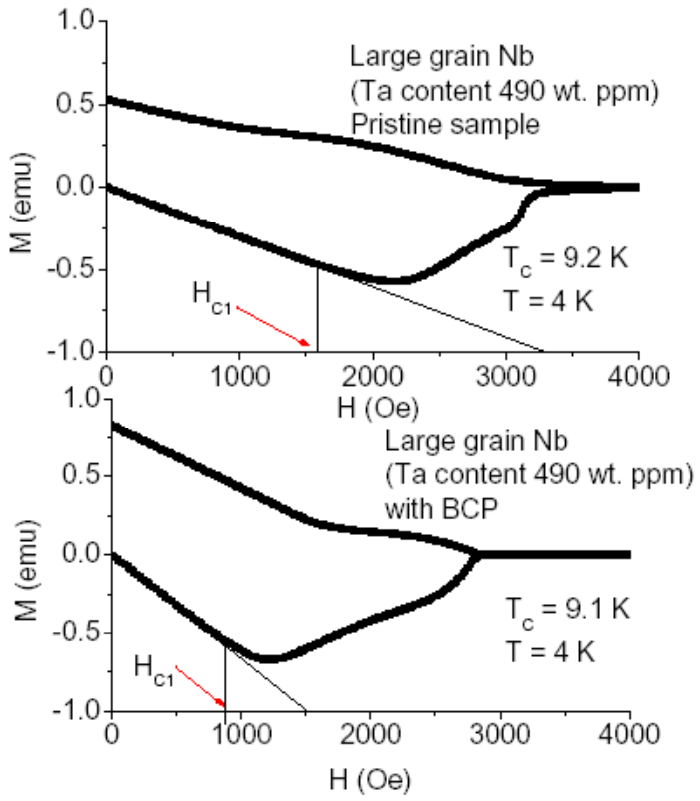
*So a **better qualification scheme is needed** using **HC1** **since that sets an upper limit on achievable SC-RF accelerating gradients.**

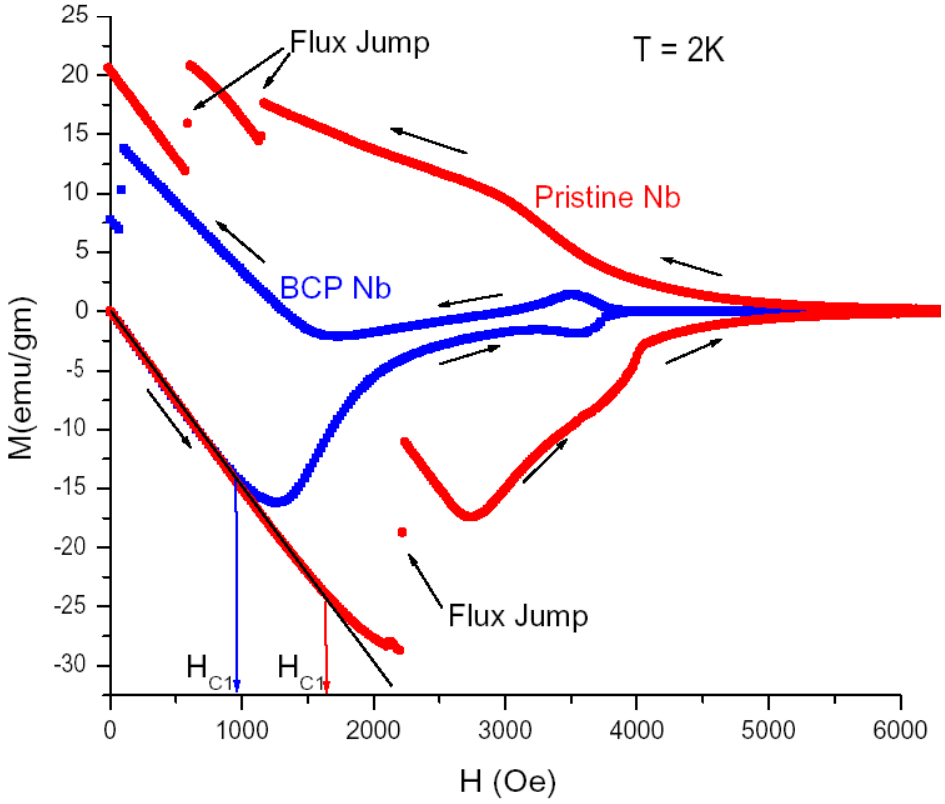
Main content of patent: Provide a material 'qualification scheme' involving the measurements of HC1 and thermal conductivity to ensure that most of the SC-RF cavities give high gradients.

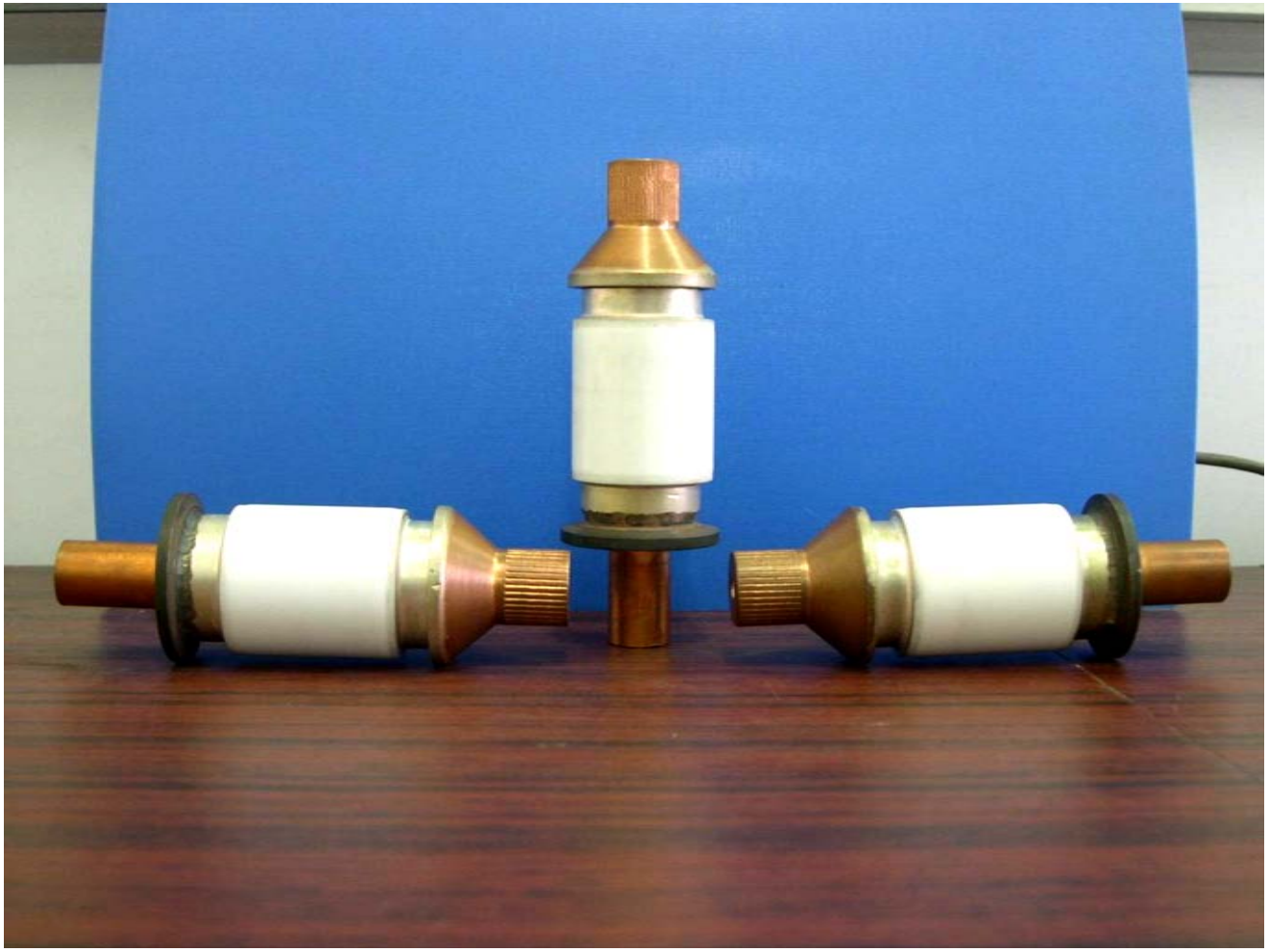
Figures below show how chemical treatment can affect HC1:

Two large grain Nb- samples -one pristine & other a bcp treated.

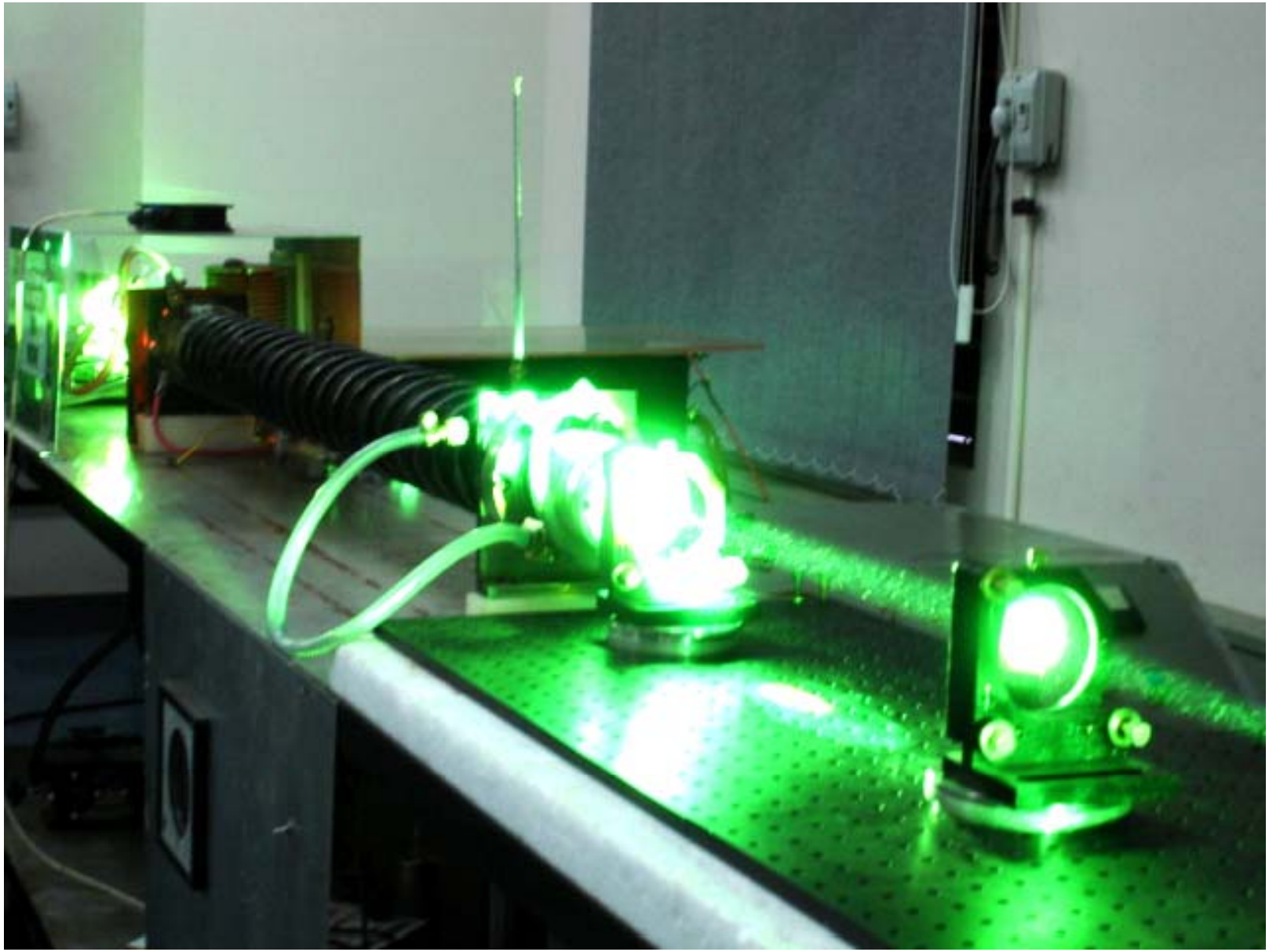
Gradients in these cavities correlated strongly with HC1 values.







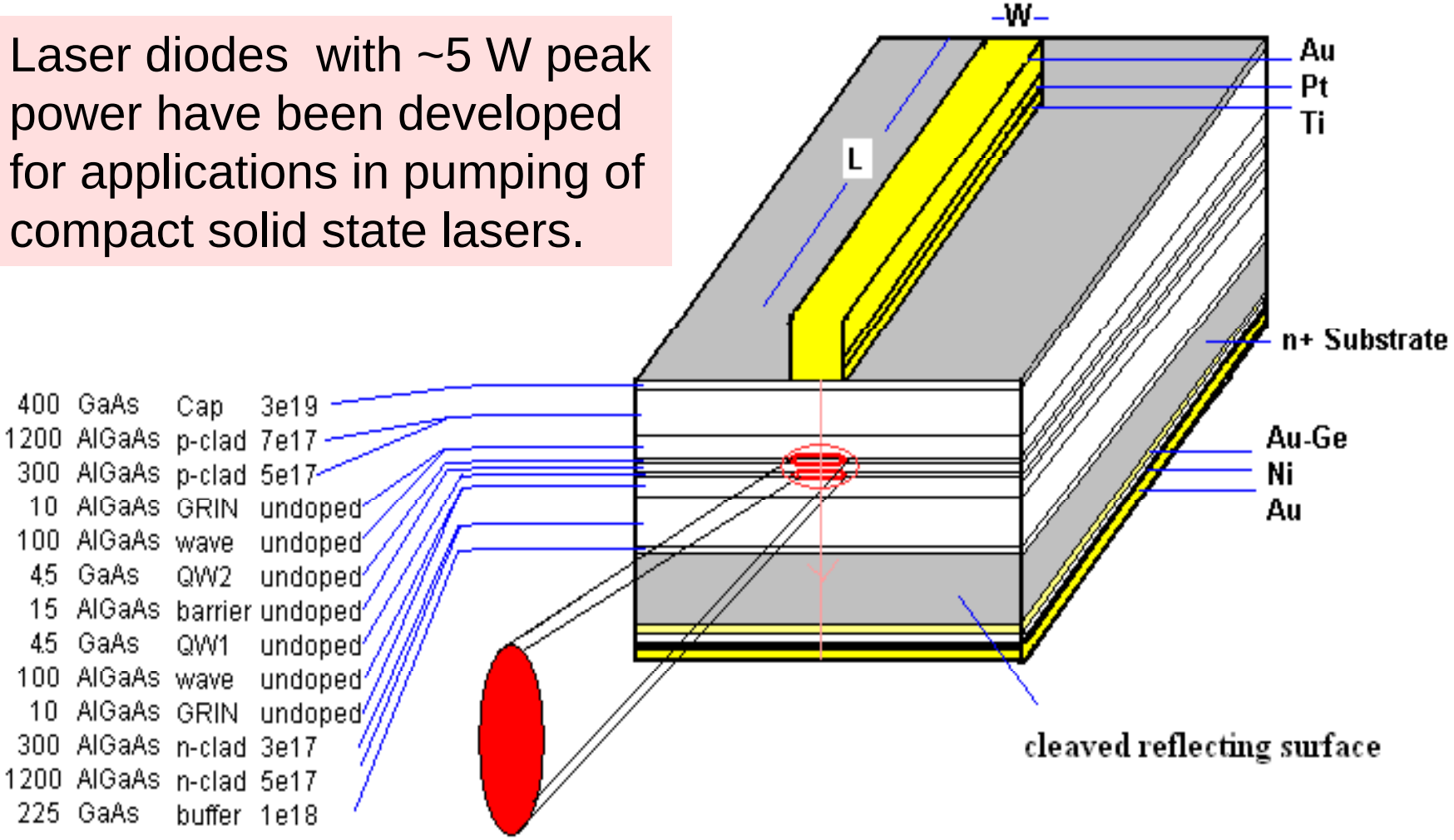
High current (1000A) feed throughs developed to serve as vapour cooled current leads for powering superconducting magnets.

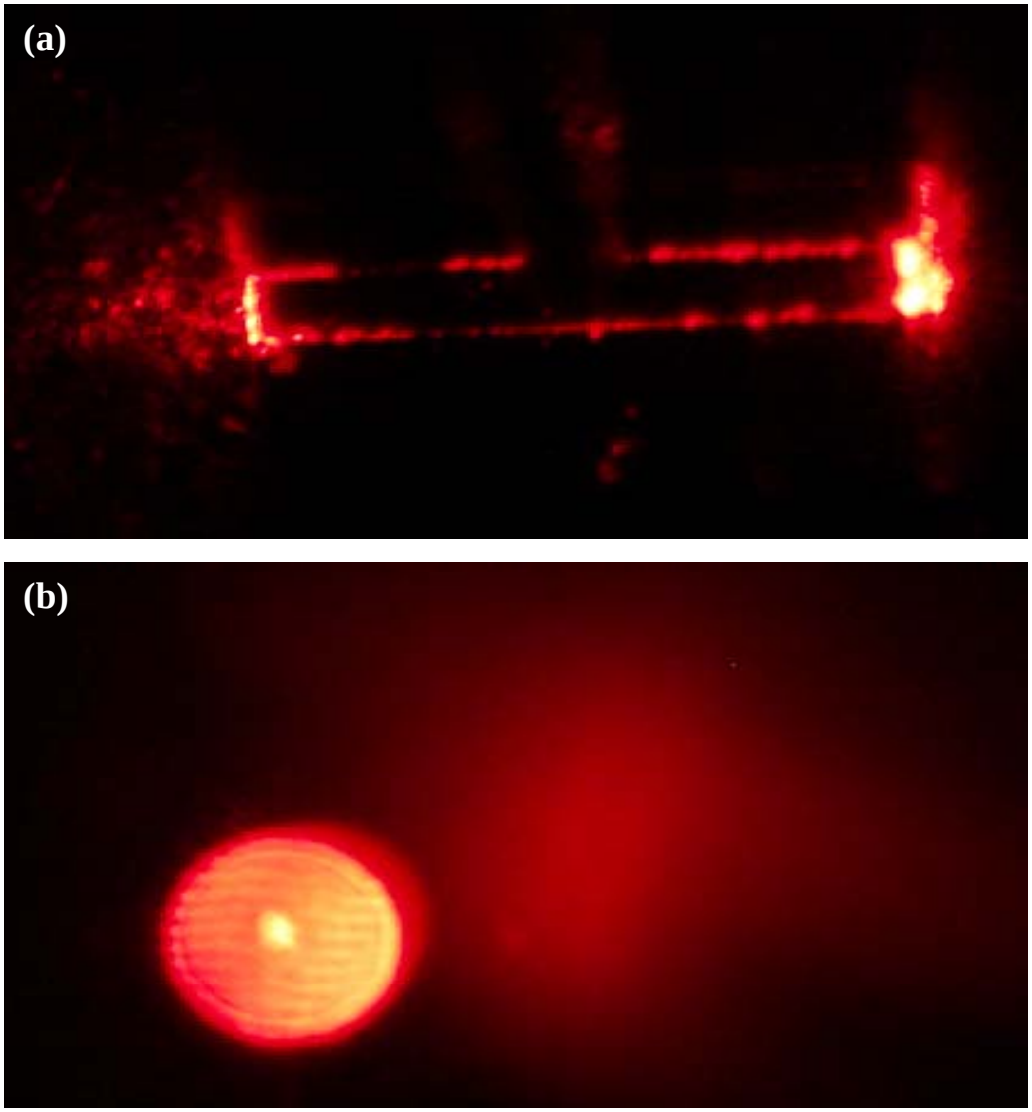


A 60 W prototype version CuHyBrID laser

Development of Laser Diodes

Laser diodes with ~5 W peak power have been developed for applications in pumping of compact solid state lasers.





Photographs of red laser diode (a) showing emitting light from both facets. (b) photograph of laser diode beam

Recent Developments of More Powerful Laser Systems

A view of 880 W cw Nd:YAG laser

High repetition rate, high pulse energy line tunable TEA CO2 laser

Nd:YAG Laser based bellow-lips cutting & welding set up for use in PHWRs. (Successfully used at NAPS will be deployed at KAPS)

Laser cutting mock-up for bellow lip

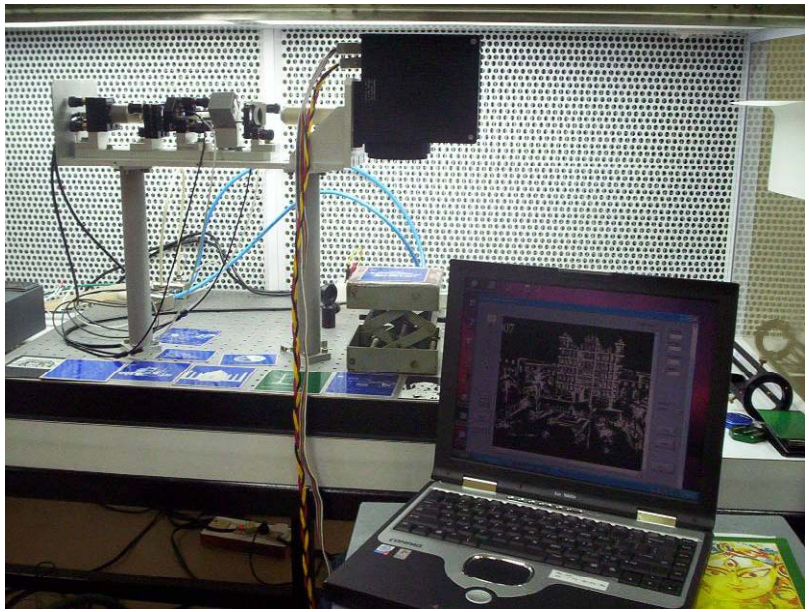
Bellow lip cutting fixture

Salient features

- MANREM reduction
- Ease in system handling
- Time saving
- Reliable operation

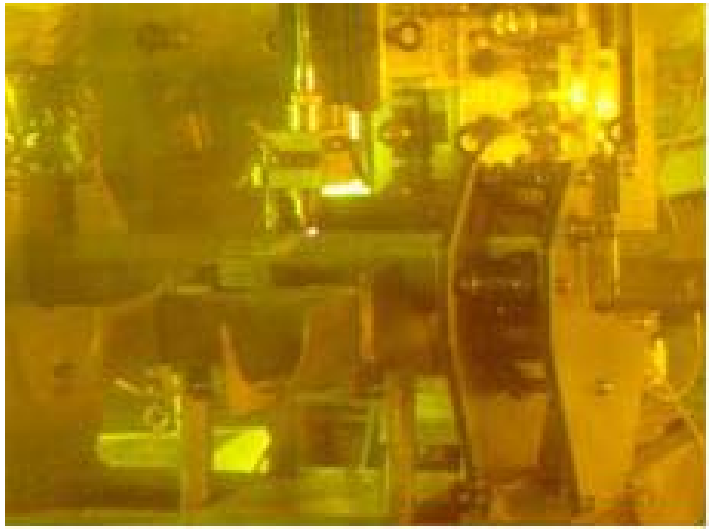
Separated bellow lip

Welded bellow lip

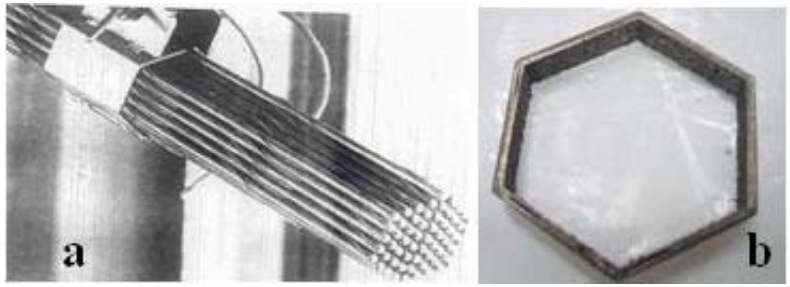


A general view of laser marker

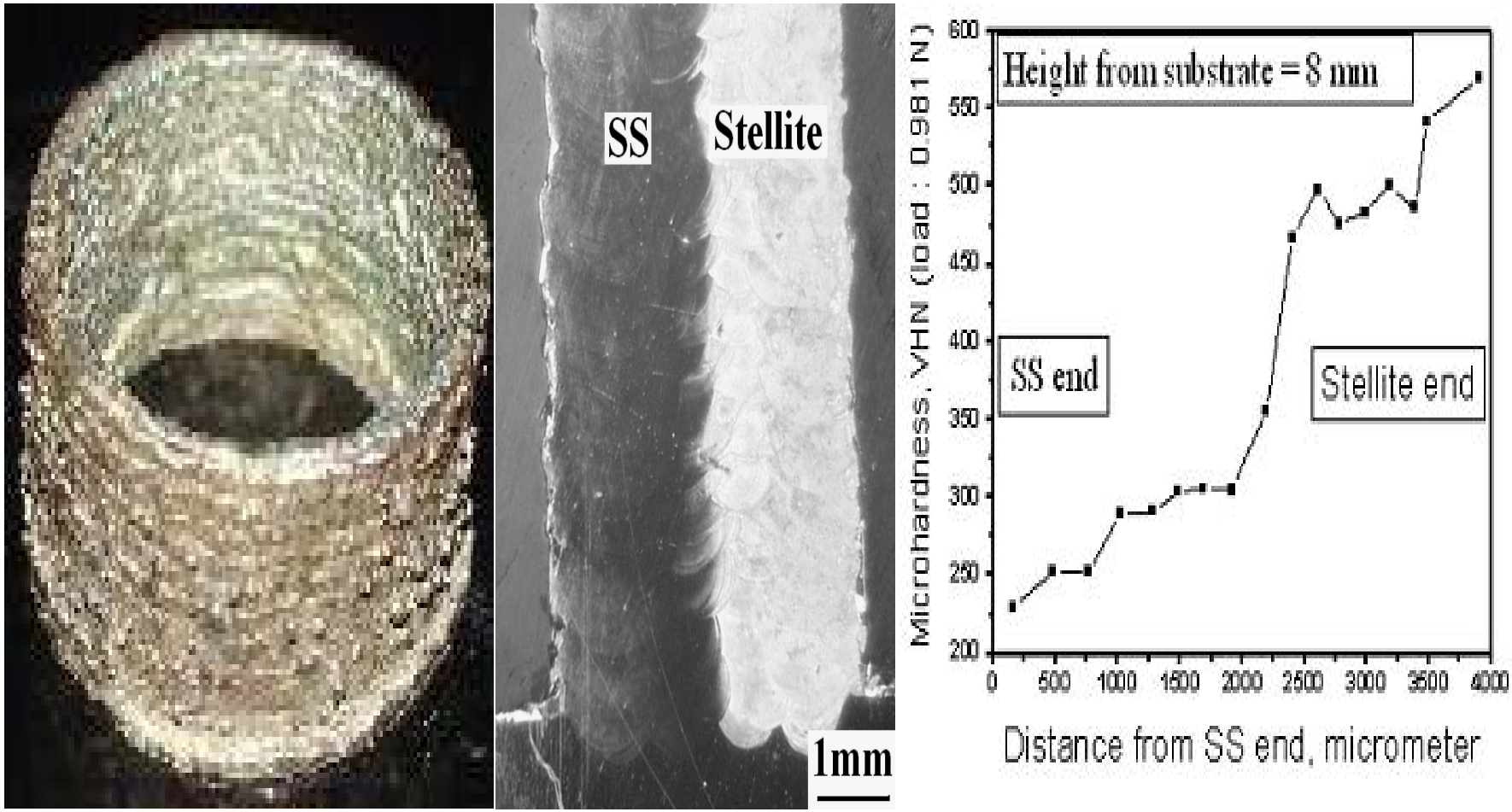
Samples of picture transferred to metal plates using laser marker



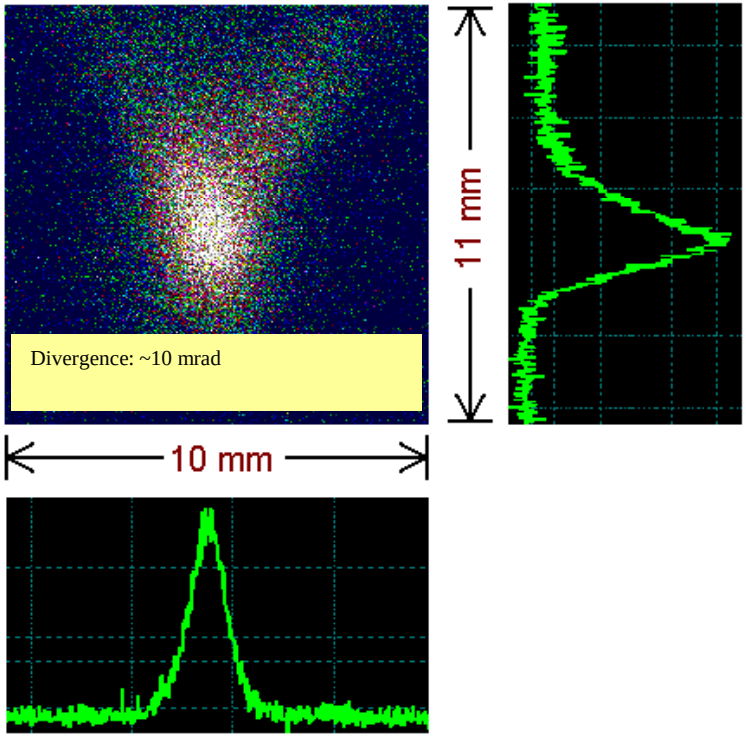
Laser cutting of FBTR fuel subassembly in a hot cell at IGCAR



a) A fuel pin bundle being extracted from a fuel subassembly; b) A cut sample of the hexagonal fuel subassembly



A laser rapid manufactured bimetallic bush made of type 316L stainless steel (on OD) and Stellite 21 alloy (on ID). Figure also shows longitudinal cross-section (middle) and associated micro-hardness profile across wall thickness (right



A 10 TW Ti:Sapphire 45 fmsec laser system (left), that has been used for laser-plasma acceleration experiments, producing ~ 40 MeV electron beam (right) of low-divergence (~10 mrad).

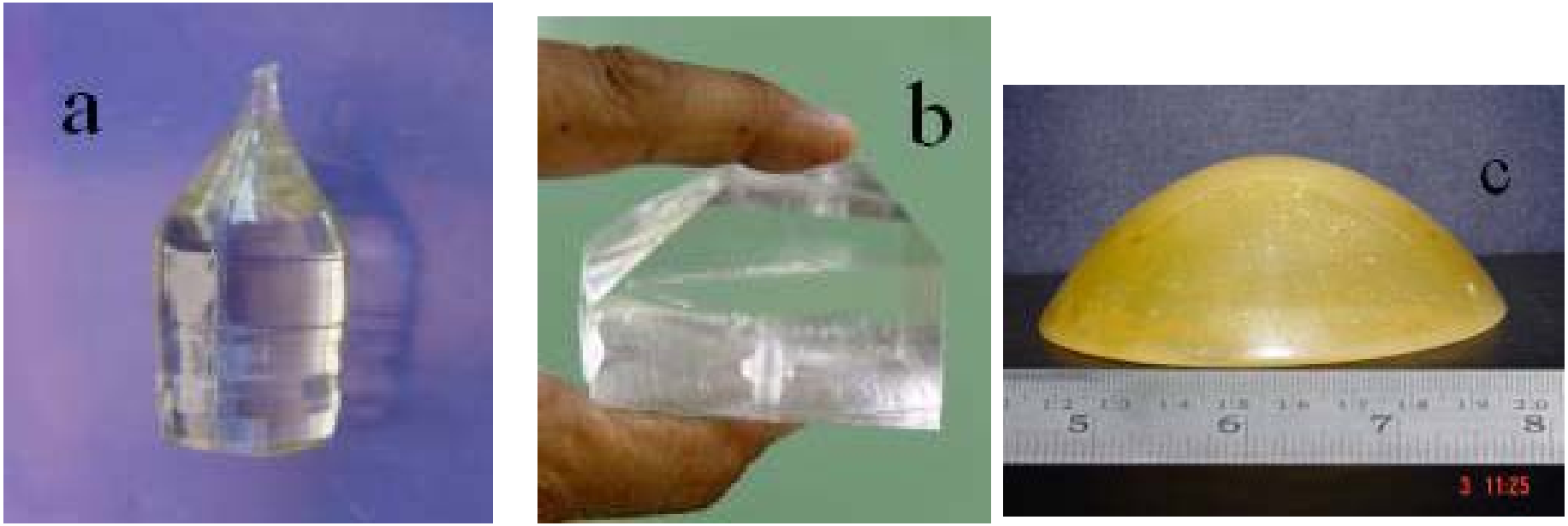
ADC Crystal Pull Head Developed at RRCAT and crystals grown using it

NaCl, BSO, LN

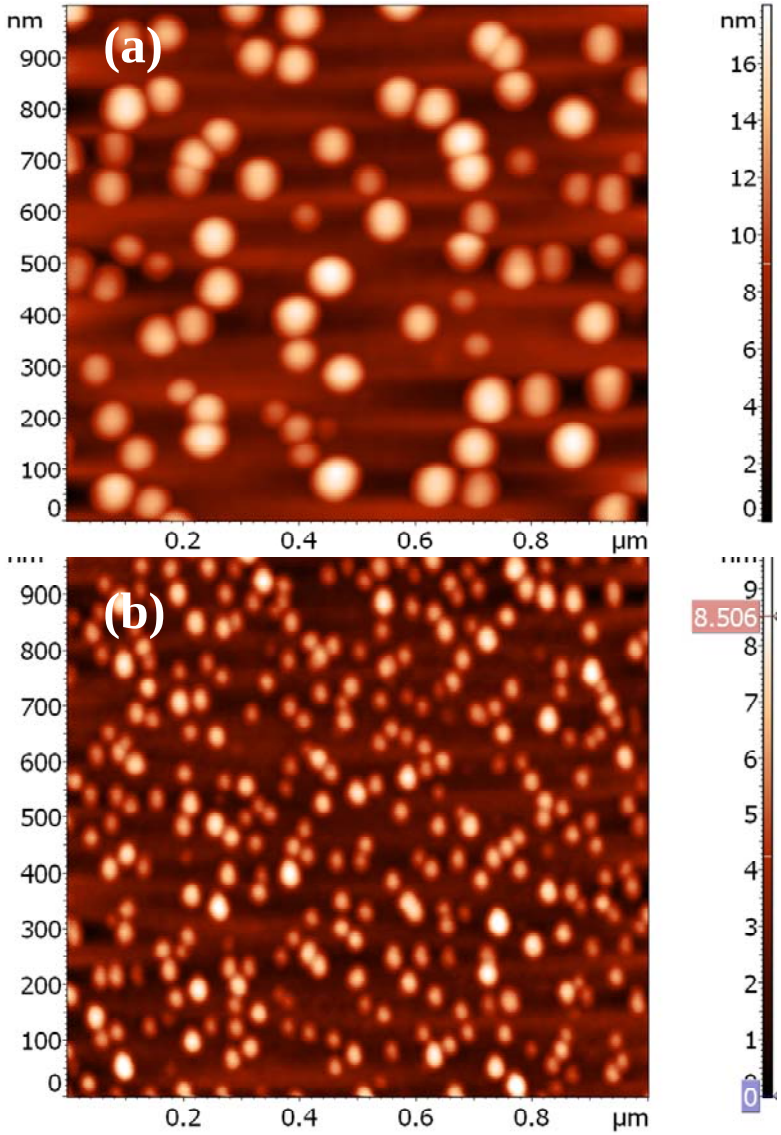
Progress in Some Materials Development Activities

Growth of Optical Crystals and IR-transparent free-standing ZnS dome

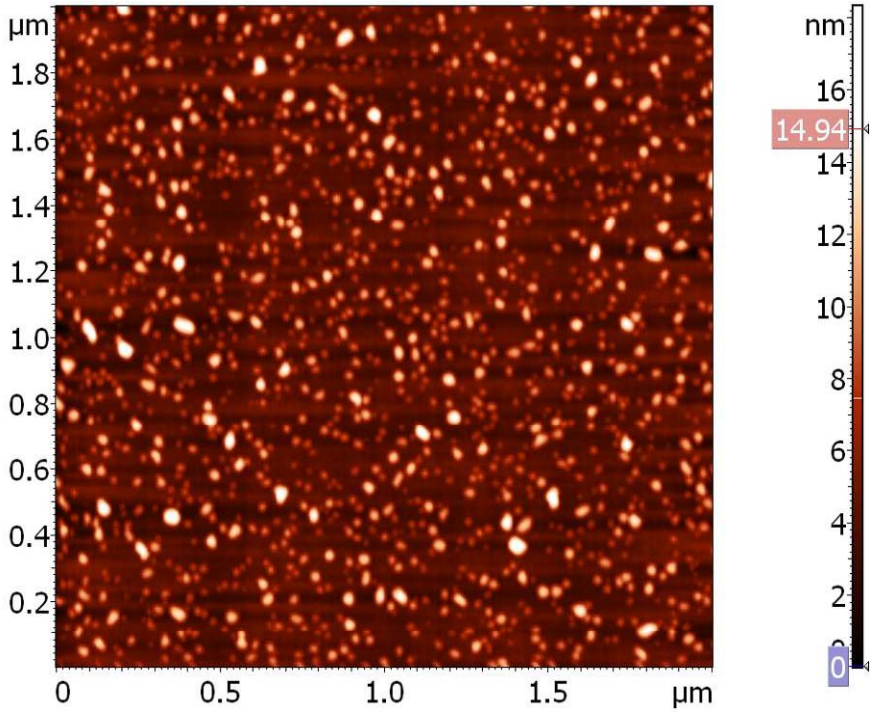
- Stoichiometric lithium niobate (SLN) crystals (undoped, & doped) with diameters up to 25 mm & lengths 30 to 40 mm were grown using in-house developed growth systems.
- Oriented KDP crystals of size 60x40x40mm^3 have been grown for SHG of Nd:YAG laser.
- Good quality free-standing ZnS dome (diameter 80 mm & thickness 2 mm) were grown



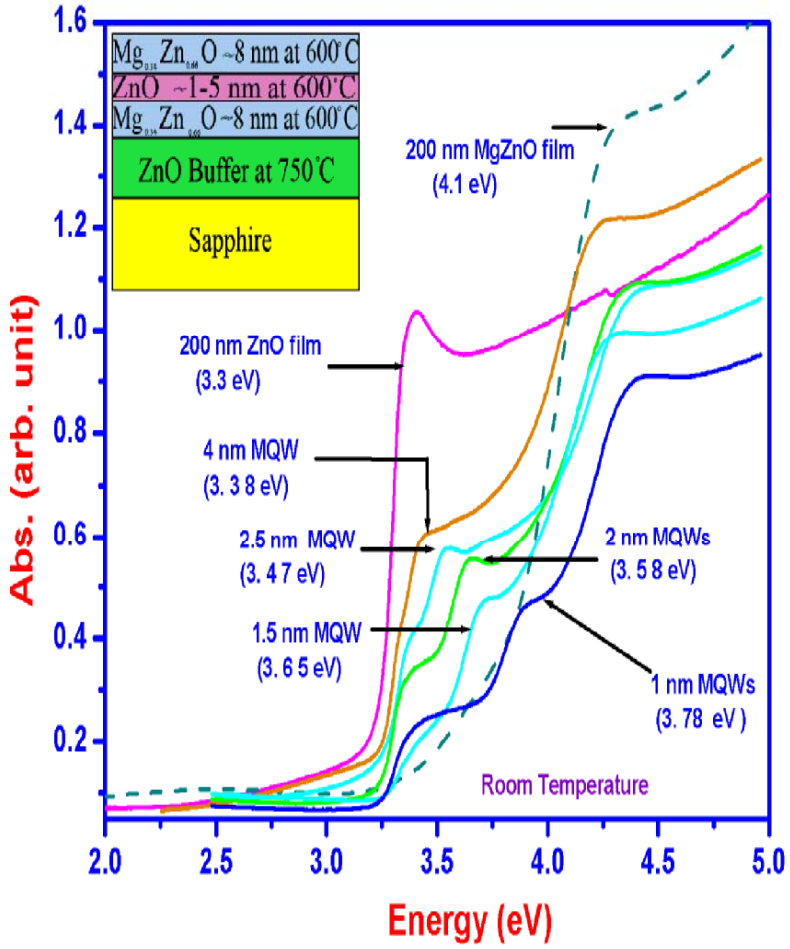
(a) SLN Single Crystal, (b) Oriented KDP crystal & (c) free-standing ZnS dome



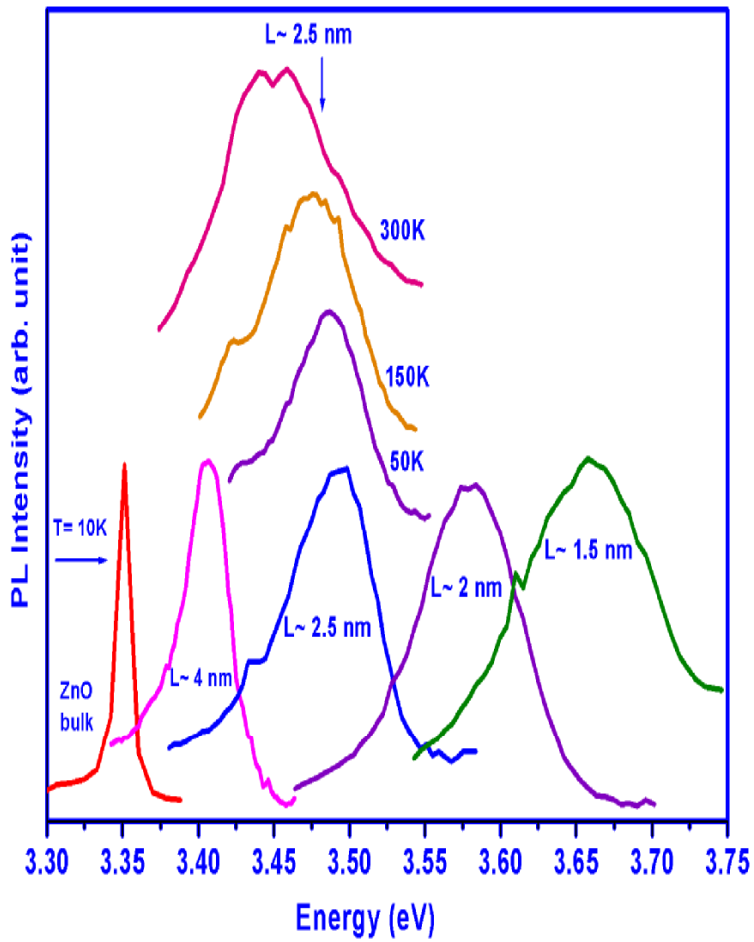
AFM pictures of InP QD grown at (a) 600 0C and (b) 550 0C



AFM picture of InAs QD



Schematic of the ZnO quantum well (inset) and its absorption spectra at different well layer thickness.



Photoluminescence from ZnO QWs of different well layer thickness (L) and at different temperatures.

MEMORANDUM OF UNDERSTANDING BETWEEN HEAVY WATER BOARD, MUMBAI AND RAJA RAMANNA CENTER FOR ADVANCED TECHNOLOGY, INDORE BOTH CONSTITUTENT UNITS OF THE DEPARTMENT OF ATOMIC ENERGY, GOVERNMENT OF INDIA FOR DEVELOPMENT OF INDUSTRIALLY SUITABLE WET PROOF CATALYST FOR ISOTOPIC EXCHANGE REACTIONS INVOLVING HYDROGEN AND WATER

NOW, IT IS HEREBY AGREED BY THE PARTIES AS FOLLOWS:

1. INTENT:

To develop industrially suitable wet proof catalysts for Hydrogen Water Isotopic Exchange reactions.

2. ROLES AND RESPONSIBILITIES:

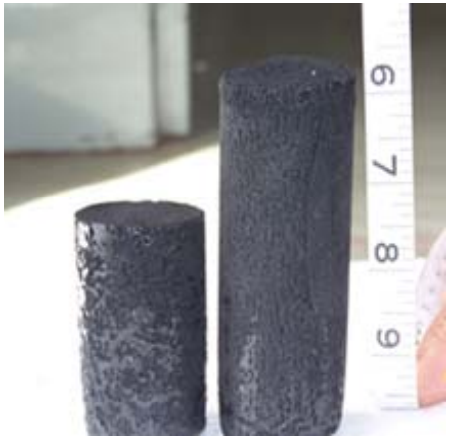
For Heavy Water Board **For Raja Ramanna Centre for Advanced Technology**

(A. L. N. Rao)
Chief Executive, HWB

25-1-2008

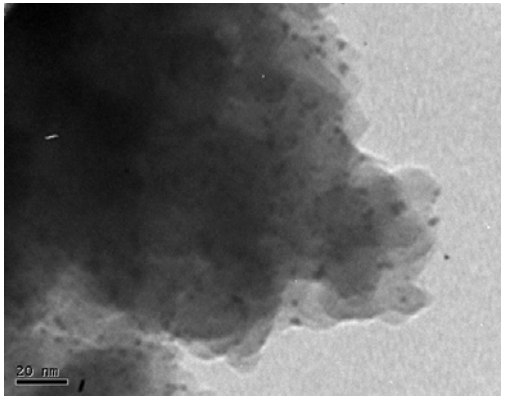
(V. C. Sahni)
Director, RRCAT

Development of Carbon aerogels of different morphologies to suit specific applications



Pt-Loaded Carbon –silica composite cylinders and disc

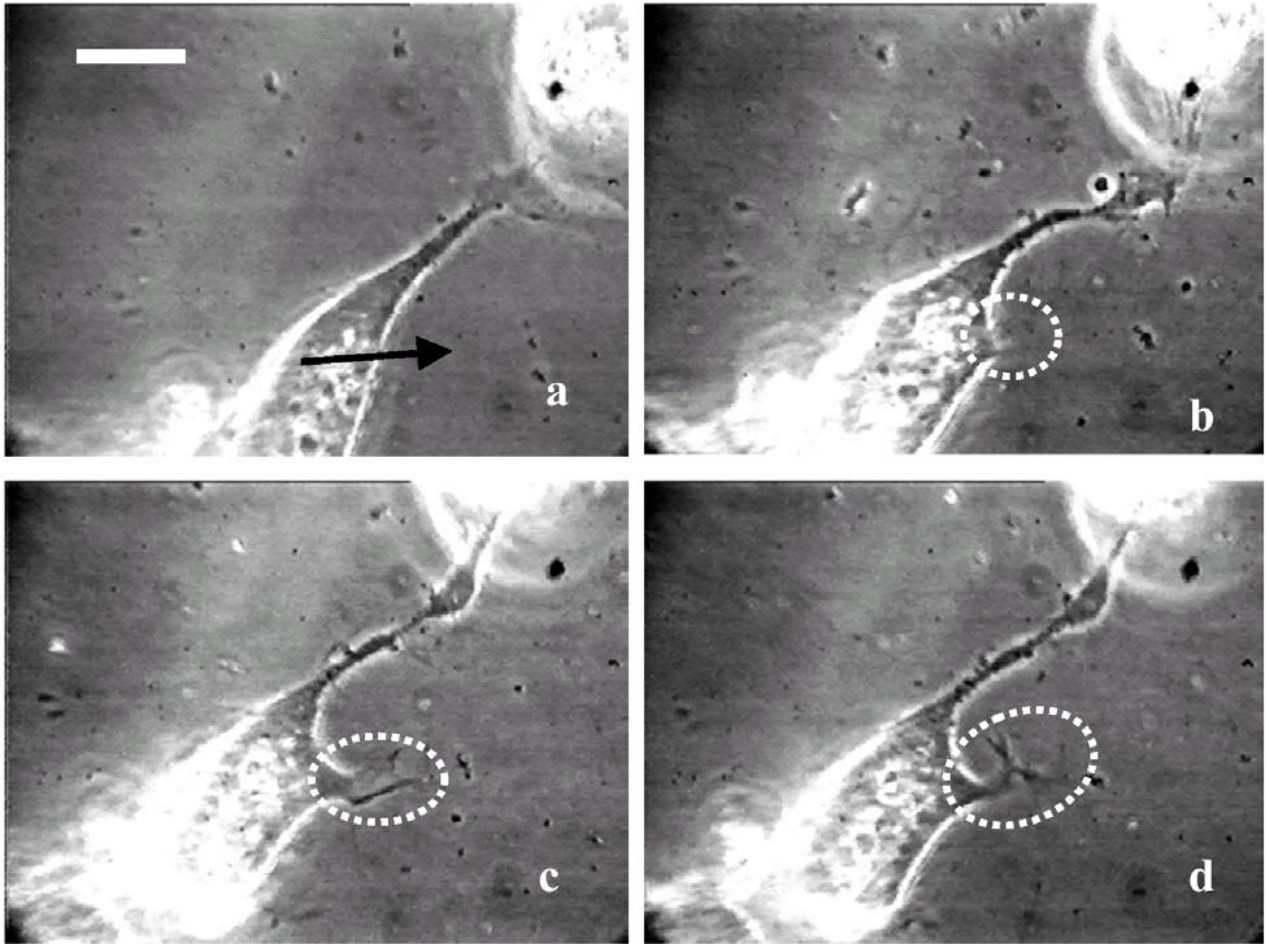
Carbon Foam Electrode (125 x 80 mm)



TEM of Pt loaded Carbon Foam showing 2-3 nm clusters of Platinum

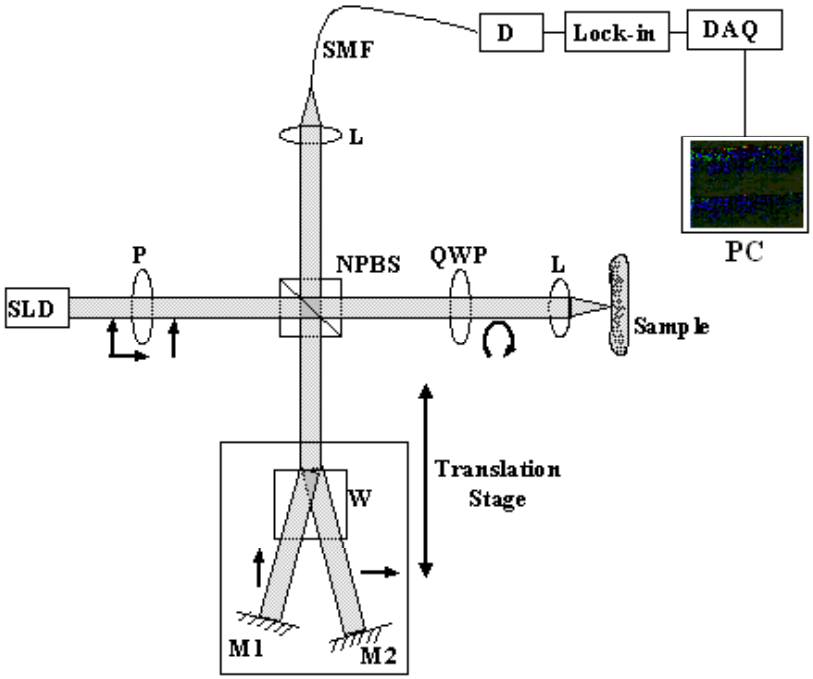
Raschig Ring Morphs of Pt-Carbon Composite Catalyst.

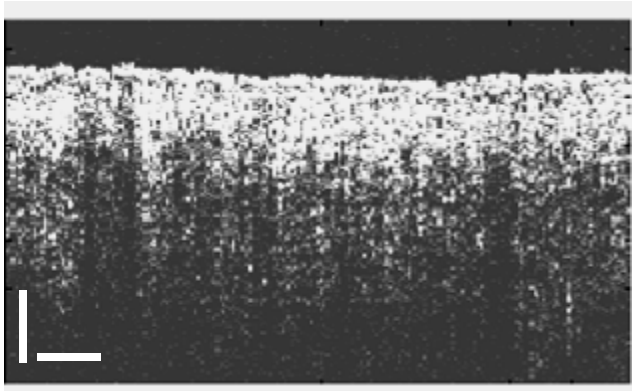
USB based power meter for use with cw lasers



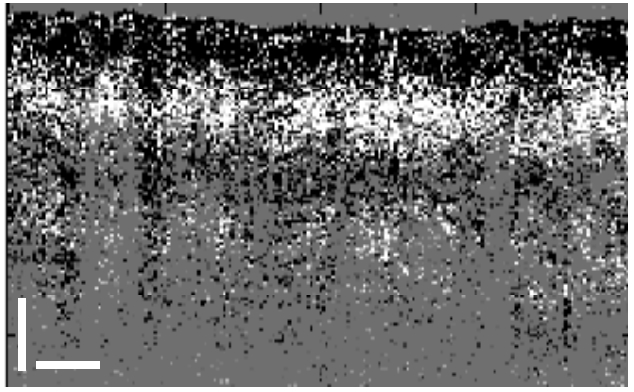
Induction of new neuronal growth cone induced by laser tweezers:
A neuronal cell is subjected to **asymmetric intensity profile line tweezers** (trap beam power 120 mW) **in the direction marked by arrow (panel a).** Induction of **new growth cone (shown encircled)** after exposure time of **20 min (panel b), 25 min (panel c)** and **45 min (panel d). Natural branching of induced growth cone can be observed in panel d. Scale bar: 20 μm.**

Polarization Sensitive Optical Coherence Tomography (OCT)





Intensity based OCT image of chicken breast (size bar 200μm)



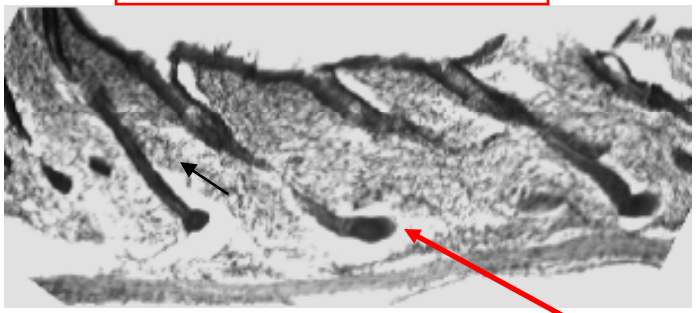
Polarization sensitive OCT image (size bar 200μm)

Single detector based bulk optic PSOCT Setup. Used a Wollaston prism to monitor **two orthogonal polarization components** of scattered light from tissue **using a single detection system.**

Saratov Fall Meet Sept. 2007

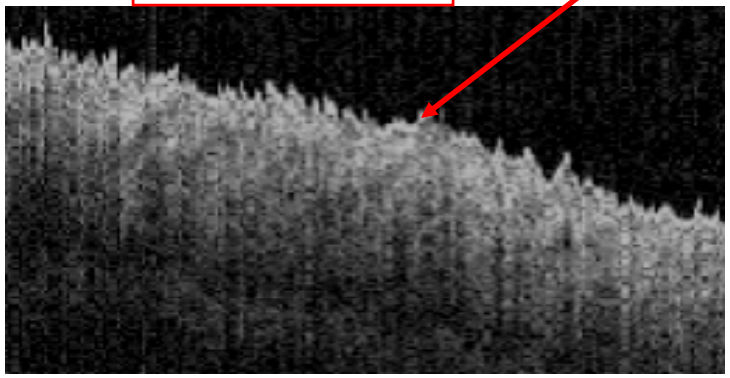
Effect of Helium-Neon laser (632.8 nm) irradiation on hair growth in mice studied by histology and OCT.

Histology image

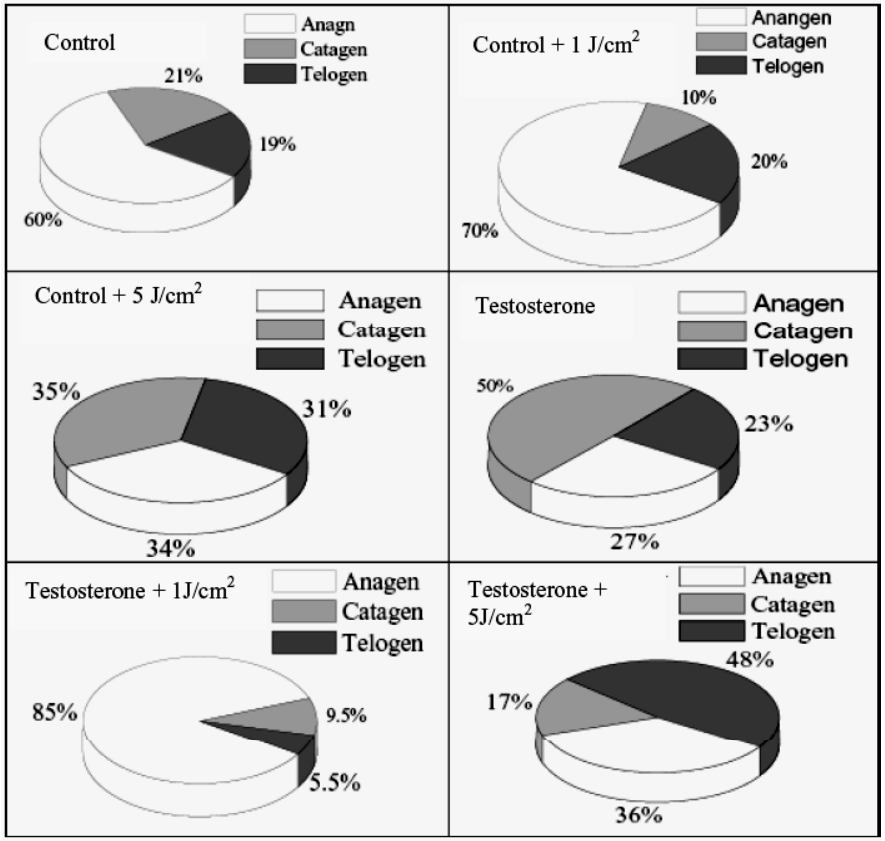


Hair follicle

OCT image



Measurements on Hair follicle growth stages

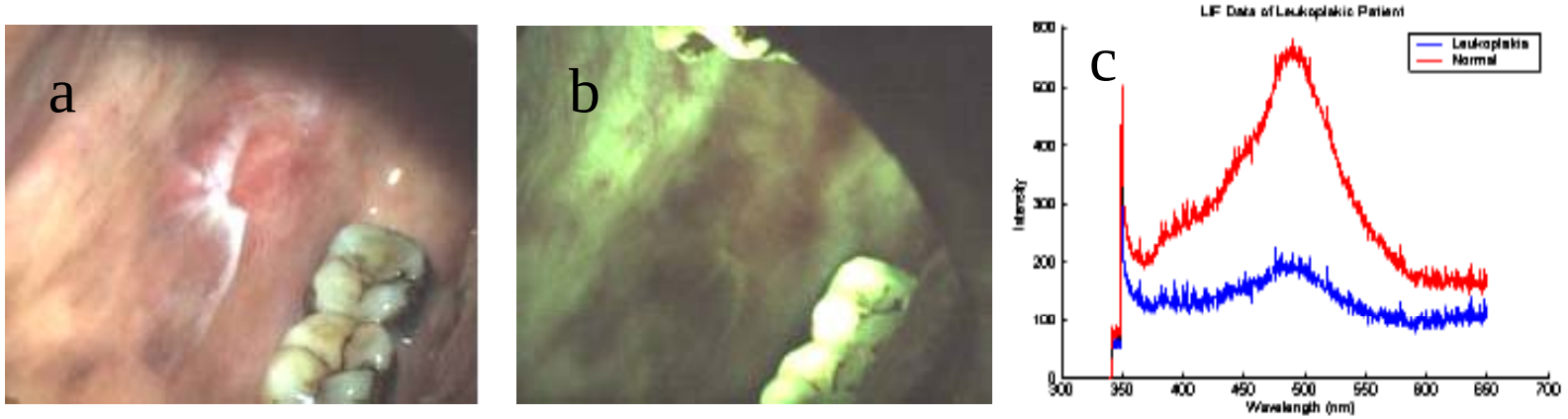


Significant increase was observed in hair growth and proliferation of cells in mice skin by He-Ne laser irradiation at 1 J/cm^2

Best poster award at NLS-2007

Use of optical spectroscopy for biomedical diagnosis

Optical diagnostic system was installed at TMH & used for studies on patients being screened for abnormalities of oral cavity



(a) Conventional white light image of buccal mucosa,
(b) Fluorescence Image obtained with 442nm excitation &
(c) fluorescence spectra recorded from the normal (red) and Leukoplakik site (blue)

MOU for Technology development of Laser Marking systems

MOU has been signed between RRCAT and Laser Scanning Systems, Indore for the development of Laser Marking systems for Industrial use.

Other activities & photo gallery

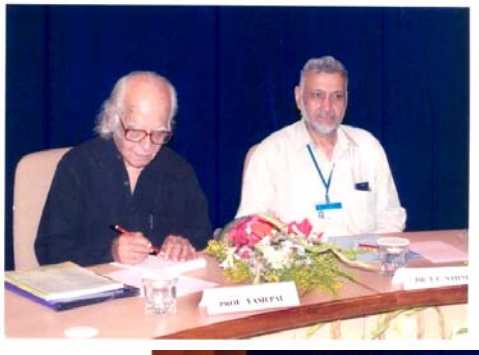
 # We organized a 2 week Joint Accelerator School (JAS 2008), supported by BRNS, HBNI, Fermilab, USA & KEK, Japan with about 100 students from national labs.

 # RRCAT Team organized National Laser Symposium 2007 at M.S. Univ Vadodara.

 # On National Science Day neighborhood school students were given tour of labs.

 # Scientific staff continued giving help to many national labs/agencies for laser & accelerator based programs.

 # Dr. A.P.J. Abdul Kalam & Prof Yash Pal were amongst the distinguished visitors to have visited our Centre this year.



Dr. Kalam wrote "Inspired to visit RRCAT…… *I congratulate RRCAT team, for excellence……* and I hope ……. you will contribute in realizing Atomic Energy mission: Thorium nuclear reactor".

Thank You