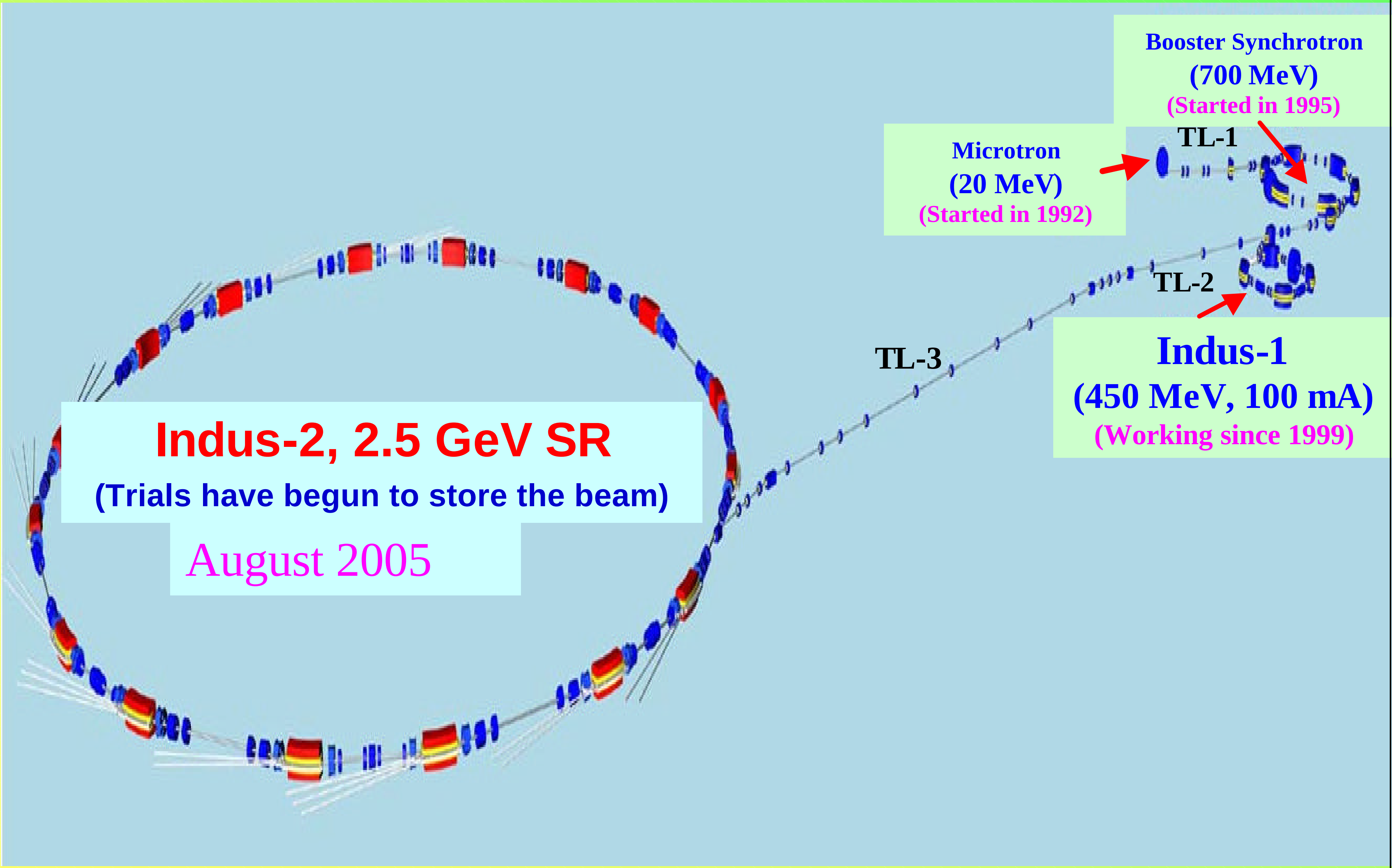

August 28, 2005
7th SAC-PM Meeting at Centre for Advanced Technology, Indore
A Presentation on Indus-1 & Indus-2
A very warm welcome to
Prof C N R Rao, Chairman, SAC-PM and
Esteemed Members & Invitees to our
Centre



Schematic view of Indus Complex

Timeline of Indus Accelerator Program

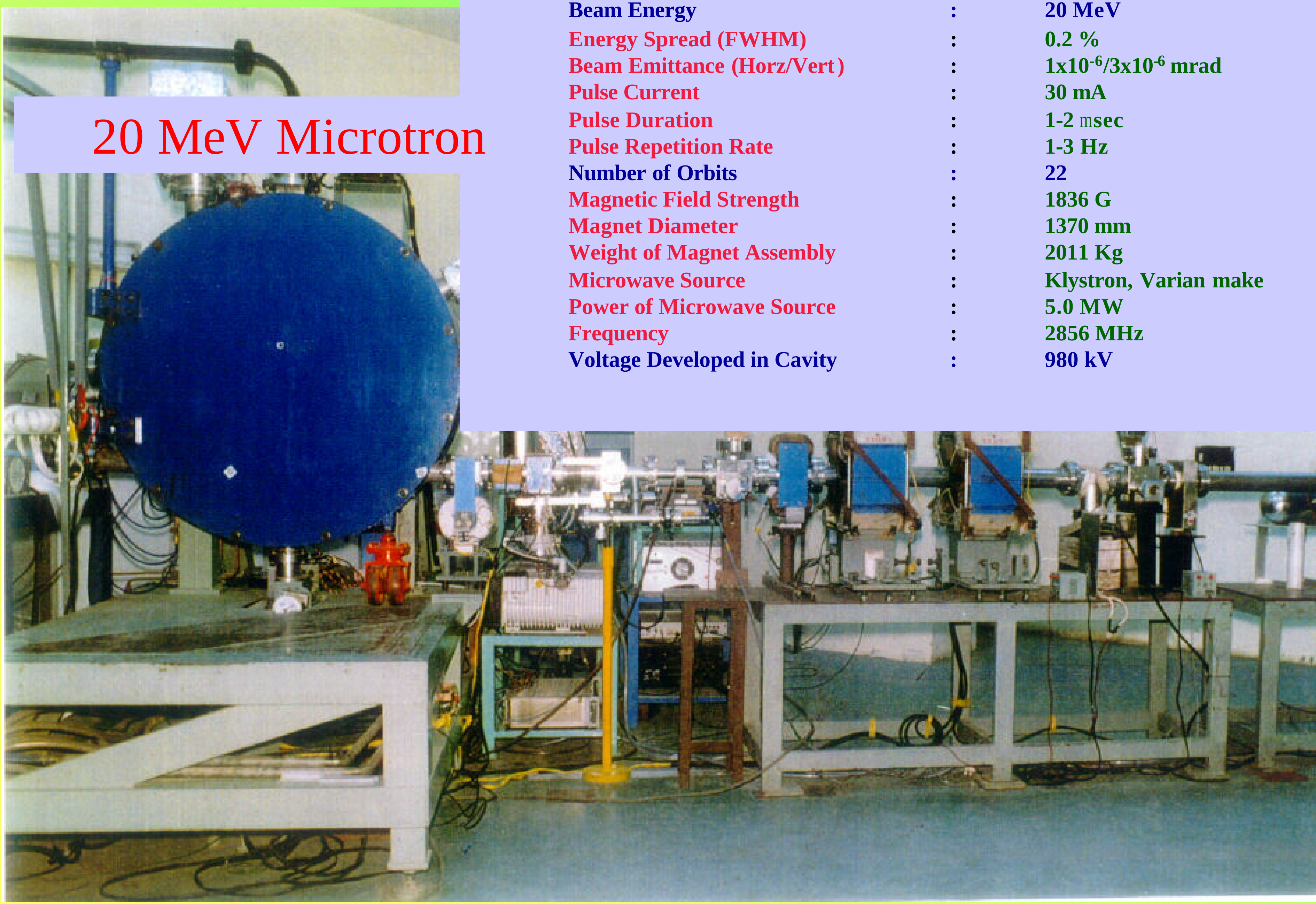
- **1986 : Scientific activities begin with modest infrastructures, such as, 11 kV / 350 KVA Electric Substation.**
- **1987-91 : Temporary set up. Developed components & sub-systems for Microtron & Booster Synchrotron. Most of these were bench tested.**
- **1992 : 20 MeV Microtron assembled & commissioned.**
- **1989- 93 : Civil construction & electrical infrastructure improvement.**
- **1991 onwards : Indus-1 components & subsystems built and bench tested.**
- **1993 : Full building to house all synchrotron facilities gets ready.**
- **1994 : 132 kV, 1250 KVA substation operational in Dec 1994. So stable power becomes available to operate booster dipole magnets .**
- **1995 : Booster Synchrotron assembled and first ramp up of the beam from 20 MeV to 450 MeV achieved in Sept. 1995.**
- **1996 onwards : Installation of Indus-1 started.**
- **1999 : Indus-1 commissioned in April 1999.**
- **1998 – 2002 : Civil construction of Indus-2 building**
- **2000-2004 : Components & subsystems of Indus-2 built and most of them were bench tested & qualified.**
- **2004 onwards : Indus-2 & TL-3 installation & integration of subsystems.**
- **2005 : Trials to store the beam in Indus-2 start on Aug 15, 2005.**
- **2005 : Beam completes full circle in Indus-2 on Aug 26, 2005 at 2:00 pm.**

Hallmark of Our SRS Program is

- Intense focus on ***indigenous development & qualification*** of **most of the sub systems** through **home based efforts**.
- These include the magnets & their power supplies, vacuum chambers, ion pumps & gauges, beam diagnostic accessories, RF driver and control systems etc.
- ***Vendor development*** for many high quality components for these accelerators.

20 MeV Microtron

Beam Energy	:	**20 MeV**
Energy Spread (FWHM)	:	**0.2 %**
Beam Emittance (Horz/Vert)	:	**$1x10^{-6}/3x10^{-6}$ mrad**
Pulse Current	:	**30 mA**
Pulse Duration	:	**1-2 msec**
Pulse Repetition Rate	:	**1-3 Hz**
Number of Orbits	:	**22**
Magnetic Field Strength	:	**1836 G**
Magnet Diameter	:	**1370 mm**
Weight of Magnet Assembly	:	**2011 Kg**
Microwave Source	:	**Klystron, Varian make**
Power of Microwave Source	:	**5.0 MW**
Frequency	:	**2856 MHz**
Voltage Developed in Cavity	:	**980 kV**

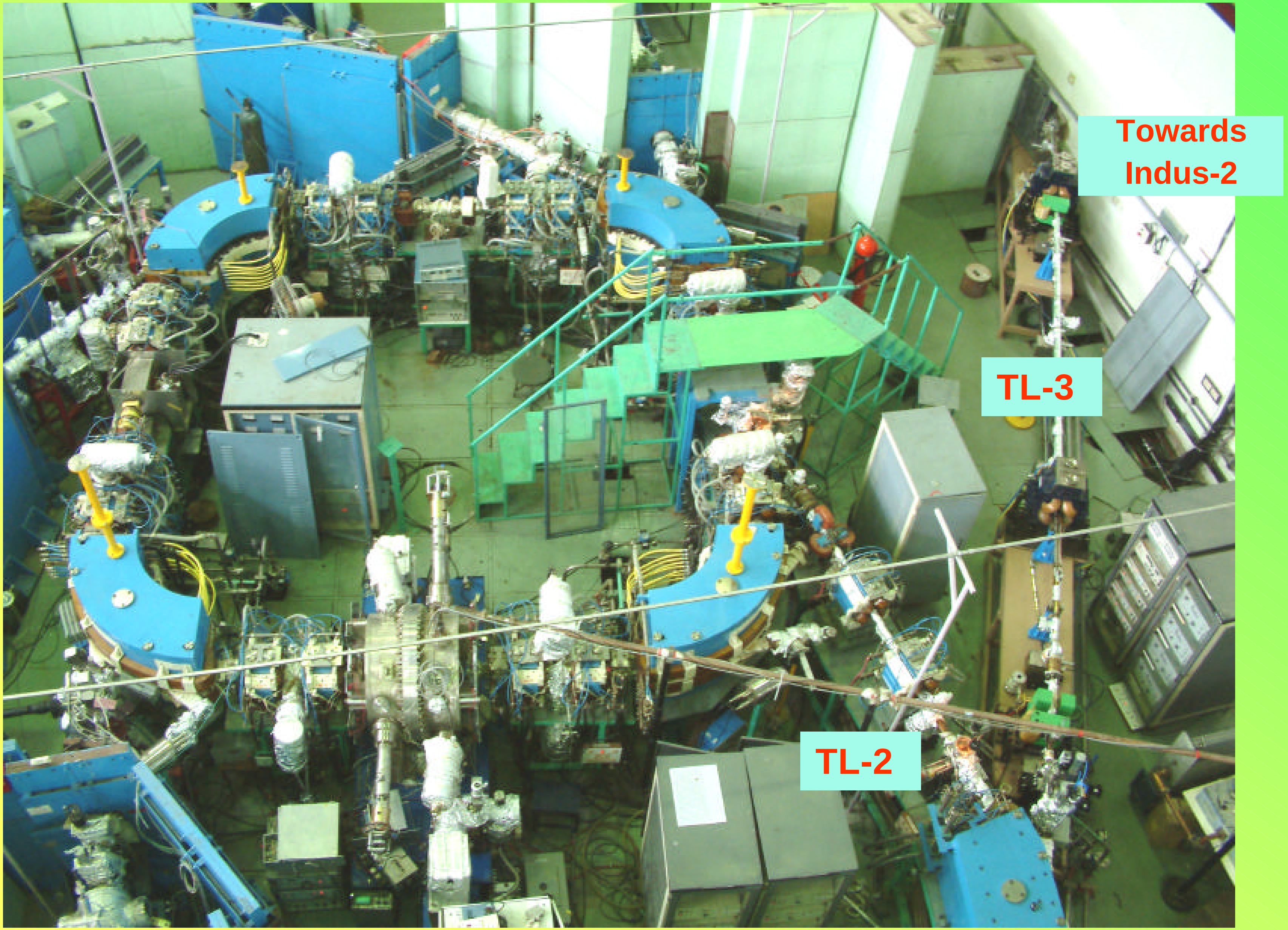


700 MeV Booster Synchrotron

Parameters of the Booster Synchrotron

Energy (maximum)	: 700 MeV
Current	: 30 mA
Lattice Type	: Separated function
Circumference	: 28.44 m
Super periods	: 6
No. of Dipoles	: 6
Bending Magnet Field (maximum)	: 1.32 T
Dipole Length	: 1.887 m
No. of Quadrupoles Q_F & Q_D	: 6, 6
Quadrupole Length	: 0.25 m
Quadrupole Strength (max) Q_F & Q_D	: 7.5 T/m, 7.5T/m
Straight Section Length	: 1.31 m
Tune Point ($?_x$,$?_z$)	: 2.25, 1.22
Beam Emittance (e_x) 450 MeV	: 8.8 x 10^{-8} mrad
700 MeV	: 2.0 x 10^{-7} mrad
Damping times (tx,tz,te) msec	
450 MeV	: 68.3, 42.4, 17.8
700 MeV	: 18.2, 11.3, 4.7
RF	: 31.613 MHz
Harmonic Number	: 3

Indus-1 Hall, Beam-lines, TL-2 & TL-3

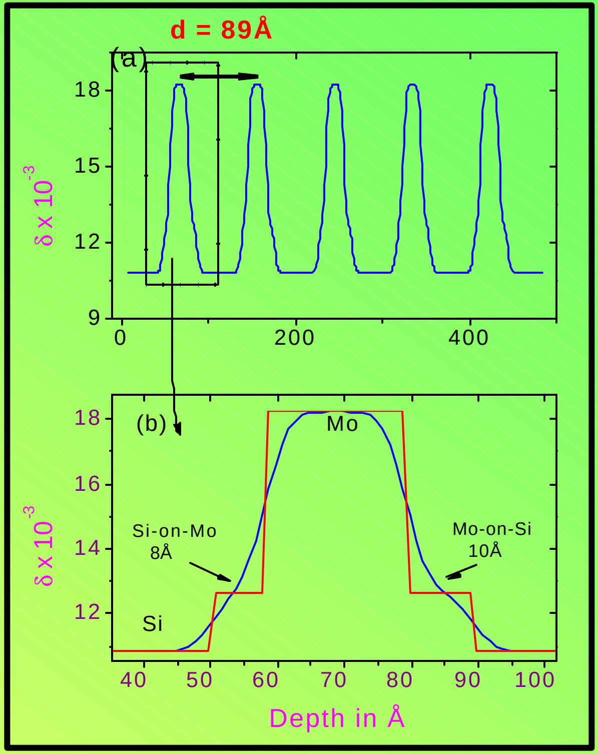


Indus-1 Beam-lines : Monochromators used & wave lengths covered (in A)

1. **Reflectivity – TGM (40 – 100A)**
2. **Photo physics – SN (500 – 2000A)**
3. **Angle resolved PES – TGM (40 – 1000A)**
4. **High resolution VUV Bl – RC (700 – 2000A)**
5. **Angle integrated PES – TGM (60 – 1600A)**
6. **Photoabsorption (PASS) – PGM (17 – 225A) $**

$ Under construction

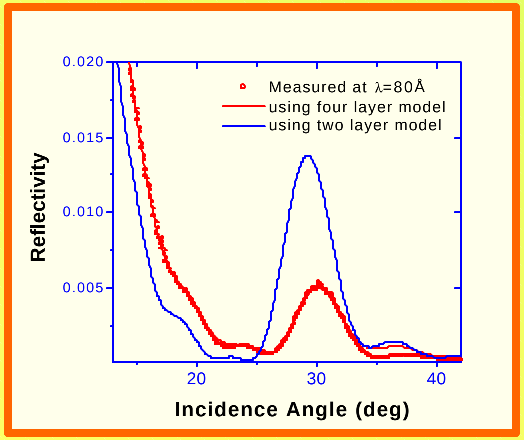
Reflectivity Beamline (40 – 100 A^0) on Indus-1



Multilayer depth profile extracted from reflectivity data

Mo/Si multilayer: Interfacial studies

- Period 89Å (30Å Mo/ 59Å $Si)_5$
- Reflectivity Measurement @ λ=80Å

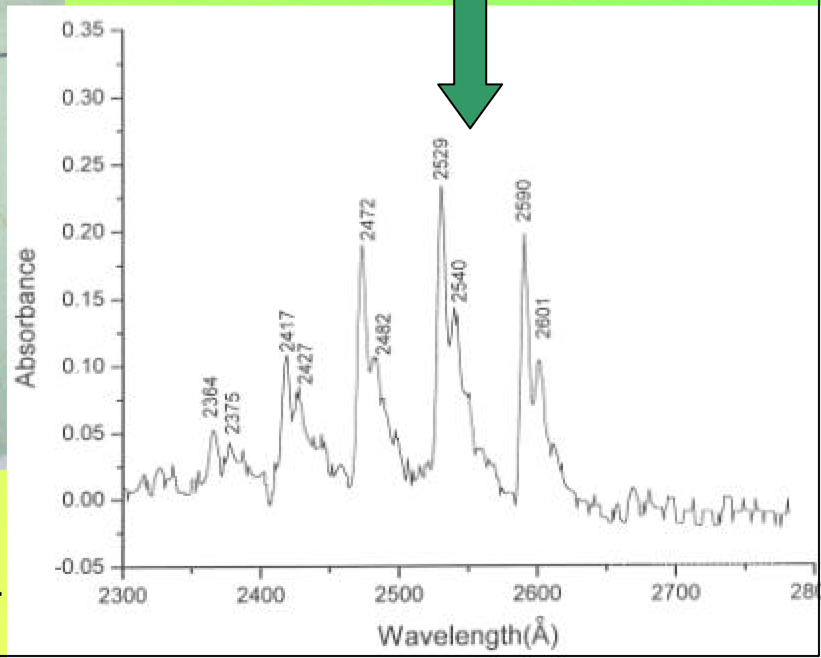


- Mo-on-Si Interface is thicker than the Si-on-Mo interface
- Interface asymmetry is due to large difference in thermal conductivities of Mo and Si

Photo-Physics Beamline on Indus-1
for

Photo-absorption Spectroscopy of stable molecules
Study of photo-fragmentation of molecules/transient species
Optical reflectivity/optical constants of solid samples
Fluorescence studies of materials

Vibrational structure of Benzene in Ultra-violet region



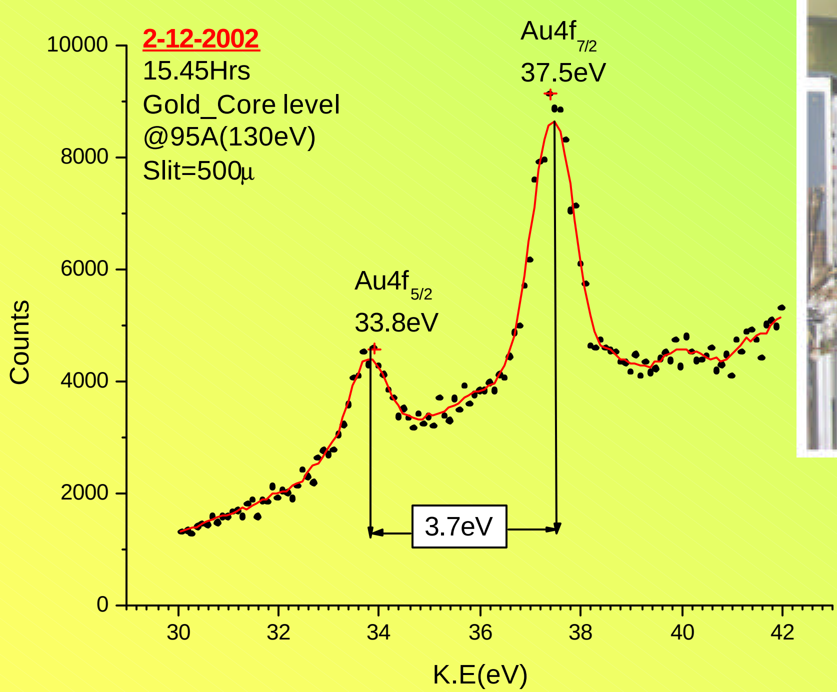
Specs. →
Wavelength Range: 500-2000 Å
Monochromator: Seya-Namyoka
Resolution: 1 Å

Angle Resolved Photoelectron Spectroscopy (ARPES) Beamline on Indus-1

for

Photo-emission Spectroscopy for probing the states of electrons in atoms, molecules, solids and surfaces

Measurement of Angular Distribution of photo electrons from oriented surfaces



Core level photoelectron spectrum of gold measured at ARPES beamline

Wavelength Range: **400-1000 Å**

Monochromator: **Toroidal grating Monochromator**

Resolution of electron spectrometer: **50-100 meV**

High Resolution VUV Beamline on Indus-1

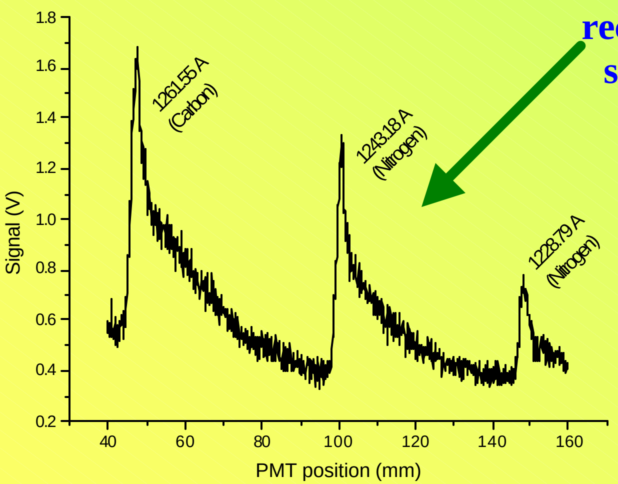
for

High Resolution studies of Atoms/Molecules for probing high-lying energy states

Identification of Rydberg states

Determination of ionisation potential of atoms/molecules

Measurement of photo-absorption cross-sections of individual and rotationally resolved absorption lines



Vacuum UV line of carbon and nitrogen recorded by the spectrometer

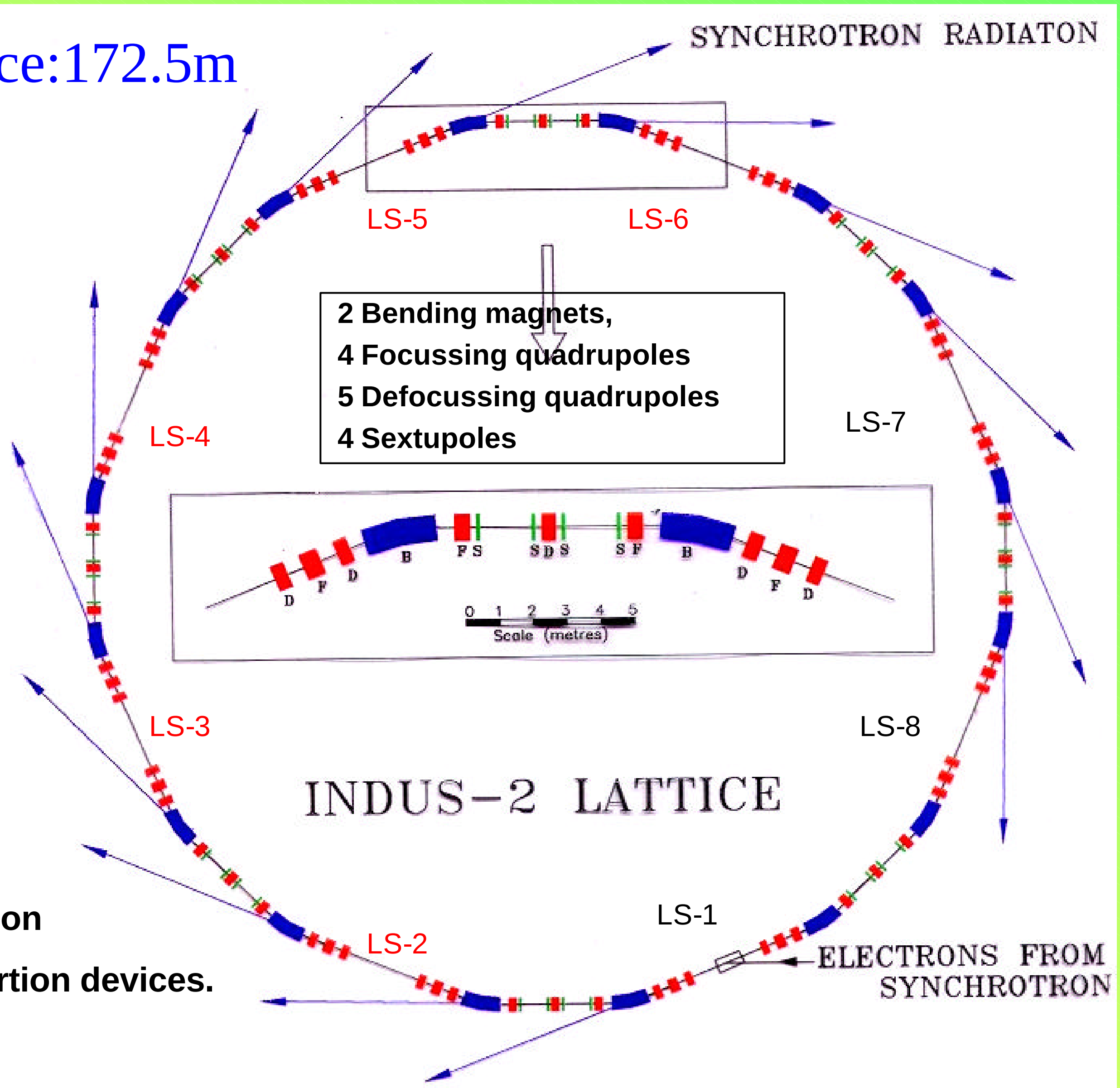
Wavelength Range: 700-2000 Å

Monochromator: Indigenous off-plane Eagle spectrometer

Resolution: 0.01 Å

Indus – 2 lattice & its components

Circumference:172.5m



LS-1: used for injection

LS-2 to LS-6: for insertion devices.

LS-7: Unusable

LS-8: for RF cavities

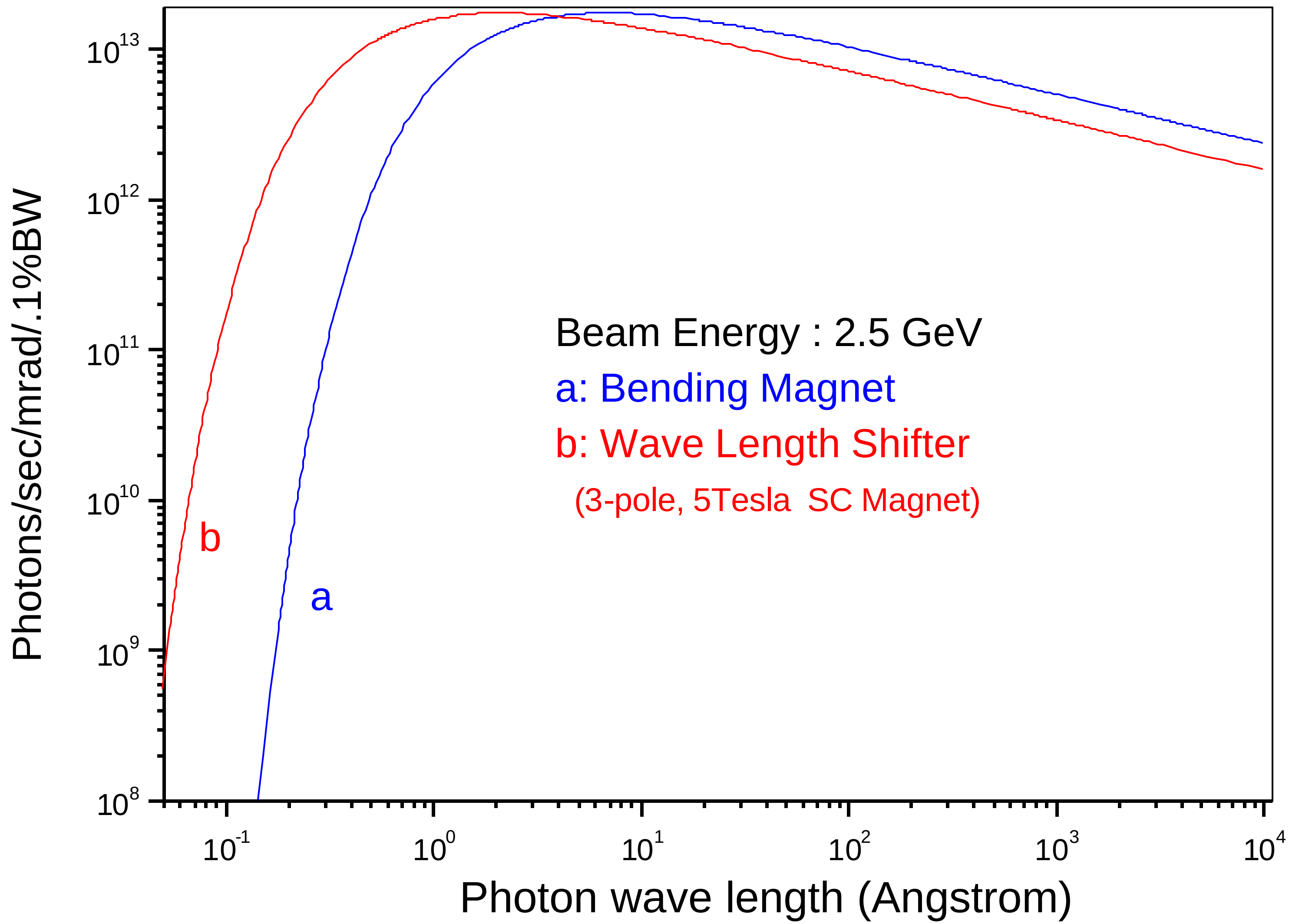
PARAMETERS OF Indus-2

Maximum energy		:	2.5 GeV
Maximum current		:	300 mA
Lattice type		:	Expanded Chasman Green
Superperiods		:	8
Circumference		:	172.4743 m
Bending field		:	1.502 T
Typical tune points		:	9.2, 5.2
Beam Emittance	ex	:	5.81×10^{-8} mrad
	ey	:	5.81×10^{-9} mrad
Available straight section for insertion devices		:	5
Maximum straight length available for insertion devices		:	4.5 m
Beam size	s x	:	0.234 mm
(Centre of bending magnet)	s y	:	0.237 mm
Beam envelope vacuum		:	$< 1 \times 10^{-9}$ mbar
Beam life time		:	15 Hrs
RF frequency		:	505.812 MHz
Critical wavelength		:	1.98 Å (Bending Magnet) 0.596 Å (High Field Wiggler)
Power loss		:	186.6 kW (Bending magnet)

Magnets:

Dipoles : 16; Q'poles: 32 focusing & 40 defocusing type; S'poles: 32

Spectrum of Radiation from Indus-2



Indus-2 OVERVIEW

1997 : Decision to make 2.5 GeV energy machine

1998- 2002 : Civil construction, adding infrastructure; design of major components & prototype development; material procurement for in-house production & vendor identification for series production etc.

2000-2004 : Subsystem fabrication/evaluation phase.

2004 onwards: Installation & final commissioning of various subsystems in the tunnel.

Cost : Rs. 95 Crores (Cost of machine & building).

Indigenous Systems Developed : Vacuum chambers, magnets, power supplies, beam diagnostics and RF power system etc.

Imported Items: RF cavities & Klystrons.

Various Subsystems of Indus - 2

Main Dipole Magnet

Coil winding, assembly & testing at CAT (Yoke made by Godrej)

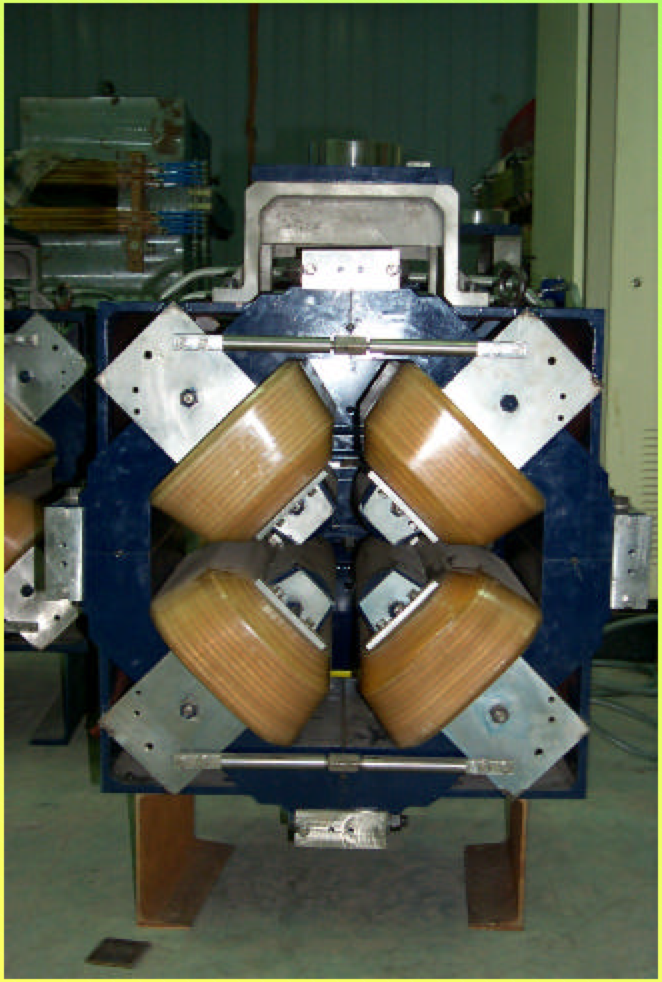
(Pole Gap: 50mm, Tolerance < 50 µm, flatness & parallelism<10 µm, Core length 2m±0.5mm; Field: 1.5T, NI: 70,000 Amp turns)

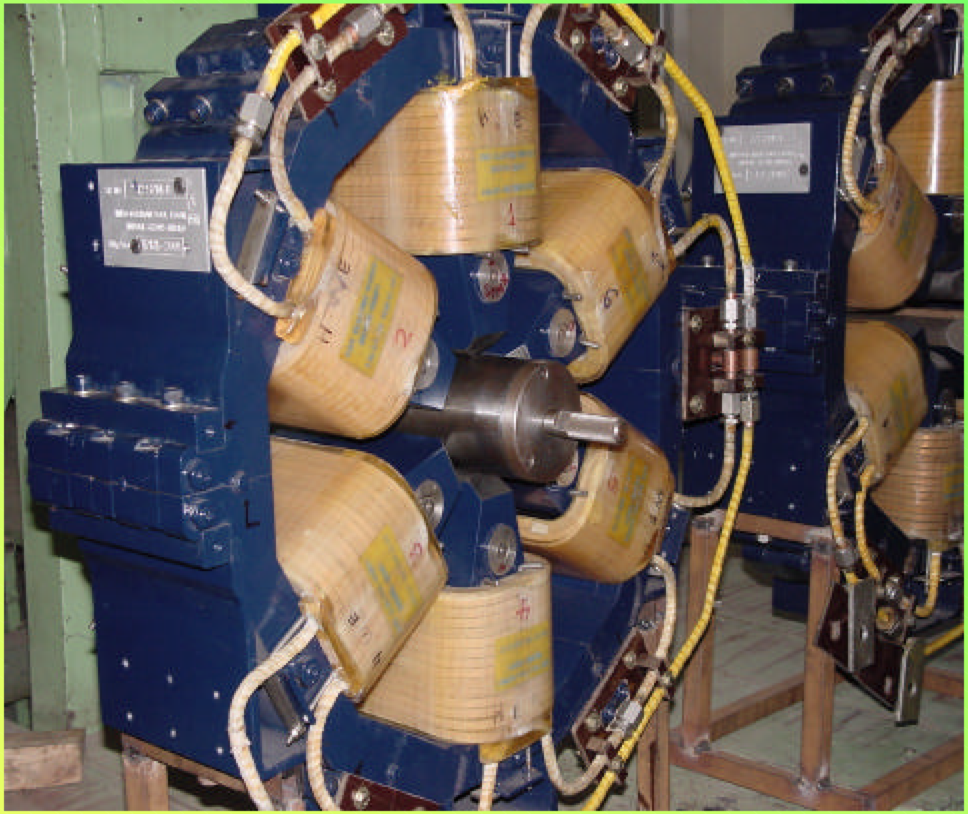
Q'poles & S'poles made at CMTI & CAT

(Q'p: Field:16T/m; NI:13,000 A turns; Gap: 85 mm)

(S'p: Field: 400T/m2; NI: 5,700 A turns; Gap: 92 mm;

Tolerance on Geometry: pole gap < 50 μm)



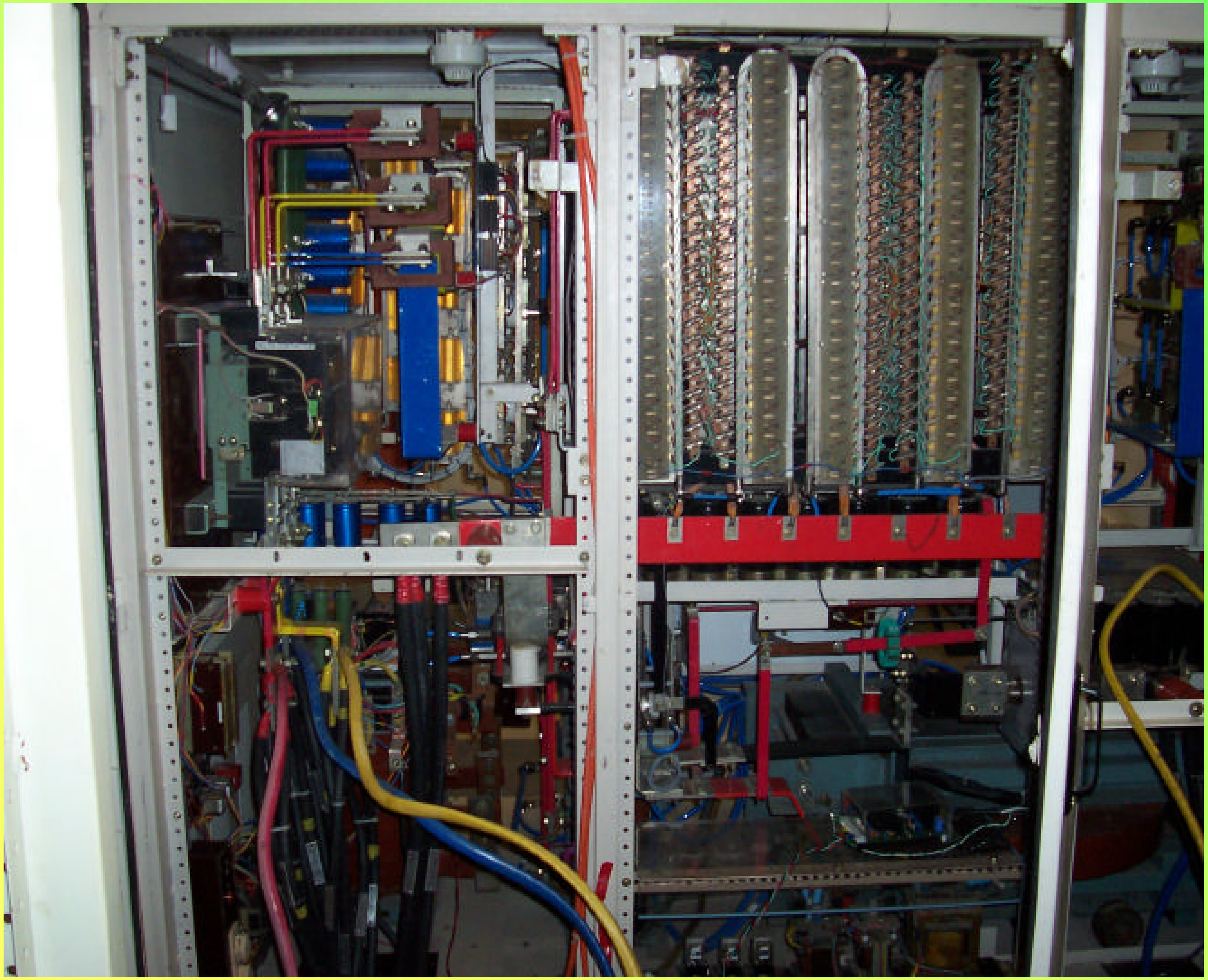


Magnet Power Supplies: Main features

- High stability
- Wide current range
- Provision for cycling
- One-, Two- and Four-quadrant operation
- Magnet protection
- Pulse PS: low jitter fast switches, High voltage, high current

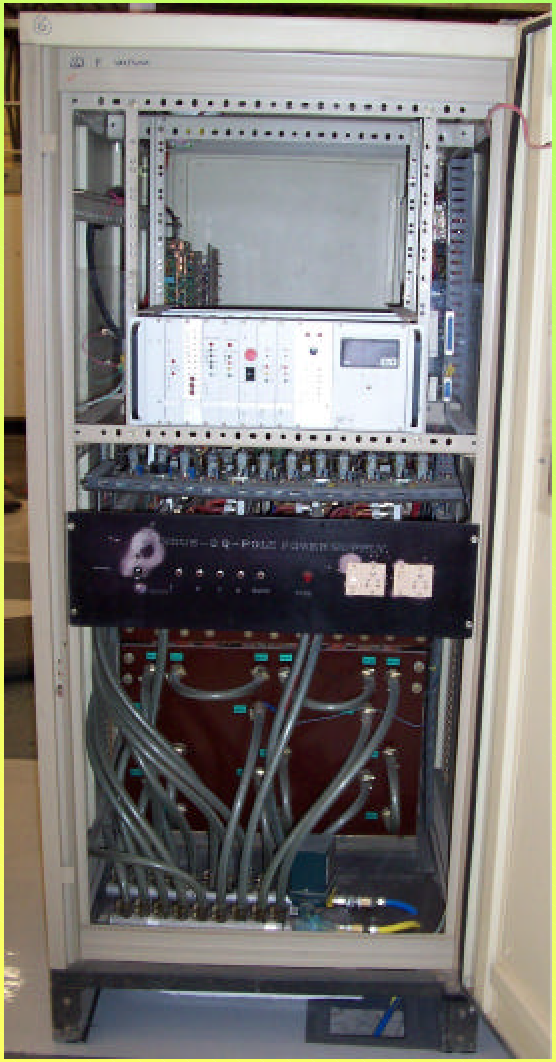
Indus-2 Dipole Power Supply

One P/S for 16+1 dipole magnets, **Current 200 - 900 Amp, Stability ~ ± 50 ppm & ripple ~ ± 100 ppm**; Max Voltage 680 Volts



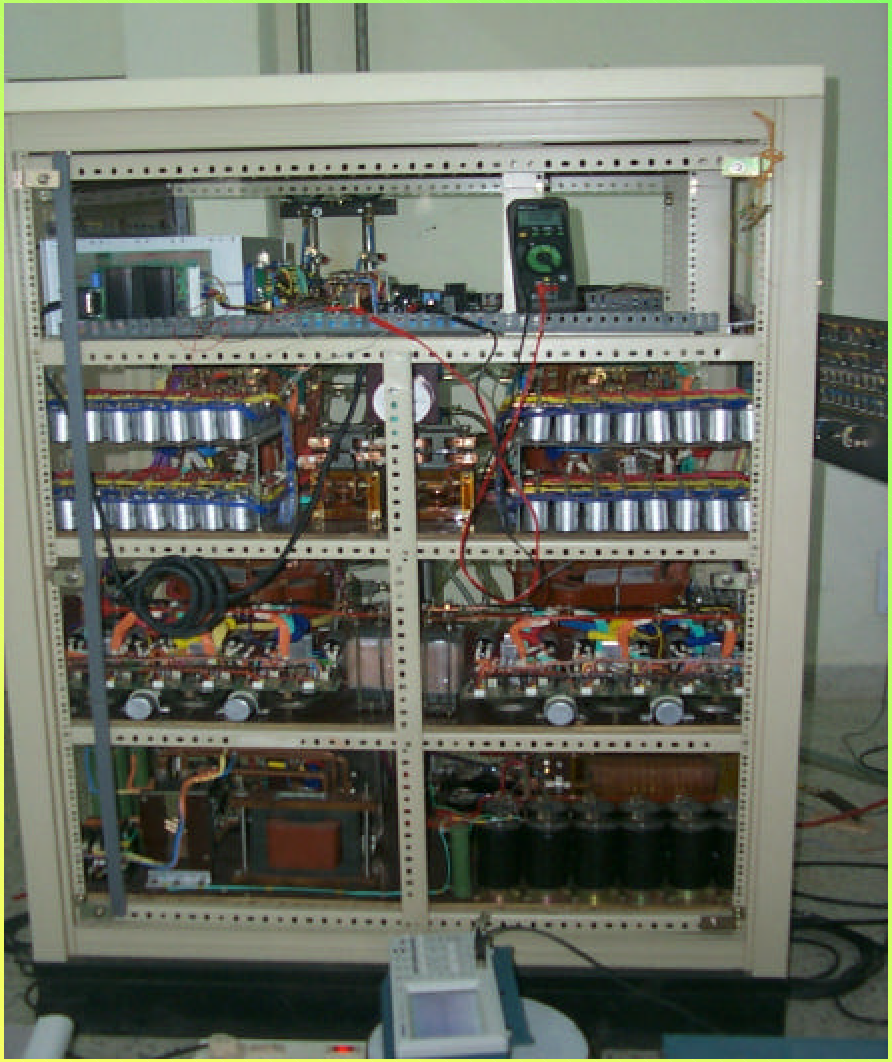
Indus-2 Q/P-1,2,3 Magnet P/S

8+8+8 P/S for Q-pole magnets, **Current 30-180 Amp, Stability ~ ± 50 ppm & ripple ~ ±100 ppm;** Max Voltage 87 - 119 Volts



Indus-2 Sextupole Magnet P/S

Two P/S for 32 Sextupoles magnets, **Current 40-230 Amp,**
Stability ~ ± 500 ppm & ripple ~ ±500 ppm; Max Voltage 300 Volts

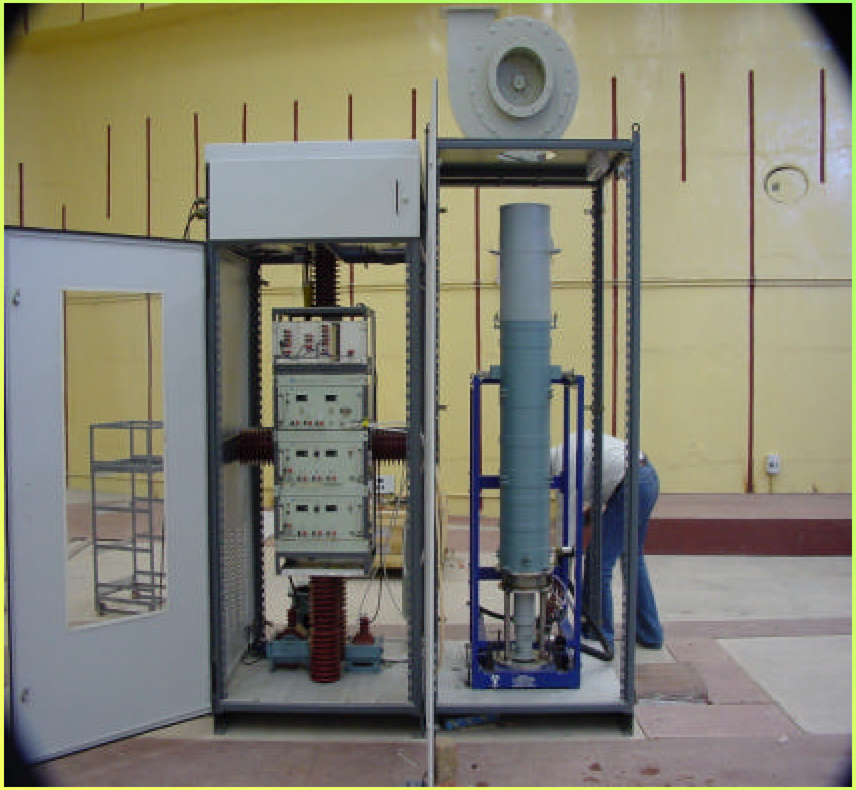


RF System

- Cavity : Precision cooling, online tuning & HOM frequency shifter
- Conditioning for high power
- Power Supply: Solid state / tube amplifiers
- Transmission line components
- Control, protections (crowbar)

RF System

Co-axial Line, Circulator & Klystron



Klystron Tube & Auxiliary PS / Interlock

Solid-state Driver Amplifier

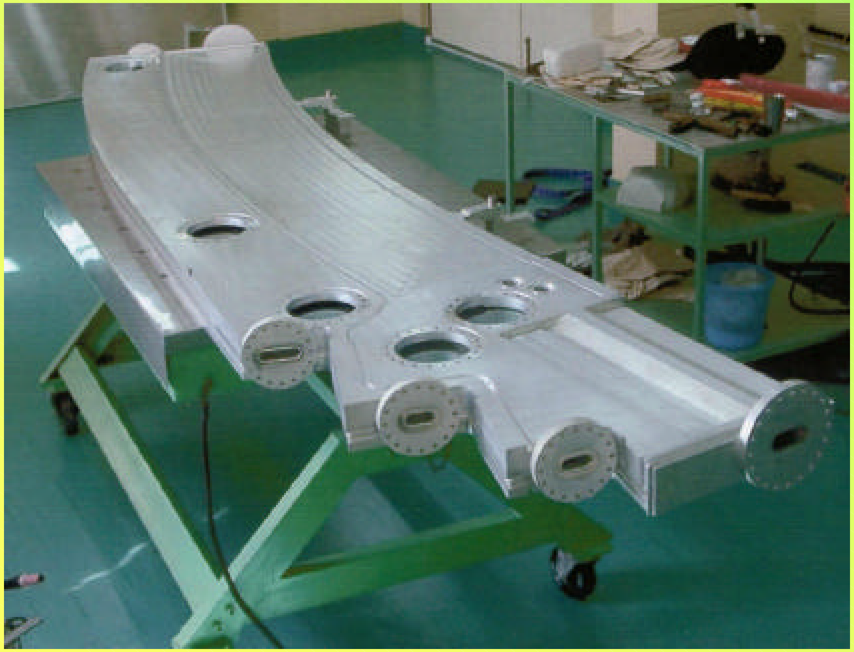
Indus –2 RF Power System

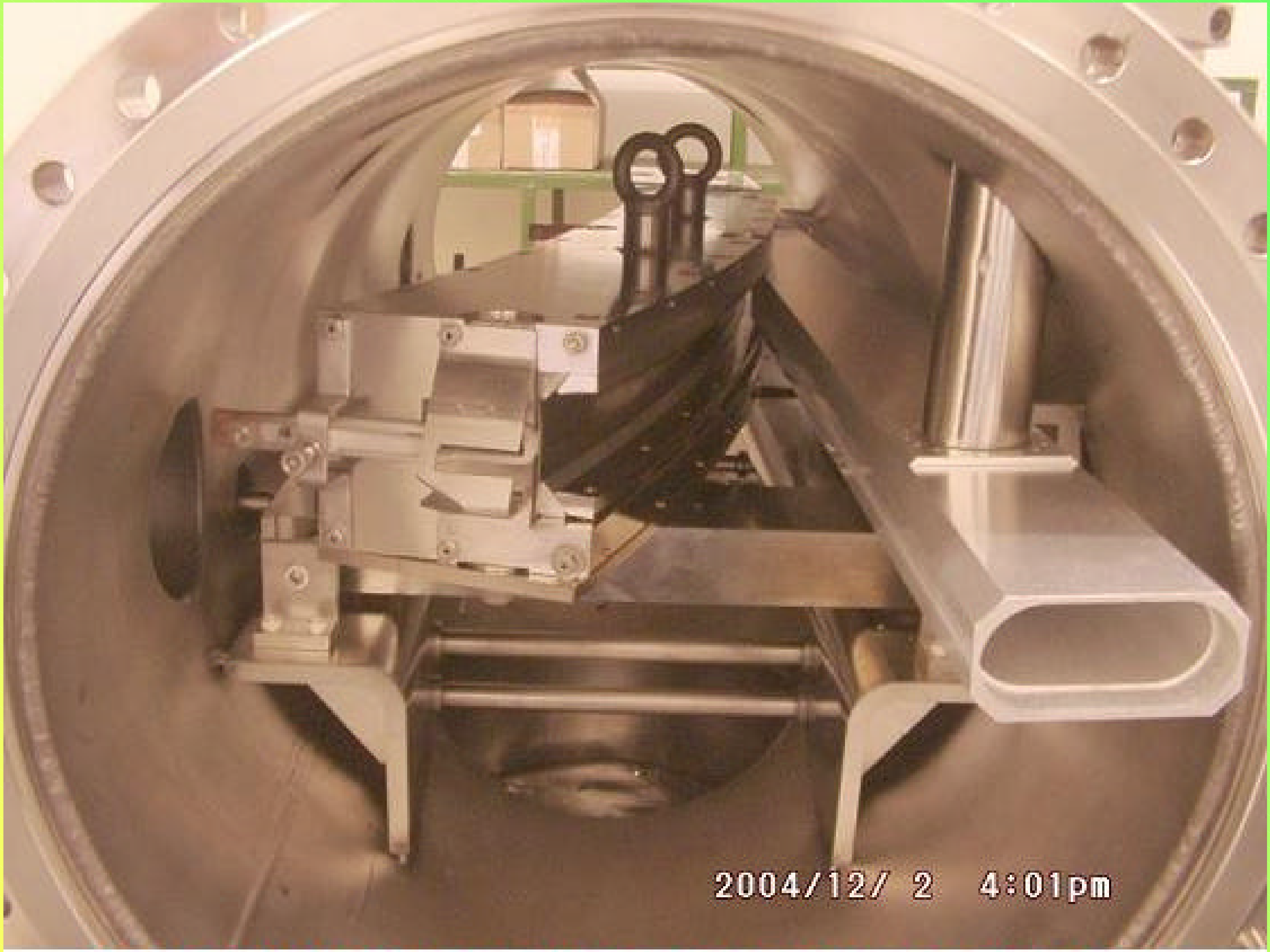
UHV System: Main features

- Fabrication (Aluminum alloy welding) Baking, discharge cleaning/ testing of vacuum chambers
- Pumping systems (Sputter Ion pumps, Titanium Sublimation Pumps, Non evaporable getter pumps, TMPs)
- SR Load, absorbers, cooling elements
- Interlocks / protection
- Low beam impedance

Dipole Chambers

- Material: Aluminium alloy A5083-H321 (Machining of 2 halves done by HAL; Welding plus leak checking etc. done at CAT)
- Two beam ports at 5^0 and 10^0 in each dipole chamber
- Additionally, port at 0^0 is also provided in five dipole chambers for insertion devices





DETAILED INSIDE VIEW OF SEPTUM CHAMBER

- Photon Absorber
  - To absorb unwanted photon x-ray radiation and protect the vacuum chambers
  - Material: OFHC Copper

Beam diagnostics

- Precision fabrication/ assembly
- Calibration, fast signal processing
- UHV compatibility
- Devices used: Beam Position Monitors (Electrostatic pick-up), Beam Profile Monitors, Stripline Monitors, DCCT, Beam Scrapers, Wall current monitors, Secondary emission wire monitors, Sighting Beamline, Visible / X-ray diagnostic beam line.

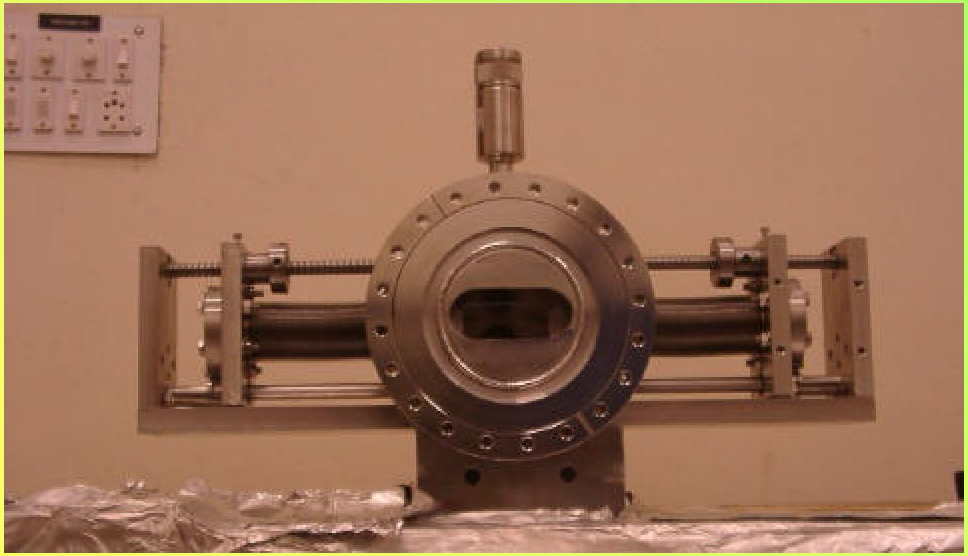
Beam Diagnostics …cont.

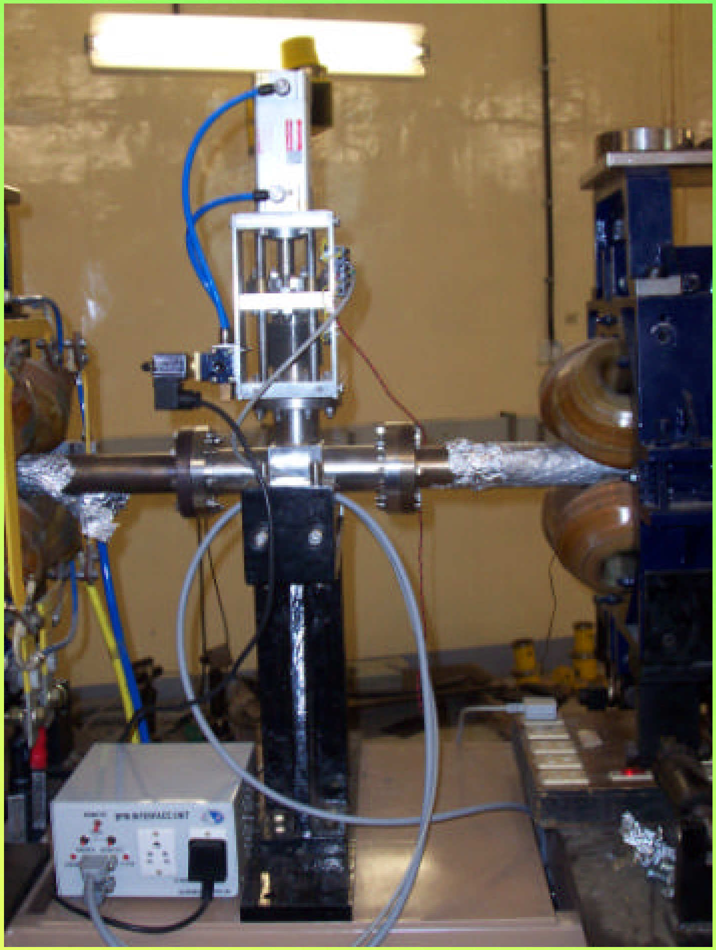
- **Calibration setup for beam position monitor**

Beam Diagnostics ...cont.

Beam profile monitor

Horizontal Scraper during assembly



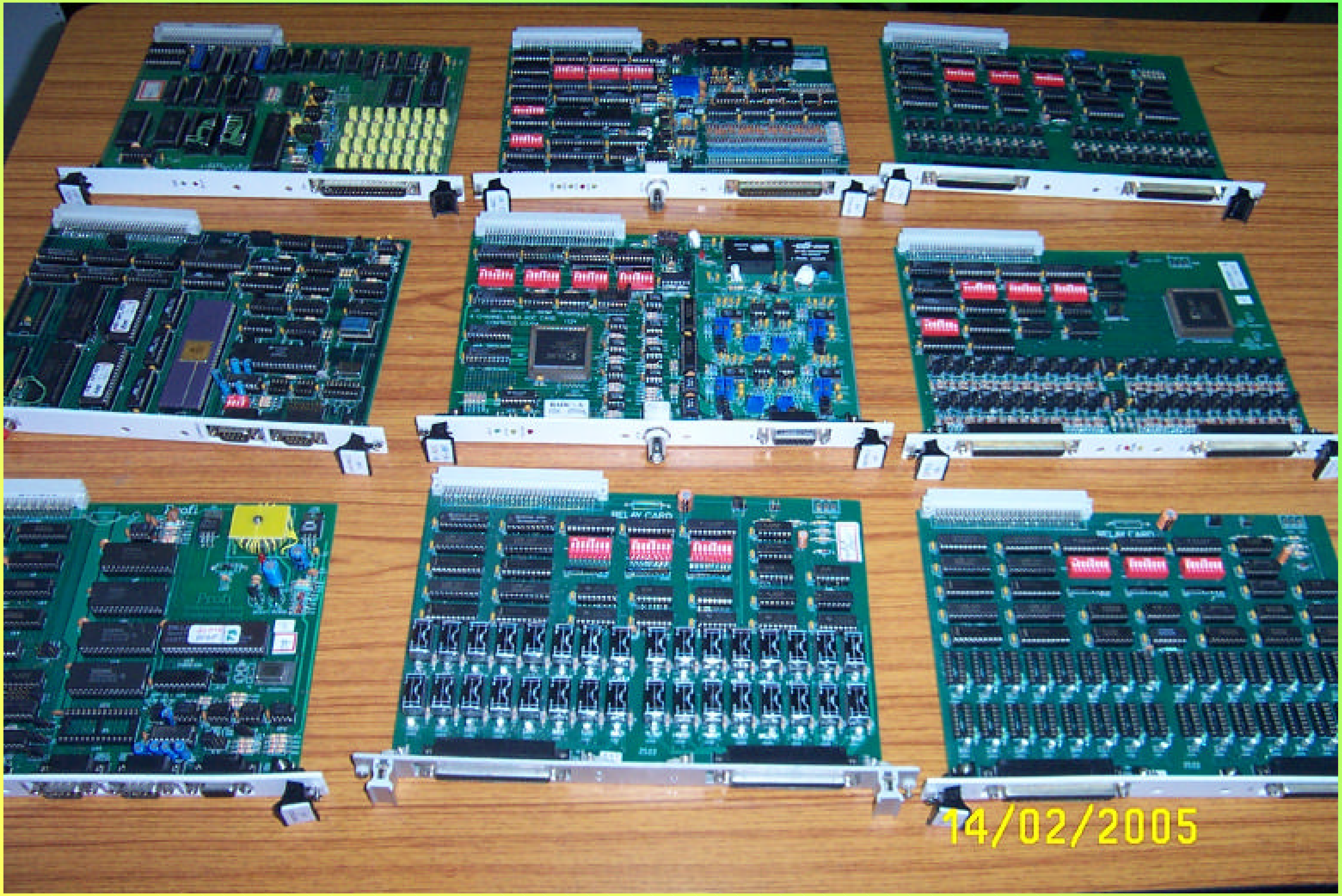


Control System

- Programs for machine operation
- On-line beam control
- Architecture : 3 layer (user interface, supervisory, equipment controller
- Software : GUI, Ethernet, Profibus
- Hardware : Controller board (based on 680 x 0 CPU), Interface module, ADC board (12 bit, 16 bit), DAC board (16 bit, 18 bit), Digital I/O boards, Ramp boards, Memory board. UHV compatibility
- Timing System used for injection, bunch selection / filling

Control System … cont.

Various VME boards



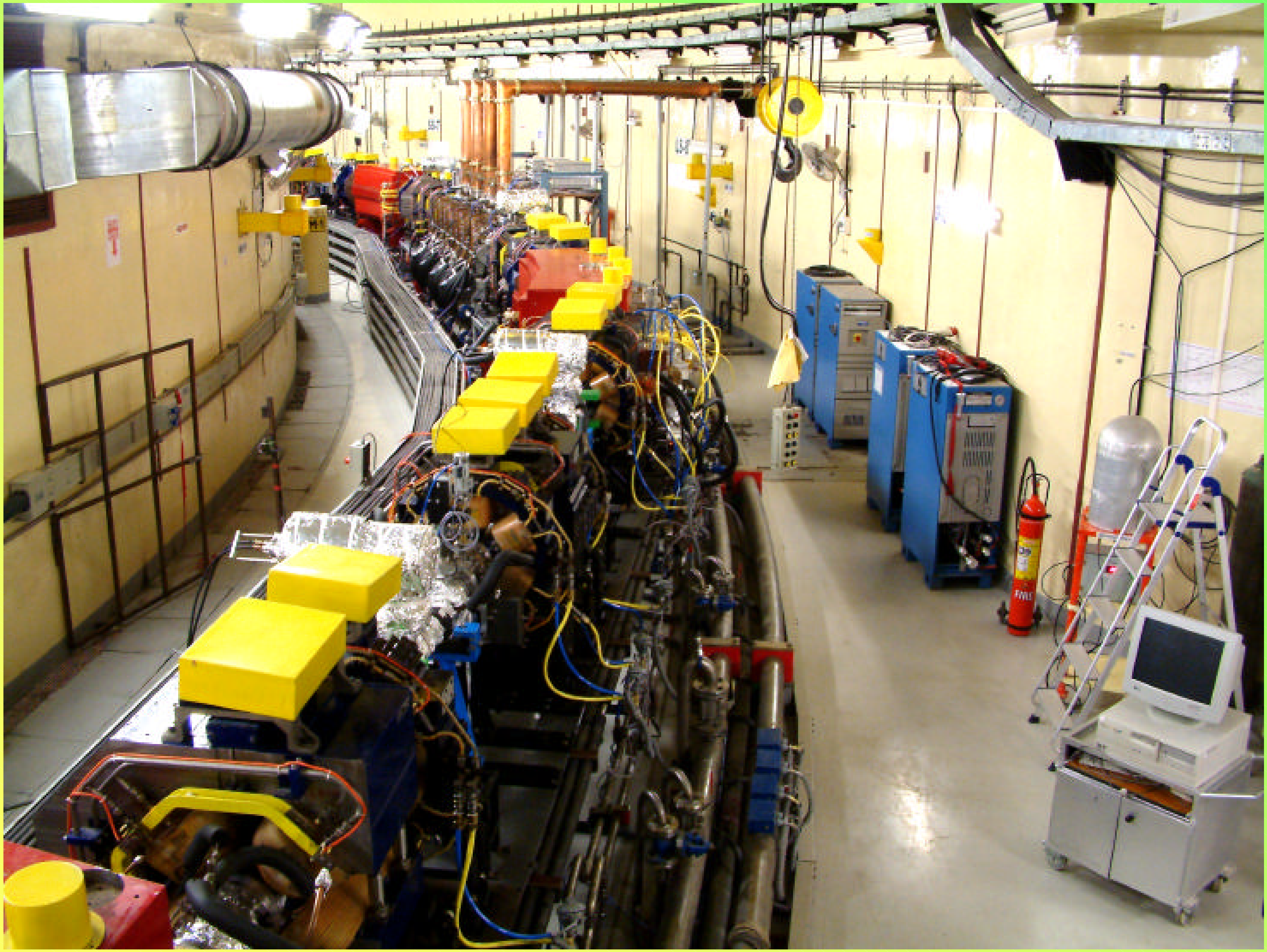
Control System … cont.

Control room for Indus-1 and 2

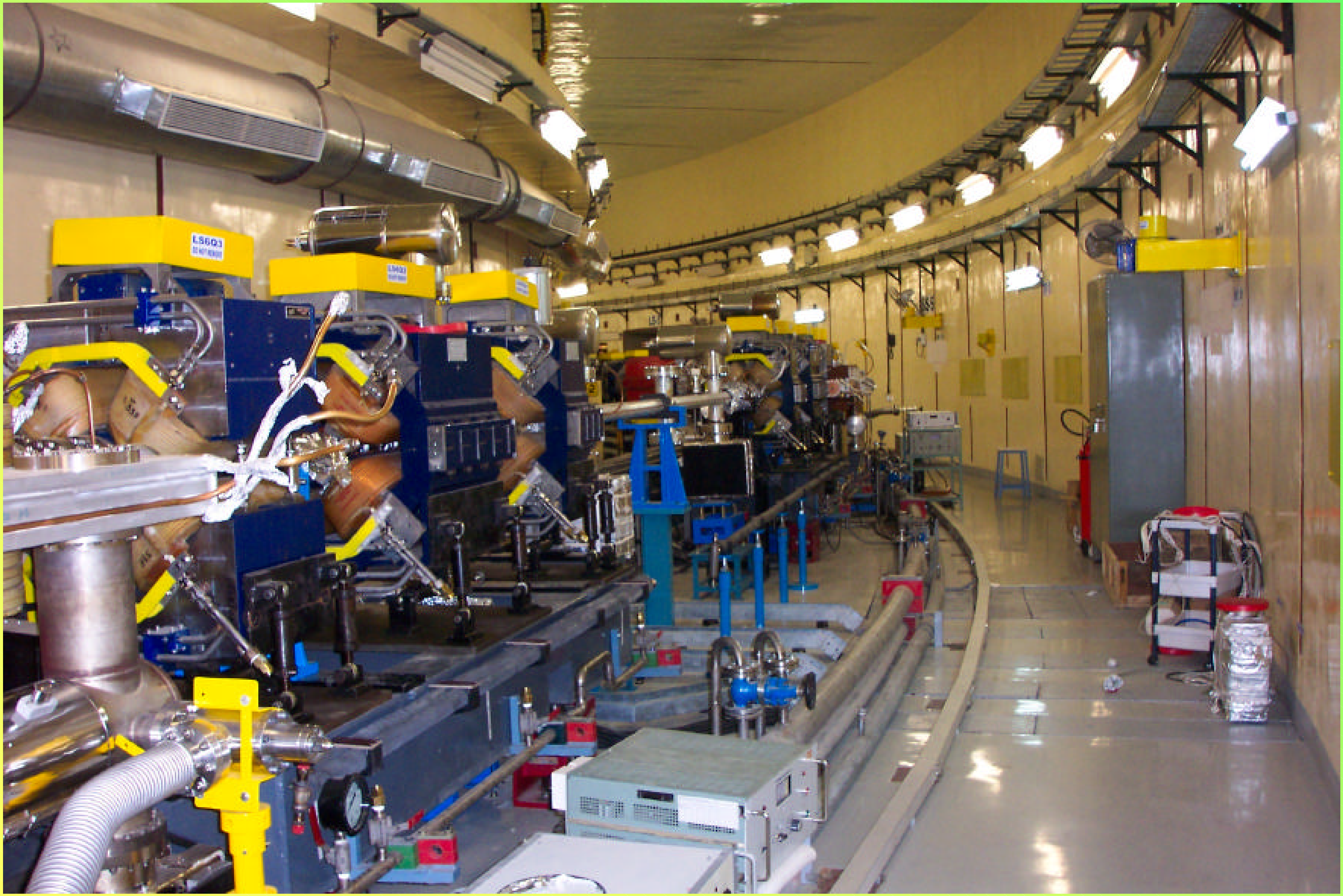
Subsystem Qualification and Installation Details

1. All vacuum chambers were baked to get ~10^{-9} mbar before assembling in the ring.
2. All p/s were tested with dummy loads.
3. Field mapping done on each magnet. Data was used **to optimize magnet locations ie “which one to place where”for best performance of ring**.
4. This optimization was arrived at using the simulated annealing algorithm.
5. All Transfer Line (TL-3) & Indus-2 components were installed after full qualification.

Assembly of Indus-2 Ring in the Tunnel

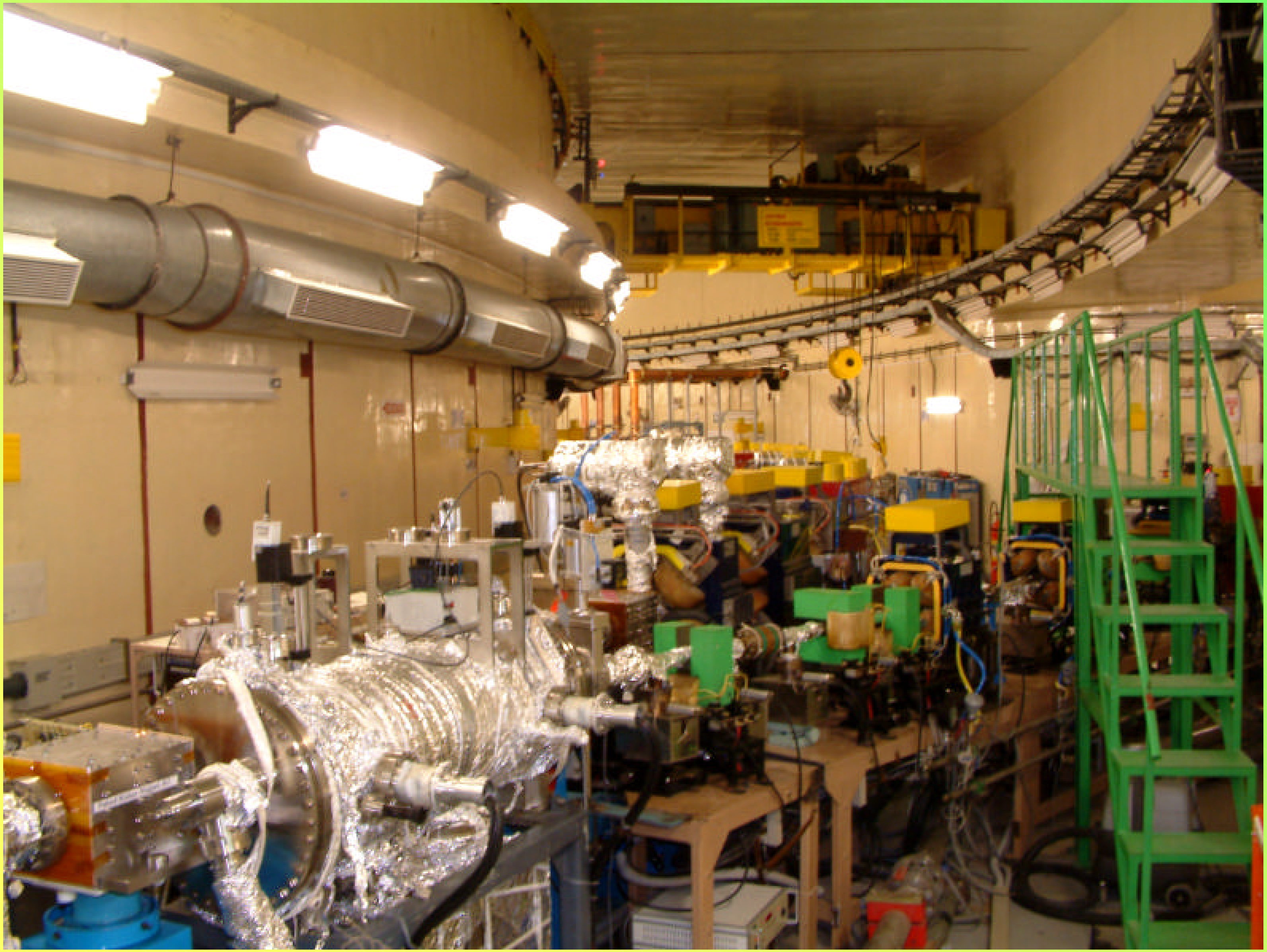


RF Cavities Commissioned in Indus-2 Ring



Long Straight Section LS-6 Assembly

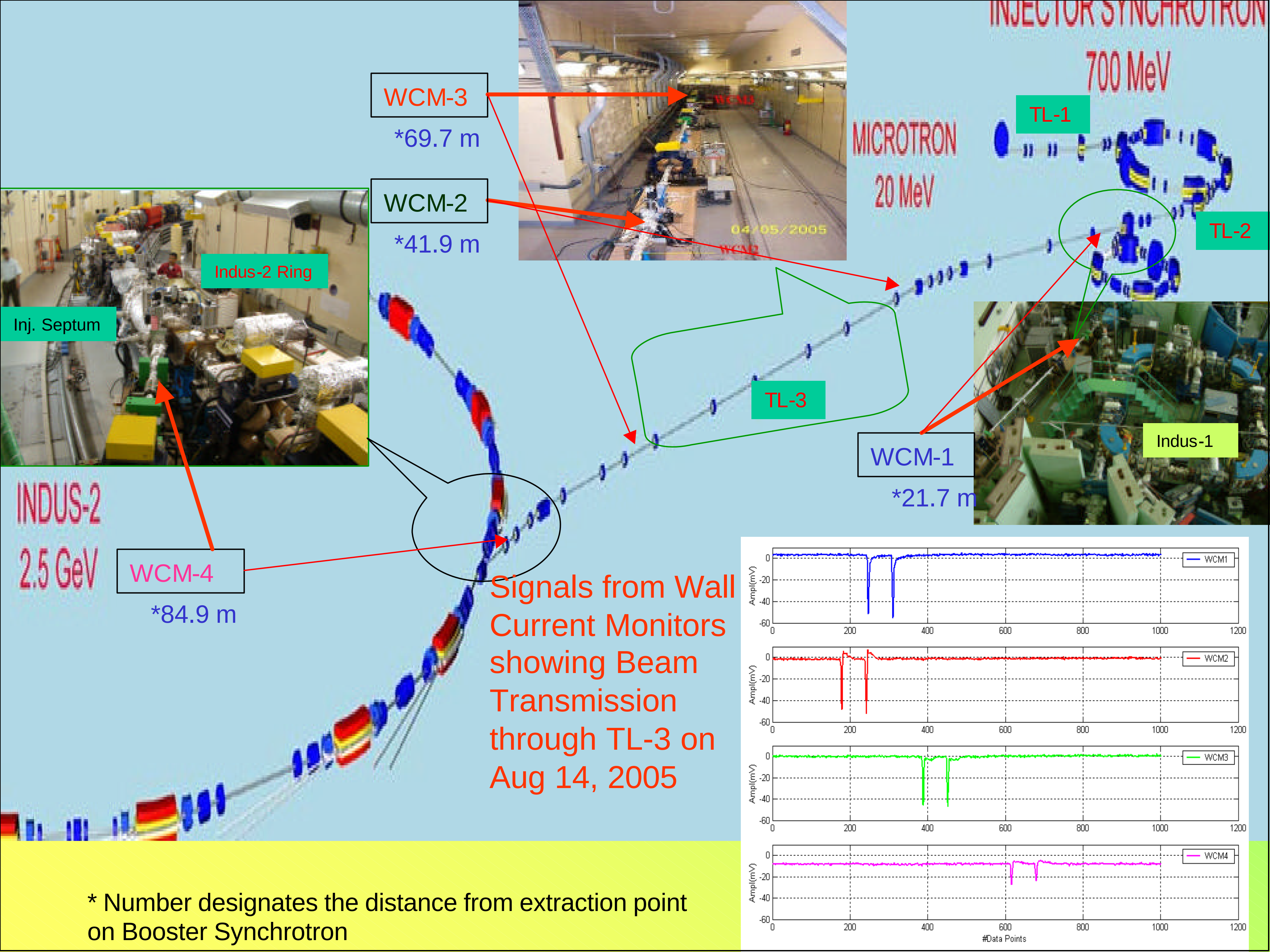
Septum and Kicker



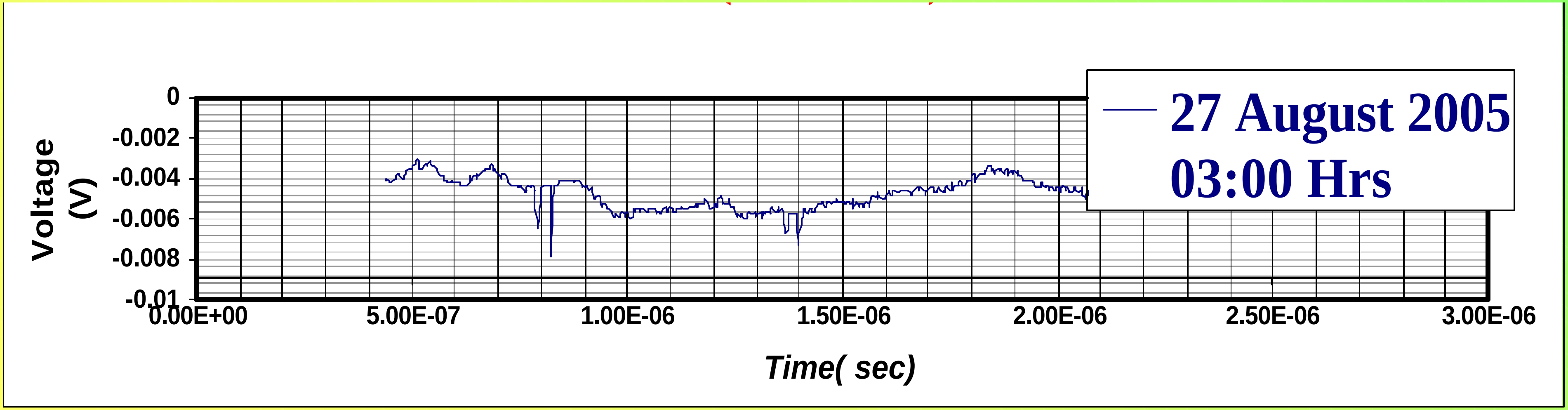
TL-3 Joining on to Indus-2

Get Set Go

Photograph of Indus-2 team taken in the experimental hall on 11.08.05 after getting AERB's consent to start trial beam injection into the storage ring.

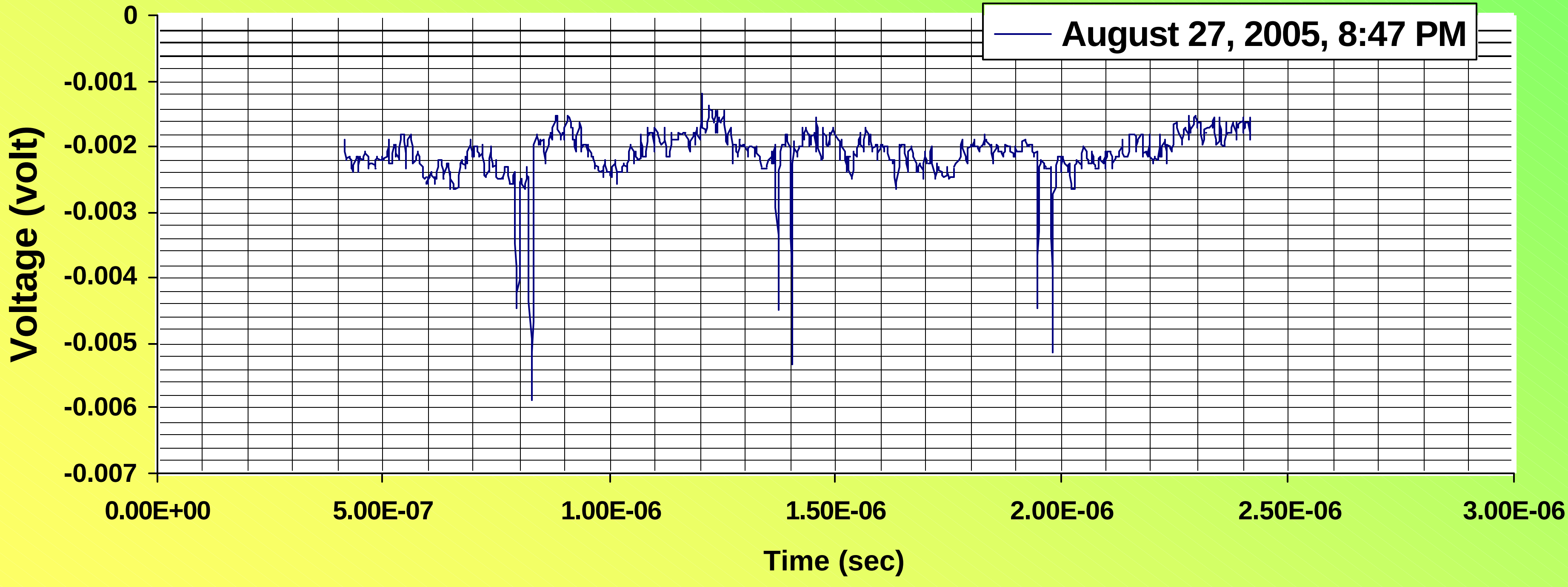

INJECTOR SYNCHROTRON
700 MeV
MICROTRON
20 MeV
TL-1
TL-2
TL-3
WCM-3
*69.7 m
WCM-2
*41.9 m
WCM-1
*21.7 m
WCM-4
*84.9 m
Indus-2 Ring
Inj. Septum
Indus-1
INDUS-2
2.5 GeV
04/05/2005
Signals from Wall Current Monitors showing Beam Transmission through TL-3 on Aug 14, 2005
WCM1
WCM2
WCM3
WCM4
Ampl(mV)
#Data Points
* Number designates the distance from extraction point on Booster Synchrotron

Two Turn Beam Circulation in Indus-2 Ring as seen on Wall Current Monitor (SS-8)



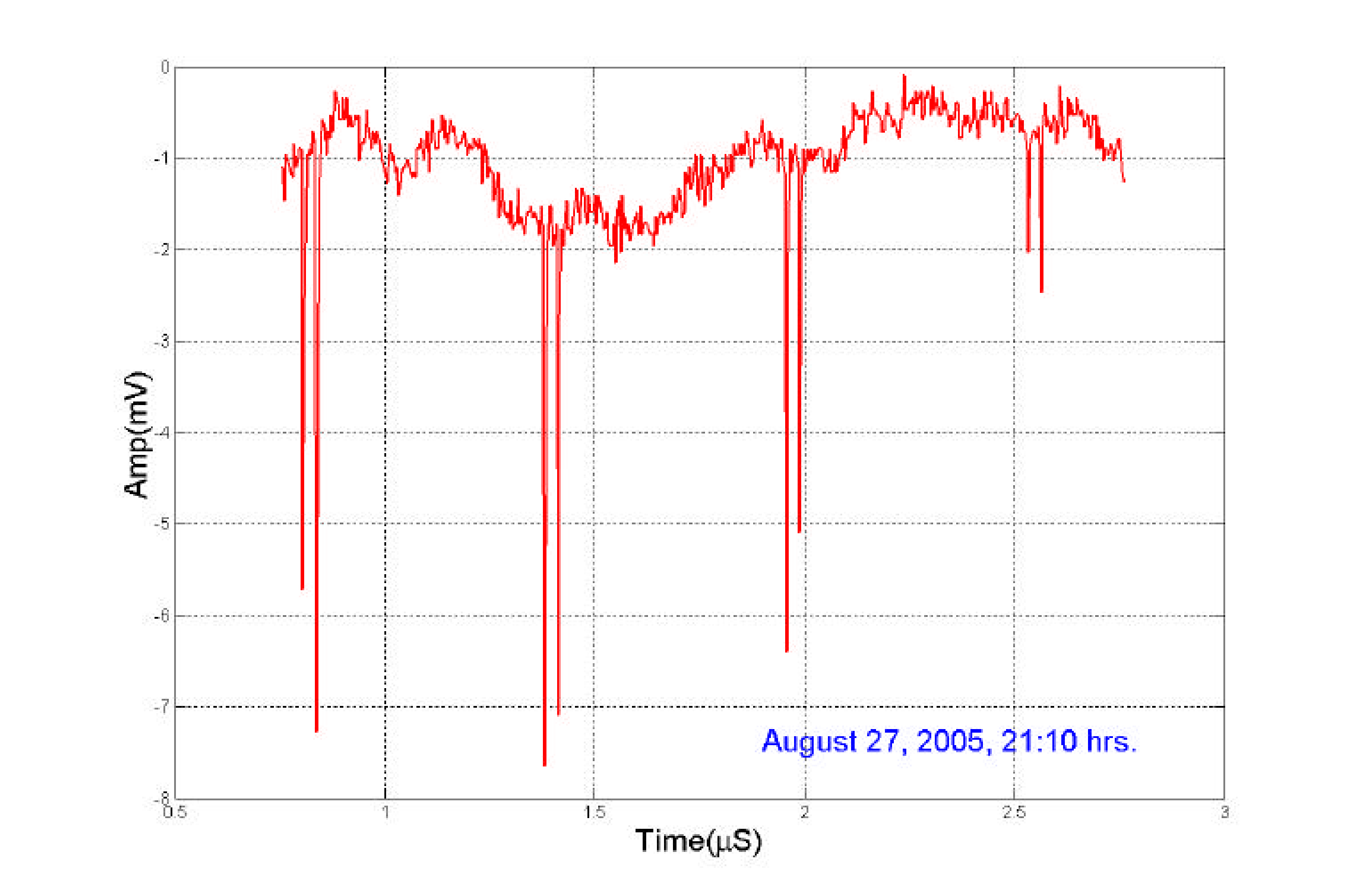
Three Turn Beam Circulation

(As seen on Wall Current Monitor (SS-8))



Four Turn Beam Circulation

as seen on Wall Current Monitor(SS-8)



Status of Indus-2 as of August 27, 2005

- Storage ring & TL-3 installation & evacuation completed.
- Booster synchrotron operated upto ~ 550 MeV.
- Dipole magnet P/S of Indus-2 connected and energized to a level so that ~ 700 MeV energy beam can be circulated.
- All main subsystems can be controlled from Control Room Consoles and final tests have been completed.
- On August 11, 2005 AERB gave consent to carry & inject up to 10 mA beam into Indus-2 & raise its energy up to 2 GeV.
- Trial experiments to store beam in Indus-2 started. First runs with 450 MeV beam from booster to injection point on Indus-2 (via TL-2 and TL3) successfully completed ~ 8 pm on Aug 14, 2005.
- Beam quality improved & taken into the ring up to first BPM, (past kicker magnets K3 & K4) ~ 4:30 pm on August 20, 2005.
- Beam went through its full turn on Aug 26, 2005 at 2 pm .
- Beam improved to reach 3 turns on Aug 27, 2005 at 8:47 pm.

भारत सरकार
परमाणु ऊर्जा विभाग
GOVERNMENT OF INDIA
DEPARTMENT OF ATOMIC ENERGY

डॉ. अनिल काकोडकर
Dr. Anil Kakodkar
अध्यक्ष, परमाणु ऊर्जा आयोग
एवं
सचिव, परमाणु ऊर्जा विभाग
Chairman, Atomic Energy Commission
&
Secretary, Department of Atomic Energy

No.DAE/ND/52/2005/

August 27, 2005

Dear Dr. Sahni,

Kindly accept my heartiest congratulations to you and the entire team that has worked on INDUS-II on the first successful transport of electrons around the ring.

2. It is indeed an important milestone and I wish more such professional successes for the CAT team in the years to come.

With kind regards,

Yours sincerely,

(Anil Kakodkar) 27.8.05

Dr. V.C. Sahni,
Director,
Centre for Advanced Technology,
P.O. CAT, Indore-452013.

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Letter from Prof. Herman Winick from Stanford Linear Accelerator Centre, Stanford Synchrotron Radiation Laboratory, USA

STANFORD LINEAR ACCELERATOR CENTER
STANFORD SYNCHROTRON RADIATION LABORATORY
SSRL

Professor Anil Kakodkar
Chairman, Atomic Energy Commission and Secretary D.A.E.
O.Y.C.
Mumbai – 400 001

July 6, 2005

Email: chmn@dae.gov.in

Dear Professor Kakodkar

At the recent US Particle Accelerator Conference (PAC05) in Knoxville Tennessee, I chaired a session which included a talk by Professor Vinod Sahni on the Indus facilities following which Professor Sahni kindly invited me to come to India for a five day visit on my way to a meeting in Melbourne of the International Scientific Advisory Committee (ISAC) for the Australian Light Source. I gladly accepted this invitation because I was eager to see the progress on the synchrotron radiation program at CAT since my previous visits there many years ago. From June 23-27 I spent two days at BARC and two days at CAT. I gave two talks at each laboratory and engaged in discussions with scientists at both labs for several hours. At the suggestion of Dr. Sahni I am writing to give you my

In a detailed tour around the Indus 2 ring the high quality of the engineering and fabrication that has gone into the technical components (magnets, vacuum system, rf system, etc.) was apparent. This is equal to standards in storage rings in the most developed countries. It is particularly noteworthy that most of this equipment was built in India, significantly expanding India's high-tech capacity. Indus 2 is very close to completion and injection trials should

In a detailed tour around the Indus 2 ring the high quality of the engineering and fabrication that has gone into the technical components (magnets, vacuum system, rf system, etc.) was apparent. This is equal to standards in storage rings in the most developed countries. It is particularly noteworthy that most of this equipment was built in India, significantly expanding India's high-tech capacity. Indus 2 is very close to completion and injection trials should start within a few months. An important milestone was recently achieved with the successful transport of the electron beam from the injector all the way down the long transfer line to Indus 2, so that injection trials can start as soon as the last few components of Indus 2 are installed. This is indeed an exciting time and the staff is eager to begin injection to the ring.

I spent several hours with the machine staff, particularly the very important beam dynamics group which is responsible for the basic design of the machine, including the specification of tolerances, diagnostics, instrumentation and controls, application programs, etc. I was very impressed with the thoroughness and professional level of their work. The next challenge will be commissioning the ring. Based on my observations and detailed discussion with the staff, I expect that commissioning will go well. Two reasons for this are the excellent array of diagnostic instrumentation, and the careful study of a relaxed optics that could facilitate commissioning in the early stages. I was so impressed with the quality of this work that I urged them to start commissioning using the more demanding final optics, since I believe that there is a good chance they can achieve a stored beam in this configuration within a week or so of first injection trials.

I did not make as thorough an evaluation of the status of work on the beam lines and experimental program, although there is clearly much activity underway at BARC and particularly at CAT, where I met with several scientists working on the design and construction of beam lines and planning the experimental programs on Indus 2. I would have liked to see more beam line equipment on the experimental floor since the storage ring will very likely be able to offer some stored beam within a few months. Although it will take several more months to reach the design level of stored beam current, stability and lifetime, I expect that very soon there will be enough to start commissioning and characterizing beam lines and in fact doing the first experiments.

As I am sure you know, Indus 2 has immense potential for basic and applied research, including biomedical and environmental studies of great relevance to developing strategies for dealing with societal issues that are of great importance to India and other countries in the region. In this regard it is very good that the energy of Indus 2 was raised from 2 GeV to 2.5 GeV, bringing the facility into the class of new rings recently completed at my laboratory at Stanford University and in Canada, and rings in construction in Australia, China, France, Spain and the UK. This relatively small increase in electron beam energy greatly expands the scientific range of Indus 2, since at this energy it is possible to use recently developed undulator designs (such as in-vacuum, small gap, short period devices) to produce very high brightness x-ray beams up to about 15 keV, a spectral range of particular importance to structural molecular biology (including protein crystallography) and molecular environmental science. With an electron energy of 2.5 GeV Indus 2 can take advantage of these technological developments to achieve hard x-ray performance levels that are much closer to that of the very biggest third generation rings (the 6-8 GeV rings in Europe, Japan, and the US) than was previously expected.

In discussions with Professor Sahni during this visit I learned of his intention to make the Indus rings available to scientists from other countries, including Pakistan, and to offer the expertise and experience gained with designing, building, and commissioning the Indus rings to assist nascent projects such as SESAME in Jordan and CANDLE in Armenia. This is highly commendable and I strongly support this.

former Director-General of CERN when he visited CERN during the week of June 27. I was happy to hear from Prof. Schopper that he had a very positive discussion with Prof. Sahni about this.

It may be of interest to you to know that I have developed strong connections with scientists in Pakistan, initially through their participation in SESAME. In the summer of 2004 I gave a series of lectures on synchrotron radiation sources and research at the Nathiagali Summer College in Pakistan. I was pleased to be asked by Prof. Riazuddin to join the International Advisory Scientific Council (IASC) of the National Centre for Physics (NCP) of Pakistan of which he is the director. Prof. Riazuddin would be the best person in Pakistan with whom to discuss India/Pakistan cooperation in synchrotron radiation science.

While in Pakistan, and also at several SESAME meetings, I met with Pakistani scientists who are effectively promoting synchrotron radiation science and technology in Pakistan, including plans for designing and building a world-class soft x-ray spectroscopy beam line for SESAME and eventually constructing a national synchrotron radiation facility in Pakistan. The scientist leading the design of the beam line project is Dr. Zahid Hussain, a senior scientist from Pakistan who is now at the Advanced Light Source at the Lawrence Berkeley National Laboratory. I worked with him in the early 1980's in commissioning the first permanent magnet undulator and have great respect for him as a scientist and as a person eager to promote science and technology in the developing world. The beam line that is being designed for the 2.5 GeV SESAME ring would also be very appropriate for Indus 2. If a cooperative agreement between India and Pakistan could be worked out I could imagine that two identical beam lines could be built, at considerable savings, one for SESAME and one for Indus 2. This is but one example of possible scientific and technical cooperation between India and Pakistan.

My interest in international scientific activities has led me to run (successfully) for election as Vice Chair of the Forum on International Physics (FIP) of the American Physical Society (APS). I will move on to chair FIP in 2007. In these positions I will work with others in the APS and the US government to assist India and other countries such as those in the Middle East, Africa and elsewhere to make progress in the development of scientific research in their countries, with particular emphasis on the role of synchrotron radiation.

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[EOB]

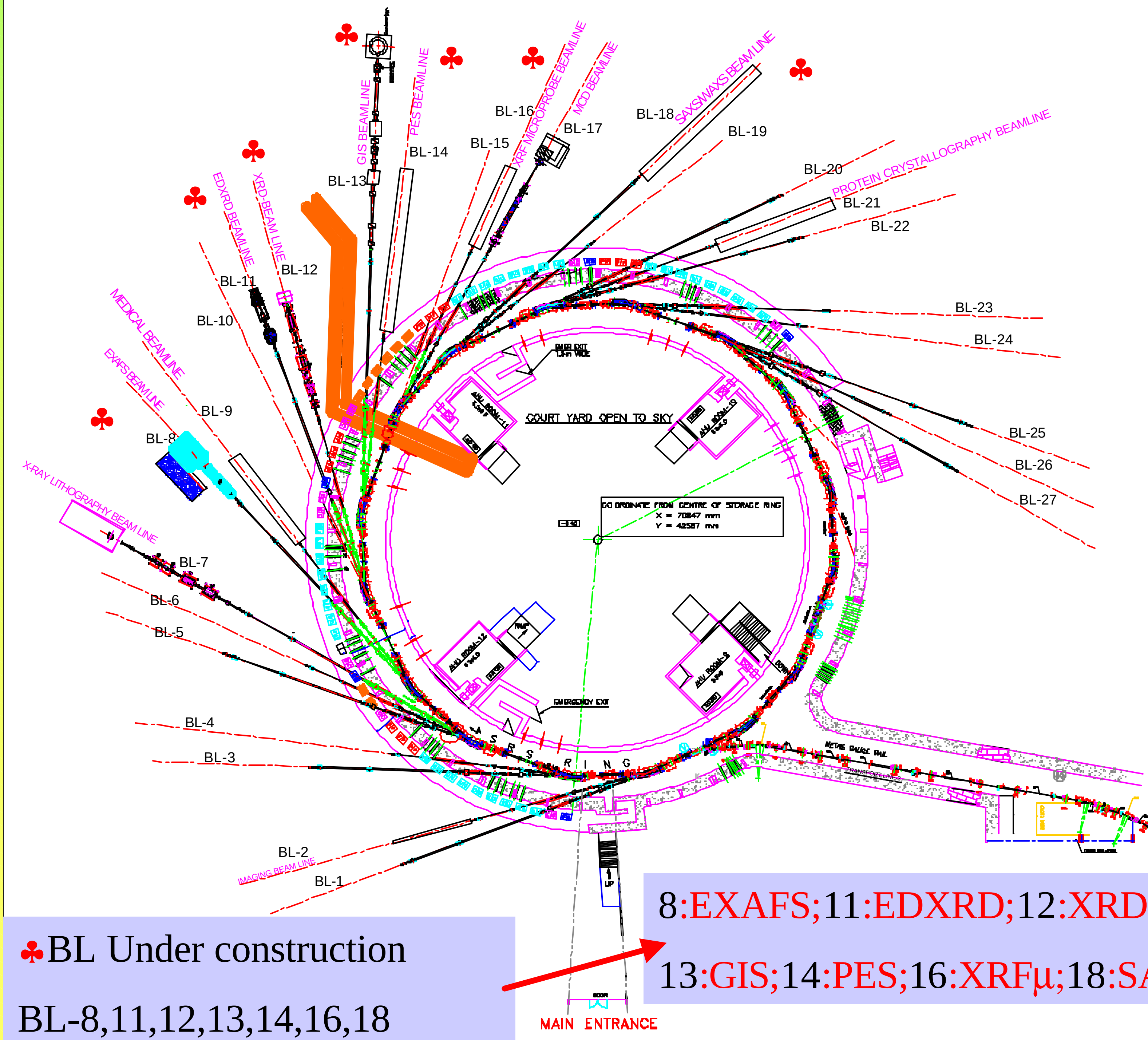
Program related to Indus-2 usage

- Work to indigenously make bending magnet beam-line front-ends is going on at CAT.
- Effort to make beam-line subsystems is also under way at BARC & CAT. The subsystems include DCM, mirrors & their movement mechanisms, UHV chambers, slits, beam stoppers, mirror bender, beam viewer, beam position monitor etc.
- There are 8 groups currently engaged in building various Indus-2 beam-lines.

Prototype Front-end of Indus-2 Beam-line

List of Beam-lines being built/designed/planned

	Range (KeV)	Groups
Being built		
XRD powder diffraction	5 – 25	CAT
XRF-microprobe	2 – 20	CAT
Energy Dispersive – XRD	10 – 70	BARC
EXAFS	5 – 20	BARC + UGC-DAE-CSR
Grazing incidence mag scattering	5 – 15	SINP, Kolkatta
PES	.08 - 15	BARC
Small angle X-ray scattering (SAXS)	8 - 16	BARC + UGC-DAE-CSR
Being designed		
Protein Crystallography	6 – 25	BARC + UGC-DAE-CSR
White-beam lithography	1 – 10	CAT
MCD / PES on bending magnet	0.03 – 4	UGC-DAE-CSR
Medical imaging beam-line	10 – 35	BARC
Planned		
IR-beam-line	2 – 100 ❍m	BARC
Undulator-MCD	0.1 – 1.5	CAT
Imaging beam-line	15 – 35	UGC-DAE-CSR
Multipurpose white-EDXRD	5 – 40	UGC-DAE-CSR
X-ray beam diagnostics	6.2	CAT
Visible beam diagnostics	Visible	CAT



♣BL Under construction

BL-8,11,12,13,14,16,18

8:EXAFS;11:EDXRD;12:XRD

13:GIS;14:PES;16:XRFμ;18:SAXS

National Committee for Utilization of Indus Rings (NCUIR)

Government of India
Department of Atomic Energy

Anushakti Bhavan,
C.S.M. Marg,
Mumbai-400 001.

No.26/5/2004/CAT/R&D-I/ 1124 September 10 ,2004.

OFFICE ORDER

Subject: Constitution of National Committee for Utilization of Indus Rings (**NCUIR**).

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1. NCUIR will have members from all the leading institutions in the country having long-term interest in the use of synchrotron radiation for research and various applications. Director, CAT, Indore will serve as the Chairman of the Committee.

assembly of Indus-2 is also to start soon and the work on a number of

NCUIR Members' Affiliations

CDFD, IOP, UoP, TIFR, DST,SINP, UoR, IISc, IGCAR, NPL, SCL,SSPL, UDCSR,BARC, CAT

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contd..2..

:: 2 ::

No.26/5/2004/CAT/R&D-I/ 1124 September 10 ,2004.

2. The committee will have a two-year term with effect from 1st September 2004 and composition of the committee now being constituted is given in the Annexure.

3. The Committee shall meet preferably twice a year and review the progress and chalk out action plan to boost the overall R&D

(Anil Kakodkar)
Secretary to the Government of India

Chairman & Members of the Committee

Assembly of X-Ray Diffraction Beam Line BL-12

Concluding remarks

- We have created a good indigenous base in the course of building Indus-2. With ring ready & poised to store beam, users can expect photons by early 2006. By our collective national effort, we can shape Indus-2 into a world class facility.
- With synchrotron usage growing in India, we must augment beam line development activity to tap the full potential of Indus-2. At present work on less than a third of the available beam line positions is under execution. Lot more effort & funds (~ 5 Crores per beam line) are needed to realize this goal.

Concluding remarks (contd.)

- **We solicit the guidance and kind support of SAC-PM to identify "Participating National Teams" so that the work to build more beam lines gets under way quickly.**
- **We propose that, to get the best out of this National Asset, SAC-PM may consider creation of a *National Synchrotron Utilization Centre around Indus-1 & Indus-2,* with participation of scientists from universities and other research institutions.**

Thank You