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# BARC

## NEWSLETTER

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## Message from Director, BARC

*Dear Colleagues,*



*It is indeed a matter of great pleasure for me to welcome you all to the year 2002 and to wish a lot of excitement and professional satisfaction in your pursuit for excellence in nuclear science and technology in the New Year. I take this opportunity to compliment all of you for the tremendous contributions made by BARC during the last year towards our nation building tasks, both in terms of our contributions in the areas of energy, food and health care as well as in the field of national security. Mention must also be made of the painstaking efforts made by all of you in detailing the various programmes to be pursued in the 10<sup>th</sup> Plan period that will ultimately lead us along the road map of our overall objective of utilising nuclear science and technology for the well being of our society.*

*Now that the last year of 9<sup>th</sup> Plan is nearing its end, we must organise ourselves to complete the pending tasks for successful completion of all*

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projects that we have promised to complete during the 9<sup>th</sup> Plan period. To my mind, *inter alia*, the completion of projects, like POTION Irradiator for enhancing the shelf life and minimising the waste of potatoes and onions; Facility for Uranium Separation (FUS) for reprocessing of irradiated thorium fuels; Medical Cyclotron for supply of  $F^{18}(\beta^-)$  - FDG (Fluoro Deoxy-Glucose), for health care of our people through PET; Nuclear Desalination Development Project (NDDP) for production of drinking water through hybrid (MSF/RO) technologies; Waste Immobilisation Project at Trombay for vitrification of high level wastes; Refurbishing of CIRUS reactor, etc., are some of the tasks to be assigned topmost priority.

As you are aware, we have a very ambitious programme in the Xth Plan, both in the power generation as well as non-power generation sectors. To implement these plan programmes, we need to work out a right strategy by taking advantage of our traditional multi-disciplinary strength along with measures to take care of our existing weaknesses so as to achieve the goals of various important programmes, which are targeted to find solutions to the country's energy security on sustainable basis, and also to contribute progressively more and more in non-power generation fields by induction of radioisotopes and radiation technology. Since India has to fall back on its vast thorium resource for its energy security on sustainable basis, our priority for future R&D work for power generation sector are centered around PFBR, AHWR and ADSS.

I am confident that, with the full cooperation and commitment from each one of you, BARC will find solutions to the above needs of the country by following the path of pursuing excellence in related areas of all basic sciences while we move towards advances in engineering science and technology development. This would also call for strengthening our links with other research institutions and University system.

I must take this opportunity to compliment each one of my colleagues for the exemplary cooperation in accepting some amount of inconvenience and hardship in our professional life because of certain security measures that have been enforced to adopt in the interest of all of us. I must also take this opportunity to compliment the commendable tasks that have been carried out by the various wings of our total security system to preserve a sense of security in our working life (which is essential for performing high level R&D work) during a time when a sense of insecurity prevails almost everywhere else.

Before I conclude, I also take this opportunity to send the season's greetings and best wishes for the New Year to all the family members of my BARC colleagues.

Thank you.

(B.Bhattacharjee)  
Director

# TRANSDUCER SYSTEM FOR REMOTE DETECTION OF WIRE SPACERS IN ANNULAR GAP OF COAXIAL METALLIC TUBES

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## Introduction

A low cost eddy current transducer system, capable of detecting thin wire metallic spacers made of non-ferrous, low electrical conductivity materials placed in the annulus of coaxial tubes made of similar material properties (as that of spacers) under wide range of operating temperatures, has been designed and developed by Reactor Engineering Division, BARC. The design and development involved sensor design, signal conditioning unit circuit design and data acquisition system hardware and software development. The transducer system can be operated remotely with 100 metres cable under elevated operating temperature up to 100°C in noisy EMI and RFI fields.

A typical transducer system, namely Garter Spring Detection Probe (GSDP), has been designed for precise detection of Garter Spring (GS) spacers in coolant channels of 220 MWe operating Indian Nuclear Pressurised Heavy Water Reactors within an overall accuracy of 3 mm. This system has been

successfully used as an integral part of INGRES (INtegrated Garter spring REpositioning System) tool, for remote detection and repositioning of garter spring spacers in 31 coolant channels of Unit-1 of Madras Atomic Power Station (MAPS-1) during March-April 2000. This report gives design, development and performance evaluation of the transducer system.

## Background

The core of 220 MWe Indian PHWR (Pressurised Heavy Water Reactor) mainly consist of 306 horizontal coolant channel assemblies submerged under heavy water moderator. Each coolant channel assembly consists of two concentric horizontal tubes called Pressure Tube (PT) and Calandria Tube (CT). Fig.1 shows schematic of coolant channel assembly of PHWR. Each PT is spaced from associated CT by means of bangle type spacers called Garter Springs (GS) which are

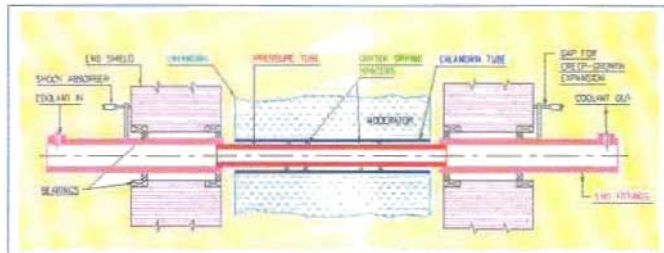


Fig 1 Schematic of coolant channel assembly

placed around the PT at predetermined locations along its length. The GS maintains the spacing between PT and CT. The GS, PT and CT are made of zirconium alloy which is a non-ferrous, low electrical conductivity material. The actual location of GS plays a very significant role in maintaining stipulated service life of coolant channels. The displaced GS can lead to develop contact between PT and CT, resulting in formation of hydride blisters over a period of operation. The embrittlement and cracks caused by the hydrides (developed in the form of blisters) will result in rupture and will lead in eventual failure of PT. There has been evidence of these GS spacers shifting from their installed locations in the early generation PHWRs. As such it was needed to design and develop a tool system which can precisely detect and reposition these displaced GS spacers in the PHWR coolant channel assemblies.

A tool, namely INGRES, has been designed and developed for remote repositioning of these GS spacers in highly radioactive coolant channels of 220 MWe Indian PHWRs. One of the modules of this tool system is the eddy current transducer system Garter Spring Detection Probe (GSDP), which is used for online detection of thin Garter spring spacers in the annular space of PT and CT during operation of INGRES tool. The precise detection of GS opposite to the material having

unfavourable electrical and magnetic properties of similar nature under hostile operating conditions of intense nuclear radiation, presence of heavy water and wide range of operating temperatures is very difficult task. It adds to the challenge when the system is required to be operated from a distance of 100 meters in the background of high EMI and RFI noise generated in the reactor building, as the success of INGRES operation depends on precise and un-ambiguous on-line detection of GS.

The GSDP system uses indigenously developed custom made low cost transducer and signal conditioning units. The data received from the signal conditioning units of transducer system is processed through PC-based control system using custom-made Data Acquisition System (DAS) programs specially developed in Visual Basic software for operation of the system. The constructional features and performance evaluation of GSDP transducer system during INGRES operation at MAPS-1 are described in the following sections.

## Constructional Features

The schematic of transducer system is shown in Fig. 2.1. It consists of GSDP transducer, Signal Conditioning Unit (SCU), Waveform Generator (WG) and PC-based Data Acquisition System (DAS-PC) along with shielded signal cables.

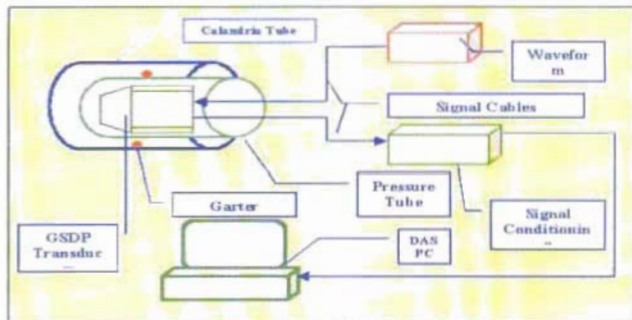


Fig. 2.1 Schematic of GSDP transducer system

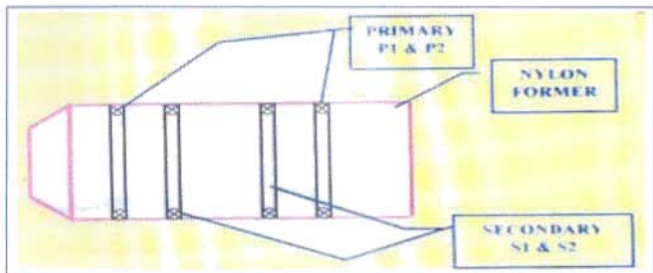


Fig 2.2 GSDP transducer schematic

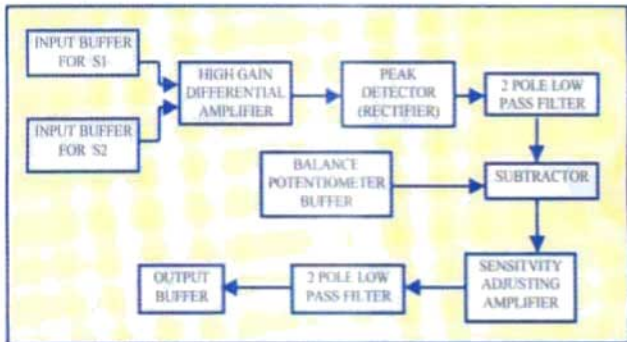


Fig 2.3 Schematic block diagram of signal conditioning unit

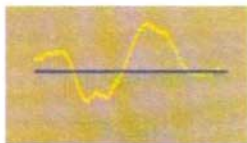


Fig 2.4 Unprocessed garter spring signal



Fig 2.5 Processed garter spring signal

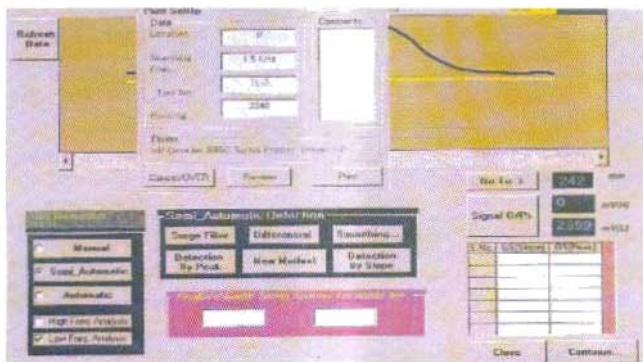


Fig. 2.6 Software features of GSDP signal analysis module

a) **Transducer & Signal Conditioning Unit** : The schematic of transducer and SCU is shown in Fig.2.2 and Fig. 2.3 respectively. The transducer is made of nylon former having two sets of primary and secondary coils P1, P2 and S1, S2. These coils are connected in differential mode to eliminate the effect of common mode signals. The coils are made of super enameled fine winding wire having very low resistance temperature coefficient in order to minimise the effect of temperature on the performance.

b) **PC Based Data Acquisition** : The transducer movement in the channel, viz. position and feed, is controlled by PC-based control system through the commands given by operator. The GSDP signals received after processing from signal processing unit is sampled, captured and stored along with axial position information of tool by the software. The unprocessed and processed Garter Spring signals as obtained on PC is shown in Fig. 2.4 and Fig. 2.5 respectively. The noise filtering and precise signal profile features of the software can be clearly visualised from these figures.

c) **Signal Analysis Module** : This module facilitates off-line or online analysis and processing of GSDP signature data for precise detection of GS position in PHWR coolant channel. Signal Slope Detection (SSD) algorithms have been formulated for estimation of GS position by processing the data received from GSDP signal conditioner unit. The software is designed such that one can use digital techniques like filtering and smoothing of the raw signal waveform in order to minimise the scanning disturbances and noise for ease in detection of GS location. User can go for Automatic mode of operation for auto detection of GS location without manual intervention. This feature is shown in Fig. 2.6.

### Salient Features of Transducer System

- (a) Position detection accuracy : within 3 mm
- (b) Operating temperature : Ambient to 100°C.
- (c) Operating distance : 100 metres cable length.
- (d) Operating capability : Under intense radiation fields of  $10^5$  to  $10^6$  rads/hr in the presence of EMI and RFI fields.
- (e) User friendly software features: for auto detection of GS spacers.
- (f) In-

situ operating life (under 220 MWe operating PHWR coolant channel conditions): No failures observed even after 300 hrs of operation in MAPS-1 coolant channels.

## Conclusion

The transducer system was successfully used as a part of INGRES system for detection of garter spring spacers in 31 coolant channels of MAPS-1 reactor during March-April 2000. The performance evaluation of the transducer was based on the

actual operation of the system in MAPS-1 reactor coolant channels. The system has been designed and developed indigenously and is a low cost alternative for any of the systems (having similar features) available in the international market. Although the system was used for detection of garter spring spacers in PHWR coolant channels, its application can be extended for precise detection of metallic objects or thin wire spacers in the annulus of coaxial metallic tubes at elevated temperatures.

# INTERFEROMETRIC TESTING OF OPTICAL COMPONENTS: TESTING FACILITIES AT THE SPECTROSCOPY DIVISION OF BARC

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## Introduction

Optics and Spectroscopy have both evolved as companion sciences with their histories dating back to the times of Galileo and Newton. Realizing the crucial role that optics was bound to play in guiding spectroscopy research in times to come, the founding fathers of the Spectroscopy Division had envisaged the establishment of an advanced optics laboratory in the Division for the in-house fabrication and testing of precision optical components. In tune with this philosophy, the Division, from the very beginning, has been engaged in the design and development of optical and spectroscopic instruments in addition to pursuing basic and applied research in atomic and molecular physics. These instruments include high resolution Fabry-Perot interferometer, 10.6 meter grating spectrograph, 1.0 meter Czerny-Turner monochromator cum spectrograph, 1.0 meter scanning monochromator, 22 channel direct reading atomic emission spectrometer, Seya-Namioka VUV

monochromator, high resolution VUV monochromator, multi-channel spectrograph using CCD detector, telescopes, periscopes and interferometers. The indigenous development of these instruments require high precision optical components such as Fabry-Perot plates of surface flatness  $\lambda/100$ , concave spherical mirrors of surface accuracy  $\lambda/20$ , plane mirrors of surface accuracy  $\lambda/20$ , prisms, lenses, glass windows, plane and concave diffraction gratings. Therefore, an optical workshop was established for the fabrication of precision optical components to meet the requirement of the instrumentation group in Spectroscopy Division and other divisions of BARC. Precision testing of the optical components is absolutely important during the fabrication process in order to achieve high accuracy in the range of  $\lambda/20$  to  $\lambda/100$ . An optics shop was, therefore, established and a variety of auxiliary facilities were developed for the fabrication and testing of optical components from the initial grinding stages to the

final figuring stages. Fig. 1 shows the two-spindle grinding and polishing machine for fabrication of optical components. Fig. 2 shows different types of components fabricated in the optical workshop. The present article summarizes the facilities credited for testing the various types of optical components in the Spectroscopy Division.



Fig. 1 Two-spindle optical grinding and polishing machine



Fig.2a Varieties of prisms



Fig.2b Optical components such as plane mirrors and concave mirrors

Interferometry plays a major role in the testing of optical components. The main advantages of interferometric tests are their high sensitivity and relative ease in interpretation. The unit of measurement is a wavelength ( $\lambda$ ) of visible light. The most common light sources for interferometry are sodium vapour lamp ( $\lambda=589$  nm), cadmium lamp, filtered mercury lamp, thallium lamp and He-Ne laser ( $\lambda=633$  nm) emitting monochromatic radiation. The interferometric testing methods can be divided into two categories :

- (1) Classical interferometric tests using a monochromatic source of light, such as sodium lamp, filtered mercury lamp, thallium lamp, or Cd lamp, having a short coherence length of less than 10 cm.
- (2) Laser interferometric tests using a He-Ne laser as source of highly monochromatic light having long coherence length of 100 cm or more.

The choice of a particular test depends on many factors such as simplicity of fabrication of the test set-up, simplicity of the adjustment, ease of interpretation, availability of properly configured laboratory space such as dark room, space with long corridor, dust free room and availability of equipments such as vibration isolation table, spectral lamps, lasers, specifications of optical components such as size, radius of curvature, f-number and cost of the equipment. Therefore, a single test set-up will not serve the purpose of testing optical components of various specifications. Keeping in view the present and future testing requirements, a laboratory consisting of several test equipment was established in the Division. Applications of the various interferometers and testing equipments based on them are discussed below.

#### **Newton Interferometer**

One of the first facilities to be set up was the Newton interferometer to test the accuracy of plane surfaces up to 200 mm in diameter. Here, the interference fringes are obtained between a master



surface and the test surface with sodium lamp as a source of illumination. The estimation of surface accuracy is done visually in the optics shop during polishing and figuring the plane surfaces. The accuracy of the measurement is  $\lambda/8$ .

#### ***Fizeau Interferometer***

A Fizeau interferometer was designed and fabricated to test the accuracy of plane surfaces up to 150 mm in diameter. The collimated beam of sodium light is used to obtain the fringes formed by the interference of light bouncing off from the master surface and the test surface. This is a laboratory equipment to test the finished optically plane surfaces with an accuracy of  $\lambda/20$ .

#### ***Twyman Green Interferometer***

A Twyman Green interferometer was designed and set up to measure homogeneity of plane ended glass materials like prisms, laser rods, finished glass windows, etc. The instrument is essential for testing varieties of prisms and laser components up to an aperture of 95 mm. The instrument is useful for measuring wedge angle of nearly parallel plates of diameter 95 mm with an accuracy of 1.0 arc-second. A thallium lamp is used for obtaining the interference fringes while testing the optical components.

#### ***Laser Fizeau Interferometer***

A laser Fizeau interferometer was designed and developed to measure the homogeneity of raw glass material, laser material and finished glass windows up to an aperture of 95 mm. The instrument is useful for measuring wedge angle of nearly parallel plates of diameter 95 mm with an accuracy of 0.5 arc-second. The source of light used in the interferometer is a low power (~2 mW) He-Ne laser emitting visible radiation ( $\lambda=632.8$  nm).

#### ***Oblique Incidence Interferometer***

An oblique incidence interferometer was designed and developed for the testing of unpolished surfaces and non-optical surfaces such as lapped

metal plates, finely ground surfaces, etc. The interferometer makes use of a wedged plate as a beam splitter. Large surfaces (say, one metre across) can, at one stretch, be examined at an angle of incidence of  $83^\circ$  with an accuracy of 2.5 microns. It is also possible to use the interferometer to test the straightness of cylindrical rods and tapered rods. The source of light used in the interferometer is a 2 mW He-Ne laser emitting a wavelength of visible radiation (632.8 nm).

#### ***Jamin Interferometer***

A Jamin interferometer was developed to ascertain the homogeneity of laser rods and Brewster windows up to an aperture of 25 mm. Low power He-Ne laser is used for obtaining interference fringes. The instrument is compact and stable and does not require any special adjustment or a dark room. It is used for quick measurement of wedge angle of Brewster windows with an accuracy of 10 arc-second.

#### ***Mach-Zehnder Interferometer***

The Mach-Zehnder interferometer is a wide aperture (100 mm) interferometer which employs a low power He-Ne laser ( $\lambda=632.8$  nm) as the light source. The instrument was designed and fabricated to measure the homogeneity of glass materials. Such an instrument was supplied to C. G. C. R. I., Kolkata. Wavefront deformations in long laser rods (say 500 mm) can be measured with an accuracy of  $\lambda/10$  using this interferometer. In addition, wedge angle of nearly parallel plates is determined with an accuracy of 2.5 arc-second. The instrument is stable and does not require a dark room and vibration isolation table for obtaining the interference fringes.

#### ***Murty Interferometer***

The Murty plate shearing interferometer (named after Dr. M. V. R. K. Murty who headed the optics section of Spectroscopy Division until 1981) was designed and fabricated for measuring the divergence of a laser beam. The instrument is used routinely to measure the focal length of lenses,

radius of curvature of concave and convex spherical mirrors with an accuracy of 10 micron. The interferometer consists of a single plane parallel plate and low power He-Ne laser ( $\lambda = 632.8 \text{ nm}$ ). The interferometer is used for measuring refractive index of glasses and liquids with an accuracy of  $\pm 0.0002$ .

#### **Ronchi Test Facility**

This test facility consists of a 25 mm X 25 mm grating of ruling frequency 80 lines/inch illuminated by a filament lamp. The set-up was developed to measure the radius of curvature of concave spherical surfaces. The instrument is used routinely for estimating the surface accuracy of concave surfaces during fabrication stages. It is possible to test the surface of concave spherical mirrors with an accuracy of  $\lambda/10$ . The accuracy in the measurement of radius of curvature is one part in one thousand.

#### **Scatter Plate Interferometer**

The scatter plate interferometer was set up to measure surface distortions of concave spherical mirrors (i.e., concave surfaces coated with a thin film of aluminium) of f-number greater than 5. The interferometer consists of a scatter plate illuminated by a 36 watt automobile lamp. The accuracy of measurement in the surface distortion is  $\lambda/8$  whereas the accuracy in the measurement of radius of curvature is one part in one thousand.

#### **Point Diffraction Interferometer**

The point diffraction interferometer was procured to measure mainly the wavefront aberrations of lenses. A He-Ne laser is used as the light source to produce interference fringes. The interferometer was also used for measuring the wavefront distortions produced by a concave spherical mirror. Maximum aperture ratio for testing of lenses and concave mirrors is  $1/2$ . The accuracy of measurement is  $\lambda/20$ .

#### **Modified Jamin Interferometer**

The conventional design of the Jamin interferometer was modified to measure small differences in

refractive indices of nearly identical liquids. The instrument was fabricated with 6V, 3A tungsten filament lamp as a source of light. All the optical components like precision optical plates, liquid cell and wedge plate compensator were fabricated indigenously with an accuracy better than  $\lambda/20$ . With a cell of length 25 mm, it has been possible to do analysis of heavy water in the purity range of 99.9% to 99.99% with an accuracy of 0.01%, taking advantage of the small difference in the refractive indices of  $\text{H}_2\text{O}$  and  $\text{D}_2\text{O}$ . With shorter cells, it is possible to reduce the sensitivity and increase the analytical dynamic range. With each cell, a calibration curve has to be obtained for any liquid before measurement. Fig. 3 shows the photograph of the modified Jamin interferometer developed in Spectroscopy Division.



Fig.3 Modified Jamin interferometer for heavy water analysis

#### **Zygo Interferometer**

This interferometer is a very expensive, state-of-the-art instrument procured under the VIIIth plan mainly to improve the existing polishing procedure and to develop further optical grinding and polishing facility for generating cylindrical surfaces required for synchrotron related optics. The instrument has a built-in He-Ne laser ( $\lambda = 632.8 \text{ nm}$ ) as a source of light, CCD camera for recording the interference fringes and a computer-based data acquisition system to measure the fringe spacing and for analyzing the data to convert them to the actual

shape of the wavefront under test. The accuracy of the measurement is better than  $\lambda/50$  and is dependent on the optical quality of the reference surface. The system accuracy is  $\lambda/20$  for plane surfaces and  $\lambda/10$  for spherical surfaces.



Fig. 4 Zygo phase measuring interferometer for precision testing of optical components

Maximum test aperture is 102 mm. Fig. 4 shows the photograph of the Zygo interferometer procured from M/s Zygo Corporation (USA). Fig. 5 shows the interference fringes obtained for plane surfaces on the Zygo interferometer. Fig. 6 shows typical contours / isometric phase recorded for a plane surface using Zygo interferometer. The phase map shows the shape of the actual surfaces along with peak-to-valley (p-v) deviation and the root mean

square (rms) deviations from the ideal plane surface.

The principal performance capabilities of the Zygo interferometer system are:

To measure surface distortion of :

- Plane surfaces
- Convex spherical surfaces
- Concave spherical surfaces
- Cylindrical surfaces

To measure transmitted wavefront quality of :

- Windows
- Prisms
- Lenses
- Lens systems
- Optical systems

To measure radius of curvature of :

- Concave spherical surfaces
- Convex spherical surfaces

To measure refractive index and inhomogeneity of :

- Laser glass materials
- Crystals such as BSO
- Liquids
- Heavy water

All these features have been exploited for the various R&D activities of the Department.



Straight, equally spaced fringes for a plane surface showing a peak error of  $\lambda/10$ .



Curved fringes for a plane surface showing a peak error of  $\lambda/2.5$ .

Fig. 5 Typical interferograms obtained for a plane surface in a Zygo interferometer

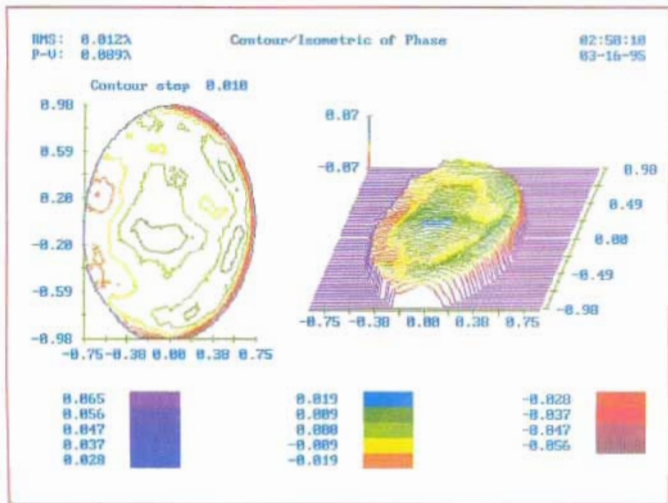


Fig.6 Isometric/phase contour recorded for a plane surface in the Zygo interferometer. The peak to valley deviation from the ideally plane surface is 0.089λ and the RMS deviation is 0.012λ.

### Interference Autocollimator

An interference autocollimator was designed and fabricated to measure the error in the 90° angle of the cube corner prism and the right angle prism. The accuracy of measurement is of the order of one arc-second.

### Autocollimator, Angle Dekkor and Goniometer

The autocollimator and angle dekkor have been set up for measuring the errors in the 90° angle and 45° angle for right angled prisms and cube corner prisms in the laboratory. The angle dekkor measures the errors in the 90° angle in the range of 0-50 arc-minute with an accuracy of 20 arc-second. The autocollimator measures the errors in 90° angle in the range of 0-60 arc-minute with an accuracy of 10 arc-second. The goniometer is used to measure angles of prisms such as 60° prism, 30° prism, 90°

prisms required for laser and spectroscopic instruments.

### Cylindrometer

A cylindrometer was designed and fabricated for measuring the radius of curvature of cylindrical surfaces. Although its working principle is based on geometrical optics rather than interferometry, it is included in the present article because it has been repeatedly found to be useful for checking the radius of curvature of Rowland circle mounts, glass tubes, metal cylinders and cylindrical surfaces during the grinding and polishing stages.

### Conclusion

An advanced optics laboratory has been established for the fabrication and testing of varieties of optical components. The facilities are

being extensively used for fabricating precision optical components such as Fabry-Perot plates (surface accuracy  $\sim \lambda/100$ ), laser mirrors, Brewster windows, concave spherical mirrors, plane mirrors, etc. required for R & D activities of Spectroscopy Division, Laser & Plasma Technology Division and other Divisions of BARC as well as other DAE units.

## BARC TRANSFERS TECHNOLOGY TO NUCLEONIX SYSTEMS PRIVATE LIMITED

BARC transferred the technical know-how for 'Spectrum Stabilising 8K MCA Card with associated software' to M/s Nucleonix Systems Pvt. Ltd., Hyderabad, on non-exclusive basis.



Signing of Technology transfer agreement. Seen from right to left: Mr P.K. Mukhopadhyay, Dr S.K. Kataria, Head, Electronics Division, BARC, Mr A.M. Patankar, Engineer-in-Charge, E&I, TT&CD, Dr G. Govindarajan, Director, A&M Group, BARC, and Mr J.N. Reddy, Managing Director, M/s Nucleonix Systems Pvt. Ltd., Hyderabad.

This MCA card is a PC plug-in card consisting of 8K Channel 100 MHz Wilkinson type ADC with capabilities such as spectrum stabilization, advanced dead-time correction and multi-channel scaling (MCS) mode of operation. It is used extensively in nuclear instrumentation for research in physics, radiochemistry and many branches of science. Four of these cards can be run on a single PC. They can operate independently in different

modes. This is a low cost, economic, versatile and multipurpose PC add-on card, affordable for University Laboratories.

This technology was developed at Electronics Division, BARC. Technology Transfer and Collaboration Division coordinated the complete technology transfer process involving the preparation of technology documents, technology transfer agreement and advertising of the technology.

## TRAINING COURSE ON USE OF RADIOTRACERS

A BRNS-RTAC sponsored National Training Course on 'Use of Radiotracers in Increasing Agricultural Productivity' was held at Radiation & Isotopic Tracer Laboratory (RITL), College of Basic Sciences and Humanities, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttaranchal State, during July 30-August 10, 2001. There were 33 participants from different parts of the country.



Inaugural function. From left to right: Dr P. Singh, Dr R.C. Pant, Prof J.B. Chowdhury, Vice-Chancellor, G.B. Pant University of Agriculture and Technology, and Dr S.P. Kale.

The course was inaugurated by Prof Dr J.B. Chowdhury, Hon'ble Vice-Chancellor, G.B. Pant University of Agriculture and Technology. Dr Chowdhury appreciated the help of BRNS-RTAC and BARC for organizing this Training Course in

Pantnagar. He expressed that further cooperation between these two national institutes would strengthen the agricultural research in India. Dr S.P. Kale, Nuclear Agriculture and Biotechnology Division (NABTD), BARC, expressed the need for the nationalization of research efforts for achieving the goal of evergreen revolution. Dr Kale read the keynote address on "Food Security" by Dr S.F. D'Souza, Head, NABTD, BARC. Dr S.P. Kale, Dr (Ms) S. Ramani and Ms A. Verma from NABTD, BARC, served as faculty members. The Course Coordinator, Dr K.P. Singh, In-Charge, RITL and Professor of Physics, G.B. Pant University, expressed his heartfelt thanks to BRNS-RTAC for sponsoring this national event.



Ms A. Verma demonstrating nuclear techniques at the Training Course

The participants in their feedback were very enthusiastic and hoped that such Training Courses with considerable in-house practical work would help them in their research. Prof. P. Singh, Head, Physics Department, and Dr R.C. Pant, Dean, College, College of Basic Sciences and Humanities and Chairman, Organizing Committee, actively participated in the Training Course making it more meaningful. The course generated a lot of interest in the local and national Press. A collection of lecture notes was brought out at the end of the course, which would serve as a manual for use of radiotracers in agricultural research.

## SYMPOSIUM ON 'INTELLIGENT NUCLEAR INSTRUMENTATION (INIT-2000)

A BRNS-sponsored Symposium on 'Intelligent Nuclear Instrumentation (INIT-2001)' was organized by Electronics Division of BARC during February 6-9, 2001 at Multipurpose Hall of BARC Guest House and Training School Hostel, Anushaktinagar, Mumbai.

The symposium received overwhelming response from all the units of DAE, Defence Laboratories, IITs and other similar institutes, including participation from about 18 industries in related areas. Over 350 scientists and engineers participated in the symposium with 120 contributory papers and invited talks.



Dr Anil Kakodkar, Chairman, AEC, inaugurating the symposium on 'Intelligent Nuclear Instrumentation (INIT-2001)'. Sitting on the dais (from left to right) are Mr D. Das, Electronics Division, BARC, Dr K.A. Neelakanthan, Director, ANURAG, Mr G. Govindarajan, Director, A&M and E&I Group, BARC, Dr S.K. Kataria, Head, Electronics Division, BARC, and Dr P.P. Vaidya, Electronics Division, BARC

The symposium was inaugurated by Dr Anil Kakodkar, Chairman, AEC, who emphasized the need for high quality and reliable instrumentation for smooth and efficient operation of reactors and accelerators, as well as for advanced experimental studies. He observed that the nuclear instrumentation had undergone a sea change in

recent times with rapid developments in the field of semiconductor electronics like development FPGAs, ASICs and various Networking techniques and wireless technologies. A symposium like this provided a good opportunity to scientists and engineers in India, particularly those working in DAE, to come together to discuss related issues and plan co-ordinated designs for development and deployment of futuristic instrumentation.

With the help of contributory papers and invited talks by experts in respective fields, following important topics in nuclear instrumentation were covered in the symposium.

(1) Radiation Detectors, (2) Application of FPGAs and ASICs in Instrumentation, (3) Smart/Portable/Field Instruments, (4) Accelerator/Reactor/Health and Environment Monitoring Instrumentation, (5) Nuclear Instrumentation for Basic Research, (6) Medical Instrumentation, (7) Instrument Networking including Field Buses, (8) Software Tools, Techniques and their Application for Instrumentation, and (9) AI Techniques in Instrumentation.

In addition to regular sessions, the symposium also included a dedicated session for deliberation on the topics of current trends in instrumentation, in which representatives from various R & D centers, Public Sector units like ECIL and private industries participated for discussing issues for quick and efficient realisation of the projects.

Dr R. Chidambaram, Scientific Advisor to the Government of India, delivered an evening talk on "Nuclear Instruments : the Present and the Future", highlighting the future technology.

The proceedings of symposium containing all the contributory papers was also brought out before the symposium and was well appreciated.

Considering the usefulness of such symposia for keeping in pace with rapid developments taking place in the field of nuclear instrumentation, it was suggested by many participants that the symposium in the field of nuclear instrumentation should be organized more frequently, probably once in every

two years, instead of once in every four years as has been the practice so far.

## GRADUATION FUNCTION OF OCES44 & OCEP10

The graduation function of the 44<sup>th</sup> batch of the Orientation Course for Engineering graduates and Science post-graduates (OCES44) and the 10<sup>th</sup> batch for Engineering post-graduates (OCEP10) was held on Thursday, August 23, 2001 at the Central Complex Auditorium, BARC. Air Chief Marshal A.Y. Tipnis (PVSM, , AVSM, VM, ADC) was the chief guest for the function and gave away the Homi Bhabha prizes. 118 trainee scientific officers from OCES44 and 12 from OCEP10 graduated and were inducted into the DAE family. The table below lists the Homi Bhabha Awardees. Mr Suman Neogy of metallurgy discipline stood first among all the twelve disciplines of OCES44 securing 87.69% marks. Dr Anil Kakodkar, Chairman, AEC & Secretary, Department of Atomic Energy, Mr B. Bhattacharjee, Director, BARC, Dr R.B. Grover, Associate Director, TC&IR Group, BARC, and Dr S.P. Garg, Head, HRDD, BARC, addressed the trainee officers.



Mr Suman Neogy of metallurgy discipline who stood first among all the twelve disciplines with 87.69% marks, receiving the Homi Bhabha prize from the Chief Guest, Air Chief Marshal A.Y. Tipnis

## Homi Bhabha Awardees

Name	Discipline	Percentage Marks
Mr A. Chakravarty	Mech. Engg.	84.96
Mr A.K. Tiwari	Chem. Engg.	85.43
Mr S. Neogy	Metallurgy	87.69
Mr Suresh Kumar	Elect. Engg.	78.80
Mr V.M. Shagaya	Instr. Engg.	81.74
Mr H. Balakrishna	Electronics Engg.	83.49
Ms S.A. Damle	Comp. Engg.	81.10
Mr Y.S. Kashyap	Physics	81.22
Mr M. Kumbhakar	Chemistry	86.57
Mr D. Sharma	Bio-Science	80.59
Mr S. Anand	Environ. Science	72.03
Mr D.C. Biswas	OCEP10	88.80

meeting of the Governing Council held on October 20, 2001 in recognition of his distinguished contribution to "Engineering".

- Dr Ramesh Chander of Food Technology Division, BARC, has developed Artificial Viral Envelopes (AVE) during his post-doctoral studies at University of Florida, Gainesville, USA. Viral mimicry using AVE may be a means for targeted intracellular delivery of



peptides, proteins, enzymes, toxins, oligonucleotides and gene constructs. These were demonstrated by his studies with Ricin A and Cystic Fibrosis Trans-membrane Regulator (CFTR) gene delivery system. Effective targeting of the respiratory epithelium and subsequent correction of cystic fibrosis defect using AVE and the p CMV, CFTR expression vector has been studied. Thus, the potential of AVE for gene therapy, vaccination and cell targeting of anti-bacterial, anti-viral drugs was shown. The AVE technique has been patented (US Patent No.: 5232342) by University of Florida. Dr Chander received a sum of US\$ 3925 for making this important contribution.

- A technical paper "Ceramic Processing under Microwave Field" by Abhijit Ghosh, D.D. Upadhyaya, Ram Prasad and A.K. Suri of Materials Processing Division, BARC, and presented by Mr Abhijit Ghosh of Ceramics



Technology Section, has won the Best Presentation Award at National Conference on Recent Advances in Materials Processing, RAMP-2001, held at Annamalai University, September 2001. Mr Abhijit Gosh is engaged in the development work on structural ceramic materials through conventional and microwave processing routes.

## BARC SCIENTISTS HONOURED



- Dr J.P. Mittal, Director, Chemistry & Isotope Group, BARC, has been awarded the Goyal Award in the discipline of chemistry for the year 2000 for his outstanding work. The award

given annually by Goyal Foundation, Kurukshetra, carries a cash amount of Rs 1 lakh and a gold medal (22 ct.), weighing 20 grams, along with a citation.



- Dr D.K. Bose, Head, Uranium Extraction Division, BARC, has been elected a Fellow of the Indian National Academy of Engineering (INAE) at the

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