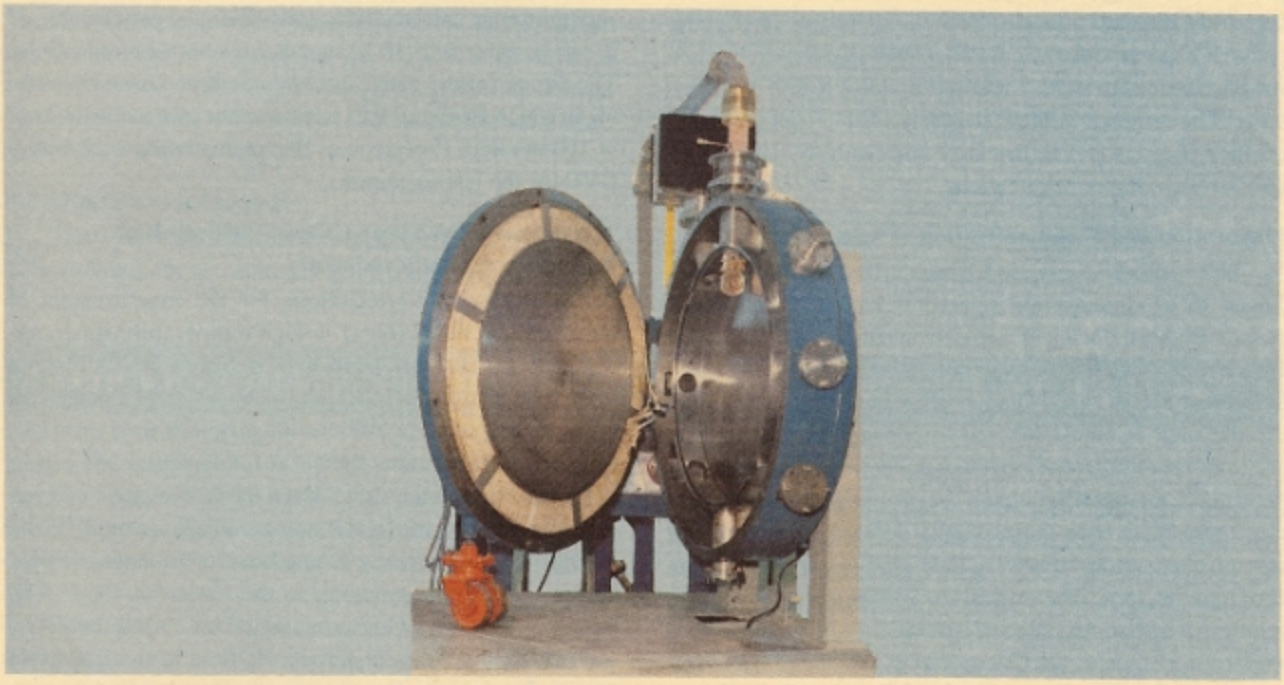
Newsletter

CENTRE FOR ADVANCED TECHNOLOGY

Year - 5 No. 1 January - June 1992



RESEARCH AND DEVELOPMENT

LASER PROGRAMME

CW Nd:YAG Laser

A 60 watt CW Nd:YAG laser has been developed at CAT. The laser has a compact gold plated single elliptical cavity in which the laser rod is pumped by a 75 mm length arc lamp. A 200 V DC, 35 A power supply with 1% current regulation and current ripple better than 0.5% (peak to peak) operates the lamp. The laser system is cooled with de-ionised water (resistivity > 1 MΩ/cm), using a compact water to water heat exchanger capable of handling 6 kW heat load. The laser can operate in both CW and pulsed modes (pulse duration variable from 0.01 sec upwards) with CW / average power variable from 5 W to 60 W. This is achieved by means of an electronically controlled in-

tracavity shutter with iris.

The laser will be useful not only for surgical applications but with the incorporation of an acousto-optic Q-switch it will also find several industrial applications like marking and resistor trimming.

Laser Beam Profile Monitor

A laser beam profile monitor based on CCD (charge coupled device) camera has been developed at CAT. It can capture and measure the beam parameters of lasers (both CW or pulsed) instantaneously and thus help in optimisation and control of laser systems. The profile monitor can operate over a spectral range of 400-1100 nm using an image converter tube. Further, the use of a pair of wedge plates with attenuation of upto 10^6 enables operation over a wide range of laser intensities.

The beam profiler has an elaborate software package for fast capture, acquisition and display of the laser beam profile with single key operation. The software simultaneously displays raw and processed images in pseudo colour. The two dimensional display is augmented by cursor based measurement capabilities along X and Y directions. The system is being extensively used to capture beam profiles of lasers (CVL, dye laser and Nd:YAG laser) and also for wave meter applications.

Preparation and Characterization of Fullerenes

The recently discovered large carbon molecules with closed three dimensional structures called "Fullerenes", possess highly delocalized π-electron clouds and hence are expected to be attractive as nonlinear optical materials. Solutions of C_{60} and C_{70} have been prepared at CAT to explore their nonlinear optical response. The first step in preparation of fullerenes involves collection of carbon soot produced by arc-discharge evaporation of graphite electrodes in an inert atmosphere. Solvent extraction and column chromatography were then used to extract C_{60} and C_{70} from this soot. The optical absorption spectrum of C_{60} solution in hexane was in good agreement with the reported spectrum. However, the C_{70} spectrum showed presence of some impurities like C_{60} and higher fullerenes. Preliminary experiments on transmission of 25 ns, 1.5 mJ, 532 nm pulses through a solution of C_{50} in toluene have shown changes in temporal and spatial profiles which are being investigated.

Opto-Isolator Card

Lasers require high voltages (around 20 kV to 40 kV) to be switched with rise time from nanosecond to several microsecond. The peak current in such devices reaches a few kiloamperes. Such switched discharges generate high Electro-Magnetic Interference (EMI)/Radio Frequency Interference (RFI), both radiative and on line. Conventional optoisolators fail to protect the control electronics against such EMI because capacitance of the order of 10 pF couples input and optically isolated output.

For microprocessor control of lasers, special isolator cards with air gaps between transmitter and receivers have therefore been developed with input/output coupling capacitance of the order of 0.01pF. The analog isolator card has eight channels compatible with EURO standard and uses an IR link operating at 940 nm. A digital isolator card with EURO standard has also been developed. This card accepts TTL or CMOS signals. Both the cards have very high RFI immunity and are being used with Copper Vapour Lasers (CVLs).

Electronic Vacuum Gauge

An electronic vacuum gauge with a range of 1 mb to 1000 mb has been developed using Motorola monolithic sensor. It consists of three small modules viz. power supply, sensor electronics, and display. The modules can be plugged on to each other with mating connectors. The vacuum gauge can be connected to a digital panel meter or it can transfer 0 to 10 V signals for control applications. The circuit for the gauge has been designed for easy working in a high EMI and RFI environment with a sensitivity of ~ 100 mV/mb. Prototype of this unit is being used with a CVL for the last six months.

Measurement of Lower Critical Fields in High Temperature Superconductors

A new sensitive technique for the measurement of lower critical fields (H_{C1}) in high temperature superconductors (HTSC) has been demonstrated at CAT. The technique exploits the fact that when a sintered pellet of a HTSC is subjected to a sinusoidal magnetic field (at ω), its magnetisation contains signals at fundamental and higher order odd harmonics only. Even harmonics are observed only when the bias dc field is non-zero because the J_C in the intergrain weak links is a strong function of magnetic field and produces an asymmetry in the hysteresis loop. The existence of a second harmonic signal (at 2ω) is, therefore, a sensitive indication of a finite dc field in the intergrain region. To measure H_{C1} the sample is cycled from zero to H_{dc} and back to zero, and its response is studied in this remnant state. If a response at 2ω is observed, it implies that flux is trapped in the grain, and $H_{dc} > H_{C1}$. Quantitative estimates of H_{C1} require detailed corrections because demagnetisation and flux compression effectively enhance the intergrain field to values larger than the applied H_{dc}. A theoretical model to estimate H_{C1} incorporating these corrections has also been developed.

COVER: *Inside view of the 20 MeV microtron showing RF cavity, vacuum envelope and magnet system.*