CAT— Scientific Programmes

Dr. D. D. Bhawalkar
Director, CAT

The major thrusts at the Centre for Advanced Technology (CAT) will be in the areas of accelerators, lasers and fusion related research and technology.

Synchrotron Radiation Facility

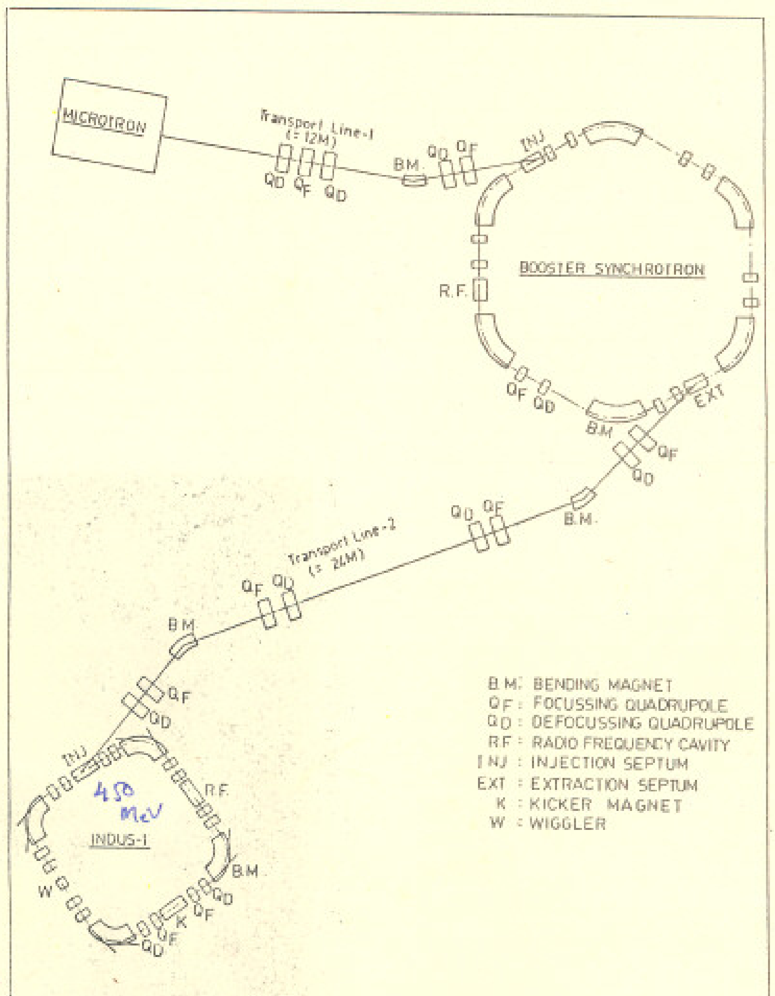
Accelerator Programme of CAT initially envisages construction of electron storage rings as Synchrotron Radiation Sources (SRS). The energies of the stored electron beams in the three proposed machines are 450 MeV (INDUS-1), .7—1.2 GeV (INDUS-II) and 2.5 GeV (INDUS-III). The corresponding critical wavelengths of emitted radiation spectrum are 61 Å, 21 Å and 2.5 Å respectively. In the first phase of the programme, the design and construction of INDUS-I with its Pre-injector and Booster Synchrotron (700 MeV peak energy) and transfer lines is to be taken up.

It is planned to inject an electron beam from a 20 MeV Microtron Injector into the booster synchrotron through transport line I. The booster synchrotron will be capable of accelerating the electrons to 700 MeV so that it can also be used for injection of electrons into future higher energy machines. The booster synchrotron consists of six superperiods, each consisting of a dipole bending magnet, a focussing and a defocussing quadrupole. For injection into INDUS-I, the beam will be extracted at 450 MeV and will be sent through transfer line II to INDUS-I.

INDUS-I will be a 450 MeV electron storage ring dedicated for the production of synchrotron radiation having a critical wavelength of 61 Å for a dipole magnetic field of 1.5 Tesla. The flux at the critical wavelength will be about 7.2×10^{11} photons/sec/mrad horizontal in 0.1% bandwidth for a beam current of 100 mA. The

magnetic lattice of INDUS-I will have four super-periods, each consisting of a dipole magnet and two pairs of focussing and defocussing quadrupoles. INDUS I is designed to extract the synchrotron radiation mainly from the bending magnets. The lattice is designed to have flexibility in the operation of the ring and to have stored beam with different specifications. In order to achieve the beam life time of a few hours, the pressure in the chamber containing the beam will be less than 10^{-9} torr.

The major systems of INDUS-I are—Magnets, Radio-frequency cavity, vaccum system and Power supply. The design and indigenous manufacture of these components offer a great challenge. Different types of electromagnets provide guiding and focussing fields for circulating the electron beam. C-type 60° and 90° sector magnets are designed for bending of beam (Dipoles) whereas laminated quadrupoles/sextupoles are designed for focussing/defocussing purpose. In view of their different operating conditions, Booster synchrotron bending magnets are designed with laminated core (type CRGO Si-steel sheets) whereas INDUS-I bending magnets are designed with core.



SCHEMATIC OF INDUS-1

DR. RAJA RAMANNA
CHAIRMAN, GOVERNING COUNCIL
(Formerly, Chairman,
Atomic Energy Commission)

Dear Dr Bhawalkar,

"I was very happy to hear that the Centre for Advanced Technology is proposing to bring out a quarterly Newsletter about its activities.

As I recall, the Centre was started for the propagation of advanced Science and Technology in the State of Madhya Pradesh. The more information is available to the Universities and the public at large, the better it will be for the beautiful State of Madhya Pradesh to take up the leadership in these fields once again, as it did in the ancient past."

R. Ramanna

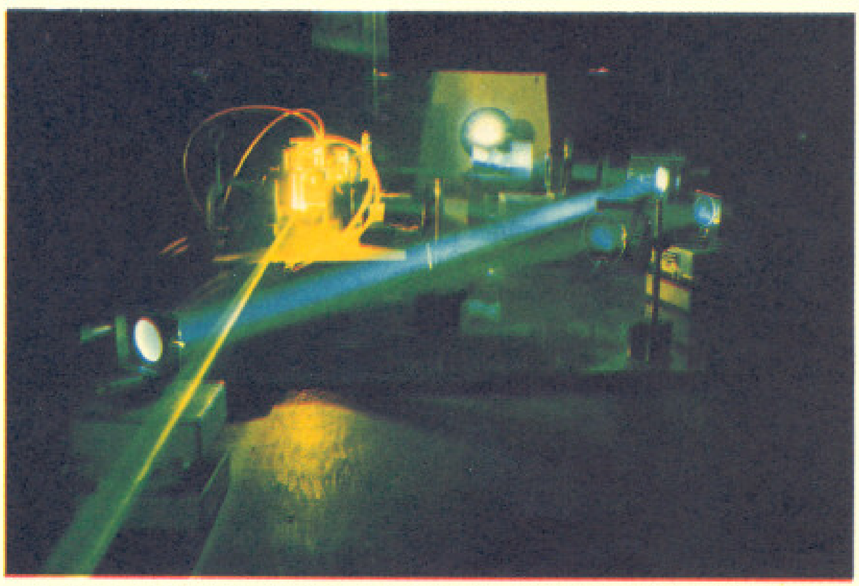
made of forged and machined material (Low carbon steel of magnet grade).

Laser Programme

Laser will rank amongst the most important inventions of this century. During the last 25 years of its existence, laser has found applications in almost all areas of human endeavour. It has applications in medicine, industry, research and even in entertainment.

In India, work in lasers started way back in 1960s at BARC with the successful development of a semiconductor laser and an optical communication link over a distance of 20 kms. Work on several other lasers, namely helium-neon laser, carbon-di-oxide laser, Ruby laser, Nd: YAG and Nd: glass laser, Dye laser was taken up and several lasers were developed. Laser development reached a stage where it was felt that a major push in these areas was required. With this in mind, laser was taken up as a major area of technological thrust at CAT.

The laser activity at CAT can broadly be grouped into two major areas, viz. Laser fusion and Advanced Laser Technology. The Laser fusion work involves development of short duration, high power lasers using Nd: Glass oscillator and several amplifiers. The short intense laser pulses when focussed on any target, heat it to extremely high temperatures. Charactrization of the high temperature, high density plasma is essential to take up the study of laser plasma interaction. This work is presently being carried out at BARC and will be shifted to CAT after the laboratories are built. The work in Advanced Laser Technology includes work in the areas of tunable lasers, high power industrial laser, laser instrumentation and engineering and non-linear optics. The tunable laser programme involves developing a moderate power copper vapour laser and a dye laser. The most common types of lasers for industrial application are optically pumped Nd:YAG laser and electrical discharge multikilowatt CW CO_2 laser. The Nd: YAG laser is used for micromachining and the CO_2 laser is used for heavy duty material processing applications. Work on 25 Watt average power, 1 to 25 Hz Nd: YAG laser and 500 Watt CO_2 laser has started.



Copper vapour laser (green colour beam) pumping a dye laser (Yellow colour beam)