ray pulses at the small laser energy of few mJ is possible since the laser produced plasma is used only as a source of electrons. This can be important in producing a compact Kα pulse x-ray source. Another advantageous feature of this diode is that the x-ray radiation pulse can be temporally synchronised with the incident laser pulse.

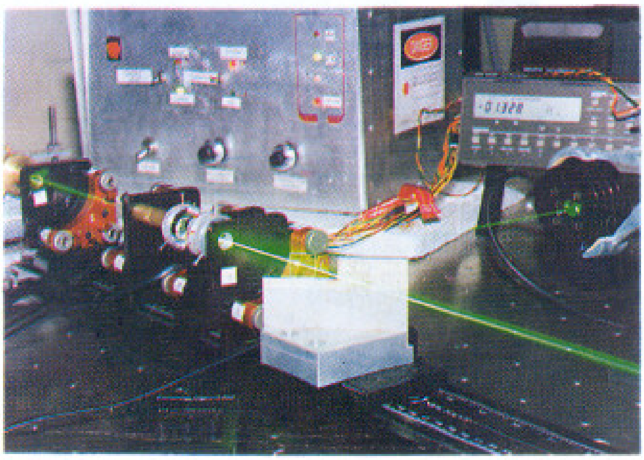
Study of diffraction efficiency of gold microstructure transmission gratings in keV spectral region

X-ray line emission from a laser produced plasma has been used to study diffraction efficiency of a gold microstructure transmission grating in the keV spectral region. Free-standing gold microstructures such as transmission gratings and Fresnel zone plates are being increasingly used as x-ray optical elements in a wide variety of research and applied areas, involving XUV-soft x-ray sources such as synchrotron radiation, laser produced plasmas, z-pinch plasmas etc. These microstructures due to their sub-micron thickness become partially transparent in the soft x-ray region ($h\upsilon \geq 1$ keV) and thus behave like a phase grating. This results in modification in the spatial intensity distribution of the diffracted x-ray radiation.

A high resolution transmission grating spectrograph is set up using a gold microstructure with a grating period 'd' = 0.2 μm and a/d ratio of ~0.42, where 'a' is the free space between the grating bars. The spectrograph parameters are optimised to achieve a spectral resolution of 0.6 Å in the wavelength region 3-90 Å. X-ray source was produced by irradiating a planar magnesium target using 2 GW, 25 ns single laser pulses at intensities of $\sim 4 \times 10^{12}$ W/cm^2. Relative intensities of the Mg XI, $1s^2$-$1s^2p$ line emission (9.2 Å) in the zeroth to fourth order were measured. The contribution of continuum and line radiation at other wavelengths to the zeroth order was suppressed by using a 6 μm aluminium filter. Ratio of intensities of the first to fourth orders w.r.t. the zeroth order was experimentally determined to be (1.3 ± 0.15), $(1.0 \pm 0.15) \times 10^{-1}$, $(5.9 \pm 1.2) \times 10^{-2}$ and $(4.6 \pm 2.4) \times 10^{-2}$ respectively. It is noted that these experimentally measured ratios are more than two times higher than those expected for longer wavelengths, where the grating bars are totally opaque. The observed diffraction efficiencies are found to be in agreement with theoretical calculations considering the effect of partial x-ray transmission through the gold bars, for the known grating parameters. This increase in first order diffraction efficiency at the expense of the zeroth order has interesting possibility of using such gratings as x-ray optical elements in the keV spectral region, such as beam splitters and beam combiners for setting up a x-ray interferometer.

300mW diode pumped green laser

A semiconductor laser pumped, intracavity doubled, laser giving 300 mW cw power at 532 nm has been developed at CAT. These lasers have important applications in medicine as well as for R & D Labs. The gain medium is a 1 mm thick YVO_4 crystal with 1 atom % doped Nd_3^+ ions. The laser is



300mW diode pumped green laser developed at CAT

pumped by a 2.6 W diode laser of wavelength 809 nm, and 5 mm thick type II phase matched KTP crystal is used as the intra cavity doubler. With the intracavity doubler removed, this laser can give 760 mW of IR power at 1064 nm (with an output coupler).

ACCELERATOR PROGRAMME

Mapping power supply for quadrupole magnets

A power supply for mapping of Indus-2 quadrupole magnets is developed using the high-frequency resonant power processing technique. Resonant converters have become very attractive for power conversion, due to numerous advantages such as elimination of switching loss, low switching transients, reduced EMI, small size and use of loss-less snubbers.

The main part of the power supply is the variable-frequency square-wave inverter and resonant network that transfers and controls the fundamental power to the output in a piece-wise sinusoidal manner. Overall performance of the power supply depends upon the design and optimisation of resonant network. There are multiple constraints for the optimisation,

Specifications of Mapping Power Supply for Indus-2 Quadrupole Magnets	
Input Supply	Three-phase , 415V±10% , 50Hz
Max. output voltage	60V
Max. output current	170A
Min. output current	22A
Current stability (Including drift and ripple)	± 50ppm
Operating frequency	20 to 50 kHz
Control loop bandwidth	3.5 kHz
Efficiency	89.5 % maximum
Cooling	Forced air

a computer program has been developed for this purpose. This program is also used to decide the ratings of resonant network components and inverter. The inverter is developed using IGBT modules. The supply is protected against fault conditions. The power supply has many advantages to encourage its use in future; it also has some limitations such as, load dependent characteristics that do not permit very wide load variations and high circulating energy in the resonant network.

The power supply has been tested and used for the mapping of prototype Indus-2 quadrupole magnet.

Electron Gun for Cherenkov FEL

A collaborative project between the Department of Physics, University of Pune and CAT, which envisage development of a Cherekov Free Electron Laser has been approved by BRNS. Under this project CAT has to develop and supply an electron gun with associated power supplies and vacuum system to Pune University. Recently, Director CAT formally handed over this electron gun facility to Dr. V B Asgekar of Pune University.

The triode electron gun consists of LaB_6 cathode emitter, indirectly heated by a pancaked Tungsten filament, beam forming electrode, non-intercepting grid or modulator anode and accelerating anode. The gun is designed keeping in mind the high temperature of the electrodes during operation. These electrodes are housed inside a ceramic tube, which acts as an isolator. Electron gun is assembled with a water-cooled Faraday cup which has an aperture to length ratio of 1:8 and a low Z graphite, as the base material for negligible secondary electron and low X-ray emission. The vacuum system comprises of sputter ion pump (140 lit/sec) and sorption pump, thus enabling a clean dry system. It produces a vacuum of 1×10^{-6} Pa.

The power supply consists of a 20kHz inverter, which drives the filament, bombarder and modulator through a 45kV isolation transformer. The cathode supply is a simple Cockroft-Walton type doubler circuit driven by 230 V to 26 kV 50 Hz transformer. The input is varied to get 40 kV DC. A pulse transformer accomplishes the grid drive. The current at the Faraday cup is monitored by directly terminating the standard RG58 cable at scope with a 50Ω termination.

The electrode configuration is optimised using the computer program EGUN. The perveance and emittance of the gun are 0.07 μperv and 14 π mm.mrad respectively. The radius of the emergent electron beam is 1.6 mm in the down flange region, for injection into the accelerating column.

The present model is a improved model of electron gun reported in Newsletter (Year-6, No.1, Jan-June 1993). The present gun delivers 500 mA current pulses at 40 kV, with pulse duration of 2 μsec. The repetition rate of pulses can be varied from 1 to 100Hz. Dark currents are 30 nano amps for negative bias to the modulating anode.

INFRASTRUCTURAL DEVELOPMENT

Construction of Indus-2 Building

Construction work of Indus-2 building has been spilt in two phases. Phase-1 consists of the S R S ring and transport line-3, i.e. radiation shielded structure. The phase-2 consists of experimental hall & users labs. The Phase-1 is nearing completion.

The building includes an annular ring with 1.5 m thick outer wall and 0.6 m inner wall. The overall diameter of the ring is 63m. The civil works include provision of beam line pipe embedded pipes (EP's), accurate magnet foundation EP's, which are placed to a very high accuracy (±3 mm) and checked using electronic theodolite. Concrete for radiation shielding walls have been placed at controlled temperature of 22 ± 1°C. Special care has to be taken for this, since the ambient temperature in this region goes as high as 46°C during summer. Also special precautions have been taken while placement of concrete to avoid subsequent radiation leakage. This has been accomplished by providing only 'Z' shaped opening and also by staggering the construction joints.

Properties of concrete as shielding material are utilised in two ways, as a structural member to support radiation shielded slab as well as for supporting EOT cranes for SRS ring & experimental hall. Conventionally steel girders are

Cover: Birds eye view of Indus-2 ring, presently under construction at CAT, Indore

Radiation shielding walls of Indus-2 building. In the center is the magnet foundation, also seen at the middle is junction of Indus-2 ring and transport Line-3.