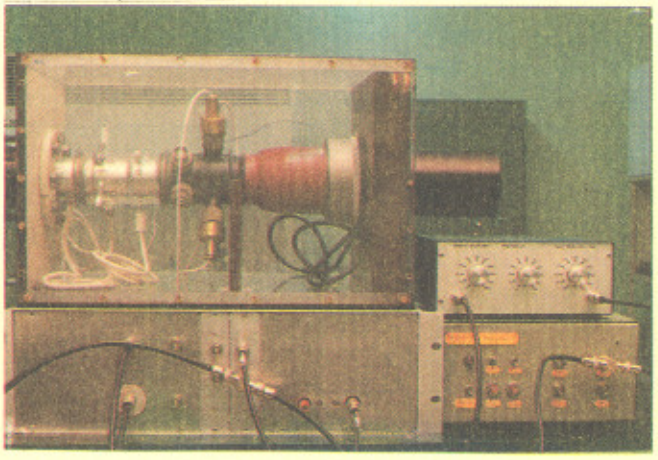
LASER PROGRAMME

A Picosecond X-ray Streak Camera

A picosecond X-ray streak camera has been developed. It provides valuable information about the temporal and spatial X-ray emission from laser produced plasma. This has a streak rate of 15 mm/nsec measured on a phosphor screen. X-ray streak and intensifier tubes for this camera were obtained from General Physics Institute, Moscow. The driving electronics viz. a fast sweep circuit, a gate pulse circuit, a trigger pulse generator and various biasing voltages for photocathode (- 12 kV), accelerating grid (- 10 kV) and focussing electrodes (- 11 kV), have been developed at CAT. Two fast and symmetrical opposite polarity pulses of ~ 1 kV amplitude and ≤ 1 ns rise time were used for deflecting photoelectrons in the streak tube. The time resolution (expected value is ~7 ps) of the camera depends crucially on the speed of the sweep voltage (1 kV/ns) and the spatial resolution of the intensifier (10 line pairs/mm). A pulse generator triggered by a reference signal from a fast photodiode provides a trigger to the streak sweep circuit and intensifier gate circuit. A suitable combination of optical delay in the laser beam and electrical delay in trigger signal is used to synchronize the arrival of photoelectrons with the start of the sweep voltage on the deflection plates. The streak tube has a demountable photocathode of gold (300 Å) on a thin nitrocellulose film (1000 Å). The slit has 100 μm width and 9 mm length. The streak camera was connected to a target chamber and successfully tested using short duration X-rays, generated by focussing a laser beam of 35 picosecond duration and 75 mJ energy from a mode locked Nd:YAG laser on a copper target. A polycarbonate foil was used to block any ultraviolet emission from the plasma. The streak on the screen of intensifier was contact photographed on polaroid film. Development is underway to take the photograph of a streak on negative film, as well as on a PC with the help of CCD camera.



Streak camera set-up

Development of Sealed-off N_2 Laser

A transversely excited sealed-off N_2 laser having glass housing has been developed. It emits 1 mW average power in 7ns pulses, with a repetition rate of 15 Hz, at a wavelength of 337.1 nm. The advantage of glass housing is that it is inexpensive and bakeable upto 350°C. One of the prototype laser tubes sealed-off six months ago, has completed 150 hours of operation without any observable deterioration in output power. The expected life of this sealed-off tube is two years, after which it can be reprocessed.

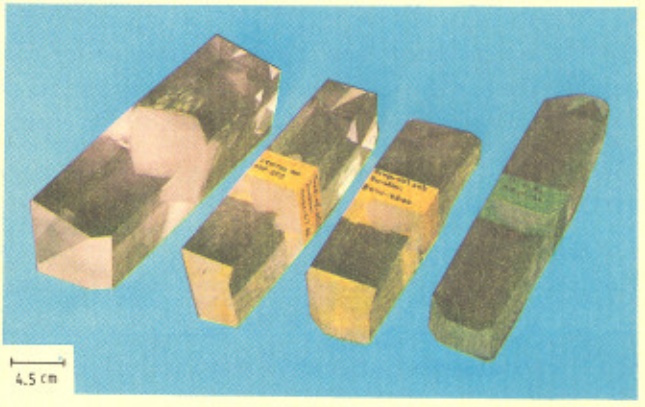
Power Supply for He-Ne Lasers

Power supplies conventionally used for He-Ne lasers are either a 50 Hz step-up transformer with a multiplier and a regulator, or an SMPS (switch mode power supply) with a step-up transformer and a PWM (Pulse width modulation) regulator. The failure rate of these supplies is high as they are sensitive to line variations and short circuit at load.

To overcome these problem a compact line operated resonant power supply has been developed. Our design has a regulator in the input stage and can work between 180 V to 270 V of mains variations. It can also withstand accidental open and short circuits. The mains voltage is rectified and switched using bipolar transistors at 25 KHz. This power supply gives a voltage of 10 kV to initiate the discharge in the tube and settles to 3 kV when discharge is established. A regulator in the input stage regulates the current in the discharge tube. These supplies have been tested on 2 mW and 5 mW He-Ne lasers.

Crystal Growth and Device Fabrication

Large good-quality crystals of a number of water-soluble materials are being grown for making devices for frequency conversion and for electro-optic modulation of laser radiation. Some of the crystals grown are : KDP (potassium dihydrogen phosphate), ADP (ammonium dihydrogen phosphate), and LAP (l-arginine phosphate



KDP crystals grown at CAT