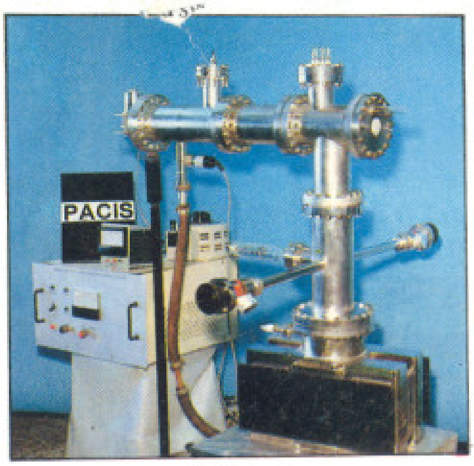
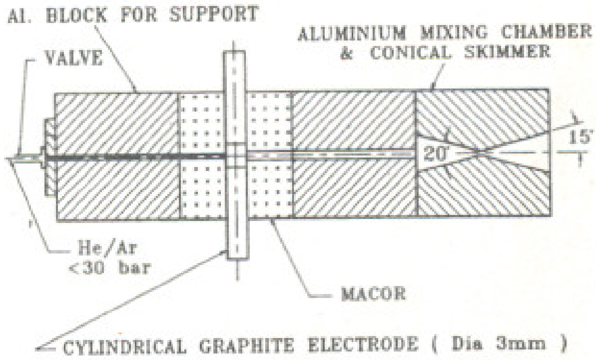


PACIS setup.



Schematic of PACIS

subsequent "mixing chamber". This has a volume of about 300 mm^3 and serves as thermalization zone while effectively mixing the hot helium/plasma part with colder portions of the carrier gas. The resulting mixture is again compressed to 1.5 mm dia. followed by a 35 mm long 15° total angle cone skimmer. This source has been used for producing carbon and rhodium clusters.

Metal - carbon multilayers

As a part of the development of multilayers as soft x-ray optical elements, metal carbon multilayers are being studied. Platinum-carbon multilayer mirrors with a bilayer spacing of 50 Å were fabricated in an ultrahigh vacuum electron beam evaporator. The thermal stability of these multilayers under vacuum annealing has been studied using x-ray reflectivity and x-ray diffraction. It has been observed that upto 450 °C, the bilayer spacing increases monotonically accompanied by a gradual increase in the crystallite size and grain texture. At 500 °C, multilayer reflection vanishes and platinum crystallites grow abruptly. There is a strong texture of platinum in [220] planes.

Surface analysis equipment commissioned

A spark emission spectrometer model JY56E from M/s Jobin Yvon has been installed during May 1995. This spectrometer is different from the conventional vacuum emission spectrometer in that the optics is in dry nitrogen thereby protecting it from contamination. This machine has been programmed to detect 10 elements viz. P, S, C, Si, Ni, Cr, Mo, Mn, Zr and Fe in a steel sample. Low atomic weight elements like C, S, P, Si can be detected to a level of 0.001%. Using standard stainless steel samples, the equipment has been calibrated and composition of any stainless steel sample can be detected in less than 5 minutes.

LASER PROGRAMME

Development and characterization of Optical and X-Ray Streak Cameras

Measurement of optical and x-ray intensities with a time resolution of few picosecond has become an essential part of a variety of studies e.g. laser-plasma interaction, laser induced fluorescence, non-linear optics etc. High speed streak cameras have emerged as the most important diagnostic tool for this purpose. Three streak cameras : one uv visible (S-20), one visible-near IR (S-1) and one x-ray streak camera have been set up at CAT in collaboration with General Physics Institute (GPI), Moscow, and their performance has been characterized.

The cameras consist of appropriate streak tubes followed by image intensifier tubes, supplied by GPI. Fast streak circuitry based on avalanche transistors, synchronization circuit, various HV biasing power supplies, MCP gated power supply, delay line etc. were made using indigenously available components.(See CAT Newsletter Jan. - June 1993). The output image was recorded either on a film camera kept in direct contact with the MCP screen or by using a CCD camera through an optical imaging system. All the cameras have provision of operating in five different streak speeds.

The operation of the streak cameras has been tested by using 20 psec and/or 100 psec laser pulses from picosecond Nd:glass laser chain. Whereas a part of laser beam was used to illuminate the entrance slit of the S-1 camera, the x-ray streak camera viewed an on-line x-ray emission source produced by intense laser pulses.

Measurements of streak speed and dynamic range have been performed by two methods : 1) by introducing an optical delay in the beam path corresponding to the lower half of the input slit, 2) by using a series of temporarily separated laser pulses of successively decreasing intensity by passing the incident laser beam through an etalon. Two streaks appear due to introduction of an optical delay of 67 psec (4cm long BK-7 glass slab) in the beam path for one half of the slit. The streak images are analyzed using 'Promise' software developed at CAT. A streak speed of 20mm/350 psec is determined from the physical separation (on the MCP screen) of the two peaks and the known time delay. The FWHM duration of the laser pulse is observed to be 21.3 psec as compared to a nominally expected value of ~ 20 psec.

Fig.1a shows streak pictures obtained from the S-1 camera for a train of 20 psec pulses (with interpulse separation of 233 psec) for the second fastest speed (20 mm/2.1 nsec). The intensity versus time trace shown in Fig.1b agrees well with the expected intensity reduction factor of 2 between successive pulses. A dynamic range of 20 is estimated from the data obtained from a large number of such pictures. Next, temporal resolution measurements were limited by the shortest laser pulse duration of 20 psec used in the present experiments. However, a resolution of ~3.6 psec is theoretically expected from the slit width of 100 μm and camera magnification of 2.1 for the fastest speed setting for the S-1 camera.

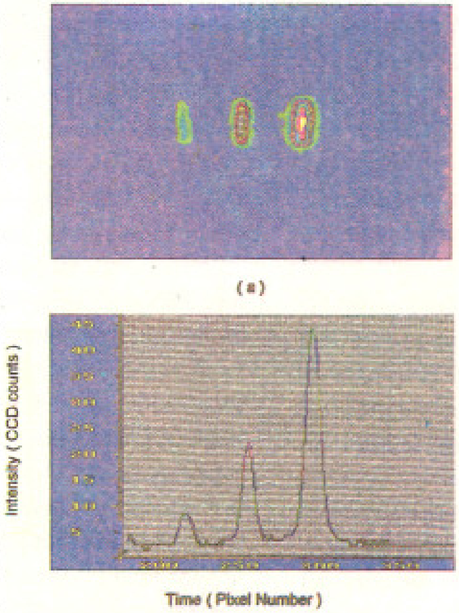


Fig.1 a) Streak pictures of a train of 20 psec laser pulses for dynamic range measurements of S-1 streak camera. b) corresponding intensity versus time profile.

The x-ray streak camera has also been tested by producing x-rays from copper and aluminium targets using 20 psec laser pulses of 50-70 mJ energy from Nd:glass laser chain. Fastest streak speed on this camera was measured to be 35 mm/1 nsec, with an expected temporal resolution of ~6psec. The camera has been used to record time profile of x-ray emission in different spectral regions by mounting various x-ray filters on the photocathode slit. Fig.2a shows a streak picture of x-rays transmitted through one and two numbers of aluminized polycarbonate foils (1 μm thickness) for emission from a copper plasma. The corresponding intensity profiles are shown in Fig. 2b and 2c respectively. It was seen that the relative intensity and duration of emission for the x-rays transmitted through two filters qualitatively agreed with the expected behaviour.

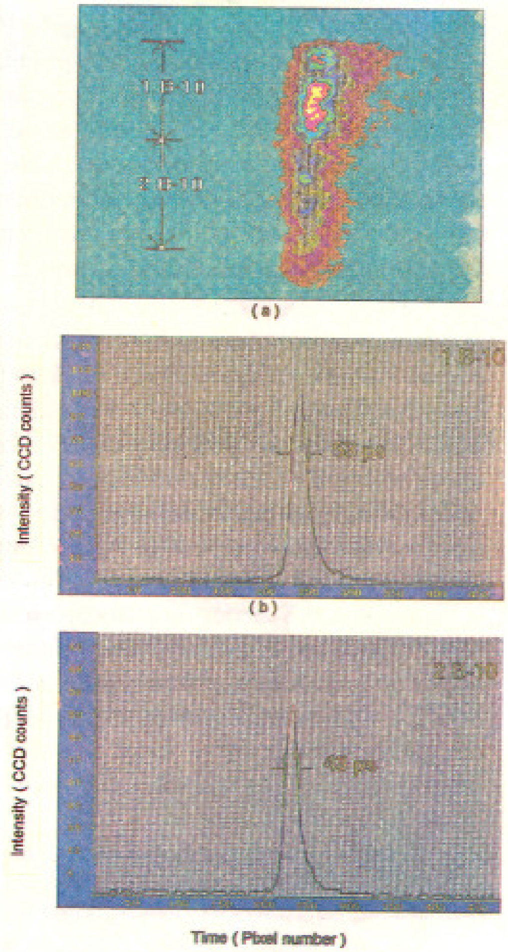
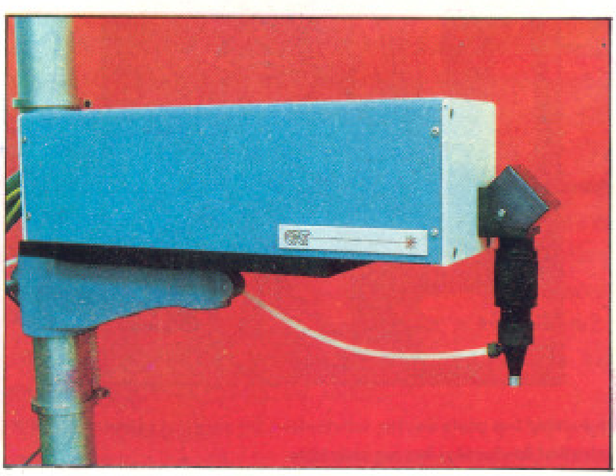


Fig.2 a) Streak picture of x-ray pulse transmitted through different filters for a laser produced copper plasma.
b,c) Intensity versus time profile for 1 B-10 and 2 B-10 x-ray filters respectively.



Development of a control system for 100 GW Nd:Glass picosecond laser chain.

A 100 GW Nd:Glass picosecond laser chain is being set up at CAT for studies of intense x-ray generation in laser plasma interaction. The laser chain consists of a picosecond oscillator-amplifier (supplied by Quantel, France) fol-

Cover: *Industrial YAG Laser Model IL YG - 150 during operation. This Laser has been delivered to Jadavpur University, Calcutta. The YAG Laser delivers a maximum of 150 W average power, pulse duration variable from 2 - 20 msec & has pulse shaping facility to cater to wide range of material processing procedures. Photograph on left side shows the Laser.*