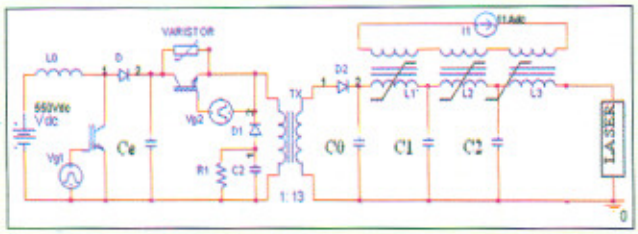

Fig. L.9.1 Circuit diagram of power supply

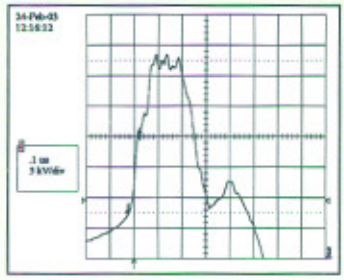

Fig. L.9.2 Voltage waveform

Max Peak Power	150MW
Output Voltage	35kV
Peak Current	3-4kA
Rise time	<80nSec
Pulse width(FWHM)	275nSec
Pulse Energy	15J
Max Repetition Rate	500Hz
Efficiency	~75%

Table 1

The electrical circuits of power supply and voltage waveform at laser head are shown in figures L.9.1 and L.9.2 respectively. The semiconductor switch produces a pulse with a rise time of 10μs and the three MPC stages compress the pulse to 75ns. Thus, a total compression gain of 125 is achieved. The input energy is regulated using a high voltage DC-DC boost converter and this stabilizes the laser output energy. The specification of ASSE is given in Table 1. The TEA CO_2 laser has been operated using ASSE at 35kV peak voltage in the range of 1 to 500Hz pulse repetition rate. It gives maximum 500W average power at 500Hz repetition rate with an electro-optic efficiency of about 8%.

(Contributed by: Dr. AK Nath; aknath@cat.ernet.in)

L.10 Diffusion cooled V-fold CW CO_2 laser

A diffusion-cooled continuous wave V-fold CO_2 laser has been developed for material processing applications, which require good quality laser beam in 100-250W power range, like zero-width glass cutting. The laser with a total discharge length of 6 meters, in 4 limbs each having two discharge sections of 75cm length each, yielded a maximum output power of 260W with 12% electro-optic efficiency. This is excited by high voltage dc discharge which is superimposed on high frequency (5kHz) pulses of ~10kV peak voltage. The high frequency pulses facilitate uniform and stable discharge in 8 sections(fig. L.10.1). Because of the large resonator length (7.5meter) and small discharge tube diameter (9mm) the diffraction loss of plano-concave resonator, which is commonly used, is very large.

Fig. L.10.1 V-fold CW CO_2 Laser

In order to circumvent this problem a symmetric optical resonator (confocal type) has been used which is formed with all mirrors i.e. rear reflector, v-folding mirrors and zinc selenide output coupler, having 5meter radius of curvature. In this resonator, the diffraction loss is relatively less as the same laser beam propagation profile repeats in all limbs. Since the v-folding angle is within 5 degree, curved mirrors do not introduce significant astigmatism. The output beam is of 6mm diameter and its intensity distribution is near Gaussian.

(Contributed by: Dr. AK Nath; aknath@cat.ernet.in)

L.11 Diode laser pumped high power Nd: YAG laser in side-pumping geometry

The development of high-power diode arrays allows the use of highly efficient diode lasers for pumping solid-state lasers. In one set up, using 5mm diameter, 100mm long Nd:YAG rod pumped by fifteen laser diode bars of 50W in an axially multiplexing scheme, we have achieved more than 215W of CW power at a diode pump power of 700W.

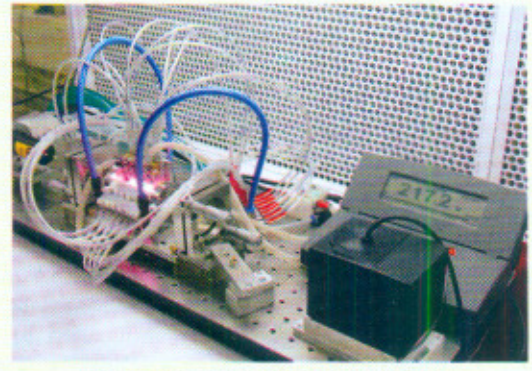

Fig. L.11. 1 The DP Nd:YAG laser

The slope efficiency and optical-to-optical efficiency are 37% and >30% respectively. The experimental set up and optical slope efficiency data are given below (fig. L.11.1 and fig. L.11.2).

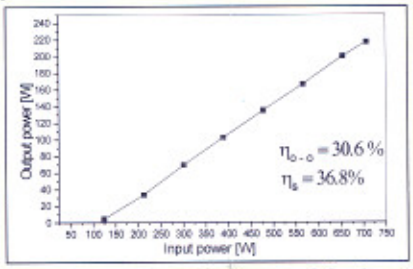

Fig. L.11.2 The efficiency of the laser

In another setup, with a laser rod of 4mm dia x 60mm length of 0.6% doping enclosed within a gold plated flow tube, except for three slits of 1mm width lengthwise 120° angularly separated for coupling of diode pump power, 60W laser power was obtained at a pump power of 180W.

(Contributed by: TPS Nathan; nathan@cat.ernet.in)

L.12 High average power intra-cavity frequency doubled green laser

High average power green beam at 532nm are useful for many basic research studies, industrial and medical applications. Such sources can be realized by intra-cavity frequency doubling in a Q-switched Nd: YAG laser. We have designed a V-shaped cavity for intracavity green generation as shown in fig. L.12.1. The cavity was folded by a curved mirror (M2) with 200mm ROC (HR@1064 nm and HT @532nm). The front mirror (M1) is highly reflecting at the fundamental wavelength. The flat end-mirror (M3) has a high reflectivity coating at both the fundamental as well as the second harmonic wavelength.

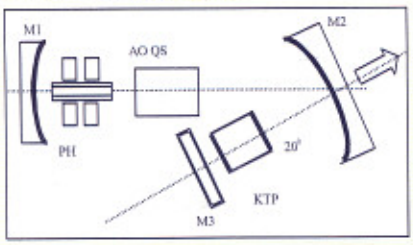

Fig. L.12.1

The spot size at the KTP, which was kept near M3, can be adjusted by adjusting the respective arm lengths. The pump head consists of a 60mm long Nd:YAG rod (4mm diameter) with 0.6at.% Nd^{3+} doping concentration enclosed within a gold-coated flow tube, described earlier, for coupling of diode pump power(fig.L.12.2). With KTP crystal 10mm long and Type-II phase matched at 80°C temperature, a maximum of 19W of average green power at a repetition rate of 8kHz has been obtained at a total diode pump power of 180W, corresponding to more than 10% optical to optical conversion efficiency.

Fig.L.12.2

(Contributed by: TPS Nathan; nathan@cat.ernet.in)

L.13 DPSS single mode IR laser (1064nm) with 100mW output power

Solid-state laser of Nd:YVO_4 with single mode, high polarization purity at 1064nm with 100mW of output power has been developed. For a typical diode pumped 3-at-% doped crystal of 0.5mm crystal length, the SLM is possible up to 5.5 times the lasing threshold. Single transverse operation is possible by adjusting the ratio of the mode to pump spot-size and by keeping the ratio around 1.3.

The experimental setup consists of a coated a-cut 3-at-% Nd:YVO_4 crystal end-pumped by a 1W fiber coupled laser diode operating at 809nm with 400mW of output power. The laser resonator is a standing wave type with the input mirror directly coated on the laser crystal and a 15% transmitting concave mirror with 80mm radius of curvature acting as the output coupler.

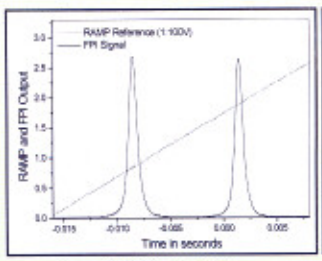

Fig. L.13.1

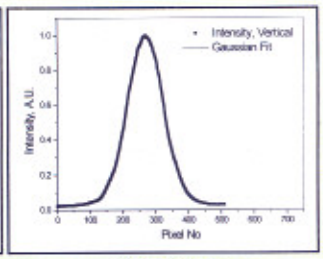

Fig. L.13.2

The SLM operation is confirmed by measuring the spectral profile with a scanning FPI. The spectral profile and spatial scan are shown below. The M^2 value is 0.99 ± 0.08. The IR output is linearly polarized parallel to the c-axis of the Nd: YVO4 crystal with more than 1:10,000 polarization ratio as confirmed by glan polarizer with high extinction ratio (fig.L.13.1 and fig.L.13.2). The output power stability recorded after 30min warm-up shows a power fluctuation < 1%. We have developed a Hansch-