operating close to 50% fracture limit. The laser resonator was formed by a plane high reflection (near 100%) mirror, and an 80% reflectivity plane output coupler, separated over a distance of 180 mm. The measured thermal focussing coefficient was 5.46 D/kW. The beam quality factor (M^2) of the laser was around 110. The overall size of the laser head is 225 x 220 x 250 mm^3.

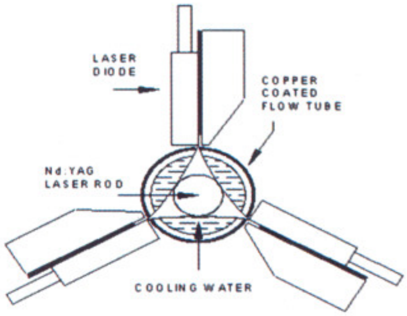

Fig. L.10.1 A cross-sectional view of the pump cavity.

Figure L.10.2 shows the performance of the laser for multimode operation versus the total diode pump power. Fig.L.10.3 shows the photograph of the system in operation.

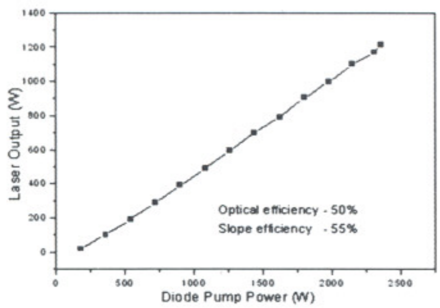

Fig. L.10.2. Laser performance for multimode operation versus the total diode pump power.

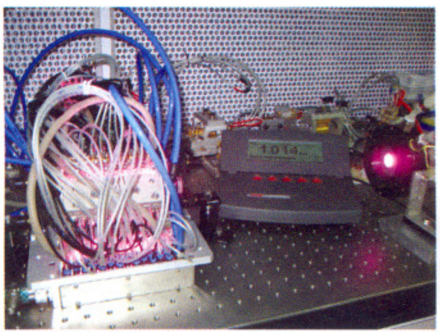

Fig. L.10.3. A photograph of the laser system in operation.

Reported by:
K.Ranganathan (ranga@rrcat.gov.in) and P. Mishra

L.11: Role of location and orientation of Pockels cell in a laser resonator cavity

Location and the orientation of the Pockels cell (i.e. the orientation of the crystallographic axes of the crystal with respect to the plane of polarization of the beam incident on the Pockels cell), along with other active Q-switching elements in a resonator cavity, can affect the cavity Q-value and the polarization state of the output. This was experimentally studied and analyzed using Jones matrix formalism in Solid State Laser Division of RRCAT.

The effect of position of all active Q-switching elements namely polarizer, Pockels cell, and $\lambda/4$ plate were studied in two positions, one in the output leg, and the other in the feedback leg of the resonator as shown in the Figs.L.11.1 and L.11.2. In each configuration, two sets of experiments were conducted by swapping the location of Pockels cell and the $\lambda/4$ plate. The effect of Pockels cell rotation on the hold off condition of the cavity and the

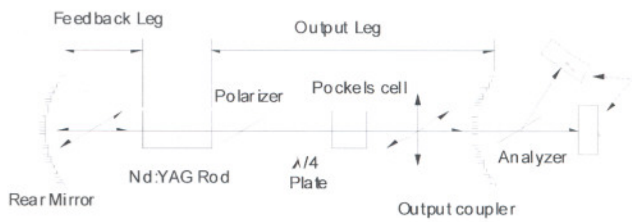

Fig. L.11.1: Resonator with the Pockels cell kept after the polarizer and before the λ /4 plate in the output leg

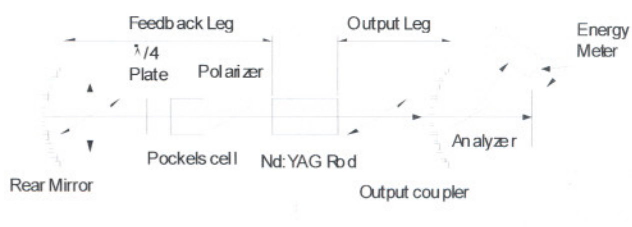

Fig. L.11.2: Resonator with the Pockels cell kept after the polarizer and before the λ /4 plate in the feedback leg

polarization state of the output was monitored for each configuration. Rotation of the Pockels cell can affect objective of achieving the low Q-value, under the "no voltage on the cell" condition. This may lead to the depopulation of the exited state and hence inefficient Q-switched pulse. Jones vectors for the configuration are J1 and J2 respectively and they are given by:

$$J_1 = AQ_1Q_2MQ_2Q_1\binom{1}{0}, \qquad J_2 = AQ_2Q_1MQ_1Q_2\binom{1}{0}$$

where J_1 and J_2 represent the state of polarization of the light transmitted by the intra-cavity polarizer, A is the Jones matrix for analyzer, Q_1 is the Jones matrix for $\lambda/4$ plate when its fast axis is oriented at an angle 45°, Q_2 is the Jones matrices for Pockels cell with $\lambda/4$ voltage and kept at angle θ, M is the Jones matrix for the mirror for normal incidence, and $\binom{1}{0}$ represents the polarized light. Plot of J2 and J1are shown in Fig.L.11.3 and Fig.L.11.4 respectively.

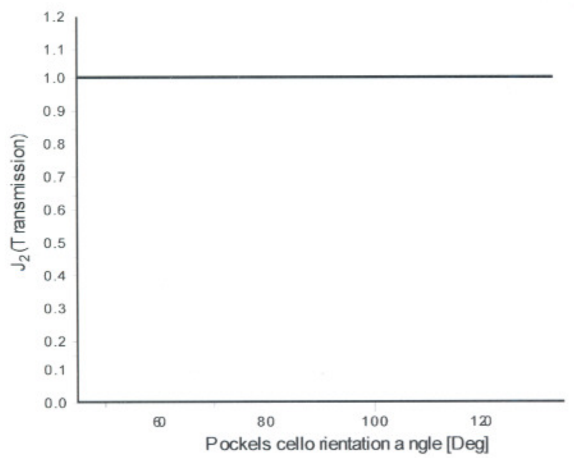

Fig. L.11.3: Theoretically calculated transmission of the intra-cavity polarizer (J_2) versus the orientation of Pockels cell.

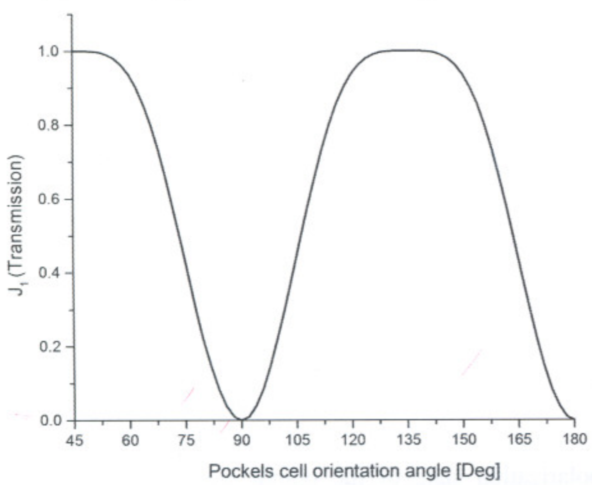

Fig L.11.4: Theoretically calculated transmission of the intra-cavity polarizer (J_1) versus the orientation of Pockels cell

From Fig.L.11.3 it is clear that low cavity Q can be maintained irrespective of orientation of the Pockels cell, whereas this is not true in Fig. L.11.4. As a result of this, the otation of the plane of polarization is observed in the output when compared to the plane of polarization of intra cavity polarizer.

It is also observed that when the λ /4 plate and the cell are interchanged in Fig.L.11.3, one can maintain high cavity Q, irrespective of the orientation of Pockels cell. However, the plane of the polarization of the output is rotated depending on Pockels cells orientation. Here one can generate orthogonal polarization with maximum output energy, when the Pockels cell is kept at 45° or 135°

Figure L.11.2 shows that the cavity Q depends on Pockels cell orientation. Here, the output energy is a function of the orientation angle and it varies from zero to maximum. However the output polarization is linear and insensitive to orientation. It is found that interchanging the cell and $\lambda/4$ plate in Fig.L.11.4gives an ideal configuration in which the cavity Q, the output energy, and the polarization are insensitive to the orientation of the Pockels cell. [For more details, please see : *R. Sundar et al, to appear in Optics and Laser Technology, 2009.]*

Reported by:
R. Sundar and
K.Ranganathan (ranga@rrcat.gov.in)

L.12 Development of platinum-loaded carbon aerogel catalyst for isotopic exchange of hydrogen and deuterium

Carbon aerogels, due to their large surface area, high porosity, and low density, are finding increasing use for a variety of applications like ultrahigh value capacitors, fuel cells, and catalysts. Target Laboratory, RRCAT, has over the years successfully developed the technology for the synthesis of these materials. Both, aqueous route (water-ethanol-liquid CO_2), and surfactant based open air drying method, have been developed for this purpose. Further, various scaffolding techniques have been developed and utilised to prepare carbon aerogels of different morphologies (thin large sheets of up to 200 mm x 150 mm; cylinders of up to 100 mm length and 30 mm diameter and Rasching rings of size 8 mm x 10 mm). The SEM image (Fig.L.12.1a) of carbon aerogel synthesised by the surfactant based method shows the high porosity and interconnected open pore structure of the material. The pore volume and surface area of the aerogel were measured to be 1.4 cm^3/g and 550 m^2/g. The pore size ranged from 10 nm to 30 nm.