AD-A147 450 INTENSE EXCITATION SOURCE OF BLUE-GREEN LASER(U) 1/1
HAMPTON UNIV VA DEPT OF PHYSICS AND ENGINEERING STUDIES
K S HAN 15 OCT 84 N00014-80-C-0957

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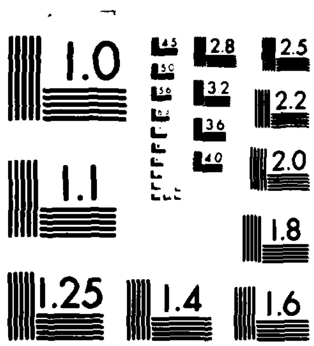

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An Intense Excitation Source of Blue-Green Laser

Under ONR grant an intense excitation of blue-green laser useful for underwater communication and detection system being developed. The source in use, hypocycloidal-pinch plasma (HCP), can produce near uv photons which match the absorption spectra of solid state blue-green laser such as Tb:YLF and dye lasers. The optical pumping method is effcient and simple for

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exciting short pulse lasers repetitively without coupling capacitor energy directly the laser medium.

During the previous project year, the device demonstrated successful pumping of the blue-green dye (LD490) laser with a peak power of 230kW. The laser pulse repetition rate was limited to 0.5 pulse per second due to the limited current (70mA) of the power supply used (See publication 4). Furthermore the characterization and optimization experiment on both laser system and the HCP device have been carried out extensively (See publication 5,6,7,8 and 9).

In order to accomplish a better coupling of uv light from HCP to pumpband of LD 490 dye laser, the following dyes are mixed with LD 490 dye respectively: Exciton dye BBQ, LD390, and NPO etc. In another words LD490 dye acts as the lasing medium while other dyes mentioned above as a spectrum converter. At present time experimental result shows that BBQ dye increases the laser output energy of LD490 dye by about 200% as compared with that of LD490 alone. On the other hand LD390 and NPO dyes decrease the laser output energy. For the reproducibility of the experimental results mentioned above, tests are still in progress.

Since the considerable amount of uv pumping light from the HCP has been attenuated before it actually reaches the laser gain medium and also uv light loss through the quartz window and the reflecting mirror, our HCP uv pumping light has not been exceeded the threshold level of Tb rod and uv dye laser (See publication 8). In order to circumvent these problems, a new geometry of the plasma focus device as shown in figure 1 is designed and constructed.

The new pump source as shown in figure 1, utilizes an elliptical-cylinder mirror for collecting the radiation from the dense plasma focus (DPF) and line-focussing on the axis of the laser tube. The new plasma pump source is expected to produce a plasma density of $10^{18}cm^{-3}$ and temperature of 10eV which is an extremely intense UV source. Figure 2 shows the experimental setup currently operating. In order to measure the speed of current sheet formed during the rundown phase, two photodetectors are placed at A and B. Another two photodetectors are also placed near the axis of the plasma line focussing as shown in Figure 2. Consequently the velocity of current sheet near the formation of plasma focussing will be measured. Figure 3 shows a typical oscillogram picture of light signal detected at A and B. Lower trace is for the location at A and upper one for B. The operating conditons of the plasma pumping source are argon fill pressure 1 Torr, an applied voltage 17.5KV and capacitance of capacitor 50μF. With these preliminary data the velocity of current sheet calcualted from distance between 1st peak positions of upper and lower traces, is $2x10^6$cm/s.

For further optimization of the new plasma pump source, the measurement of the emission spectra in the 200-400nm range will be continued as a function on operating conditions such as input energy, voltage, gas type, and pressure before uv dye laser pumping.

Annual Summary Report

of

Intense Excitation Source of Blue-Green Laser

under

(ONR Grant No. N00014-80-C-0957)

Principal Investigator

Kwang S. Han

Oct 15, 1984

Hampton University

Hampton, Va 23668

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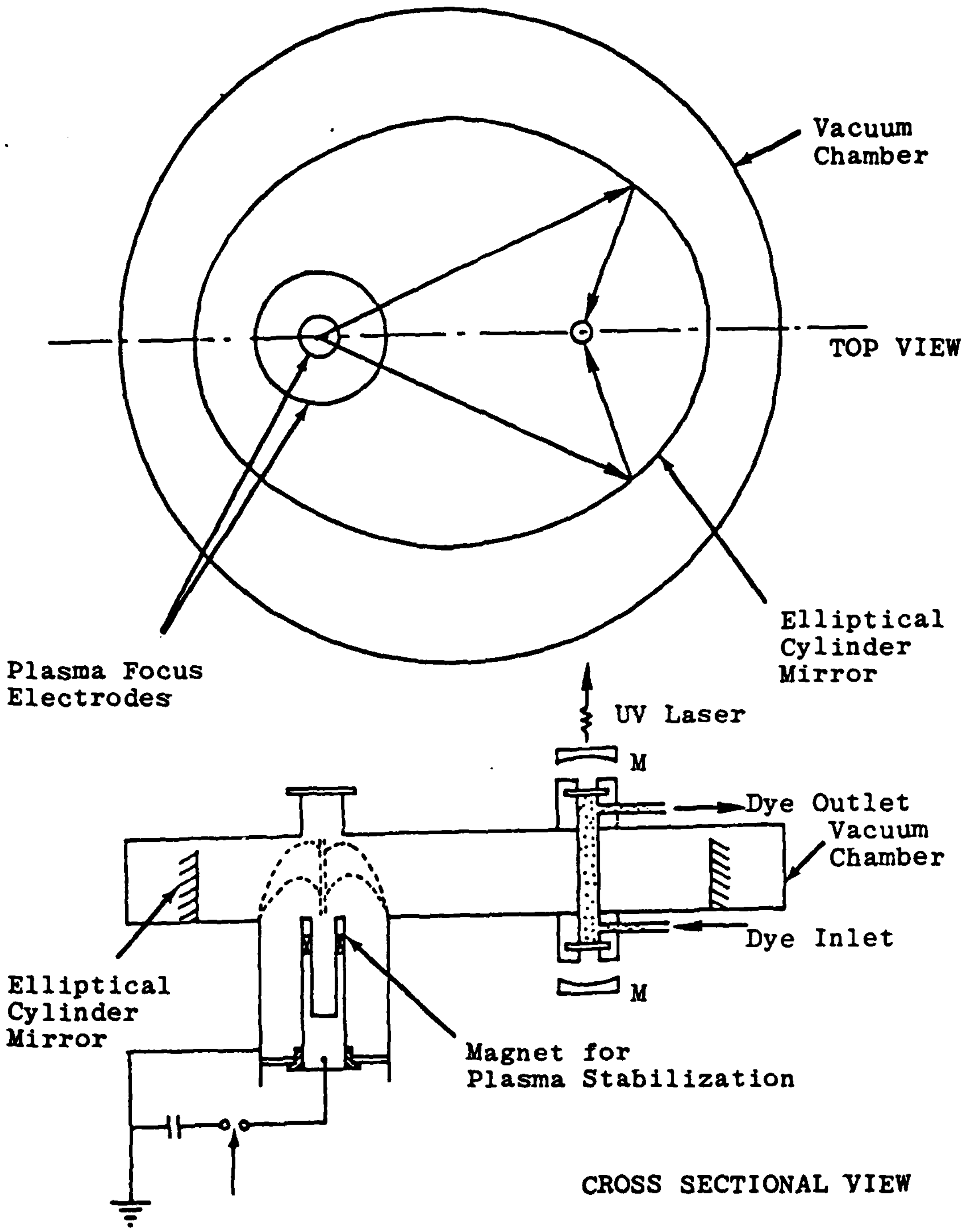

Figure 1. A schematic diagram of plasma pumping source for short wavelength lasers.

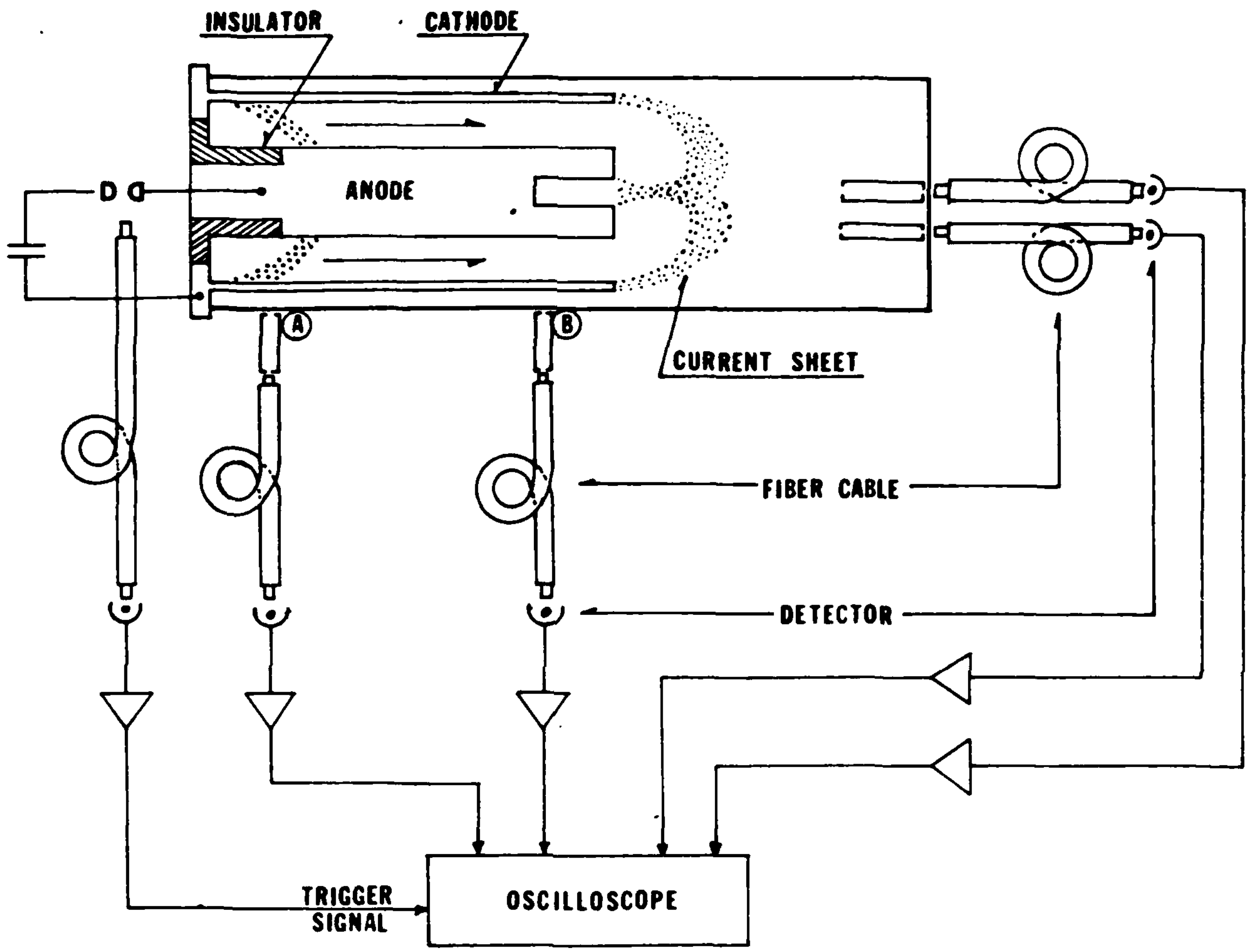

Fig. 2. Schematic diagram for the speed measurement of current sheet in the plasma pumping source.

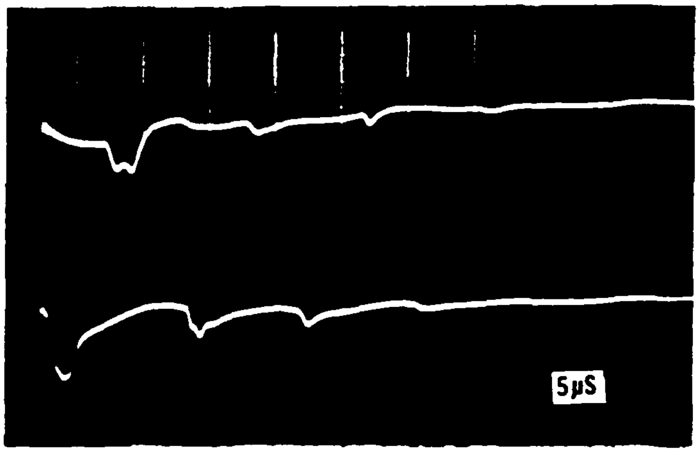

Fig. 3. Oscillogram of the light signals generated by current sheet in the plasma pumping source. Lower and upper traces are signals detected at the position A and B as shown in Fig.2. Ar fill pressure = 1 Torr, E_o = 17.5KV, C = 50 μF.

List of Publications

generated Oct. 1, 1984 - Dec. 31, 1984

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1. "Visible Emission of Hypocycloidal-Pinch Plasma" K. S. HAN, D. D. Venable, and J. H. Lee, Conf. Record IEEE 81CH1640-2 NPS, P.156 (1981).
2. "Dye Laser Pumped by Hypocycloidal Pinch (HCP) Discharge", K. S. Han, C. H. Oh, D. D. Venable,and J. H. Lee, Conf. Record IEEE28CH147-1, P. 182 (1982).
3. "Near uv Emission of Hypocycloidal-Pinch (HCP) Discharge", K. S. Han, D. K. Park, D. D. Venable, and J. H. Lee, Bull. of APS. Vol. 27, 1063 (1983).
4. "High Power Pumping Blue-Green Laser by Hypocycloidal-Pinch Plasmas", K. S. Han, S. H. Nam, and J. H. Lee, Journal of Applied Physics. 55, 4113 (June, 1984).
5. "Radiative Properties of Hypocycloidal Pinch Plasma for Optically Pumped Blue-Green Lasers", M. Niimura, K. S. Han, S. T. Ko, and J. H. Lee. To be submitted in Journal of Applied Physics for Publicatiion in 1984.
6. "High Pressure Plasma Source for pumping Atomic Iodine Lasers", K. S. Han, D. K. Park, and J. H. Lee, Virginia Journal of Science. Winter issue (1985).
7. "Blue-Green Dye Laser Pumping by Hypocycloidal Pinch Plasma", S. H. Nam (M.S. Thesis Dec. 1983).
8. "Ultraviolet Emission of Hypocycloidal Pinch Plasma for Laser Excitation", S. T. Ko (M.S. Thesis Dec. 1983).
9. "Spectral Optimization of Hypocycloidal-Pinch Array as Laser Pump Source", J. H. Lee and K. S. Han, 1984 IEEE International Confrence on Plasma Science Record.