

the output energy increased by 10%, in good agreement with numerical modeling. The increased extraction efficiency with off-axis resonators is due to the better overlap of the beam passes with the nonuniform single-sided transverse electron beam pumping profile.

Near field beam profile and divergence measurements were performed using the experimental arrangement shown in Fig. 1. The beam profiles of the injected laser exhibit a smooth intensity distribution. The amplified beams, however, show an intensity variation which can be attributed to nonuniformities in the pump profile.

The dependence of the measured and theoretical XeF ($C \rightarrow A$) laser beam divergence upon resonator magnification is shown in Fig. 2. The smallest divergence value of $150 \mu\text{rad}$, i.e., three times the diffraction limit, was obtained for a resonator geometry with magnification $M = 3.0$. The divergence of square mirror resonators was comparable to round mirrors of the same magnification and was smallest when operated in an off-axis mode. The divergence was not significantly changed by the amplification process.

The maximum brightness of the laser beam of $2.7 \times 10^{13} \text{ W/cm}^2/\text{sr}$ was obtained for a circular mirror resonator with magnification $M = 2.5$ (Fig. 3). New experimental results are presented describing an internal, square resonator with a maximized output aperture.

Measurements of the amplified laser beam with a Fabry-Perot etalon indicate complete tracking of the injected laser linewidth. The smallest measured linewidth was 0.001 nm . Even narrower linewidths and hence an increased spectral brightness should be obtainable with an ultranarrow bandwidth injection laser source.

(Poster paper)

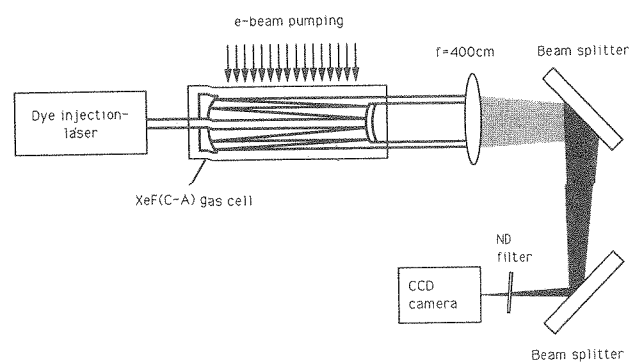
CTUH22 Resonator design for a high intensity XeF($C \rightarrow A$) laser

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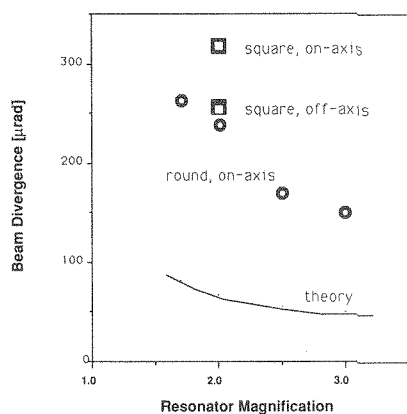
The design of a resonator for an e-beam pumped, injection-controlled XeF ($C \rightarrow A$) laser¹ with particular regard to the divergence of the laser output is reported. Various resonators, including off-axis configurations, were tested for beam divergence and output energy. Experimental results were confirmed by numerical modeling.²

The laser cavity consists of a positive branch, unstable resonator, with the mirrors located either internal or external to the laser chamber. Three different resonators with magnifications of $M = 2.0$, $m = 2.5$, and $M = 3.0$ were tested, yielding output energies of 430, 290, and 210 mJ, respectively. An internal resonator with magnification of $M = 1.7$ provided 740 mJ, confirming modeling results which predict a higher output energy for a shorter cavity and a smaller magnification. Latest experiments with an internal, $M = 1.33$ resonator shows output energy in excess of 1 J. In addition, a set of external, square mirrors was tested in on-axis and off-axis configurations. The square, on-axis resonator showed the same performance obtained with round optics. With the off-axis cavity

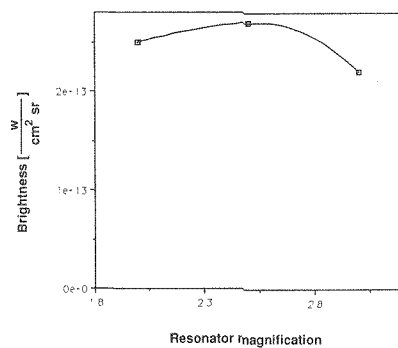
1. C. B. Dane, G. J. Hirst, S. Yamaguchi, T. Hofmann, W. L. Wilson, R. Sauerbrey, F. K. Tittel, W. L. Nighan, and M. C. Fowler "Scaling Characteristics of the XeF ($C \rightarrow A$) Excimer Laser," submitted to IEEE J. Quantum Electron. (Sept. 1990).
2. N. Hamada, R. Sauerbrey, and F. K. Tittel "Analytical Model for Injection-Controlled Excimer Laser Amplifiers" IEEE J. Quantum Electron. QE-24, 2485 (1988).



CTUH22 Fig. 1. Experimental setup of the injection-controlled XeF (C → A) laser for divergence measurements.



CTUH22 Fig. 2. Dependence of the divergence on the resonator magnification for on-axis and off-axis resonators. The $M = 1.7$ resonator is internally mounted, all others are externally mounted.



CTUH22 Fig. 3. Dependence of laser brightness on the resonator magnification.