Second harmonic generation of external cavity tapered diode lasers

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Outline

• The external cavity tapered diode laser – setup
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• Second harmonic generation – results
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The external cavity tapered laser - setup

- 4 mm long tapered amplifier with 1 mm long ridge section and 4° taper angle. GaAsP tensile-strained single quantum well. SLOC structure with a vertical divergence angle of 15° (FWHM). AR coated.
- \( f = 3.1 \text{ mm}, \ NA = 0.68 \) aspherical collimation lens.
- 1200 grooves/mm blazed grating. \( \lambda_{\text{blaze}} = 750 \text{ nm} \).
- 15 mm cavity length.
- Temperature stabilized base plate.

High brightness diode laser sources workshop 18-06-2007. Ole Bjarlin Jensen
The tapered laser - results

- 1.41 W output power at 3 A.
- Slope = 1.16 W/A
- $M^2 < 1.2$ in both axes.
The tapered laser - results

26 nm tuning range (FWHM). Single-frequency over entire tuning range


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Second harmonic generation - setup

- Isolation between laser and enhancement cavity
- Four-mirror Bowtie resonator
- Nonlinear material is $1 \times 2 \times 10$ mm PPKTP with period of $3.4 \ \mu$m. AR coated at $810$ nm and $405$ nm on both facets. Placed in a temperature controlled oven. Beam waist = $42 \ \mu$m in crystal.
Second harmonic generation - results

• 364 mW of blue light at 405 nm obtained from a coupled fundamental power of 570 mW.
Second harmonic generation - results

- Up to 67% conversion efficiency. 64% at maximum blue power.
- Thermal effects are responsible for the drop in efficiency at high power.
Second harmonic generation - results

New cavity design
Preliminary results

![Diagram showing second harmonic generation process with PPKTP crystal and input/output interfaces.]

Graph showing the relationship between input power (mW) and blue power (mW). The graph is linear, indicating a direct proportionality between input and output power.


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Summary

- External cavity tapered diode laser at 809 nm. Up to 1.4 W tunable single-frequency nearly diffraction-limited output power.
- Second harmonic generation in an external bowtie cavity.
- 364 mW CW blue output power at 405 nm.
- 540 mW blue peak power at 405 nm.
- Up to 67 % conversion efficiency.
- Thermal effects and gray tracking in the PPKTP crystal set an upper limit on the amount of generated blue light.
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