Tunability of High Power External Cavity Diode Laser Systems

Sandra Stry, Lars Hildebrandt, Joachim Sacher

In the last years, laser-based spectroscopic techniques for trace gas detection have received increasing attention. For some of this spectroscopic techniques high power laser systems with a linewidth of only a few MHz and a mode hope free tuning range of some GHz are required.
So we developed a compact tunable diode laser system in an external cavity design, called TIGER, with an output power of more than 300 mW and a very good beam quality with a beam propagation factor of $M^2 < 1.7$ in both directions. First of all the linewidth of our new laser system and the tuning range were determined. The centre wavelength can be preadjusted between 775 nm and 785 nm. Fine tuning can be achieved via tuning of the external cavity with a piezoelectric transducer. Figure 1 shows the spectrum of the TIGER Laser measured with an optical spectrum analyser and a Fabry Perot interferometer. The Tiger laser system works single mode with a mode hope free tuning range of 4 GHz and a side mode suppression of better than 40 dB.

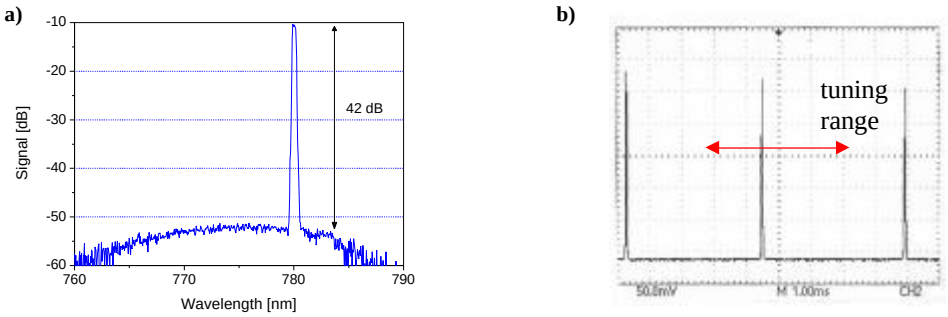

Figure 1: a) Spectrum of the TIGER laser system measured with an optical spectrum analyser
b) Fabry Perot Spectrum (FP) of the TIGER laser system, free spectral range of the FP is 8 GHz

For high resolution spectroscopy a small linewidth is essential. Therefore we determined the linewidth of the TIGER lasersystem via a heterodyne experiment with a Littman laser system, which has a linewidth of lower than 1 MHz in 50 ms. The width of the resulting heterodyne signal is shown in Figure 3. Thus it appears that the linewidth of the high power TIGER laser is in the dimension of 1 MHz in 1 ms sweep time and in the dimension of 12 MHz in 20 s.

To give proof of the suitability for high resolution spectroscopy an absorption spectrum of Rubidium was measured in a simple absorption experiment. As tuning the laser wavelength around 780 nm , the absorption lines of Rubidium can be easily seen by this simple setup (Figure 2). Because of the small linewidth of this laser system the hyperfine structure is resolved.

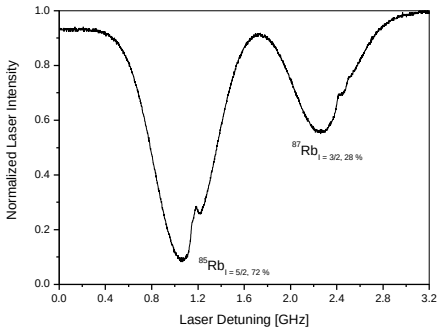

Figure 2: Absorption spectrum of Rubidium, length of the absorption cell: 10 cm

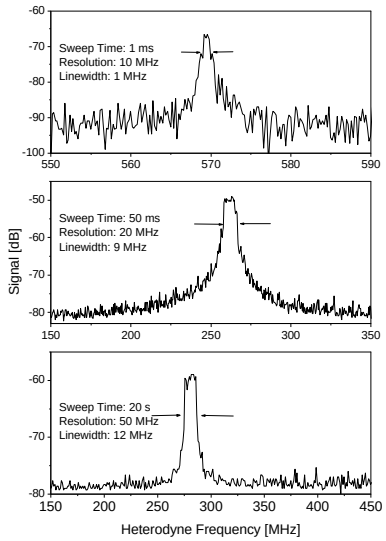

Figure 3: Heterodyne signal of the TIGER laser and a narrowband Littman diode laser for three different time bases.

This measurement shows the high potential of this laser system for the high resolution spectroscopy or for the stabilization of a Bose-Einstein condensate.

Document: http://data.sacher.de/techdocs/TA-Tuning.pdf
Note: Specification are subject to change without further notice .

Sacher Lasertechnik GmbH
Hannah Arendt Str. 3-7
D-35037 Marburg, Germany
Tel.: +49 6421 305290
Fax: +49 6421 305299
Email: contact@sacher.de

Sacher Lasertechnik, LLC
5765 Equador Way
Buena Park, CA 90620, USA
Tel.: 1-714-670-7605
Fax: 1-714-670-7662
Email: sales@sacher-laser.com