

Sacher Lasertechnik

Next Generation Littman/Metcalf

LION™

orator:

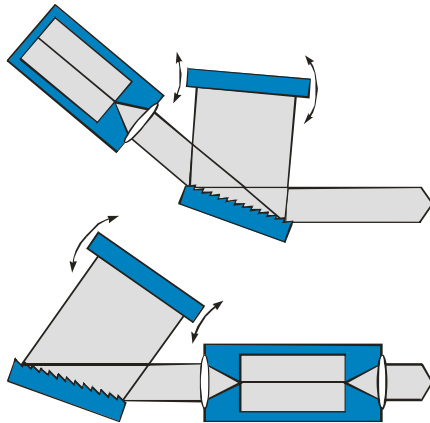


Joachim R. Sacher



(confidential technical documentation)

➤ Cavity Layout



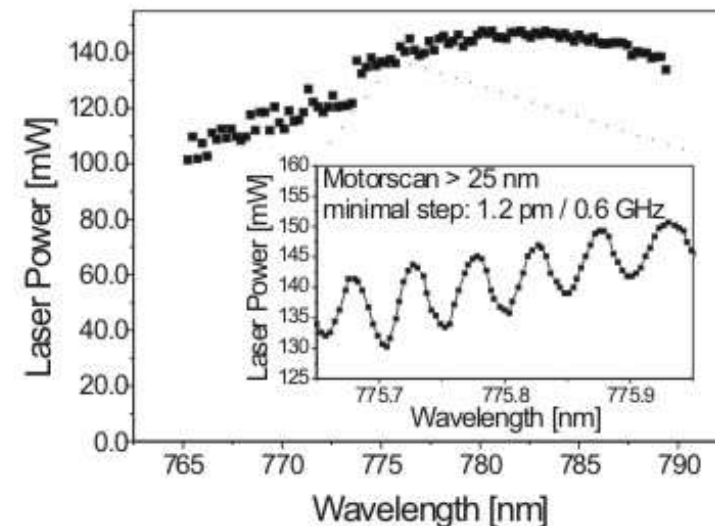
➤ Product Photo



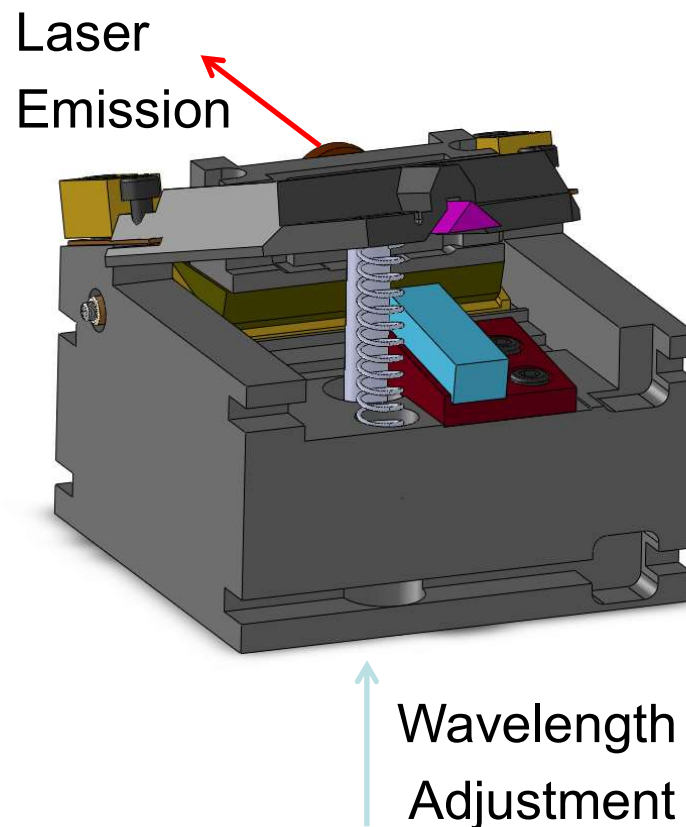
➤ Application

- Optical Cooling & Trapping
- Quantum Dot Spectroscopy
- Interferometry, Holography
- Telecom Quality Control
- Master Laser for MOPA

➤ Motorized Version



➤ Next Generation Littman/Metcalf Cavity



- Excellent Stability
- Low Temperature Drift
- >1.7kHz Cavity Resonance Freq.
- Narrow Linewidth <100kHz

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➤ Alignment Insensitive Laser Cavity

➤ Reflection Prism as Cavity Mirror

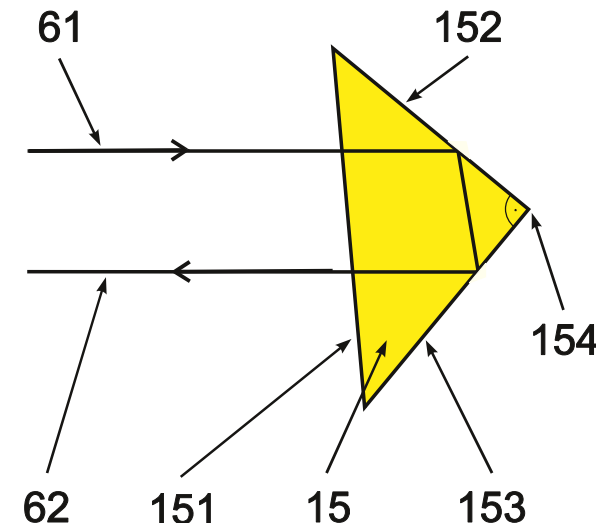
➤ Results:

➤ Ultra Stable Laser Cavity

➤ No Mechanic Disturbance

➤ Hands Off Operation

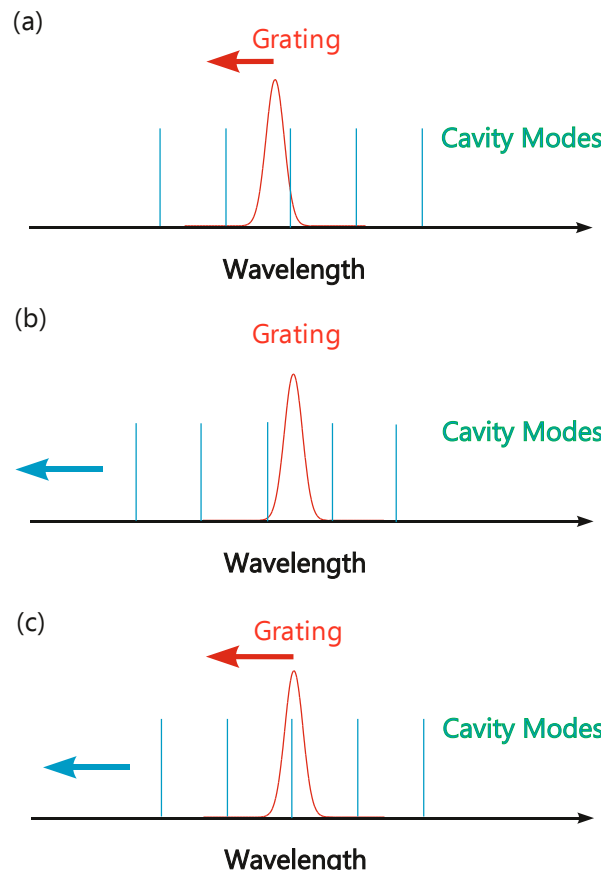
➤ No Servicing Required



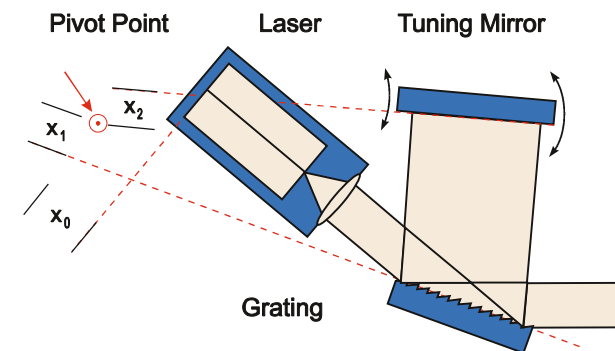
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➤ Tuning Performance

➤ Mode-Hop Free Tuning



➤ True Pivot Point Selection



➤ Exact Choice of x_0 , x_1 , x_2

➤ Synchronization

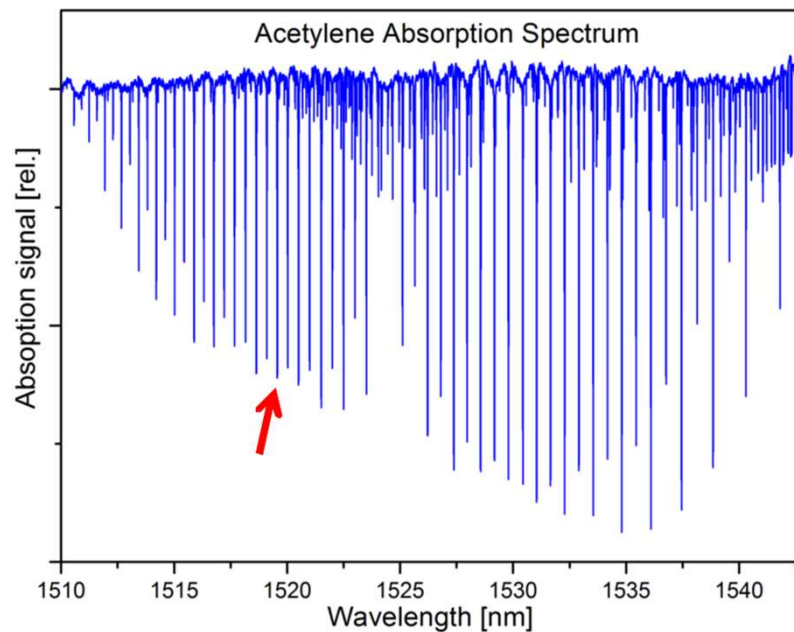
- Cavity Defined Wavelength
- Grating Defined Wavelength

➤ Result:

- 10s of Nanometers Mode-Hop Free Tuning

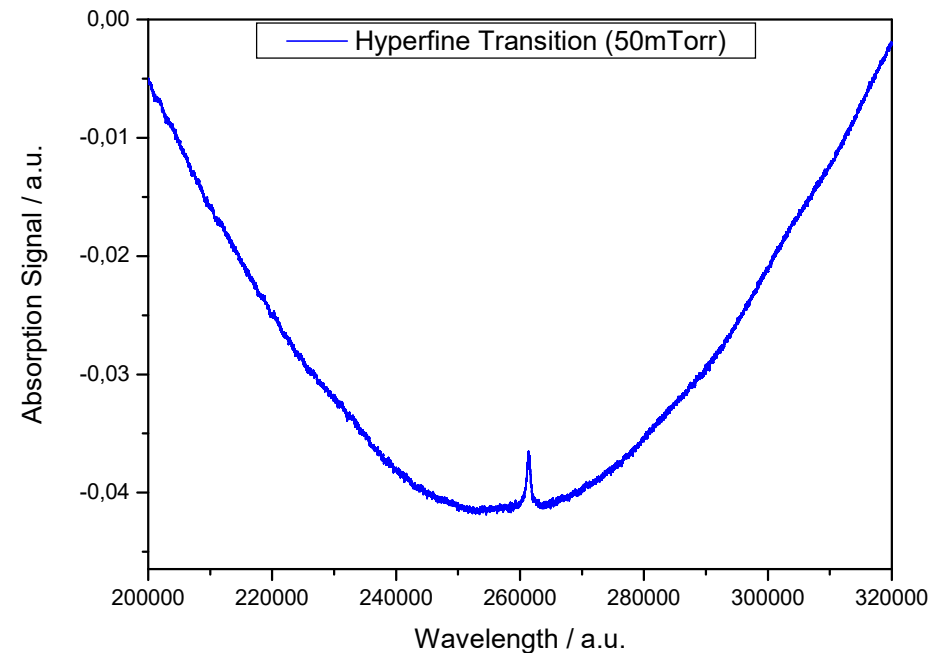
➤ Application Example: Acetylene Spectrum

➤ Spectrum Recorded via DC-Motor Tuning



➤ Complete Spectrum
no missing lines

➤ Spectrum Recorded via Piezo Fine Tuning

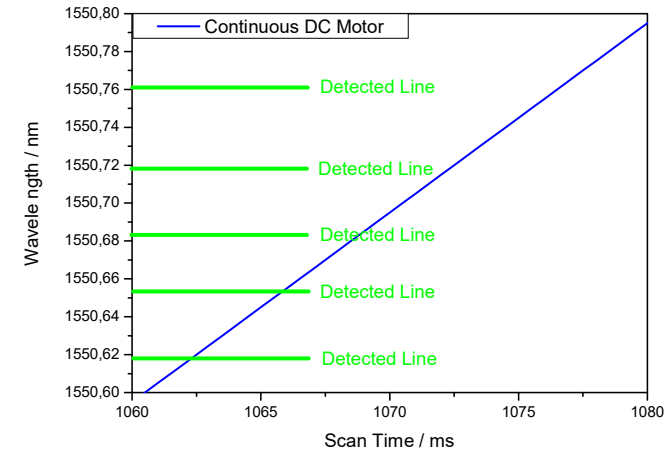
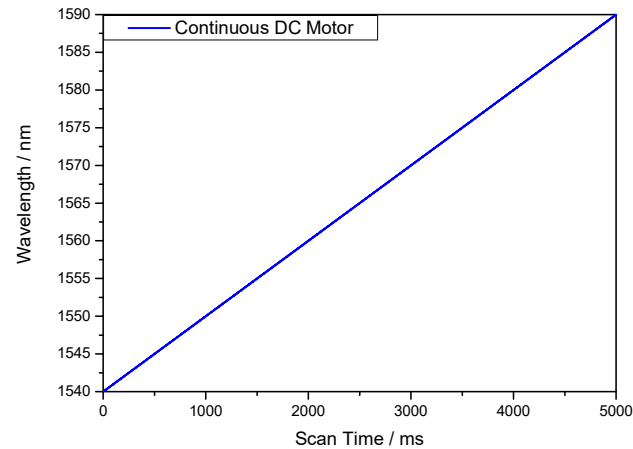


➤ Hyperfine transition
clearly resolved

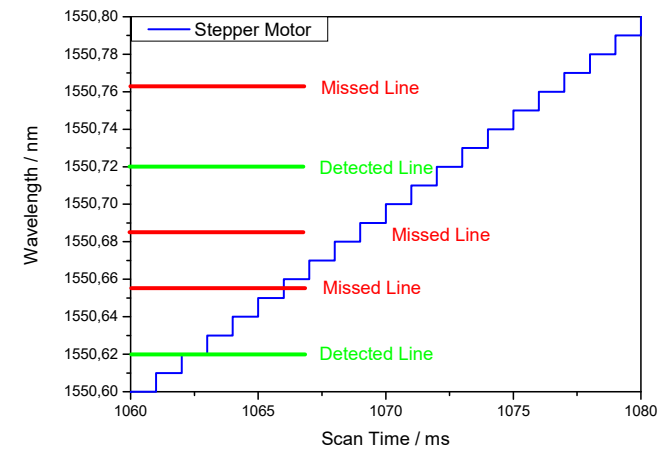
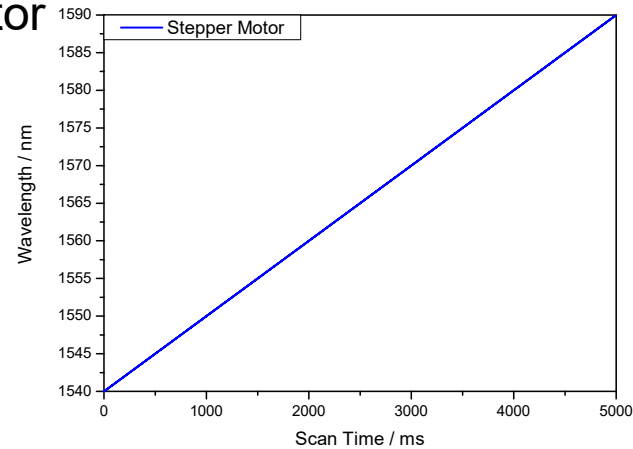
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➤ Truly Continuous Wavelength Tuning via DC Motor

➤ DC Motor



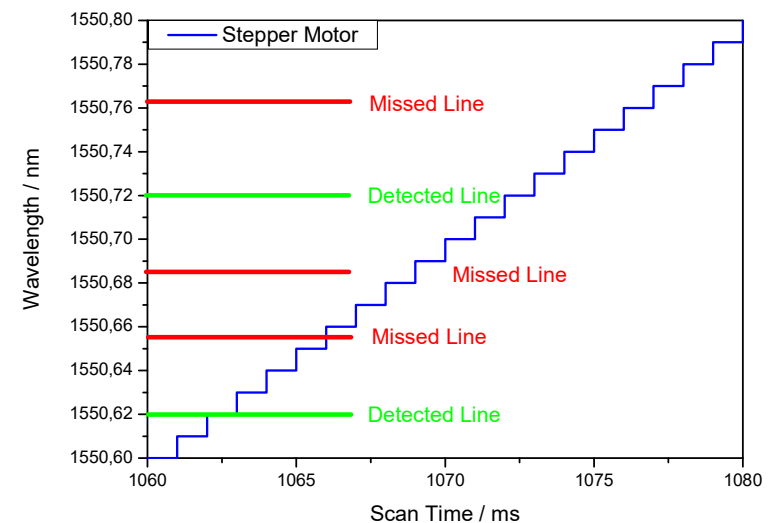
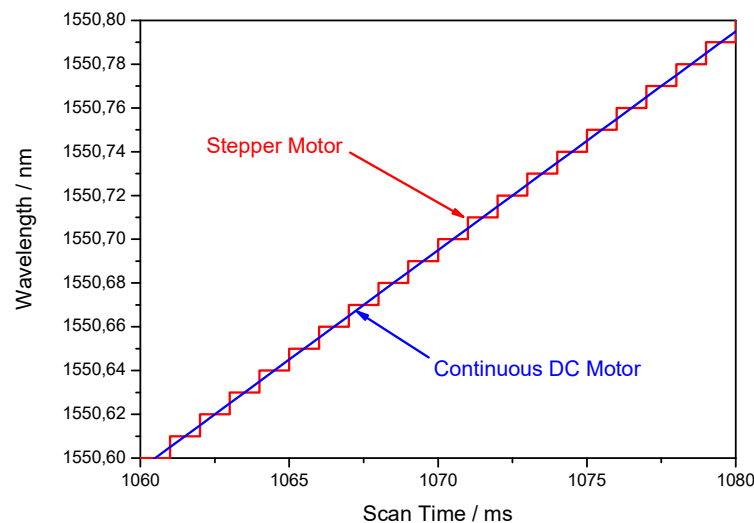
➤ Stepper Motor



➤ DC Motor Tuning is the preferred solution

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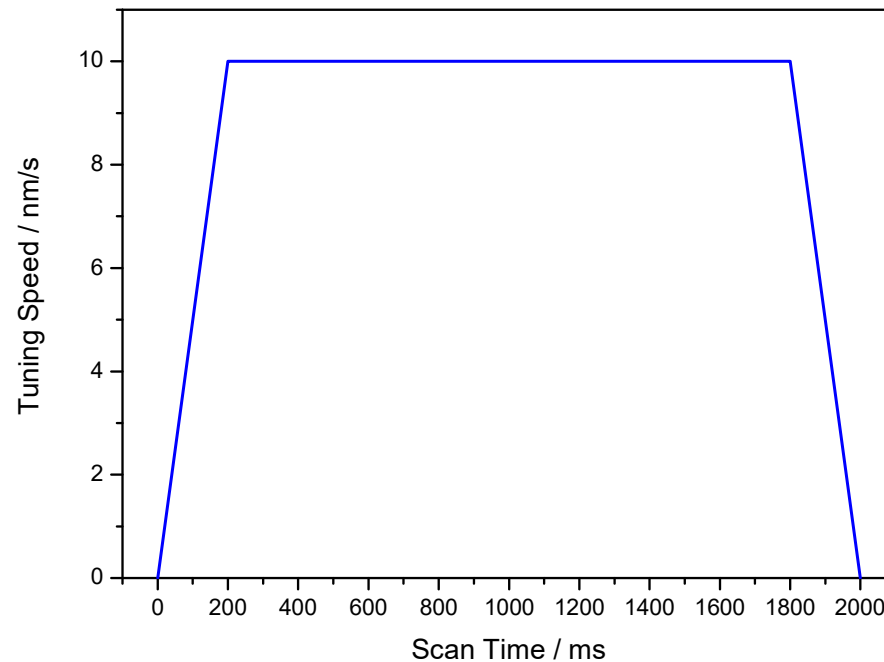
- Comparison between DC Motor and Stepper Motor
- Each Step of the Stepper Motor causes a Mode-Hop



- Typical size of a Mode-Hop of a Stepper Motor driven system is in the order of 3 GHz, depending on the Mode-Spacing of the External Cavity.
- Depending on the speed of the detection system, Mode-Hops may not be obvious within the records. Results may be incomplete due to missing spectral lines.
- Sacher Lasertechnik decided only to supply DC Motor driven Laser Systems

➤ DC Motor Tuning Features

➤ Acceleration and Deceleration Behavior



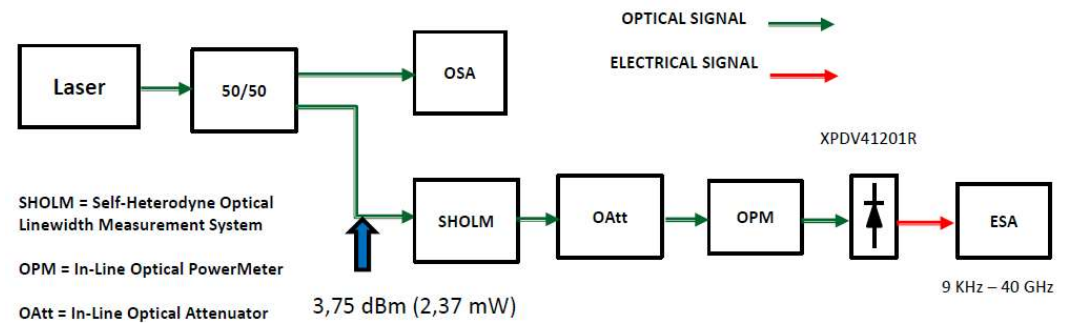
- DC Motor tuning requires a Acceleration and Deceleration period before reaching the preset tuning speed.
- Tuning Speed and Acceleration, Deceleration parameters can be set via Software.

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➤ Linewidth Measurement

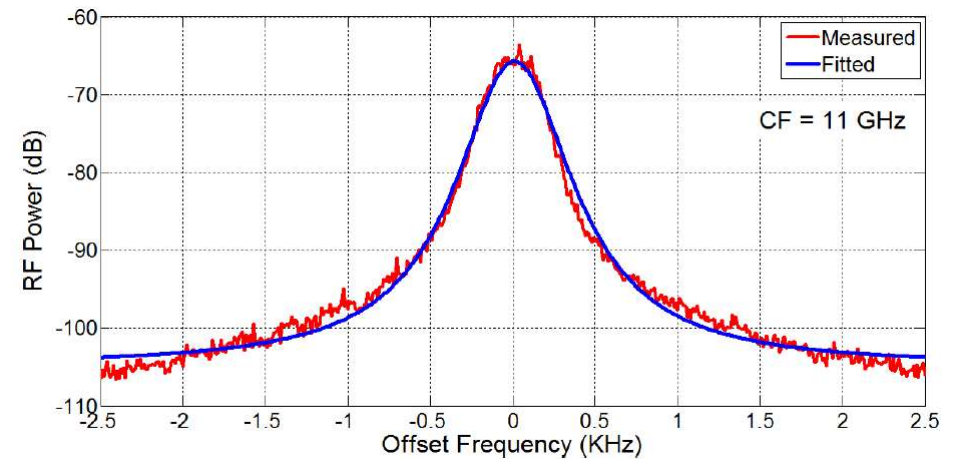
➤ Measurement Setup

- Self-Heterodyne Setup
- Laser: 1550nm



➤ Test Results

- Linewidth: 15 kHz (Lorentz Fit)
- Scan Rate: 1ms / div.
- RBW: 1kHz



Data provided by G. Carpintero, Univ. Carlos III, Madrid

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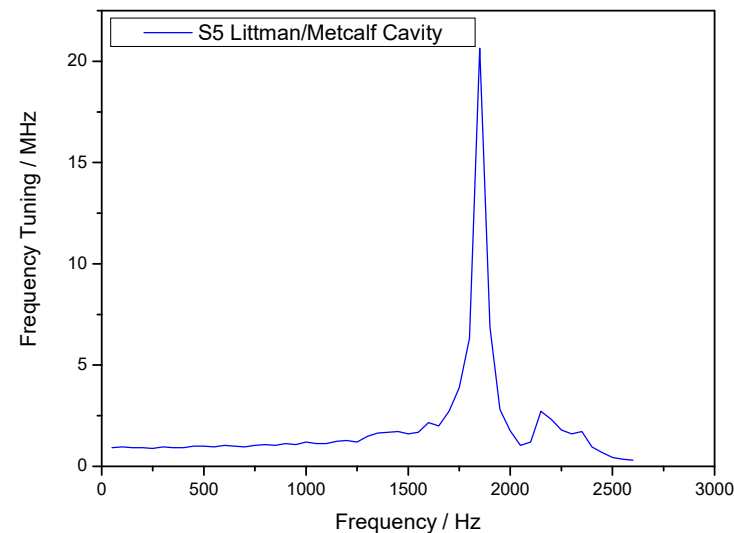
➤ Mechanic Cavity Resonance

➤ Measurement Setup

- Heterodyne Beat Setup
- Laser 1: 30 kHz Littrow Cavity Laser (not modulated)
- Laser 2: Littman/Metcalf, 5mV Piezo Modulation
- Detection: Linewidth Enhancement via Modulation

➤ Mechanic Resonances

- No resonances below 1.7kHz
- 1st resonance 1.85kHz



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➤ Micro Controller Operated Laser Controllers

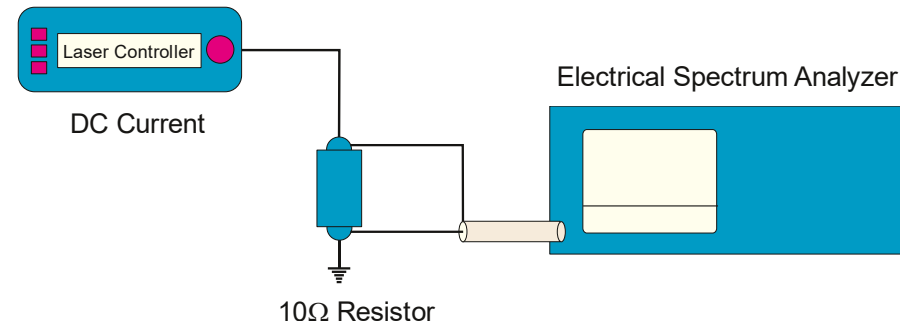
- Sub μ A Noise Figure
- Up to 4000mA Laser Current
- Integrated Function Generator
- Integrated Piezo Amplifier
- Fully Remote Control Features
- USB, GPIB, RS232
- Laboratory and OEM Versions



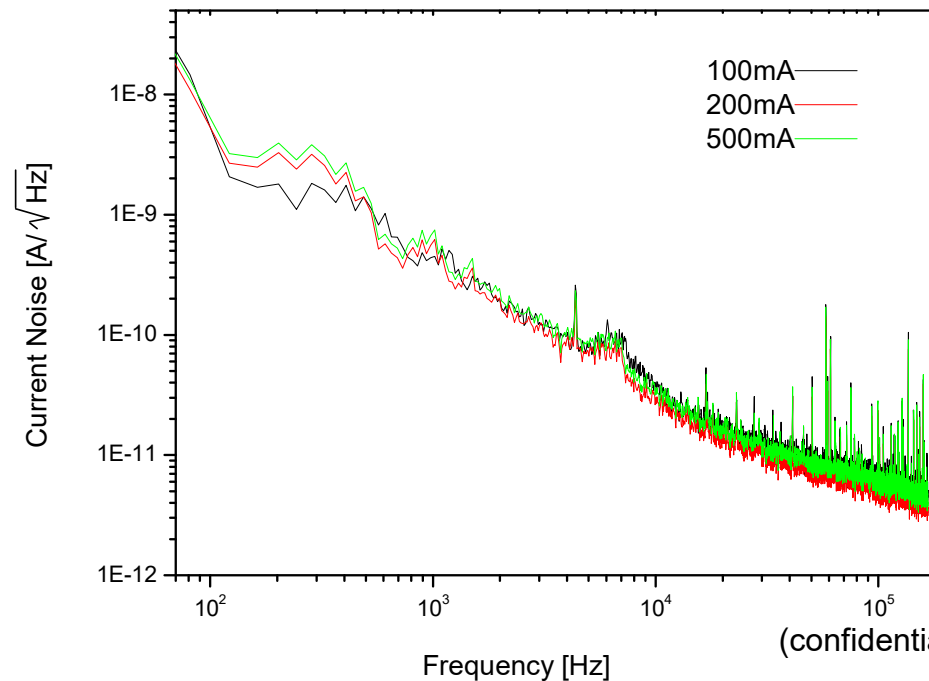
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Low Noise Laser Controllers

- Laser Diode Current
- Sub μA Noise Figure



Pilot PZ 500 Noise Spectrum

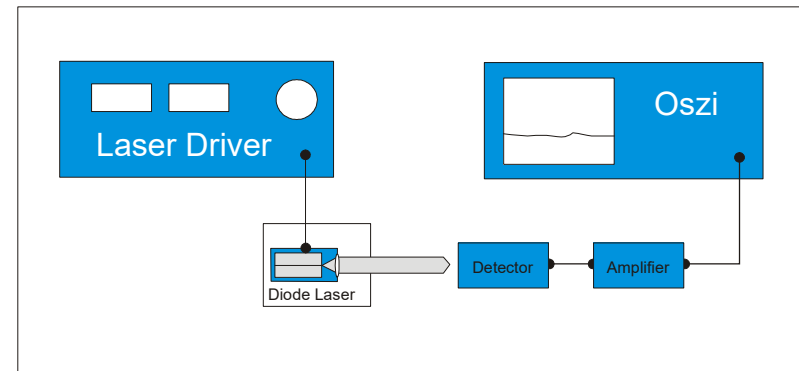


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➤ Realitive Intensity Noise

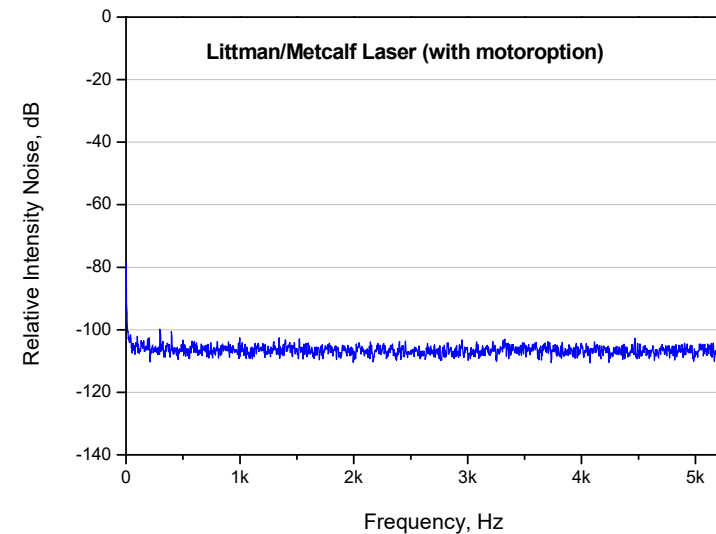
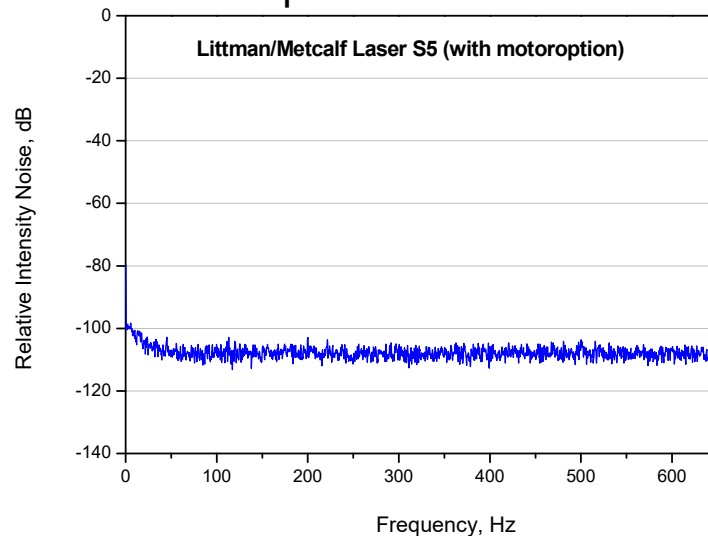
➤ Measurement Setup

- Laser Controller (PilotPZ 500)
- 20MHz Photoreceiver
- 12 bit Digital Oscilloscope with FFT



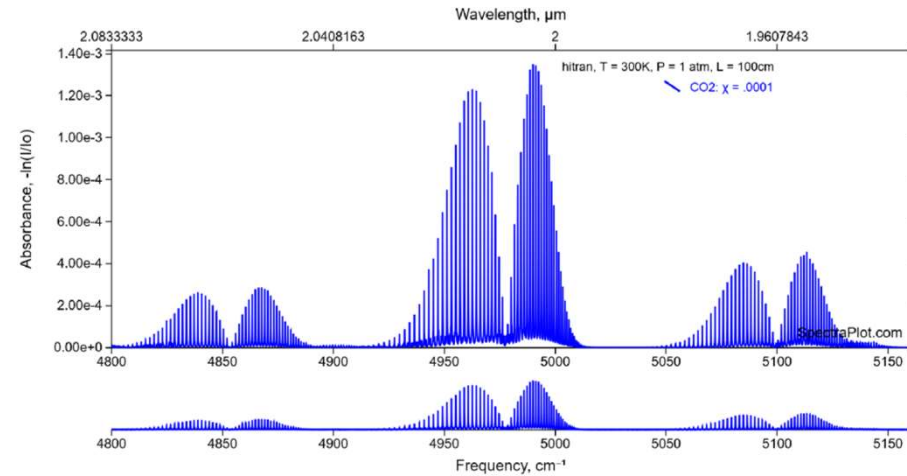
➤ Test Results

➤ RIN Spectrum

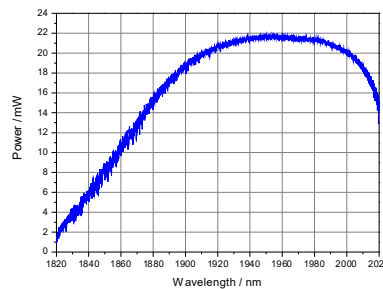


➤ Application Example: Carbon Dioxide

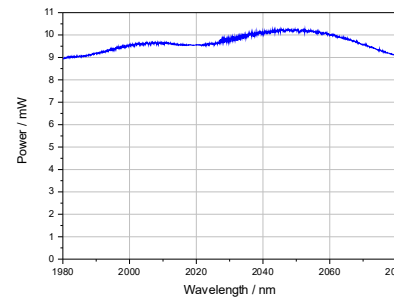
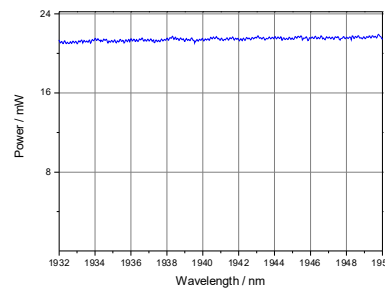
➤ CO₂ Absorption Spectrum



➤ Matching Laser Systems



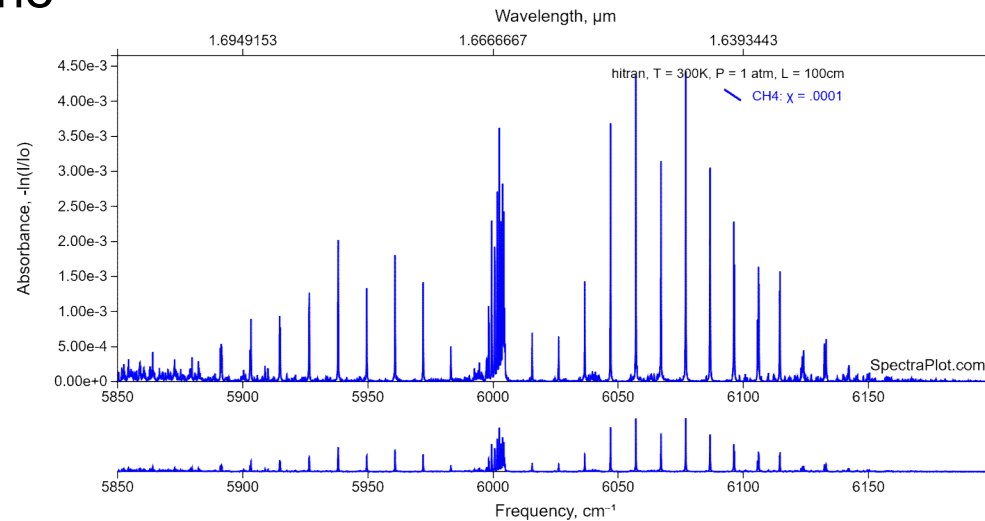
1900nm .. 2020nm



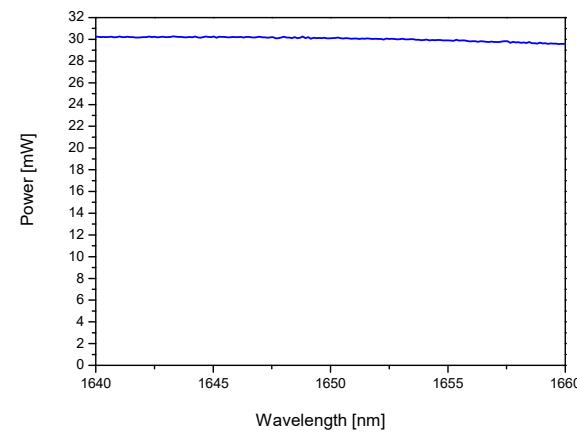
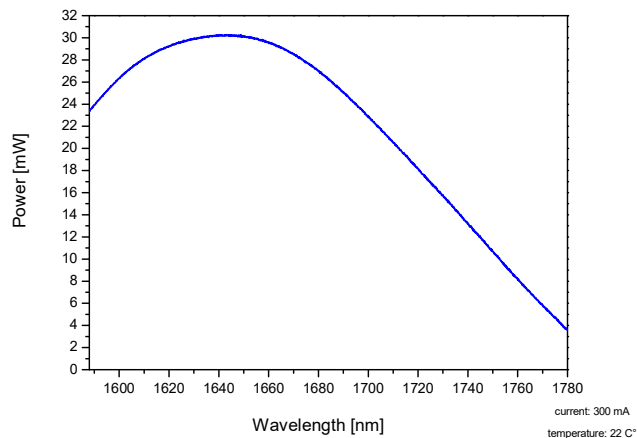
1980nm .. 2080nm

➤ Application Example: Methane

➤ CH₄ Absorption Spectrum

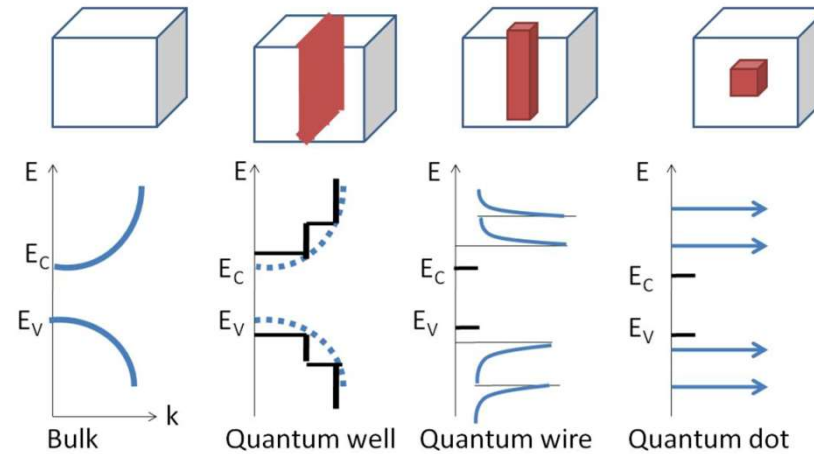


➤ Matching Laser System

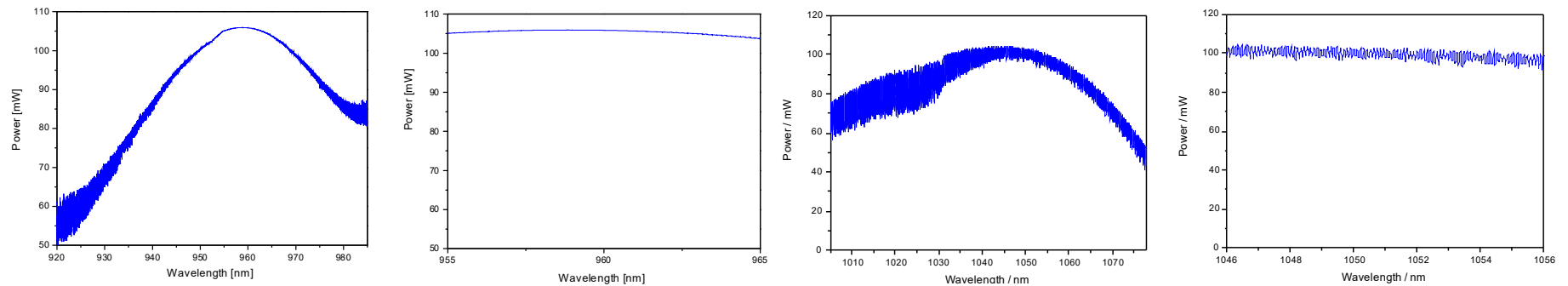


➤ Application Example: Quantum Dot Spectroscopy

➤ Schematic

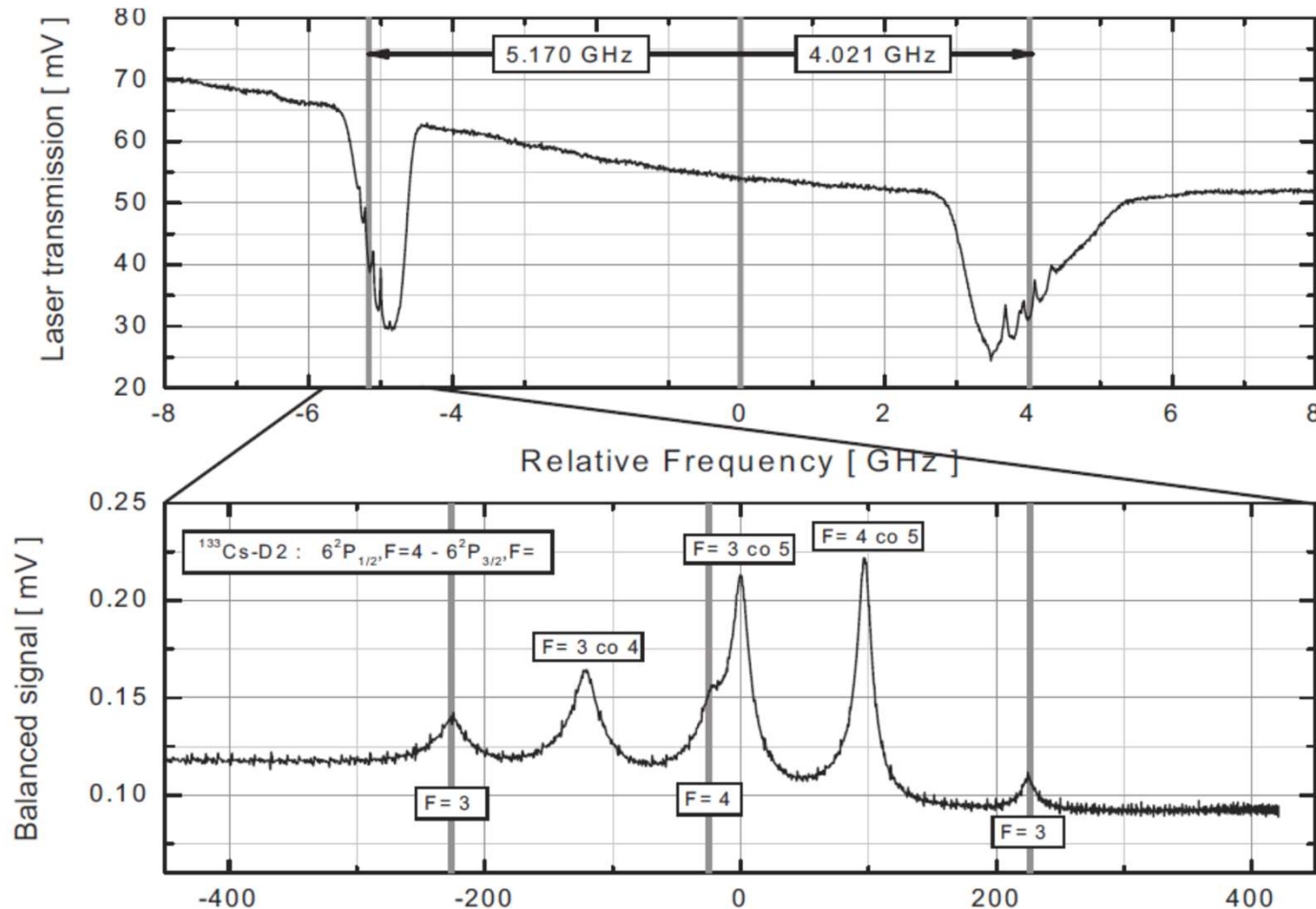


➤ Examples for Matching Laser Systems



➤ Application Example: Cesium Spectroscopy

➤ Cs D2 Spectra



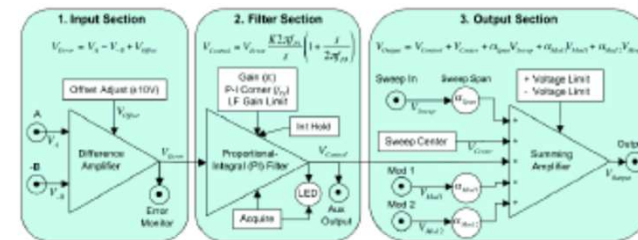
➤ High Frequency PI Regulator

- 10MHz Bandwidth
- Adjustable Corner Frequencies
- Integration Hold Function
- Low Frequency Gain Limit
- FPGA Controlled Operation
- Fully Remote Control via USB

➤ Application: Laser Stabilization

- Optical Cooling & Trapping
- Linewidth Narrowing

➤ Principles of Operation



➤ Product Photo



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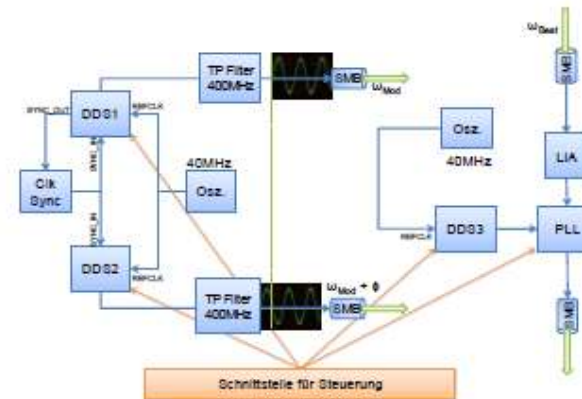
➤ High Frequency Synthesizer

- Central 3GHz Clock
- 2 DDS Synthesizer
- 100kHz to 100MHz Modulation
- ns Phase Adjustment
- High Frequency Mixer
- High Modulation Amplitude
- Fully Remote Control via USB

➤ Application: Laser Stabilization

- Pound Drever Hall Lock
- Optical Cooling & Trapping
- Linewidth Narrowing

➤ Principles of Operation



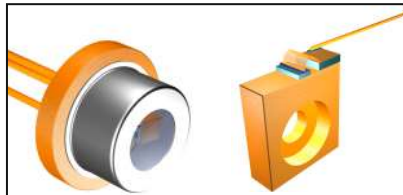
➤ Product Photo

➤ Sacher Lasertechnik Headquarter

- Space 1200m²
12900 square ft.
- 30 employees at location



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AR Coated Laser Diodes



DFB Laser Diodes



DFB Laser Diodes



ns Pulsed Laser System



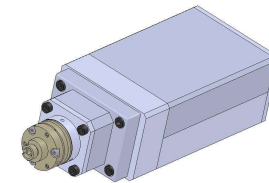
Laser Controller



Laser Controller



Laser Controller



ps Mode Locked Laser



Micro Cavity Laser



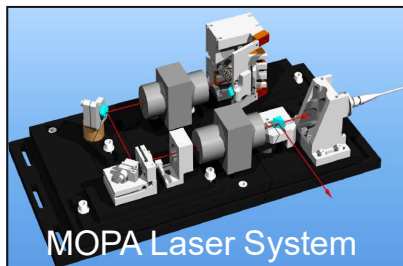
Littrow Laser System



Littman Laser System



Laser Amplifier System



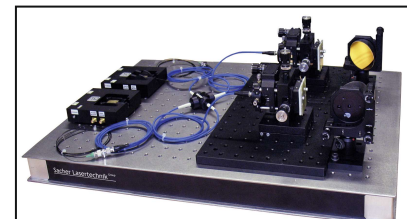
MOPA Laser System



MOPA Laser System



SHG Laser System



THz Laser System

➤ Thin Film Coating Equipment

➤ Sputter Coater

- High Volume Production
- R&D Coatings

➤ E-Beam Coater

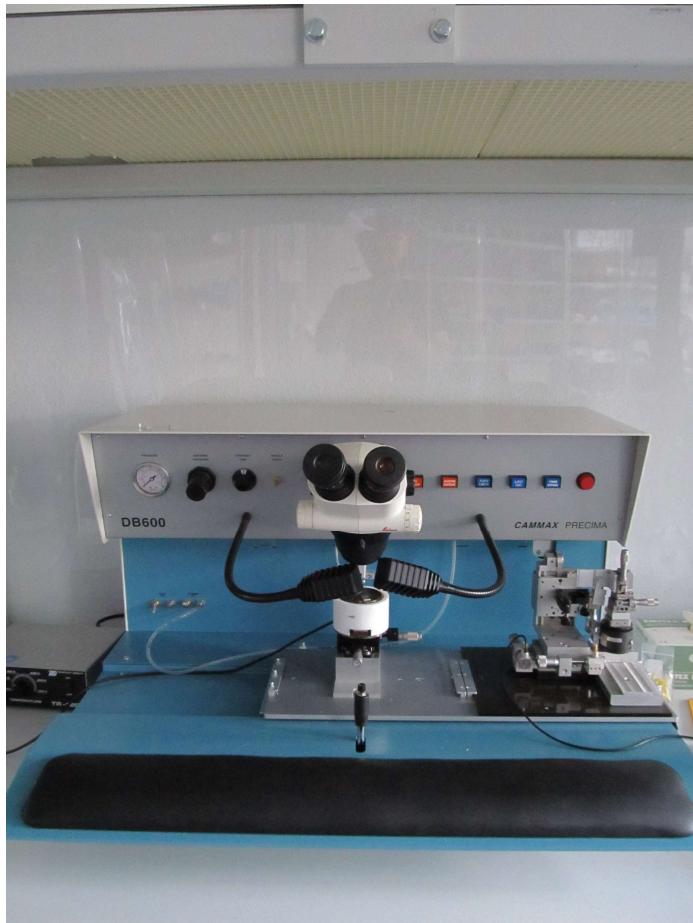
- R&D Coatings



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➤ Dye Bonder

➤ Laser Chip Mounting



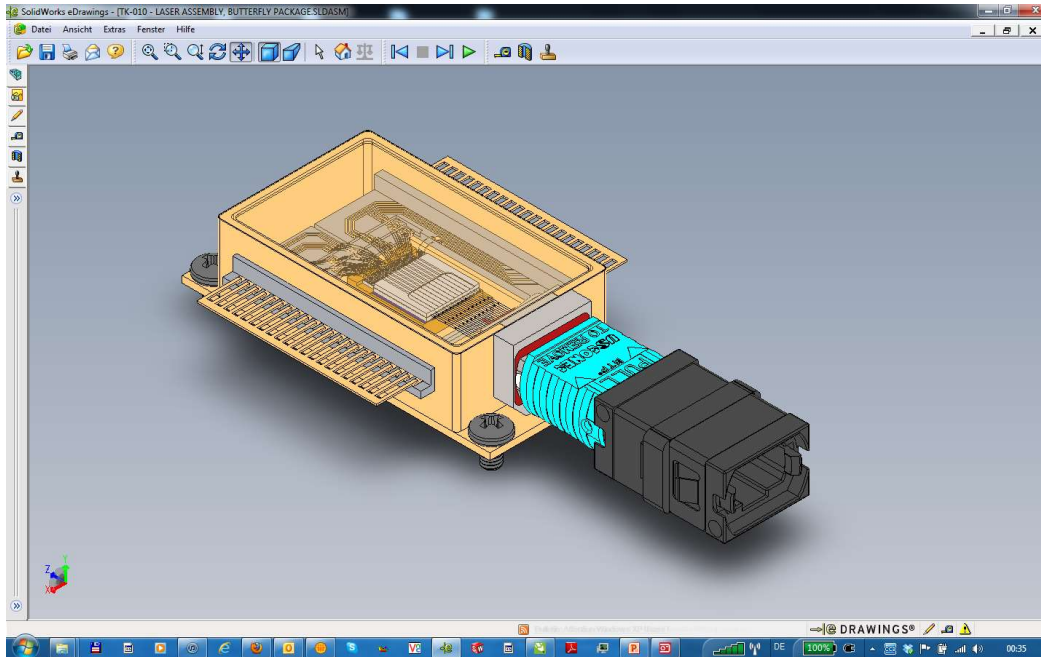
➤ Wire Bonder

➤ Laser Chip Electrical Connection

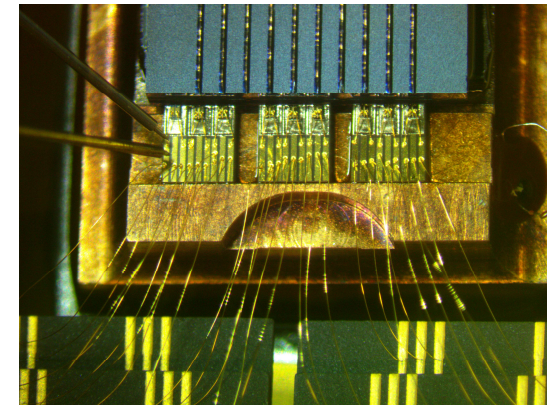


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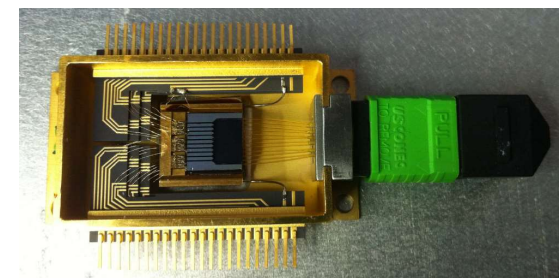
➤ Multi-Emitter Fiber Coupling



➤ Up to 12 Single Mode Emitters Fiber Coupled



➤ Multi-Wavelength Emitter
➤ Fiber Coupled



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➤ Micro External Cavity



- Compact Package
- Excellent Stability
- No Moving Parts
- No Mechanic Cavity Resonances
- Narrow Linewidth
- Low Temperature Drift

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▶ *Thank You For Your Attention!*

Sacher Lasertechnik Group

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