

## Press Release

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January 15, 2008

### Coherence control over nine orders of magnitude New modules for both laser linewidth reduction and broadening

TOPTICA Photonics AG introduces two new modules that serve to control the linewidth of tunable diode lasers. The Fast Analog Linewidth Control module FALC 110 is a high bandwidth regulator for laser linewidth reduction and fast frequency locking. The Laser Coherence Control unit LCC, by contrast, provides a modulation source to broaden the laser linewidth up to GHz ranges, maintaining single-line emission and spectral control.

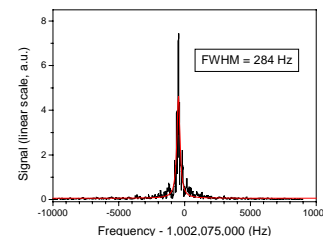
Numerous applications in precision spectroscopy, quantum optics or metrology require fast frequency stabilization loops, and a reduction of the linewidth of Distributed Feedback (DFB) or external-cavity diode lasers (ECDLs, typical linewidth ca. 1 MHz). The high-speed control amplifier FALC 110, part of TOPTICA's established DC 110 series, is ideally suited for these tasks. The module comprises a PID regulator with 10 MHz bandwidth to control the driver current of an ECDL or DFB laser. Additionally, a slow integrator serves to cancel out long-term frequency drifts, by acting either on the grating piezo of an ECDL, or on the current or temperature of a DFB system. The overall design was optimized with respect to a fast circuit layout (signal delay times < 15 ns), and controller parameters can be widely varied without compromising regulator bandwidth.

One important application is the stabilization of the frequency of a tunable diode laser to the transmission peak of a high-finesse interferometer. Tests performed with leading researchers in the field have proven that linewidths below 1 Hz could be realized, even on a time scale of several seconds.

On the other hand, certain tasks demand just the opposite: increasing the spectral line in a well-controlled way, in order to match the laser emission e.g. to Doppler-broadened absorption profiles of gaseous molecules or atoms. TOPTICA's other new module, LCC, accomplishes just that: Via a dedicated current modulation scheme, the output of an ECDL or DFB laser is broadened, while spectral control and tuning properties are maintained. This allows the researcher to tailor the



Fast analog linewidth control module FALC 110: Linewidths below 1 Hz are possible.



Beat measurement of two TOPTICA DL pro lasers, stabilized to a commercial Fabry Perot cavity (FPI 110) with the new FALC 110. The beat linewidth is < 300 Hz.

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coherence length of his laser to any value between 100 m and a few cm. At the same time, the laser line center may remain tuned to e.g. a molecular absorption line.

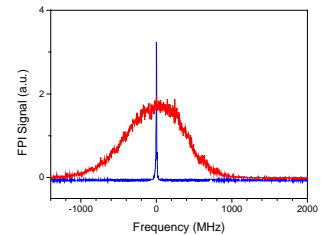
The compact LCC unit provides a modulation output up to 30 dBm (1 W), which can be attenuated in steps of 1 dB (0 .. -61 dB). The output is fed to an AC-coupled modulation port of a tunable ECDL or DFB laser head. Using the LCC in conjunction with a TOPTICA DL DFB, spectral widths up to 3 GHz were realized, corresponding to a minimum coherence length of only 4 cm.

Application examples of the LCC are optical pumping of metastable Helium-3 (1083 nm, linewidth 2 GHz), or seeding of high-power fiber amplifiers whilst avoiding unwanted nonlinear effects.

With TOPTICA's new modules FALC 110 and LCC, the coherence length and linewidth of tunable diode lasers can thus be varied over more than nine orders of magnitude – from sub-Hertz levels into GHz ranges (coherence length 130 000 km .. 4 cm).



Laser coherence control unit  
LCC 110.



Mode spectrum of a TOPTICA DL DFB laser. Blue: 1 MHz linewidth without modulation, red: Linewidth broadening to 900 MHz using the LCC 110.

*TOPTICA Photonics AG develops, manufactures, services and distributes technology-leading diode and fiber lasers and laser systems for scientific and industrial applications. Sales and service is offered worldwide through TOPTICA Germany and its subsidiary TOPTICA USA, as well as all through 13 distributors. A key point of the company philosophy is the close cooperation between development and research to meet our customers' demanding requirements for sophisticated customized system solutions and their subsequent commercialization.*

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