Ultra-Stable Clock Laser for Real-World Quantum Applications

TOPTICA's CLS delivers 10^{-15}-level frequency stability in a robust, deployable system

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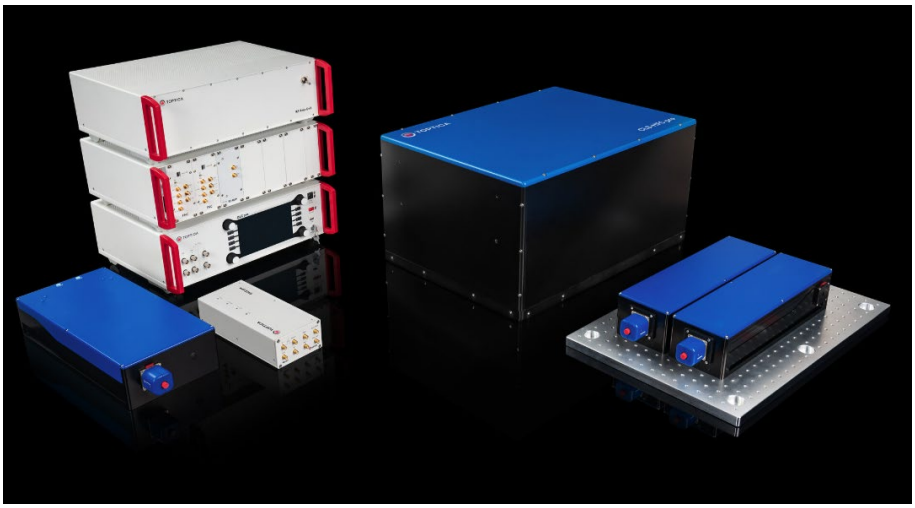
TOPTICA Photonics is strengthening its position in ultra-stable laser technology with its Clock Laser System (CLS), designed to deliver reliable and ultra-low phase noise optical frequency references for quantum technologies, precision metrology, and advanced sensing.



CLS Tabletop-Setup: TOPTICA's ultra-stable "CLS" lasers yield highest frequency stability far beyond 1 second integration time to drive very narrow optical transitions in atoms like Yb, Sr or ions like Yb+, Sr+, Ca+, and Ba+ or even in Th nuclei.

As quantum applications transition from research labs to real-world deployment, demand is growing for laser systems that combine highest frequency stability with operational robustness. The **CLS** addresses this need by integrating narrow-linewidth external cavity diode laser technology with a highly stable optical reference.

"Our focus was to combine ultimate frequency stability with a system design that is robust and practical to operate. This enables users to benefit from ultra-stable laser performance without the complexity and maintenance efforts of laboratory setups," says Dr. Florian Schäfer, Development Engineer Laser Reference at TOPTICA.

The system achieves frequency instabilities at the 10^{-15} level and phase noise levels down to -90 dBc/Hz. It is engineered to minimize environmental influences such as temperature fluctuations, vibrations, and optical power variations. This ensures stable operation over extended periods, even outside controlled laboratory environments.

Available in both tabletop and rack-mounted configurations and across a wide wavelength range, the CLS can be flexibly integrated into applications including optical atomic clocks, quantum computing, quantum simulation, and optical frequency combs.

Further details are presented in the **white paper** *"Design, Implementation, and Performance of the TOPTICA Clock Laser System"* by Dr. Florian Schäfer, Dewni Pathegama, and Dr. Filippo Bregolin, describing the system design, stabilization approach, and performance validation of the CLS.

About TOPTICA

TOPTICA Photonics develops and manufactures high-end laser systems for more than 25 years. Its portfolio includes optical quantum clocks, rack-integrated laser systems, optical frequency combs, diode lasers, ultrafast fiber lasers, terahertz systems, as well as continuous-wave fiber lasers and amplifiers.
The company employs more than 600 people worldwide across seven business units and operates more than 8,000 m^2 of production space, generating annual revenues exceeding €140 million.

TOPTICA Photonics SE
Lochhamer Schlag 19
82166 Graefelfing
Germany
www.toptica.com

PR Contact
Mr. Jan Brubacher
+49 89 85837-123
jan.brubacher@toptica.com