

SINGLE-FREQUENCY LASER *for research*

Features

- ▶ High-power output
- ▶ Broad-wavelength selection
- ▶ Narrow-linewidth single frequency spectrum
- ▶ Excellent spatial quality

Applications

- ▶ Laser cooling
- ▶ Rydberg transitions
- ▶ Optical traps
- ▶ Raman gates
- ▶ Optical clock transitions



*Vertical-external-cavity surface-emitting laser (VECSEL)
a.k.a. Optically pumped semiconductor laser (OPSL)*

Specification	VALO SF	VALO SHG
Architecture	Direct emitting VECSEL	Intracavity doubled VECSEL
Gain	Optically-pumped semiconductor gain mirror	
Target wavelength	700 – 2150 nm	350 – 800 nm
Free-space output power ¹	0.5 – 10 W with integrated pump laser	0.01 – 3 W with integrated pump laser
Coarse tuning ²	5 – 100 nm	0.5 – 10 nm
Mode-hop free tuning range ³	> 1 GHz	> 2 GHz
Free-running linewidth (typical)	< 100 Hz (instantaneous), < 10 kHz (RMS, 10 μs), < 100 kHz (RMS, 100 μs)	
Slow modulation (typical)	Piezoelectric element on cavity mirror, 10 kHz bandwidth, 50 MHz/V modulation depth	
Fast modulation (typical, optional)	Intra-cavity electro-optical modulator (EOM), 1 MHz bandwidth, 50 kHz/V modulation depth	
RMS RIN (typical, unlocked)	< 0.05 % (10 Hz – 3 MHz)	
Long-term power stability (unlocked)	< 0.1 % (1.5 h)	
Optical signal-to-noise ratio (typical)	> 70 dB	
Beam quality ⁴	$M^2 < 1.1 \text{ TEM}_{00}$	
Beam diameter and divergence ⁴	< 1.5 mm, < 5 mrad	< 1.5 mm, < 8 mrad
Polarization, linear	Horizontal, p-polarized	Vertical, s-polarized
Secondary output beam	Not applicable	Fundamental λ (horizontal, p-pol.)
Polarization extinction ratio (PER)	> 20 dB, linear polarization	
Laser head dimensions	320 mm x 190 mm x 101 mm (6.1 L; 3U height requirement, breadboard mountable)	
Control electronics ^{5,6}	Control Unit for CW operation, height 3U + 1U for ventilation	
Cooling ⁶	Water-to-air chiller, height 4U. Water-to-water and other form factors optional	

¹ Output power is wavelength dependent. See the next page for typical power levels. Single-stage isolator is recommended for applications with back reflections.

² Coarse tuning range is wavelength and output power dependent. Maximum 10 THz tuning range corresponds to the typical gain bandwidth.

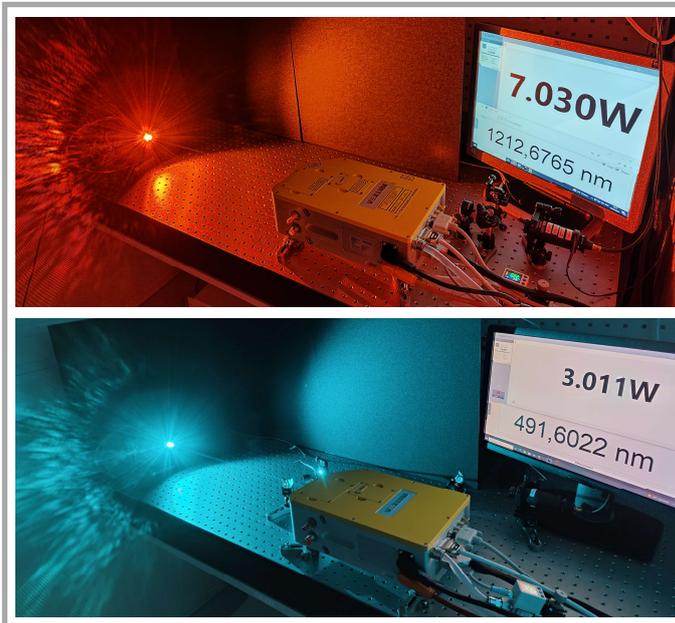
³ Mode-hop free tuning range corresponds to the laser cavity free-spectral range scanned with piezo voltage control. Larger tuning range can be reached by adjusting other tuning elements simultaneously.

⁴ Typical values at the laser exit aperture. Beam diameter = full width at 1/e² level of the beam. Divergence = full mean divergence angle. Values depend on the laser cavity configuration, i.e. the wavelength.

⁵ The control unit includes a low noise laser diode driver for the pump laser, and up to 5 cavity element temperature controllers, which can be used for wavelength tuning and power optimization.

⁶ The control unit and the standard water-cooling unit are 19" rack mountable.

Turnkey single-frequency laser system for AMO research



Versatile VECSEL platform

- ▶ Designed to meet the diverse needs of the atomic, molecular and optical (AMO) physics research community
- ▶ High output power with excellent beam quality, with small SWaP-C, thanks to simple disk laser geometry
- ▶ Efficient ("3-in-1") seed, amplification, and intra-cavity second harmonic generation (SHG) for unparalleled power at visible wavelengths
- ▶ Proven sub-Hz linewidth using intracavity EOM
- ▶ Tunable output wavelengths for spectroscopy

