Matisse® 2

ULTRA-NARROW LINEWIDTH TUNABLE RING LASER

The Spectra-Physics® Matisse® 2 series is a family of state-of-the-art single frequency ultra-stable, narrow linewidth tunable ring lasers. The Matisse 2 system has the industry's highest output power, the narrowest external linewidth, the broadest tuning range, and the most flexible architecture.

Coupled with the Millennia® eV™ pump laser, the Matisse 2 produces over 6.5 W of output power. With flexibility to be configured for either Ti:Sapphire or dye as the laser gain medium, Matisse 2 provides an unprecedented tuning of >470 nm and linewidths ranging from 20 MHz down to 30 kHz.

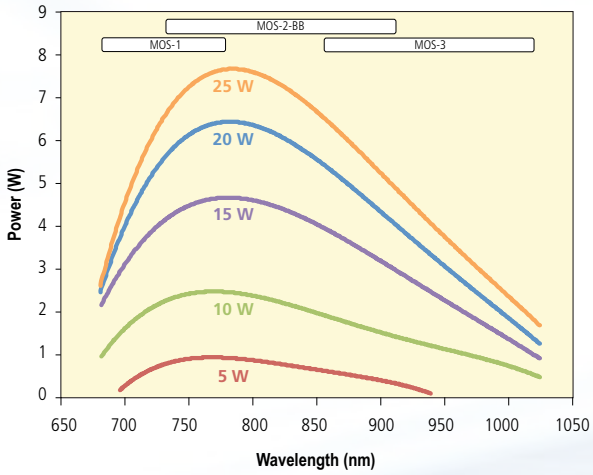
The Matisse 2 Advantage

- *Highest output power available >6.5 W*
- *Narrowest linewidth <30 kHz*
- *Field-upgradeable to dye or Ti:Sapphire gain medium*
- *Wavelength tuning of resonator over 50 GHz*
- *Dust-sealed housing and massive steel baseplate*
- *Fast Digital Signal Processing (DSP) with open-source software*
- *Sapphire dye jet nozzle*
- *Fully automated*

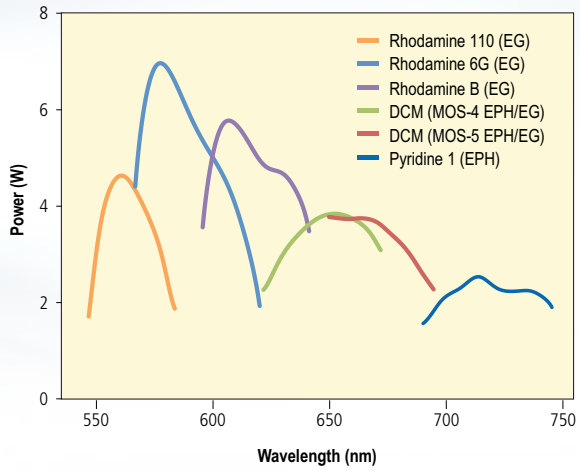
Applications

- *High-resolution spectroscopy*
- *Atom cooling and magneto-optic trapping (MOT)*
- *Atomic clocks*
- *Bose-Einstein condensates*

Typical Ti:Sapphire Tuning Curves[1]



Typical 25 W Pumped Dye Tuning Curves[1]



1. Typically measured performance; not a guaranteed or warranted specification.

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Matisse® 2

Matisse 2 TR and DR

The Matisse 2 "R-Series" ring laser with its mechanically "quiet" design provides excellent passive stability and noise free, single-frequency operation. Electronically controlled wavelength-selecting elements—a birefringent filter, a thick etalon, and a thin etalon—keep the laser centered on a single longitudinal mode. This enables long, mode-hop-free wavelength scans while maintaining constant, low-noise output power levels.

The Matisse 2 TR Ti:Sapphire ring laser provides a spectral linewidth of <4 MHz and can be readily upgraded to the higher resolution Matisse 2 TS. In fact, because of its modularity, any Matisse 2 laser can be field upgraded to either a Ti:Sapphire or dye gain medium, or to a configuration with higher resolution – from an R-Series to an S-Series or an X-Series.

Matisse 2 TS and DS

The Matisse 2 "S-Series" actively-stabilized ring laser incorporates an external reference cavity with feedback to a cavity-length-stabilizing fast piezo-driven mirror. To guarantee a truly independent frequency feedback signal, the reference cavity is thoroughly isolated against thermal and mechanical perturbations and is fiber coupled outside the laser housing.

The Matisse 2 TS actively-stabilized Ti:Sapphire ring laser has an internal spectral linewidth of <50 kHz, while the Matisse 2 DS dye ring laser provides a spectral linewidth of <250 kHz.

Matisse 2 TX and DX

The Matisse 2 "X-Series" ring laser provides spectral linewidths to below 30 kHz for the Ti:Sapphire active gain medium, and 100 kHz for the dye laser. This ultra-narrow linewidth is the result of very fast cavity length stabilization with a response bandwidth in the MHz range. This is achieved by use of an intra-cavity electro-optic modulator (EOM).

Also key to achieving this ultra-narrow linewidth is the feedback error signal from the external reference cavity using the Pound-Drever-Hall stabilization scheme and a high finesse external reference cavity. Pound-Drever-Hall provides an unambiguous measure of wavelength position uninfluenced by laser intensity fluctuations.

Matisse 2 TX-light

The Matisse 2 TX-light fills the linewidth gap between the Matisse 2 TS and the Matisse 2 TX. It utilizes the Pound-Drever-Hall locking technique and the high-resolution reference cavity of the TX to provide the feedback signal to the fast Piezo-driven mirror of the TS. The negligible sensitivity of the Pound-Drever-Hall method to intensity fluctuations, as well as the extremely stable locking it provides, lead to laser linewidths of less than 60 kHz.

Open cavity Matisse 2 TX showing intra-cavity EOM for fast cavity length stabilization.

Matisse 2 TX with separate high-finesse reference cavity with Pound-Drever-Hall feedback scheme.

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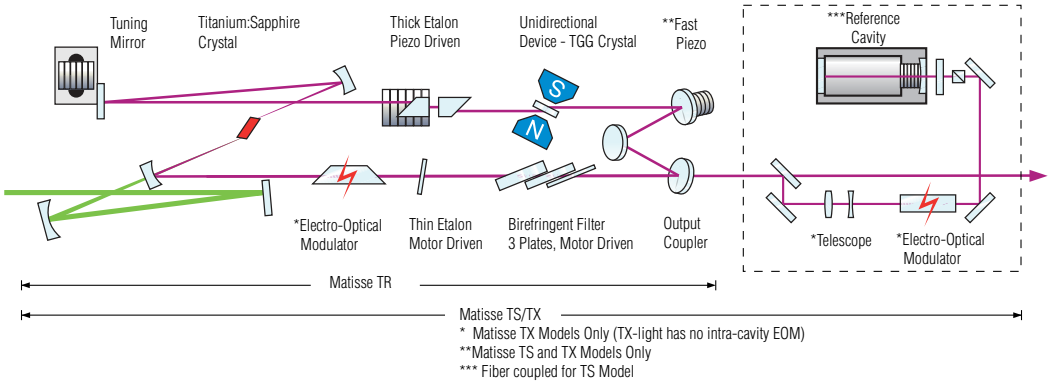
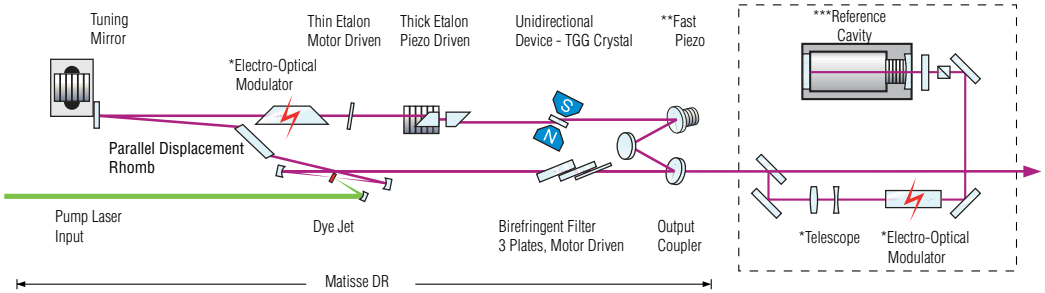
Matisse 2 Ti:Sapphire Optical Layouts



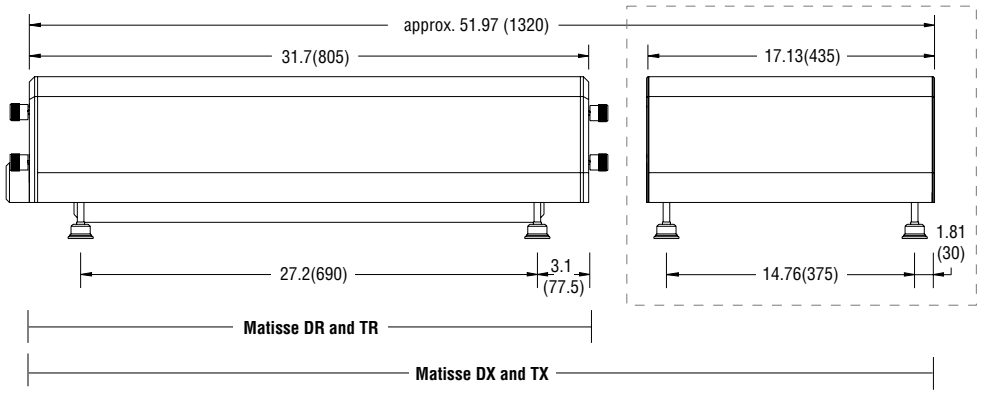
* Matisse TX Models Only (TX-light has no intra-cavity EOM)
**Matisse TS and TX Models Only
*** Fiber coupled for TS Model

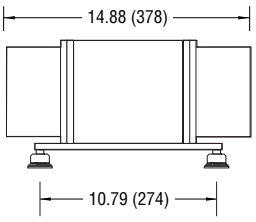
Matisse 2 Dye Optical Layout



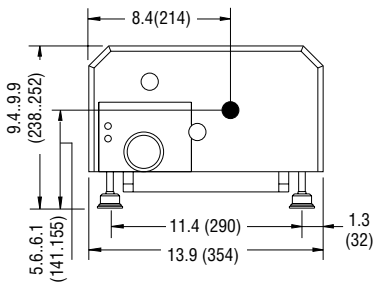
* Matisse DX Models Only
**Matisse DS and DX Models Only
*** Fiber coupled for DS Model

Matisse 2 Dimensions

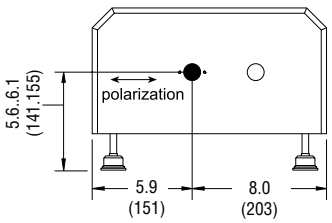




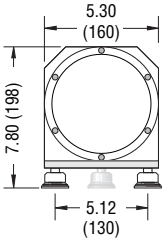
Matisse DS and TS Reference Cell (Side View)



Pump Laser Input End



Matisse Output End



Matisse DS and TS Reference Cell

Dimensions in inch (mm)

Matisse® 2

Specifications[1]

	Matisse 2 TR	Matisse 2 TS	Matisse 2 TX-light	Matisse 2 TX	Matisse 2 DR	Matisse 2 DS	Matisse 2 DX
General Characteristics							
Laser Gain Medium	Ti:Sapphire	Ti:Sapphire	Ti:Sapphire	Ti:Sapphire	Dye	Dye	Dye
Linewidth[5]	<4 MHz rms	<50 kHz rms[6]	<60 kHz rms[6]	<30 kHz rms[6]	<20 MHz rms[6]	<250 kHz rms[6]	<100 kHz rms[6]
Spatial Mode	TEM_{00}				TEM_{00}		
Beam Diameter[2]	1.4 mm (typical)				1.4 mm (typical)		
Beam Divergence[7]	<1 mrad				<1 mrad		
Amplitude Noise	<0.25% rms				<2.0% rms		
Scan Range	>50 GHz (at 780 nm)				>60 GHz (at 575 nm)		
Tuning Range[3, 8]							
MOS-1 Optics Set	680–780 nm	680–780 nm	680–780 nm	690–770 nm			
MOS-2 Optics Set	750–870 nm	750–870 nm	750–870 nm	750–870 nm			
MOS-2-BB Optics Set	730–930 nm	730–930 nm	730–930 nm	730–930 nm			
MOS-3 Optics Set	860–1020 nm	860–1020 nm	860–1020 nm	860–1010 nm			
MOS-4 Optics Set					550–660 nm	550–660 nm	550–660 nm
MOS-5 Optics Set					650–760 nm	650–760 nm	650–760 nm
Output Power[4]							
Millennia eV 25 W	6500 mW	6500 mW	6500 mW	5800 mW	6000 mW	6000 mW	4500 mW
Millennia eV 20 W	5000 mW	5000 mW	5000 mW	4400 mW	4500 mW	4500 mW	3400 mW
Millennia eV 15 W	3800 mW	3800 mW	3800 mW	3200 mW	3000 mW	3000 mW	2200 mW
Millennia eV 10 W	2000 mW	2000 mW	2000 mW	1600 mW	1800 mW	1800 mW	1400 mW
Millennia eV 5 W	800 mW	800 mW	800 mW	N/A	800 mW	800 mW	N/A
Millennia Pump Laser and Lab Requirements							
Pump Laser Polarization	Horizontal						
Pump Laser Power	5–25 W						
Ambient Conditions	±0.5°C in the 20–25°C range, non-condensing humidity conditions						
Cooling	Water required to remove 20 W of heat from crystal; series connection from Millennia chiller recommended; 16–21°C ±0.1°C suggested Dye versions: Water required to remove 100 W from dye circulator						
Laboratory	Vibrational isolated optical table, dust-free air (flow box)						
Electrical	100–250 VAC, max 2.5 A						
Computer Control	Windows operating system; USB port						

1. Due to our continuous product improvement, all specifications are subject to change without notice.
2. At Matisse 2 output port.
3. Specification applies to Millennia eV 15 W, 20 W and 25 W pump lasers. Please inquire for other pump powers.
4. At 780 nm for Ti:Sapphire and at the peak of R6G dye for dye version.
5. Linewidth measurements made over a period of >100 msec.
6. Linewidths relative to built-in reference cavity.
7. Measurement of half angle.
8. Extended tuning ranges available upon request. Contact Spectra-Physics.

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