

# Matisse<sup>®</sup> 2

## Ultra-Narrow Linewidth Tunable Ring Laser



The Spectra-Physics<sup>®</sup> Matisse<sup>®</sup> 2 series is a family of state-of-the-art single frequency ultra-stable, narrow linewidth tunable ring lasers that are ideal for Quantum and AMO (atomic, molecular and optical physics) applications. 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<sup>®</sup> eV<sup>™</sup> 25 pump laser, the Matisse 2 produces over 7.2 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 down to 30 kHz, with fully integrated PDH lock to X reference cell.

### Matisse 2 TR and DR

The Matisse 2 R-Series ring laser with its mechanically quiet design provides excellent passive stability and ultra-low noise, 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 Advantage

- Highest output power available >7.2 W
- Narrowest linewidth <30 kHz rms
- Field-upgradeable to dye or Ti:Sapphire gain medium
- Widest mode-hop-free Diezo tuning of 50 GHz
- Dust-sealed housing and massive steel baseplate
- Fast Digital Signal Processing (DSP) with open-source software
- Sapphire dye jet nozzle
- Automated picomotor alignment

### Applications

- High-resolution spectroscopy
- Atom cooling and magneto-optic trapping (MOT)
- Atomic clocks
- Bose-Einstein condensates
- Frequency combs
- Quantum computing
- Microcavity resonators
- Quantum applications



# Matisse 2

## 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 <200 kHz.

## Matisse 2 TX and DX

The Matisse 2 X-Series ring laser provides spectral linewidths to <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 50 kHz.

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



Matisse 2 TX with separate, optional reference cavity with Pound-Drever-Hall feedback scheme



# Matisse 2 Specifications<sup>1, 9</sup>

	Matisse 2 TR	Matisse 2 TS	Matisse 2 TX-light	Matisse 2 TX	Matisse 2 DR	Matisse 2 DS	Matisse 2 DX
<b>General Characteristics</b>							
Laser Gain Medium	Ti:Sapphire	Ti:Sapphire	Ti:Sapphire	Ti:Sapphire	Dye	Dye	Dye
Linewidth <sup>5</sup>	<4 MHz rms	<50 kHz rms <sup>6</sup>	<50 kHz rms <sup>6</sup>	<30 kHz rms <sup>6</sup>	<20 MHz rms <sup>6</sup>	<200 kHz rms <sup>6</sup>	<100 kHz rms <sup>6</sup>
Beam Diameter <sup>2</sup>	1.4 mm (typical)				1.4 mm (typical)		
Beam Divergence <sup>7</sup>	<1 mrad				<1 mrad		
Amplitude Noise	<0.1% rms (above pump noise, added in quadrature)				<0.5% rms		
Scan Range	>50 GHz (at 780 nm)				>60 GHz (at 575 nm)		
<b>Tuning Range<sup>3, 8</sup></b>							
MOS-1 Optics Set	680–790 nm	680–790 nm	680–790 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	880–1038 nm	880–1038 nm	880–1038 nm	880–1010 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
<b>Output Power<sup>4</sup></b>							
Millennia eV 25 W pump		7.2 W		6.2 W	6.0 W		4.5 W
Millennia eV 20 W pump		5.5 W		4.7 W	4.5 W		3.4 W
Millennia eV 15 W pump		3.8 W		3.3 W	3.0 W		2.2 W
Millennia eV 10 W pump		2.0 W		1.6 W	1.8 W		1.4 W
Millennia eV 5 W pump		0.8 W		N/A	0.8 W		N/A
<b>Millennia Pump Laser and Lab Requirements</b>							
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.

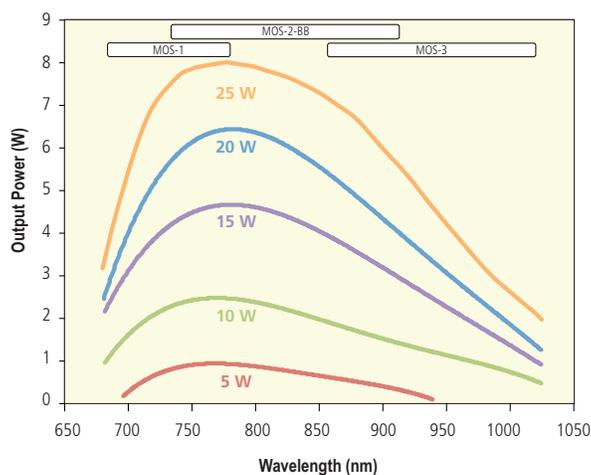
6. Linewidths relative to built-in reference cavity.

7. Measurement of half angle.

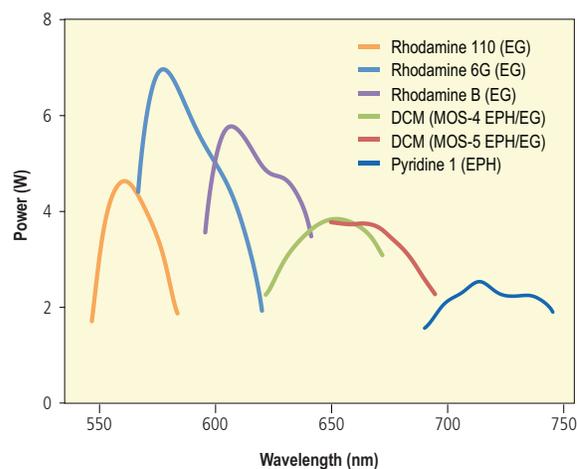
8. Extended tuning ranges available upon request. Contact Spectra-Physics.

9. The Matisse 2 is a Class IV – High Power Laser, whose beam is, by definition, a safety and fire hazard. Take precautions to prevent exposure to the direct and reflected beams. Diffuse as well as specular reflections can cause severe skin or eye damage.

Typical Matisse TR, TS Tuning Curve<sup>1</sup>

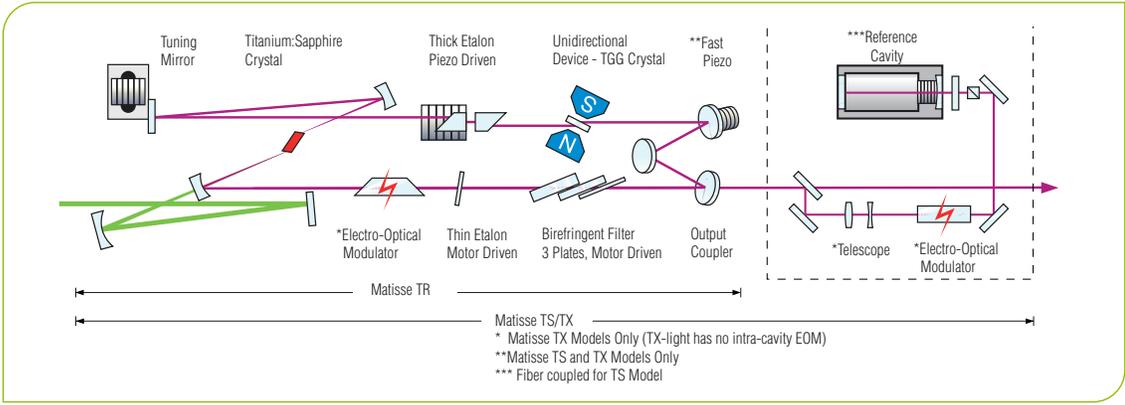


Typical Matisse DR, DS Tuning Curve 25W Pumped<sup>1</sup>

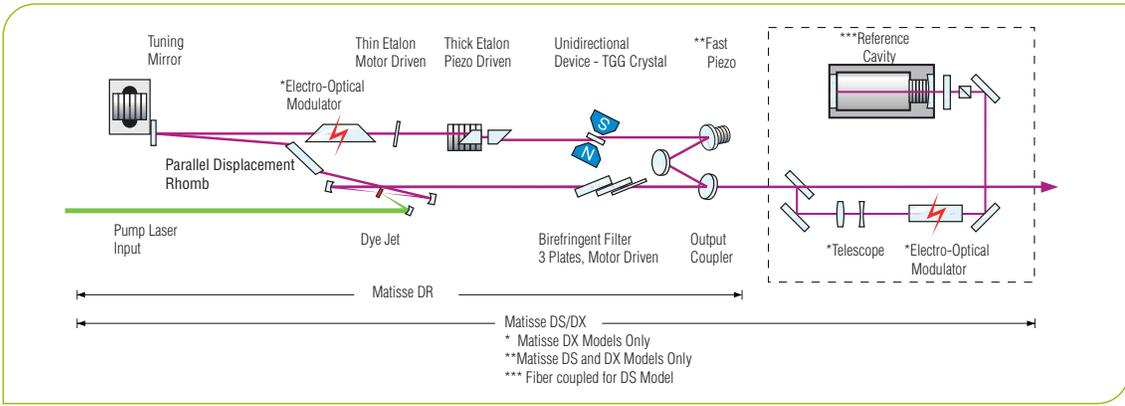


1. Typically measured performance; not a guaranteed or warranted specification, pumped by Millennia EV.

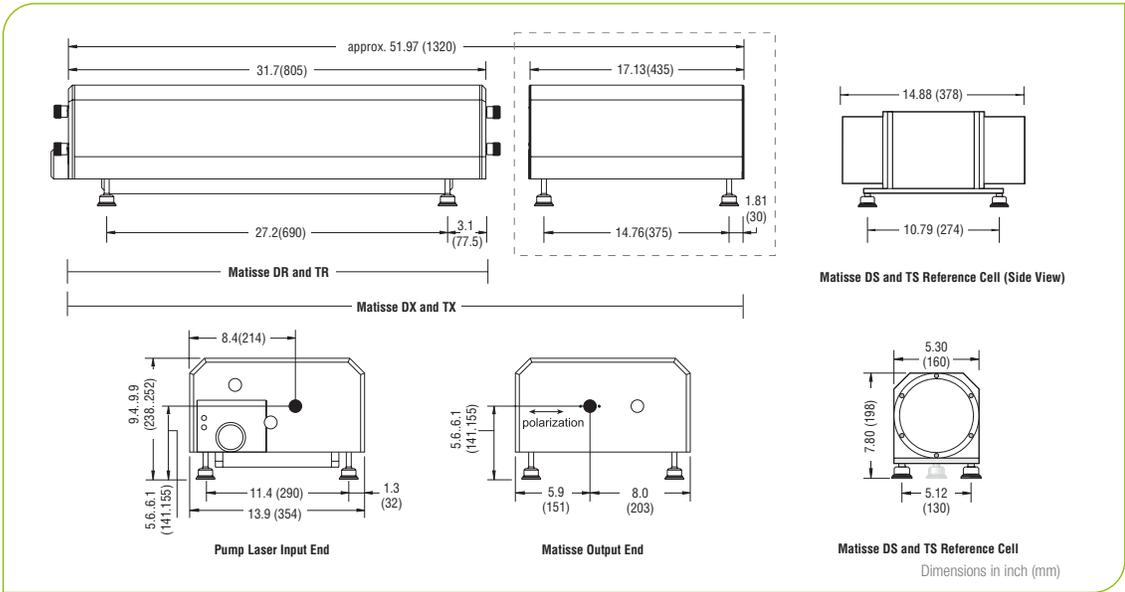
# Matisse 2



Matisse 2 Ti:Sapphire Optical Layouts



Matisse 2 Dye Optical Layouts



Matisse 2 Dimensions



www.spectra-physics.com

1565 Barber Lane, Milpitas, CA 95035 USA  
 PHONE: 1-800-775-5273 1-408-980-4300 FAX: 1-408-980-6921 EMAIL: sales@spectra-physics.com

Belgium	+32-(0)800-11 257	belgium@newport.com	Korea	+82-31-8021-1600	korea@spectra-physics.com
China	+86-510-8113-2999	spectra-physics-china@mksinst.com	Netherlands	+31-(0)30 6592111	netherlands@newport.com
France	+33-(0)1-60-91-68-68	france@newport.com	Singapore	+65-6664-0040	sales.sg@newport.com
Germany / Austria / Switzerland	+49-(0)6151-708-0	germany@newport.com	Taiwan	+886-3-575-3040	sales@newport.com.tw
Japan	+81-3-3556-2705	spectra-physics.jp@mksinst.com	United Kingdom	+44-1235-432-710	uk@newport.com