Tricolor. Multi-Channel Femtosecond Solid-State Laser

- 1050, 525 and 800 nm simultaneous output
- >1.2 W, >300 mW and >300 mW (respectively)
- Repetition rate synchronization with external source (optional)
- Self-starting of femtosecond regime
- Time delay jitter 1050 nm to 800 nm <1 fs
- Sum frequency generation (optional)

The Tricolor Ultrafast Multi-Channel Laser Head

Product overview

The Tricolor Ultrafast Multi-Channel Laser System is a multi-wavelength femtosecond laser source. It combines three inherently synchronized laser outputs emitting three different wavelengths (1050 nm, 525 nm and ~800 nm). The system is based on the principle of synchronous pumping of a tunable titanium-sapphire laser with the frequency-doubled radiation of the TEMA ytterbium laser. The Tricolor laser system makes use of a non-linear interaction mechanism allowing for the precise synchronization of the three pulse trains, thus effectively equalizing their repetition rates. The output beam selection system of the Tricolor is similar to that of the TEMA-DUO and allows the Tricolor system to simultaneously emit up to three spatially separated beams at different wavelengths, so that the following combinations are possible:

1) 1050 nm
2) 1050 nm + 525 nm
3) 1050 nm + 525 nm + (800 +/- 50) nm

In the first mode, the Tricolor system is analogous to TEMA ytterbium solid-state laser emitting 6+ Watts of output power with emission spectrum centered at 1050 nm. In the second mode, a second harmonic generation module is introduced into the primary beam, followed by a beam splitter mirror redistributing the energy of the ytterbium laser and its second harmonic among two channels (at least 2W at 525 nm and 1W at 1050 nm). In the third mode, the frequency doubled emission of the TEMA laser is used to pump a titanium-sapphire laser, which results in one more beam with tunable wavelength (750 - 850 nm) at the system output. In this case, the average optical power of the residual 525 nm radiation is lowered to at least 300 mW, as is the ouput power of the titanium-sapphire laser (300 mW at 800 nm).

The patented optoelectronic synchronization system used in the Tricolor system allows to maintain synchronous operation of the three channels with extremely low relative jitter (under ~10 fs) at any given wavelength of the third channel (Ti:S laser) for almost an unlimited period of time. In addition, the synchronization system provides fully automatic mode-locking behavior of the individual lasers, effectively allowing for the turn-key mode of operation of the entire system.

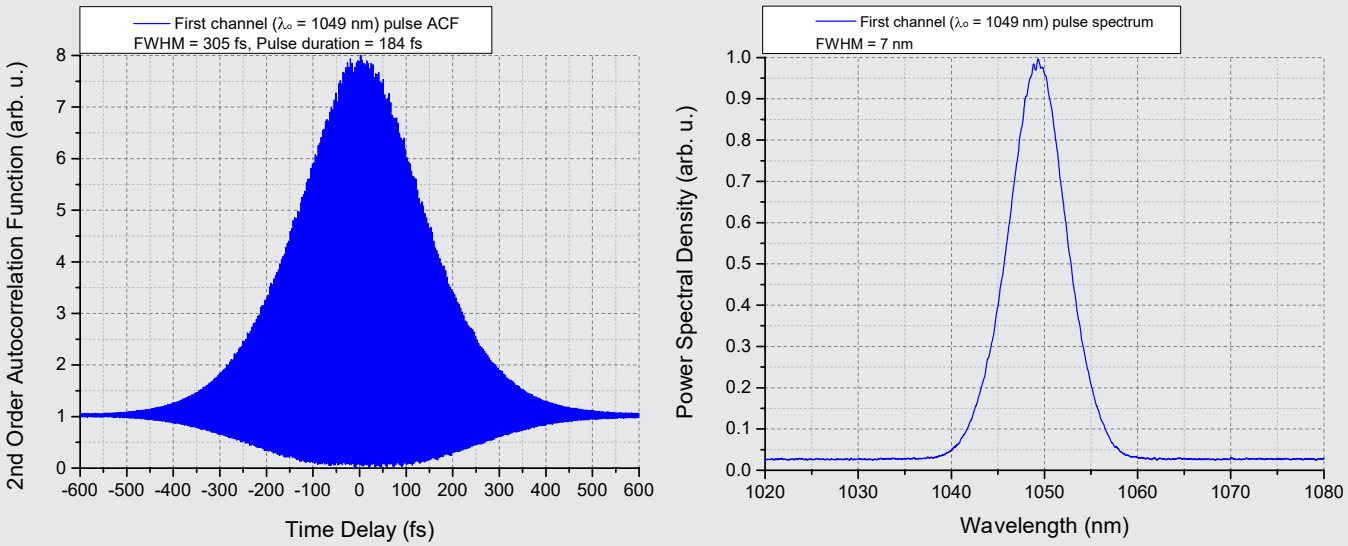
Multiple advantages of the Tricolor system make it an extremely versatile source of femtosecond pulses, excellent for multidisciplinary research laboratories, as well for scientific experiments in various spheres.

Possible applications of the Tricolor Multi-Channel Laser System:

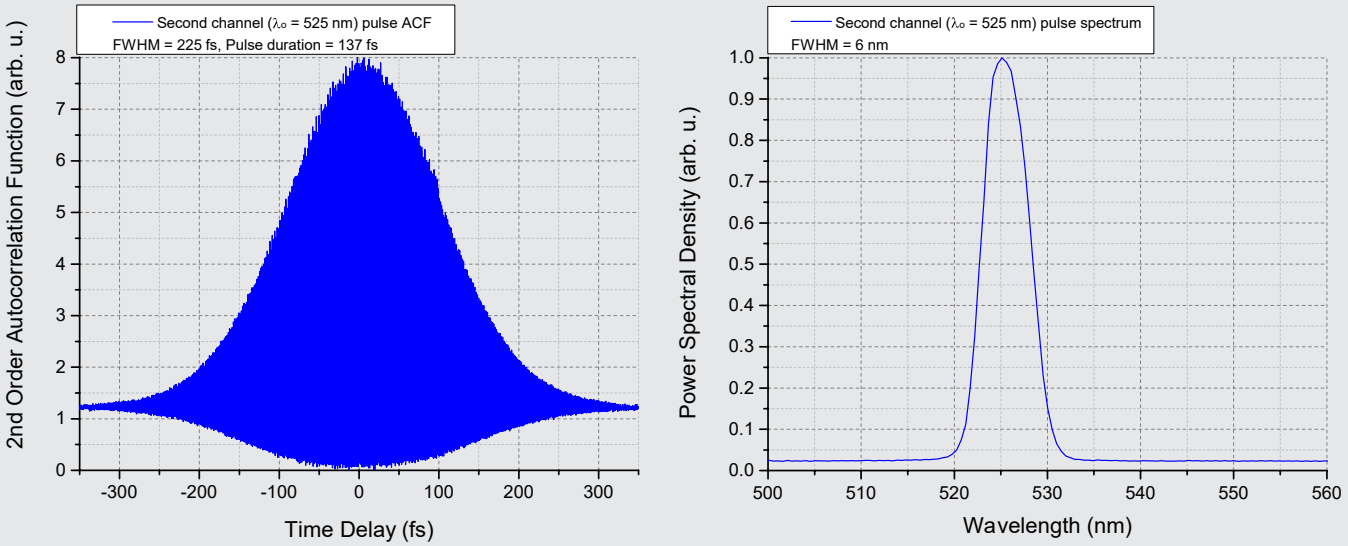
- Multiphoton Microscopy (TPE)
- Three-photon imaging (3-photon)
- SHG/THG (second/third harmonic generation) microscopy
- Time-Resolved Ultrafast Studies
- Optical Coherence Tomography
- Fluorescence Upconversion Spectroscopy
- Fluorescence Spectroscopy of Biological Markers
- Raman Spectroscopy
- Pump-Probe Spectroscopy
- Conversion of Laser Radiation
- Supercontinuum Generation
- Generation and Detection of Terahertz (THz) Radiation
- Laser Systems Design, Integration and Amplification
- Seed Oscillator for Ultrafast Amplifiers
- Chemical researches
- Other fundamental reseaches

	Channel 1 (1050 nm)	Channel 2 (525 nm)	Channel 3 (~800 nm)
Output power (Ch 1 only)	>6 W	N/A	N/A
Output power (Ch 1 + Ch 2)	>1 W	>3 W	N/A
Output power (Ch 1 + Ch 2 + Ch 3)	>1 W	>0.3 W	>0.3 W
Output pulse duration[1)]	<200 fs	<150 fs	<100 fs
Pulse repetition rate (fixed)	80 +/- 5 MHz		
Central wavelength	1050+/-5 nm (fixed)	525+/-5 nm (fixed)	800+/-50 nm
Spectrum width (FWHM)	>7 nm	>6 nm	> 10 nm
Relative timing jitter[2)]	<10 fs		
Beam mode	TEMoo		
M^2	<1.1	<1.3	<1.2
Beam diameter (at 1/e^2)	1+/-0.2 mm	<2 mm	<2 mm
Output polarization	linear, horizontal	linear, vertical	linear, horizontal
Beam divergence	<1.8+/-0.3 mrad	<2.0+/-0.3 mrad	<1.0+/-0.3 mrad
Beam asymmetry	<10%		
Beam astigmatism	<10%		
Long-term stability[3)]	<0.3% rms		
Cold start warm-up time	<20 min		
Cooling requirements			
Laser Head	Closed-loop chiller included		
Power Supply	air-cooled		
Physical dimensions (L × W × H)			
Laser head dimensions	450 × 140 × 280 mm		
Laser control unit dimensions	290 × 200 × 80 mm		
Closed-loop chiller dimensions	430 × 340 × 190 mm		
Umbilical length	1.8 m		
Environmental and utility specifications			
Operating temperature	18-28 °C		
Relative humidity	<60%, non-condensing		
Voltage	single-phase; 100-240 VAC; 50/60 Hz		
Power consumption	<2 kW		

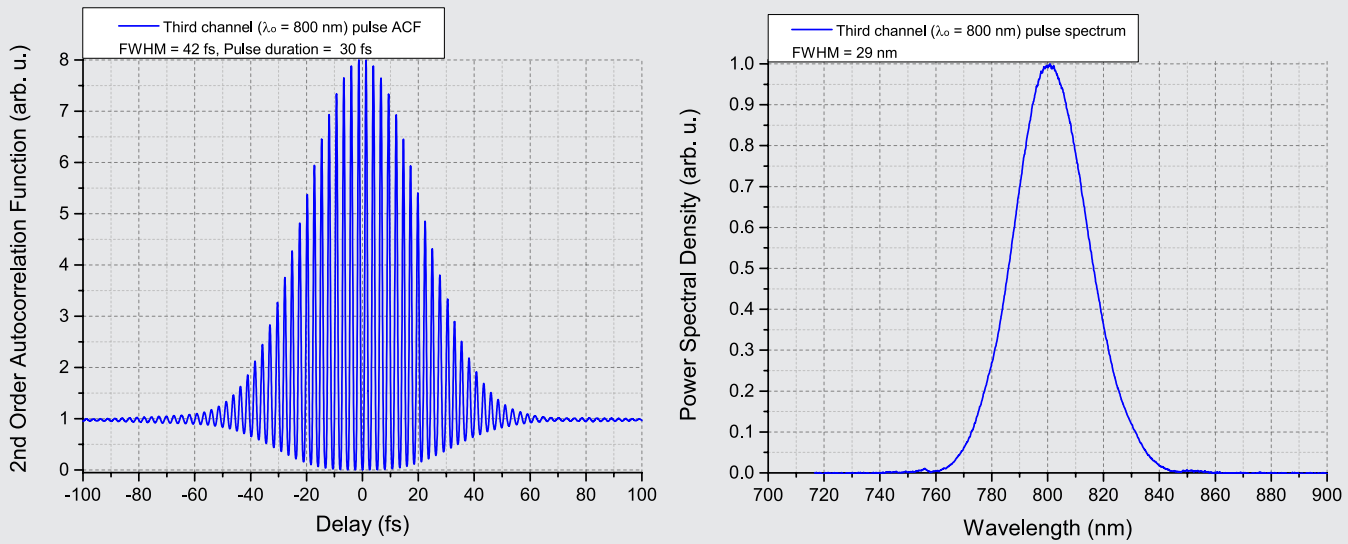
1) a $sech^2$ pulse shape is used to determine the pulse duration. Measured with an Avesta AA-20DD interferometric autocorrelator;
2) relative timing jitter between Channel 1 and Channel 3 measured within 1 Hz – 20 kHz bandwidth;
3) after 30 min warm-up with cold start, during 12-hour continuous operation under equal room temperature conditions using recommended stabilized closed-loop chiller with proper capacity.



ACF and pulse spectrum at 1050+/-5 nm



ACF and pulse spectrum at 525+/-2 nm



ACF and pulse spectrum at 800 nm (tuning is optional)