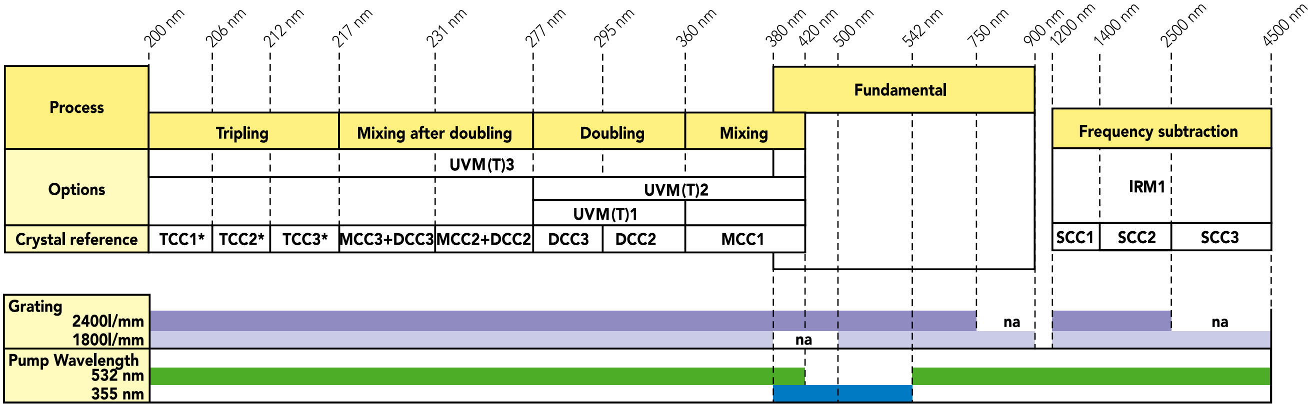
TDL 90

Tunable Dye Laser

Pumped by pulsed Nd : YAG

Quantel



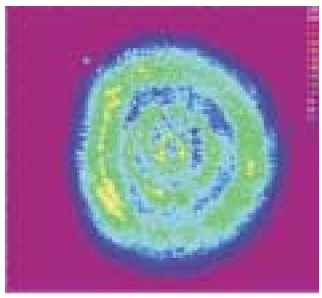
* To cover 200-217 nm, Quantel's choice is to propose three crystals, each covering 6 nm at FWHM. On request, this tuning range can also be covered with two crystals, with lower energy on the edge of their band.

Wavelength	205nm	222nm	280nm	367nm	510nm	560nm	615nm
Process	3ω	2ω+IR	2ω	ω+IR	ω	ω	ω
Pump laser							
YG981E-10							
820mJ at 532nm	5	10	51	56		200	150
490mJ at 355nm					40		
YG981C-10							
600mJ at 532nm	4	7	36	44		160	120
280mJ at 355nm					27		
YG981C-20							
520mJ at 532nm	3	5,5	30	34		140	105
220mJ at 355nm					22		
YG981-20							
290mJ at 532nm	1,4	2,4	14	16		80	60
125mJ at 355nm					14		
YG981-30							
220mJ at 532nm	0,9	1,6	10	12		60	45
90mJ at 355nm					10		
BRILLIANT B or YG980E-10							
400mJ at 532nm	3	4,5	25	30		110	85
165mJ at 355nm					17		
BRILLIANT or YG980-10							
180mJ at 532nm	0,5	1	8	5		45	34
65mJ at 355nm					5		

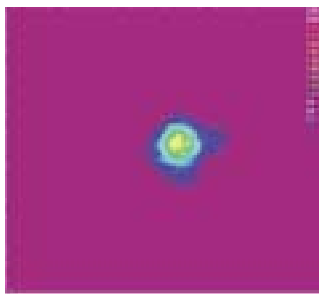
Energies are in mJ, standard linewidth, with UVM tracking option (automatic tracking: 15% less energy in UV).

Pulse Duration	Depends on pump laser (4-5ns with Brilliant, or 8-10ns with YG980 series)
Beam Divergence	<0.5mrad (full angle at $1/e^2$ of the peak for a 5 mm dia beam)
Beam Diameter	Depends on pump laser (from 3 to 6 mm)
Beam Pointing Stability	< 50 µrad at 560 nm on 200 shots (with NBP)
Polarization	98% vertical in fundamental with NBP
Linewidth (at 560nm, FWHM, including stability assuming ΔT< ±2°C, 2400l/mm grating)	
Standard	0.8 cm^{-1}
NBP2	0.08 cm^{-1}, 10% less energy in fundamental
NBP3	0.06 cm^{-1}, 35% less energy in fundamental
Dual grating	0.05 cm^{-1}, 50% less energy in fundamental
BBP	100 cm^{-1}
Absolute Wavelength Error	50 pm
Thermal Stability	0.05 cm^{-1}/5°C/h
Resettability	1 pm (measured after a roundtrip scan of 30nm)
ASE (standard configuration) :	
Center of dye band (Rh590) <0,2%	
Edge of dye band (Rh590) <0,5%	
Service Requirements:	110V/240V, 50/60Hz, <4A, single phase

Specifications are given at 560 nm, without NBP options



Beam profile @ 560 nm, at 1 m from the laser output.



Beam profile in far field @ 560 nm.

Many options and configurations are available, please contact us for the best match to your needs and for compatibility between options.

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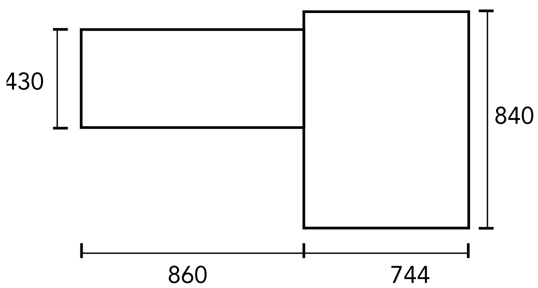
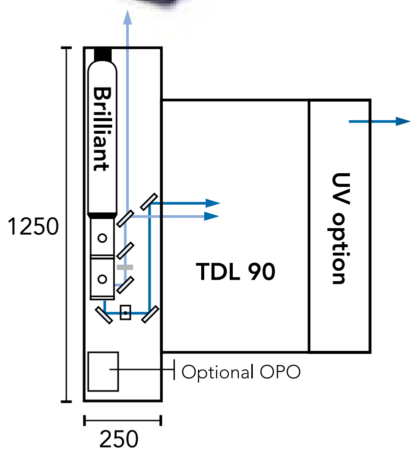
Example of configurations

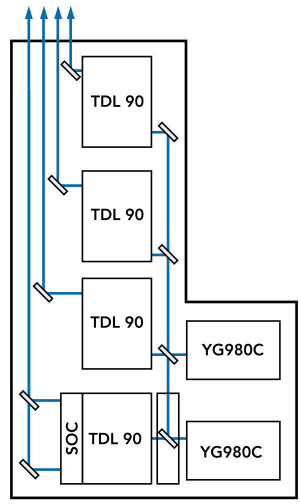
YG980/TDL 90



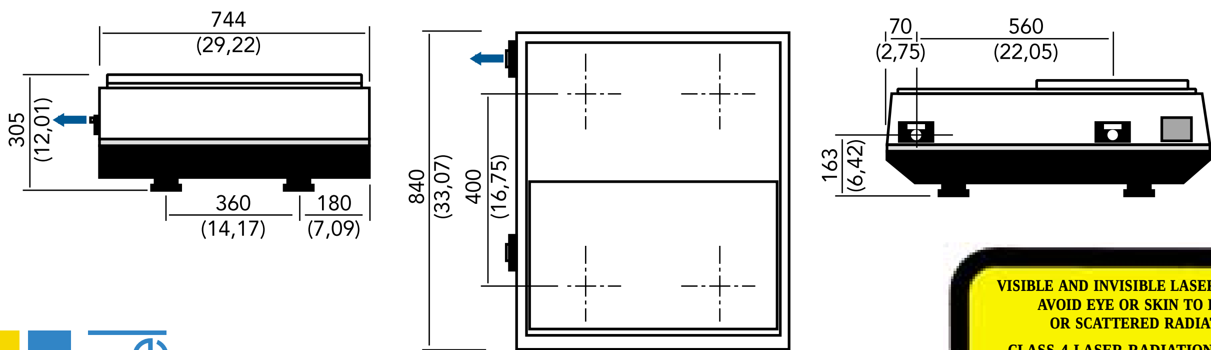
Brilliant/TDL 90/OPO



2 YG 980/4 TDL 90



TDL 90
Dimensions are in mm (in)



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AVOID EYE OR SKIN TO DIRECT
OR SCATTERED RADIATION.
CLASS 4 LASER RADIATION PRODUCT

Max Average Power	:	2 W
Max Energy/pulse	:	0,2J
Pulse duration	:	< 10ns
Emitted Wavelength	:	200/4500 nm

CE

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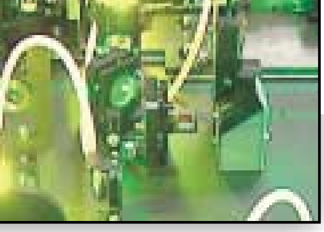
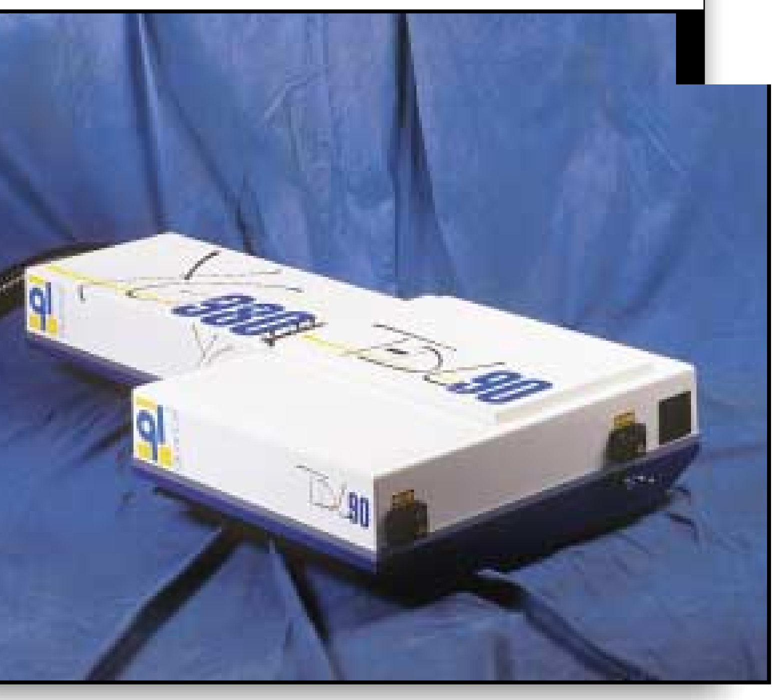


YG980 & TDL90 : The YAG/DYE tunable system

For many years, Quantel has never considered its tunable dye laser as an attachment to a Nd:YAG laser but designed it as a complete and homogeneous laser system.
Unlike other systems, with their subsystems laid down on an expensive optical table, the YG980 laser, the TDL90 and all wavelength extensions are tightly united in one compact, integrated structure.
The control unit is integrated and the system may be operated without an external PC.
The latest TDL90 dye laser employs Quantel's modular concept for flexible operation. It is pumped by the second or third harmonic generated by the YG980 or BRILLIANT series of pulsed Q-Switched Nd:YAG lasers.



Flexible and User Friendly

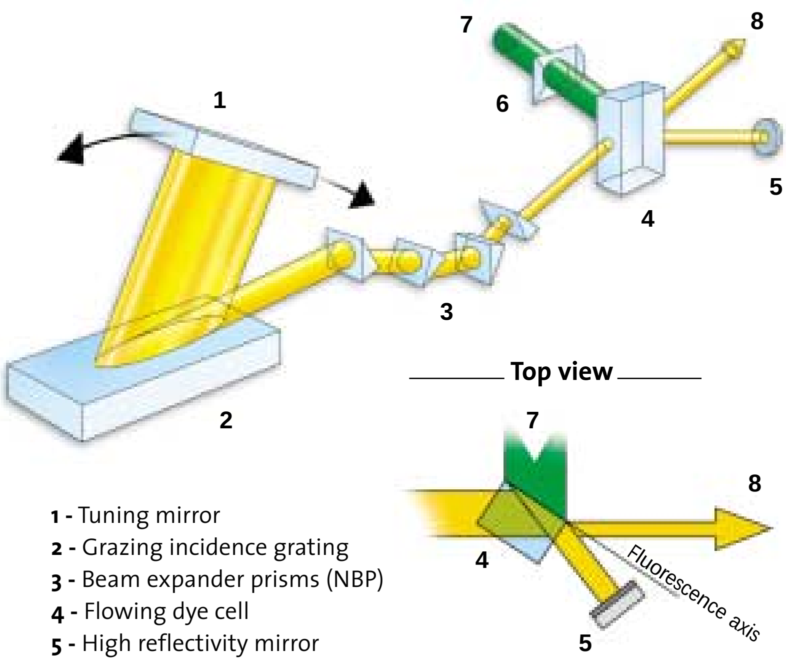
The modular design enables the TDL90 to operate across a very large range of wavelengths - 200 nm to 4,5 µm - with several linewidth options. Many of the options can be retrofitted in the field.
Our pump lasers are designed for easy conversion between second and third harmonic pumping, while maintaining alignment.
Tuning is achieved either via the integrated remote control unit or via an optional PC through the built-in RS232 interface.

Technologically Advanced Design

Low ASE Oscillator

The heart of the TDL90 is Quantel's outstanding oscillator (patent n° 77.12.405). Its quality and reliability have set the standard for tunable dye lasers for many years.

TDL90's Oscillator



1 - Tuning mirror
2 - Grazing incidence grating
3 - Beam expander prisms (NBP)
4 - Flowing dye cell
5 - High reflectivity mirror
6 - Focusing lens
7 - Pump beam
8 - Dye beam

The low level of amplified spontaneous emission (ASE) of the laser lies in the pumping configuration of the oscillator and the way energy is coupled out of the resonator. The intra-cavity beam undergoes total internal reflection from the dye cell window. This configuration ensures that the main direction of emission of ASE does not coincide with the direction of the beam.

Laser oscillation takes place between two totally reflecting mirrors. Energy is coupled out by diffraction around one edge of the oscillator dye cell. This configuration ensures that fluorescence coming back from the amplifiers does not hit any reflecting surface before striking the grating, thus dispersing it and attenuating it to very low levels. When the TDL90 is tuned out of the lasing range of Rh 590, so that the only output is fluorescence, ASE is specified as less than 0.5 % of the output as measured when the laser is tuned to the peak of the dye. In normal operation, the ASE measures well below 0.2 % of the signal at its peak.

Temperature Stabilized Oscillator

All mechanical and optical components of the oscillator are temperature stabilized and isolated from the bench. This leads to very low long term frequency instability of less than dye laser linewidth. The TDL90 easily shows its superiority in this respect by exhibiting less than 0,012 cm^{-1}/°C.

Wide Tunability

Wavelength tuning is achieved by means of a mirror rotating in front of a grazing incidence grating.

A precision sine-bar gives a linear relationship between stepping motor angular motion and selected wavelength. With this design, each step of the motor corresponds to a wavelength displacement of 0.25 pm over the entire tuning range.

In standard version, the oscillator is fitted with a 2400l/mm grating. It provides tunability from 380 to 750nm. The IR configuration utilizes a 1800l/mm grating and provides tunability from 500 to 900nm.

A built-in microprocessor based controller drives the stepping motor. It provides a wide set of functions allowing the user to select wavelengths, spectral scanning, scan speeds and modes. The wavelength read on the controller display shows a maximum absolute error of less than 50pm. It can be easily recalibrated by the user if necessary.

Narrow Bandwidth

Due to the grazing incidence grating, the TDL90 delivers a constant linewidth over the entire fundamental tuning range ($\Delta\lambda$=cst). Different linewidths are offered, depending on which optional narrow bandwidth package is installed. The standard oscillator gives a 0.8cm^{-1} linewidth at 560nm, while two different sets of expanding prisms allow 0.08cm^{-1} and 0,06 cm^{-1}.

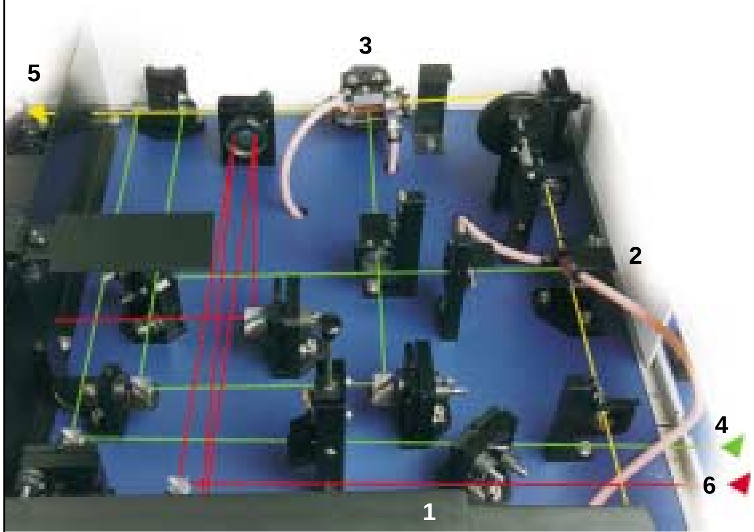
Narrower bandwidth (0,05 cm^{-1}) is obtained by replacing the tuning mirror with a Littrow grating. In this particular case, the linewidth depends on the wavelength.

High Quality Amplification

The output beam of the TDL90's oscillator is amplified with two amplifiers.

The first is a transversely pumped flowing dye cell and the second can be either a capillary cell or a Bethune cell, depending on the pump energy. The two kinds of amplifiers, with their cylindrical geometry, give a circular output beam, unlike other, more conventional dye cells. Both configurations give excellent spatial uniformity of the beam and high nonlinear frequency conversion efficiencies.

Two independent dye circulation loops allow optimization of the dye concentration in each amplifier, in order to reach the best trade-off between output energy, beam quality and low ASE.



1 - Oscillator
2 - First amplifier
3 - Final amplifier
4 - Pump beam
5 - Fundamental dye beam
6 - 1064 nm residual beam for mixing in UV extension (Delay line)

Ultraviolet and Infrared Generation

The fundamental dye laser emission can only be at a longer wavelength than the pump source. Thus, pumping at 355nm does not allow shorter UV wavelengths to be reached without nonlinear optical processes.

To access ultraviolet and infrared wavelengths, various wavelength extension techniques are used. These include second and third harmonic generation and sum and difference frequency mixing.

IR Extension

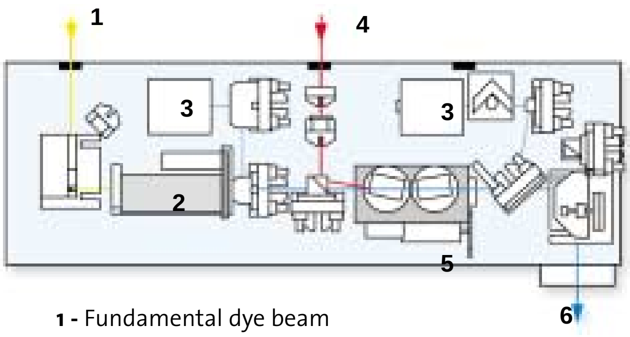
It is based on difference frequency mixing of a dye wavelength and the residual infrared from the pump laser. A set of three lithium niobate crystals is used to cover a wide spectral range from 1,2 µm to 4,5 µm with pulse energies of several mJ across a large part of that range*.

UV extension

Much scientific work with dye lasers is done in the ultraviolet. That is why Quantel's choice is to include this UV extension on the TDL90 bench for better mechanical stability and compactness. It is a modular frequency doubling and mixing system, consisting of two mechanical rotating supports for crystals and related fused silica compensators, the infrared delay line (mixing) and the optional automatic tracking system.

- **360-420nm spectral range:** achieved with mixing the fundamental frequency of the dye laser with the residual infrared from the Nd:YAG laser. Even if the 380-420nm range is directly reachable with 355nm pumped dye, the mixing process using a 532nm pumped dye gives better results.
- **277-360 nm spectral range:** achieved with doubling the fundamental frequency of the dye laser.
- **217-277nm spectral range:** achieved by mixing the frequency doubled output of the dye laser with the residual infrared from the Nd:YAG laser.
- **200-217nm spectral range:** achieved by tripling the fundamental frequency of the dye laser.

** In some cases, other non linear crystals can be used.*



1 - Fundamental dye beam
2 - Doubling crystal and compensator
3 - Diodes for automatic tracking
4 - IR beam from pumping laser
5 - Mixing crystal and compensator
6 - UV output beam

When the fundamental output of the dye laser is scanned across the spectrum, doubling and/or mixing crystals have to be kept angle tuned in order to maintain a high UV output power. This is achieved either by manual adjustment option (UVM) or by the automatic tracking option (UVT). This option uses of a closed feedback loop to maintain a peak output of each UV generating stage. It enables the proper crystal angle to be maintained while the dye laser is scanning, even in the presence of laser-induced or ambient heating of the crystal. The system is naturally insensitive to temperature drifts or inaccuracies in crystal angle cut.

TDL 90 options:

To help you:

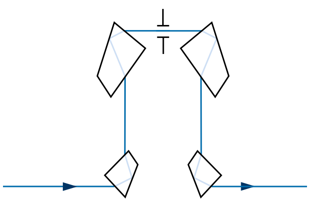
$\Delta\lambda$ (Å) = λ^2 (μm) x $\Delta\sigma$ (cm^{-1})
$\Delta\sigma$ (cm^{-1}) = Δf (Hz)/c (cm/s)

Broadband Option (BBP)

Some applications require a very broad linewidth. By using the zero order of the grating, the beam is reflected from a mirror and a fixed, non-tunable linewidth of more than 100 cm^{-1} at 560nm is obtained.

Separated Output Compensator (SOC) schematic

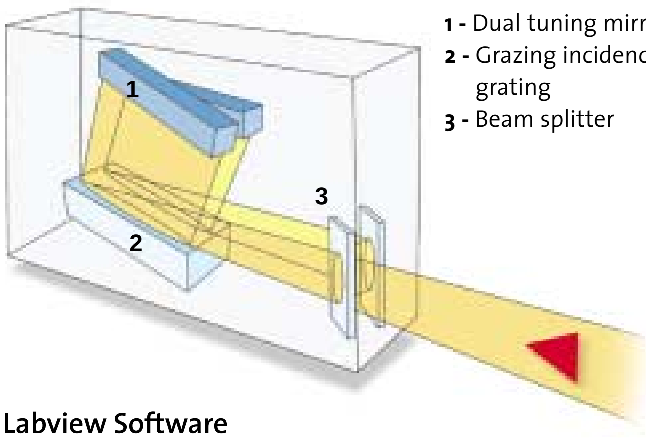
The separated output compensator is a bandpass wavelength filter designed with four Pellin-Broca prisms. This accessory selects the UV from the fundamental wavelengths and compensates the beam displacement due to wavelength tuning of the dye laser.



Dual Wavelength Option (DWO) schematic

This option transforms the normal TDL90 oscillator into a dual wavelength oscillator.
The intra cavity beam of the dye is split in two. The two beams are reflected after the dispersion grating by two tuning mirrors mounted on the same arm. An adjustable angle between these mirrors gives two wavelengths. The maximum separation is 7nm in the fundamental.

This option is compatible with some of the UV generation options.



1 - Dual tuning mirror
2 - Grazing incidence grating
3 - Beam splitter

Labview Software

Software allows control of the TDL90. The available functions are the same as those of the remote built-in controller.

Adaptation to Alternative Pump Lasers

Optionally, the TDL90 may be pumped by other Nd:YAG lasers, providing the beam quality at 532nm and 355nm is compatible.