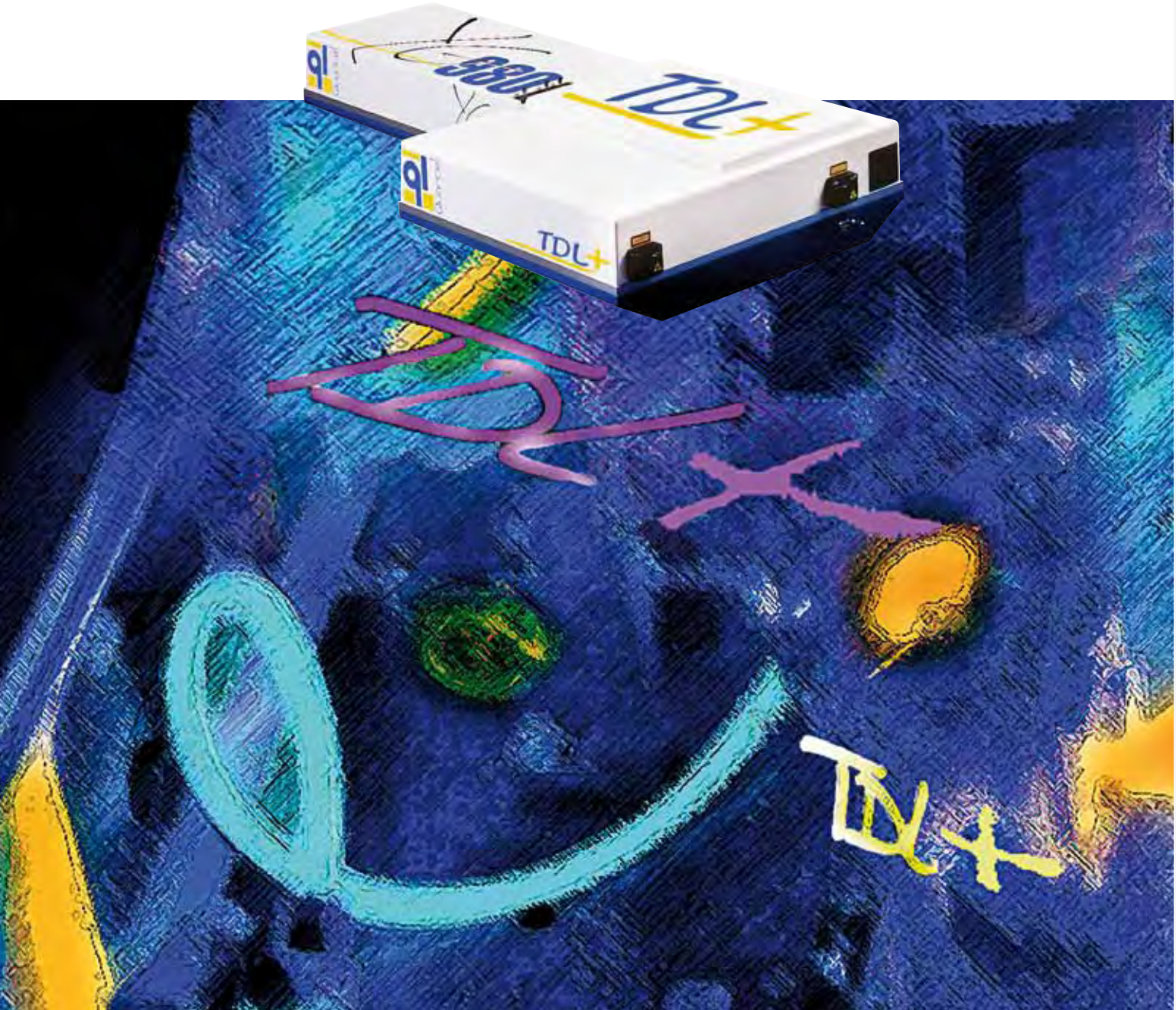
Quantel

TDL+

User-friendly Tunable Dye Laser



TDL+ ADVANTAGES

Wide tunability:
Two gratings allow for coverage of the 200- 4500nm range without realignment of the cavity. Unique dual grating option enables configuration without direct handling of the grating assemblies.

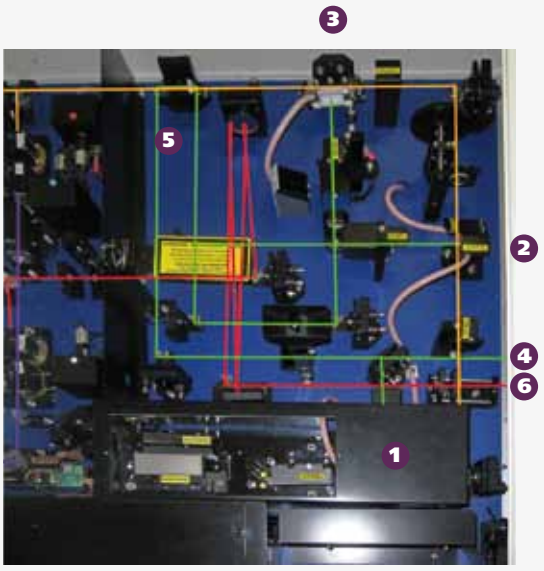
Spectral access - UV and IR generations:
Nonlinear crystals provide options for motorized or automatic phase-matching and beam compensation.

Excellent passive and active stability:
Passive stability is achieved through integrated design on option benches - Active stability is achieved by closed loop temperature control of both the oscillator spectral cavity and nonlinear crystals.

Easy dye exchange:
Dye exchange without removing dye cells prevents misalignment.

Quantel support and service:
Quantel's long history in design and manufacture of TDL tunable solutions means your productivity is backed by industry experts in installation, integration, support, and field service.

Simplicity and user safety:
- Automatic recognition of the frequency conversion crystals in IR and UV.
- Phase-matching tracking easy to use
- Dedicated software controls both pumping and dye lasers.
- Optimization and dye exchange in user operation configuration without opening the housing.



1. Oscillator
2. Pre amplifier
3. Amplifier
4. Pumping beam
5. Fundamental beam
6. 1064nm beam for UV mixing

TDL+ remote module

Courtesy : CLUPS (Orsay – France)

Crystals and IR/UV options accessories

TDL+: PERFORMANCE, RELIABILITY, FLEXIBILITY AND USER-FRIENDLY PULSED, TUNABLE DYE LASER SOLUTION

Tunable YAG/DYE system:

Compact, with new options, the TDL+ provides all the advantages of a tunable dye laser system. High optical efficiency, narrow spectral bandwidth, large tunability range, extremely low amplified spontaneous emission: TDL+ is the perfect tool for any application such as spectroscopy, Laser Induced Fluorescence, LIDAR, CARS, LIBS, ablation, and many more. Quantel Brilliant or YG980 lasers are mechanically and optically optimized to pump TDL+ for excellent overall stability.
The TDL+ can be purchased with a variety of Quantel pump lasers or qualified with an existing pump laser.

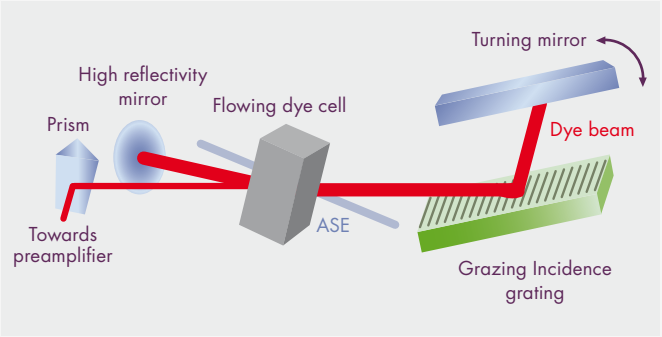
The TDL+ is the latest development in Quantel's long history in tunable dye lasers, with a continued focus on performances, safety, and ease of use.

Wide tunability: 200nm to 4,5µm

Wavelength tuning is achieved with a mirror rotating in front of a grazing incidence grating. The use of a 2400l/mm grating provides tunability from 420nm to 750nm, particularly adapted to UV conversion (200nm to 420nm) through non linear crystals. An 1800 l/mm grating covers the 500-900nm range providing IR tunability from 1200nm to 4500nm by frequency subtraction. A typical laser dye supports lasing over 40nm in the fundamental wavelength.

Low ASE oscillator, temperature stabilized:

The spectral quality of Quantel systems is the result of its patented oscillator configuration. Its geometry creates an angle between the parasitic emission axis (ASE: Amplified Spontaneous Emission) and the axis of propagation of the beam. This prevents ASE from being amplified. The output ASE is reduced to the lowest level possible (<0,2% in the center of the peak of Rh 590 dye).

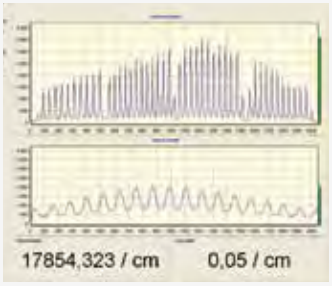


TDL+ oscillator

In standard, all mechanical and optical components of the oscillator are temperature stabilized, which leads to a high quality long term spectral stability for the system (0,05cm^{-1}/5°C/hour). This thermal regulation is particularly adapted for experiments in highly unstable temperature environments (e.g. combustion).

Narrow bandwidth

The TDL+ platform can be configured with a number of linewidth options suitable for a full range of spectroscopic applications from broadband zero-order output for multiplex CARS, moderate linewidth for survey spectroscopic scanning, and, with the Narrow Bandwidth Package, linewidth performance of <0,05cm^{-1}. The NBP package consists of 4 prisms, mounted in a convenient modular assembly, that expand the beam size in the oscillator cavity and enhance the selectivity of the grating.



Spectral measurement @560nm with HighFinesse wavemeter

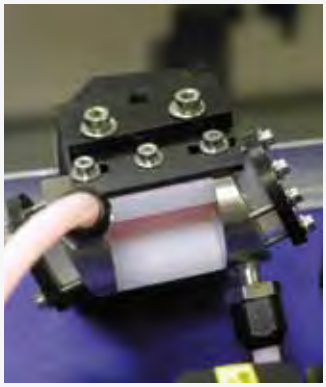
Amplification and optimized beam quality:

Amplification results from the passage of the laser beam through 2 amplifier stages, both optimized for high gain and low ASE.

The saturation of the gain insures a perfect circular output beam profile and excellent spatial uniformity. These beam characteristics allow for high nonlinear frequency conversion efficiencies. Both amplifier cells are fed by independent dye circuits in order to optimize concentration for each stage.

Modularity and flexibility:

All optical components are treated with non reflective coatings @532nm and @355nm allowing change in the pump wavelength without realignment.



Capillary cell for excellent circular output beam profile

The 2 wavelengths' axes of propagation are collinear for any Quantel Nd: YAG pumping laser. Depending on the output energy required, TDL+ can be pumped with Quantel Brilliant or YG980 systems. Quantel lasers are designed for adaptability and stability, making this combination ideal. The TDL+ can be pumped by other pulsed Nd:YAG laser, although specifications are dependant on the pumping beam quality.

Simple and quick dye exchange without any realignment:

In order to prevent any unlikely misalignment or pollution of the optical components during the dye exchange process, the TDL+ uses an external dye flowing system.

Every pump/tank assembly is connected to the system by use of quick connectors: one is dedicated to the oscillator and preamplifier and the other one to the amplifier. The design allows for efficient rinsing of the flowing circuit.

Ultraviolet and Infrared: extension of the tunability range

To generate UV or IR wavelengths, a system of nonlinear crystals configured for doubling, tripling, mixing or subtracting frequencies is used.

Performances, user safety and simplicity are all design priorities, so all optimizations of energy output within UV and IR range are carried out with the housing closed.

The generation of UV typically requires a 2400l/mm grating and generation of IR is generally more efficient with an 1800l/mm grating.

EWT option: unique combination of 2 gratings

With the EWT option (Enhanced Wavelength Tunability), the TDL+ provides the fundamental range of wavelengths from 420nm to 900nm without realignment or manipulation of gratings. Two 1800l/mm and 2400l/mm gratings are set in the oscillator side-by-side.

An assembly of mirrors allows the user to switch from the 420-750nm range (2400l/mm) to the 500-900nm range (1800l/mm) and to combine UV and IR experiments easily.

Double grating

Ultraviolet generation

The UV range (200-420nm) is obtained by using nonlinear crystals; a first stage provides doubling, a second provides mixing after frequency doubling and tripling, depending on the chosen crystals.

The wavelength ranges in conjunction with the type of nonlinear crystal used (KDP/BBO) have been optimized in regard to conversion efficiency, simplicity and lifetime of the dye. Each stage includes positioning mounts, beam steering compensators, delay line and nonlinear crystal. The mechanical mounts allow for precise and quick crystal exchange. Crystals are thermally regulated within a sealed oven, providing excellent power stability. Phase matching occurs through angle tuning, and the compensator is automatically rotated to preserve the propagation axis.

Temperature stabilized crystal

This option is integrated on the TDL+ bench to obtain better mechanical stability and compactness.
A Pellin-Broca prism installed after the UV output allows for wavelength separation. To compensate the deviation generated by the wavelength shift, the prism is mounted on a motorized assembly.

UVT option: automatic phase-matching

To optimize wavelength tuning, the phase matching of the nonlinear crystals is computer-controlled.

The controlling system uses two methods which can be combined, using a lookup table and/or real time closed-loop control.

These two methods provide a quick scan of the wavelengths and an optimization of the conversion efficiency for any level of output energy.

Automatic recognition of the type of crystal installed allows for look up of its settings and positioning quickly.

The furnished software gives access to different parameters: user mode (look-up tables, closed-loop and combination of both), type, temperature and position of the recognized crystal.

The compensation of the angle generated during the scanning of UV wavelength is automatic: the position of the Pellin-Broca prism is directly associated to the output wavelengths.

UV option: motorized phase-matching

For a defined UV wavelength, Quantel also provides a more simple system than the UVT.
Phase matching of the nonlinear crystals is still motorized, but the commands of the motor and the positioning of the crystal are controlled by the user through a dedicated module installed under the TDL+ bench; this option does not require a computer.
To compensate the deviation of the UV beam, the user can optimize the orientation of the Pellin-Broca prism.

UV SOC option: UV drift compensation and residual beams dumping

UV SOC option (Separated Output Compensator) corrects both the angular deviation and the translation of the beam axis during the wavelength scanning.
4 Pellin-Broca prisms are installed on an additional bench attached to the main TDL+ bench. The distance between these 4 prisms allows for dumping of the residual beams.

Infrared generation:

The IR extension principle relies on frequency subtraction between the fundamental wavelength of the dye and the residual 1064nm wavelength of the pumping laser. This option is installed on a separated bench attached to the TDL+. An 1800l/mm grating is typically used in the oscillator.

IR option: motorized phase-matching

Four crystals (KTP/KTA) are used to generate the wavelength range from 1,2µm to 4,5µm. They are installed in a sealed oven and temperature stabilized. Using a KTA type crystal allows operation around 2800nm which is the spectral range of water vapour absorption. The output energy slightly decreases in the area of this absorption peak. The angle phase-matching of the crystals is computer-controlled just as for the UVT option. The software can use the memorized lookup tables or close-loop control.

IR SOC option: IR drift compensation and residual beams dumping

To compensate for the deviation of the IR beams during a wavelength scanning, high IR reflectivity motorized coated mirrors are used. The residual wavelengths are dumped.

Versatility of the control software

In addition to the adaptability and stability of the assembly, software is provided to control the entire system, pumping laser and dye laser. Users have access to all parameters of the different lasers: frequency, wavelength, type of crystals, temperature and user mode (auto, table, auto/table), etc.

Control software

Quantel

Manufacturing facilities

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