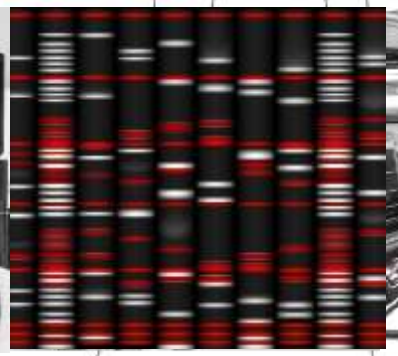
LASOS
For worldwide photonics

TE LINTELO SYSTEMS BV
photonics is our passion!

Precision fair 2017
Te Lintelo Systems presents:

Lasers, a bright future!




Where can we find lasers?

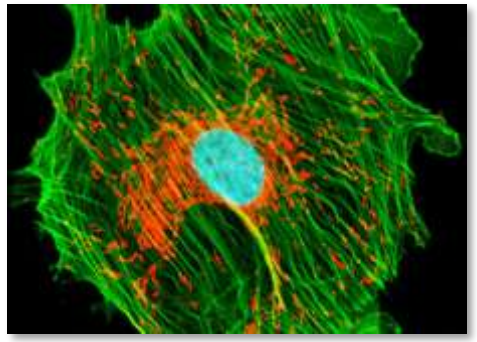
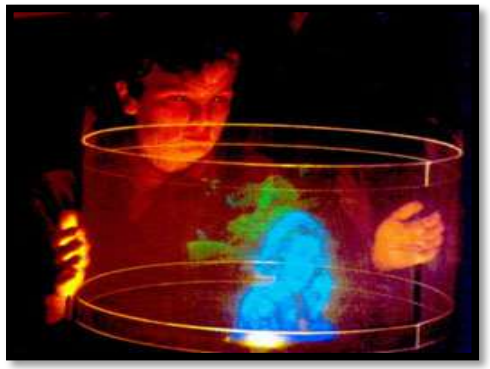
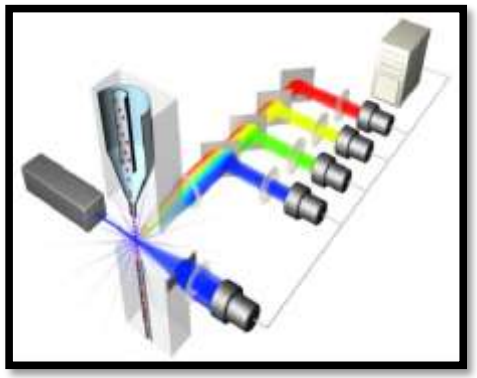
Lasers are used in:

- Media players (CD/DVD/Blu ray)
- Telephone/internet exchange network
- Barcode scanners
- Laser printers
- Medical equipment (tatoo & hair removal, skin treatments, removing kidney stones)
- Material processing (cutting and welding)
- Military and law enforcement (laser guns).
- Scientific application

1) Applications

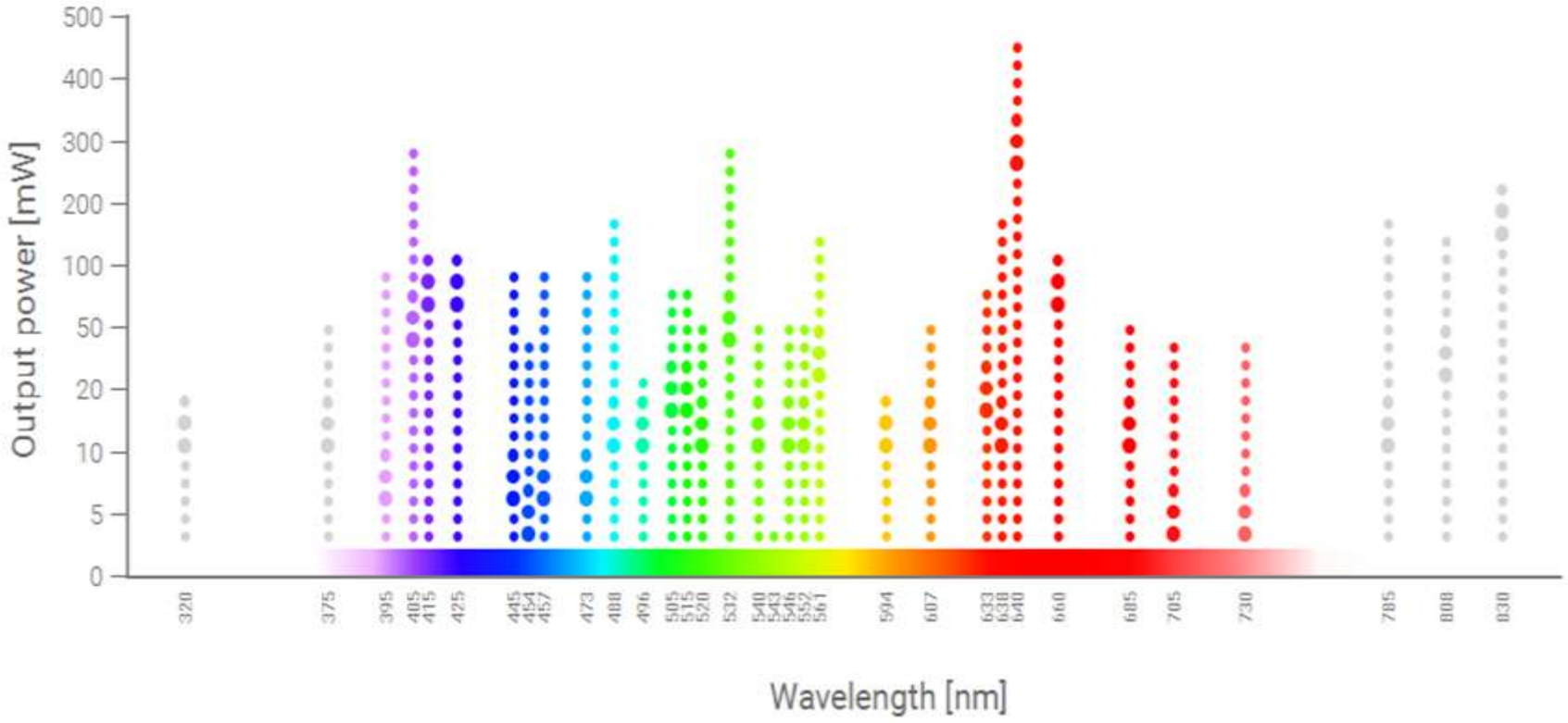
Laser systems addresses many different applications:

- Interferometry
- Spectroscopy
- Flow Cytometry
- Live Cell Imaging
- Holography
- Optogenetics
- Material processesing

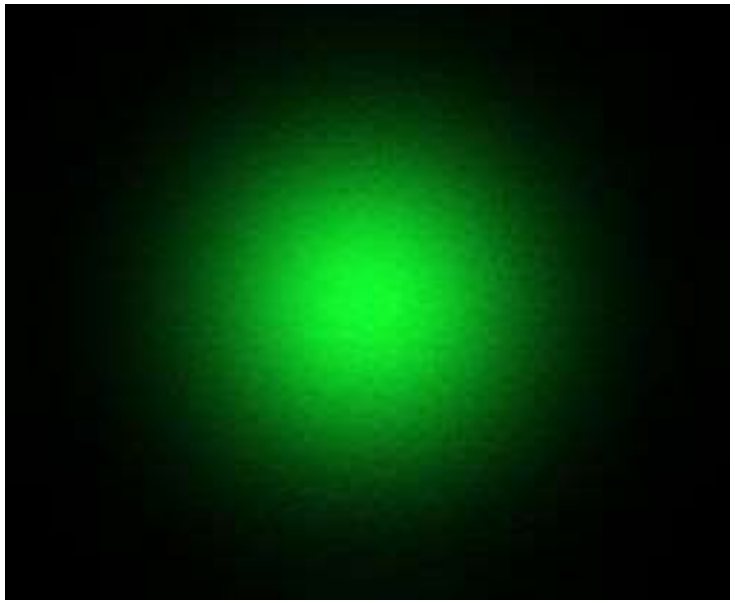
Technical demands

- Wide range of different wavelengths and power levels



Technical demands

- Wide range of different wavelengths and power levels
- Fundamental mode beam quality, M^2 close to 1
- Narrow linewidth and well defined center wavelength
- Highest possible power stability independent of environmental conditions
- Low noise - especially at fixed frequencies
- Fast digital („zero photon“ to operation power) and analog modulation
- Short pulse lasers: pulse length <100ps (FWHM)



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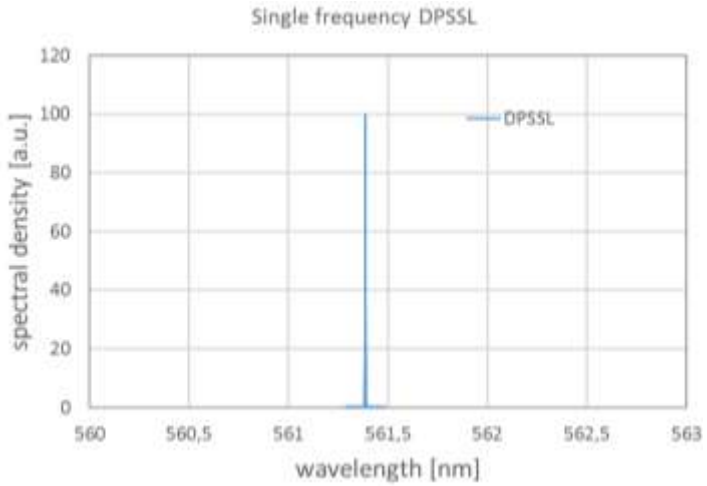
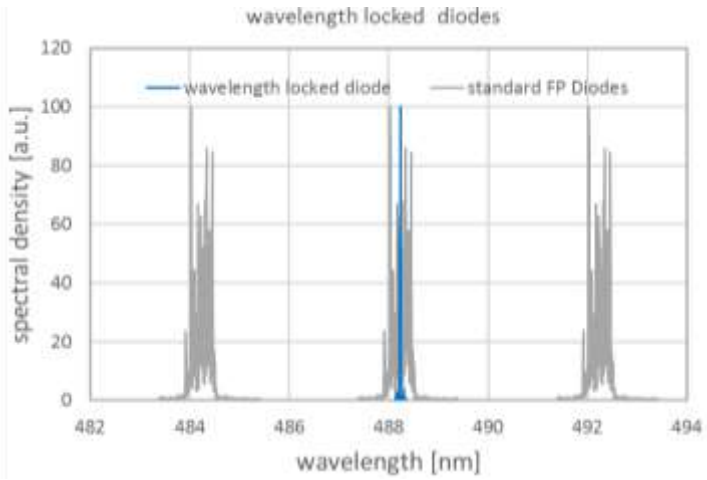
Smaller bandwidth of excitation light blocking optics → improved system performance



λ_{center} +/- 0,3nm

$\Delta\lambda$ < < 0,1nm



Commercially available FP diodes

λcenter +/- 4nm
$\Delta\lambda$ < 2nm

Wavelength locked diodes

λ_{center} +/- 0,5nm
$\Delta\lambda$ < 0,2nm

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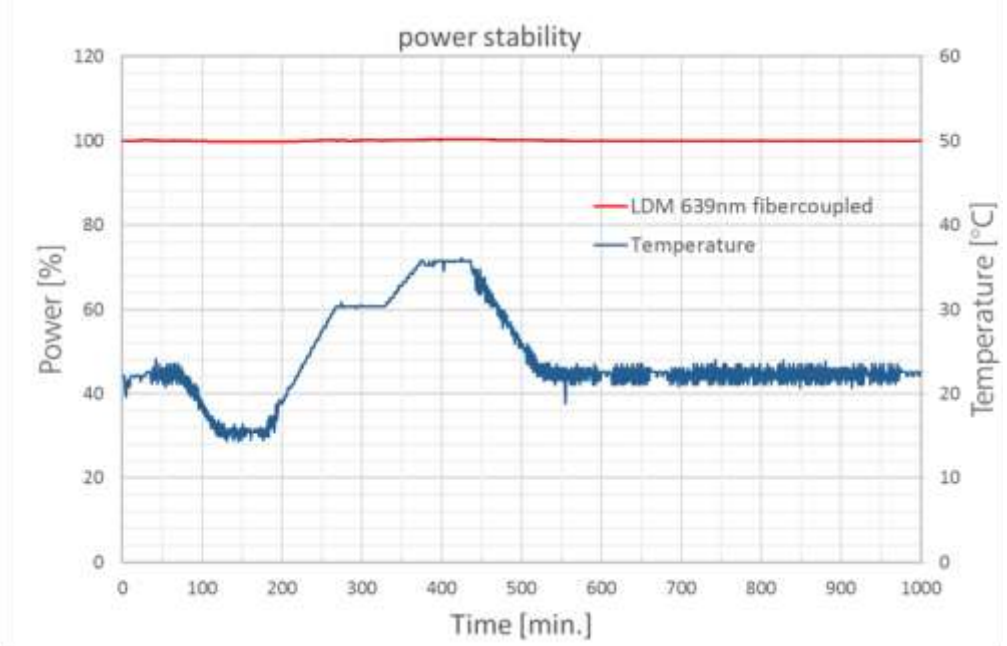

- Temperature range 15 °C - 35°C
- Power control mode
- Almost insensitive to temperature changes

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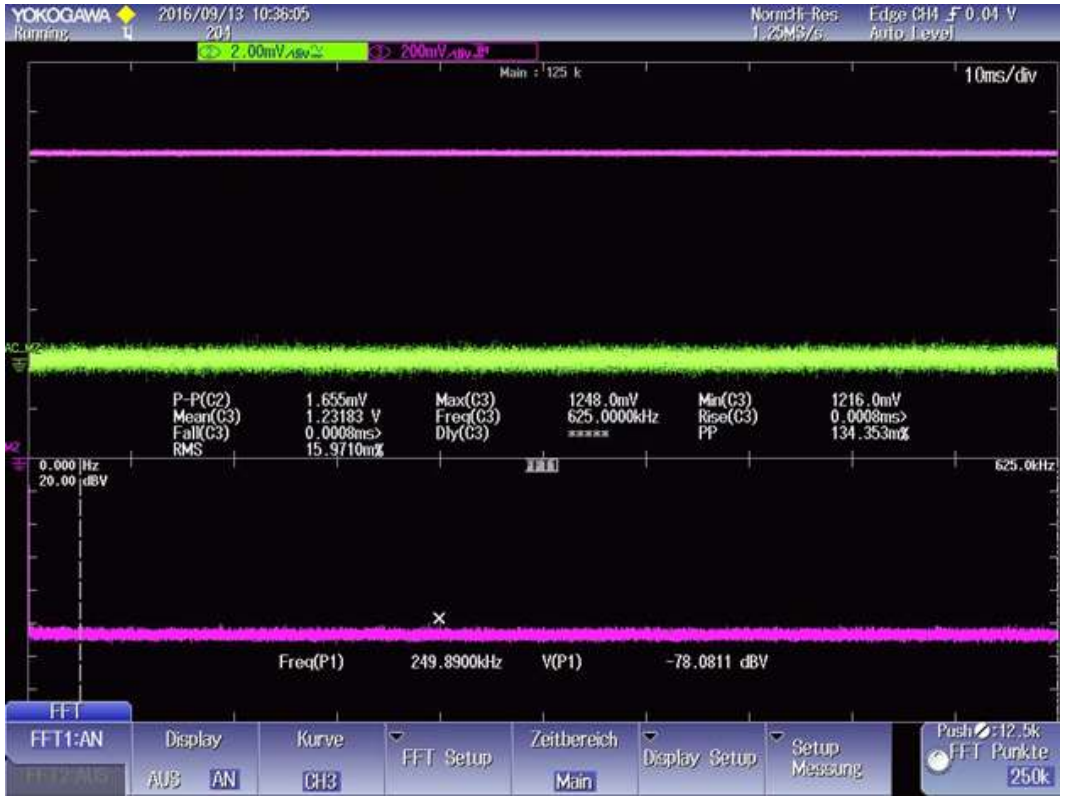

- RMS <0,02%
- Signals fft < -78dB

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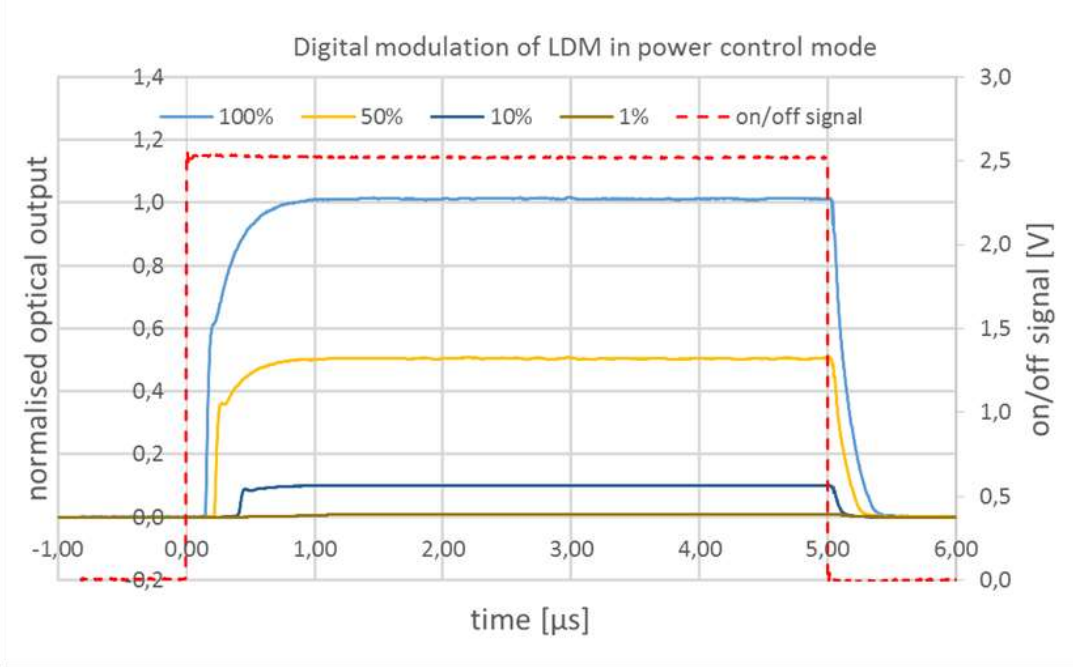
- Short pulse lasers: pulse length <100ps (FWHM)



- Rise and fall times of direct modulated diodes comparable to AOM and AOTF (<1µs)
- Modulation depth still smaller
- General demand on faster modulation
- „Diode Laser“ in the „Yellow Gap“

Technical demands

- Wide range of different wavelengths and power levels
- Fundamental mode beam quality M^2 close to 1
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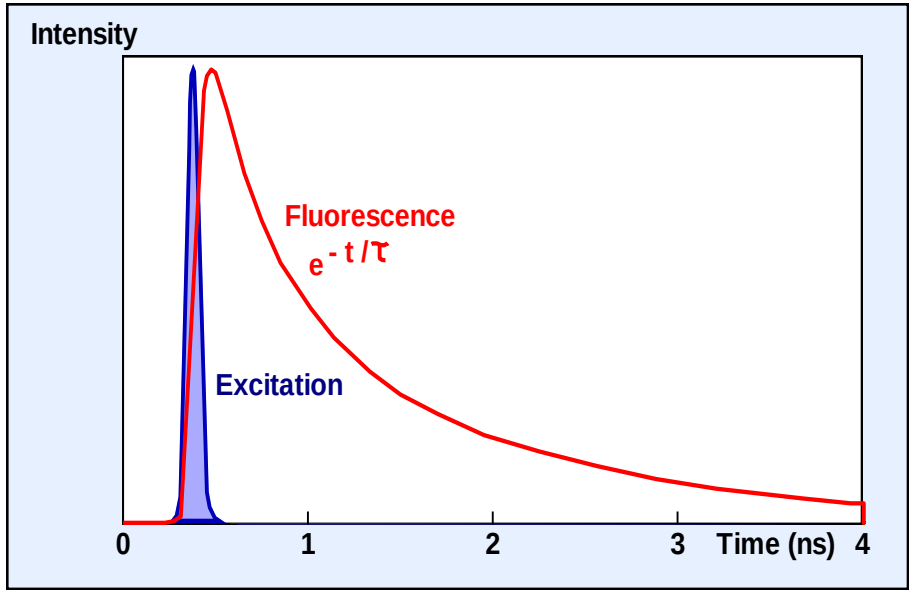
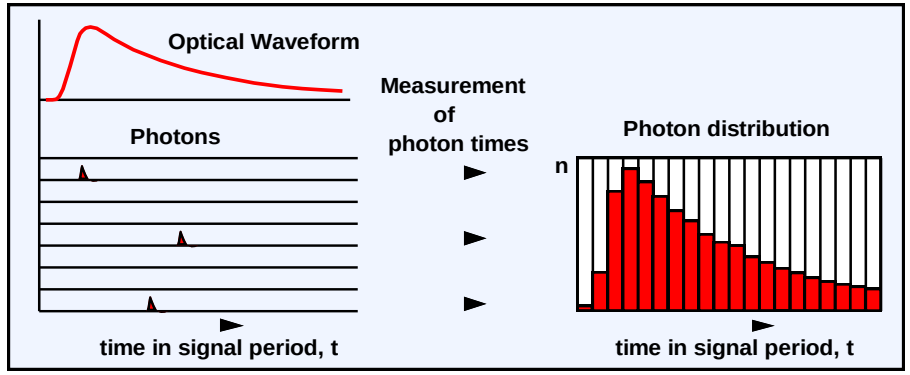
- Highest possible power stability independent of environmental conditions
- Low noise / especially at fixed frequencies
- Fast digital („zero photon“ to operation power) and analog modulation
- Short pulse lasers

- Pulse length <100ps (FWHM)
- Cw / ps laser
- Inexpensive, almost same footprint as cw laser
- Can easily be integrated in multi laser light source

FLIM (Fluorescence-Lifetime Imaging)



TCSPC (Time correlated single-photon counting)



Courtesy of Becker & Hickl GmbH

Temporal decay of fluorescence is measured

Short pulse laser sources necessary:

- Mode coupled solid-state laser
- Supercontinuum laser (pulsed white light)
- ps diode laser (50-100ps typically)

Additional parameter:

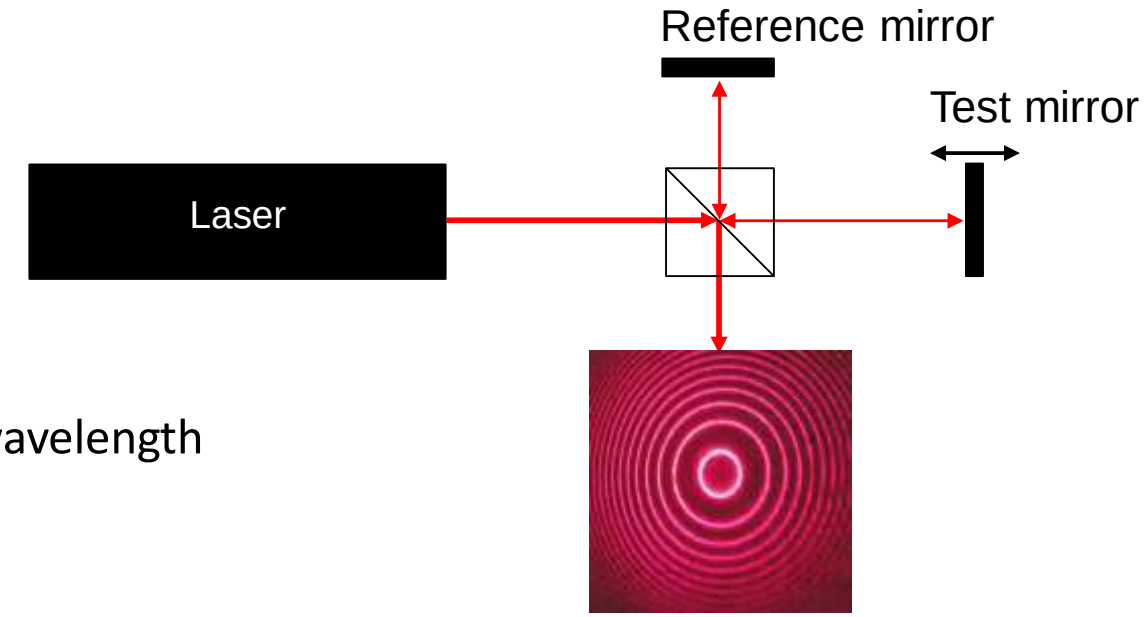
- Signal separation of different fluorophores
- Many other information,…

Stabilised Helium-Neon Laser

- HeNe-Laser is mostly used in high precision measurements
  e.g. Interferometric measurements

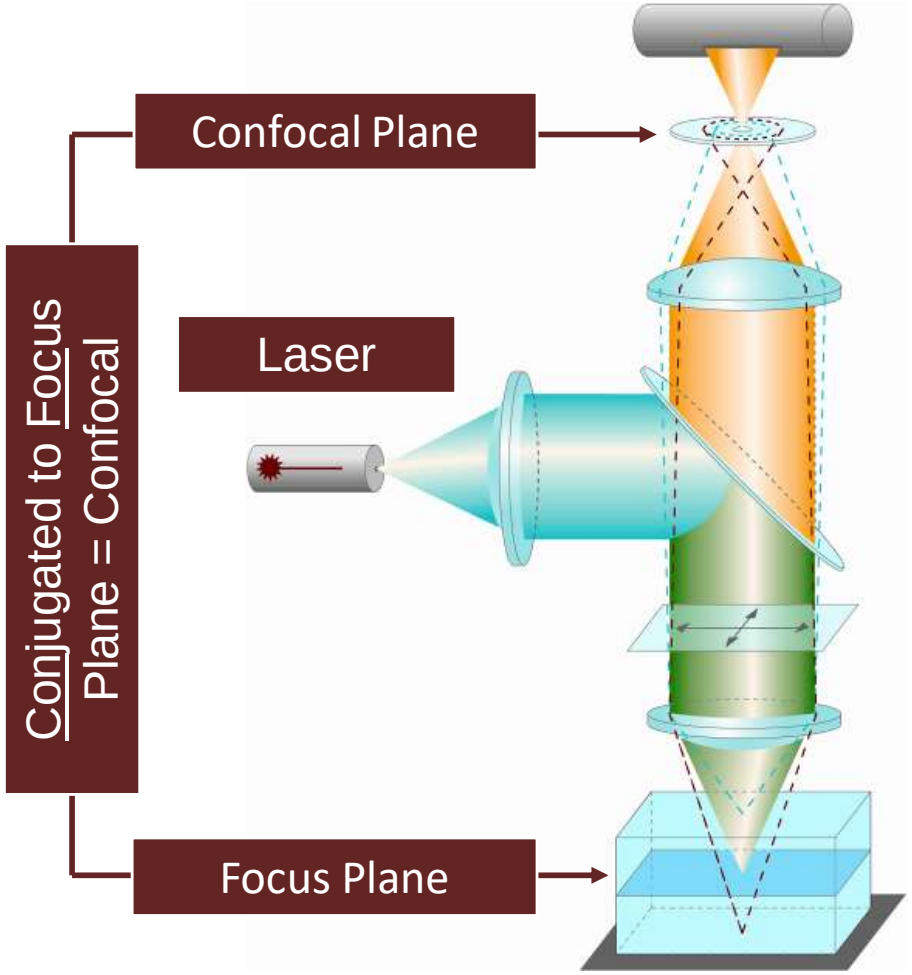
→ Power must be constant
- Signal to noise ratio

→ Frequency must be constant
- Interference pattern depends on wavelength



Laser Scanning Confocal Microscope

The confocal principle



Detector (Photo Multiplier)

Confocal Pinhole

Pinhole Optics

Main Beam Splitter

Scan Mirror

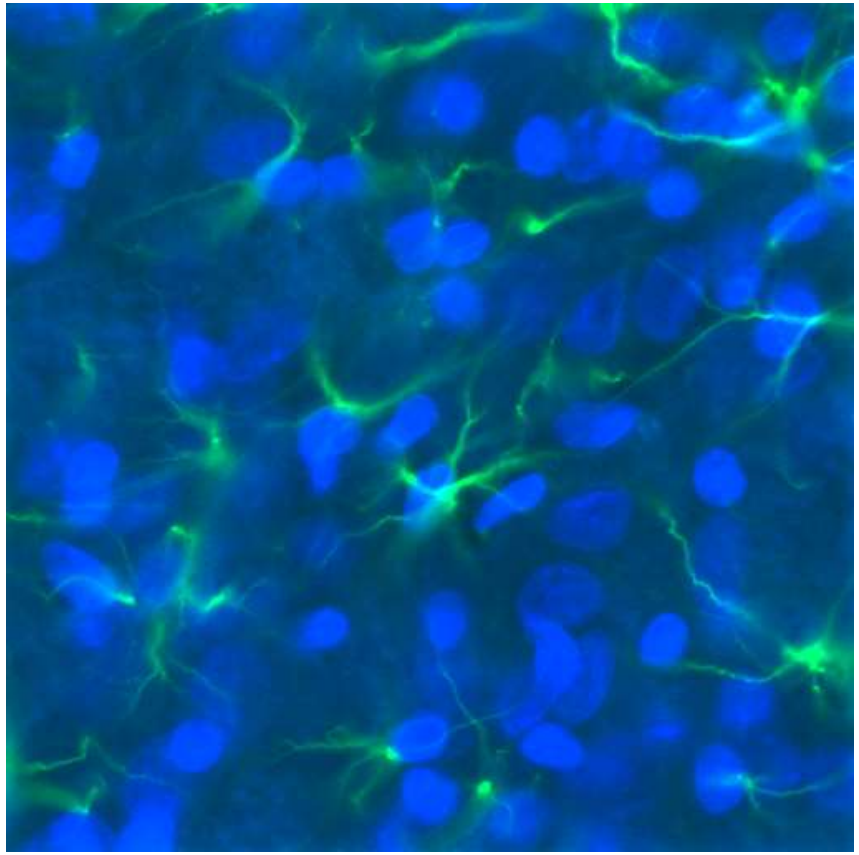
Objective

3D Sample

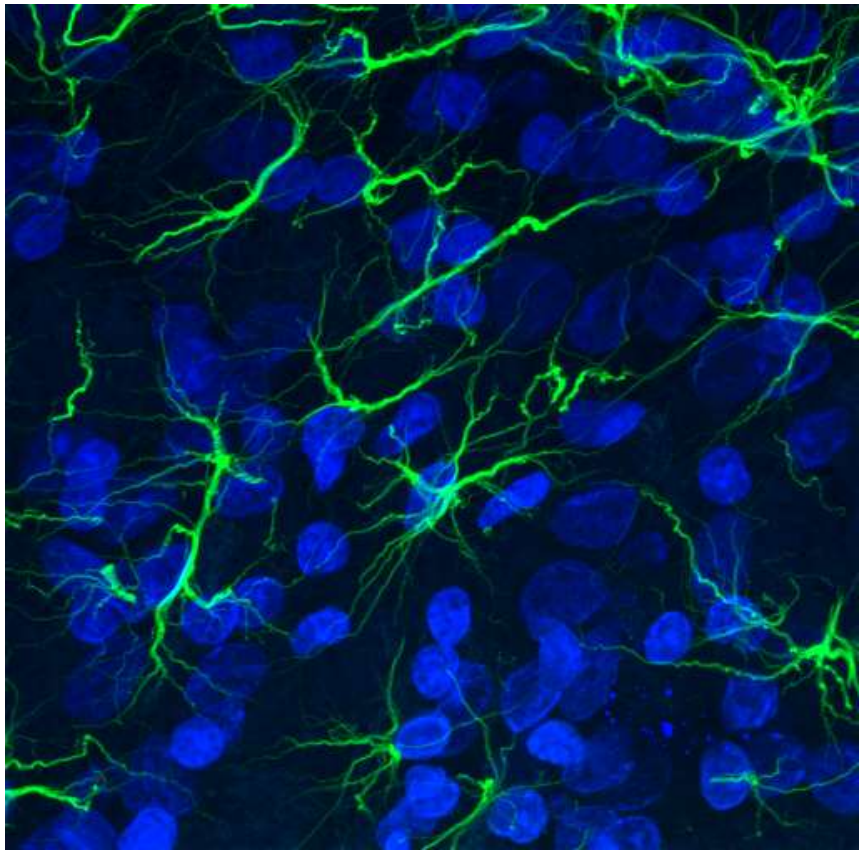
Courtesy of Carl Zeiss Microscopy GmbH

Laser Scanning Confocal Microscope

Why confocal?



Wide field



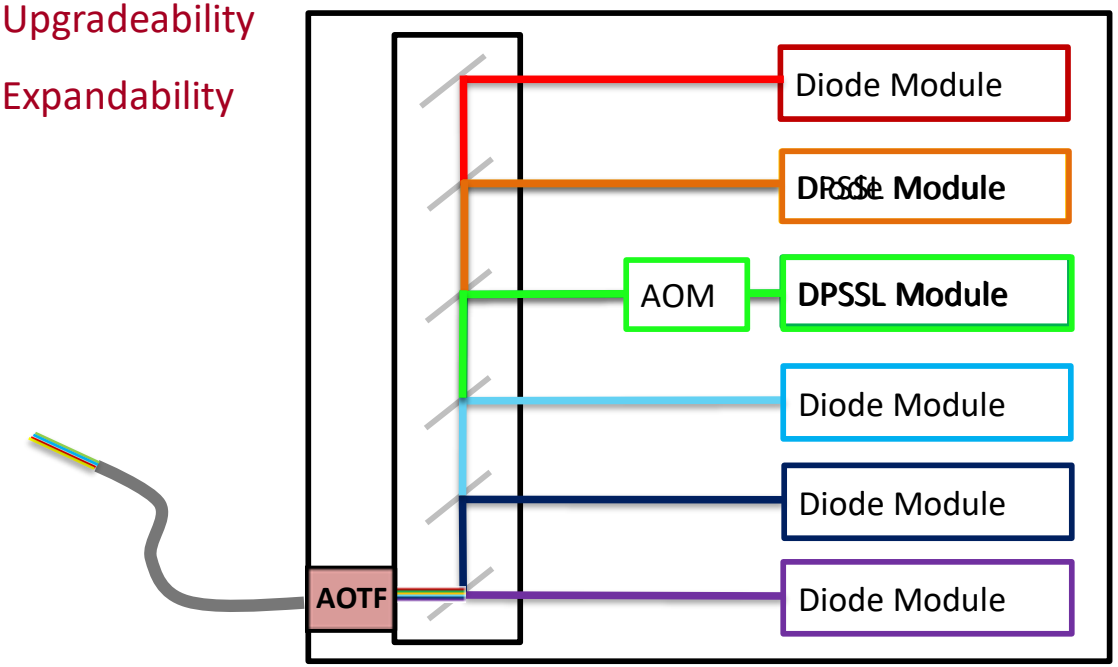
Confocal

Courtesy of Carl Zeiss Microscopy GmbH

Customer demands

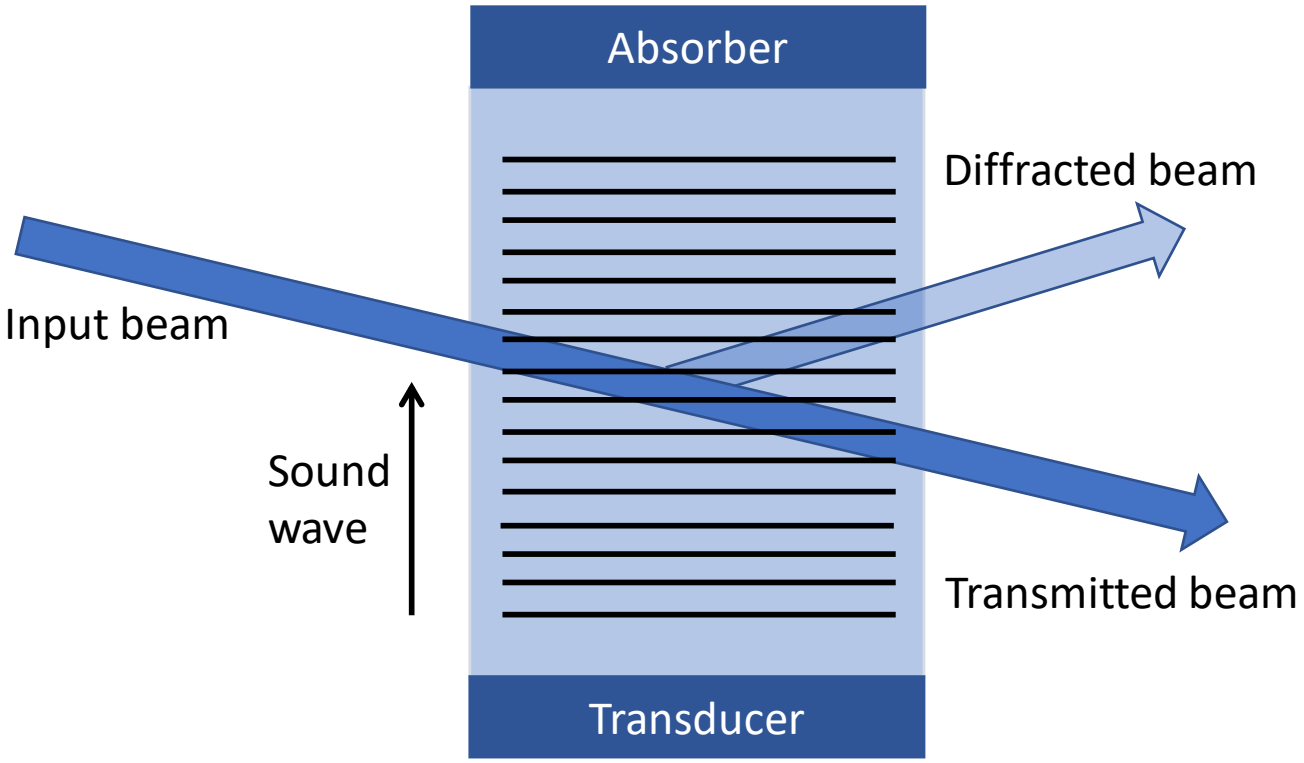
- Plug-and-Play
- Easy-to-use platform
- Customization and Modification
- Field flexibility
- Service-friendliness
- Upgradeability
- Expandability

- Up to 6 different laser sources
- Highest flexibility – each wavelength individually changeable and upgradeable in the field
- Lasting and stable quality of coupling/outcoupling
- Optional integration of AOM/AOTF for DPSS laser modulation capability



- Maximal resistance to vibration
- Plug-and-Play
- Alignment-free

Direct modulation of output power by acousto optical modulation (AOM)



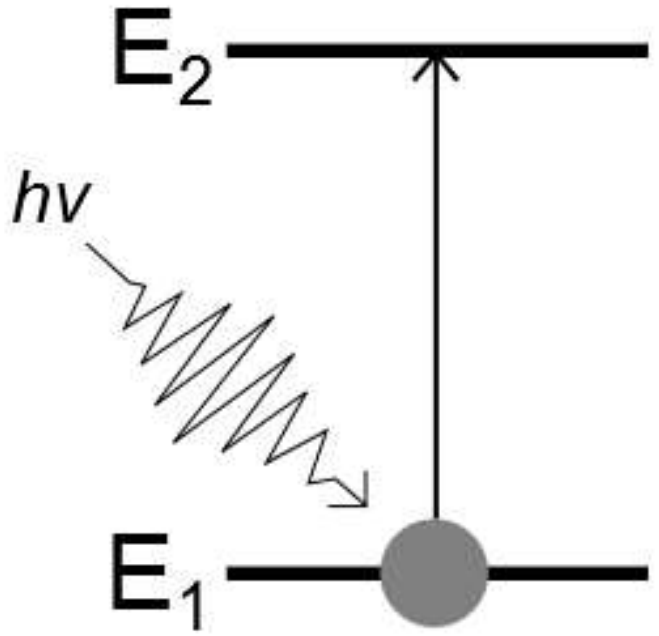
- Varying the optical power by changing RF power.
- Fast, because of acoustic velocity in crystal.
- No moveable parts, therefore long lifetime.
- Diffraction efficiency can be as high as >99%
- Design changes allow to use it as a deflector or filter.

WHY MEASURE POWER?

Low Power
ex: Laser pointer

Mid Power
ex: Laser engraving

High Power
Ex: Laser cutting



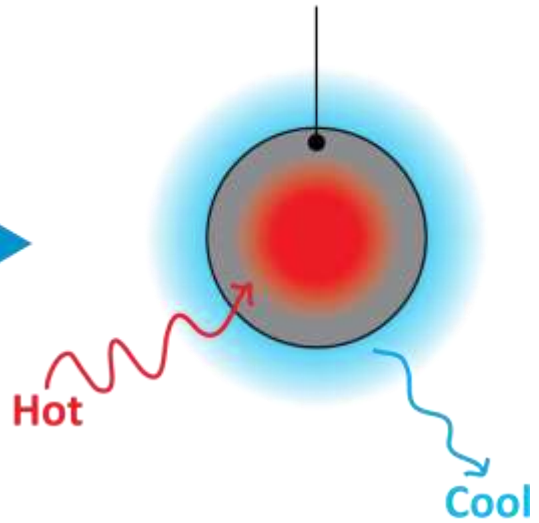
POWER DETECTOR FAMILIES

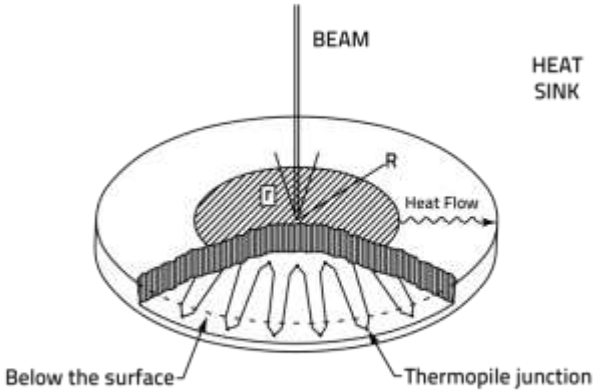
THERMOPILE DISK

UP Series
Power Detector

UD Series
Thermopile Disk

Thermopile





r = radius of beam
R = Radius of disk

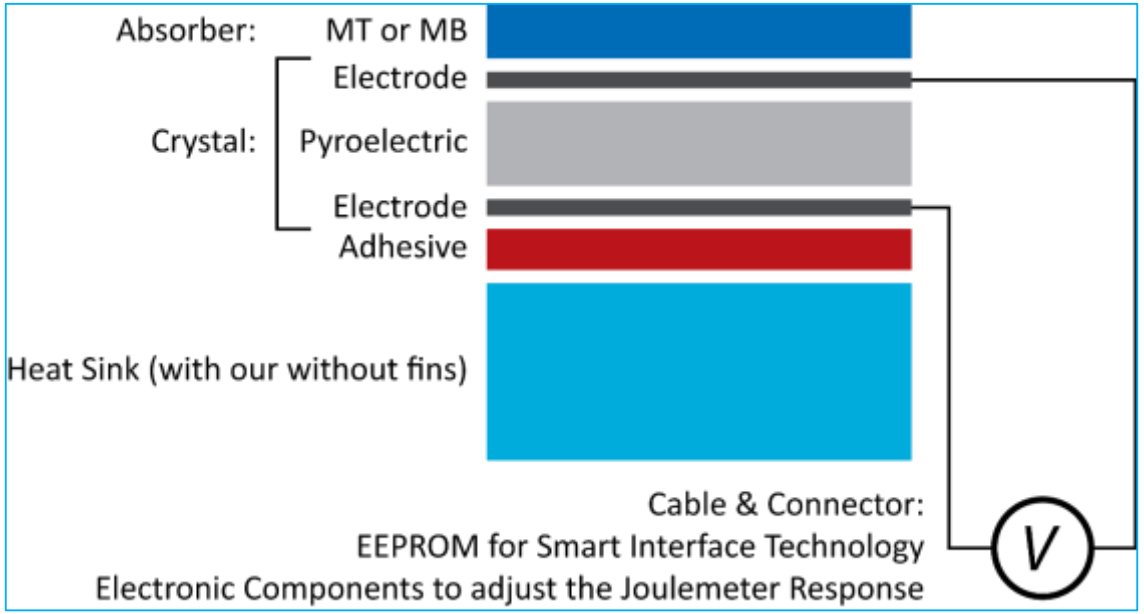
ENERGY METER THEORY

Pyroelectric crystals

- **What is a pyroelectric crystal?**

"The property of certain crystals to produce a state of electric polarity by a change of temperature."

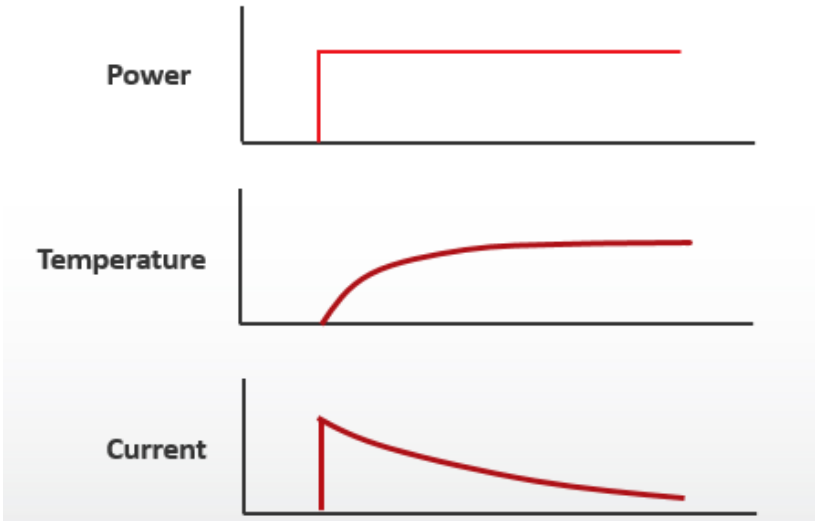
- **Principle:**
  1. Laser pulse heats the crystal
  2. Crystal changes its polarity
  3. Current flows through the electrodes



Energy meter theory

Pyroelectric crystals

- A pyroelectric crystal is a passive component: it will only generate voltage when subjected to a change in temperature
- The generated voltage is proportional to temperature change rate
- To be specific, $V \propto \frac{dT}{dt}$
- When there is no temperature change, there is therefore no voltage generated
- Calibration relates amount of voltage generated to energy value of laser pulse



SAFETY RULES

- Always wear safety goggles
- Keep your hands away from the optical table and beam path
- Never put your eyes at the height of the beam propagation
- Always close the safety curtains to avoid exposing other people to the laser beam
- Better safe than sorry, you only have 1 pair of eyes.

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gentec-eo
PARTNERS for ACCURACY

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