

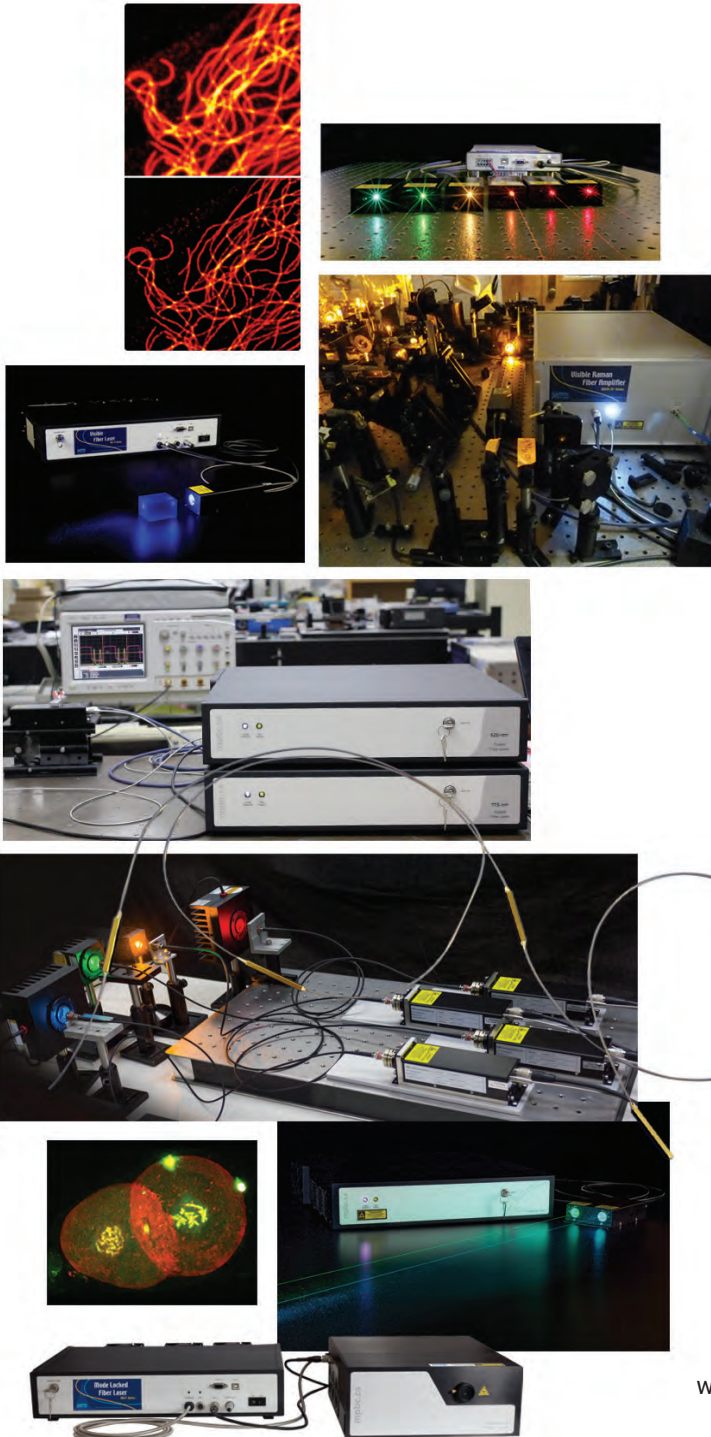
# VISIBLE FIBER LASERS FOR BIOSCIENCE

MPB launched the first visible fiber laser at Photonics West in 2006.

During the conference, this compact 1-Watt 560-nm laser, with exceptional beam characteristics, quickly became known as a product “looking for an application”.

It didn't take long for application ideas to find us. However, as with any new application, feasibility had to be proven. The best way forward? Take on the challenge of developing lasers for specific applications by working closely with the scientific community. A low power 580-nm laser was developed in conjunction with Dr. William Telford for the NIH National Cancer Institute Core Flow Cytometry Facility; a 592 nm laser for Nobel Laureate Dr. Stefan Hell at Max Planck Institute for STED microscopy; 488-, 532-, 560 - and 642- nm laser for Light Sheet Microscopy for Nobel Laureate Dr. Eric Betzig at HHMI; a 22-W 589-nm single frequency system for the European Southern Observatory's “Next Generation” Guide Star....

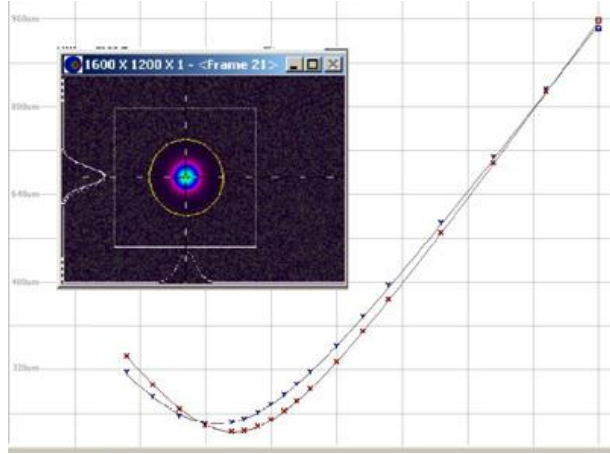
Our laser portfolio now includes these visible fiber lasers along with dozens of commercially available wavelengths in the visible and NIR range. With various output powers, multimode or single-frequency, modulated or pulse variants, all lasers have a reputation for unsurpassed beam quality, reliability and stability. We have evolved from “looking for an application” to becoming the “go-to” company for leading researchers and industrial laser users worldwide.



# Continuous Wave NIR 连续波近红外 Fiber Lasers 光纤激光器

MPBC's CW NIR Fiber Laser Series is an ideal choice for demanding research and industrial applications with wavelengths available from 976 nm to 1660 nm.

MPBC 的 CW NIR 光纤激光器系列是要求苛刻的研究和工业应用的理想选择，波长范围为 976 nm 至 1660 nm。



Output power ranges from 1 Watt to 50 Watts in an air-cooled package, and 50 Watts to 100+ Watts in a water-cooled package. Low power models are available in OEM modules for system integration or 2RU-Rack mount enclosures for laboratory use. High power models are available in robust water-cooled rack mount enclosures. The lasers emit narrowband linearly-polarized light and have true diffraction-limited outputs.

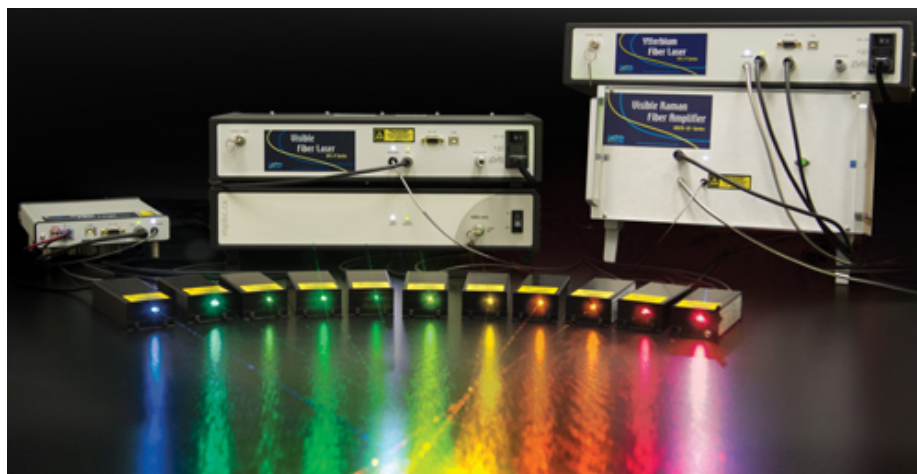
风冷封装的输出功率范围为 1 瓦至 50 瓦，水冷封装的输出功率范围为 50 瓦至 100+ 瓦。低功耗型号提供用于系统集成的 OEM 模块或用于实验室的 2RU 机架安装机箱。高功率型号采用坚固的水冷机架安装机柜。激光器发射窄带线性偏振光，并具有真正的衍射极限输出。

All lasers are offered with an intelligent Graphical User Interface for ease of installation, control and monitoring.

所有激光器都配有智能图形用户界面，便于安装、控制和监控。

A modulation option is also available.

还提供调制选项。



## Specifications 规格

Emission Wavelength user-specified range 发射波长用户指定范围	976, 1030 - 1660	nm 纳 米
Wavelength Accuracy 波长精度	± 0.5	nm 纳 米
Long Term Wavelength Stability - Nominal 长期波长稳定性 - 标称值	± 0.02	nm 纳 米
Degree of Polarization 极化程度	> 99	%
Diffraction Limited Beam M2 衍射极限光束 M 2	< 1.1	%
Long term output power drift (8 hours) 长期输出功率漂移 (8 小时)	± 1	%
Relative RMS Intensity Noise at Nominal Power, integrated over 5 Hz to 100 kHz 标称功率下的相对 RMS 强度噪声, 积分范围为 5 Hz 至 100 kHz	< 2	%

## Features 特征

- Narrow Linewidth 窄线宽
- Active Power Stabilization to ensure long term power stability of < 2%  
有源功率稳定, 确保< 2% 的长期功率稳定性
- Excellent wavelength stability to ensure spectral purity (± 0.02 nm)  
出色的波长稳定性, 确保光谱纯度 (± 0.02 nm)
- Graphical User Interface for easy command and control  
图形用户界面, 便于命令和控制
- Compact laser head 紧凑型激光头
- Tunable output power (from 20% to 100% of nominal) to adapt to application-specific requirements  
可调输出功率 (从标称值的 20% 到 100%), 以适应特定应用的要求
- High reliability 高可靠性
- Maintenance-free 免维护

## Applications 应用

- Flow Cytometry 流式细胞术
- Fluorescence Microscopy 荧光显微镜
- Structured Illumination Microscopy  
结构照显微镜
- Super Resolution Microscopy 超分辨率显微镜
- 3rd Generation DNA Sequencing 第三代 DNA 测序
- DNA Painting DNA 绘画
- Bio-Medical Research 生物医学研究
- Entertainment 娱乐
- Military, and Scientific Research  
军事和科学研究

## Specifications 规格

- Beam: Collimated 光束：准直
- Transverse Mode: TEM00 横向模式：TEM 00
- Polarization: Linear 极化：线性
- Orientation of Polarization: Vertical to the base  
偏振方向：垂直于基底

## Fiber Coupling Option 光纤耦合选项

- MPBC offers fiber coupling for all of our standard fiber lasers (488 nm - 750 nm) coupled to single mode PM patch cord.  
MPBC 为我们所有的标准光纤激光器（488 nm - 750 nm）提供光纤耦合，耦合到单模永磁跳线。
- The maximum output power from fiber for each wavelength depends on output power from our standard VFLs with typical coupling efficiency in the range of 75-80%.  
每个波长的光纤的最大输出功率取决于我们标准 VFL 的输出功率，其典型耦合效率在 75-80% 的范围内。
- Single mode PM Patch cord output options include  
单模 PM 跳线输出选项包括
  - Bare fiber 裸纤维
  - FC/PC connector (flat 0°) FC/PC 连接器（扁平 0°）
  - FC/APC connector (flat, angled 8°).  
FC/APC 连接器（扁平，弯角 8°）。

Customized wavelengths available upon request.

可根据要求提供定制波长



# Visible Fiber Lasers

brilliant power and performance

MPB's Fiber Laser Product line has grown out of its highly reliable Raman Fiber Laser deployed for 20+ years in telecom fiber optic systems. Exceptional performance is achieved based on an all-fiber architecture, which draws on MPB's telecom design practices. The all-fiber laser design eliminates the need for alignment as no bulk components are used, provides unprecedented wavelength and output power stability, and ensures a diffraction-limited linearly-polarized output.

MPB is able to offer a variety of wavelengths based on similar architectures by employing its own fiber Bragg gratings to lock the laser wavelength. Built-in intelligence allows control and monitoring through a user-friendly graphical user interface via an RS-232 or USB port and features automatic power control for excellent power stability.

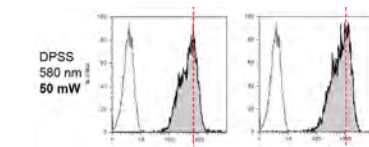
## Some Collaborations

2004-2005



Our first Visible Fiber Laser - a 200 mW 560-nm developed for Harvard University Department of Chemistry

2006-2007



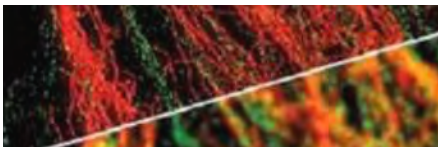
Low power 580 nm laser in conjunction with William Telford, NIH National Cancer Institute Core Flow Cytometry Facility

2007-2008



Development of low power 592 nm laser for testing in conjunction with Vladislav Verkhusha, Albert Einstein College of Medicine

2008-2009



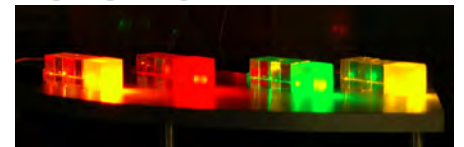
Development of the 592 nm 1.5 W laser for Nobel Laureate Dr. Stefan Hell, STED System, Max Planck Institute

2009-2011



Development of 20 W single frequency laser for the Very Large Telescope Guide Star, European Southern Observatory

2010-2011



Development of the high power lasers for Light Sheet Microscopy for Nobel Laureate Dr. Eric Betzig, Howard Hughes Medical Institute

2010-2012



Development of a suite of single frequency lasers for Atom Cooling, Prof. Martin Zwierlein, MIT

2012-2014



Development of externally triggered pulsed lasers for Nobel Laureate Dr. Stefan Hell, next generation STED platform, Max Planck Institute

2013-2014



Development of 750 nm CW 500 mW laser for STORM applications, Harvard University

2015-2016



Development of an internally / externally triggerable pulsed 631 nm laser for Max Planck Institute Göttingen Germany

2016-2017



Development of Single Mode Fiber Coupled Lasers with powers up to 1.3 W for Richard Terry Wyss Institute at Harvard University

2017-2018



Development of a High Power 607 nm CW laser for Nobel Laureate Eric Betzig

2014-2015



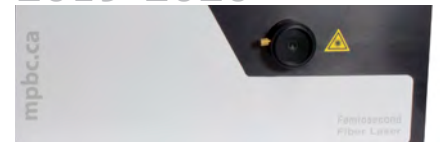
On-going development of fiber lasers for microscopy applications for Dr. Gael Moneron & Dr. David DiGregorio, Institut Pasteur Paris

2014-2015



100 W 1178 nm Raman Fiber Amplifier for the European Southern Observatory for next generation Guide Stars and to assist in resolving the resolution of the atmospheric turbulence problem experienced in uplinks in Optical Ground Station installations.

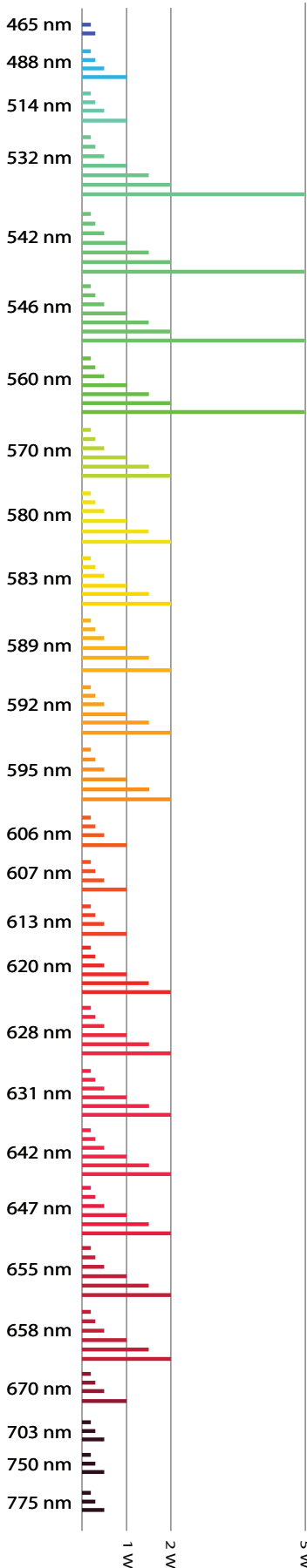
2019-2020



Development of a high power 1040 nm femto-second fiber laser featuring an all-fiber design (no bulk optics) for Dr. Arjun Krishnaswamy of McGill University's Life Sciences Complex

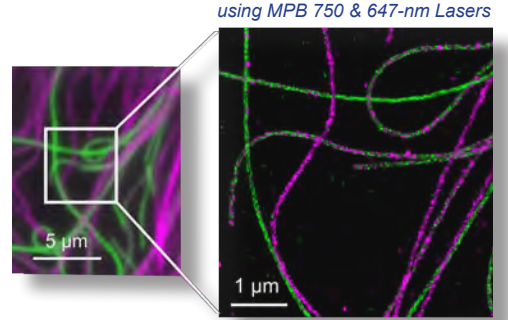
# Lasers In The Field

## MPB VISIBLE LASERS



**STORM** - The images show two-color microtubule staining in a fixed and immunolabeled B-SC-1 cell that has been **stained for tyrosinated (magenta) and detyrosinated (green) tubulin** using antibodies. Close inspection reveals a hollow feature on quite a few segments of the microtubules, which is only possible to see when the system and samples are done really well. You can see from the image how much better **STORM** does than conventional microscopy.

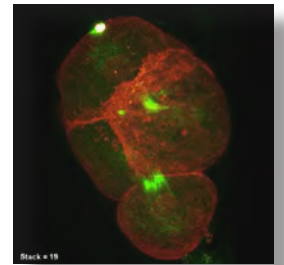
Courtesy Joshua C. Vaughan, Ph.D., Assistant professor, Department of Chemistry, University of Washington



**LATTICE LIGHT SHEET** - Localization of the chromosomal passenger protein AIR-2 during the first few cell divisions of the early *C. elegans* embryo (cf., Fig. 6A, fig. S12).

Courtesy Betzig Lab, HHMI/Janelia Research Campus, Bembek Lab, University of Tennessee

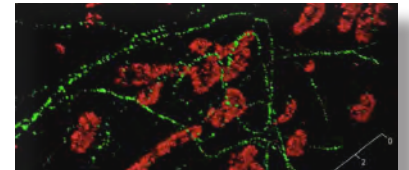
using MPB 642, 560, 532 & 488-nm Lasers



**Ground State Depletion Microscopy - GSD** COS cells stained for microtubules with Alexa 647 and mitochondria with Alexa 555.

Courtesy Leica Microsystems Prof. Ralf Jacob, Philipps-University Marburg

using MPB 642 & 532-nm Lasers

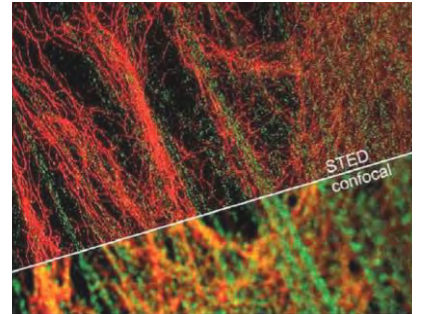


**"Next generation" STED** - The **STED** laser is a frequency-doubled pulsed fiber laser (PFL1-1000-775, MPB Communications) providing 1 ns pulses of up to 30 nJ pulse energy at a wavelength of 775 nm. The STED laser can be triggered electronically over a wide frequency range (25-40 MHz) which greatly simplifies the synchronization of the excitation and STED pulses.... STED beams at 775 nm wavelength are quite efficient for STED of fluorophores having peak emissions between 600 nm and 700 nm, a fact which can be used for multicolor recordings using a single-wavelength STED beam.

Courtesy Max Planck Institute for Biophysical Chemistry

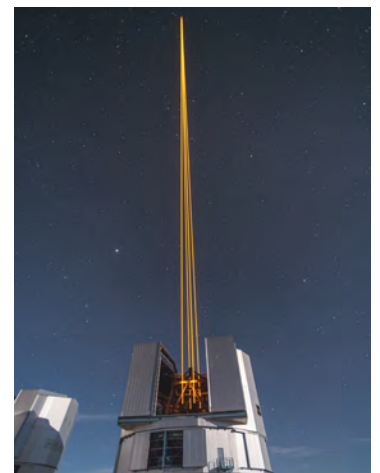
Gorlitz, Frederik, Patrick Hoyer, Henning J. Falk, Lars Kastrup, Johann Engelhardt and Stefan W. Hell - "A STED Microscope Designed for Routine Biomedical Applications." *Progress In Electromagnetics Research*, Vol. 147 (2014) pp. 57-68.

using MPB 775-nm Frequency-Doubled Pulsed Fiber Laser



In this "next generation" Laser Guide Star, installed at the European Southern Observatory in Paranal, Chile, **narrow-band 1178-nm emission from a 25-mW diode laser** is amplified to the 40-W level and then frequency doubled in a resonant cavity doubler to provide **22 W** at the desired sodium resonance wavelength of **589 nm**. The novel technology developed to achieve such high power amplification of an extremely narrow-band seed is the **polarization-maintaining (PM) Raman fiber amplifier (RFA)** developed by MPB. The 4 Laser Guide Star Facility (4LGSF), using four such lasers, is the most powerful laser guide star system in the world.

using an MPB PM RFA and an MPB 589-nm Laser



F. Kamphues/ESO

# Visible & NIR Fiber Lasers

## Features

- Narrow Linewidth
- Beam Characteristics:  $TEM_{00}$ ,  $M^2 < 1.1$
- Active Power Stabilization to ensure longterm power stability of  $< 2\%$
- Excellent wavelength stability ( $\pm 0.02$  nm)
- Graphical User Interface for easy command and control
- Compact laser head
- Tunable output power (from 20% to 100% of nominal) to adapt to application-specific requirements
- High reliability
- Maintenance-free

## Applications

- Flow Cytometry
- Fluorescence Microscopy
- Structured Illumination Microscopy
- Super Resolution Microscopy
- Light Sheet Microscopy
- Atom Cooling
- Dual Photon Microscopy
- 3rd Generation DNA Sequencing
- Micromachining
- Optical Tweezers
- Holography
- Entertainment
- Military and Scientific Research
- Environmental Sensing

## About MPB

MPBC is a leading supplier of innovative, high performance fiber laser and fiber amplifier systems and subsystems to the international high tech industry.

The company is privately held and self-financed. It has maintained its technological leadership through an ongoing commitment to R&D, investing approximately 20% of annual revenues back into research and development. MPB Communications Inc. is a Certified Women's Business Enterprise, and part of the WEConnect International's Global eNetwork.

# Laser Heritage

MPB's *Flight Sensor Demonstrator*, currently aboard ESA's PROBA-2 marks the **first time a fiber laser incorporated into an all-fiber-optic sensing system on a satellite is in space**. The system has been operating successfully since the satellite was employed in 2009.



Three innovative FBG sensors are included in the **PROBA-2** systems. The custom FBG gratings were manufactured using MPB's proprietary FBG writing facility.

MPB's *patented Super Raman technology*, based on third-order pumping techniques, is recognized throughout the telecommunications industry as a key enabling technology which appreciably augments the distance and channel counts of unrepeated systems. The award-winning Super Raman Fiber Laser was first introduced in 2002.



In 1992, MPB introduced the **first commercially available Er<sup>3+</sup> fiber laser**. This was followed in 1994 by the introduction of the **award-winning tunable single-frequency Er<sup>3+</sup> fiber laser**; the lowest-phase-noise source of any kind available commercially at the time.



From 1977 and for over 20 years, MPB offered a **GN-Series CO<sub>2</sub> Laser System**. Their long lifetime (most over 10 years), exceptional stability and excellent mode quality were unmatched in the industry.

