

Millijoules high master-slave pulse ratio 532 nm picosecond laser

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OUTLINE



Introduction



Experimental Methods



Results & Discussions



Summary & Acknowledgement



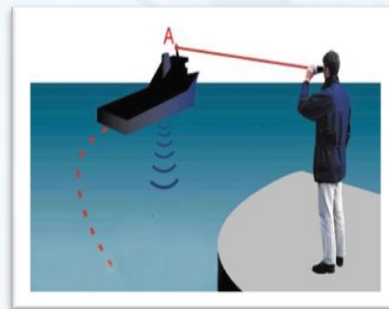
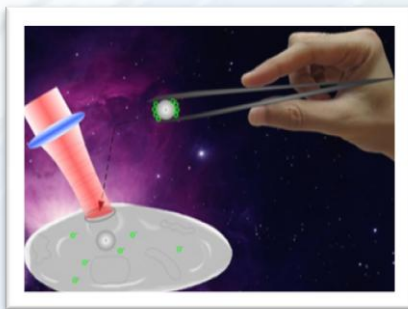
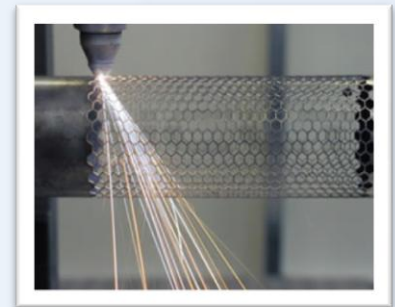
Introduction of GK Laser Technology Co., Ltd.

Introduction - Backgrounds

Applications of all-solid-state short pulse lasers:

- ✓ **Material cutting & forming**
- ✓ **Micro processing**
- ✓ **Medical equipment**
- ✓ **Space exploration**

... ..



Nanosecond

- **Serious thermal effects**
- **High edge burr**
- **High etching width**
- **Can not meet the requirements of etching width**

Picosecond

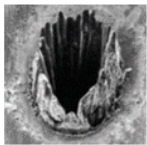
- Short action time
- Less edge burr
- Low price
- Easy maintenance
- Batch production
- Low production cost

Femtosecond

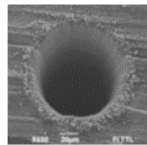
- Short action time
- Less edge burr
- **High price**
- **Poor stability**
- **Complex structure**
- **High maintenance costs**



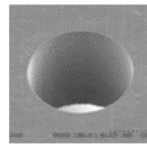
CW



Nano



Pico



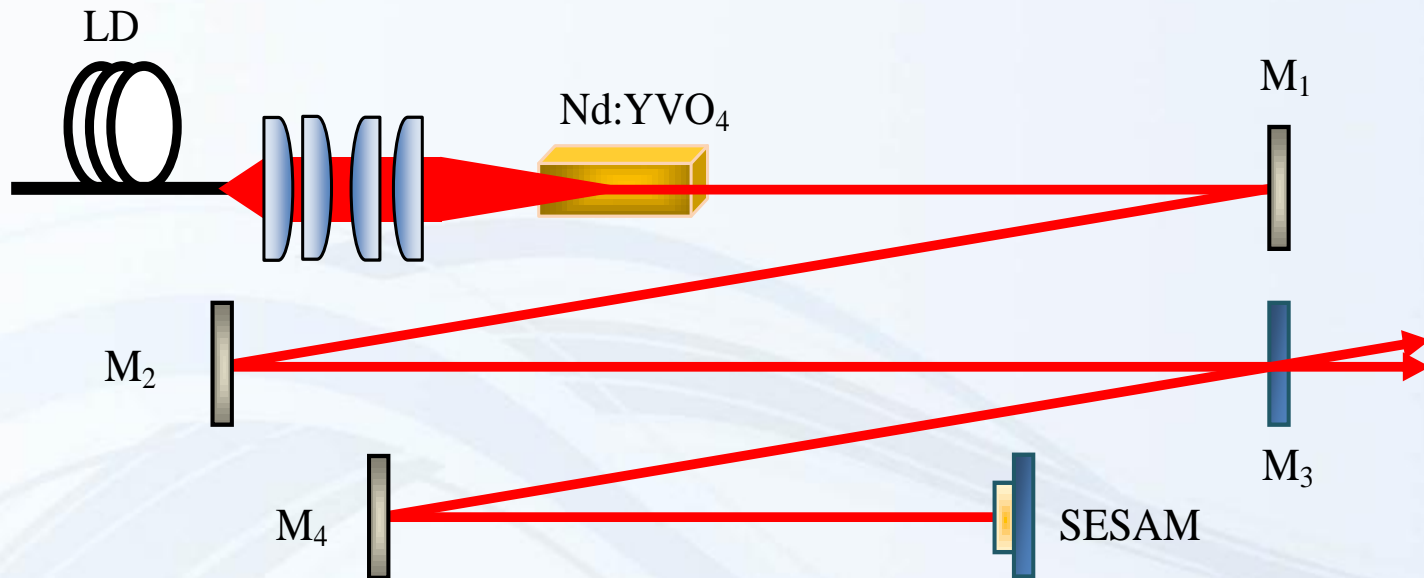
Femto

Nanosecond laser processing

Picosecond laser processing

Femtosecond laser processing

Experimental Configuration — SESAM mode-locking



SESAM mode-locking results

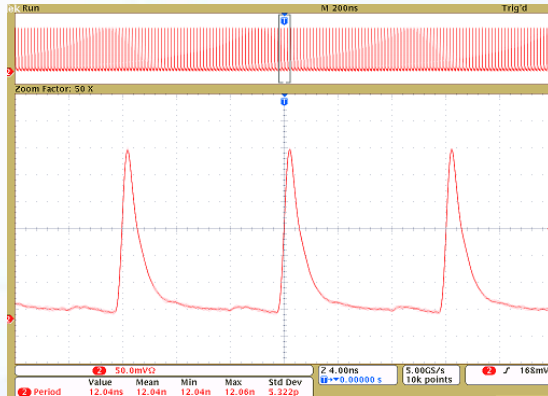


Fig.1 Waveform of CW mode-locked pulses

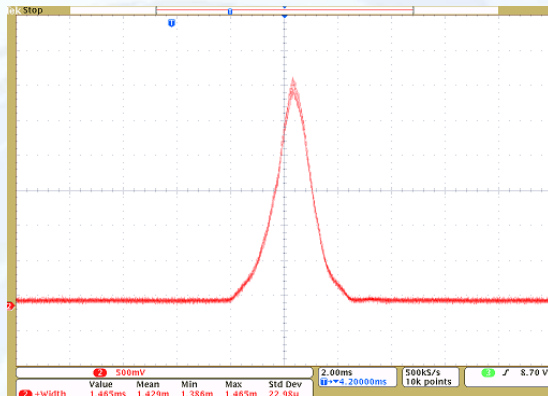


Fig. 2 Autocorrelation curves of the mode-locked pulse

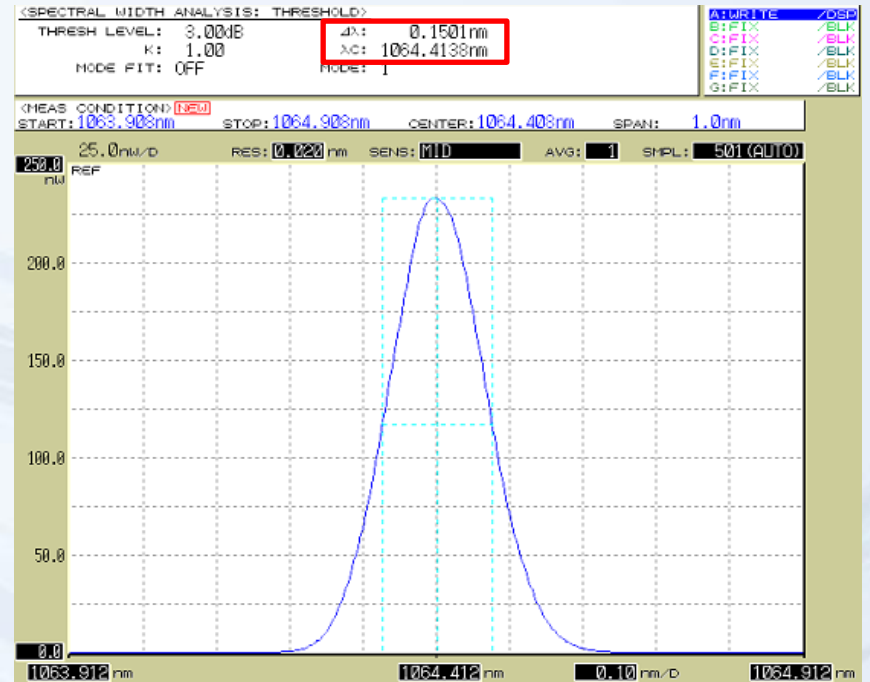
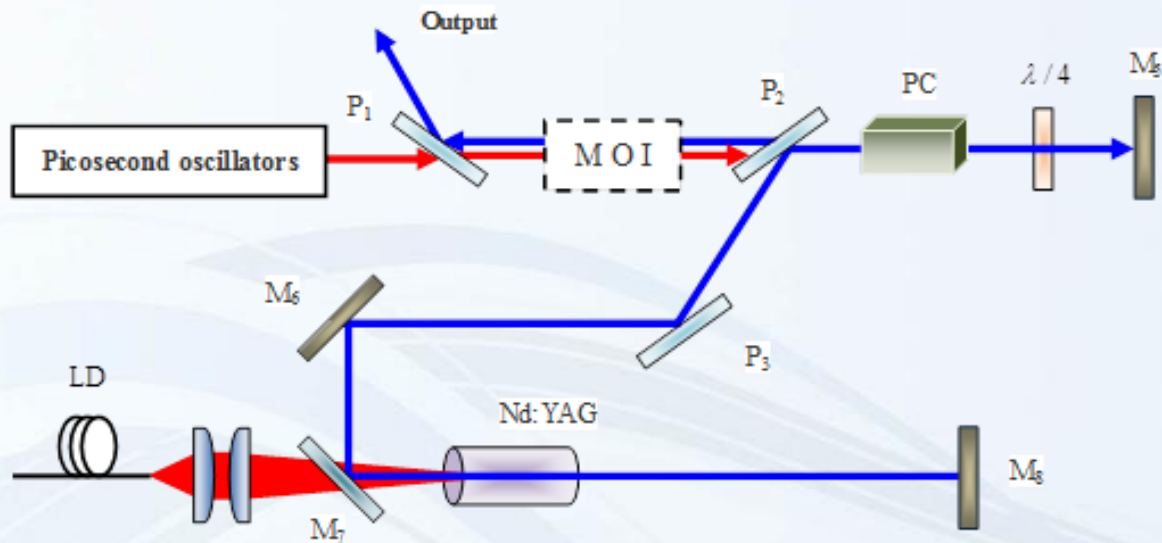


Fig. 3 Spectrogram

Experimental Configuration



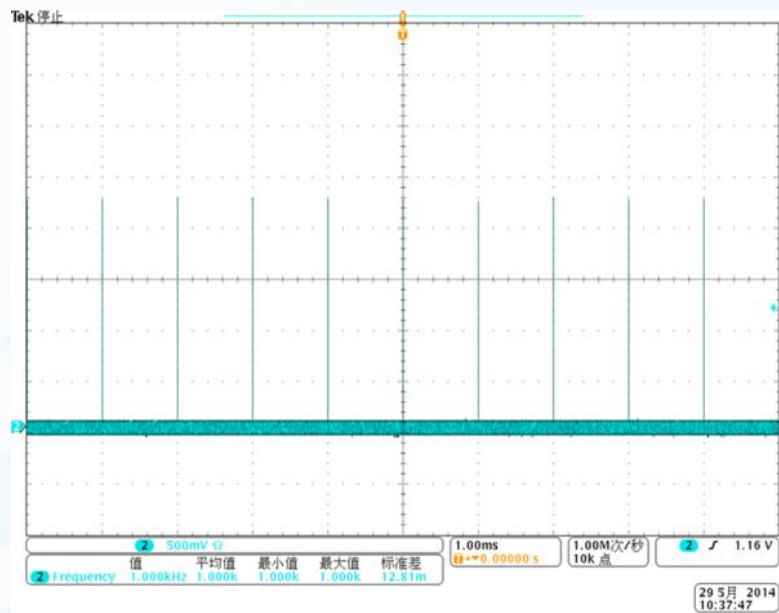
- MOI is a magneto optic isolator.
- PC is a BBO crystal Electro-Optical (EO) Pockels Cell.
- Nd:YAG rod is pumped with CW laser diodes.

Experimental Configuration

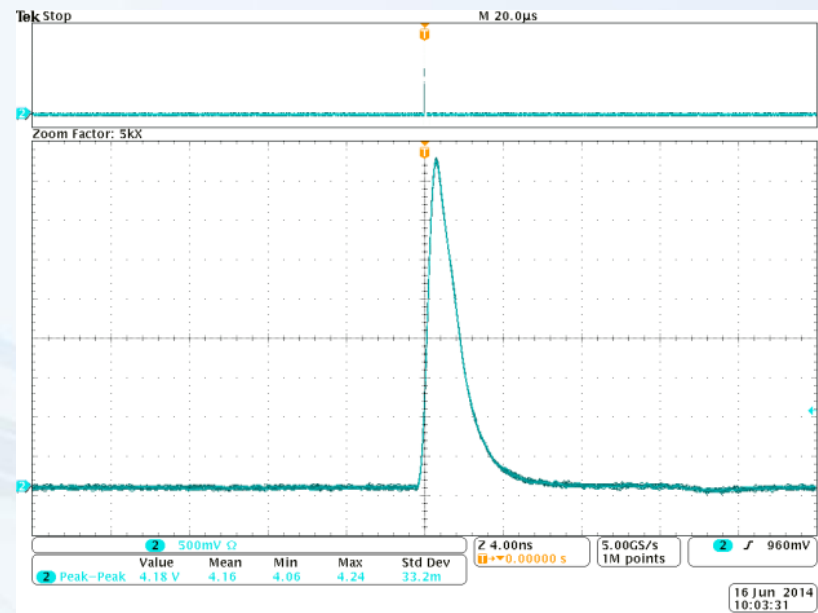


The LBO crystal is coated with 1064 nm AR coating on the incident surface and 532 & 1064 nm AR coated on the other surface. M9 is a beam splitting lens that is AR-coated at 1064 and HR-coated at 532 nm. Garbage is used to absorb the rest of infrared light.

Experimental Result

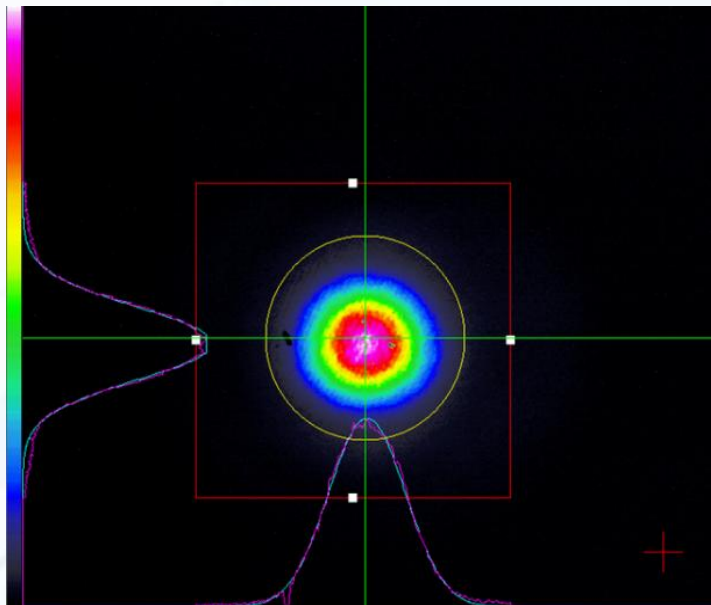


(a) Regenerative pulse sequence at 1 kHz

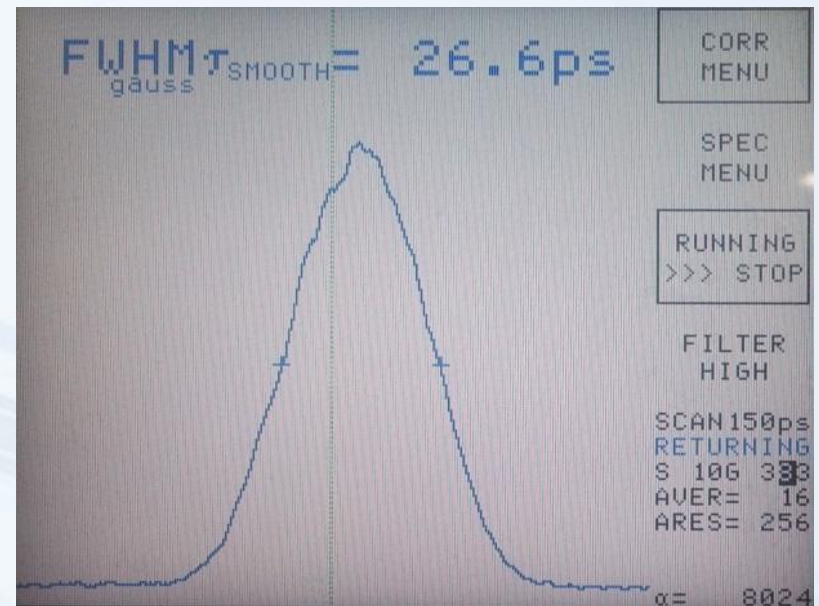


(b) single pulse

Experimental Result

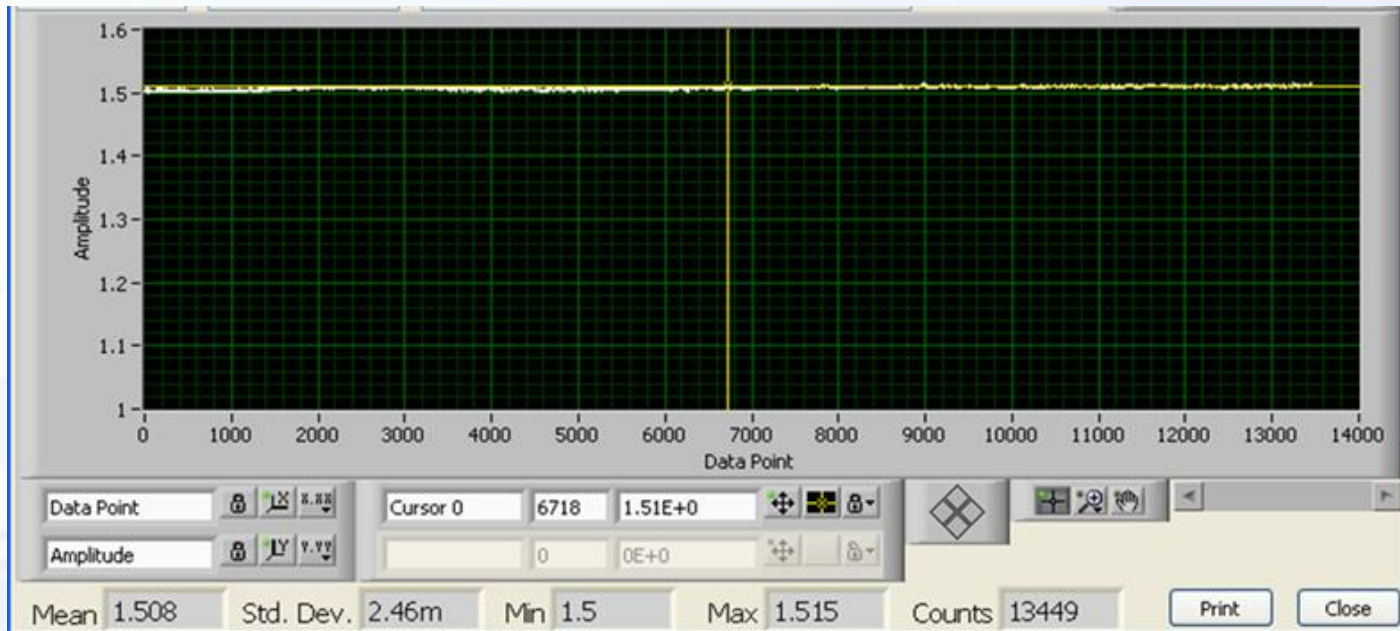


Output beam profile for the amplified pulse



Autocorrelation curve of the output pulse

Experimental Result



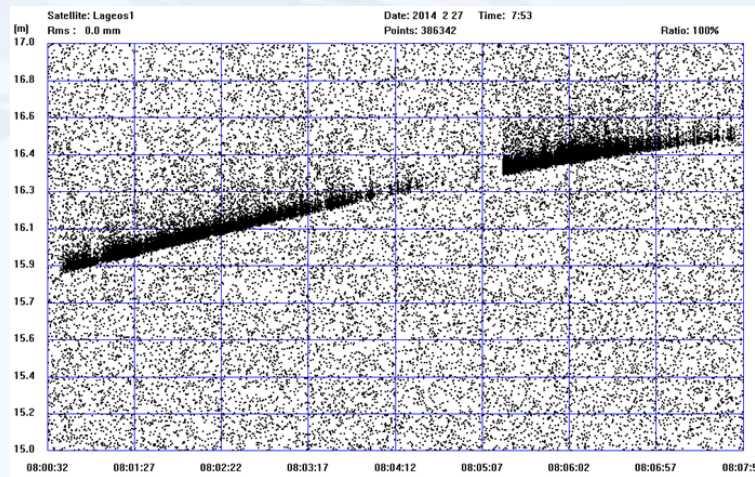
Power stability measured in long term operation (22.4 hours)



picosecond laser system



Working state of system in SLR



Laser returns from the satellite

Summary

- We have developed a high master-slave pulse ratio 532 nm picosecond laser on the magnitude of millijoules.
- The system combines the techniques of SESAM passively mode-locking, regenerative amplifier, and LBO crystal frequency doubling.
- The output pulses of the system have good beam quality and high stability that in continuous operation for more than 22.4 hours without failure.
- Through the actual ranging, we draw the conclusion that this system is capable to be applied in SLR.

我们用激光雕塑未来



Acknowledgement

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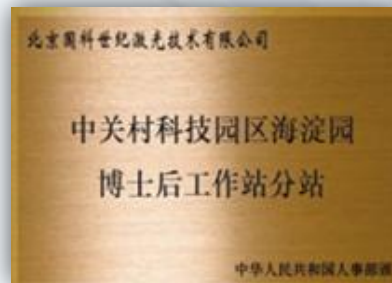
Introduction of GK Laser Technology Co., Ltd.



- Founded in 2002.
- A high-tech enterprise under holding of Chinese Academy of Sciences (CAS).
- Hi-tech Enterprise Certification by Beijing Municipal Science & Technology Commission in 2006.
- National Hi-tech Enterprise Certification in 2008.
- Hundreds of National Innovation Model innovative pilot enterprises in Zhongguancun in 2009 .
- National Torch Plan Key High-Tech Enterprise in 2012.
- Beijing international science and technology cooperation base of advanced semiconductor pump laser technology (2014).

Introduction of GK Laser Technology Co., Ltd.

- The First Class Prize of Beijing Science and Technology Progress Award (Municipal)
- The Second Class Prize of National Science and Technology Progress Award (National).



Introduction of GK Laser Technology Co., Ltd.

- More than 1,200 square meters of clean workshop and with semiconductor laser production lines .
- Producing a variety of lasers is more than thousands of sets per year.
- We has a group of more than 40 researchers, including 11 senior professional titles, 13 doctors and 23masters.
- 6 talents have been selected by Leading Talent of Scientific Beijing, New Science and Technology Star, The Excellent Talent of Beijing and Zhongguancun Leading Talent.





国家半导体泵浦激光工程技术研究中心

National Engineering Research For DPSSL

(Established in 2011)



北京国科世纪激光技术有限公司

Beijing GK Laser Technology Co. Ltd.



中国科学院光电研究院

**Academy of Opto-Electronics (AOE)
Chinese Academy of Sciences**

- Optical engineering national key disciplines and disciplines.
- Postdoctoral working station and mobile station.
- Open project (The new technology of laser, materials research etc..)

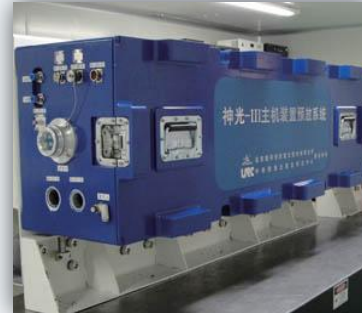
Partial products of GK Laser Technology Co., Ltd.



Laser pump module



Lamp & LD pumped laser



Laser amplifier



Laser illuminator



Laser range findor



Laser cutting machine

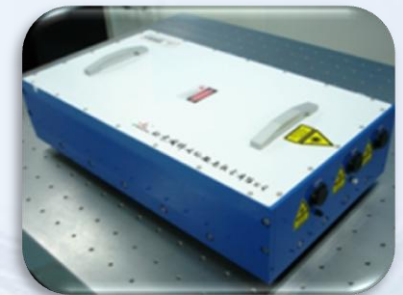
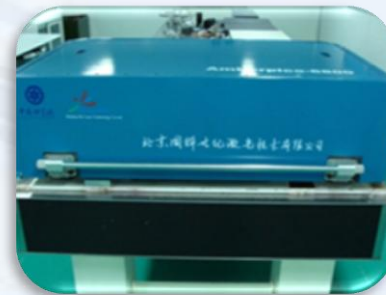
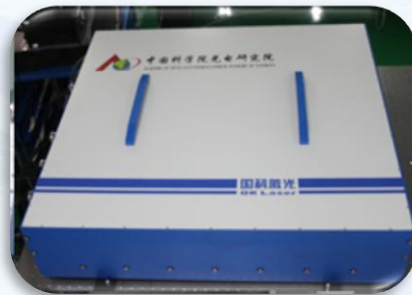
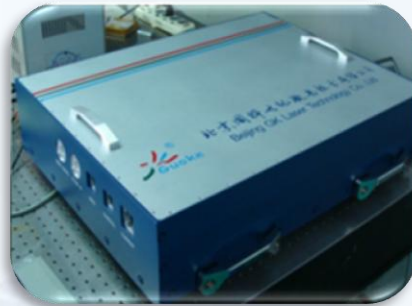


Laser marking machine



Laser power supply

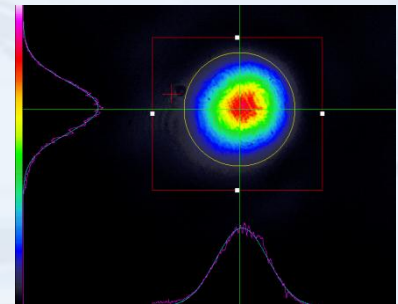
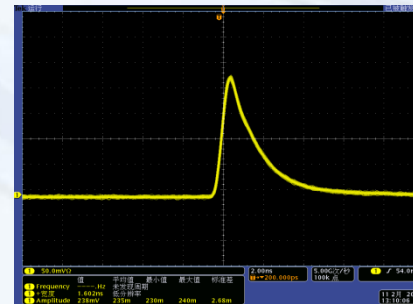
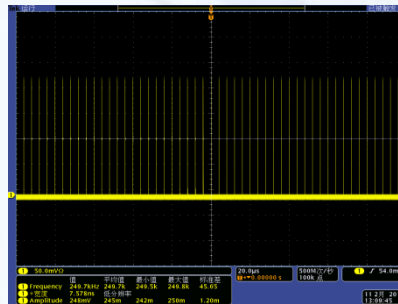
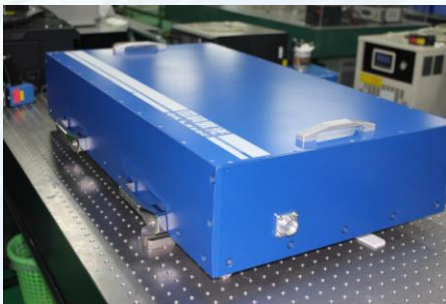
All-solid-state picosecond solutions



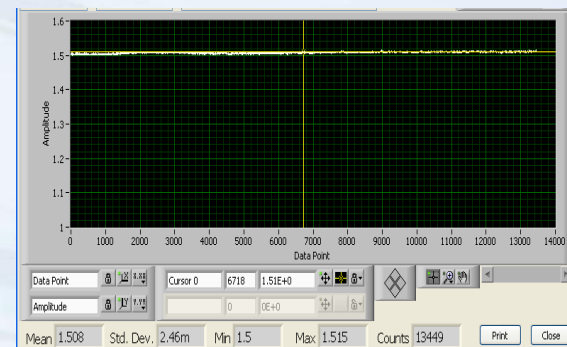
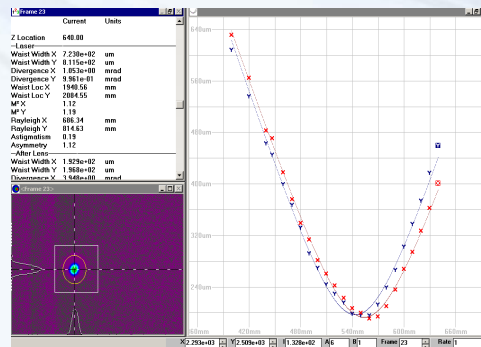
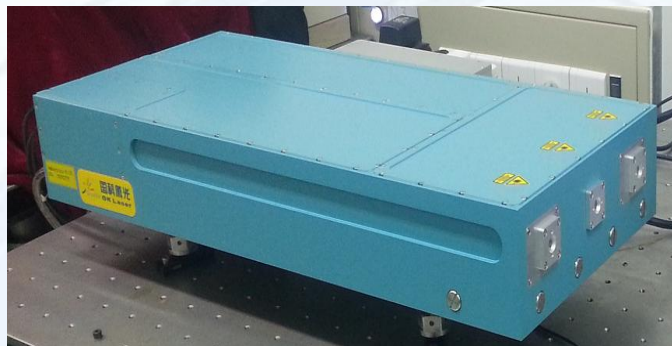
- The successful bid rate of our picosecond laser in the domestic is up to 30%.
- Our clients include Peking University, Zhejiang University, Shenzhen University, and Chinese National Astronomical Observatory of China Academy of Engineering Physics etc..

Partial picosecond products & parameters

Wavelength (nm)	1064		
Repetition Rate (kHz)	10-500		
Power (W)	30		
Energy (μ J)	120		
Beam Diameter (mm)	<3		
Beam Specifications			
Pulse Width (ps)	<20	Polarization	Horizontal (or others)
Spatial Mode	TEM ₀₀	Divergence (mrad)	<5
M ²	<2	Ellipticity	<15%
Power Stability (RMS)	<3%	Pointing Stability (μ rad)	<50
Cooling Method	Water	LD Lifetime	10000h
Dimensions Laser Head (mm)	1020×560×220		
Controller Size (U)	8		
Working Temperature(°C)	25±5		



Wavelength(nm)	1064/532	
Repetition Rate(Hz)	1-1000	
Products	常规	高能量
Energy (mJ)	≤2	≤30
Beam Diameter (mm)	<2	<6
Pulse Width(ps)	<40ps@1064nm; <20ps@532nm	
Spatial Mode	TEM ₀₀	
M ²	M ² <1.5	M ² <6
Power Stability (RMS)	3%	
Polarization	Horizontal (or others)	
Divergence (mrad)	<1mrad	
Ellipticity	<15%	
Pointing Stability (μrad)	<50	
LD Lifetime	10000h	
Dimensions Laser Head (mm)	1000×290×110	1080×580×210
Controller Size (U)	3	13
Working Temperature(°C)	25±5	



<http://www.gklaser.com/>

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Thank you for your attention!