



Status of the Photonics DP20-B527-18 laser at Caltech

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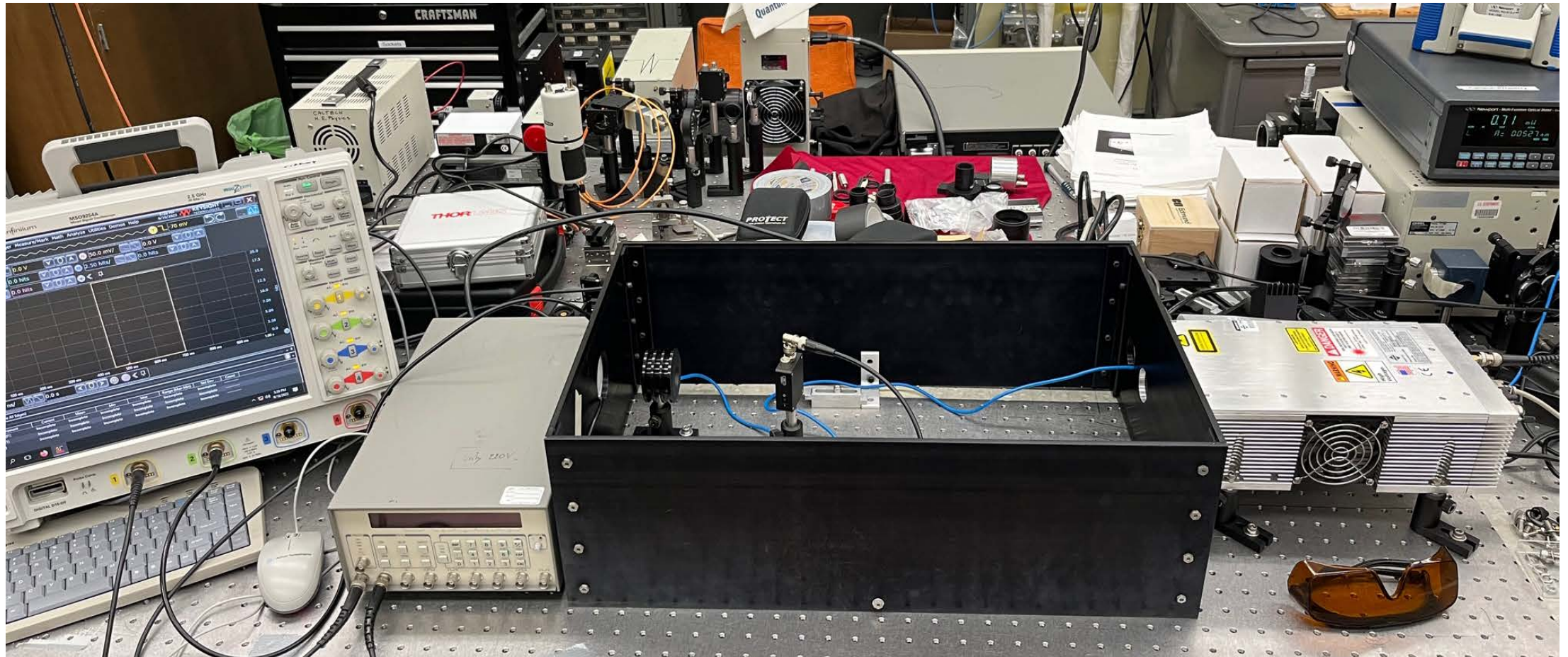
David Bailleux, Stefano Argiro and Federico Ferri

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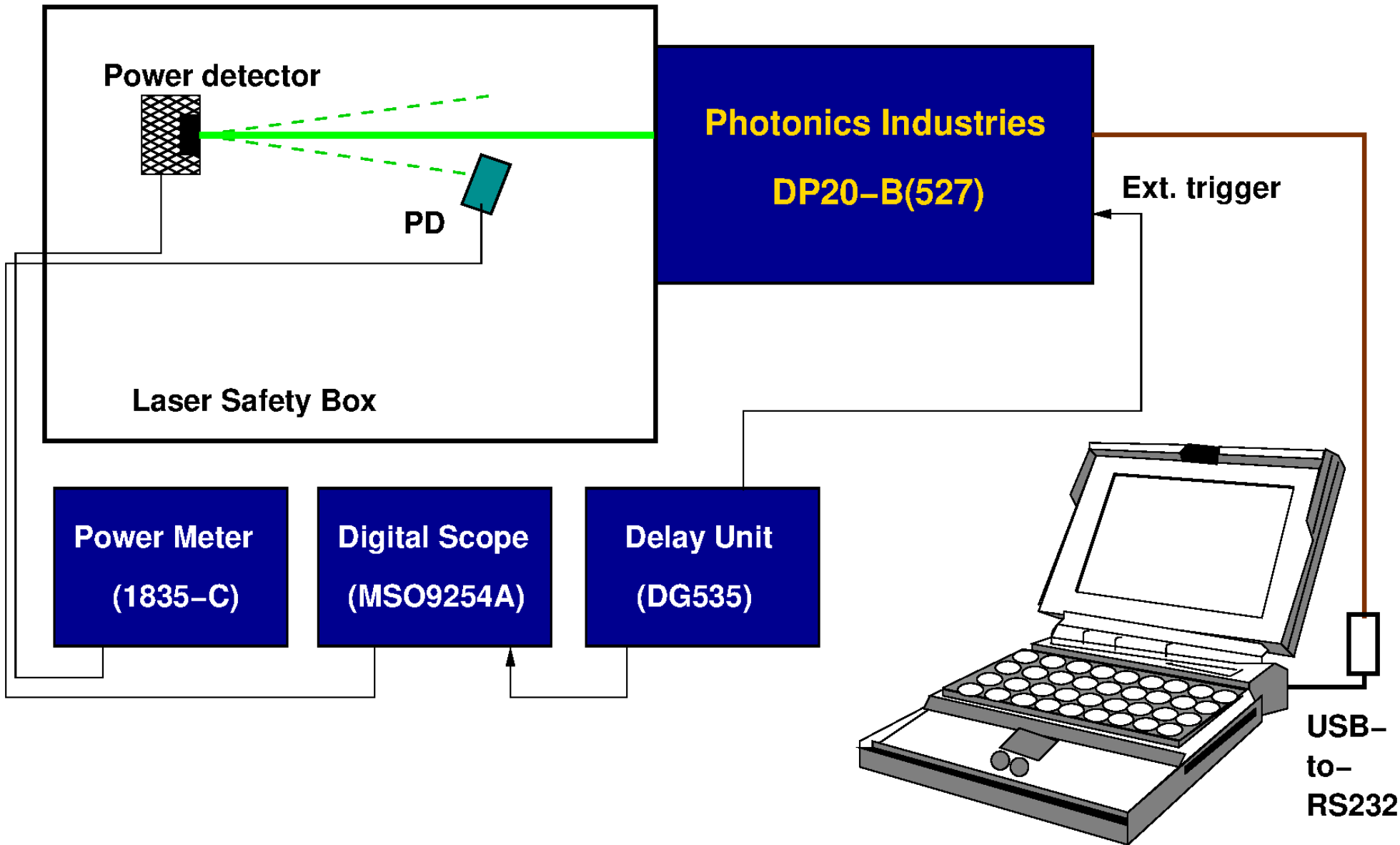
June 21, 2022

Photonics DP20-B527 Laser at Caltech

The DP20-B527 laser (18 mJ @ 527 nm) was delivered on 4/28/2022
Its performance was measured with external trigger @ 100 Hz.



The Measurement Setup



Laser pulse energy calculated by using average power measured by a Newport power meter

Stability of laser pulse energy, width, center timing (jitter) measured by using a digital scope (MSO9254A) and a fast photodetector

Trigger, Laser Pulse and Integration

MSO9254A and a fast photodetector used to measure:

rms of pulse energy
pulse width & rms
pulse delay & rms
(jitter)



DP20-B527 Specification

Beam and output specifications

Wavelengths available: 1053 nm, 527 nm, 351 nm, 263 nm

Pulse repetition rate: Single shot to 100 Hz (option up to 200 Hz)

Pulse width: ~4-8 ns

Pulse energy stability, measured at ambient temperature of $\pm 2^\circ\text{C}$: < 3% rms

Long term stability, measured over 8 hours $\pm 1^\circ\text{C}$: 3% rms

Beam spatial mode: TEM_{00} , $M^2 < 2$

Beam pointing stability: < 25 μrad

Beam divergence: < 4 mrad

Beam diameter, at exit: 1 mm

Photonics DP20 Series Brochure

Operational and system characteristics

Interface: RS232, Ethernet, Software GUI, External TTL Triggering

Warm-up time: < 5 minutes from standby, < 10 minutes from cold start

Electrical requirement: 100-240 V AC; or 32 V DC, 15 A

Line frequency: 50-60 Hz

Ambient temperature: 15°C to 30°C (59°F to 86°F) Operating Range, RH 90% Max, non-cool

Power consumption, typical: ~50 W

Cooling system: Air-cooled

	DP20	DP20-MWB
Beam and output specifications		
Wavelength output type	Standard, single-wavelength output	Multi-wavelength blended output
Pulse energy, at 100 Hz		
-a. 1053 nm	20 mJ	
-b. 527 nm	18 mJ	
-c. 351 nm	8 mJ	

Pulse energy: 18 mJ

Pulse energy stability: <3% rms

Pulse width: ~7 ns

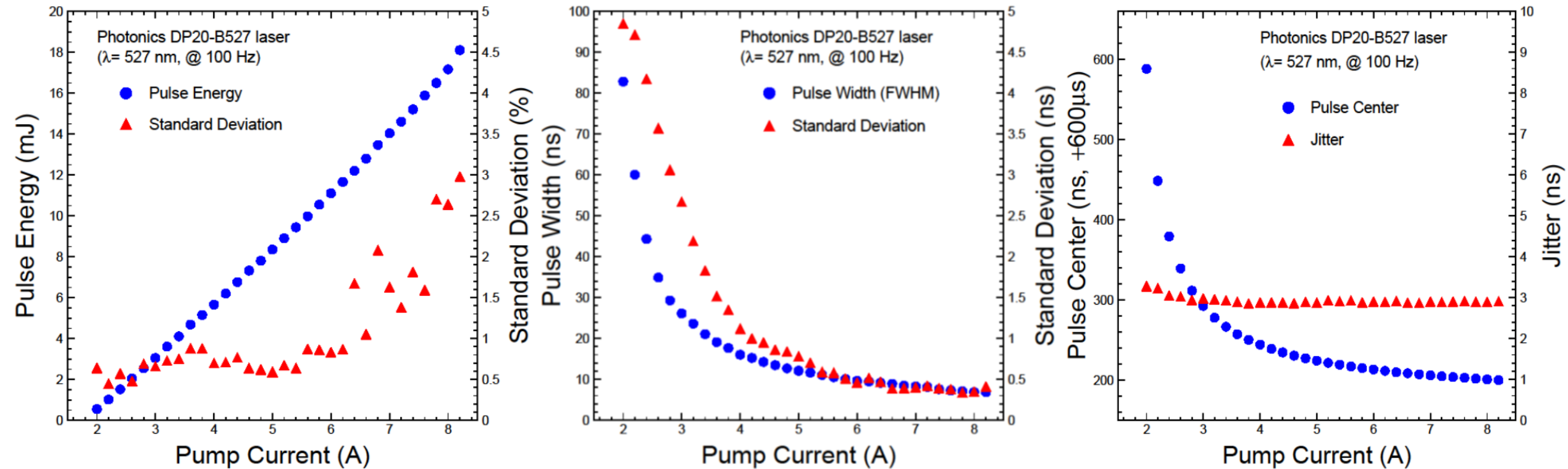
Pulse Jitter: ~1 to 2 ns

Specification in the Quotation

Description	Price
DP-527-18 Laser - Specifications Wavelength 527 nm Pulse Energy @ 100Hz 18mJ Pulse Width ~7 ns Beam Mode TEM00	\$80,000
Low Jitter Option low jitter option which would reduce the jitter to ~1 to 2ns	\$25,000
System Software DP Control software provides basic system operating controls in a convenient graphical user interface configuration.	Included
Utility Requirements Operating voltage is 100 to 240VAC, operating frequency is 47 to 63Hz, single phase power, 10 to 30°C.	
Warranty Standard Photonics Industries one-year parts and labor warranty. Warranty repairs are to be performed at Photonics Industries facilities or at customer's site. Travel and living expenses to be paid by customer.	Included
Total (US\$)	\$ 105,000.00

Laser Pulse Energy, Width and Jitter

Pulse energy meets the 18 mJ spec at >8A with rms of 3%, which agrees with Photonics brochure
Pulse width meets the 7 ns spec at >7.5 A with an excellent stability of 0.4 ns rms
Pulse jitter is about 3 ns, larger than the 1~2 ns spec. Work with Photonics engineer is on-going.



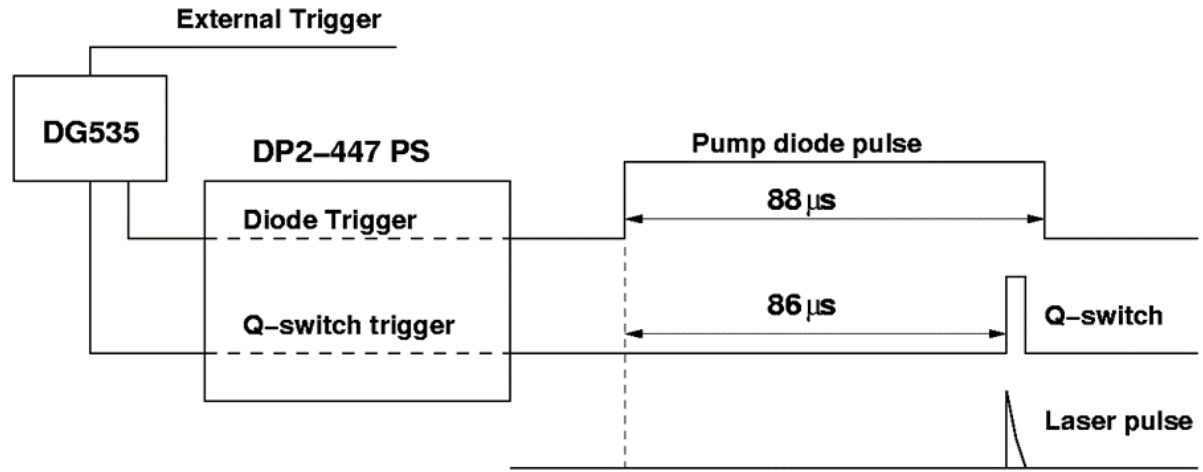
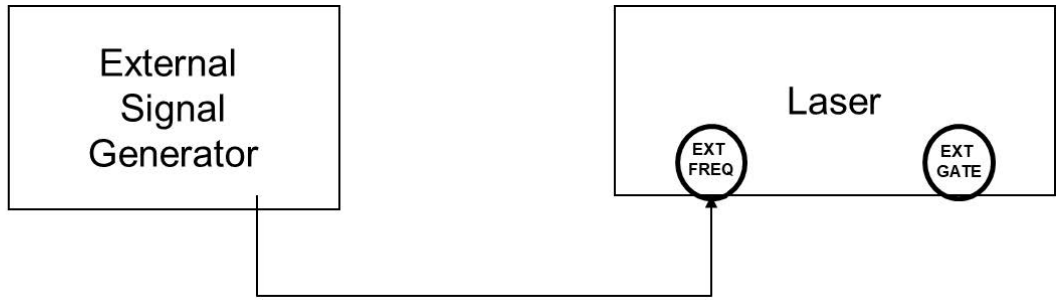
A delay of 600 μs + from external trigger required to pump diode

Plan for Pulse Jitter Improvement

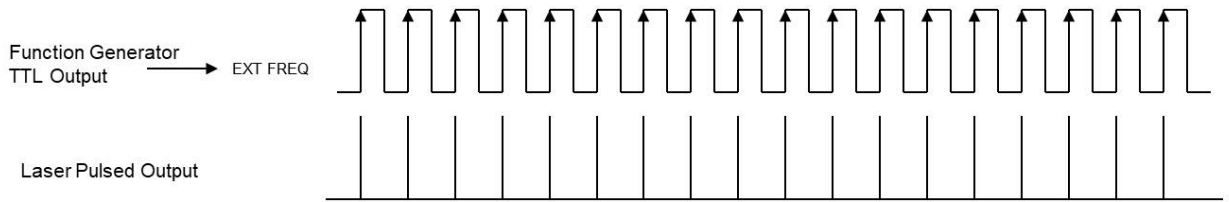
Internal FPGA will be revised to introduce a Q-switch trigger similar to DP2-447, aiming at reducing jitter to ~1 ns with a delay of ~200 ns

DP20-527 External Triggers

DP2-447 External Triggers



EXT FREQ : Each rising edge of an EXT FREQ TTL input triggers a laser output pulse. Any signal that generates a response in the laser controller is marked with an arrow.



Comparison with DP2-447 Lasers

Parameter	DP20-B527	DP2-447*
Wavelength (nm)	527	447
Pulse energy (mJ)	18	1
Pulse energy instability (rms, %)	3	1
Pulse width (ns)	7	23
Pulse width instability (rms, ns)	0.4	0.4
Pulse delay (μ s)	600 + ~200 ns	86 + 120 ns
Pulse jitter (ns)	~3 (to be improved)	~1

* L. Zhang, *J. Phys.: Conference Series* 404 (2012) 012042

Summary

The Photonics Industries DP20-B527 laser (18 mJ @ 527 nm) was delivered to Caltech on 4/28/22. Its performance was measured with external trigger @ 100 Hz.

Both pulse energy/stability and pulse width/stability meet the spec. The pulse jitter of ~3 ns is out of the spec of 1~2 ns. The delay from external trigger of 600 μ s+ required to pump diode is longer than 88 μ s for DP2 needs to be accommodated.

Following the DP2-447 laser experience Photonics engineers proposed to reprogram internal FPGA to introduce an additional external trigger for Q-switch aiming at reducing the jitter to ~1 ns.

DP20-B527 will be shipped back to Photonics for this reparation.

We plan also to test fiber coupling to DP20-B527 to understand possible optical fiber damage. Will also test long fibers together with FC connectors and an optical switch to understand the consequence of high laser pulse energy to the ECAL laser monitoring system.