High-Energy Picosecond Laser Systems between 10 Hz and 2 kHz for Next-Generation Laser Ranging

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Outline

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- High Q Laser/Innolas Cooperation
- System Design
- Performance Data
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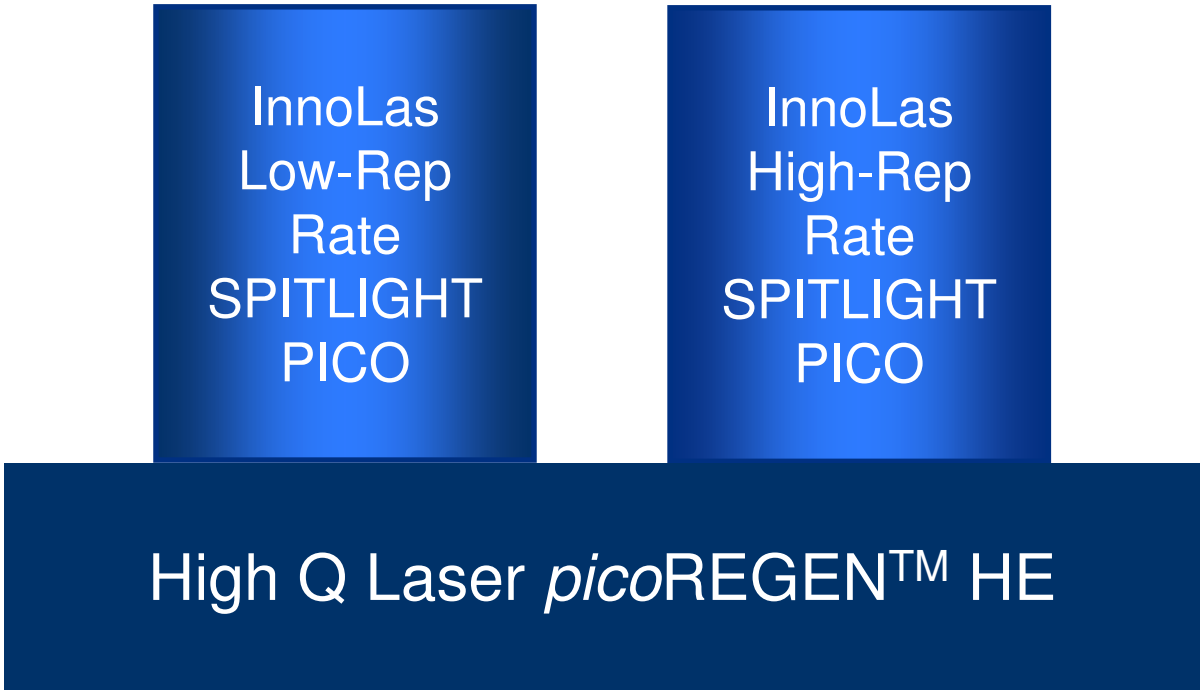
  - … Spitlight PICO
- Summary

Introduction

- application of high-energy picosecond laser systems is well established in satellite geodesy
- Different applications in satellite geodesy require a different set of laser parameters (→ repetition rate, energy)
- High Q Laser - in collaboration with Innolas - offers a wide range of laser systems to cover the needs of the SLR community



High Q Laser/Innolas Co-operation

HIGH Q LASER®
THINK ULTRAFAST!™

- >11 years of experience in the development of picosecond and femtosecond laser systems
- >6 years of experience in OEM production of compact laser systems
- well-known partner in the SLR community

High Q Laser GmbH: Rankweil in Austria

New Production Facility

since Summer 2009

~ 900 m² Clean Room Space (Production and R&D)

~ 700 m² Office Space

Ready for further expansion

High Q Laser/Innolas Co-operation

- >11 years of experience in the development of picosecond and femtosecond laser systems
- >6 years of experience in OEM production of compact laser systems
- well-known partner in the SLR community

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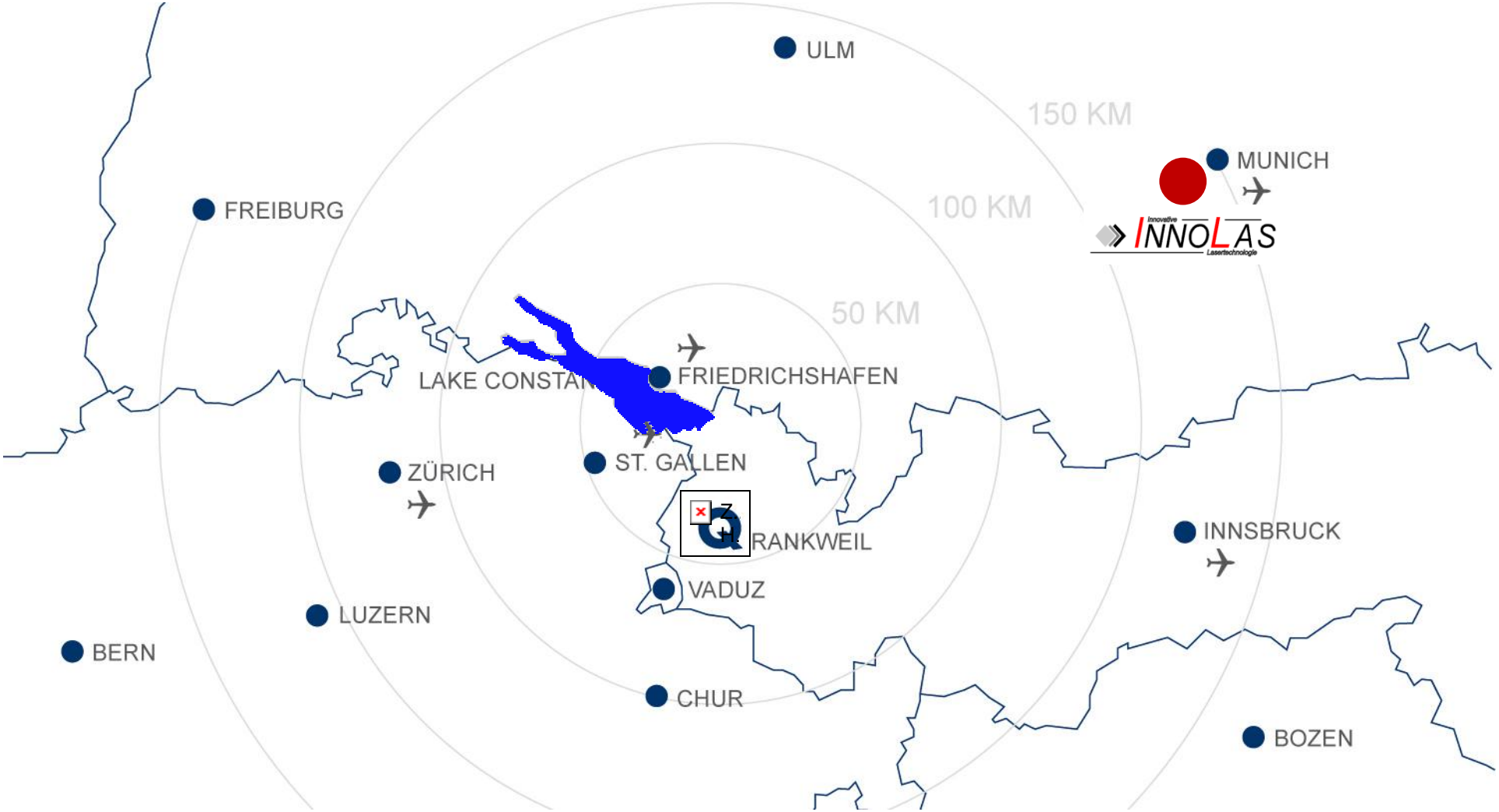
- >16 years of experience in the development of nanosecond high-energy laser systems
- >15 years of experience in the industrial market

InnoLas Laser GmbH: Krailing in Germany



InnoLas Laser GmbH

since 1995

High Q Laser/Innolas Co-operation

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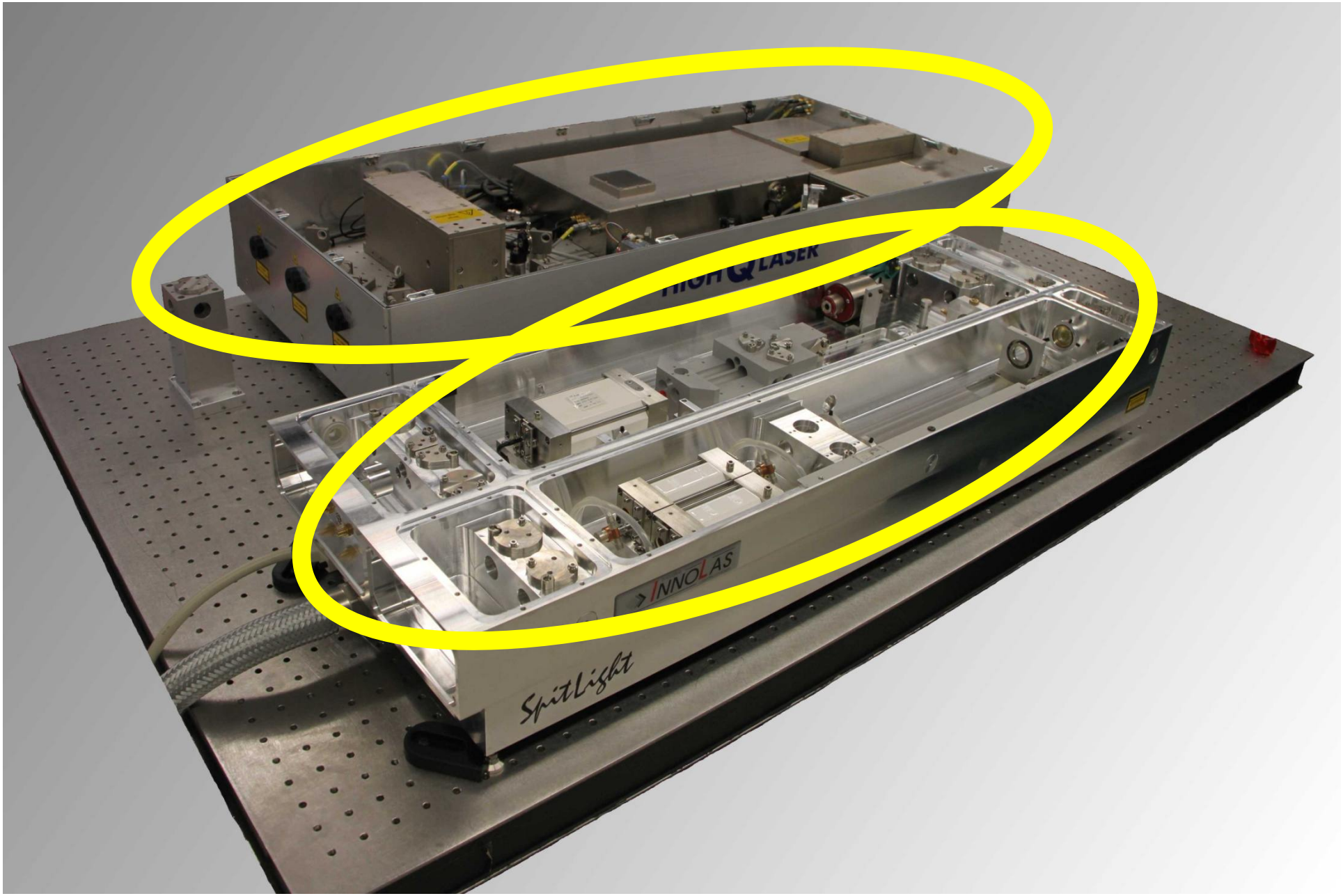
- >11 years of experience in the development of **picosecond** and femtosecond laser systems
- >6 years of experience in OEM production of compact laser systems
- well-known partner in the **SLR** community

- >16 years of experience in the development of nanosecond **high-energy** laser systems
- >15 years of experience in the industrial market

PICOSECOND HIGH-ENERGY Laser Systems

System Design



*pico*REGEN™ HE Overview

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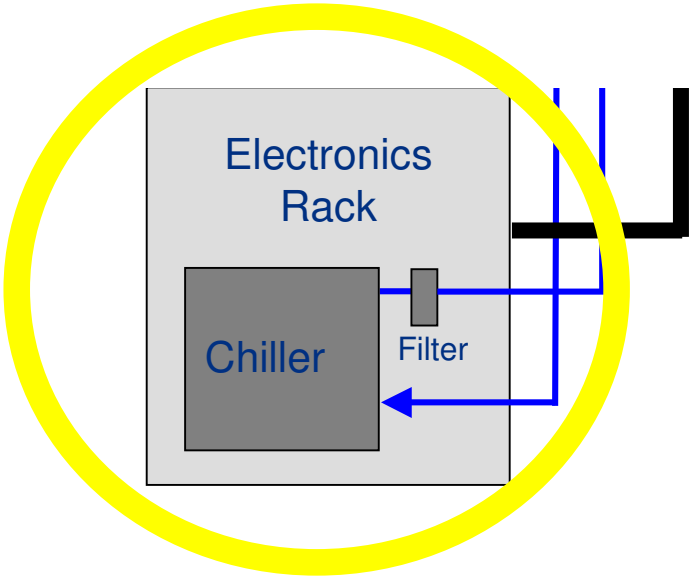
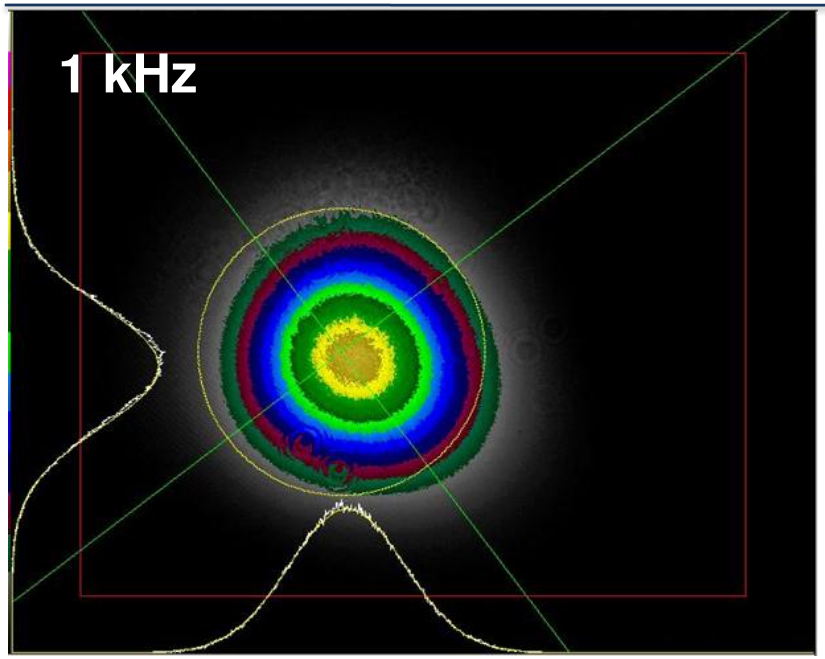
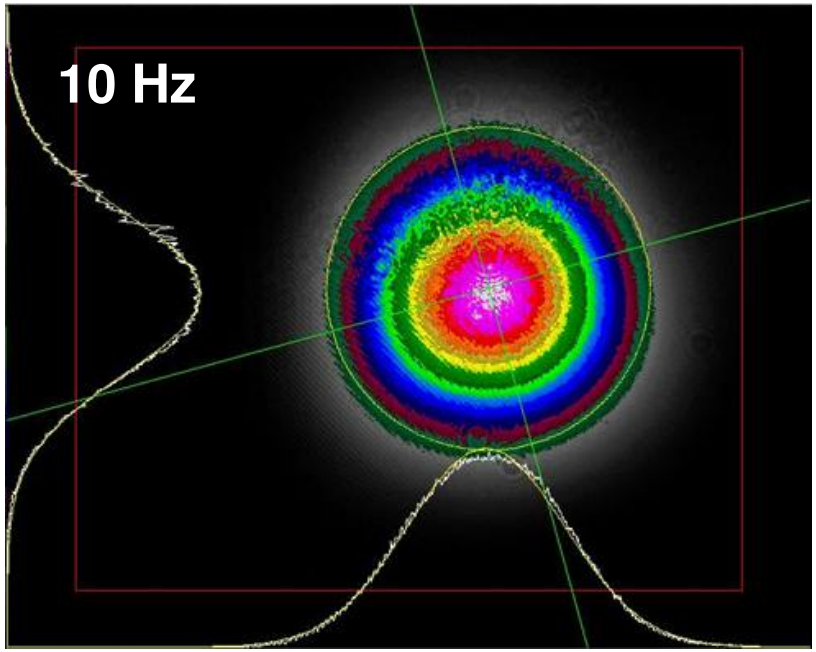


*pico*REGEN™ HE Results

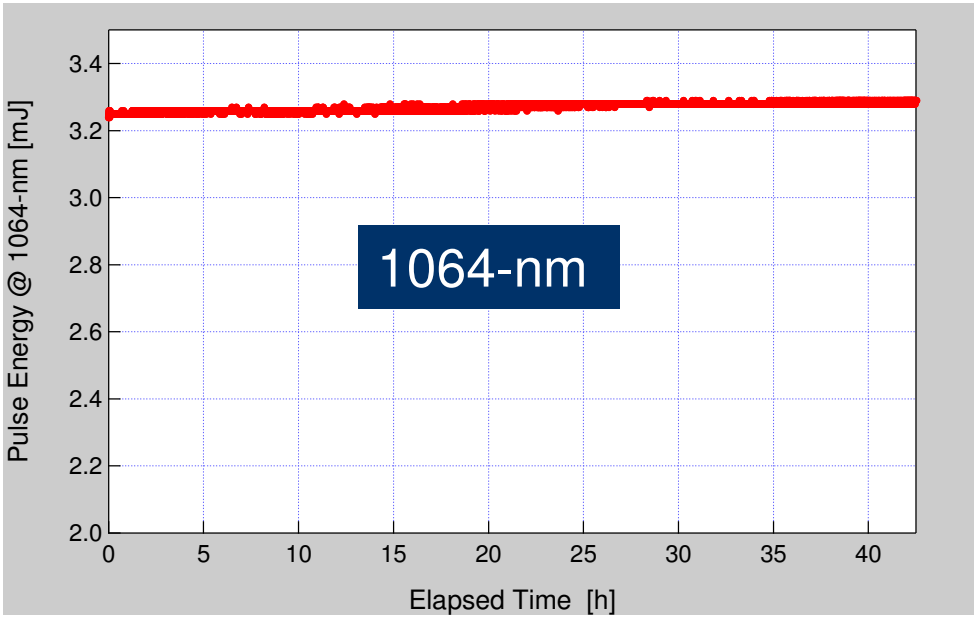


Repetition Rate:	1 kHz
Pulse Energy:	3.2 mJ
Power:	3.2 W
Beam Circularity:	91.8%
M^2:	<1.3

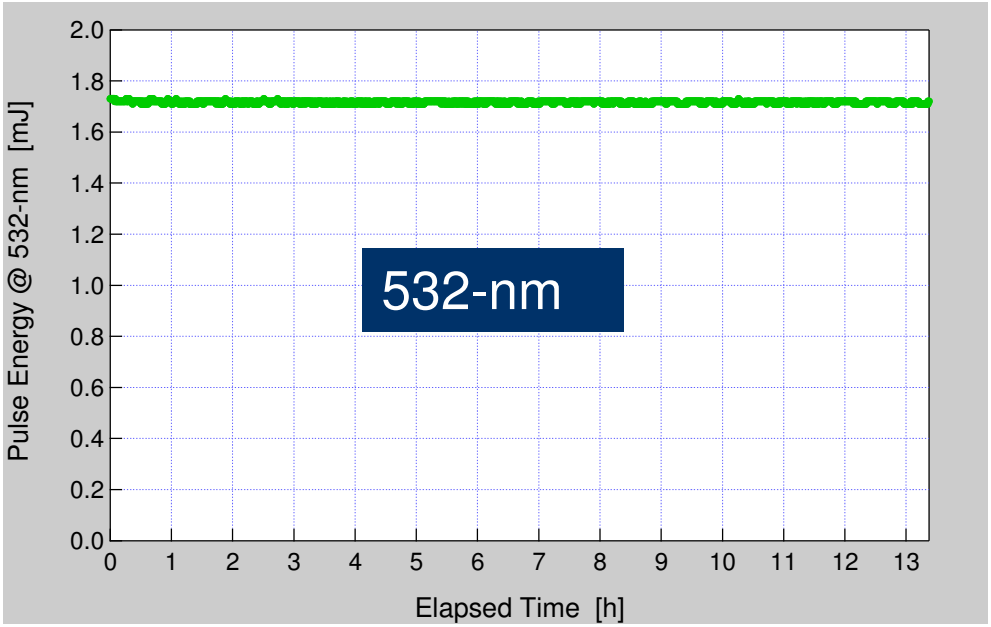


Repetition Rate:	10 Hz
Pulse Energy:	3.2 mJ
Power:	32 mW
Beam Circularity:	96.9%
M2:	<1.3

*pico*REGEN™ HE Results II

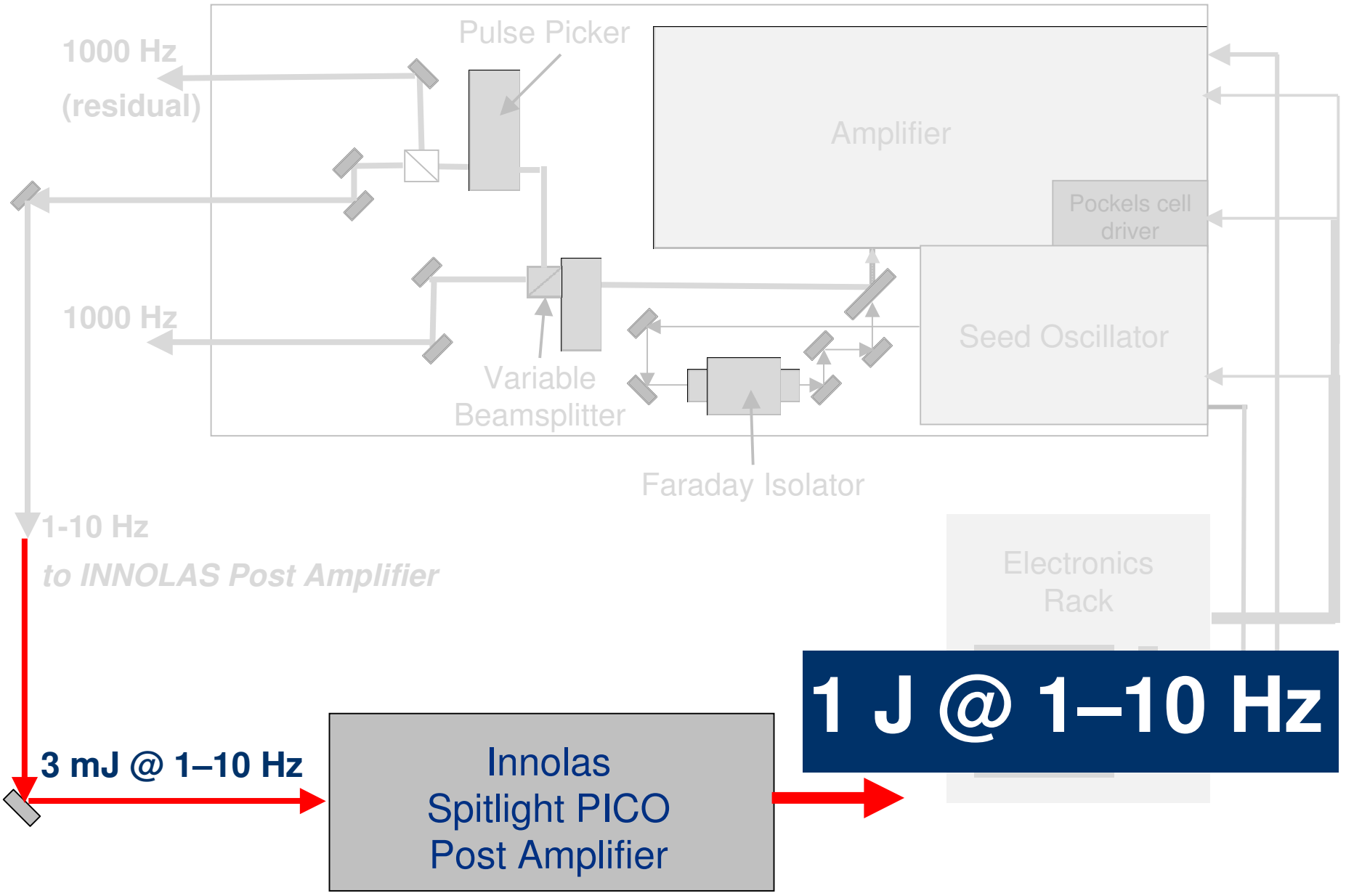


Pulse Energy:	3.3 mJ
Repetition Rate:	1 kHz
Long-Term Stability:	0.34% RMS



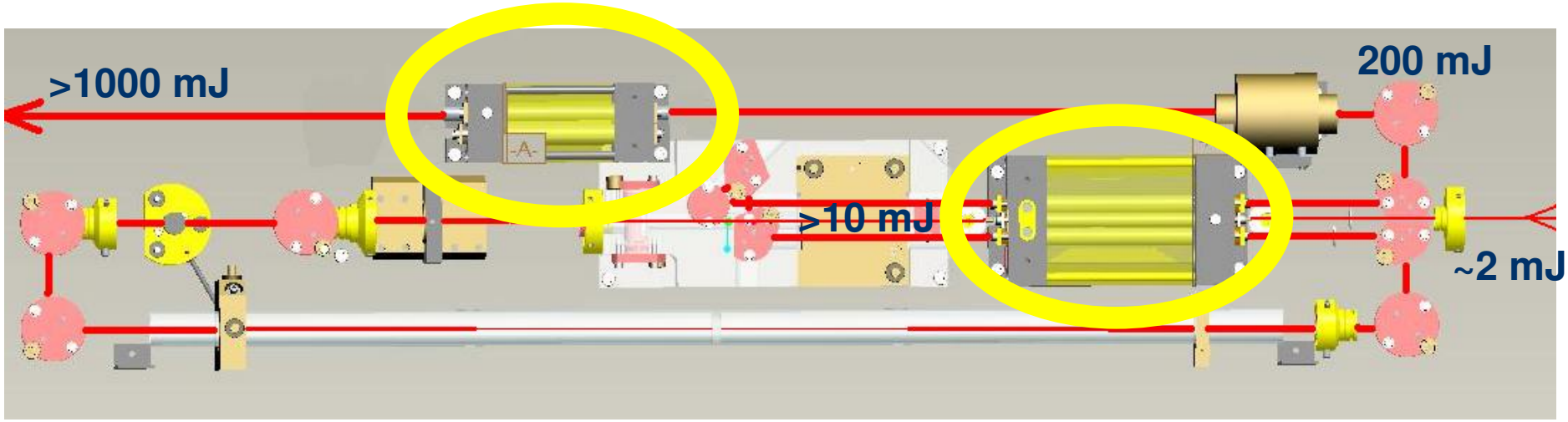
Pulse Energy:	1.7 mJ
Repetition Rate:	1 kHz
Long-Term Stability:	0.29% RMS

Low-Rep. Rate Post Amp: *Spitlight PICO*



Low-Rep. Rate Post Amp: *Spitlight PICO*

Repetition Rates: 1-10 Hz
Flash-Lamp pumped



- 2 Pump Chambers:
  - *First chamber consists of 3 Nd:YAG laser rods pumped by 1 flash lamp*
  - *Second chamber consists of 1 large Nd:YAG laser rod pumped by 2 flash lamps*

Total Amplification:

Low-Rep. Rate Post Amp: *Spitlight PICO*

Flash Lamp Pumped Version

Specifications

RepRate up to 20Hz
Energy up to 1J

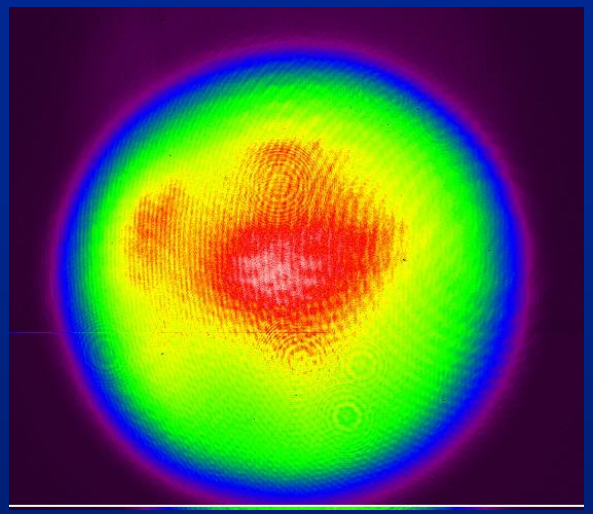
Measured Data at 1J 10 Hz 1064nm 500ps

Beam Quality: M2 =1,8
Pointing stability: D = 12,5 µrad
Energy Stability: RMS = 0,9%

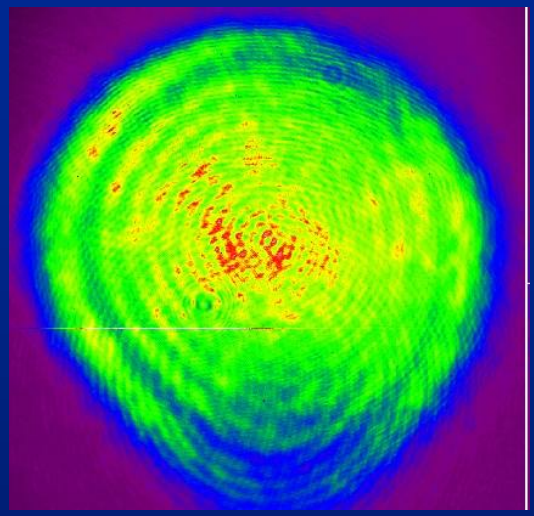
*pico*REGEN™ / *Spitlight PICO: Results*

Flash Lamp Pumped Version

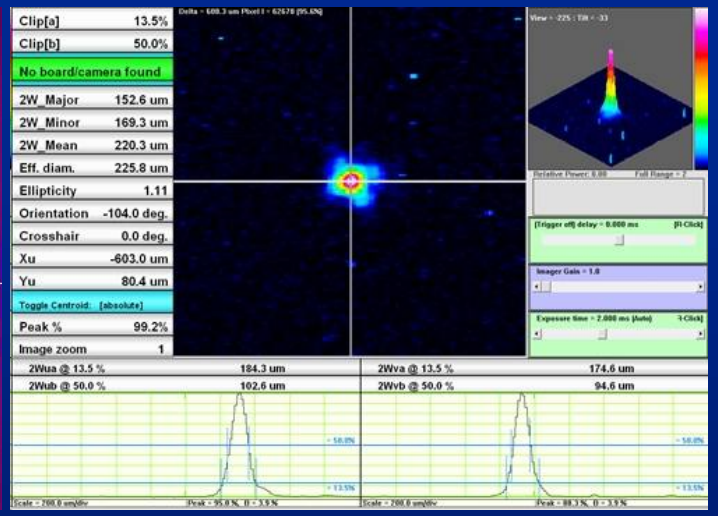
Profile 160mJ Nearfield



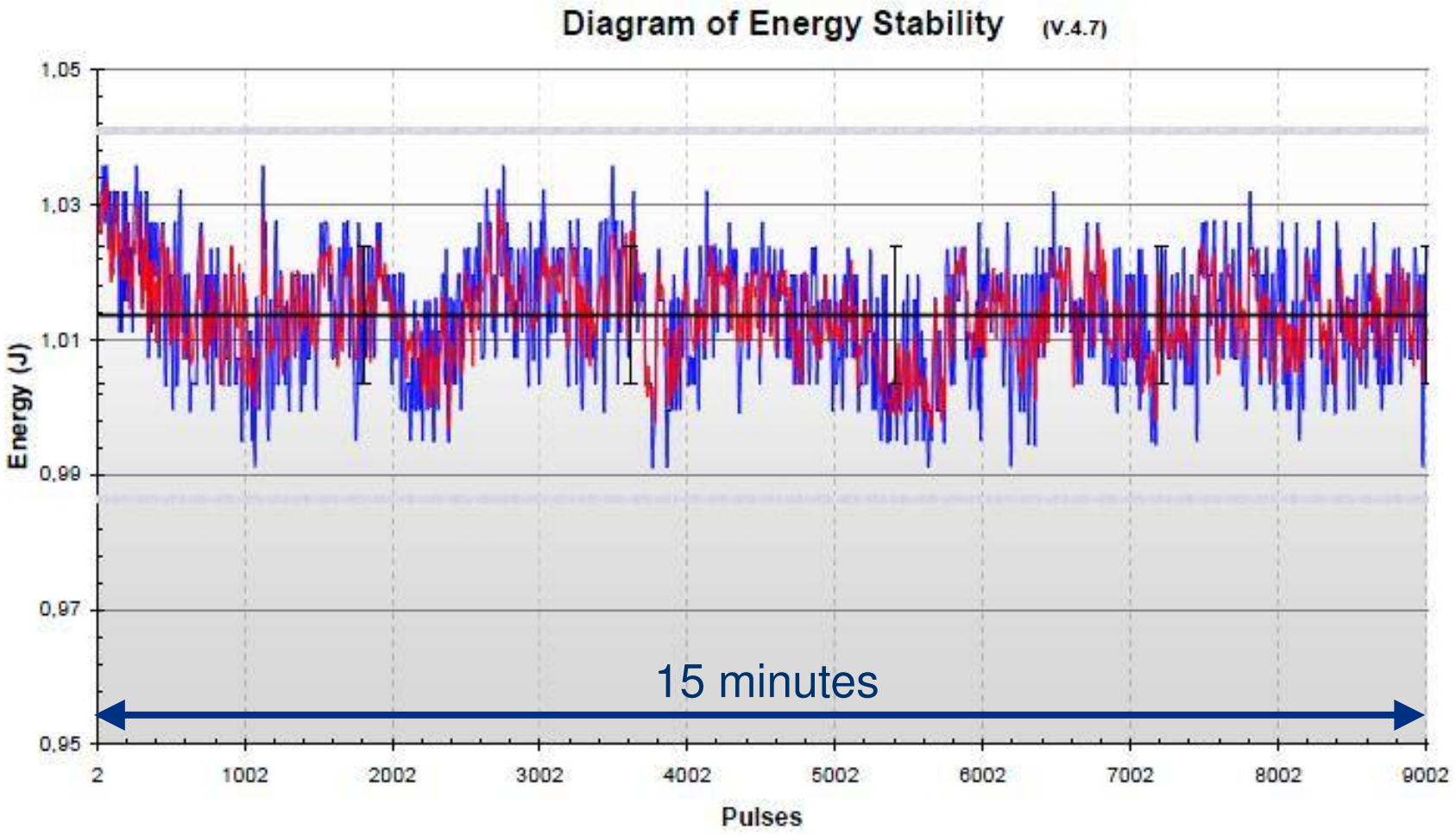
Profile 1J Nearfield



Profile 1J Beam Waist 1m Lens



*pico*REGEN™ / *Spitlight PICO: Results II*



Repetition Rate:	10 Hz
Pulse Energy:	1000 mJ
Energy Stability:	0.9% RMS

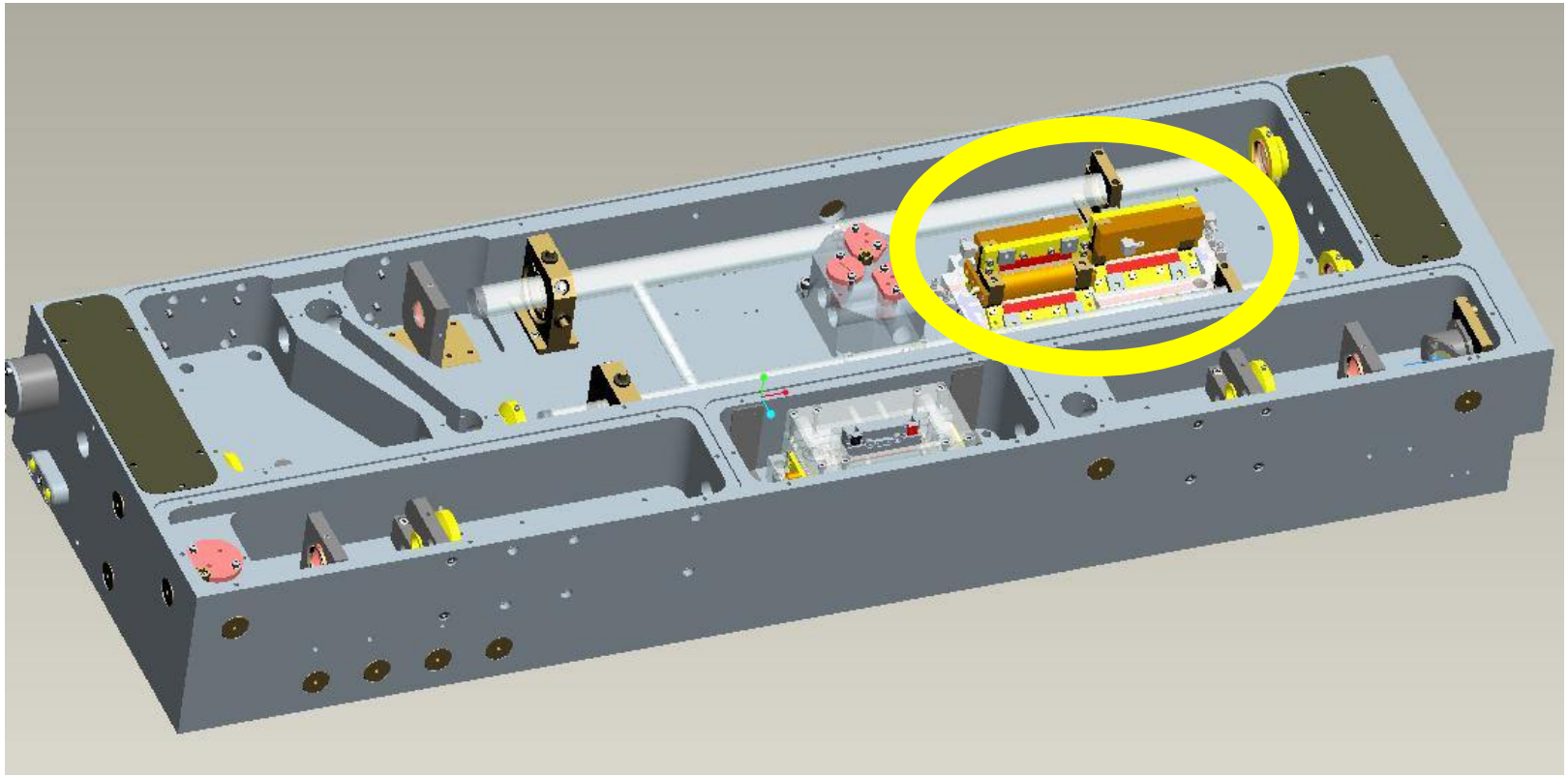
Specification Summary: Low-Rep Rate

Repetition Rates: 1-10 Hz
Flash-Lamp pumped

#Nd:YAG Laser Rods	Pulse Duration [ps]	Pulse Energy @ 1064-nm [mJ]	Pulse Energy @ 532-nm [mJ]
3	>250 ps	90	45
4	>250 ps	250	125
5	>250 ps	1000	500
3	~10 ps	20	10
4	~10 ps	50	25
5	~10 ps	200	100

High-Rep. Rate Post Amp: *Spitlight PICO*

Repetition Rates: 1-1000 Hz
Diode-pumped



- 2 Pump Chambers:
  - *Each with 1 single Nd:YAG laser rod*
  - *Each pumped by 3 laser diodes*

High-Rep. Rate Post Amp: *Spitlight PICO*

Diode Pumped Version

Specification example 100Hz, 250ps

Energy up to	30mJ @ 1064nm
	15mJ @ 532nm

Specification example 100Hz, 8ps

Energy up to	25mJ @ 1064nm
	13mJ @ 532nm

Specification example 1kHz, 8ps

Energy up to	12mJ @ 1064nm
	6mJ @ 532nm

Summary

- >3 mJ @ 1064-nm , 1-1000 Hz, ~10 ps
- >1.5 mJ @ 532-nm, 1-1000 Hz, ~10 ps
- >1.5 mJ @ 1064-nm , up to 2 kHz, ~10 ps
- >0.75 mJ @ 532-nm, up to 2 kHz, ~10 ps

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- up to 1 Joule @ 1064-nm and 10 Hz available
- up to 12 mJ @ 1064-nm and 100-1000 Hz available
- Green conversion efficiency: >50%

For Questions…

…please do not hesitate to contact our sales team:

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High Q Laser & InnoLas – your partners for high-energy ps laser ranging systems