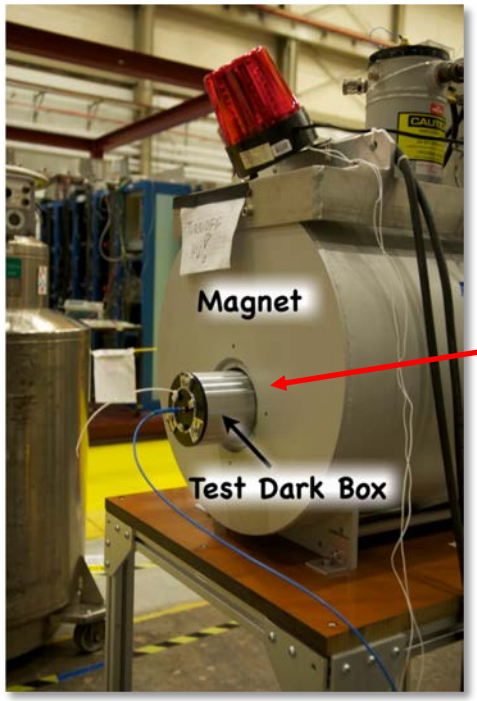
ODU Laser Setup for MCP-PMT Tests

Carl Zorn

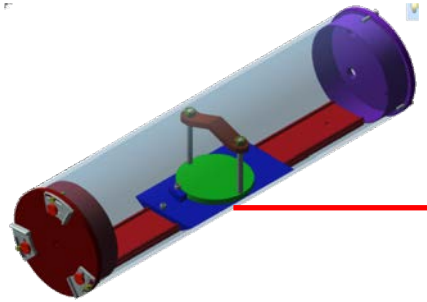
JLAB Radiation Detection and Imaging Group

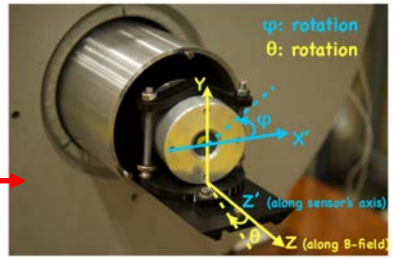
eRD14 – JLAB – High B field testing of MCP-PMTs

PI: Yordanka Ilieva, University of South Carolina

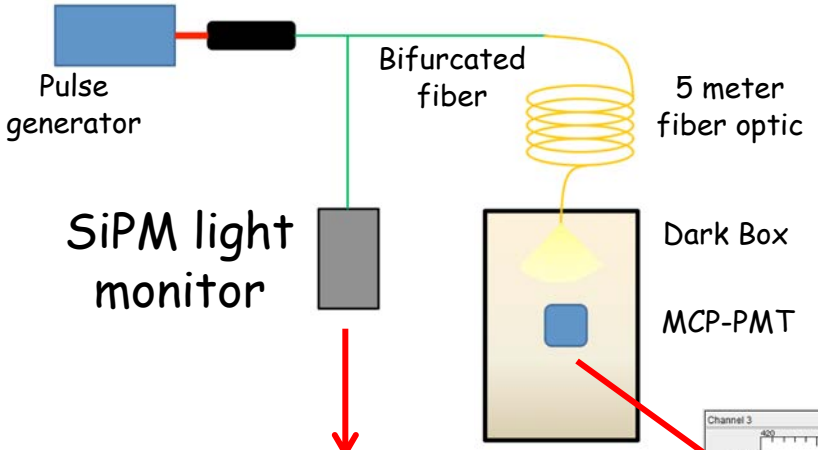


PMTs illuminated with pulsed fast blue or UV LED

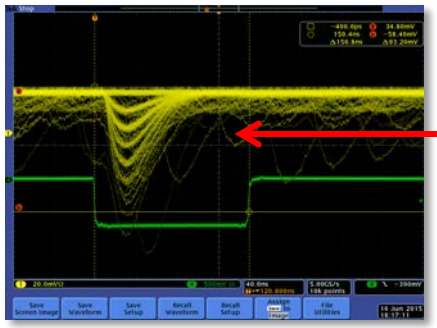


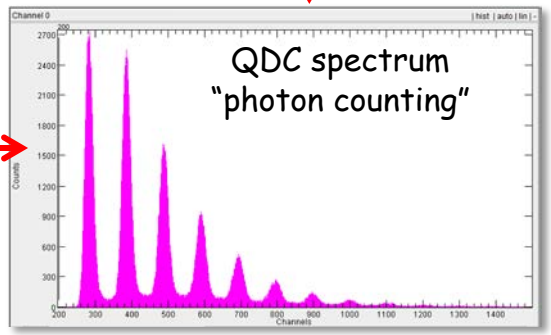


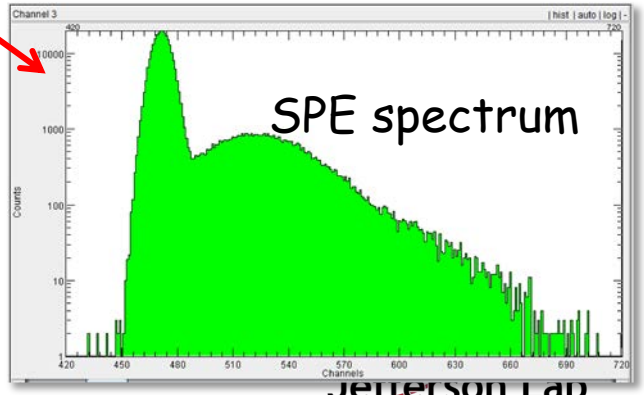
Photonis XP85112
64 channel, 10 μm pores



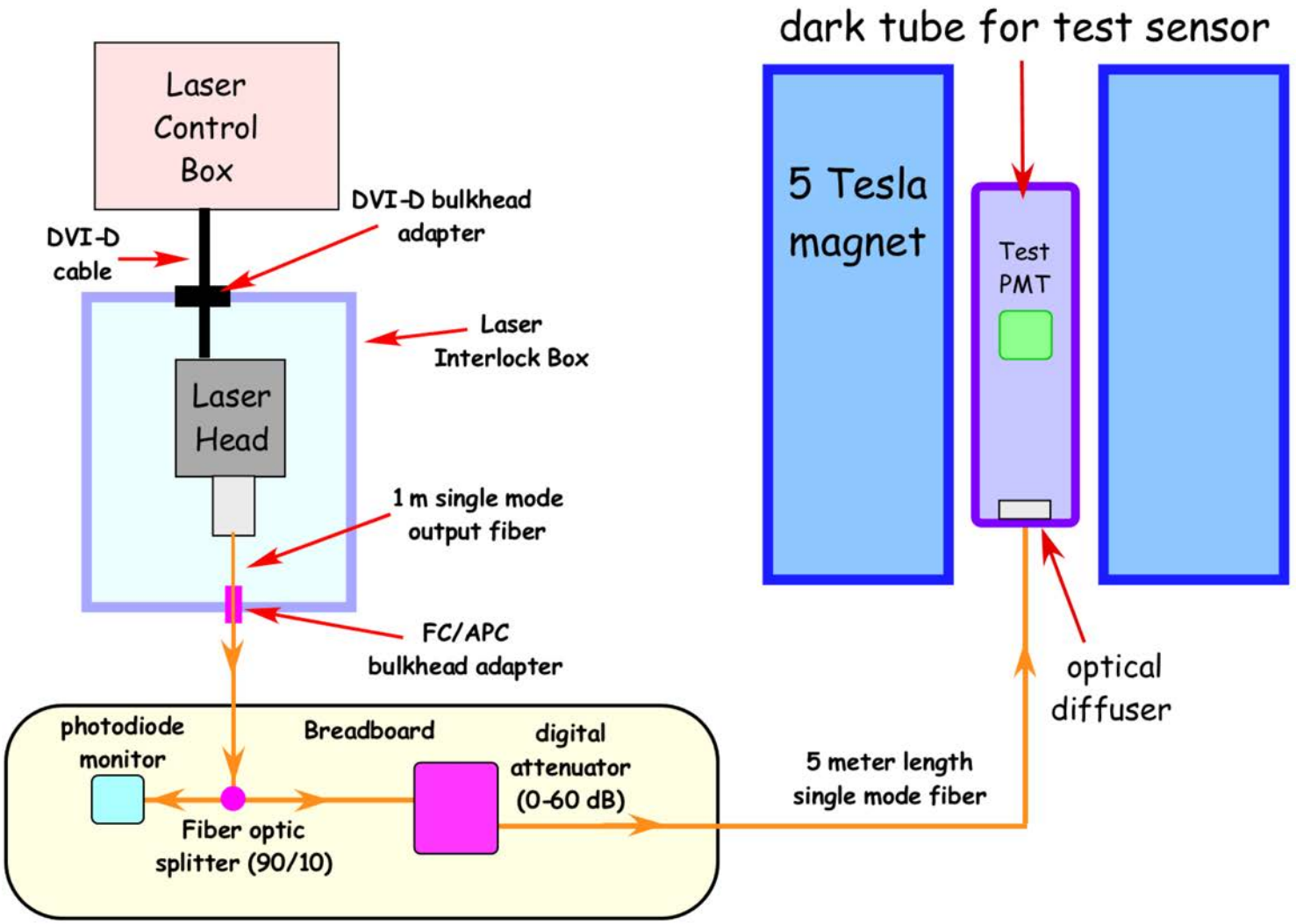
While MCP-PMT sees single photons SiPM monitors multiphoton intensity







Pulsed Laser Light Source Setup



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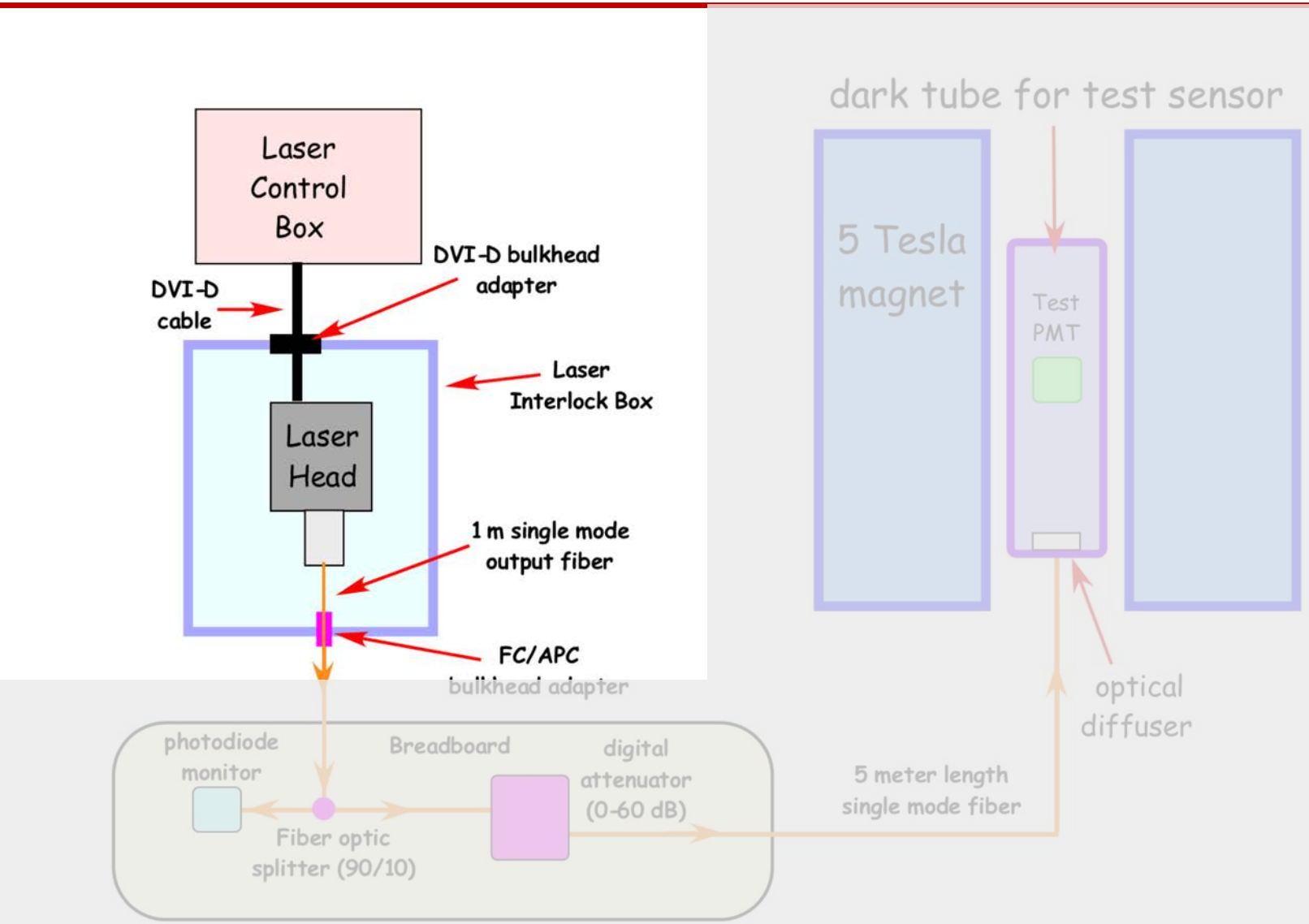
Pulsed Laser Light Source Setup



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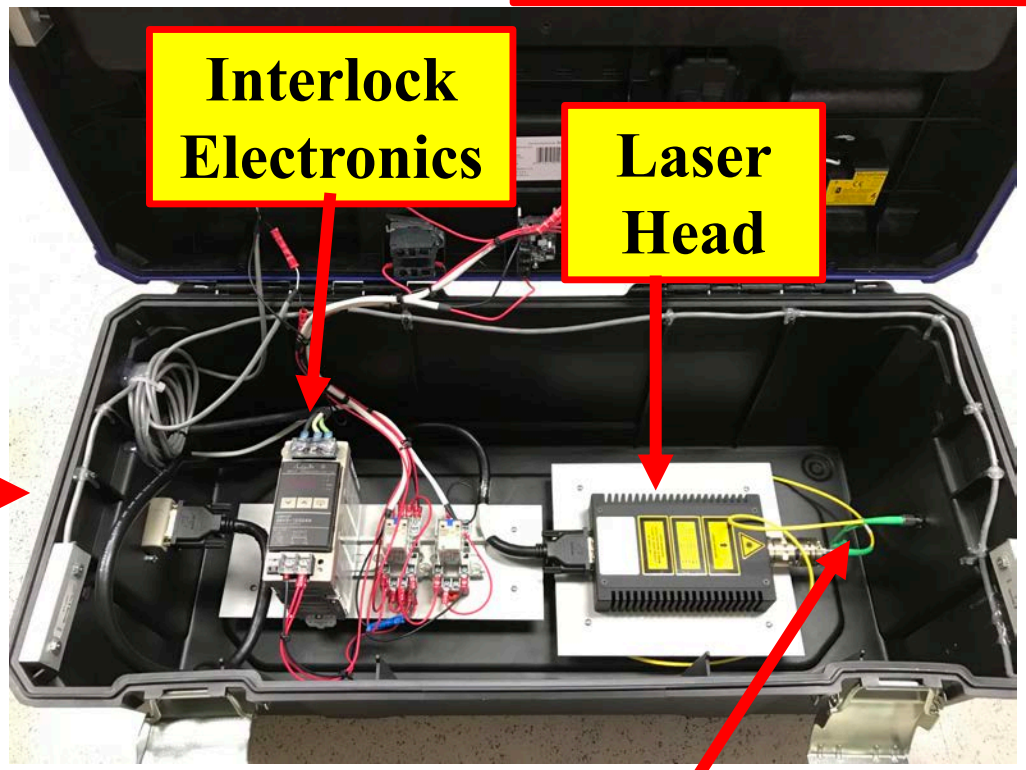
Advanced Laser Diodes Systems PiLaS PiL040XSM

Benchtop Controller

Wavelength = 404 nm
Max. Frequency = 1 Mhz
Pulse width = 37-55 ps
Peak Power = 1,000 mW
Average Power = 100 µW

Key required



Interlock Electronics

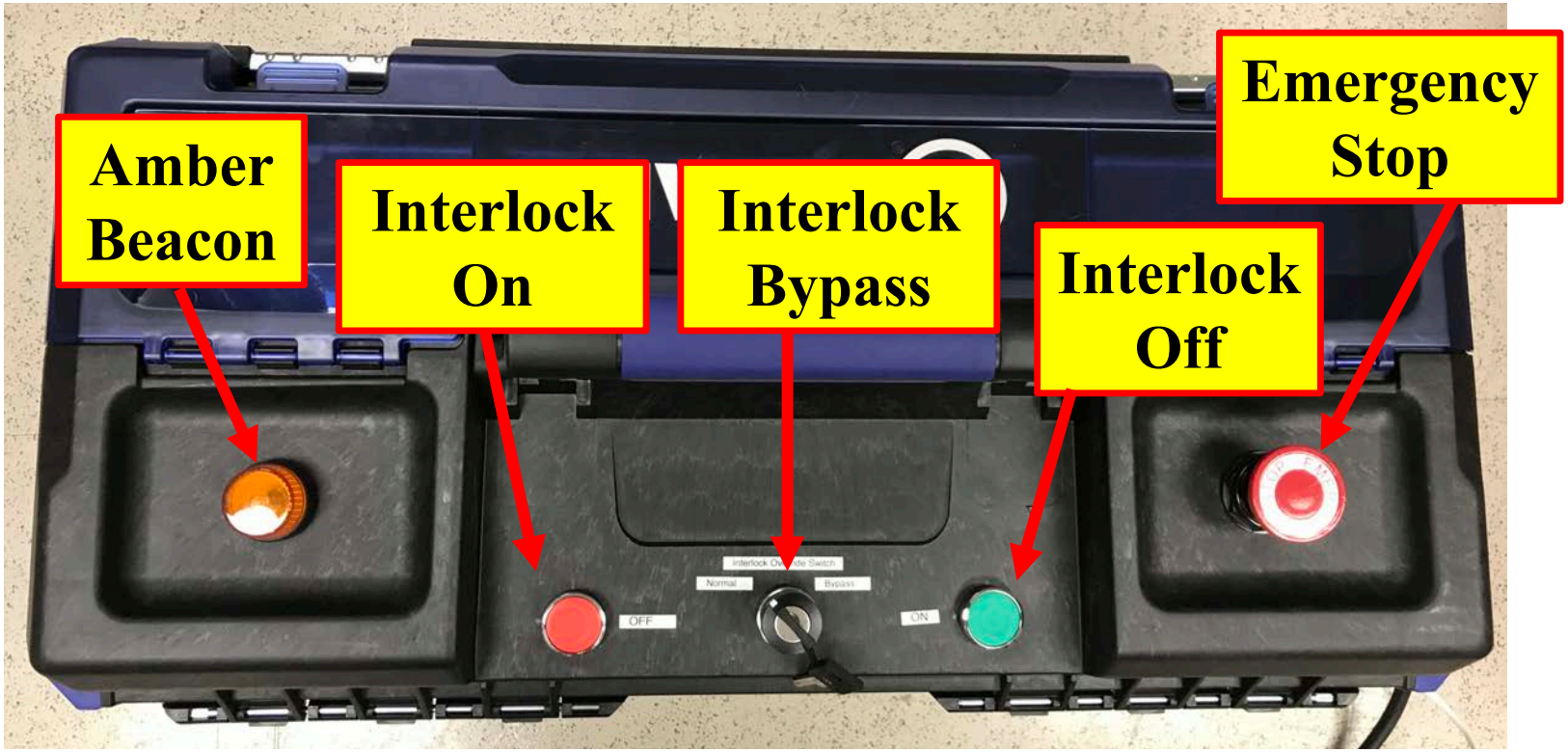
Laser Head

Class 3B laser
Hazardous to eyesight
Interlock Required

Controller connected to interlock box via DVI-D and interlock cables

Pigtail Fiber

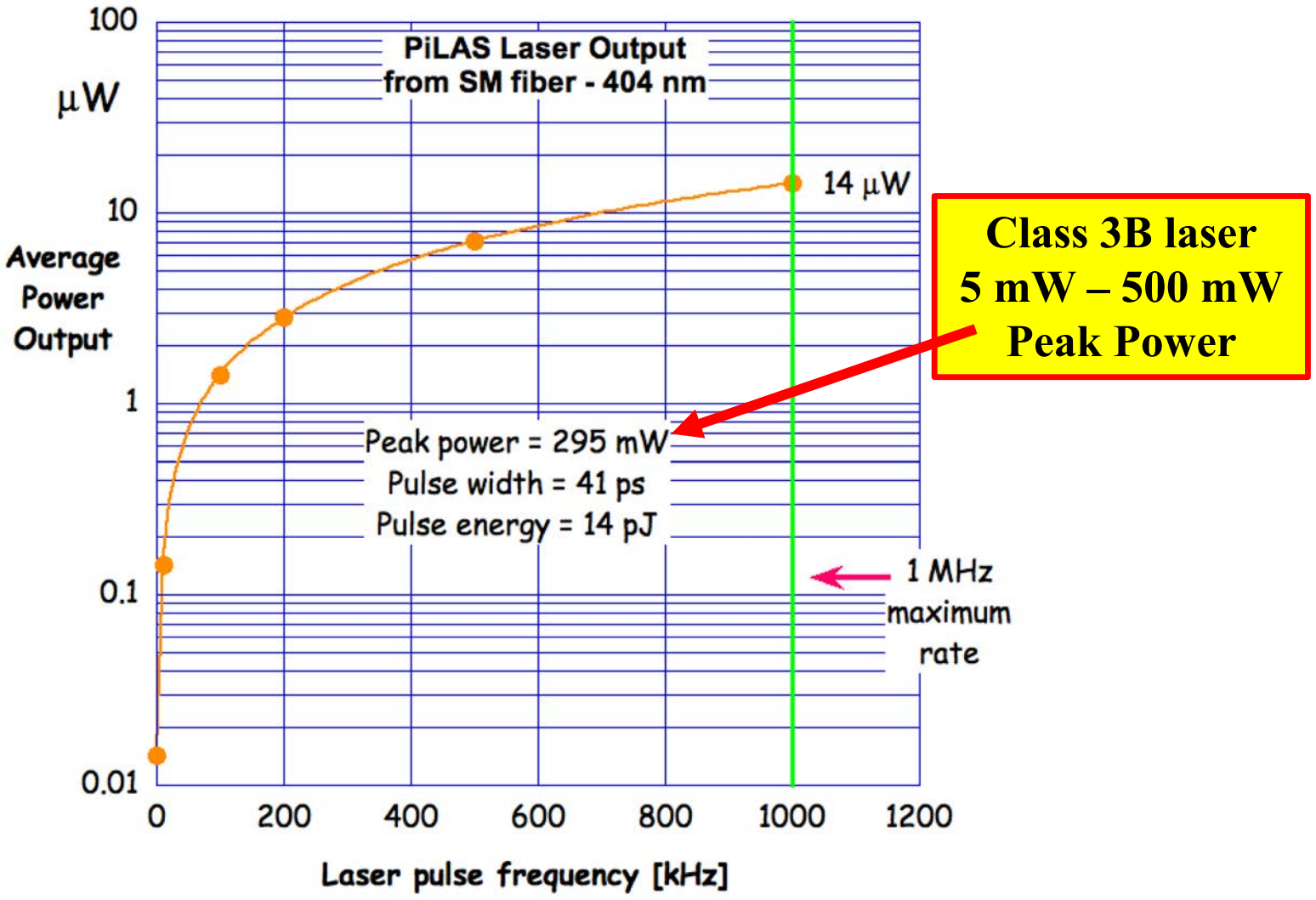
Interlock System designed and built by Mark Taylor,JLAB Fast Electronics Group



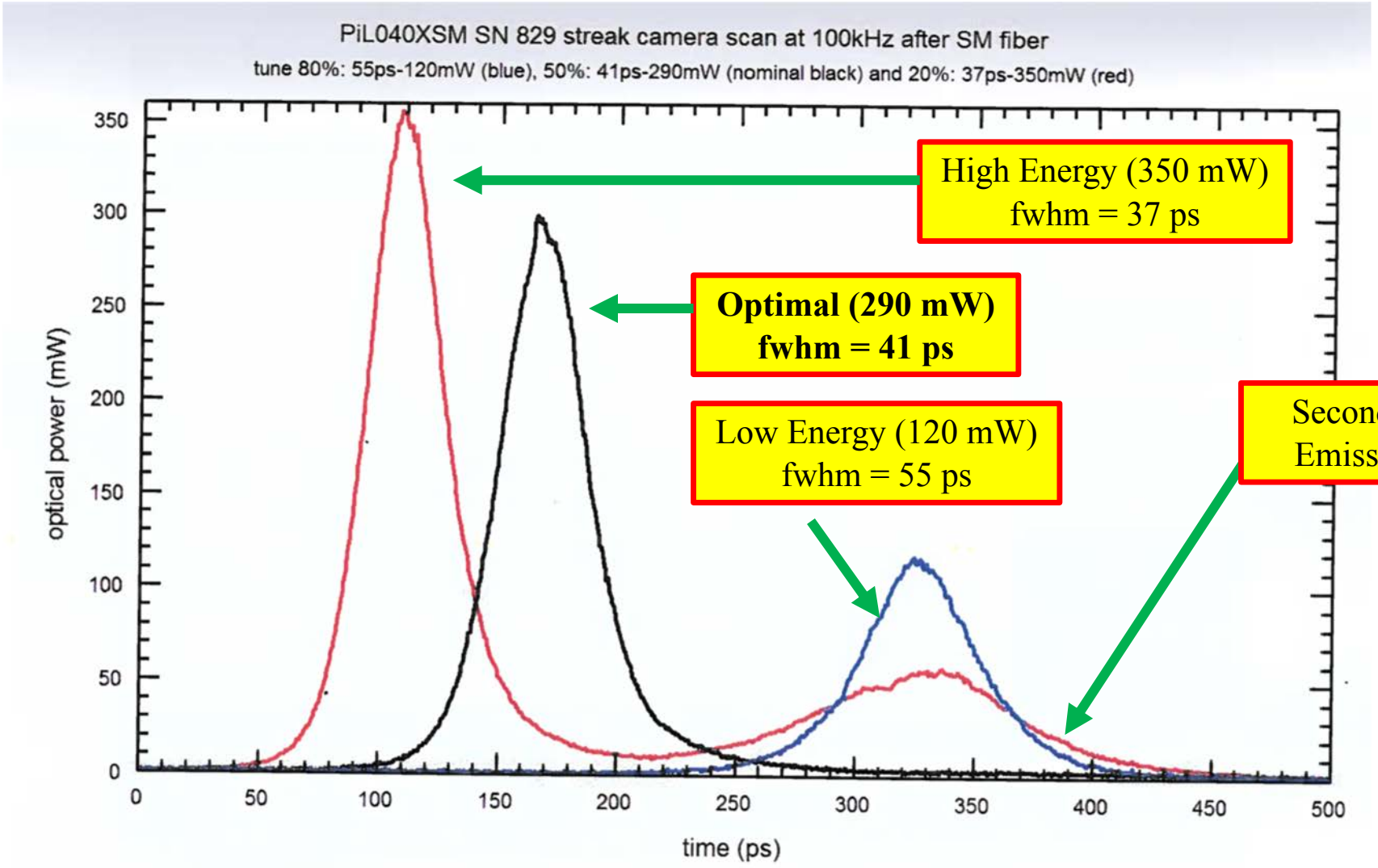
JLAB LSOP (76830) established for use in High Bay area of Test Lab

- Only certified trained workers may operate laser
- Interlock box **closed**, powered and connected to laser controller
- Laser controller powered up with key control
- Buttons on top control interlock status

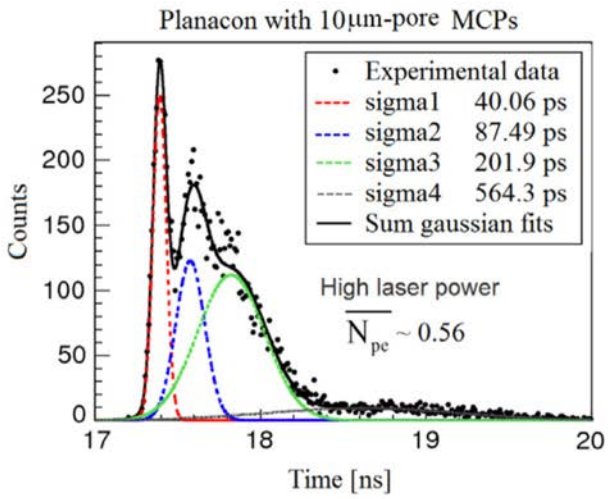
Actual emission specs with pigtail fiber

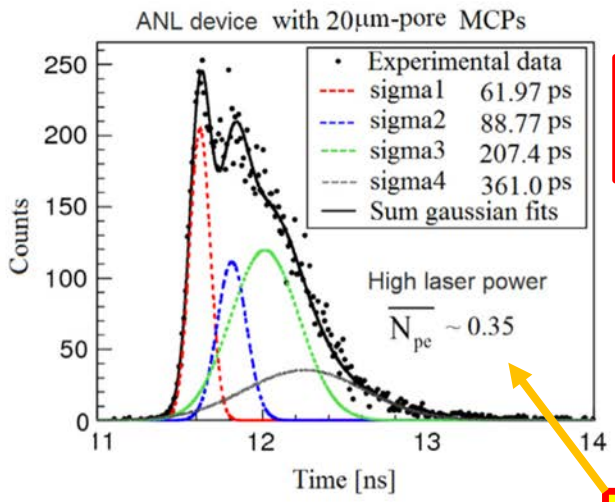


Laser Specs – Timing resolution vs Laser power



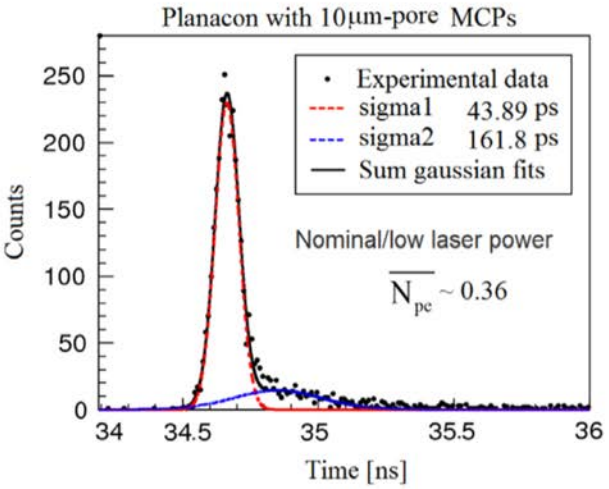
Effects of Laser Energy on Timing (ANL studies)

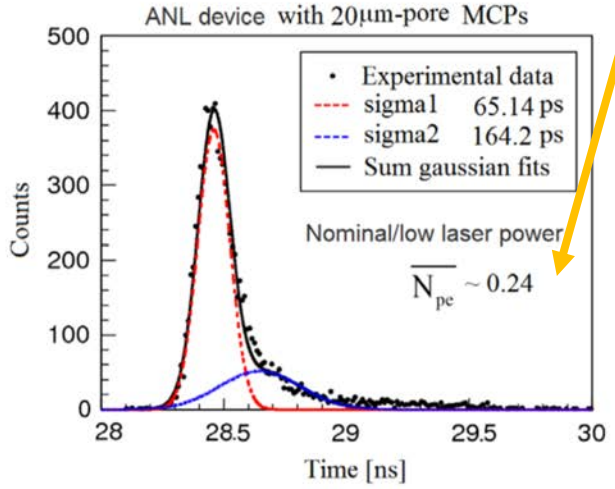




High Power Laser → afterpulsing

Single photon levels



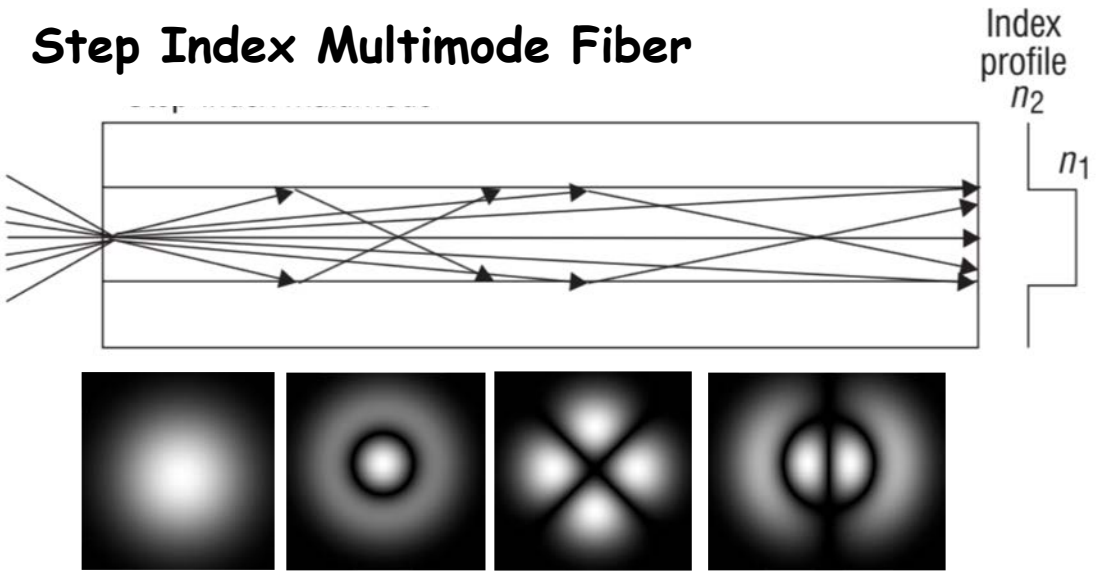


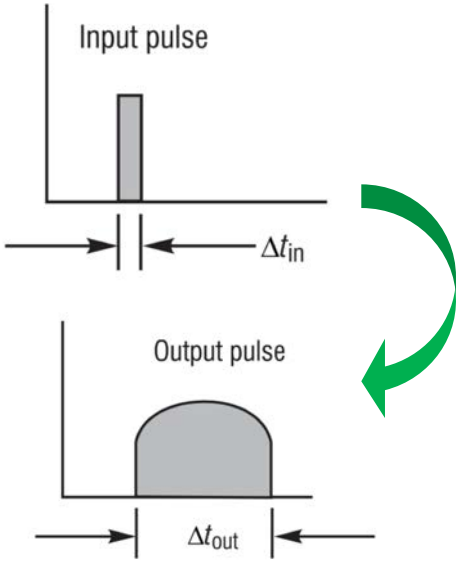
Nominal Power

Ref: J. Wang et al., NIM A 804 (2015) 84-93

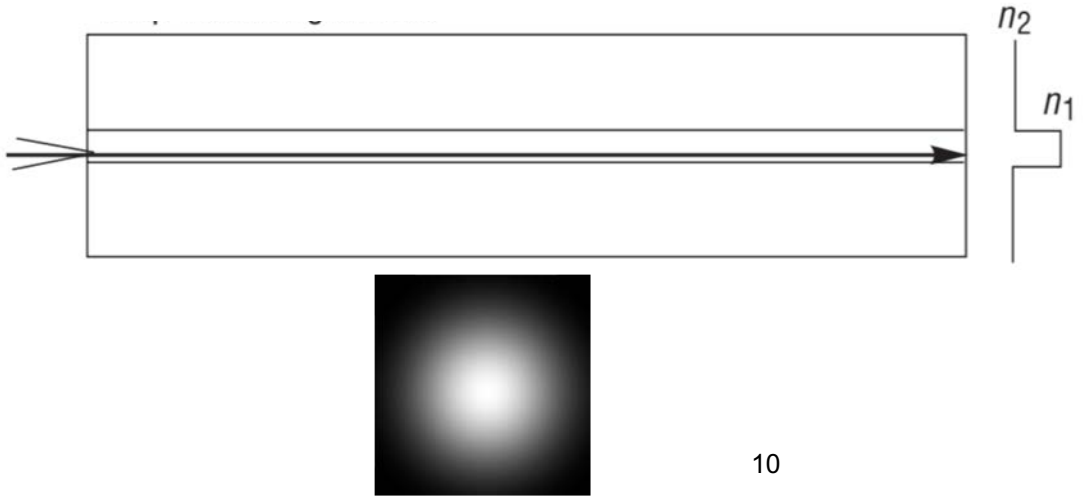
Single Mode vs Multimode Fibers – Timing Dispersion

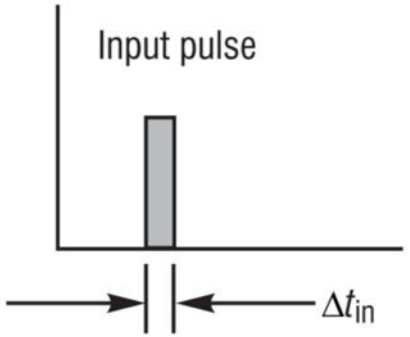
Step Index Multimode Fiber



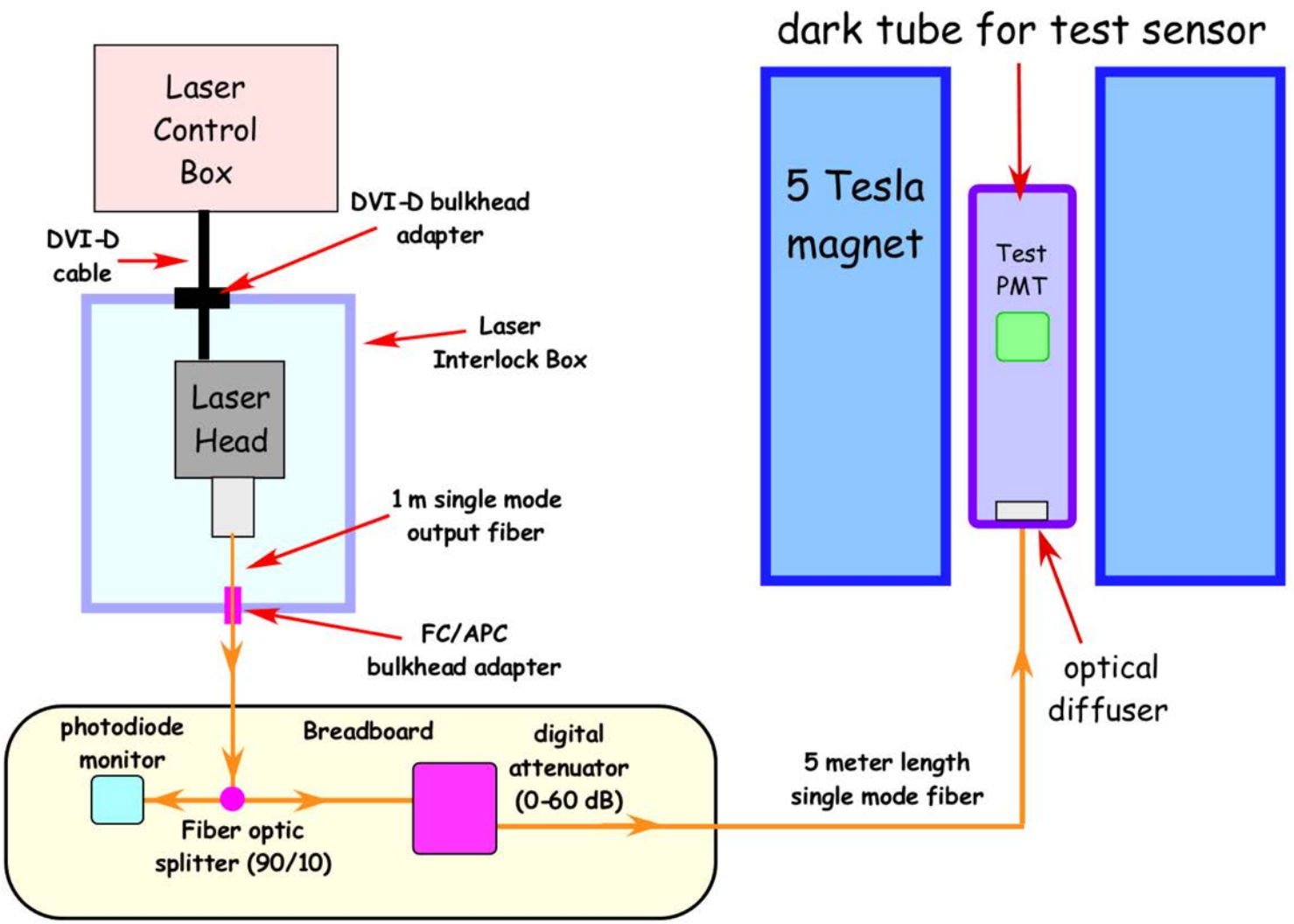


Step Index Single Mode Fiber





Pulsed Laser Light Source Setup



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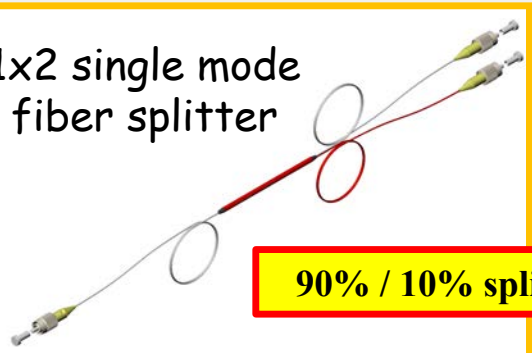
Pulsed Laser Light Source Setup

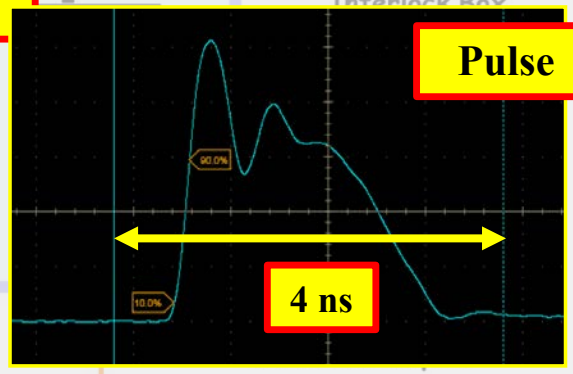
Laser monitor

Thorlabs photodiode

1x2 single mode fiber splitter

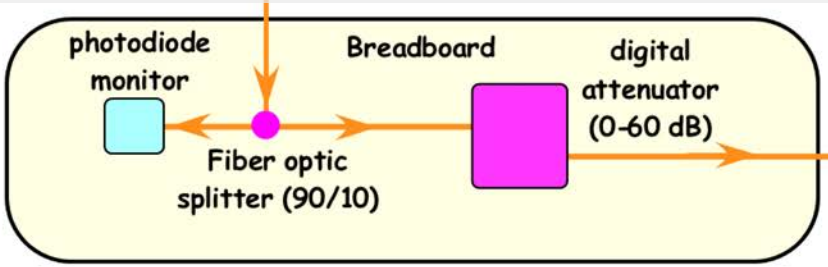


90% / 10% split



Pulse

4 ns



Digital Attenuator (0-60 dB)

➔ **Laser output ~ 10^7 photons per pulse** ➔
No shortage of light

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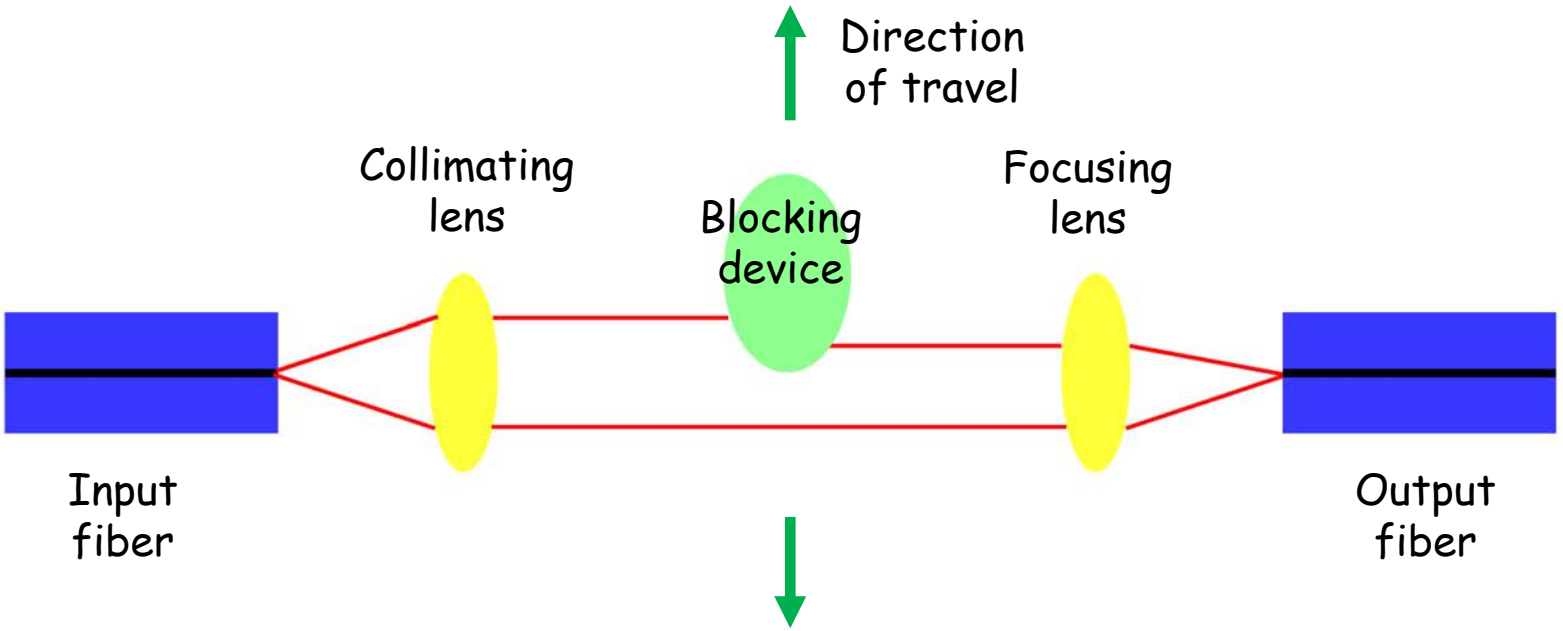
How the Attenuator Works

Light is collimated into a beam ~ 0.5 mm in diameter
Blocking device inserted to partially block collimated beam
via precision stepping motor + reduction gear assembly
➔ (*you can hear it operate*) ➔



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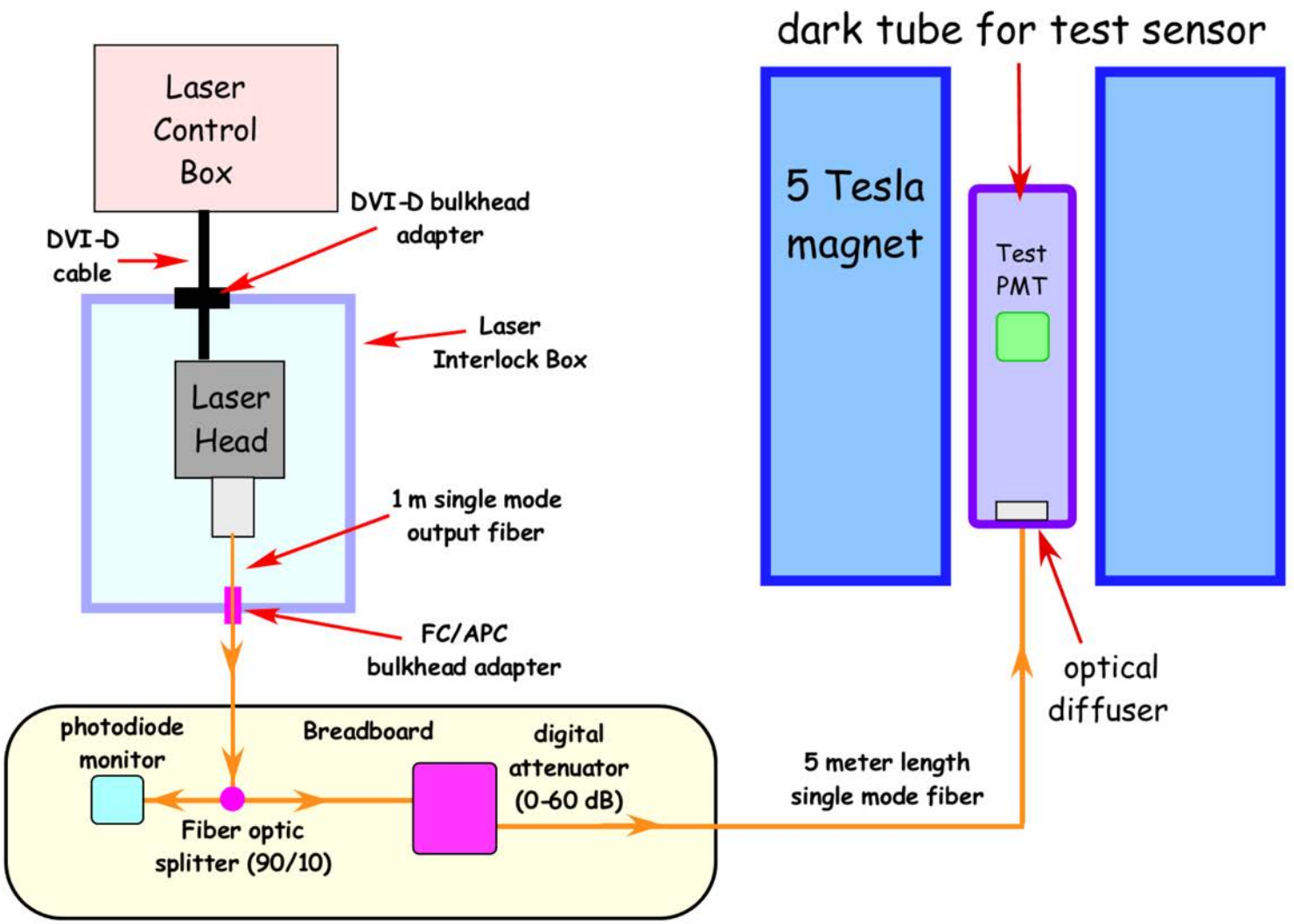

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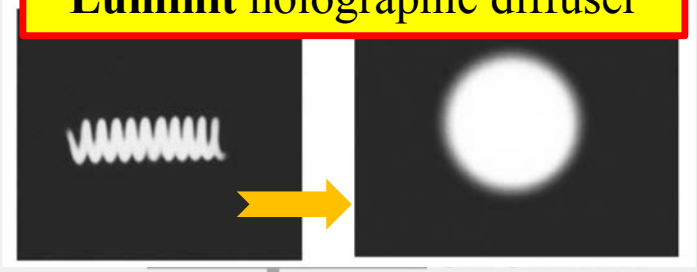
Pulsed Laser Light Source Setup

Luminit holographic diffuser



Filament light source

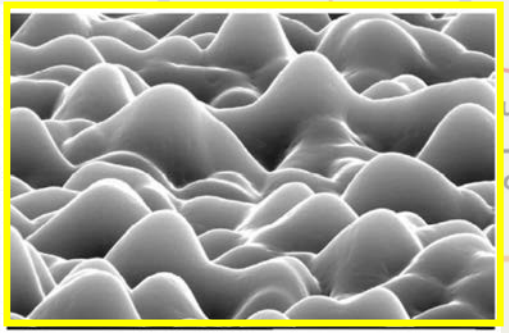
After diffuser

Laser Interlock Box

Laser

Distributor: Edmunds Optics

1 m single mode output fiber



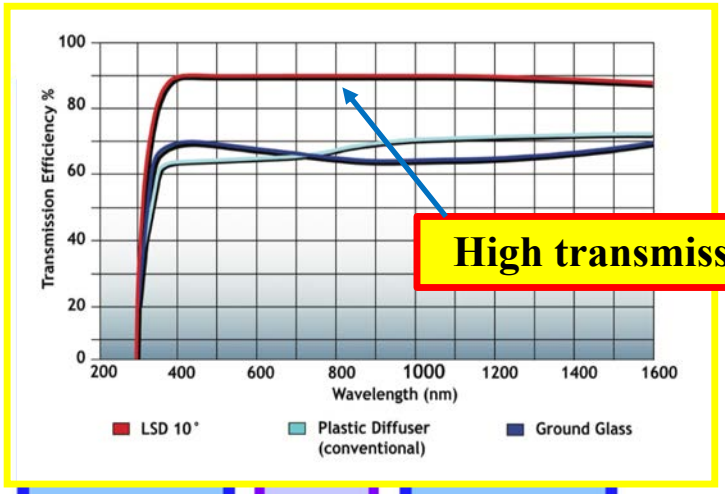
FC/APC

ulkhead adapter

oard

digital attenuator (0-60 dB)

Use random non-periodic array of micro-lenses



High transmission

optical diffuser

5 meter length single mode fiber

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Multichannel Fast Timing DAQ

This past summer run: Loan of Tektronix DSA70804
From JLAB Fast Electronics: 8 GHz BW, 25 GS/s

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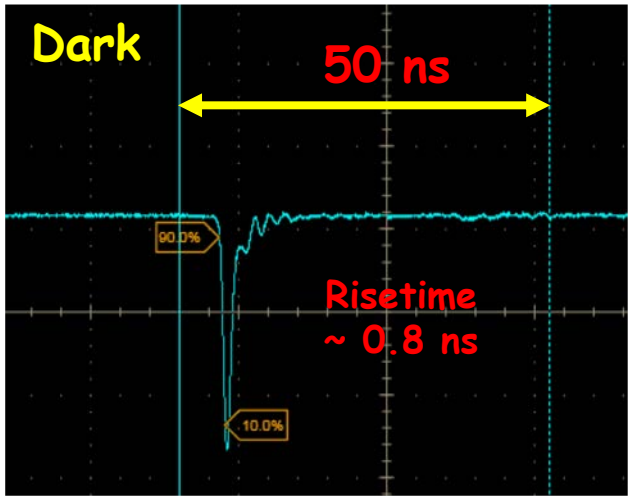
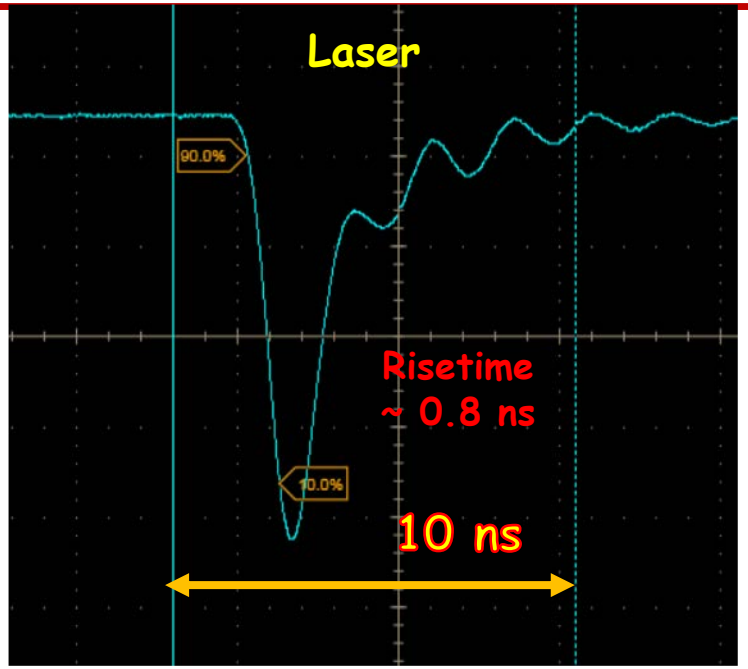
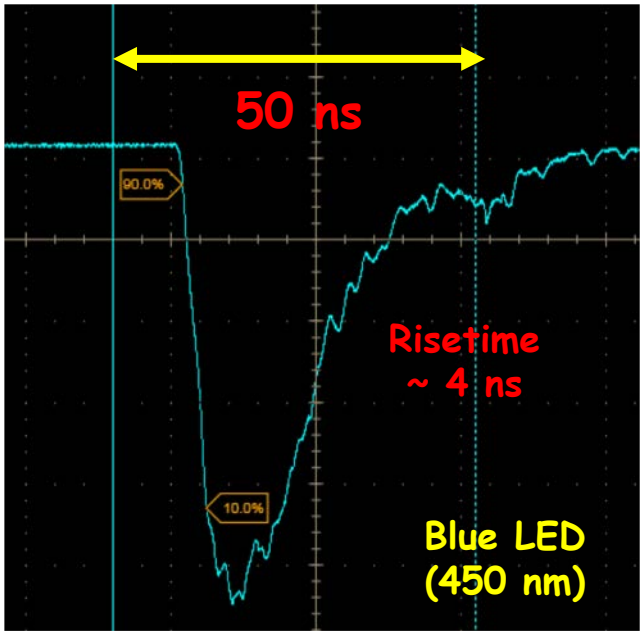
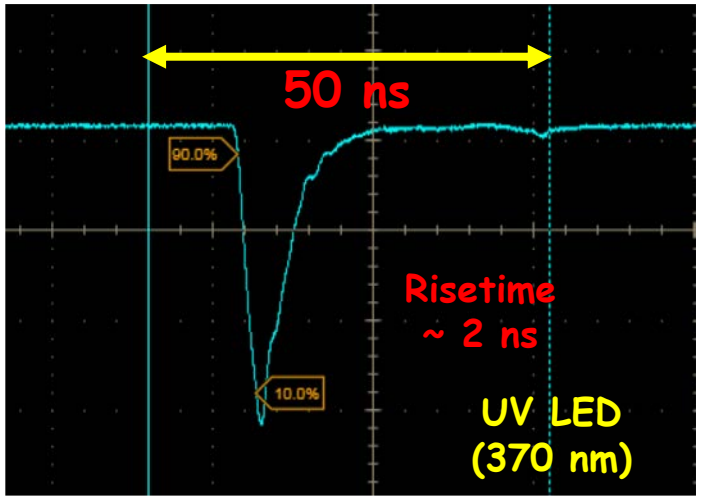
Sample Pulse Screen Captures - XP85012









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RECOMMENDED (by Junqi) PURCHASE ($7.5K)

Multichannel Fast Timing DAQ

CAEN 742 16-channel Digitizer
Based on 12-bit 5 GS/s (0.2 ns) DRS4 chip (PSI)

Warning! You need 16 MCX adapters!

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3D-printed mask for isolating pixels