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UNIVERSITÀ DEGLI STUDI DI UDINE

WP3: Muon g-2 Calibration System Update

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MUSE Scientific Board Meeting

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Outline

- Update on the new laser
- Alignment of the primary distribution system at Fermilab

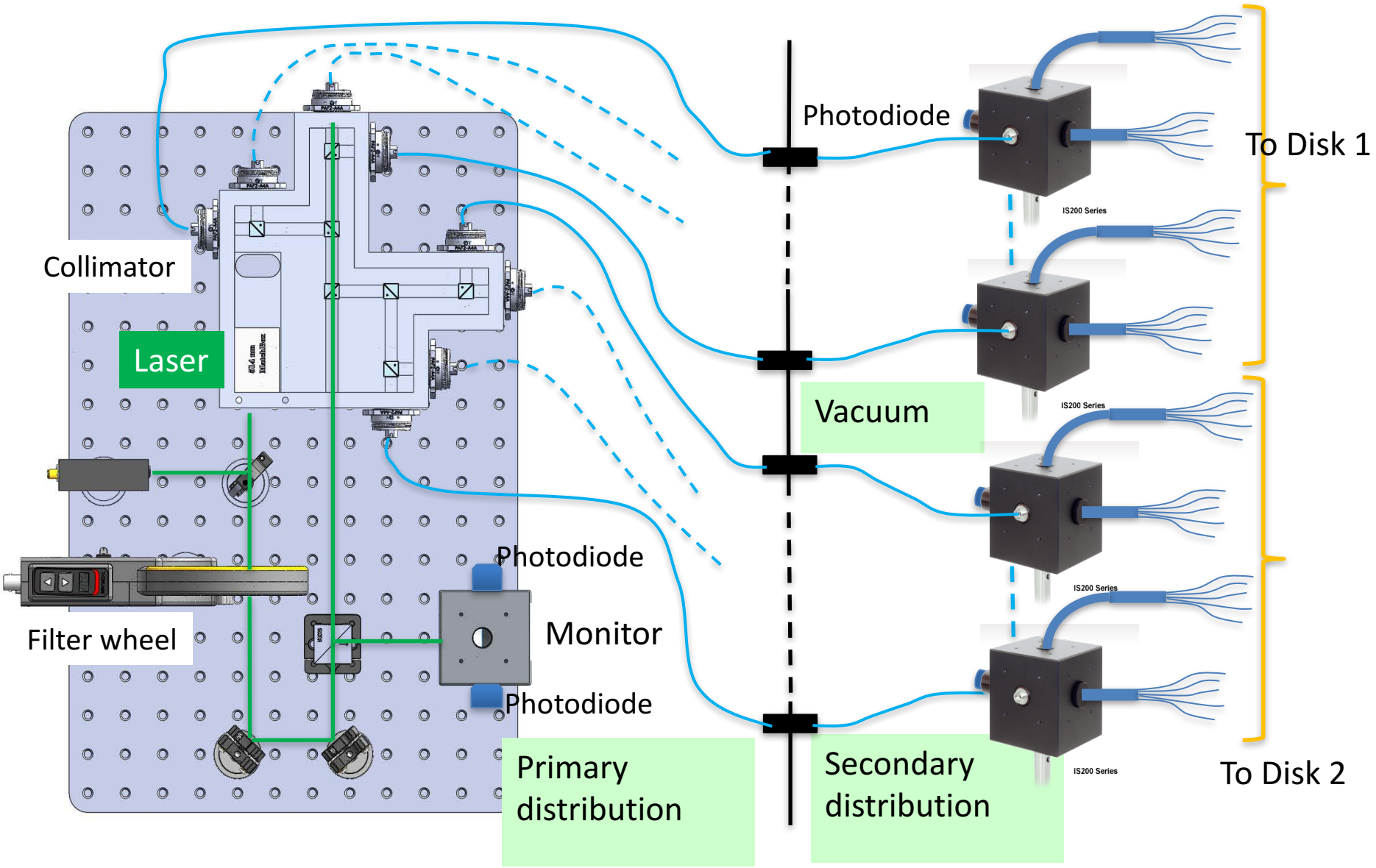
Standa laser mod. STA-01SH-2

Prototype tested

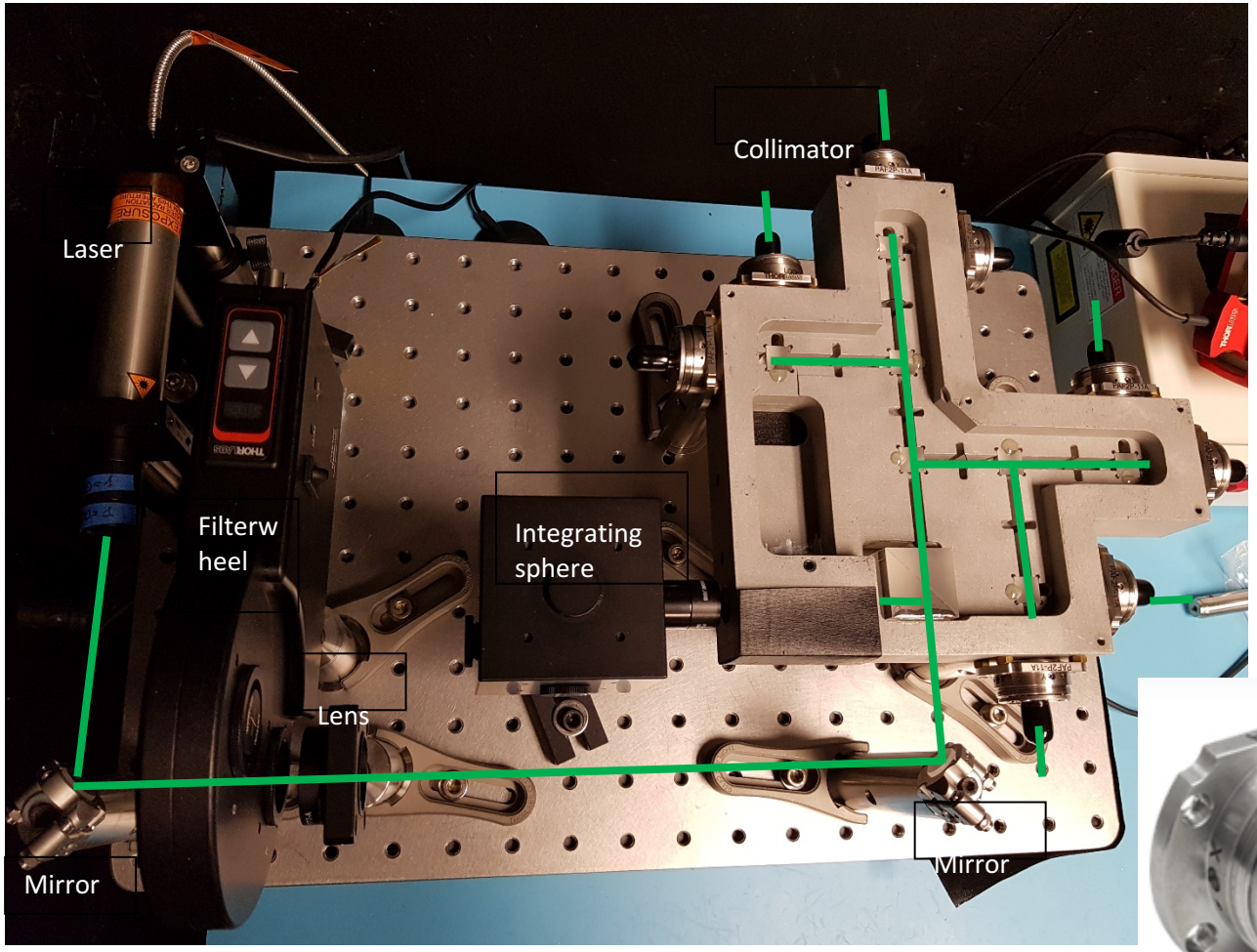
- Frequency: not measured (rated 532 nm)
- Output power: 42 mW (Class 3B)
- Repetition rate: 5.0 kHz
- Energy/pulse: 8.4 uJ/pulse
- Beam diameter: 2 mm
- Divergence: 10 mrad
- Pulse Width (FWHM): < 5 ns (affected by the photodiode rise time)
- Delay between trigger pulse and laser pulse: 19 us
- Jitter: 60 ns

The laser controller has a sync out, which is strictly related to the laser pulse, jitter respect to that signal reference is about 1 ns

Laser System Scheme



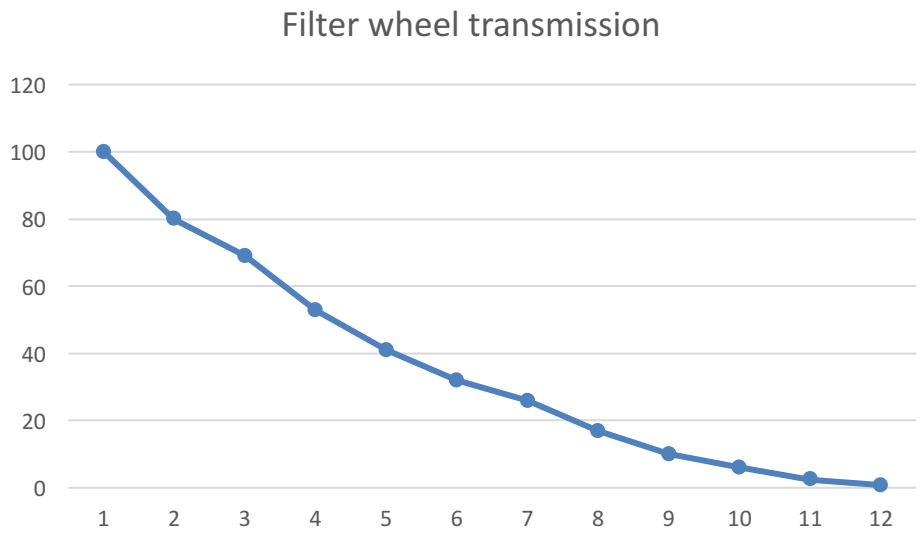
Primary distribution system at Fermilab (laser room at SiDet)



Final assembly

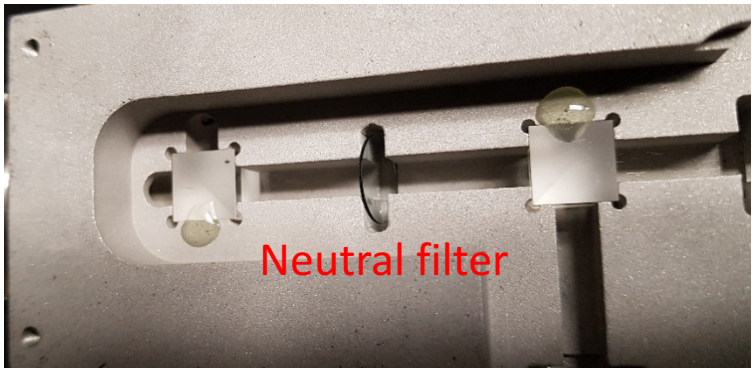
Filter wheel transmission

Position	OD	Trans% th	Power meter 1	Power meter 2	Trans% meas
1	0	100	443	300	100
2	0.1	80.6	353	300	80
3	0.2	65.5	306	301	69
4	0.3	50.8	236	302	53
5	0.4	39.0	182	303	41
6	0.5	31.6	141.5	304	32
7	0.6	25.0	116.4	304	26
8	0.8	16.4	75.6	304.5	17
9	1	10.1	47.1	304.5	10
10	1.3	5.5	25.7	304.5	6
11	1.6	2.5	11.4	304	2.5
12	2	1.0	3.50	303	0.8



Cubes splitting system

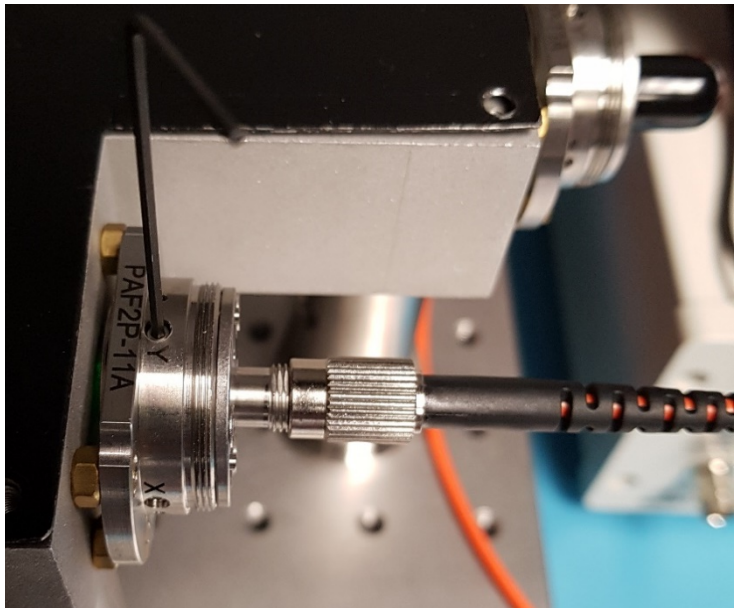
	No filters		With filters	
Beam	Pout (uW)	Trans (%)	Pout (uW)	Trans (%)
In	4270		4270	
1	315	7.4	315	7.4
2	358	8.4	358	8.4
3	404	9.5	338	7.9
4	418	9.8	349	8.2
5	425	10.0	330	7.7
6	420	9.8	326	7.6
7	423	9.9	328	7.7
8	428	10.0	332	7.8



8 beams whthin 12%
Aiming to sub 10%

Collimators: Thorlabs, mod. PAF2P-11A

Ultrastable micropositioning alignment with five degrees of freedom collimators



Beam	Pout (uW)	Trans (%)
In	4270	
1	311	7.3
2	358	8.4
3	315	7.4
4	335	7.8
5	333	7.8
6	330	7.7
7	328	7.7
8	330	7.7

The collimators are able to collect > 95% of light into the optical fibers

Energy budget

The estimated overall transmission is $T = 1.2*10^{-8}$

We need 3000 photoelectrons/photosensor

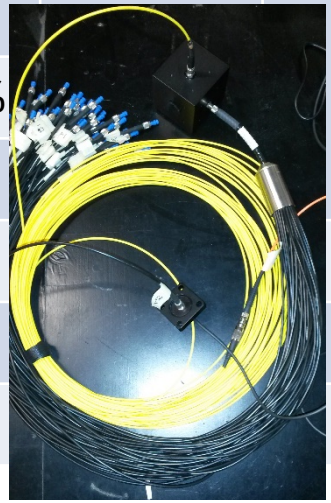
=> The laser must provide $2.5*10^{11}$ photons/pulse

@ 530 nm 1 photon = $3.7*10^{-19}$ J

=>

The laser must provide 100 nJ/pulse

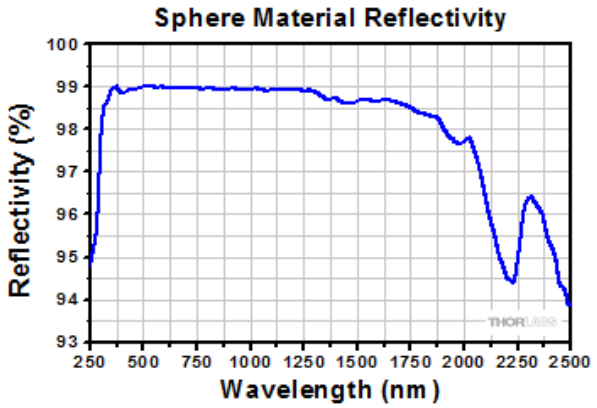
Component	Th. Trans.	Meas. Trans.	Meas. Trans.
2 mirrors	99%	97%	
Monitor	85%	80%	
3 cube splitter	10%	9%	
Collimator	70%	90%	
60 m fiber	60%		
Feedthrough	70%		0.0001%
9 m fiber	90%		
Int. sphere	0.003%		
Fiber bundle	98%		
Crystal	50%		
SiPM coll. area	18%		
SiPM PDE	20%		



Secondary Light distribution system

ThorLab-IS200 Sphere

- 1 input, 4 output ports
- 3 Bundles of fibers with SMA connector in the port and final ferrule needle on each fiber.

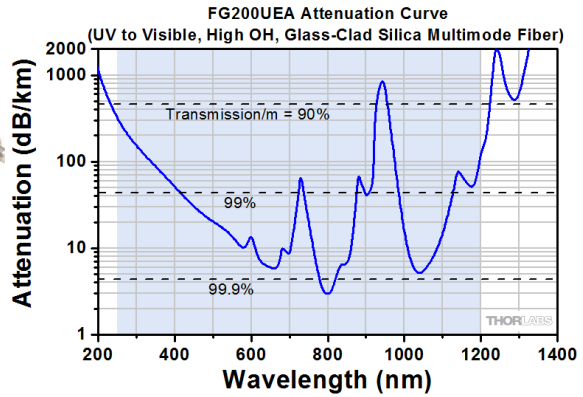


MM 200/~~400~~ µm fiber, 2 options:

- **NA = 0.22** → Silica / Fluorine-Doped Silica cladding
- **NA = ~~0.37~~** → Silica/ Hard ~~P~~olymer cladding

Downselect by RadHard test

H.P. lost 5% transmission on 80 krad



Vacuum Fiber Feedthrough

- ConFlats
- M10/12 housing
- **Feedthrough with Multifiber option under studied**

To do list (*21st Feb 2019*)

- Alignment test with collimators of primary distribution (July18) DONE
- Radiation dose test on the fiber bundle (Dec18) DONE
- Select optical fiber (mod. FIP200) and *feedthrough* (Dec18) DONE In progress
- Select laser Done
- Monitor system Photodiode irradiated
- Optical fiber routing for launching fibers and bundle Done
- TDAQ integration In progress

THE END

(thanks for your attention)