Axioma Project

Laser-based coherent scintillator

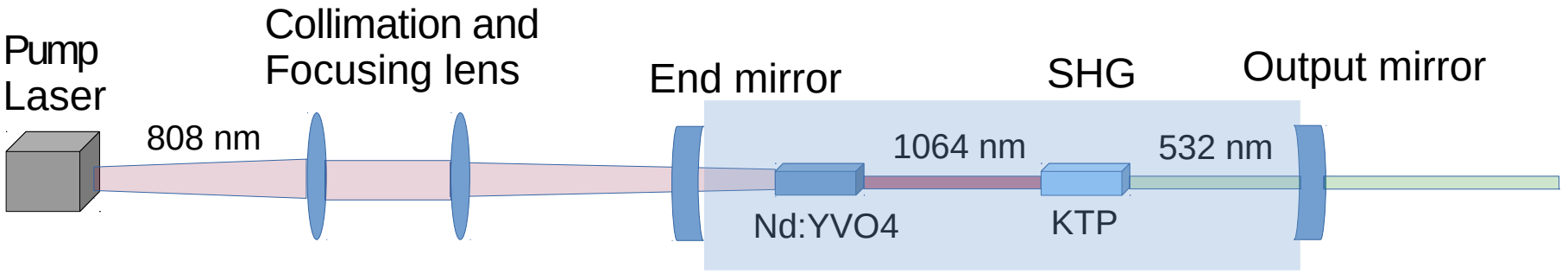
Diode Pumped Solid State (DPSS)

DPSS green lasers

Nd:YVO4 - Neodymium doped Yttrium ortho Vanadate

+

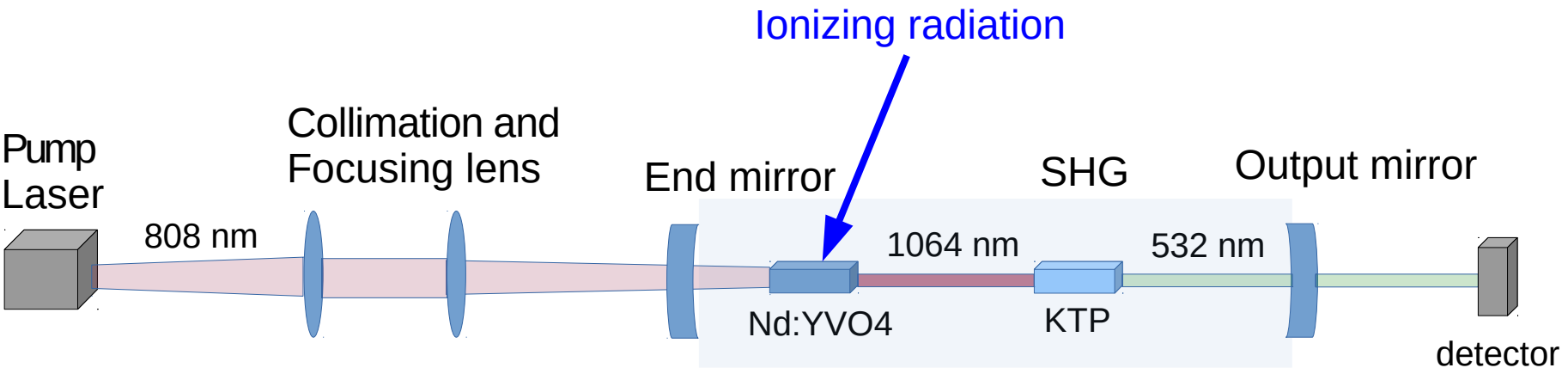
KTP - Potassium Titanyl Phosphate, KTiOPO4



typical setup

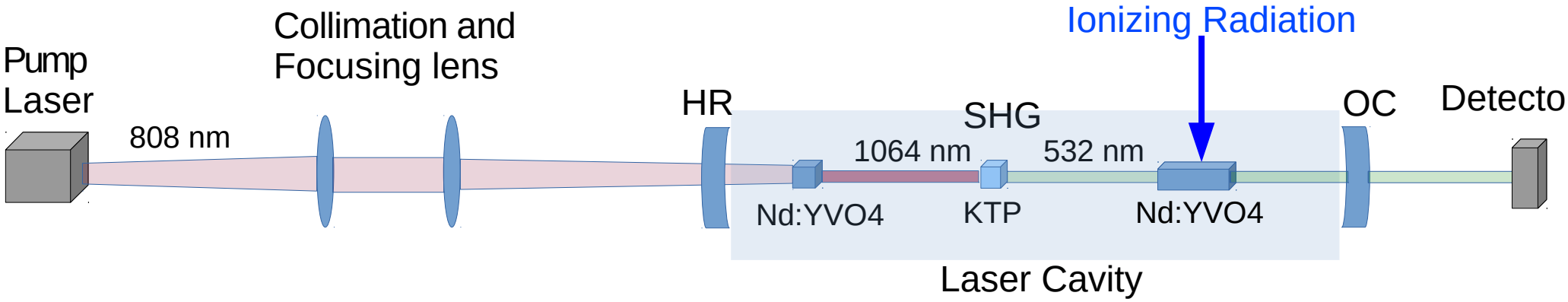
Diode Pumped Solid State (DPSS)

Laser-based coherent scintillator

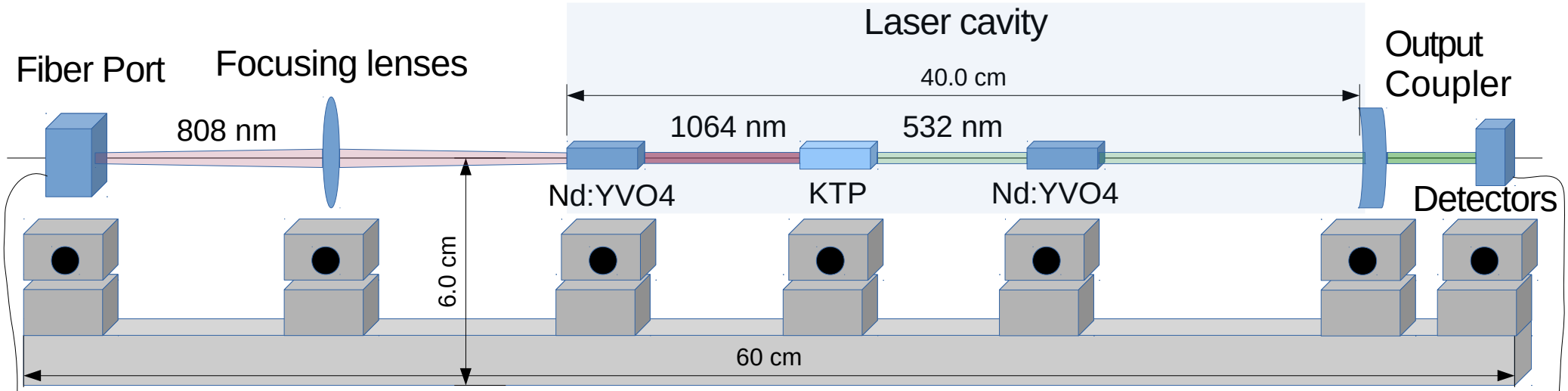


Diode Pumped Solid State (DPSS)

Laser-based coherent scintillator



Experimental setup overview



ITC4020

Laser Diode and TEC Controllers

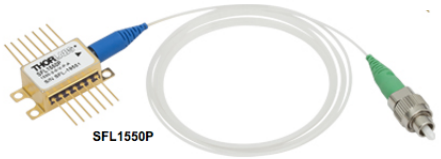
Photoreceivers

Power/Energy Meter

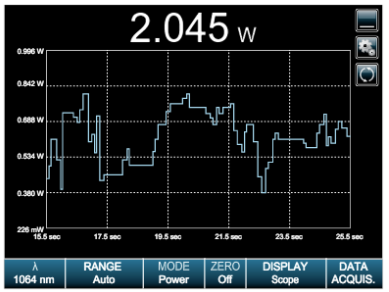
Spectrometer

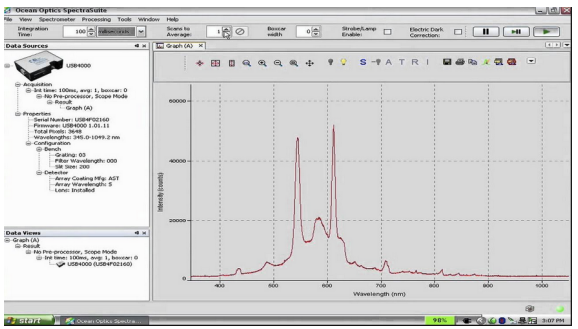
LM14S2

Butterfly mount



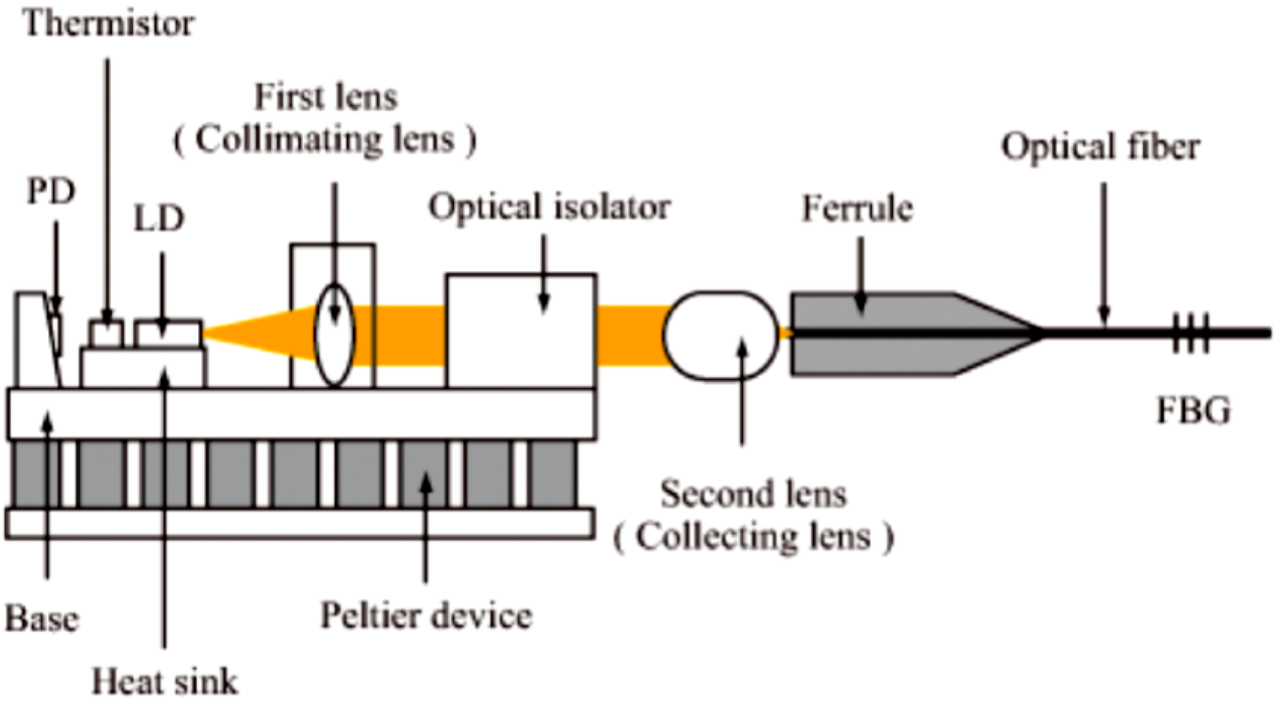
Fiber coupled Laser Diode





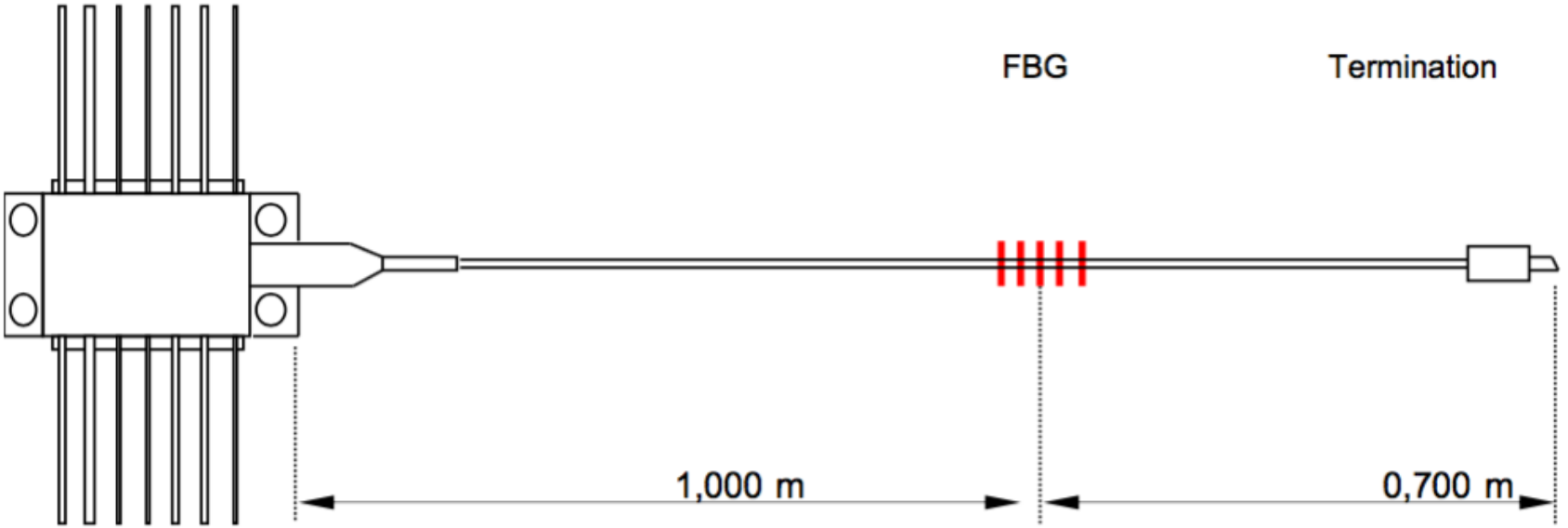
Laser diode

Butterfly package

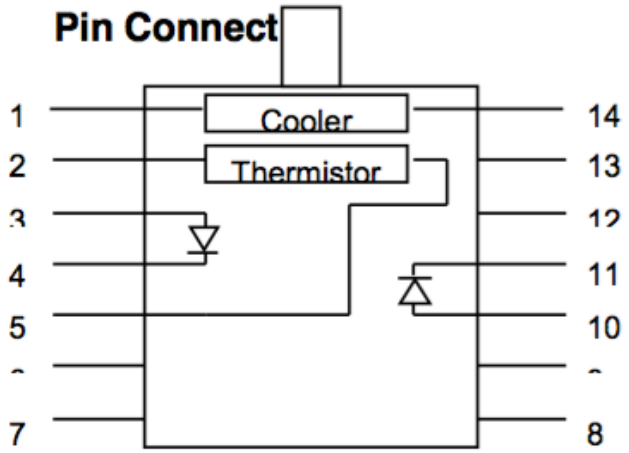


Laser diode

Dimensions

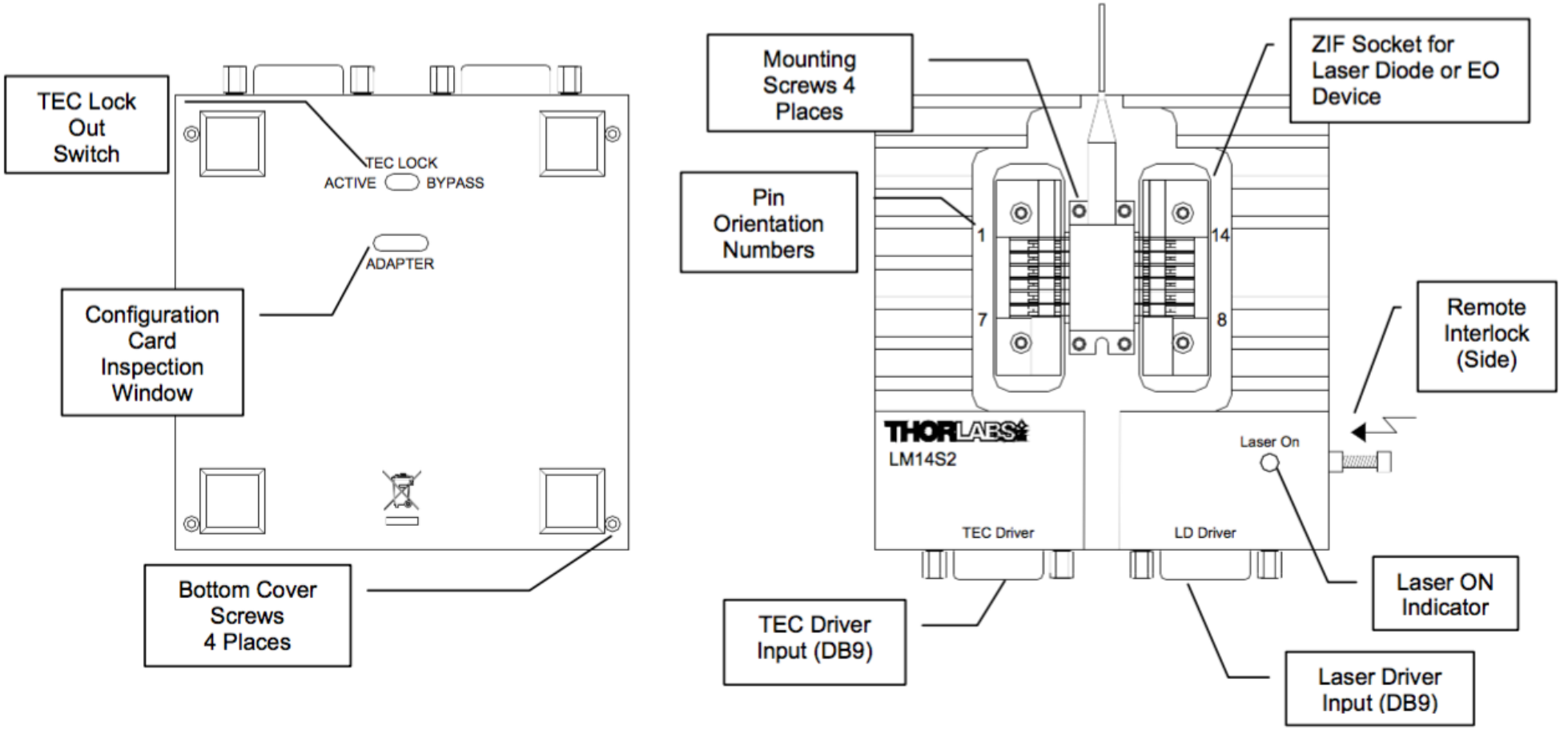


Pin Connect

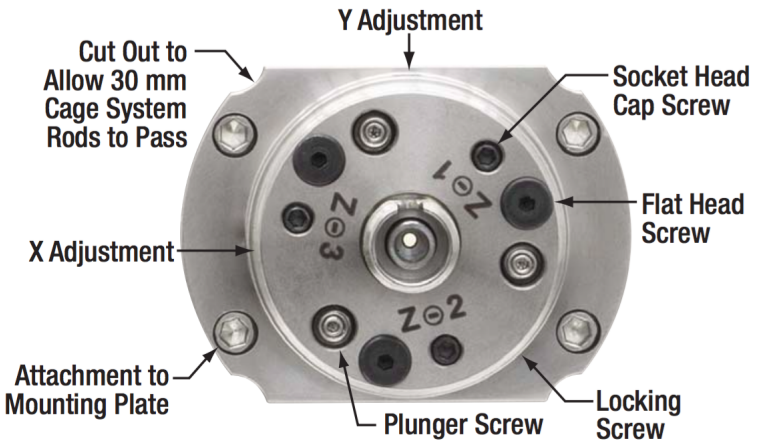


1	Cooler(+)	14	Cooler(-)
2	Thermistor	13	Case ground
3	PD Anode	12	nc
4	PD Cathode	11	Laser Cathode
5	Thermistor	10	Laser Anode
6	nc	9	nc
7	nc	8	nc

Butterfly Laser Diode Mount



Laser Port

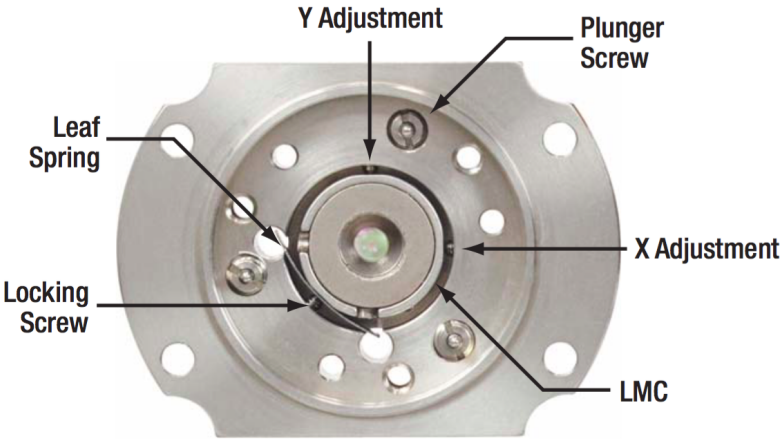


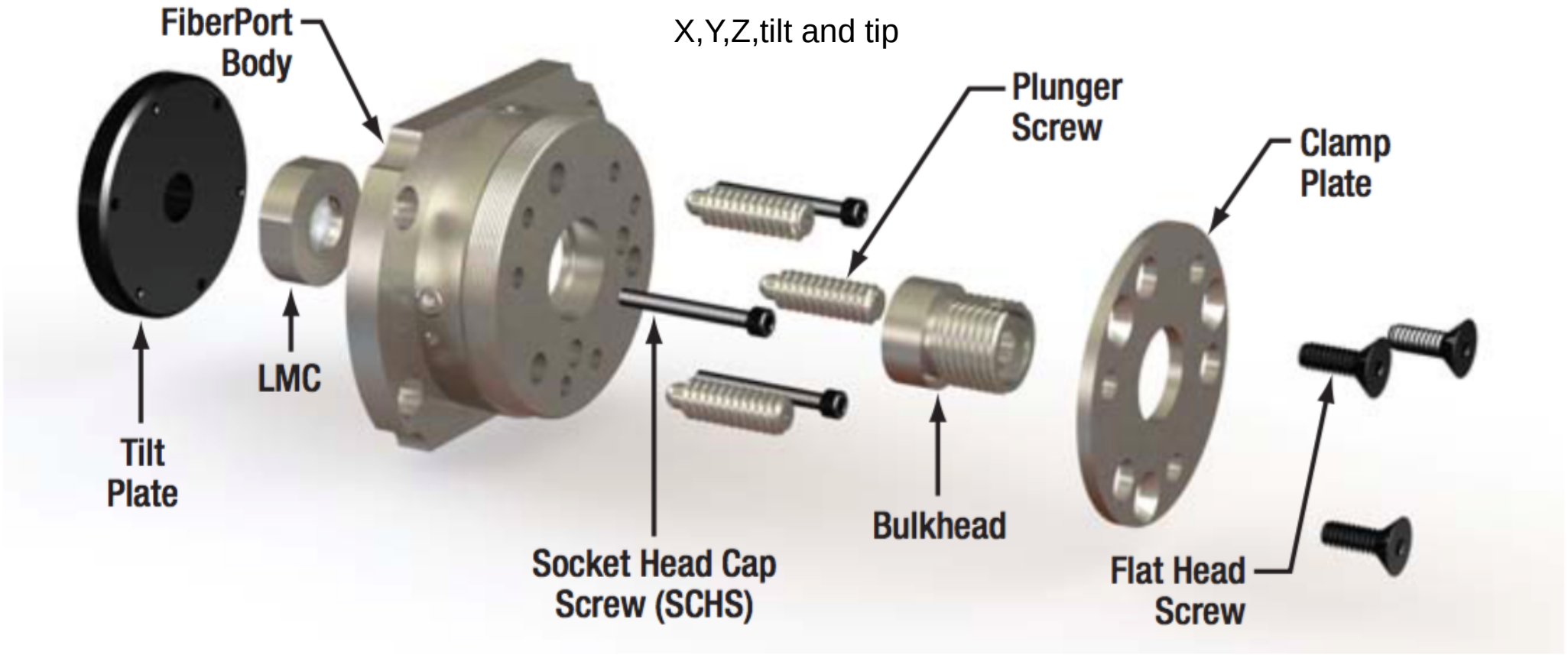
Aspheric FiberPorts for FC/PC and FC/APC Connectors

AR coatings 600-1050 nm

Five Degrees of Freedom

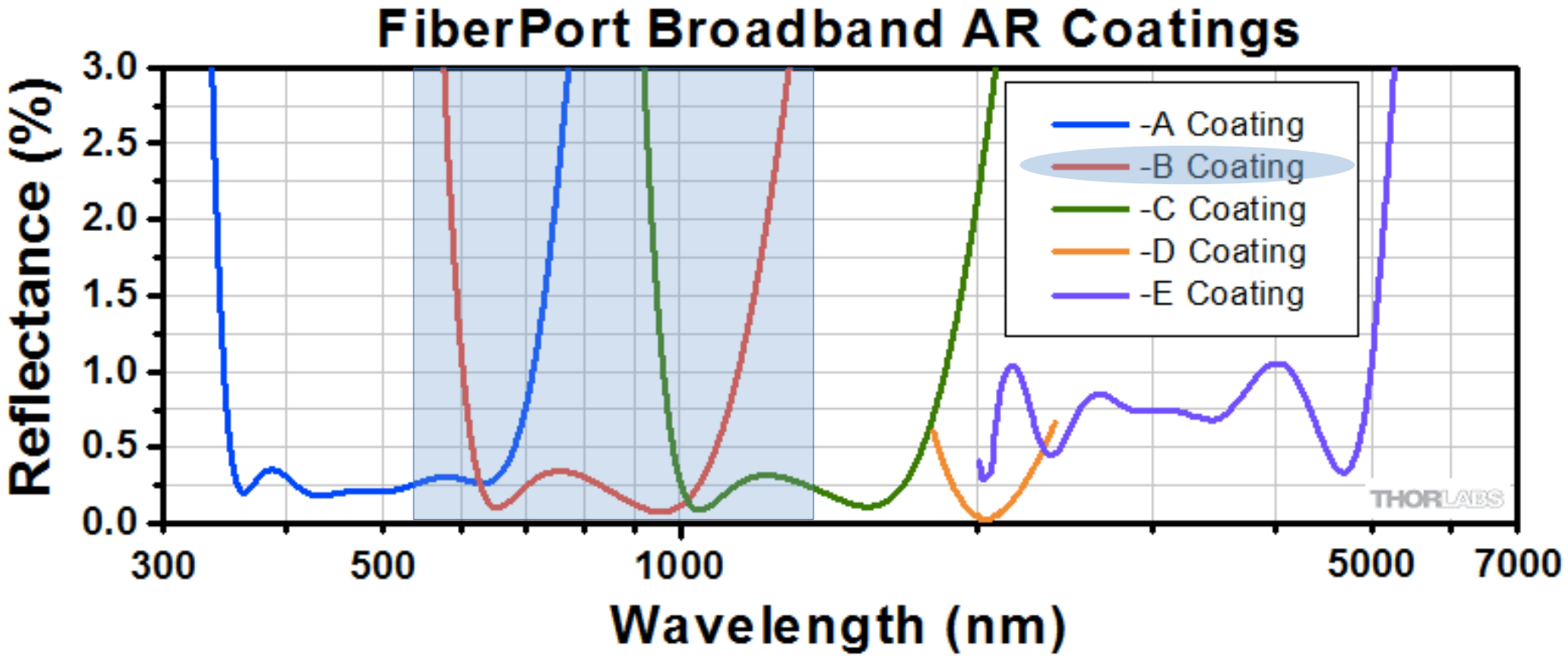
X,Y,Z,tilt and tip





Laser Port

Item#	EFL (mm)	Input MFD[1] (µm)	Output Waist Dia. (1/e²) (mm)	Max Waist Dist.[2] (mm)	Diverg. (mrad)	Lens Characteristics			Length L (in/mm)
						CA[3] (mm)	NA	AR Range[4] (nm)	
PAF-X-7-B	7.5	5.0	1.62	1225	0.667	4.4	0.29	600 - 1050	0.69/17.5



Optic mount

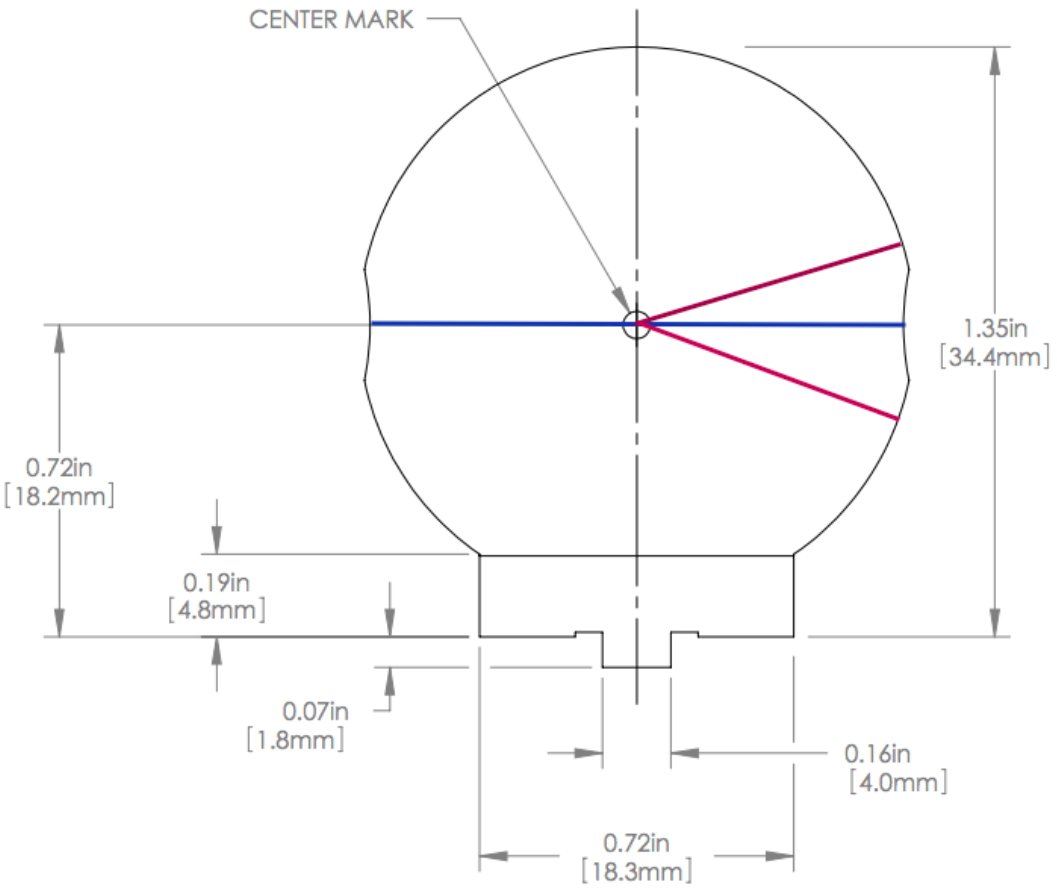
CT102

CT104

CT101

CT103

Crystal mount



Output Mirror mount

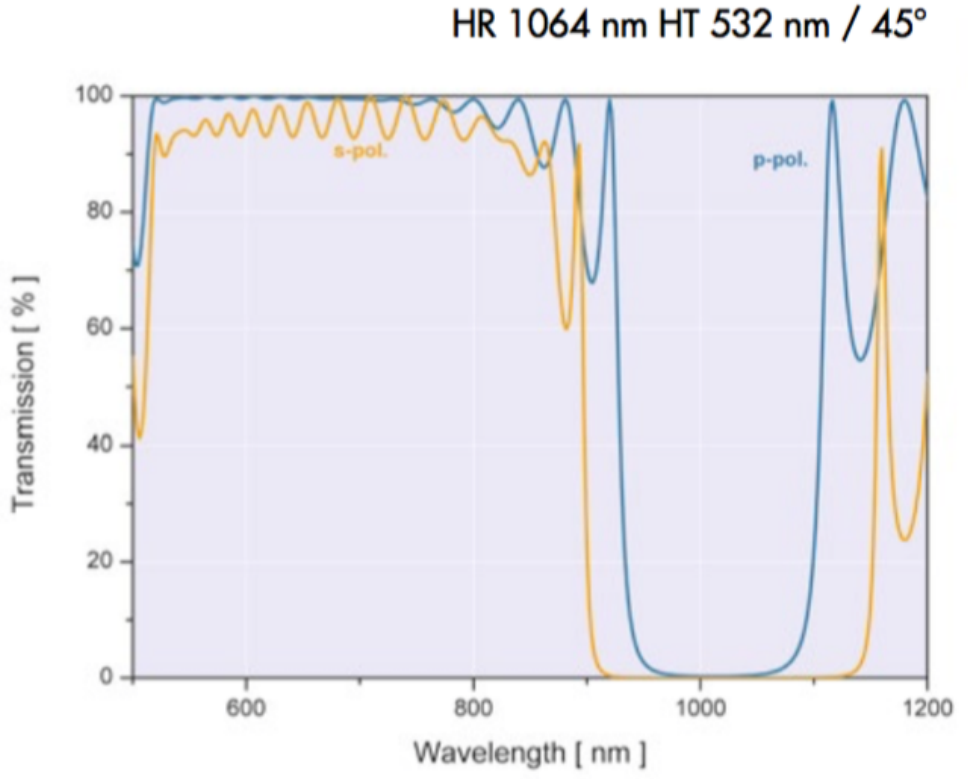
5-Axis Kinematic Optic Mount

concave laser mirror

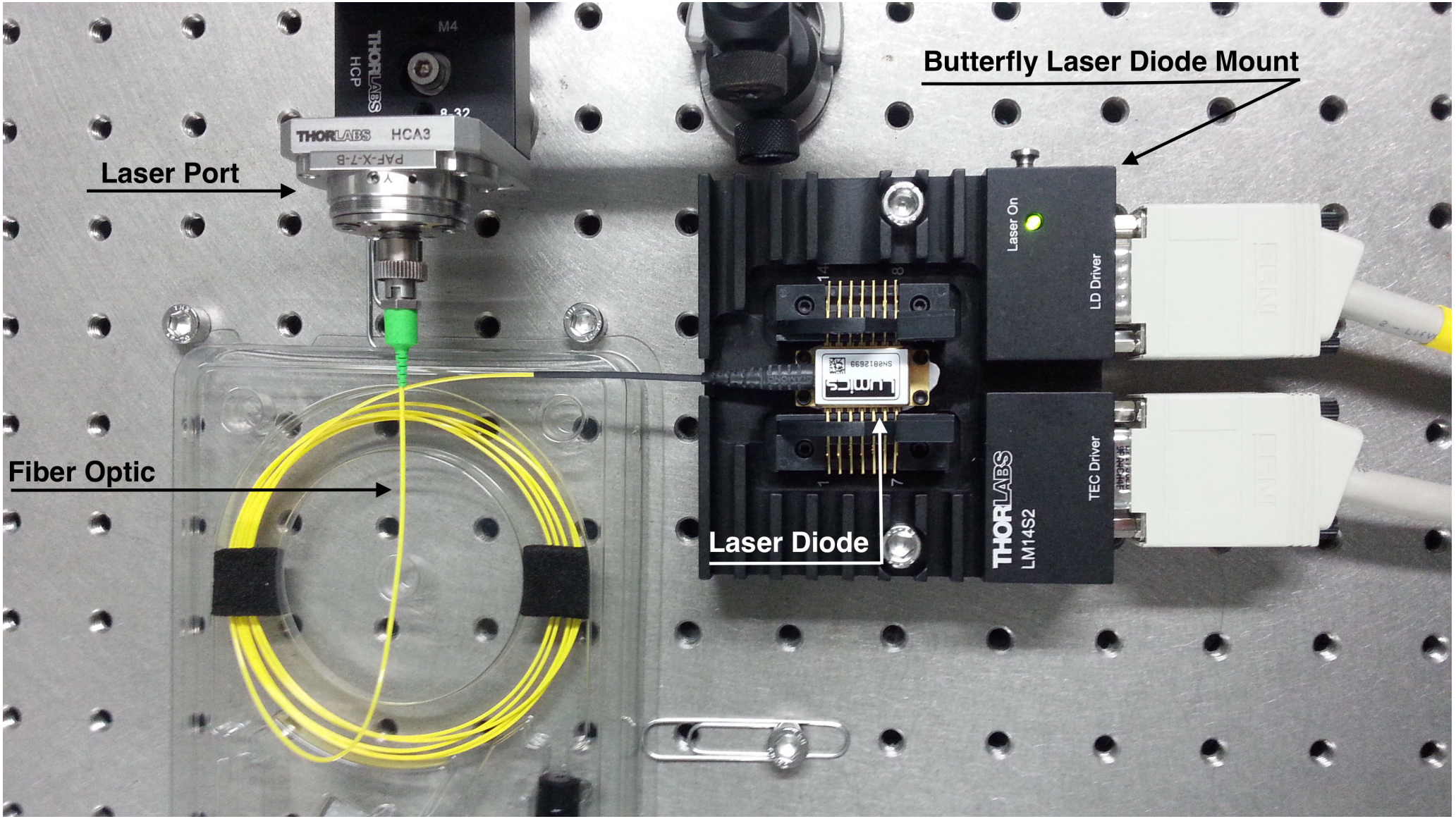
(OUTPUT COUPLER)

Coatings:

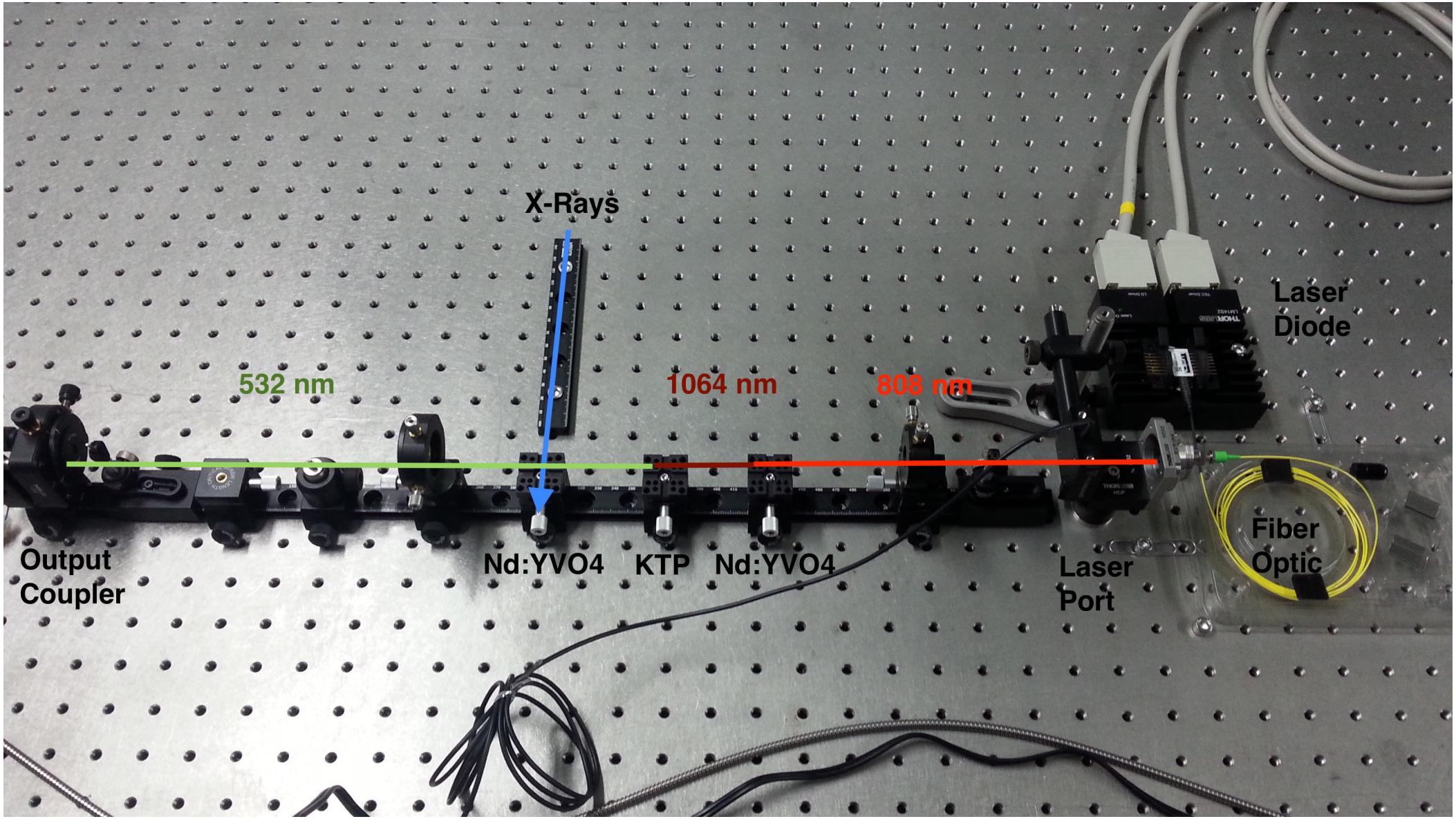
S1: R(1064)>99.9%, T(532)>97%
S2: R(532)<0.1%



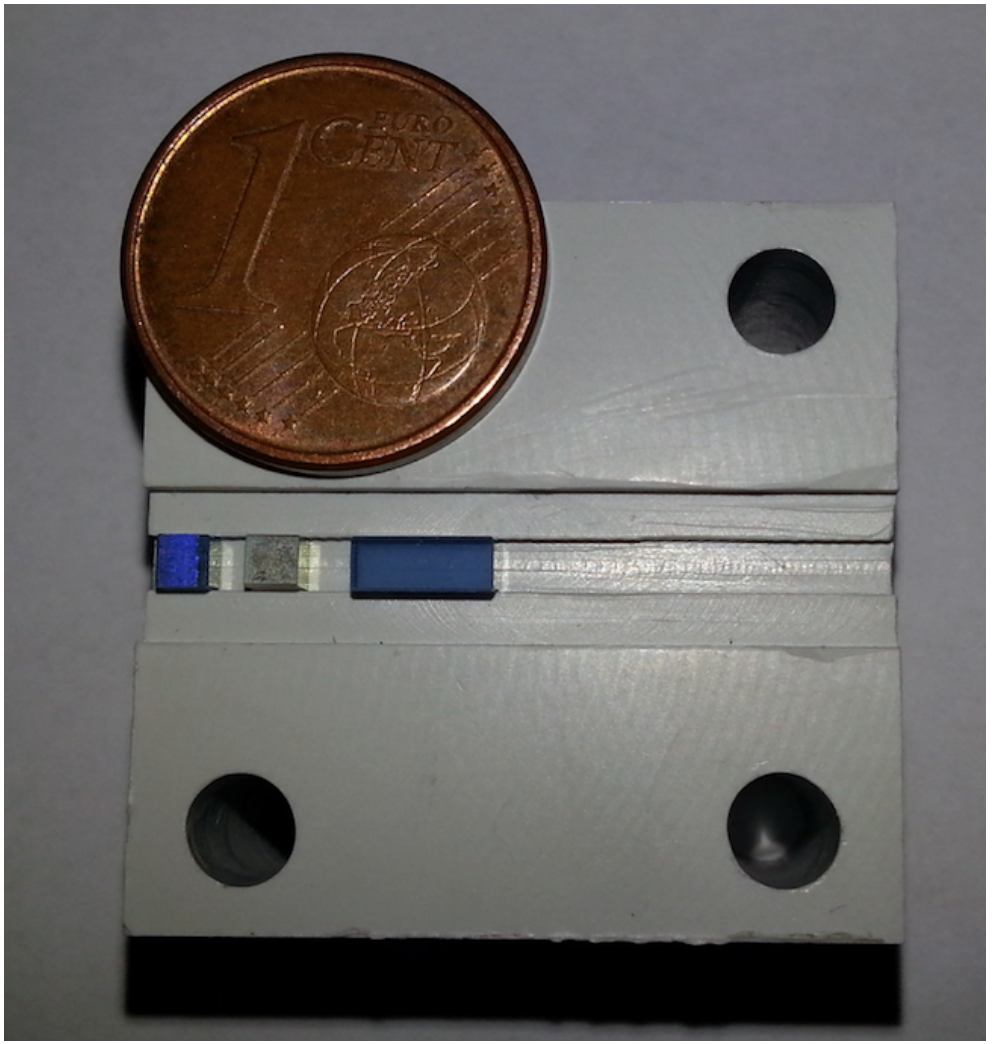
Experimental setup



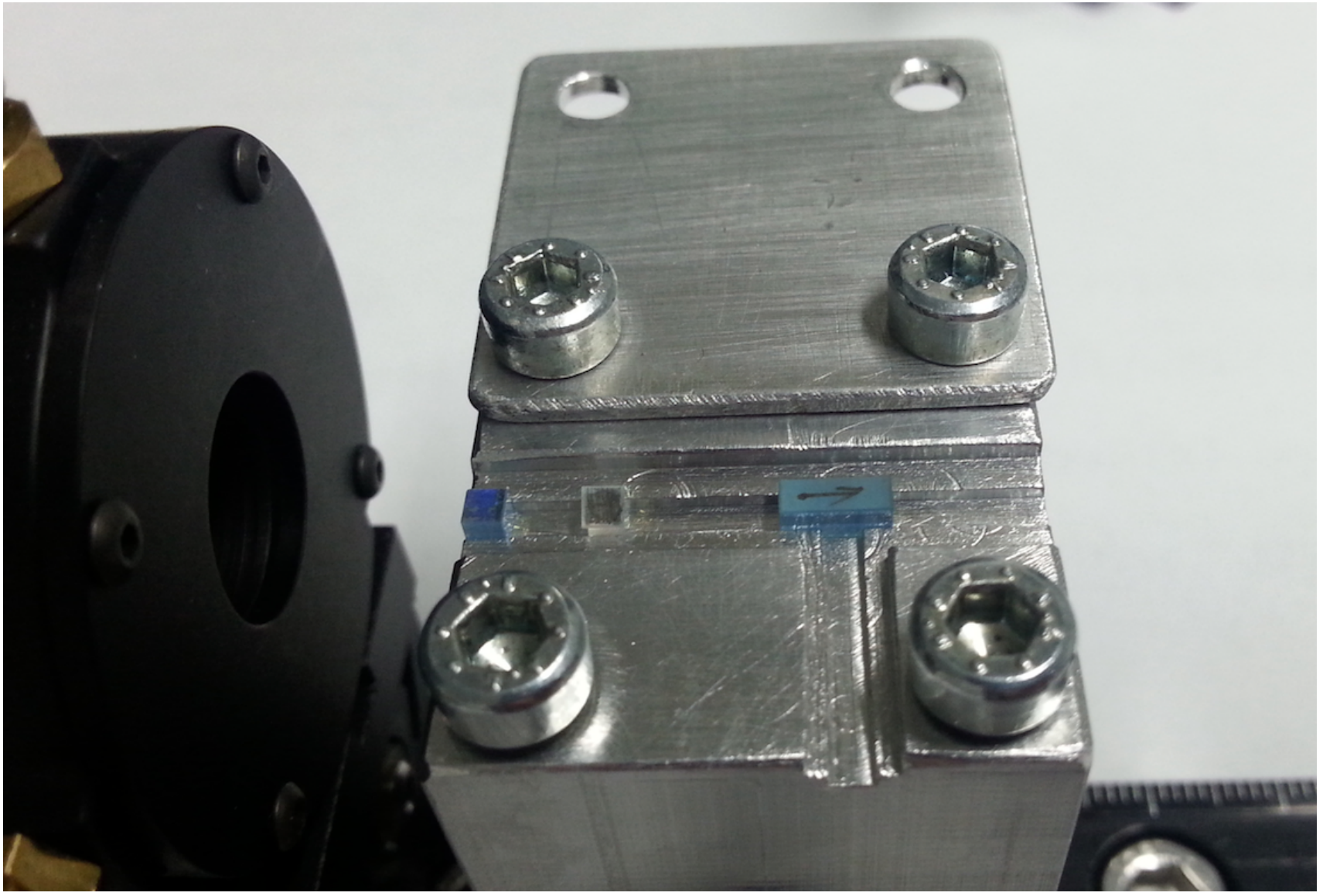
Experimental setup



Experimental setup



Experimental setup



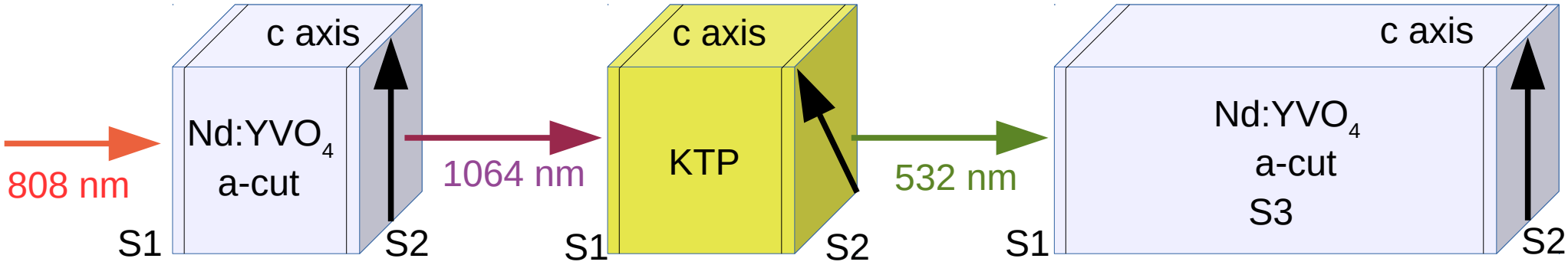
Optical properties of crystals

Pump Laser
@808 nm

Laser Emission
@1064 nm

Second Armonic Generator
@ 532 nm

KTP cut for 1064 nm
θ = 90° , φ = 23.5°



Coatings:
S1:
HT@808nm + HR@532&1064nm
S2:
AR@532&1064nm

Dimension: 2x2x2 mm

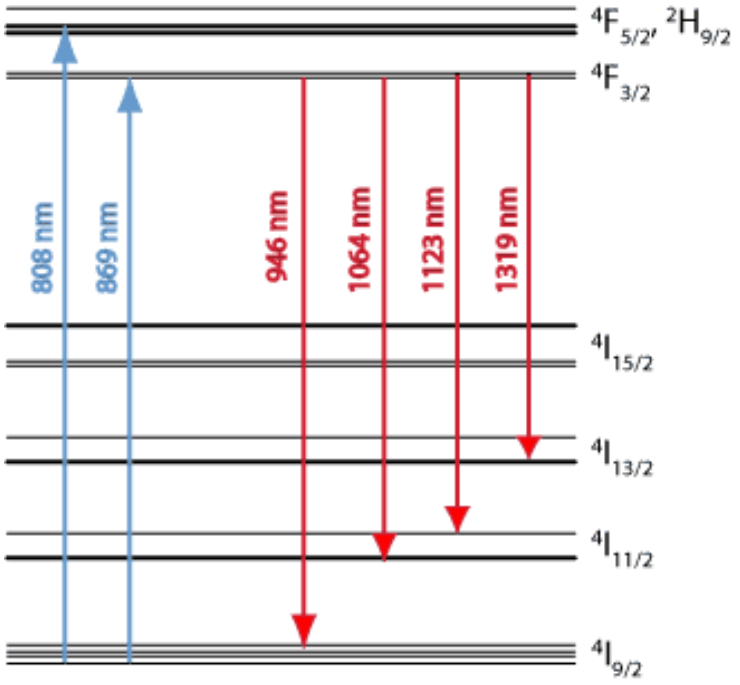
Coatings:
S1:
AR@532&1064nm
S2:
AR@532&1064nm

Dimension: 2x2x2 mm

Coatings:
S1:
AR@532&1064nm
S2:
AR@532&1064nm
S3:
polished side

Dimension: 2x2x5 mm

$Nd:YVO_4$



$Nd:YVO_4$ (a-cut):

$$1\ \%\ \text{at.} \equiv 1.26 \times 10^{20}\ \text{cm}^{-3}$$

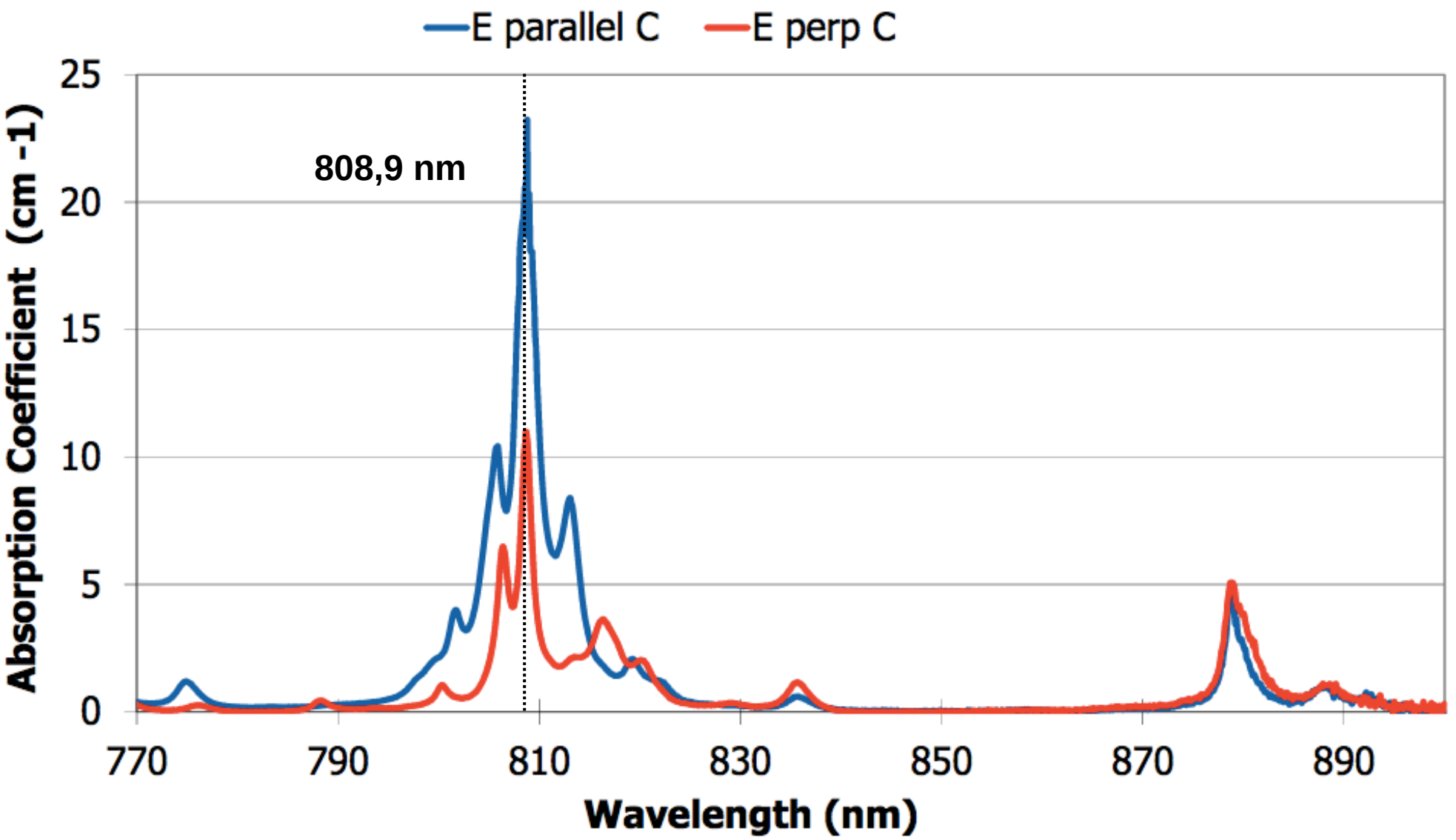
$$\sigma_A = 2.8 \times 10^{-19}\ \text{cm}^2$$

$$\sigma_E = 25 \times 10^{-19}\ \text{cm}^2$$

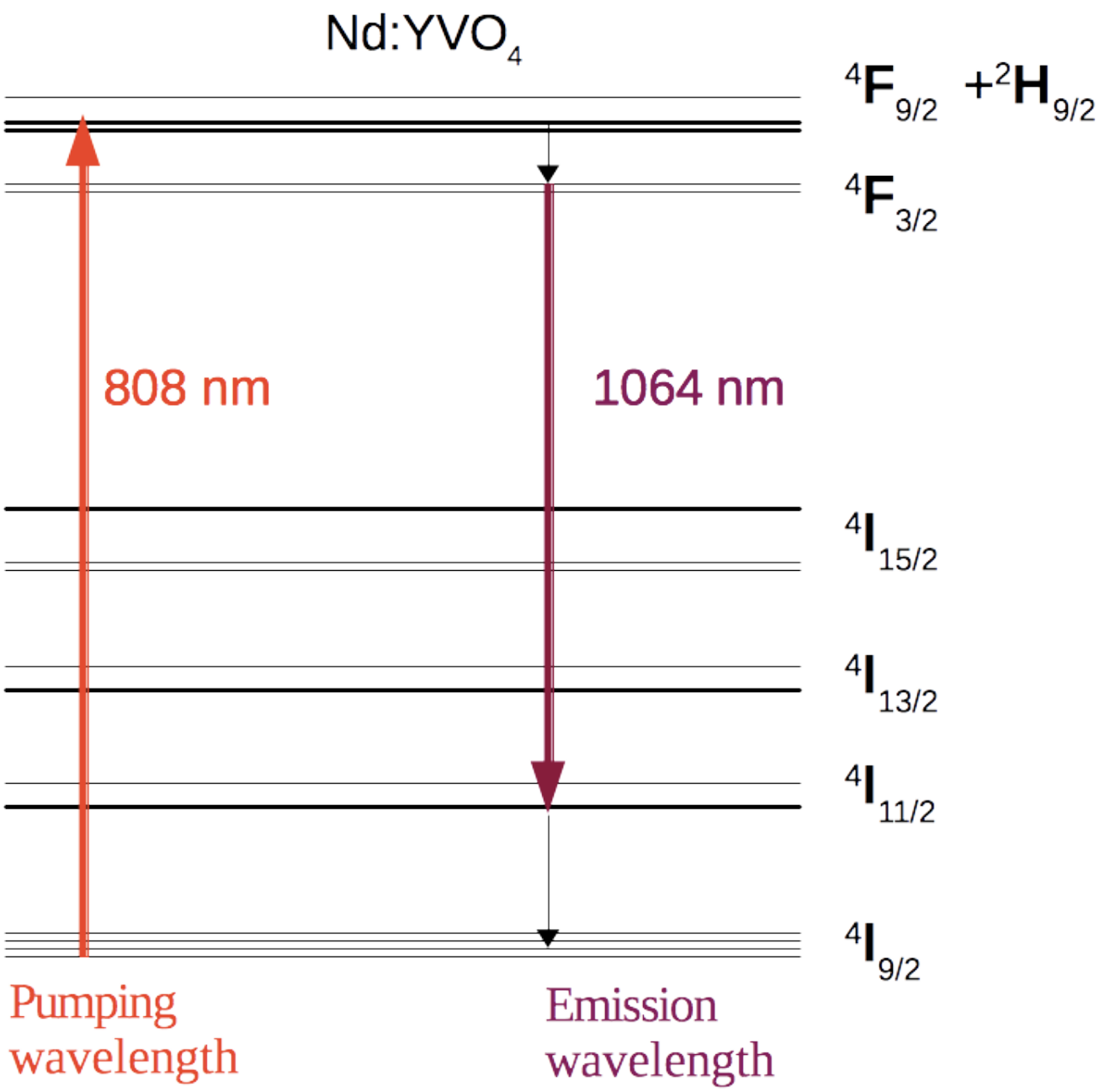
$$\tau_{sp}(3\%\ \text{at.}) \approx 30 \times 10^{-6}\ \text{s}$$

Laser crystal	Nd doped (atm%)	σ ($\times 10^{-19}$ cm^2)	α (cm^{-1})	τ μs	l_α (mm)	P_{th} (mw)	η_s (%)
$Nd:YVO_4$ (a-cut)	1.1 2.0	25	31.2 72.4	90 50	0.32 0.14	78	48.6
$Nd:YVO_4$ (c-cut)	1.1	7	9.2	90		231	45.5
Nd:YAG	0.85	6	7.1	230	1.41	115	38.6

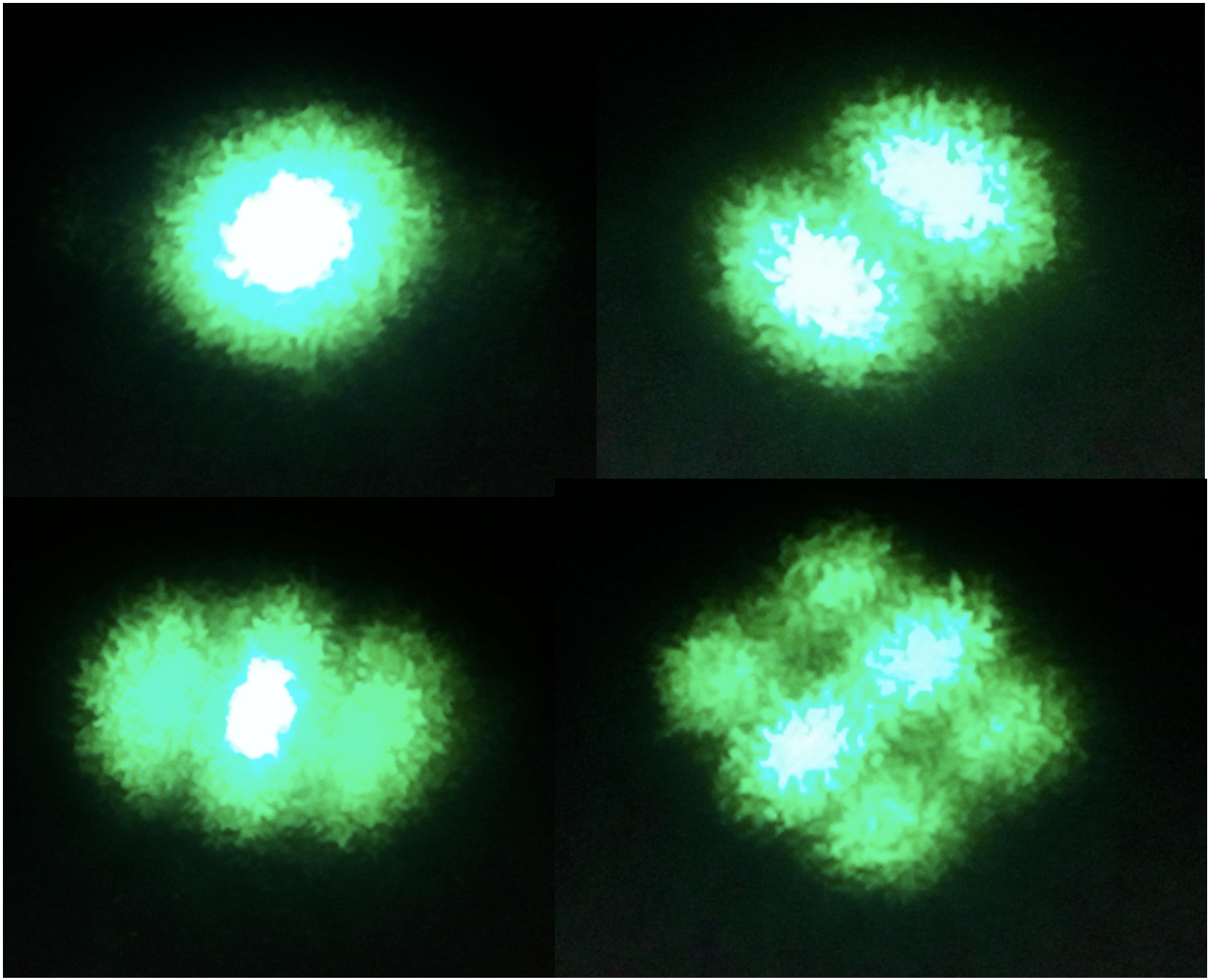
$Nd:YVO_4$

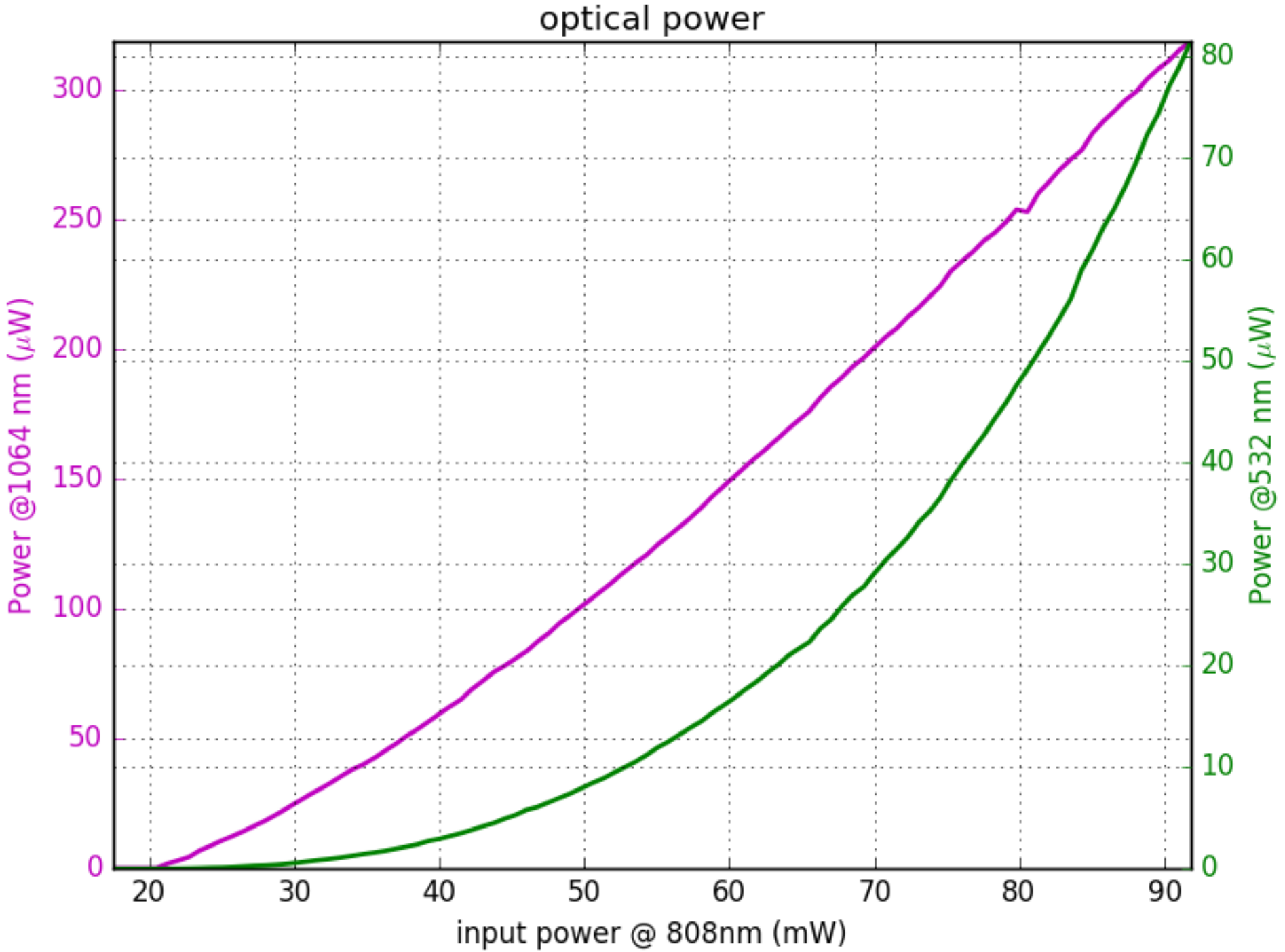

E parallel C
E perp C
808,9 nm
Absorption Coefficient (cm -1)
25
20
15
10
5
0
770
790
810
830
850
870
890
Wavelength (nm)

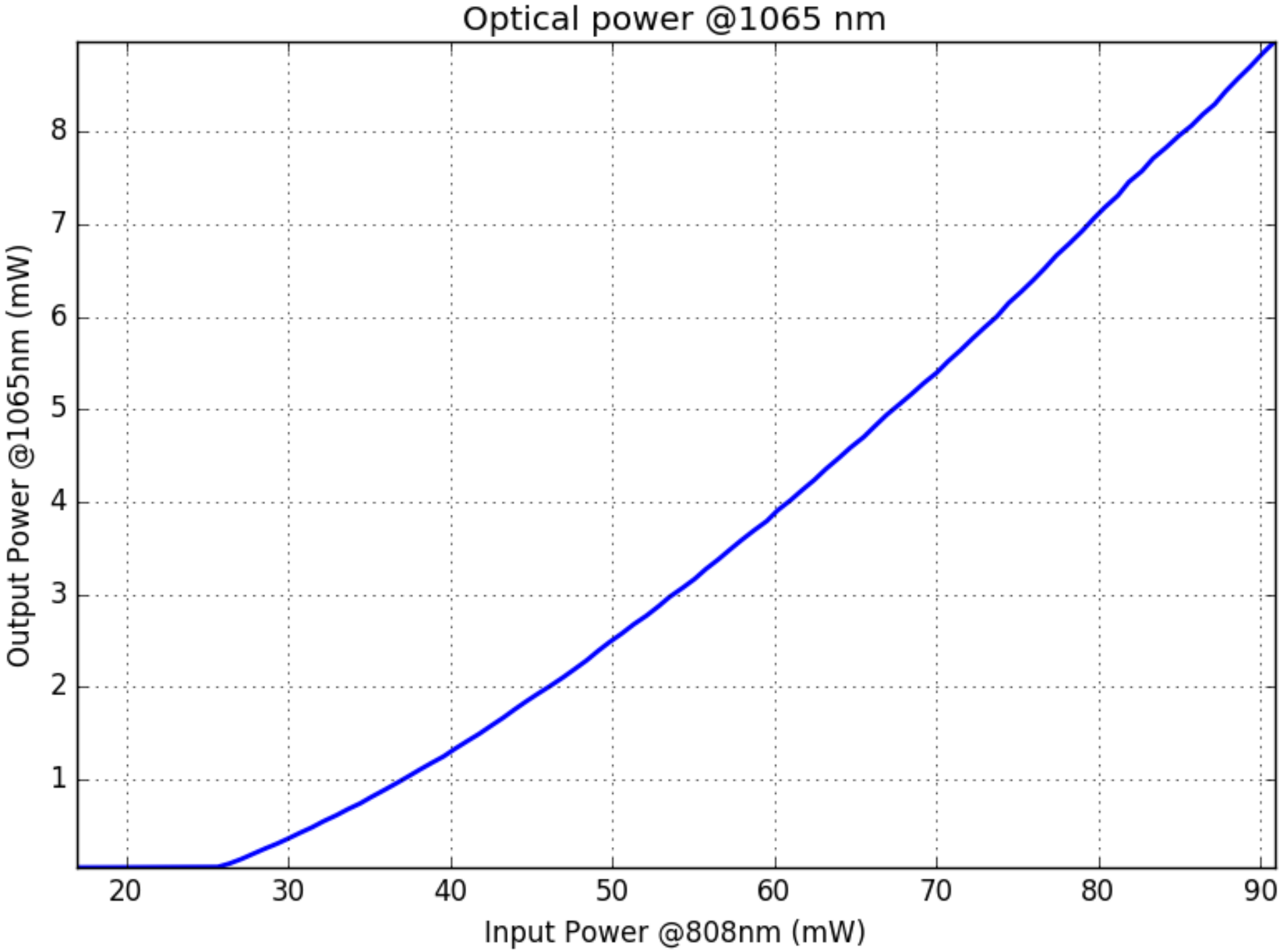
Nd:YVO4

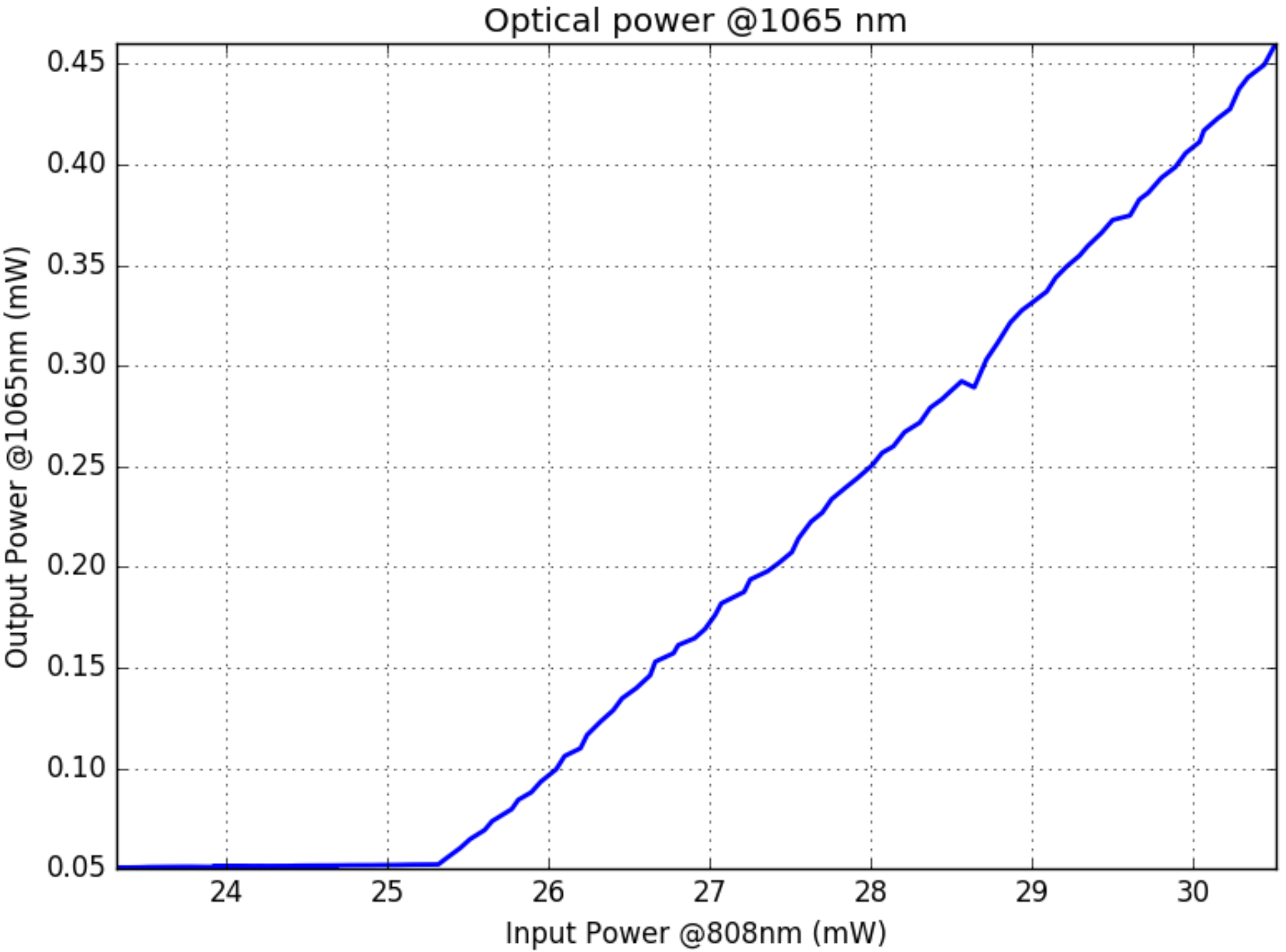

Nd:YVO4
4F9/2 +2H9/2
4F3/2
808 nm
1064 nm
4I15/2
4I13/2
4I11/2
4I9/2
Pumping wavelength
Emission wavelength

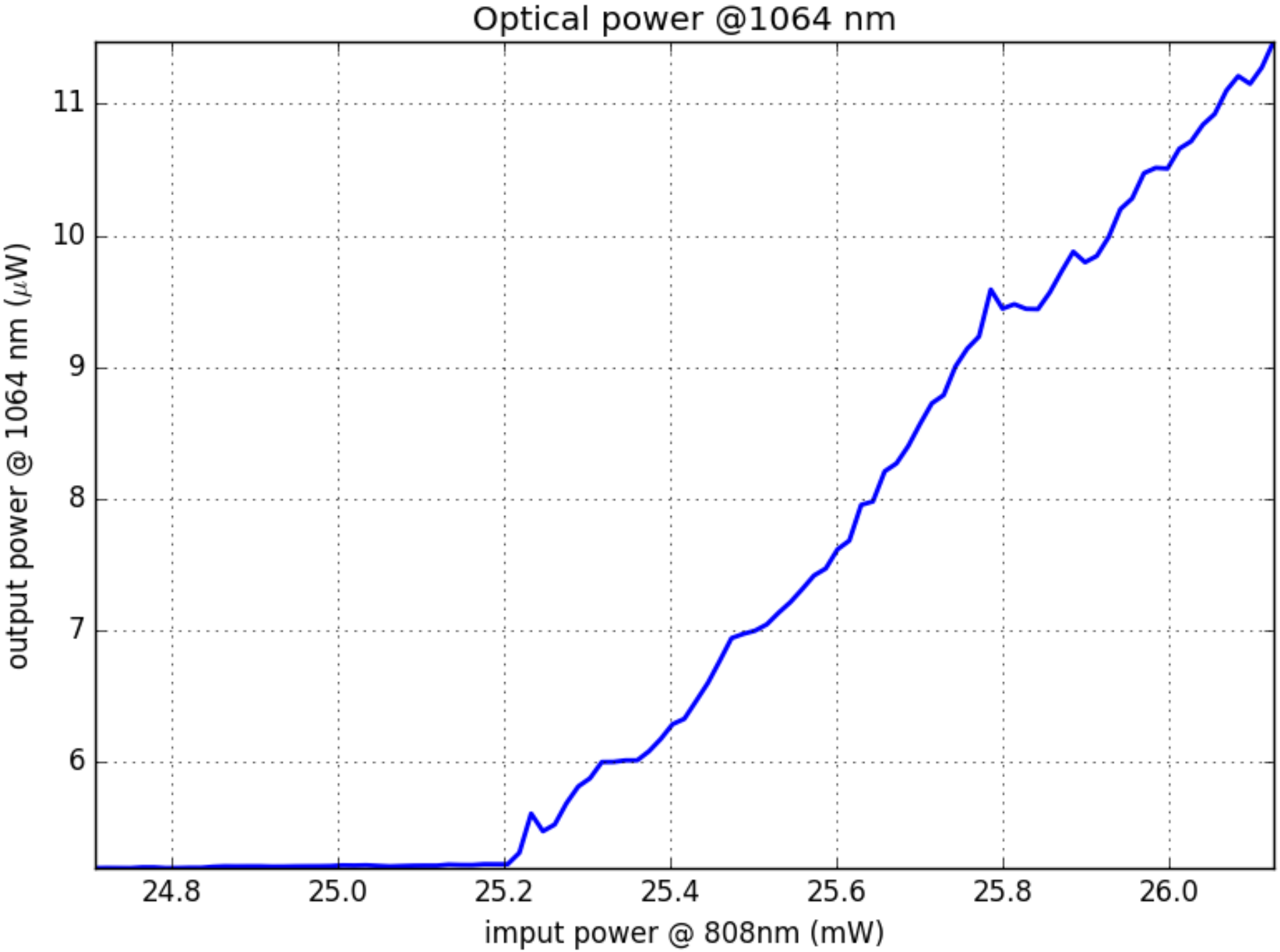
Free-space Modes

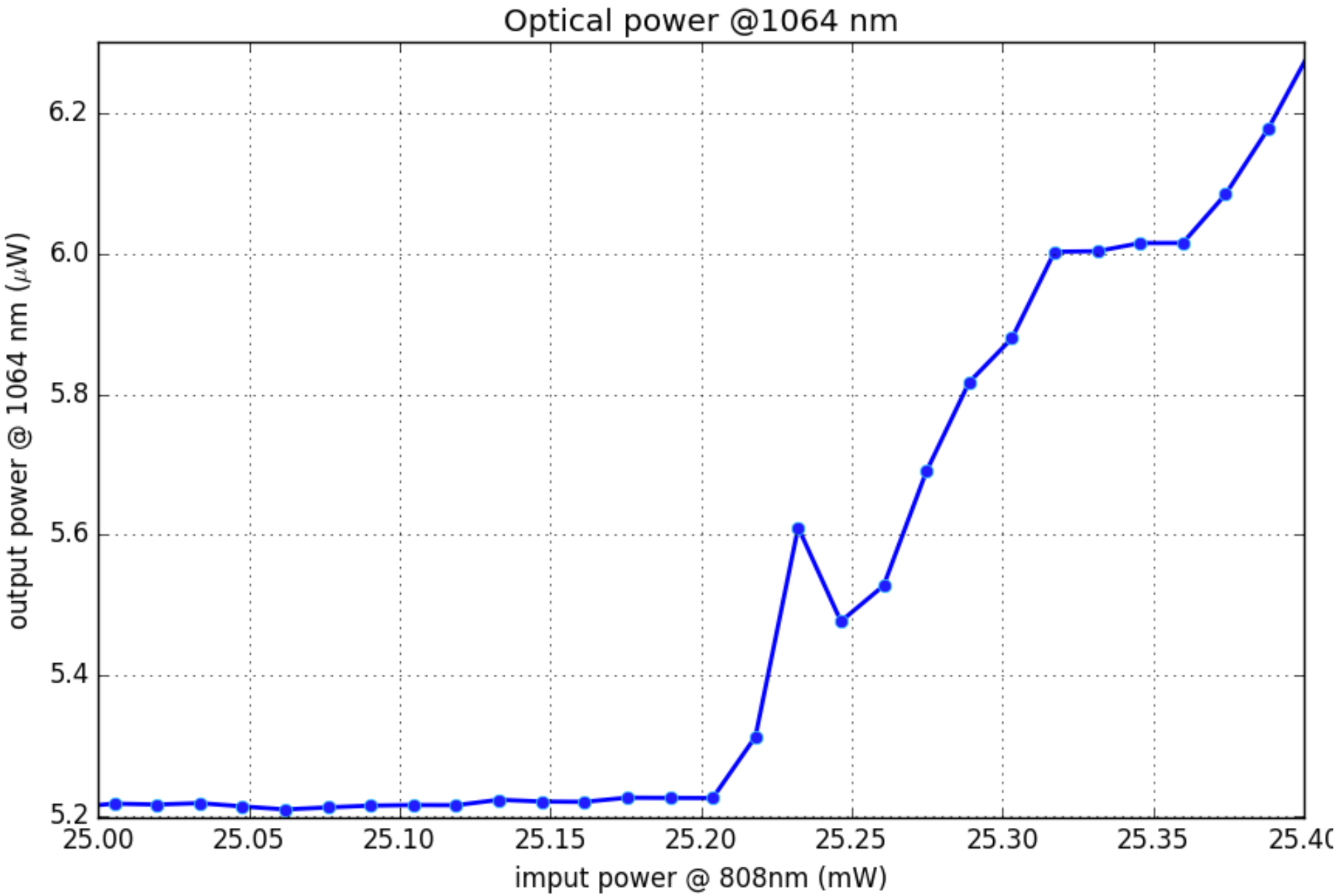


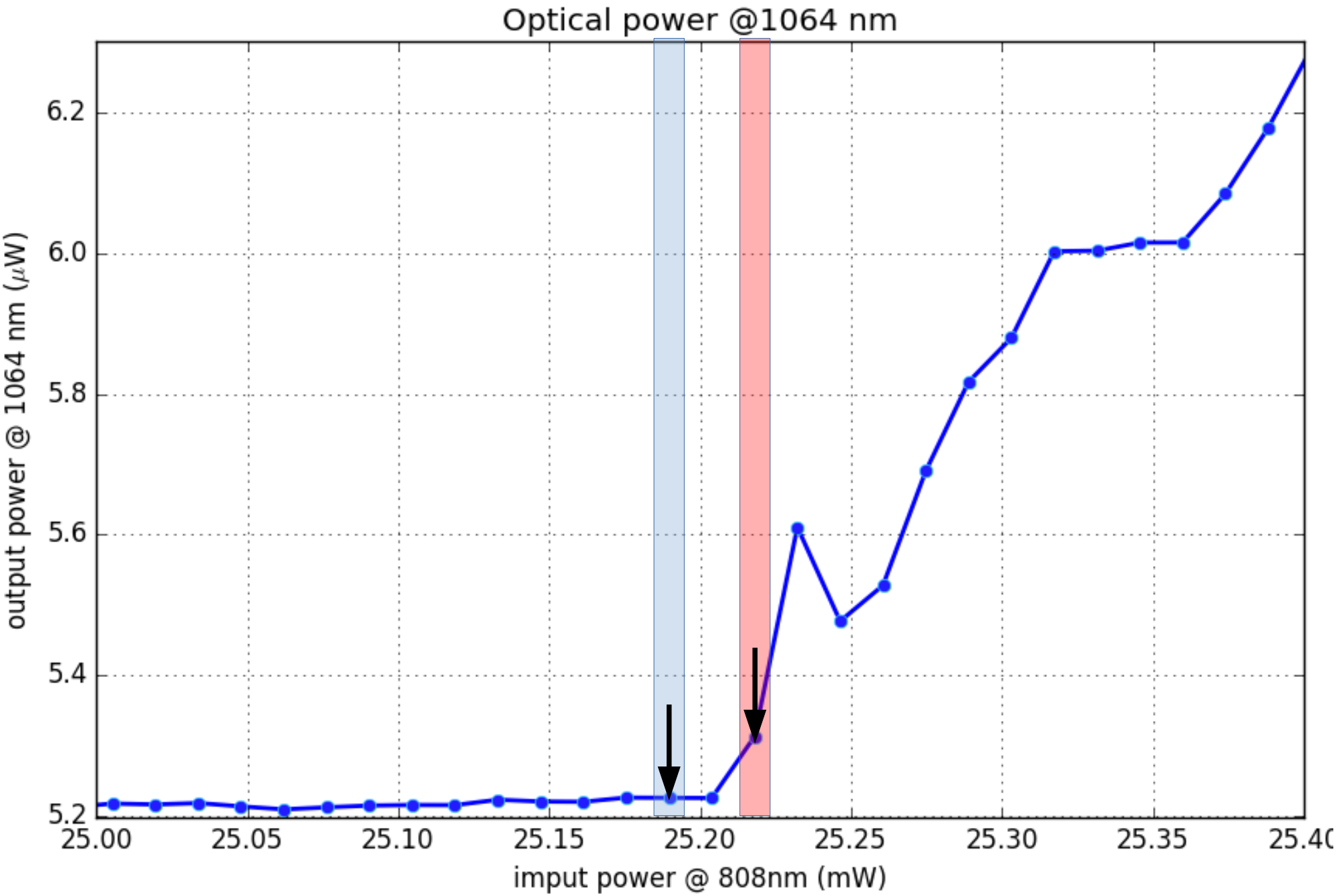

optical power
Power @1064 nm (μW)
Power @532 nm (μW)
input power @ 808nm (mW)
0
50
100
150
200
250
300
0
10
20
30
40
50
60
70
80
20
30
40
50
60
70
80
90

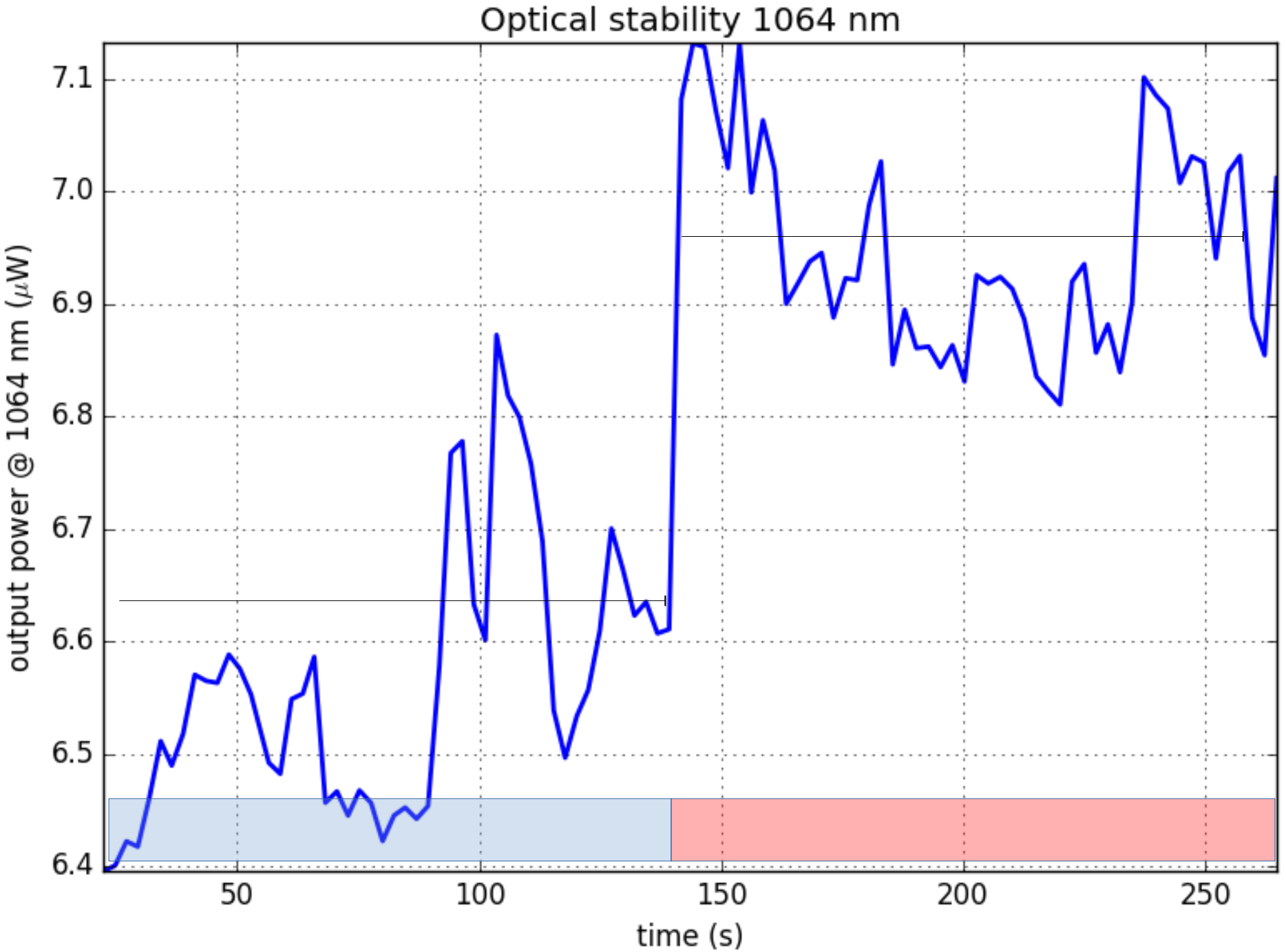

Optical power @1065 nm
Output Power @1065nm (mW)
Input Power @808nm (mW)
1
2
3
4
5
6
7
8
20
30
40
50
60
70
80
90

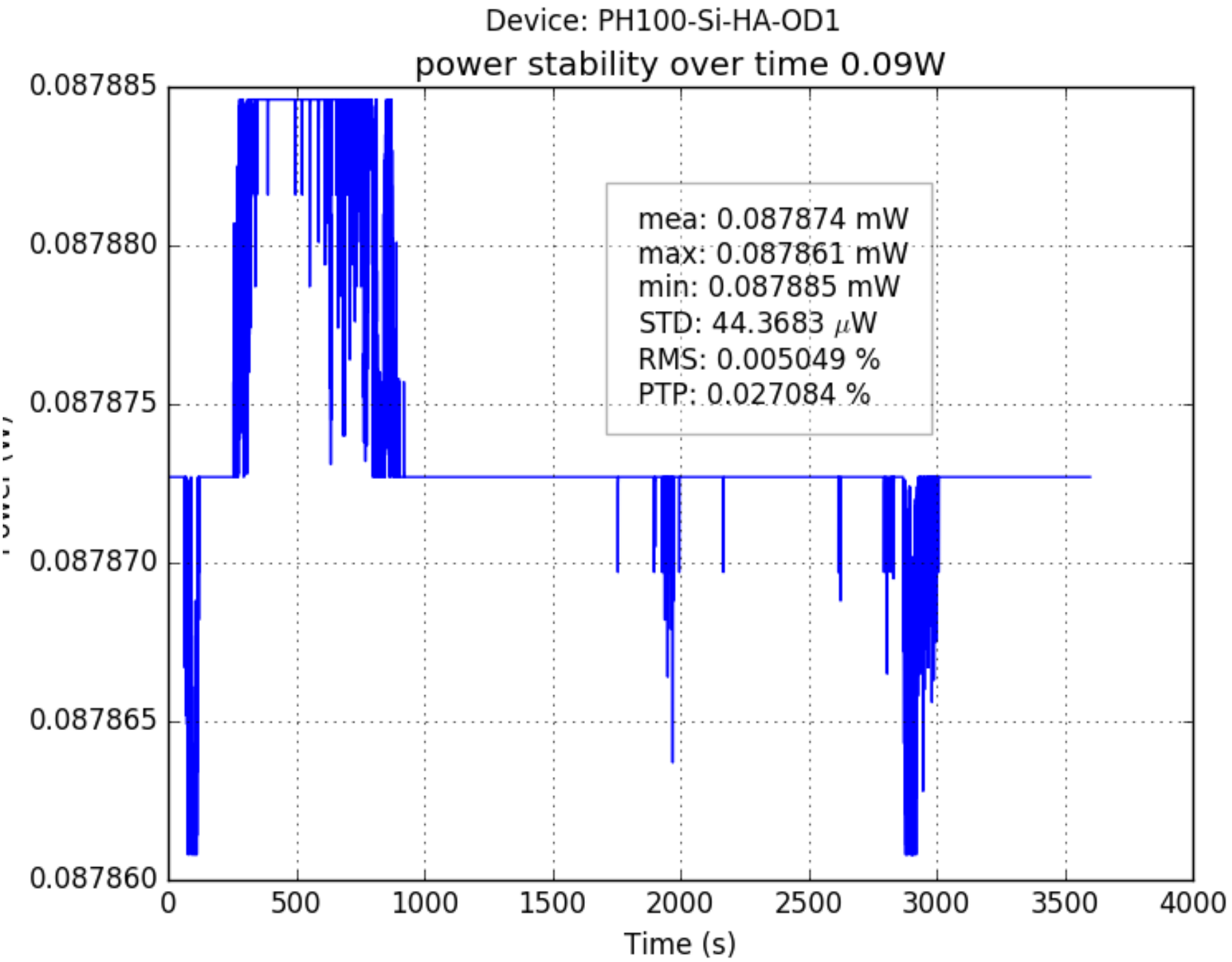

Optical power @1065 nm
Output Power @1065nm (mW)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
24
25
26
27
28
29
30
Input Power @808nm (mW)

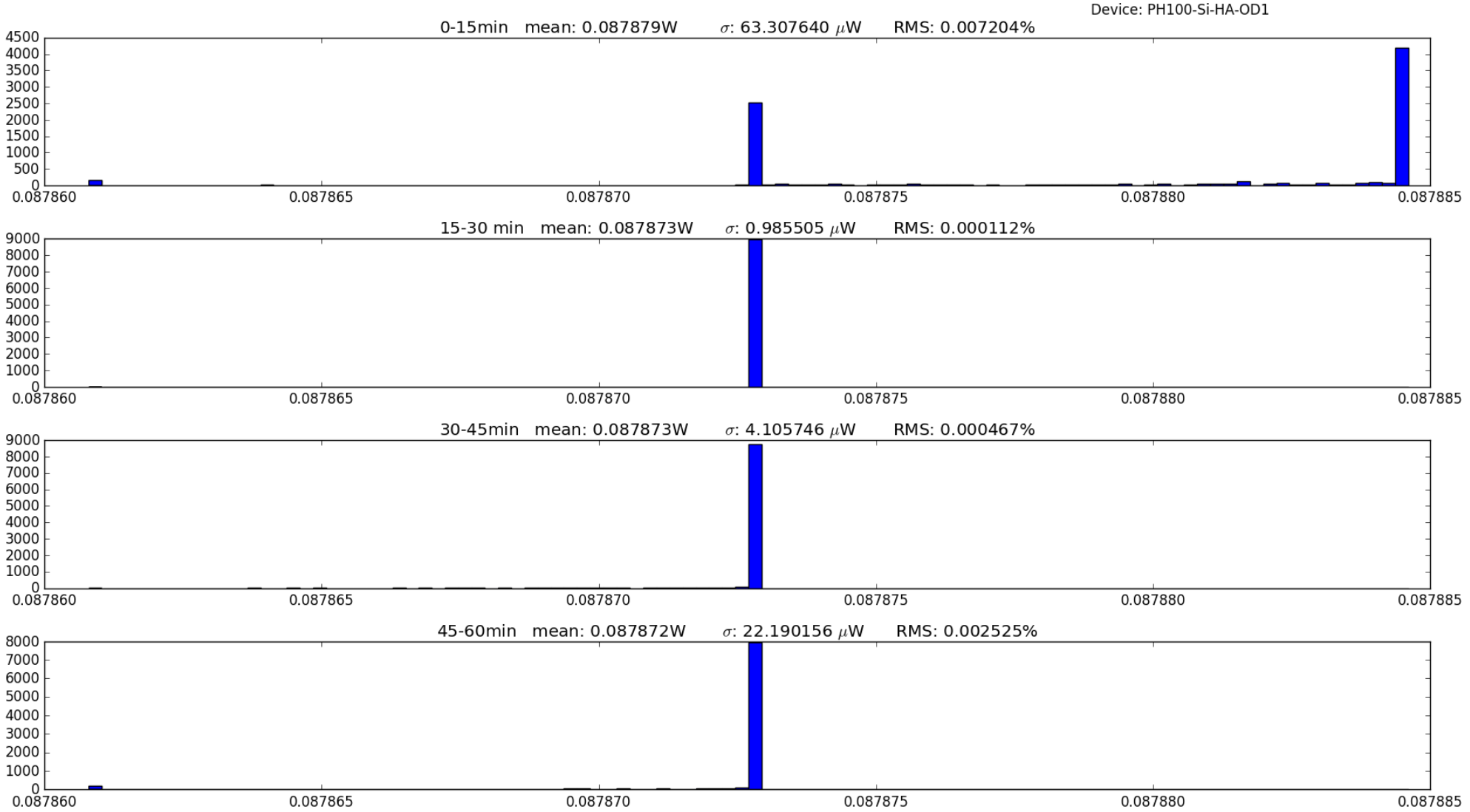

Optical power @1064 nm
output power @ 1064 nm (μW)
imput power @ 808nm (mW)
11
10
9
8
7
6
24.8
25.0
25.2
25.4
25.6
25.8
26.0


Optical power @1064 nm
output power @ 1064 nm (μW)
imput power @ 808nm (mW)
6.2
6.0
5.8
5.6
5.4
5.2
25.00
25.05
25.10
25.15
25.20
25.25
25.30
25.35
25.40

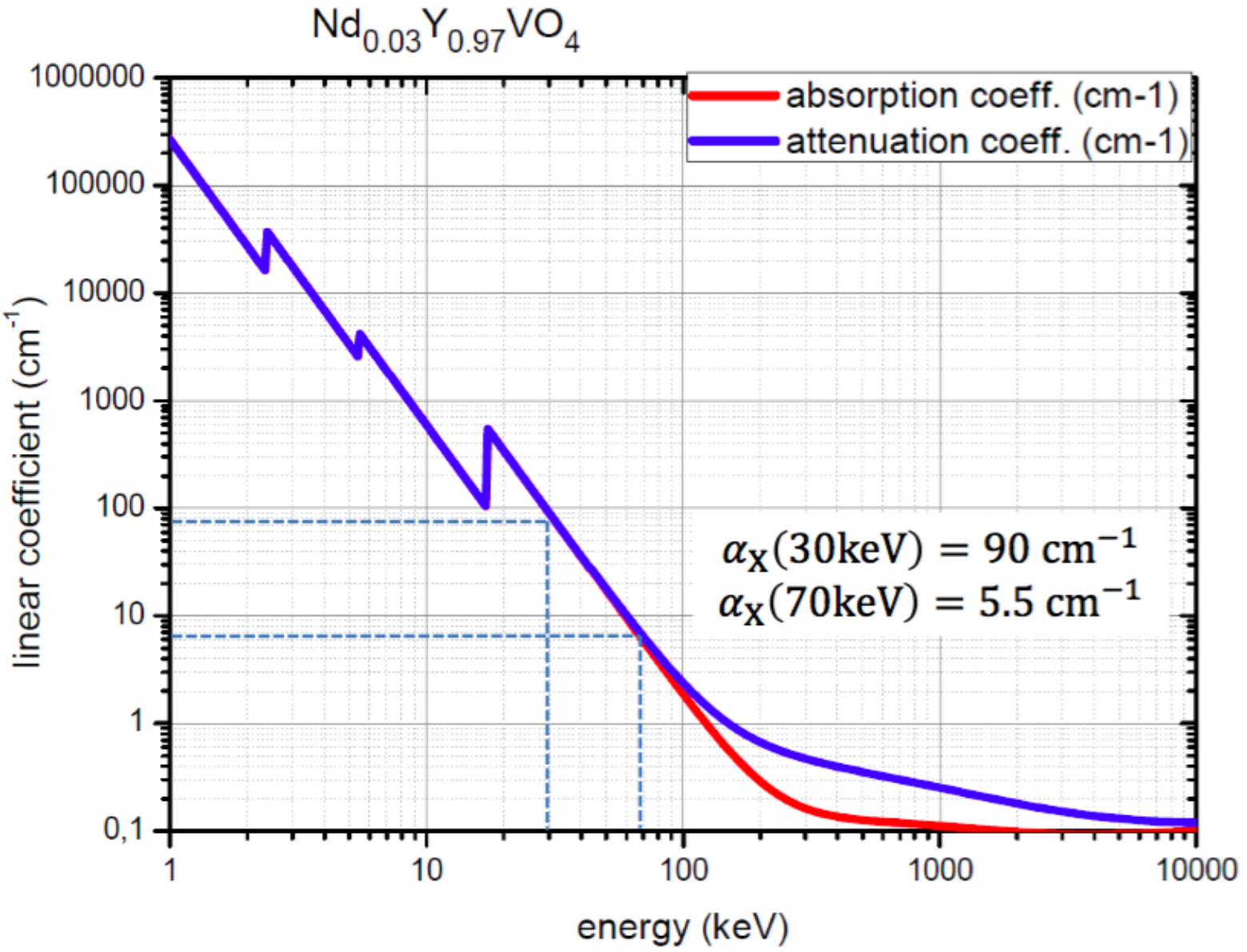

Optical power @1064 nm
output power @ 1064 nm (μW)
imput power @ 808nm (mW)
6.2
6.0
5.8
5.6
5.4
5.2
25.00
25.05
25.10
25.15
25.20
25.25
25.30
25.35
25.40


Optical stability 1064 nm
output power @ 1064 nm (μW)
7.1
7.0
6.9
6.8
6.7
6.6
6.5
6.4
50
100
150
200
250
time (s)


Device: PH100-Si-HA-OD1
power stability over time 0.09W
mea: 0.087874 mW
max: 0.087861 mW
min: 0.087885 mW
STD: 44.3683 μW
RMS: 0.005049 %
PTP: 0.027084 %
0.087885
0.087880
0.087875
0.087870
0.087865
0.087860
0
500
1000
1500
2000
2500
3000
3500
4000
Time (s)


Device: PH100-Si-HA-OD1
0-15min mean: 0.087879W σ: 63.307640 μW RMS: 0.007204%
15-30 min mean: 0.087873W σ: 0.985505 μW RMS: 0.000112%
30-45min mean: 0.087873W σ: 4.105746 μW RMS: 0.000467%
45-60min mean: 0.087872W σ: 22.190156 μW RMS: 0.002525%
0.087860
0.087865
0.087870
0.087875
0.087880
0.087885

X-ray absorption in Nd:YVO_4 laser medium



X-Ray detection limits

Pump/laser beam parameters: $w_0\,(808\ \mathrm{nm}) = w_0\,(1064\ \mathrm{nm}) = 100\ \mu\mathrm{m}$

$M^2(808\ \mathrm{nm}) = 20 \quad M^2(1064\ \mathrm{nm}) = 1.5$

Cavity parameters: $L = 0.5\ \mathrm{mm}, L_c = 2.5\ \mathrm{mm}\ (+5\ \mathrm{mm} + \cdots), \mathrm{Loss} = 3\%$

Nd sensitization efficiency: $\eta_{\mathrm{X-Nd}}(30\ \mathrm{keV}, 3\%\ \mathrm{at.}) \approx 4500$

Pump noise: $\sigma_{\mathrm{noise}}(808\ \mathrm{nm}) = 0.5\%\ \mathrm{rms}$

$P_{\mathrm{th}} = 32\ \mathrm{mW}$

$\phi_{\mathrm{X,min}} = 2.7 \times 10^{13}\ \mathrm{ph\ s^{-1}cm^{-2}}\ (0.13\ \mathrm{W\ cm^{-2}})$ cw

$F_{\mathrm{X,min}} = 8.2 \times 10^{8}\ \mathrm{ph\ cm^{-2}}\ (3.9\ \mu\mathrm{J\ cm^{-2}})$ short pulse

Axioma Project

Laser-based coherent scintillator