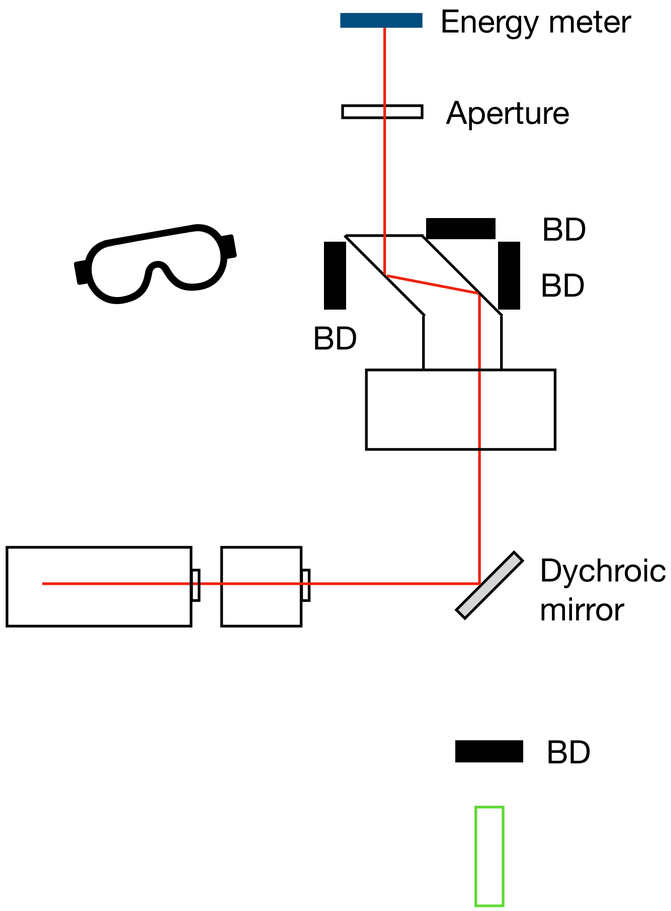
ioLaser Update

LANL temporary laser lab

Mattia - Mar 24, 2021

Overview

Recap on the lab activity on the last two weeks



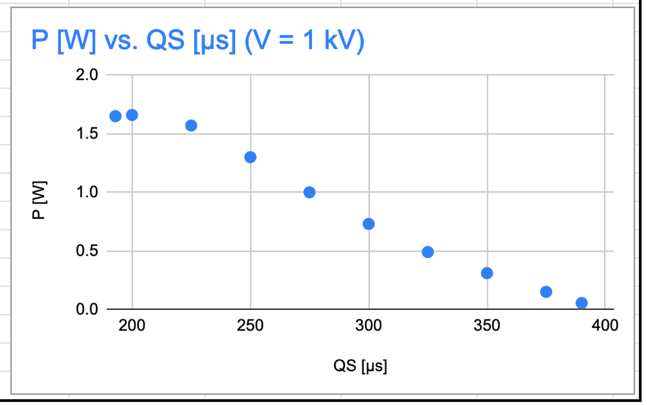
1. Setup of an installation for component tests
2. Output energy scan with a new (borrowed) energy meter
3. Mirror test, attenuator test, visible light test
    - M1 - Thorlabs harmonic separator mirror (2x)
    - M2 - Thorlabs 266 nm only mirror
4. Attenuator calibration

Power scans

Initial scans (for comparison)

10 Hz
at laser exit

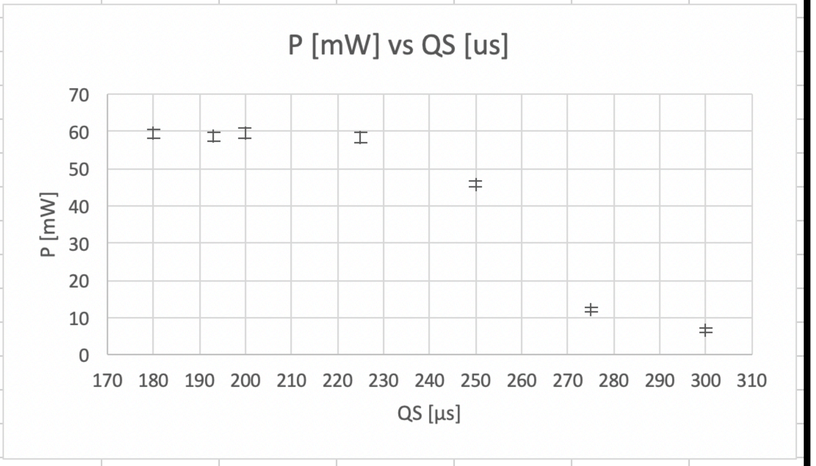
V [kV]	QS [µs]	P [W]
1	193	1.65
1	200	1.66
1	225	1.57
1	250	1.3
1	275	1
1	300	0.73
1	325	0.49
1	350	0.31
1	375	0.15
1	400	
1	390	0.055



Measurement with new power meter

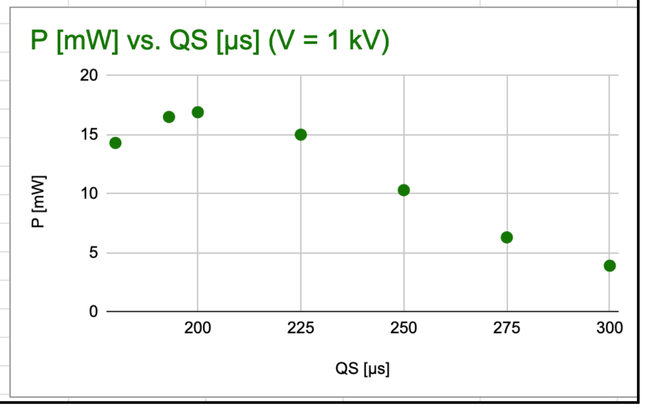
10 Hz, after SSP

V [kV]	QS [µs]	P [mW]	error [mW]
1.26	300	6.6	0.42
1.26	275	12.2	0.57
1.26	250	45.9	0.9
1.26	225	58.4	1.24
1.26	200	59.4	1.36
1.26	193	58.6	1.23
1.26	180	59.5	1.15



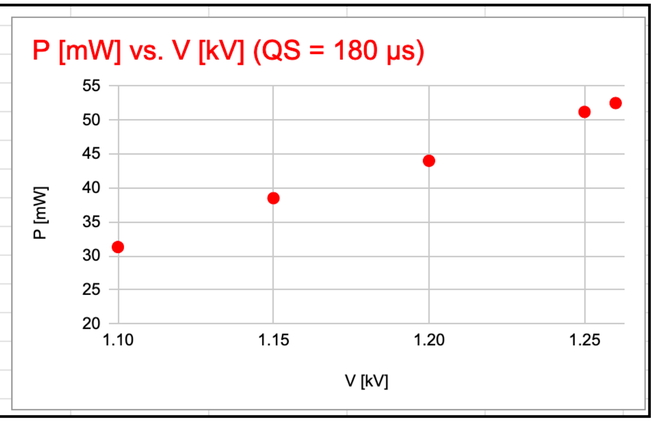
after SSP

V [kV]	QS [µs]	P [mW]
1	300	3.9
1	275	6.3
1	250	10.3
1	225	15
1	200	16.9
1	193	16.5
1	180	14.3



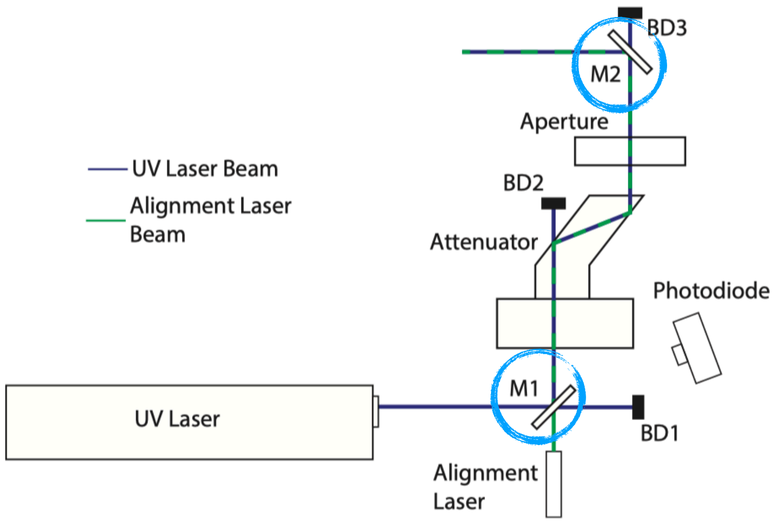
after SSP

V [kV]	QS [µs]	P [mW]
1.05	180	23
1.1	180	31.3
1.15	180	38.5
1.2	180	44
1.25	180	51.2
1.26	180	52.5



Thorlabs mirror tests

M1, M2



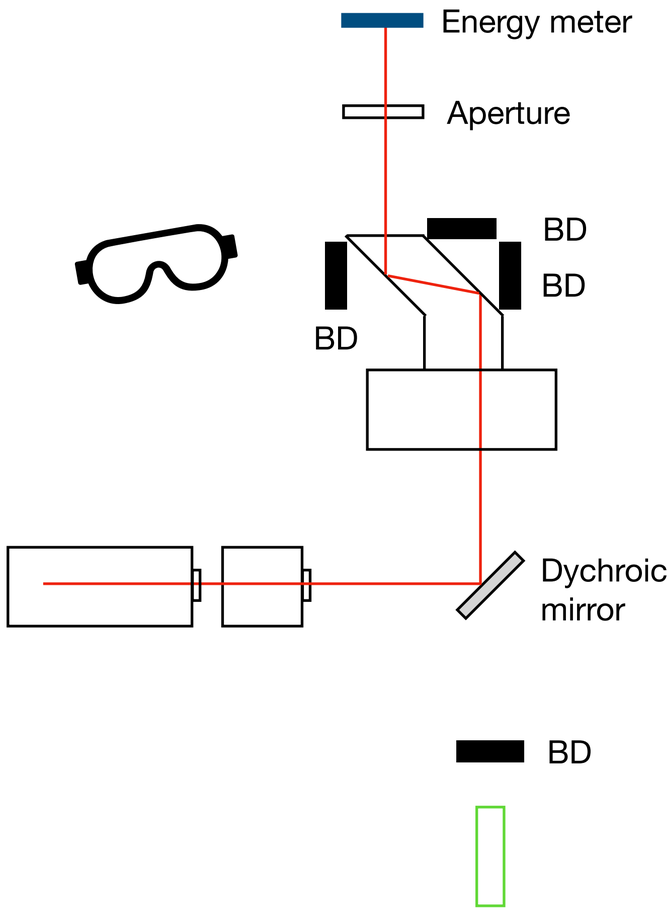
Incident (1) [mJ]	Reflected (2) [mJ]	Transmitted (3) [mJ]
53.1 +/- 1.07	51.2 +/- 1.05	covered by support
58.1 +/- 1.13	54.5 +/- 1.07	1.12 +/- 0.0293
56.3 +/- 1.23	53.1 +/- 1.12	1.11 +/- 0.0204
56.8 +/- 1.32		

Each point is obtained as the average of 30 seconds, 10 Hz, data acquisition with the power meter

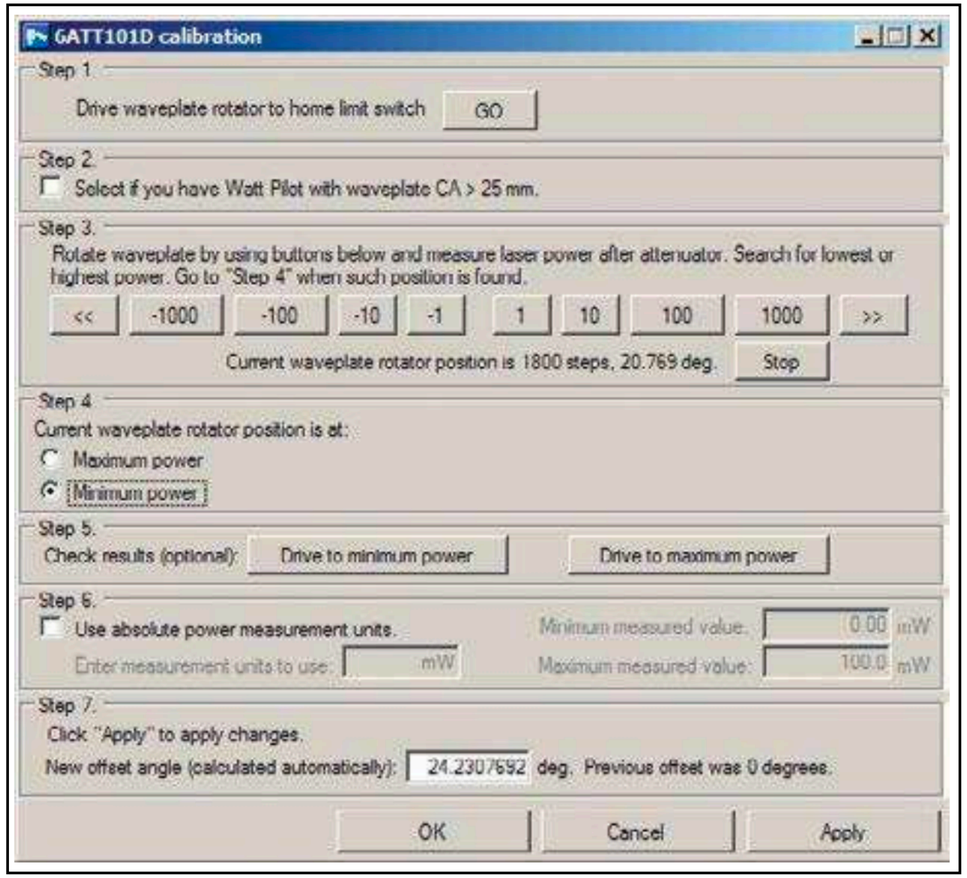
- We used both visible light for alignment and Surelite laser setup with the settings indicated (and measured over previous days) for maximum power
- Three measurement positions:
  1) exit of the SSP (incident light)
  2) front of the mirror (reflected component)
  3) back of the mirror (transmitted component)
- M1 - Thorlabs harmonic separator mirror
  - We saw several reflections coming from the mirror, using visible light. More than 5 reflected spots at 30 degrees. 3 reflected spots at 45 degrees.
  - Later, we found that the mirror was flipped: Thorlabs marks the coated surface in the direction of the passing light, opposite than Altechna does.
  - Correct tests, with mirror flipped on the support and using Surelite 266 nm light, showed some loss of power in the reflected light. However, we didn't see multiple reflections
- M2 - Thorlabs 266 nm only mirror
  - We only saw one reflected spot at 45°
  - ~ 98% reflection efficiency, in agreement with the value declared by the manufacturer (99%)

Attenuator tests

Road to calibration

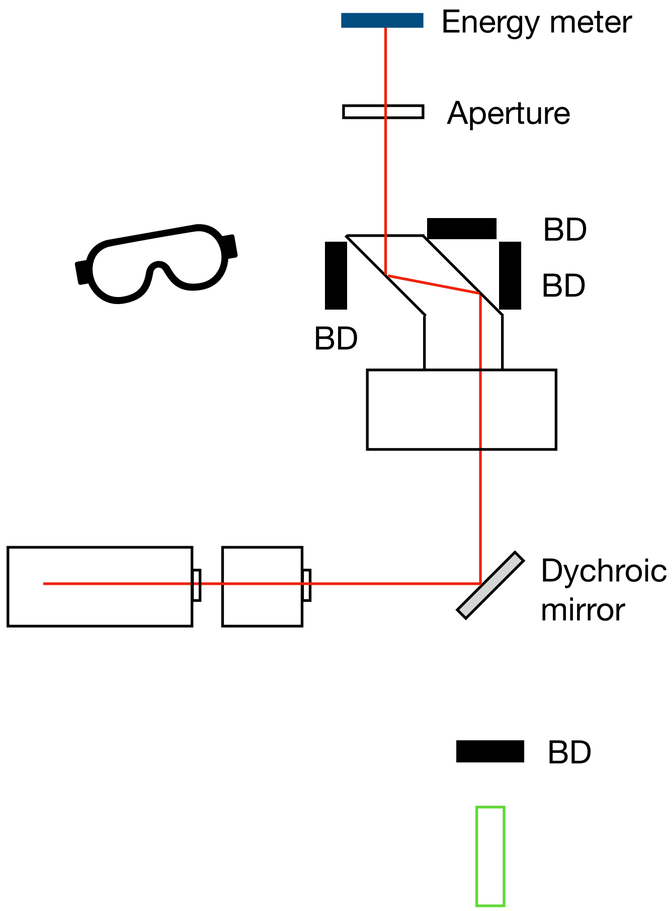


1. Find the half-waveplate position corresponding to the minimum recorded intensity
2. Set the calibration interface for the minimum at such position
3. Check the corresponding maximum
4. Get the highest value for the maximum by tuning the polarisers
5. Check the offset angle and apply changes



Attenuator tests

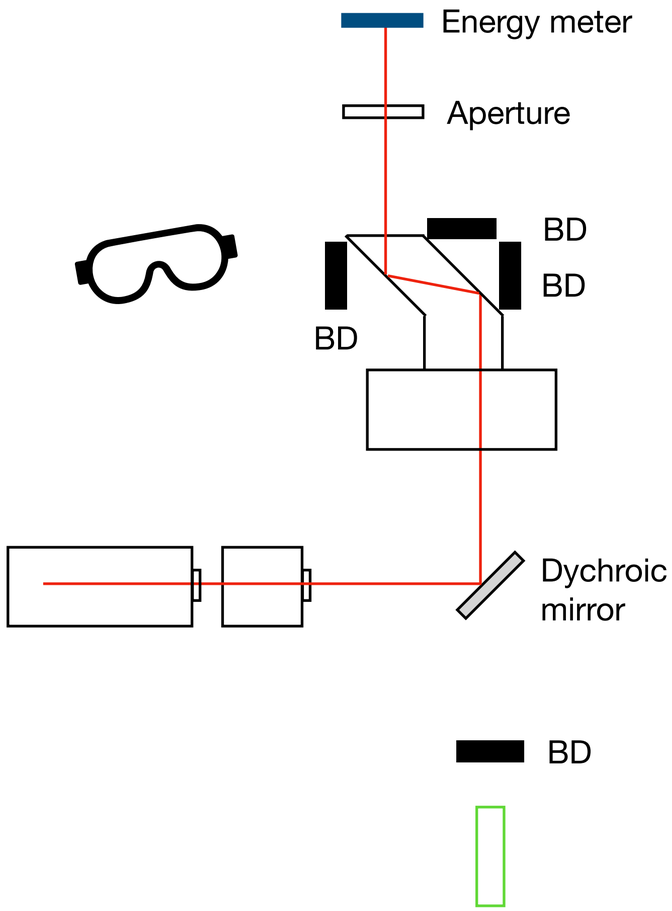
Test with class-2 visible light (safer than Surelite)



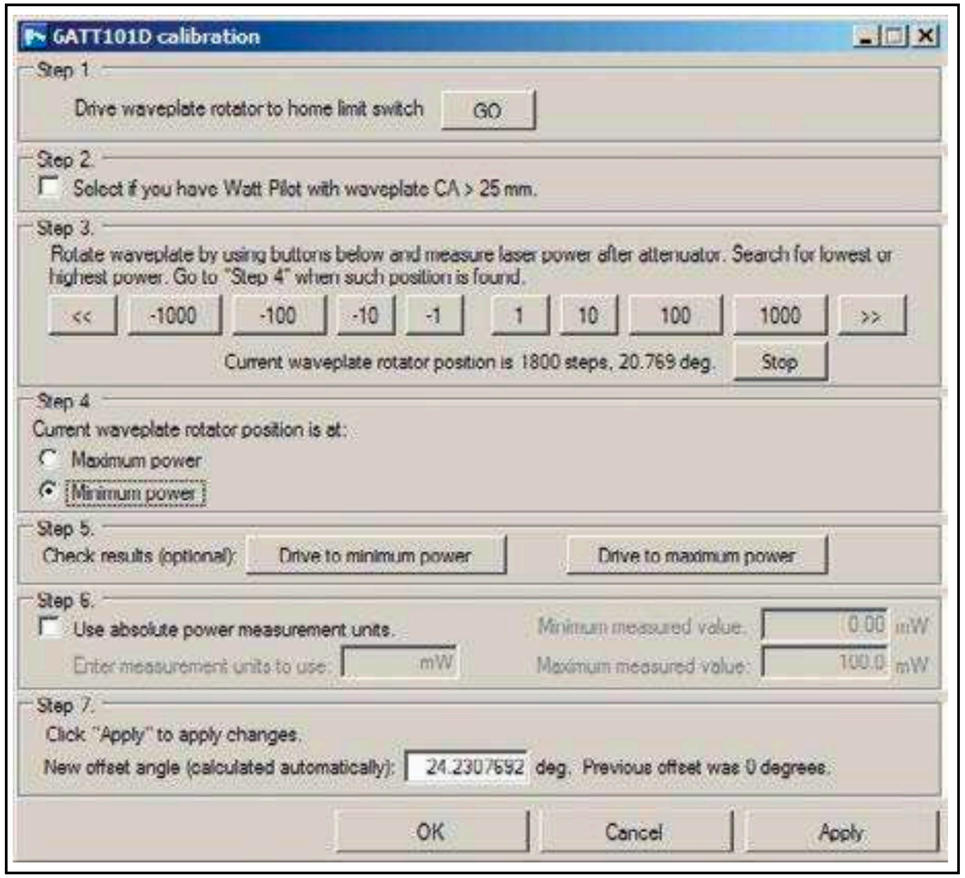
- Not successful: it wasn’t possible possible to determine the minimum/maximum position
  - Best guess: the attenuator only works with linearly polarised light and our visible light isn’t
- We found one of the polariser plates flipped. Fixed.
- We couldn't make a clear selection on rotation angles. Reflected spot(s), s-pol, never got clearly brighter or darker.

Attenuator tests

Test with (low power) Surelite laser



- We were able to complete the calibration procedure
- However, After applying the refinement, minimum got lost. Not sure what happened. Then, a quick scan gave the minimum at ~1250 steps.
- We repeat quickly at this setting. Now the result is correct.
- We will retry next time



Attenuator tests

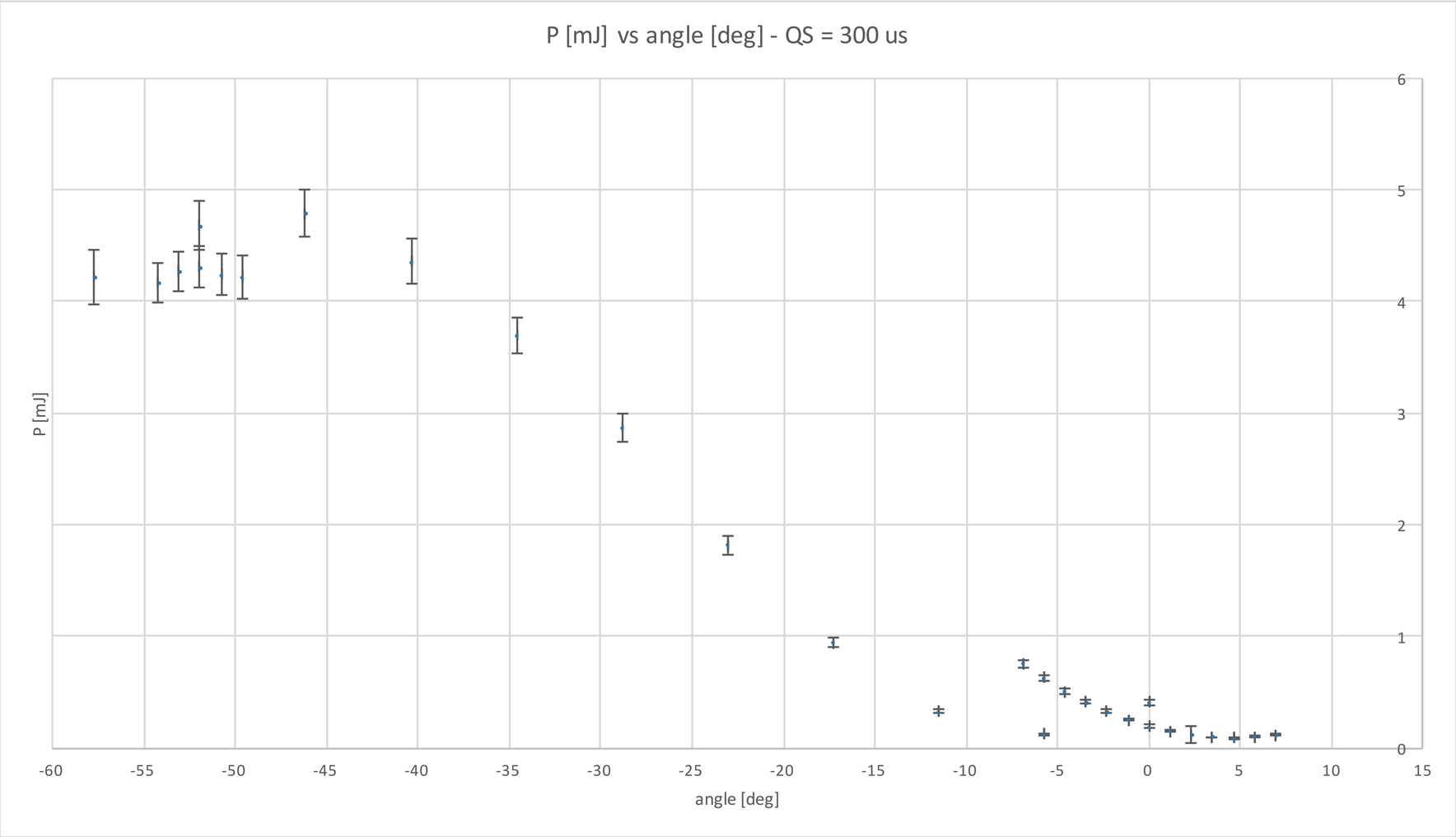
Test with (low power) Surelite laser

QS [us]	V [kV]	waveplate position [steps]	waveplate position [deg]	steps to angle conversion	Measured energy (s-pol) [mJ]	error [mJ]
300	1.26	0	0	0	0.409	0.022
		-500	-5.769	0.011538	0.126	0.0078
		-1000	-11.538	0.011538	0.326	0.0162
		-1500	-17.308	0.011538667	0.945	0.0424
		-2000	-23.077	0.0115385	1.82	0.082
		-2500	-28.846	0.0115384	2.87	0.134
		-3000	-34.615	0.011538333	3.7	0.157
		-3500	-40.385	0.011538571	4.36	0.199
		-4000	-46.154	0.0115385	4.79	0.206
		-4500	-51.923	0.011538444	4.68	0.218
		-5000	-57.692	0.0115384	4.22	0.249
		-4500	-51.923	0.011538444	4.31	0.193
		-4400	-50.769	0.011538409	4.24	0.187
		-4600	-53.077	0.011538478	4.27	0.183
		-4700	-54.231	0.011538511	4.17	0.182
		-4300	-49.615	0.011538372	4.22	0.189
		-500	-5.769	0.011538	0.629	0.0296
		-600	-6.923	0.011538333	0.756	0.0338
		-400	-4.615	0.0115375	0.506	0.0221
		-300	-3.462	0.01154	0.412	0.0175
		-200	-2.308	0.01154	0.327	0.0162
		-100	-1.154	0.01154	0.254	0.0131
		0	0		0.196	0.0108
		100	1.154	0.01154	0.151	0.0083
		200	2.308	0.01154	0.118	0.078
		300	3.462	0.01154	0.097	0.007
		400	4.615	0.0115375	0.09	0.0064
		500	5.769	0.011538	0.098	0.0079
		600	6.923	0.011538333	0.119	0.0123
			average	0.011538565		
			std	6.53883E-07		

Vs nominal: 1 step = 0.01154° (manufacturer)

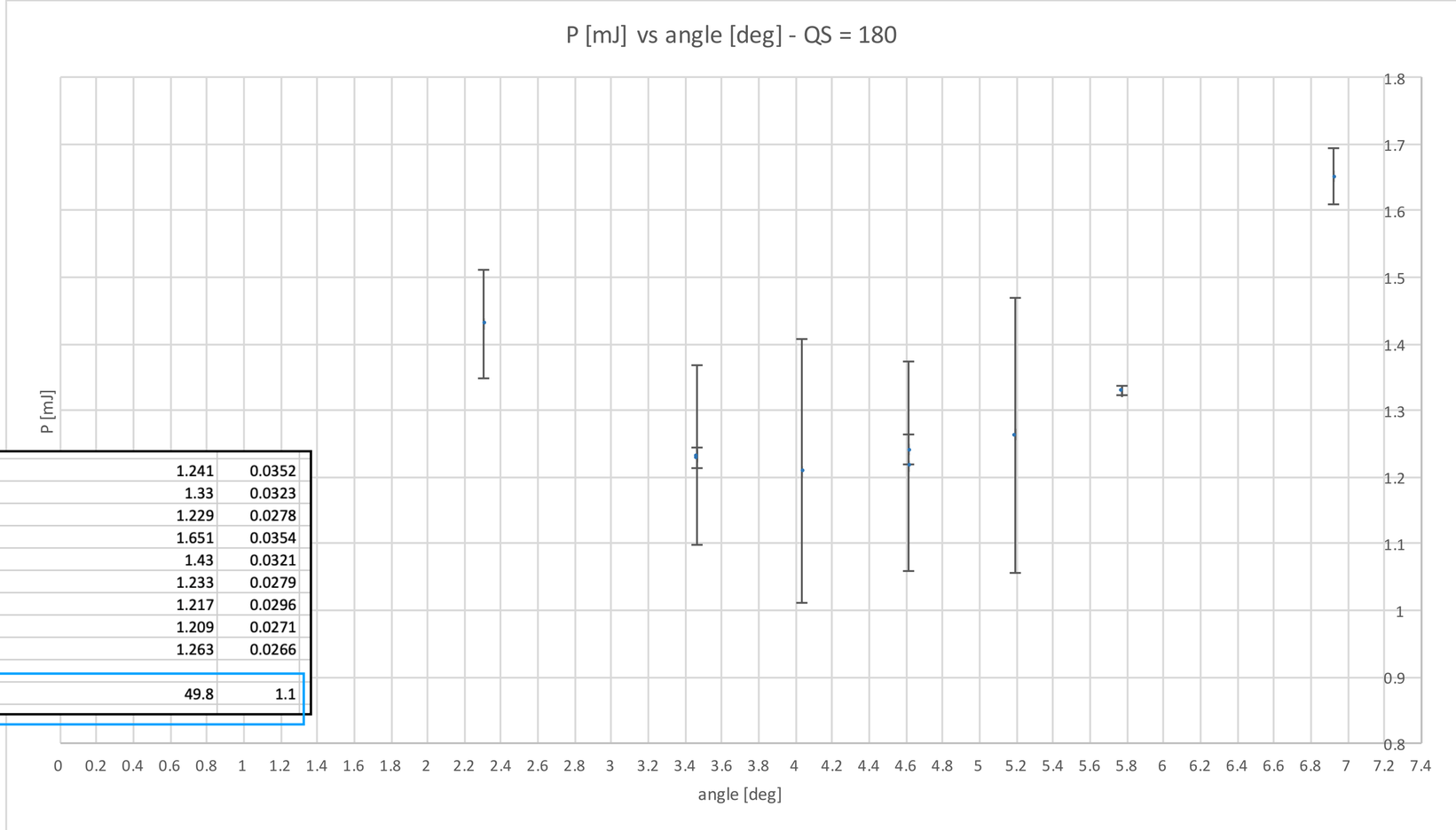
Attenuator tests

Test with (low power) Surelite laser



Attenuator tests

High power test with Surelite laser, for refinement

180	1.26	400	4.615	0.0115375	1.241	0.0352
		500	5.769	0.011538	1.33	0.0323
		300	3.461569482	0.011538565	1.229	0.0278
		600	6.923138964	0.011538565	1.651	0.0354
		200	2.307712988	0.011538565	1.43	0.0321
		300	3.461569482	0.011538565	1.233	0.0279
		400	4.615425976	0.011538565	1.217	0.0296
		350	4.038	0.011537143	1.209	0.0271
		450	5.192	0.011537778	1.263	0.0266
		-3550	-40.962	0.011538592	49.8	1.1

Th. corresponding maximum value