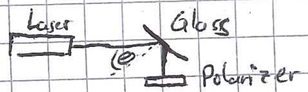
10.12.18 E 85/86/87 Grundpraktikum Optik

1) We turn on the Laser and ~~place glass~~ point it at the glass with a randomly chosen angle. We place a Polarizer in its path and first deduce ~~rogh~~ roughly the calibration by minimizing the intensity ~~that goes~~. (Around Brewester ~~angle~~ angle the polarisations is mainly S-Pol. → Minimum corresponds to P-Pol)

$P_1 \sim 94^\circ$

$P_2 \sim 120^\circ$

pic 1: finding brewster



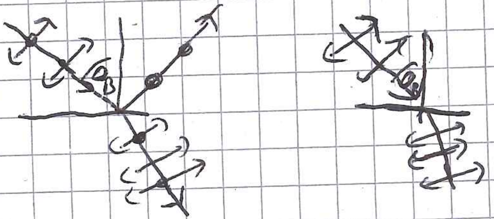
Use these settings to find brewster angle by minimizing intensity by changing the angle of incident of the glass.

We find it around $54^\circ \approx \Theta_{Brewster}$

The Polarizer just lets light wave with ~~the~~ a certain linear polarization through, meaning ~~splitting the~~ the intensity will be reduced according to the amount of polarization. Beamsplitter can split the beam by just ~~as well as act like~~ halfing the Intensity or splitting it acording to Intensity

2) If the second glass plate is installed with the x,y components of it's normal being the same as the direction of incidents and the angle between these is $\Theta_{Brewster}$, the reflection disappears

pic 2: Brewster angel



no reflection cause the S-Polar of the first plate is P-Polar for the second → Transmitted without reflection

3) To find the calibration we use same methode as 1 just without changing Glass plate angle, but instead polarization

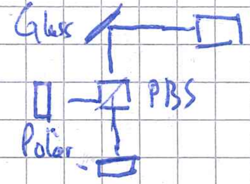
P1 ~~100,5~~ 101° for ⟷ and 281° (⟷)(P-Polari)

P2 120° for ⟷ and 300° (⟷)(P-Polari)

For the PBS you can compare it's effect for P S-Poralized Laser and the "raw" Laser to figure out which one does what

→ ~~one~~ one is 50/50 split
one is S/P-Poli split

The PBS doesn't change the Polarization.

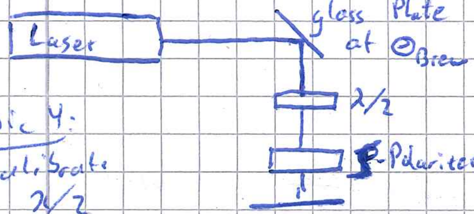


pic 3: PBS-Test for Poli

11.12.18

4) Check 3)

5)



pic 4: calibrate $\lambda/2$

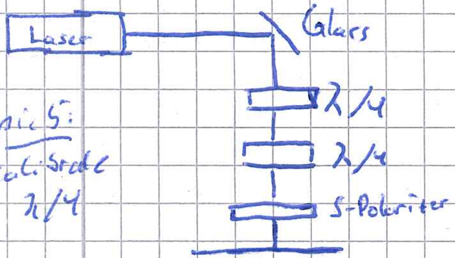
Use this setup to calibrate $\lambda/2$ by minimizing Laser after S-Polarizer

$90°, 180°, 270°, 360°$ (a)

$104°, 194°, 284°, 14°$ (b)

→ If you keep rotating the $\lambda/2$ in the same direction (360°+) you move the calibration around 2-3°

6)



pic 5: calibrate $\lambda/4$

Use this Set-up to calibrate both $\lambda/4$ by minimizing Laser

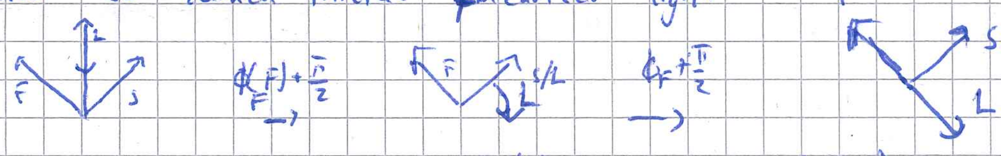
S-Polar $\xrightarrow{(\lambda/4)_1}$ Circular $\xrightarrow{(\lambda/4)_2}$ P-Polarize $\xrightarrow{(S\text{-Pol})}$ 0

20°	200°	(b)
140°	320°	(a)

→ only 180° "repeatable" cause $\lambda/4$-plate is "sensitive" to direction of circular polarized light

~~8~~7) fig 3 ~~...~~ is same as pic 5

When u ~~turn~~ rotate $\lambda/4$ ~~...~~ 90° you reverse the direction of circ polarized light and the second $\lambda/4$ will turn it into ~~90° turned~~ initial ~~l~~ linearized light



$L: \begin{pmatrix} F \\ S \end{pmatrix} = \begin{pmatrix} \cos\phi \\ \cos\phi \end{pmatrix}$ $\begin{pmatrix} -\sin\phi \\ \cos \end{pmatrix}$ $\begin{pmatrix} -\cos \\ \cos \end{pmatrix}$

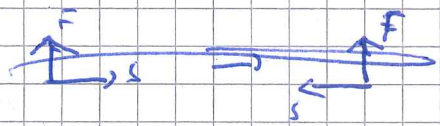
Fig 4 and 3

The difference between

and

is none because only the relativ position between light-direction and ~~Waveplate~~ Fast/slow-Axis matters.

~~And if you turn a $\lambda/4$-Waveplate around.~~



Difference only shows when we swap the direction which the $\lambda/4$-Plate is facing. Here we swap the second $\lambda/4$ waveplate and deduce via a Polarizer if the Polarisation changed or not.

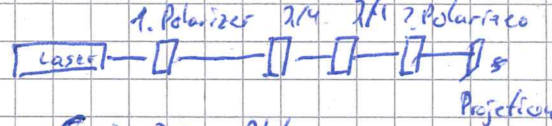


Fig 5: 2 $\lambda/4$ Plates

~~We put the~~ For Fig 3 we put the first polarizer on

P1 ~~240~~ 190, $\lambda/4$ (b) ~~20~~° (a) 140° P2 2~~4~~10° ⇒ No projection Light is ↔ pola

We flip (a)

P2 300° ⇒ No projection Light ist ↕ pola

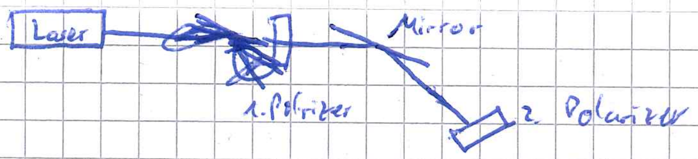
For Fig 4

P1 235° $\lambda/4$ (b) 65° $\lambda/4$ a) 185° P2 255° ⇒ No projection light is ↘ pola

Flip (a)

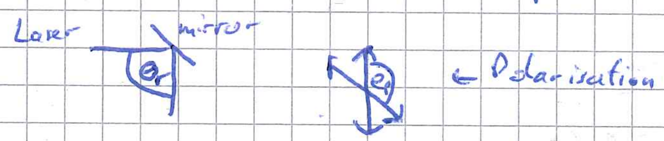
⇒ No projection Light is still ↘ p

8)



~~We~~ We set the 1. Polarizer to 190° to get an S-Pol.
~~But the second Polarizer sees no "minimum" → No linearized Polarisation~~
~~We insert a $\lambda/4$-Plate after mirror to test for circular Polarization → 2. Polarizer sees~~ minimum for which the 2. Poli can still find (minimum at 208° → Light is ↕)
Same for P-Poli (we change it between 1. Poli and Mirror with $\lambda/2$-Plate

9)
~~The~~ We still get a linear Polarization even after the mirror between first and second $\lambda/4$ but the linear polarization is turned for roughly 100°. After turning the mirror, by increasing the angle of reflection, we can see that the polarisation is turning as well. One can see that Θ_r and Θ_p are

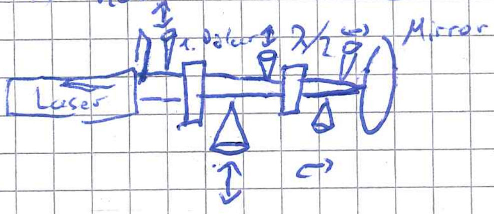


behaving similiar. ~~We~~ By inceasing ~~the~~ Θ_r for roughly 40° the Polarisation (Θ_p) also turns 40°.

10)
The mirror should not have an influence on the Polarization so that we look at the same experiment as in Fig 3 so if we expect it to be a linear Polarisation turned 90° in respect to it's starting polarization.
We test it by having the mirror at almost 0° and placing $\lambda/4$ between the first Polarizer and the mirror.
The first Polarizer will give us ↕-Polarized light but the reflected ~~and~~ Light beam which passed through $\lambda/4$ disappears

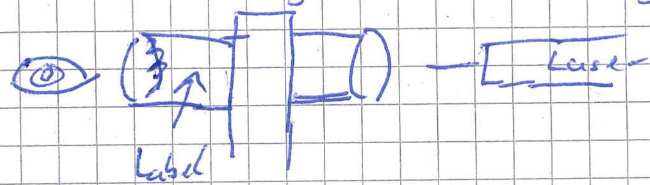
Polarizer.

11) With the ~~half~~ $\lambda/2$ -Plate we expet the Polarization to ~~not~~ not turn since the $\lambda/2$ Plate will always turn if it's placed with $45°$ between it's S/F-axis and P/S-Polarisat



12) ~~The isolater let's~~

We check with the ceiling lights, ~~One~~
One direction appears green, the other appears orange
The Laser only is let through the isolater when it would show orange for white light.



Faraday-Effect

13) It's the same

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EOM

5.2.1.1

1)/2) factor Power Supply/High Voltage

Wave Generator [V]	High Voltage [kV]
0,160	0,06
0,592	0,19
1,036	0,32
1,712	0,52
2,350	0,71
3,127	0,95
3,632	1,09
4,389	1,32
5,174	1,56
5,948	1,79

Label 1: Amplifier:
This equals roughly 300 as a factor as shown in Fig

→ Never exceed 5.5V to below 1,8 kV

5.2.2

1) The optical axes are at $-90°, 0, 90°$ of the Pockel cell

2)-3) Done → Parallel beams, below 3V

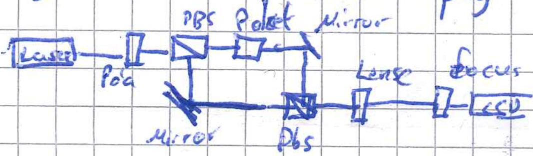
4) +90° tek2.csv

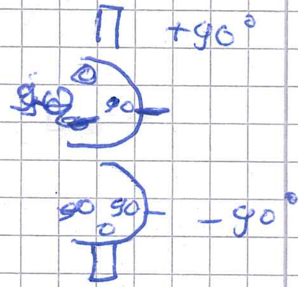
Sawtooth Voltage 0 ~ 5,5 V

0,5 Hz

0 tek3.csv tek0.png

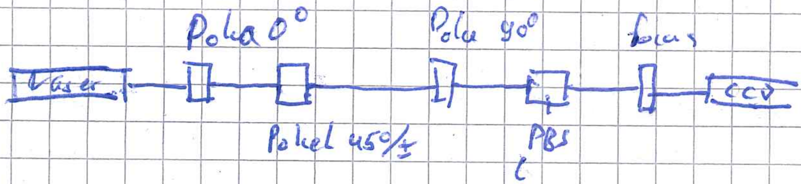
−90° tek4.csv tek1.png





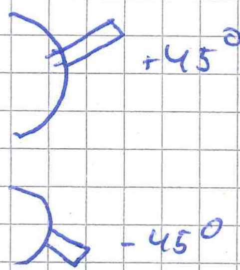
5.3

1)



2) +45° tek5.csv tek5.png

−45° tek6.csv tek6.png



~~5.3~~

5.3.1

1) The Transmitted Signal is only visible when we around the point of V_π meaning we are at the linear area of the Intesity-Voltage-Ratio which ~~roughly follows~~ a ~~a~~ is periodically

We saved the picture

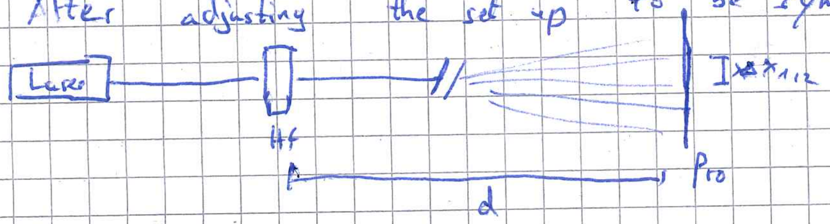
0.56 kV tek7.png

0.74 kV tek8.png

13.12.18

6.2 Aom

1) After adjusting the set up to be symmetrical in intensity



Measure +1 ⊢⊣ -1
+2 ⊢⊣ -2
$2\Delta x_1$

we start to measure.

The Amplitude Voltage is 1,4 V ± 0,1 V   d = 193,5 cm ± 0,2 cm

controls frequency →

V_{pp} [V]	f [MHz]	Δx_1 [cm]	Δx_2 [cm]
9	(85,0 ± 0,5) MHz	(5,2 ± 0,1)	(10,0 ± 0,1)
8	(91,0 ± 0,5)	(5,4 ± 0,1)	(10,7 ± 0,1)
7	(97,5 ± 0,3)	(5,8 ± 0,1)	(11,5 ± 0,1)
6	(104,1 ± 0,3)	(6,1 ± 0,1)	(~~11,8~~ 12,3 ± 0,1)
5	(110,0 ± 0,4)	(6,5 ± 0,1)	(13,0 ± 0,1)
4	(115,6 ± 0,4)	(6,8 ± 0,1)	/
3	(121,0 ± 0,4)	(7,1 ± 0,1)	/
2	(126,5 ± 0,2)	(7,4 ± 0,1)	/
1	(132,3 ± 0,2)	(7,8 ± 0,1)	/

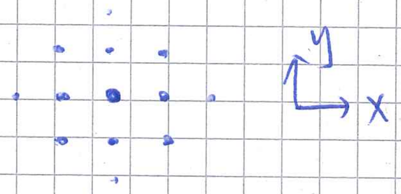
Can't see both second maxima

2) Measure of intensity of 0. 1. maxima

V_{pp} [V]	f [MHz]	I_0 [V]	I_1 [V] (~~higher~~ left Maxima)	Sound wave Amplitude A
9	(85,2 ± 0,2)	(3,35 ± 0,01)	(1,54 ± 0,01)	(17.5
8	(91.1 ± 0.2)	(3.62 ± 0.01)	(1.08 ± 0.01)	(22.5
7	(97.6 ± 0.2)	(4.06 ± 0.01)	(0.51 ± 0.01)	(30.0
6	(104.2 ± 0.2)	(4.50 ± 0.01)	(0.334 ± 0.003)	(27.
5	(109.9 ± 0.1)	(4.84 ± 0.02)	(~~0.150~~ 0.220 ± 0.002)	(24.
4	(115.4 ± 0.3)	(5.04 ± 0.02)	(0.165 ± 0.003)	(24.
3	(121.0 ± 0.2)	(5.10 ± 0.01)	(0.188 ± 0.003)	(32.
2	(126.6 ± 0.3)	(5.06 ± 0.01)	(0.240 ± 0.004)	(53.
1	(132.3 ± 0.3)	(5.15 ± 0.01)	(0.173 ± 0.006	(24.

6.2.2

1. By combining two AOMs perpendicular to each other we expect to see diffraction in both x- and y- direction. i.e. a lattice. We get a pattern like the following



2. We first change the voltage of the first AOM (we lower the V_{pp}) the ~~points~~ spots get apart from each other in x direction. Then we change the voltage of the second AOM (also lower the V_{pp}), the ~~points~~ spots get apart from each other in y direction.

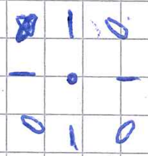
~~Now we disconnect the cabel from AOM modulator to the function generator power supply and connect it from AOM modulator to function generator.~~

We disconnected the cabel from AOM modulator LEVEL to power supply and instead connet it to a ~~gf~~ function generator.

1. It blinks.
Chaning wave form doesn't change the behavior of diffraction pattern.

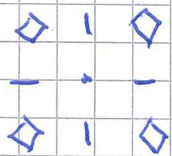
2. If we change the wave form to sinus, the spots expand and schrink around the central spot.
Rectangle form (block): the spots spring between two positions

sinus:



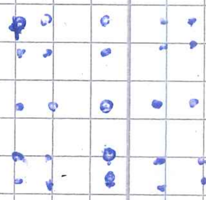
diffraction pattern

ramp



~~block~~

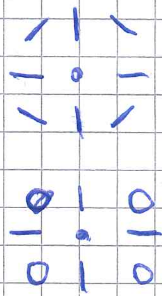
block



triangle form: similar to sinus

(peak-peak)
[V]
±0.1)
±0.1)
±0.2)
±0.1)
±0.1)
±0.1)
±0.1)
±0.2)
±0.1)

3. phase shift 180° und 0° :



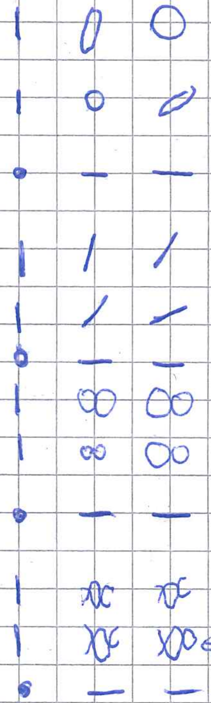
90° :

sinus

→ ~~90°~~ $\lambda/4$

~~Ellip~~

4. sinus 90°



~~dieselbe~~
same frequency

sinus 0°

sinus 90°

$f_2 = 2f_1$.

sinus 0°

← ~~smaller~~

$f_2 = 2f_1$