Gruppe 10

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Part 1:

1) $\vec{B}(z)$ measurement inside the coil at $I = 1\,A$

$z_1 = 1.0\,cm$, $B(z_1) = 5.9\,mT$

z (cm)	B (mT) ± 0.1
0	3.5
0.5	5.2
1.0	6.4
1.5	7.4
2.0	8.2
2.5	8.8
3.0	9.1
3.5	9.3

z (cm)	B (mT)
4.0	9.2
4.5	8.9
5.0	8.4
5.5	7.6
6.0	6.6
6.5	5.3
7.0	4.2

2) [redacted] $z = 3.5\,cm$

z [redacted]	I (A)	B (mT)
	0.0	-0.5
	0.20	1.3
	0.40	3.3
	0.60	5.3
	0.80	7.3
	1	

I (A)	B (mT)
1.00	9.3
1.20	11.3
1.40	13.3
1.60	15.2
[redacted]	

3) Set up the optical elements in the bench and align the lenses. Set up the Magnet and multimeter/oscilloscope.

Part 2:

1) Background measurement and measurement of $I(\varphi)$ without the glass and $\vec{B}$ field to confirm Malus law. $\varphi = 0 \Rightarrow$ Analyzer fully closed

$I_B = 0.012\,V$

φ	I (φ)	φ	I(φ)	φ	I(φ)
90	5.16	20	0.628	-50	2.99
80	5.01	10	0.259	-60	3.81
70	4.57	0	0.20	-70	4.53
60	3.89	-10	0.171	-80	5.00
50	3.04	-20	0.593	-90	5.18
40	2.15	-30	1.256		
30	1.325	-40	2.08		

2) Background measurement and confirmation of Malus's Law by measuring $I(\varphi)$ with the glass in place and $\vec{B}=0$.

$I_B(\varphi)=0.011V$

φ	$I(\varphi)$	φ	$I(\varphi)$	φ	$I(\varphi)$
90	5.16	30	1.333	-50	1.400
80	5.00	20	0.667	40	2.21
70	4.55	10	0.243	50	3.06
60	3.87	0	0.113	60	3.91
50	3.02	-10	0.274	70	4.58
40	2.15	-20	0.710	80	5.01
				90	5.17

$G=I_{\parallel}/I_{\perp}=\frac{5.16}{0.113}\approx 45.66>40 \Rightarrow$ G spot found.

3) $\varphi=45°$. $\Rightarrow$ Set using the DC signal.. Frequency set at $f=60Hz$

$I_{DC}(\varphi=45°)=\frac{1}{2}(I_{\parallel}+I_{\perp})\approx 2.545$. $I_{\parallel}=4.96$ $I_{\perp}=0.138$

$I_B=0.010V$ $G=I_{\parallel}/I_{\perp}\approx 50.74$ $\Delta I_{SS}=0.2\doteq 4$

- Now we power the magnet $B=1.00A$

φ	$I_{SS}(\varphi)$ [mV]
30°	33.0
35°	36.0
38°	38.4
40°	39.0
42°	40.0
43°	40.0
44°	40.2
45°	40.4

φ	$I_{SS}(\varphi)$
46°	40.4
47°	40.4
48°	40.2
50°	39.8
52°	39.2
55°	37.8
60°	35.2

Part 3:

1) Set up polarizer at $\varphi=45°$. Measurement of I_{eff}, I_{DC}, and I_{SS} for different $\vec{B}$ strenght values. for all 4 LEDs, of wavelenght λ_i:.

$I_{eff}\in\{0.4, 0.8, 1.2, 1.6\}A$, $\lambda_i\in\{400, 470, 508, 628\}nm$

$\lambda_1=400nm$			$\lambda=470nm$			$\lambda=508nm$			
I_{eff} (A)	I_{DC}	I_{SS}	I_{eff}	I_{DC}	I_{SS}	I_{eff}	I_{DC}	I_{SS}	
0.405	2.94	42	0.406	2.75	31	0.401	0.797	6.64	
0.800	2.95	82.4	0.803	2.76	61	0.804	0.797	7.5	7.5±0.5
1.201	2.96	125	1.202	2.76	92.4	1.204	0.795	9.5	
1.607	2.97	162	1.601	2.76	121	1.601	0.798	27.0	

$\lambda=628nm$		
I_{eff}	I_{DC}	I_{SS}
0.402	2.58	17.0
0.802	2.58	29.3
1.202	2.58	46.8
1.57	2.97	66.6

$I_{DC}=[V]$, $I_{SS}=[mV]$

$I_B^{(4)}=0.009V$ $I_B^{(3)}=0.008V$

$I_B^{(2)}=0.008V$ $I_B^{(1)}=0.008V$

$I_{II}^{(4)} = 5.02V$, $I_{\perp}^{(4)} = 0.157$, $I_{DC}^{(4)}(\varphi=45) \approx 2.59V$

$I_{II}^{(3)} = 4.522V$, $I_{\perp}^{(3)} = 0.07$, $I_{DC}^{(3)}(\varphi=45) \approx 0.80V$

$I_{II}^{(2)} = 5.09\ V$, $I_{\perp}^{(2)} = 0.363V$, $I_{DC}^{(2)}(\varphi=45) \approx 2.73V$

$I_{II}^{(1)} = 5.11\ V$, $I_{\perp}^{(1)} = 0.795V$, $I_{DC}^{(1)}(\varphi=45) \approx 2.95\ V$

Glass without lead

→ For LED #1 the Diode was calibrated for max. intens.

2) Measurement of the same parameters and LEDs for the other dielectric transparent material of the glass with lead

$\lambda_1 = 400nm$			$\lambda_2 = 470nm$		
I_{eff}	I_{DC}	I_{SS}	I_{eff}	I_{DC}	I_{SS}
0.405	2.05	127	0.401	2.64	104
0.800	2.05	248	0.801	2.64	207
1.202	2.05	372	1.204	2.64	307
1.601	2.05	492	1.603	2.64	410

$I_B^{(1)} = 0.008V$, $I_{II}^{(1)} = 4.04\ V$,
$I_{DC}^{(1)} = 2.054V$, $I_{\perp}^{(1)} = 0.068V$,

$I_B^{(2)} = 0.008\ V$, $I_{II}^{(2)} = 5.26\ V$,
$I_{DC}^{(2)} = 2.641\ V$, $I_{\perp}^{(2)} = 00.23\ V$,

$\lambda_3 = 508nm$			$\lambda_4 = 628nm$		
I_{eff}	I_{DC}	I_{SS}	I_{eff}	I_{DC}	I_{SS}
0.401	2.54	878.0	0.402	259	51.6
0804	2.53	1550	0.800	2.59	101.0
1.203	2.54	232.0	1.205	2.59	152.0
1.600	2.53	306.0	1.604	259	203.0

$I_B^{(3)} = 0.008\ V$, $I_{II}^{(3)} = 4.07\ V$,
$I_{DC}^{(3)} = 2.54\ V$, $I_{\perp}^{(3)} = 0.013\ V$,

$I_B^{(4)} = 0.008\ V$, $I_{II}^{(4)} = 5.17\ V$,
$I_{DC}^{(4)} = 2.592\ V$, $I_{\perp}^{(4)} = 0.014\ V$,