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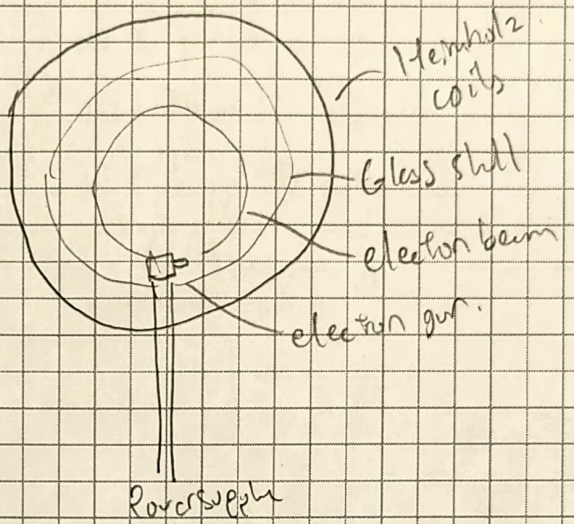
Lab #36 PHYS 122: 119B Section 32

1) Turn on power supply to 150V
2) Adjust knob so electron path is circular & not helical
3) Measure left & right side of beam, calculate center & radius.

The purpose of this lab is to confirm the established value of e/m for electrons through experimentation with Helmholtz coils.



D1

Measurements:

4.5 ± 0.5 − 15.5 ± 0.5 cm

~~10.0~~ 2r = 10.0 ± 0.5 cm

r = 5.5 ± 0.5 cm

D2

1) Max A: 2.0 A
Min A: 0.7 A

1) Increase & decrease voltage, repeat ~~measure~~ measuring the beam across 5 points including min & max

(A) ±0.1 Amperage	(cm) ±0.2 left	(cm) ±0.2 right	(cm) ±0.2 diameter
0.7	3.25	15.75	12.5
1.0	5.25	14.75	9
1.35	5.75	13.4	7.65
1.7	6.4	12.6	6.2
2.0	6.8	12.4	5.6

D3

0.7A

(V) ±1% Voltage	(cm) ±0.2 left	(cm) ±0.2 right	(cm) ±0.2 diameter
97	4.7	13.6	8.9
105	4.4	14.3	9.9
115	4.0	14.7	10.7
125	3.6	15.1	11.5
135	3.4	15.3	11.9
145	3.1	15.8	12.7
150	2.9	15.9	13.0

$\frac{1}{2}mv^2 = eV$

$\vec{F} = -e(\vec{v} \times \vec{B})$

$evB = mv^2/R$

$\frac{e}{m} = \frac{2V}{(BR)^2}$

$B = \frac{8\mu_0 N I_c}{5r\sqrt{5}}$

$\Downarrow$

$\frac{e}{m} = \frac{2V}{(8\mu_0 N I_c / 5r\sqrt{5})^2 R^2}$

m = mass of electron
v = speed of electron
$\vec{v}$ = velocity
$\vec{B}$ = magnetic field
e = magnitude of charge of electron
$\frac{e}{m} \approx 1.7588207 \pm 0.0000007 \times 10^{11} \frac{C}{kg}$
$\mu_0 = 4\pi \times 10^{-7}$ T·m/A
I_c = current
N = turns in coil = 130
$r = 0.158 \pm 0.005$ m
R = radius of beam
B = mag field
V = in. voltage

1) derive the relations between $R, I_c, V, e/c$ to ultimately calculate e/c

Varying current:

$\frac{1}{R} = \frac{8\mu_0 N}{5r}\sqrt{\frac{e/m}{10V}}\, I_c + C$ — extraneous fields

Varying Voltage:

$R = \frac{5r}{8\mu_0 N I_c}\sqrt{\frac{10}{e/m}}\,\sqrt{V} + C$

$\delta_{\frac{1}{R}} = \frac{1}{R^2}\delta_R$

$\delta_{\sqrt{V}} = \frac{1}{2\sqrt{V}}\delta_V$

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Lab #13a PHYS 122:119B Section 23

1) Connect calibration to Ch1 of the DSO
2) Measure Volts/DIV, time/DIV
3) estimate error in DSO
4) Measure period & peak-to-peak of the calibration wave.

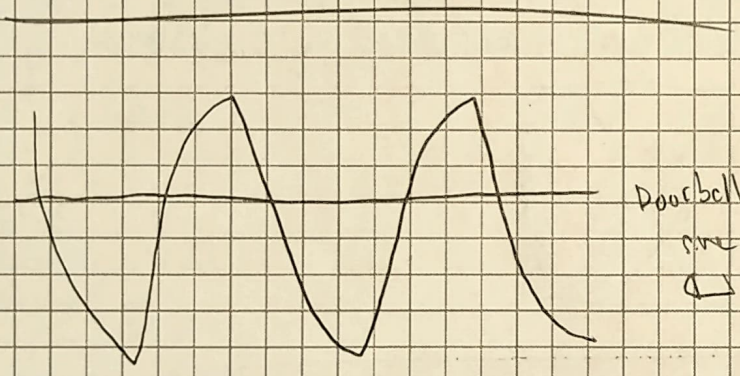
The purpose of this lab is to familiarize myself with the wave generator and the DSO, and also to explore how beeping works.

V/DIV = ~~500~~ 500 mV ms/DIV = 250

error = $\frac{1}{5}$ DIV

period = $\frac{16.6}{4}$ DIV = 1000 ms ± 1.0 ms

peak-to-peak = 6 DIV = 3V ± 100 mV



Doorbell transformer.
sine wave.

$\frac{V}{DIV}$ = 2.00V

$\frac{ms}{DIV}$ = 5.00 ms

peak to peak = 6 DIV = 12.0 ± 0.4 V

period = $\frac{16.6 DIV}{5}$ = ~~16.6 ms~~

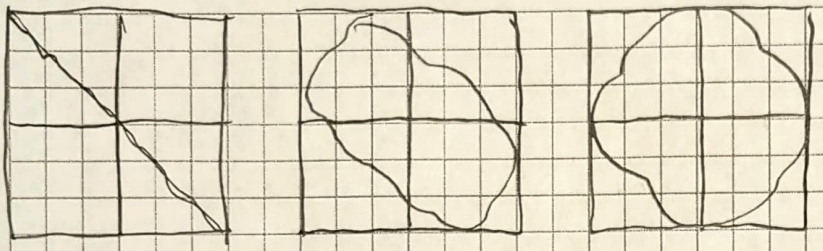
16.6 ± 0.2 ms

DMM measures 4.27 ± 1%

$V_{pp} = 2\sqrt{2} V_{rms}$

V_{pp} = 12.077, this is consistent with our oscilloscope reading.

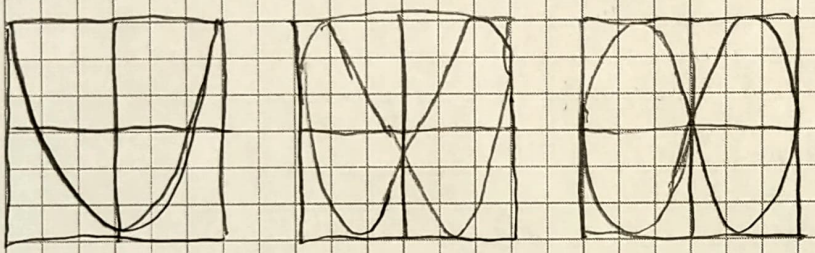
60 Hz:



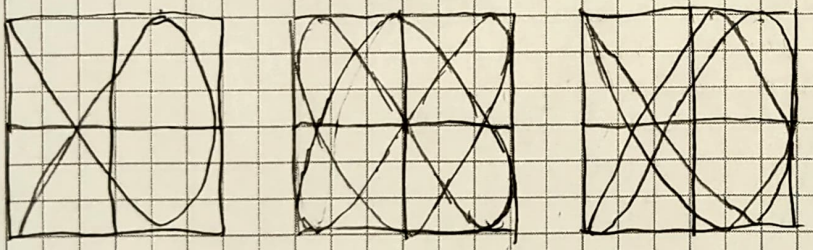
1) add wave generator to CH2 input, these patterns are XY plots of transformer vs. wave generator.

120 Hz:

V = 120.043 V



90 Hz: The ratios of the frequencies need to be a simple ratio.



$$\frac{314 \text{ ns} \pm 5}{30} = 10.47 \pm 0.2$$

$$10.5 \pm 0.2 \text{ ns}$$

1) measure waveform of sound, calculate frequency of it.