Radiation Detection

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Alfaifi, Ammar 201855360

1 Objective

To learn and analyze the electromagnetic radiation intensity as it travels through space. Also, to find some related calculations such as absorption law.

[7]:
```
# import the needed libs
import numpy as np
import scipy as sc
import sympy as sp
import astropy
import pandas as pd
import matplotlib.pyplot as plt

from IPython.display import set_matplotlib_formats, Markdown, display
set_matplotlib_formats('png', 'pdf')

# plt.rc("figure", )
plt.rcParams['figure.dpi'] = 150
plt.rc("figure", figsize=(6, 3))
plt.rc('text', usetex=False)
plt.rc('font', family='serif')
```

2 Theory

2.1 We will use the absorption equation

$$I = I_0 e^{-\mu_m t_d}$$

to find the constant μ_m.

3 Measurments & Data

First loading the data into dataFrame Given that initial initial intensity $I_0 = 8000 counts/s$

[8]:
```
# set the given value
I_0 = 8000
# Load the data into a pandas dataFrame from data.csv
```

```
data = pd.read_csv("data.csv")
data
```

[8]:

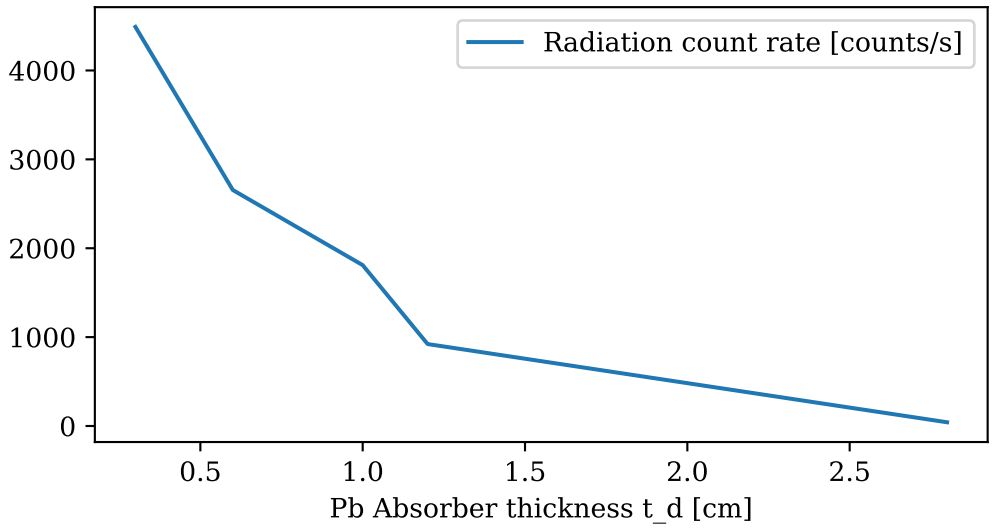
	Pb Absorber thickness t_d [cm]	Radiation count rate [counts/s]
0	0.3	4490
1	0.6	2655
2	1.0	1810
3	1.2	922
4	2.8	42

4 Calculations

4.1 First plot the raw data

[9]:
```
# Plot the raw data
data.plot(x="Pb Absorber thickness t_d [cm]", y="Radiation count rate [counts/
↪s]")
```

[9]: <AxesSubplot:xlabel='Pb Absorber thickness t_d [cm]'>



4.2 Manipulate the equation to get a straight line equation

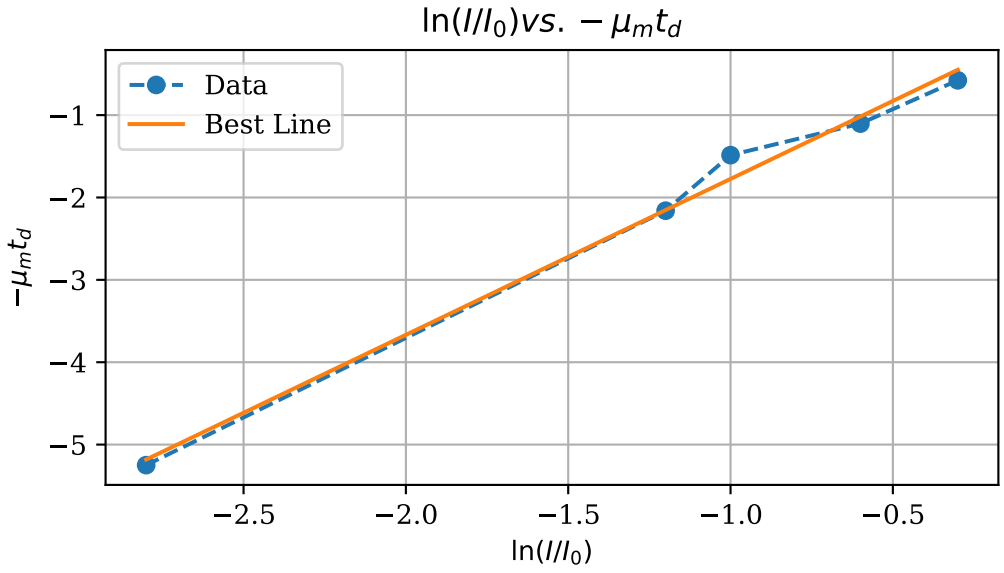
$$\ln\left(I/I_0\right) = -\mu_m t_d$$

where μ_m is the line slope

[10]:
```
y = np.log(data["Radiation count rate [counts/s]"]/I_0)
x = -data["Pb Absorber thickness t_d [cm]"]
```

```
# find the best line
slope, _ = np.polyfit(x, y, 1)
f = np.poly1d(np.polyfit(x, y, 1))
# plotting
plt.plot(x, y, "--o", label="Data")
plt.plot(x, f(x), "-", label="Best Line")
#Style
plt.xlabel("$\ln{(I/I_{0})}$")
plt.ylabel("$-\mu_{m} t_{d}$")
plt.title("$\ln{(I/I_{0})} vs. -\mu_{m} t_{d}$")
plt.legend()
plt.grid()
display(Markdown(f"Thus the slope of the best fit line is $\mu_m={slope:0.3f}/
↪cm$"))
plt.show()
```

Thus the slope of the best fit line is $\mu_m = 1.893/cm$



5 Conclusion

In short, in this lab, we aimed to learn more about electromagnetic radiation in terms of its intensity through distance. We found that as the thickness of a material increases the intensity on the other side decreases exponentially. We analyzed the experiment by the absorption equation $\ln(I/I_0) = -\mu_m t_d$ where μ_m is the line slope. We found its value approximately equals $\mu_m = 1.893 cm^{-1}$