# Hydrogen Spectrum & Rydberg Constant Lab Analysis

March 19, 2021

[1]:
```python
import matplotlib.pyplot as plt
import numpy as np
import os
```

[112]:
```python
Path = os.getcwd()
print(Path)
```

```
C:\Users\fmart\Google Drive\Semesters\Spring 2021\Phys Lab\Hydrogen Spectrum &
Rydberg Constant
```

[48]:
```python
n_2 = 2
Q_num = [3, 4, 5, 6, 7, 8]
balmer = [656.43, 486.57, 436.35, 410.916, 397., 386.571]
error = [.5, .5, 2, .5, .2, 3]
error_adj = [0.0000011, 0.0000021, 0.00001, 0.00000296, 0.00000126, 0.00002007]
```

$$y = \left(\frac{1}{n_2^2} - \frac{1}{n_1^2}\right) \tag{1}$$

[75]:
```python
y = []
x=[]
xerr=[]
for i in range(len(Q_num)):
    y.append(1/(n_2**2)- 1/(Q_num[i]**2))
    x.append(1/balmer[i])
    xerr.append(error[i])
```

[75]:
```
[0.1388888888888889,
 0.1875,
 0.21,
 0.2222222222222222,
 0.22959183673469388,
 0.234375]
```

[78]:
```python
slope, intercept = np.polyfit(x,y, 1)
xrange = np.linspace(0.0015,0.00265,5000)
```

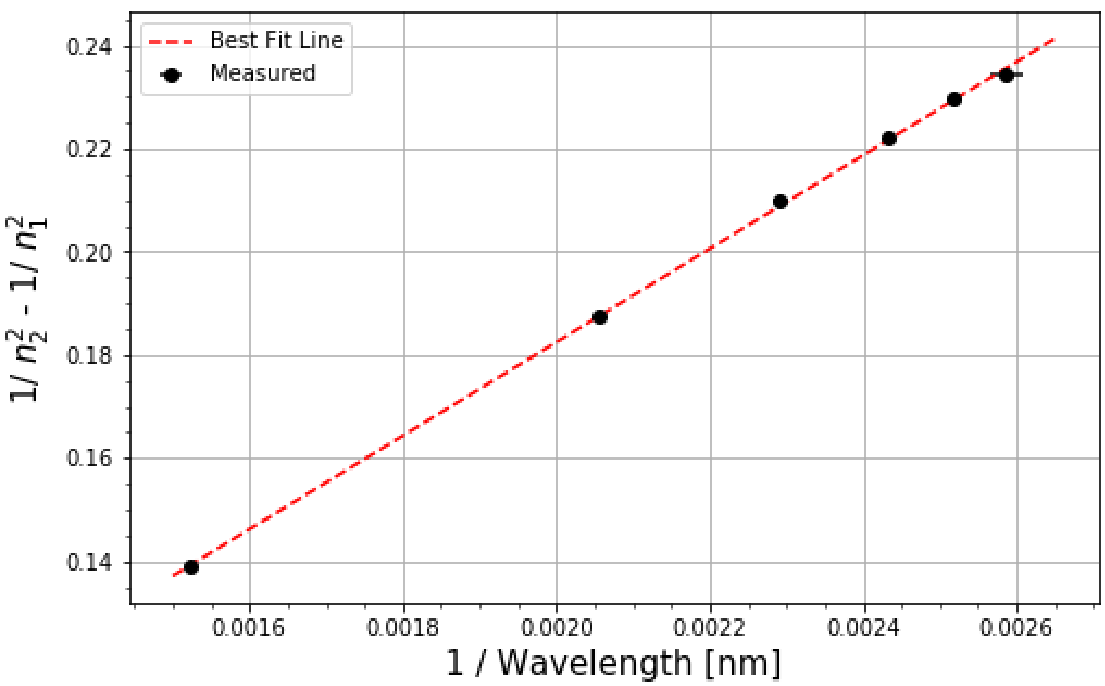
```
func = slope * xrange + intercept

#Units: uT/Amps
print("Slope = " + str(slope))
print("Intercept = " + str(intercept))

expected = []
residuals = []
new_y = []
for i in range(len(x)):
    expected.append(x[i] * slope + intercept)
    residuals.append((expected[i]-y[i]))
```

```
Slope = 90.62810808945004
Intercept = 0.0012143247428822682
```

[113]:
```
plt.figure(figsize = [8,5])
plt.errorbar(xrange, func, fmt ='--',color = 'red',label='Best Fit Line')
plt.errorbar(x, y, xerr=error_adj, fmt ='o',color = 'black',label='Measured')
plt.grid()
plt.xlabel("1 / Wavelength [nm]", size = 15)
plt.ylabel("1/ $n_2^2$ - 1/ $n_1^2$", size = 15)
#plt.title("Inverse Wavelength vs. ")
plt.legend()
plt.minorticks_on()
plt.savefig(Path + "/Inverse Wavelength plot.png",bbox_inches='tight')
plt.show()
```



[100]:
```python
#Slope is in inv nm, we can convert this to inv cm by dividing by 9e-4
R_M = slope / 9e-4

m = 9.10938356e-31    #Mass of electron in kg
M = 1.6726219e-27     #Mass of proton in kg
```

Using the equation:

$$R_M = R_\infty \frac{1}{1 + m/M} \tag{2}$$

[111]:
```python
#Calculating the Rydberg Constant
R_inf = R_M*(1 + m/M)
print("R_inf = "+str(R_inf))

#Calculating total error
R_inf_know =  109737.31568508
total_err = (R_inf_know-R_inf)/R_inf_know

print("Our total error is: " +str(round(total_err*100,3)) +"%")
```

```
R_inf = 100752.73966630323
Our total error is: 8.187%
```

[ ]:
```python

```