Homework 3.1

Timothy Holmes

May 23, 2017

1 Part 1

By looking at the color spectrum from right to left we know that red is first followed by yellow, green, and then violet. If we look at figure(1) we see the thresholds are different in order by the color spectrum. Thus, it can be concluded that the threshold voltage for different LEDs is different and in the color spectrum order. So this works.

2 Part 2

Curve fit

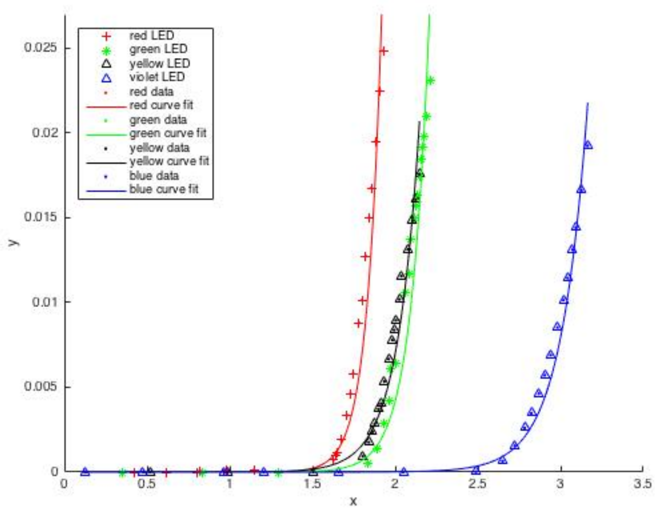

Figure 1: Curve fit.

figure(1): The code for the curve fit is in the appendix. The equation $I = a(e^{(bx)} - 1)$ was used for the fit command in matlab.

Confidence interval

Red
f(x) = a*((exp(b*x))-1)
Coefficients (with 95% confidence bounds):
a = 8.397e-12 (-2.849e-11, 4.528e-11)
b = 11.41 (9.095, 13.73)

Green
f1(x) = a*((exp(b*x))-1)
Coefficients (with 95% confidence bounds):
a = 6.406e-11 (-2.112e-10, 3.393e-10)
b = 8.998 (7.017, 10.98)

Yellow
f2(x) = a*((exp(b*x))-1)
Coefficients (with 95% confidence bounds):
a = 2.703e-09 (-3.472e-09, 8.877e-09)
b = 7.383 (6.29, 8.476)

Violet
f3(x) = a*((exp(b*x))-1)
Coefficients (with 95% confidence bounds):
a = 7.695e-11 (-1.044e-10, 2.583e-10)
b = 6.151 (5.391, 6.911)

3 Part 3

We found that our Planck's constant value is $eV = \hbar\omega = hf = \frac{hc}{\lambda} \rightarrow v = (\frac{hc}{e}) * \frac{1}{\lambda}$.
$V = (\frac{h}{e}) * frequency$ where $(\frac{h}{e})$ is the slope and frequency is x. $Frequency = fracc\lambda$, for the equation y = m*x + b.

$$h = (6.0770 \pm 0.0743) * 10^{-34} \frac{m^2 * kg}{s}$$

The code for this is also in the appendix.

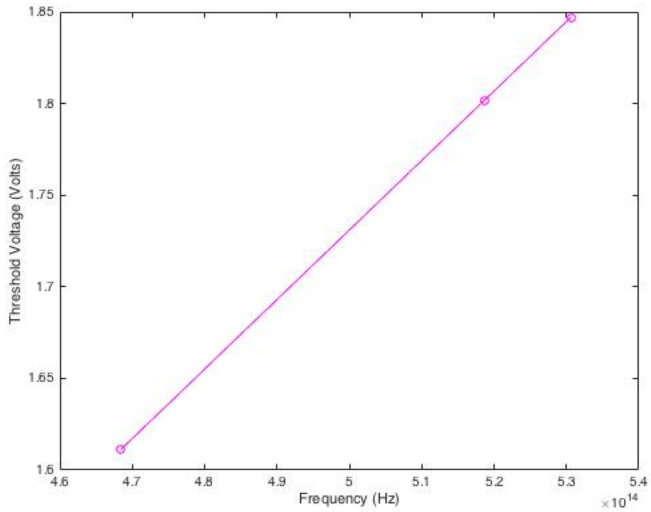

Figure 2: Curve fit.

Appendix a

```
function [ Ourh ] = homework3_1

%l = ls(e^((qv)/(nkT))-1)

load data.mat

exp3 = 'a*((exp(b*x))-1)';
startPoints = [0 12];%red start points
startPoints2 = [0 11];%green start points
startPoints3 = [0 11.2];%yellow start points
startPoints4 = [0 7];%violet start points
f = fit(data(:,1),data(:,2),exp3,'Start',startPoints);%
    red
f1 = fit(data(:,3),data(:,4),exp3,'Start',startPoints2);%
    green
f2 = fit(data(:,5),data(:,6),exp3,'Start',startPoints3);%
    yellow
f3 = fit(data(:,7),data(:,8),exp3,'Start',startPoints4);%
    violet

hold on
figure(1)
```

```
plot(data(:,1),data(:,2),'r+');%red LED
plot(data(:,3),data(:,4),'g*');%green LED
plot(data(:,5),data(:,6),'kx');%yellow LED
plot(data(:,7),data(:,8),'b^');%violet LED
axis([0 3.5 0 0.027])
xlabel('Voltage');
ylabel('Current');

fit1 = plot(f,data(:,1),data(:,2)); %red LED curve fit
set([fit1 fit1],'color','r') %red LED curve fit color
fit2 = plot(f1,data(:,3),data(:,4)); %green LED curve fit
set([fit2 fit2],'color','g') %green LED curve fit color
fit3 = plot(f2,data(:,5),data(:,6)); %yellow LED curve fit
set([fit3 fit3],'color','k') %yellow LED curve fit color
fit4 = plot(f3,data(:,7),data(:,8)); %violet LED curve fit
set([fit4 fit4],'color','b') %violet LED curve fit color
legend('red LED','green LED','yellow LED','violet LED','red data','red curve fit','green data','green curve fit','yellow data','yellow curve fit','blue data','blue curve fit','location','NorthWest')
hold off
disp(f);disp(f1);disp(f2);disp(f3);

%Frequency vs Threshold Voltage
thresh = [1.86 1.8 1.6]; %1.8 1.8 2.6
lambda = [578e-9 565e-9 640e-9]; %565 578 642
h = 6.6261*10^-34;
c = 299792458;
f= c./(lambda);
[ P,S ] = polyfit(f,thresh,1);
S = (P(1).*f)+P(2);

hold on
figure(2)
plot(f,thresh);
plot(f,S,'mo-');
xlabel('Frequency (Hz)');
ylabel('Threshold Voltage (Volts)');
hold off

%Wavelength vs Threshold Voltage
Ourh = P(1)*(1.602*10^(-19));
end
```