Report on Experiments and Findings

Lekhasree - EE23B039

Approach

First, I plotted the given 4 datasets without normalizing. Then I did curve fitting without fixing any arguments. The following plot was the output:

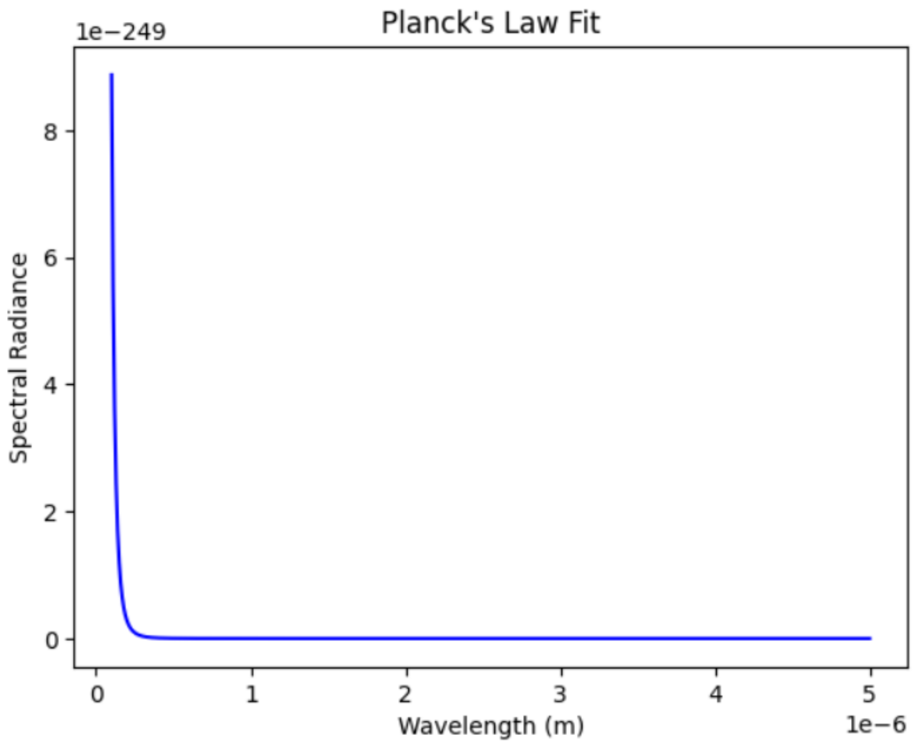

Figure 1: Plot of the curve fit output before normalization

This result was not as expected because the given datasets have a very large scale of variation (wavelength is of the order of micrometers and radiance is of the order of 10^{12}).

So, I normalized the data by multiplying the wavelength by 10^6 and the radiance by 10^{-12}.

After normalization, the curve looked like this for dataset d1, and the result was almost the same for other datasets as well:

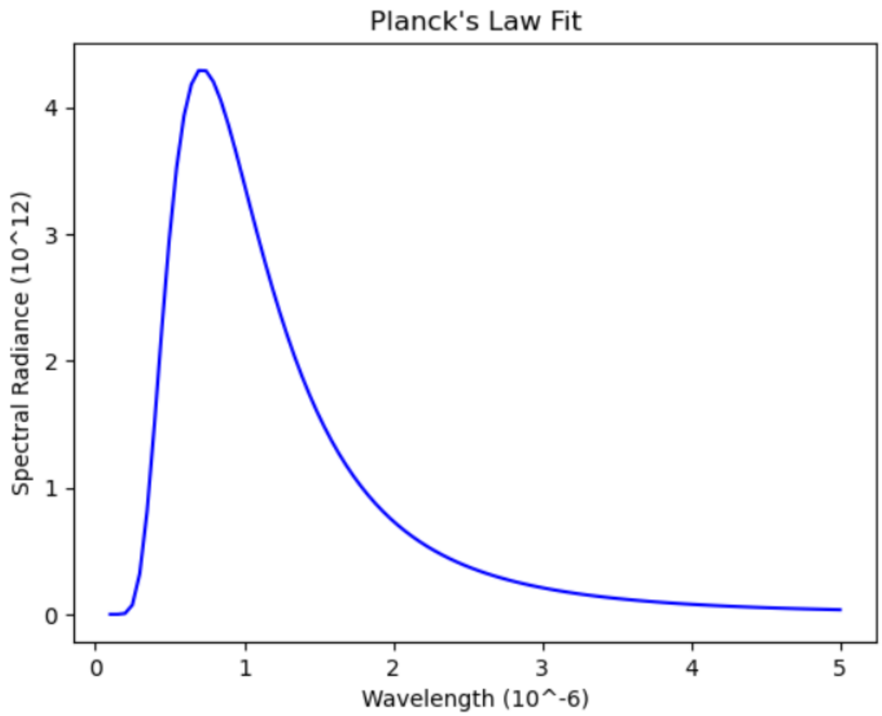

Figure 2: Plot of the curve fit output after normalization

Values of h, c, k, t obtained:

The following table presents the constants h, c, k, and t for each dataset (d1, d2, d3, d4):

Dataset	**h (J.s)**	**c (m/s)**	**k (J/K)**	**t (K)**
d1	4.876×10^{-34}	3.448×10^{8}	2.323×10^{-23}	2033.26
d2	1.740×10^{-34}	4.705×10^{8}	1.489×10^{-23}	1647.42
d3	6.043×10^{-34}	3.058×10^{8}	2.604×10^{-23}	1994.17
d4	5.011×10^{-34}	3.353×10^{8}	2.056×10^{-23}	2242.86

Table 1: Constants for each dataset (d1, d2, d3, d4)

As it can be seen, the estimates are very poor.

Implementation of partial application and observations

Observation: kt is Constant

First, T was fixed at 1, c at 3, and h at 6.626, and then k was estimated. The value of T was incrementally increased from 1 to 4, and for each value of T, k was estimated. The following observations were recorded:

- $T = 1$, $k = 5.5521 \quad \Rightarrow \quad kt = 5.5521$
- $T = 2$, $k = 2.7760 \quad \Rightarrow \quad kt = 5.552$
- $T = 3$, $k = 1.8507 \quad \Rightarrow \quad kt = 5.5521$
- $T = 4$, $k = 1.3880 \quad \Rightarrow \quad kt = 5.552$

Next, k was fixed at 1, c at 3, and h at 6.626, and then T was estimated. The value of k was incrementally increased from 1 to 4, and for each value of k, T was estimated. The following observations were recorded:

- $k = 1$, $T = 5.5521 \quad \Rightarrow \quad kt = 5.5521$
- $k = 2$, $T = 2.7760 \quad \Rightarrow \quad kt = 5.552$
- $k = 3$, $T = 1.8507 \quad \Rightarrow \quad kt = 5.5521$

- $k = 4$, $T = 1.3880 \quad \Rightarrow \quad kt = 5.552$

Thus, the product kt remains constant for a given set of c and h values, irrespective of whether k or T is predicted first.

Implementation of Partial Application

In this experiment, the following steps were performed:

1. First, h, c, and k were fixed, and T was predicted.
2. Using the predicted T_{fit}, T was fixed, c and k remained fixed, and h was predicted as h_{fit}.
3. Then, with $h = h_{\text{fit}}$, $T = T_{\text{fit}}$, and k, c was predicted.
4. Finally, $h = h_{\text{fit}}$, $T = T_{\text{fit}}$, and $c = c_{\text{fit}}$ were fixed, and k was predicted. Interestingly, k remained nearly constant at approximately 1.38, because the product kt is constant.

Below are the values obtained for each dataset:

Dataset	Estimated T (K)	Estimated h (J.s)	Estimated c (m/s)	Estimated k (J/K)
d1	4023.31	6.625×10^{-34}	2.9998×10^{8}	1.3795×10^{-23}
d2	107.64	1.010×10^{-32}	1.0000×10^{8}	1.0000×10^{-23}
d3	4004.00	6.624×10^{-34}	2.9977×10^{8}	1.3790×10^{-23}
d4	3908.04	6.624×10^{-34}	2.9977×10^{8}	1.3790×10^{-23}

Table 2: Predicted values of T, h, c, and k for each dataset

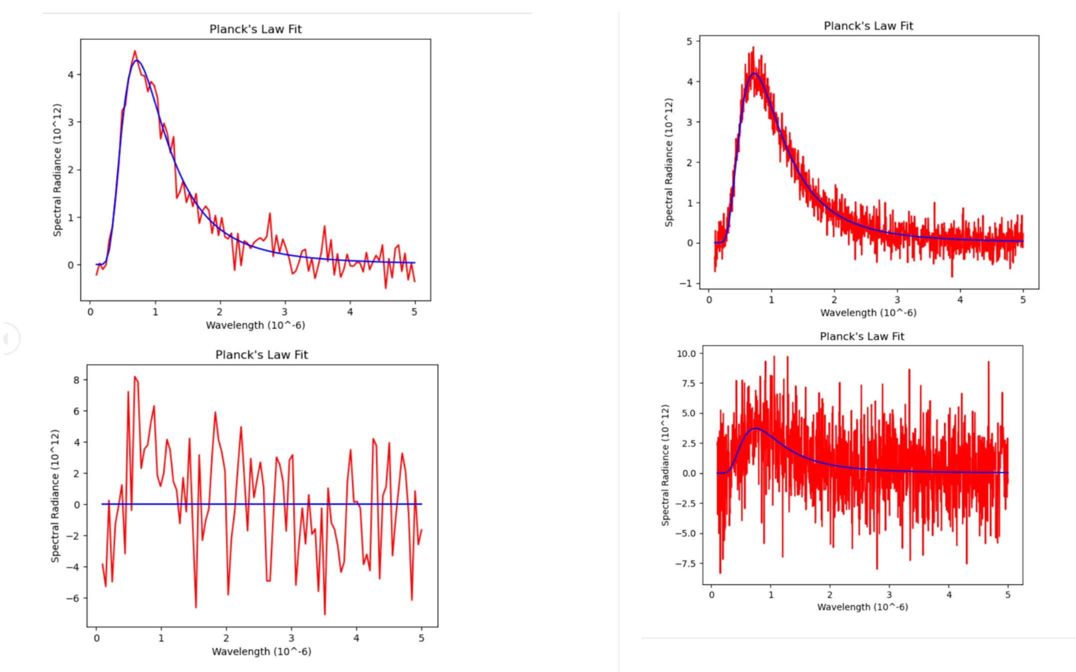

Figure 3: Curve fitting output after partial application