

## 1.88: Planck's Radiation Equation Fit to Experimental Data - Another Algorithm

n := 42    i := 1..n

$\rho_i :=$	$\lambda_i :=$
0.07	0.667
0.096	0.720
0.10	0.737
0.190	0.811
0.210	0.833
0.398	0.917
0.420	0.917
0.680	1.027
0.708	1.021
1.036	1.167
1.062	1.172
1.258	1.247
1.669	1.484
1.770	1.697
1.776	1.831
1.730	2.039
1.685	2.170
1.640	2.275
1.551	2.406
1.392	2.563
1.145	2.27
1.115	2.824
1.071	2.916
1.042	2.921
0.974	3.050
0.918	2.151
0.797	3.344
0.760	3.450
0.742	3.556
0.698	3.661
0.667	3.754
0.570	4.027

0.426	4.427
0.378	4.613
0.345	4.805
0.310	4.968
0.280	5.128
0.250	5.296
0.220	5.469
0.205	5.632
0.175	5.783
0.155	6.168

The data for this exercise is taken from page 19 of Eisberg and Resnick, *Quantum Physics*.

The values of  $\rho$  are given in units of  $10^3$  joules/m<sup>3</sup> and the values of  $\lambda$  are given in  $10^{-6}$  m. The temperature is 1595 K.

Define Planck radiation function and first derivatives with respect to parameters  $a$  and  $b$ :

$$F(\lambda, a, b) := \begin{bmatrix} \frac{a \cdot \lambda^{-5}}{\left(\frac{b}{\lambda}\right)} \\ \frac{d}{da} \frac{a \cdot \lambda^{-5}}{\frac{b}{\lambda}} \\ \frac{d}{db} \frac{a \cdot \lambda^{-5}}{\left(e^{\frac{b}{\lambda}} - 1\right)} \end{bmatrix}$$

Carry out nonlinear regression using Mathcad's genfit algorithm:

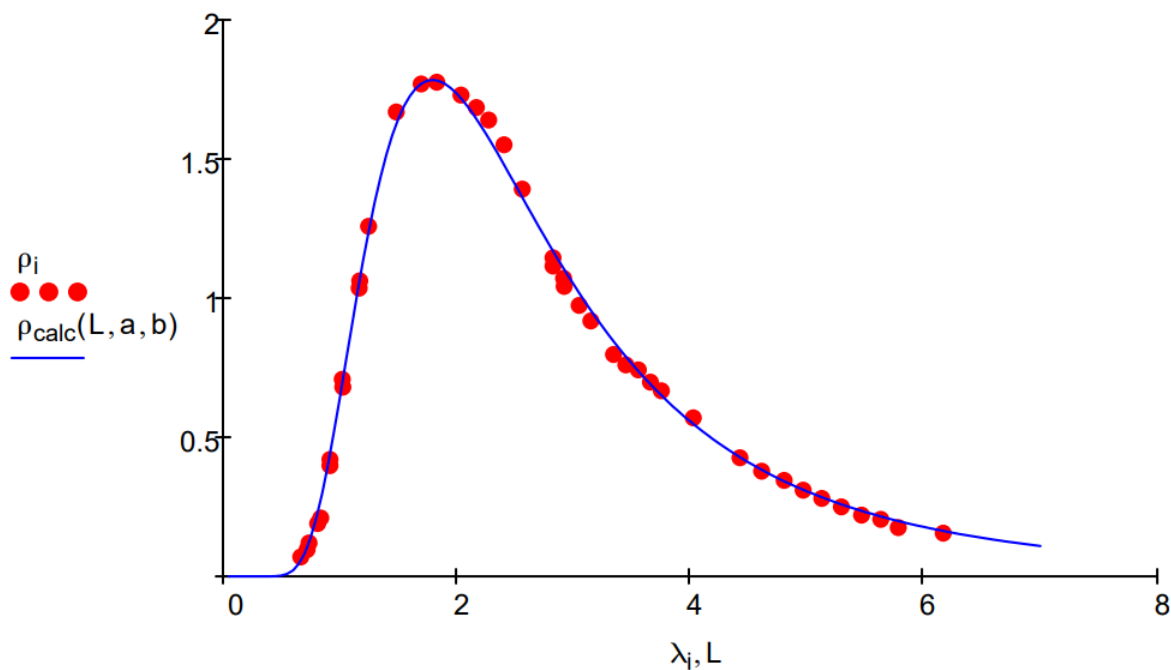
$$\text{seed} := \begin{pmatrix} 5 \cdot 10^3 \\ 10 \end{pmatrix} \quad P := \text{genfit}(\lambda, \rho, \text{seed}, F) \quad P = \begin{pmatrix} 4.715 \times 10^3 \\ 8.906 \end{pmatrix} \quad \begin{pmatrix} a \\ b \end{pmatrix} := P$$

Calculated radiation equation using output parameters:

$$\rho_{\text{calc}}(L, a, b) = \frac{a \cdot L^{-5}}{\left(e^{\frac{b}{L}} - 1\right)}$$

Plot data and fit:

$$L = 0.05, 0.1 \dots 7$$



Calculate Planck's constant using the value of  $b$ , which is equal to  $(hc)/(kT)$ .

$$h := \frac{b \cdot 10^{-6} \cdot 1.381 \cdot 10^{-23} \cdot 1595}{2.9979 \cdot 10^8} \quad h = 6.544 \times 10^{-34}$$

This page titled [1.88: Planck's Radiation Equation Fit to Experimental Data - Another Algorithm](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Frank Rioux](#) via [source content](#) that was edited to the style and standards of the LibreTexts platform.