

Curve fitting

Your assignment for this week will be to find the best fitting parameter values for several different data sets. In order to do this, we will use the fitting function within `gnuplot`.

You should go to the course web pages, and get the three different data sets you are being asked to fit. They will be for: a blackbody's flux per unit wavelength versus wavelength, a pendulum's angular offset versus time and a Hooke's law spring's angular offset versus time. I am not going to tell you in which file corresponds to which physical situation – that will be part of your job for the assignment.

For this, you will have to use three analytic functions:

$$\begin{aligned}x &= A_0 \sin(2\pi ft + \phi) \\ F_\lambda &= \frac{2hc^2}{\lambda^5} \frac{1}{e^{\frac{hc}{\lambda k_b T}}}\end{aligned}\tag{1}$$

You will then need to attempt to fit these functions to each of the data sets. You should show that either the fit is acceptable for that particular data set, and give the best fitting parameters, or that the fit is unacceptable, in which case you should reject that model as a possibility. In this particular case, you can assume that if a fit is acceptable, it is the right answer, because I have told you that there are only four possible models, and that one of them does not have an analytic function associated with it. In that case, you should expect that you will not find any of the models acceptable.

Basic assignment

A successful assignment will include:

1. A short report showing the values of χ^2 for each model applied to each data set, and a statement of which is the correct model for each data set.
2. A few representative plots of the results – you do not need to make all 9 plots of the 3×3 combinations of data and model, but you should give the plots of all of the good fits, and a few of the bad fits, as well as a few residual plots.

Challenge problem

1. Use the Linux `awk` command to create a new file in which you increase the size of the uncertainties on the data point for the pendulum output. Find by how much you need to increase them before a sine wave becomes an acceptable fit to the data. Write a sentence or two about what this means about the ability to distinguish between similar models with low quality data.