

Homework Assignment #8, Telling your Story in Figures and Captions

For this assignment, you will make two figures and write a caption for the second. We will supply data for the first figure, but you have to create the data for the second. Before you start this assignment, review the Montgomery figure criteria presented in *The Chicago Guide to Communicating Science* (which you wrote down as part of HW #7). Note that the assignment consists of two parts; be sure to do both!

1. In this part of the assignment, we will plot some experimental data points together with a theory curve.

The data are:

Scaled Heater Power P ($\text{K}^7 \text{cm}^3/\text{s}$)	Relative Transmission \mathfrak{T}	Temperature (K)
0.203 ± 0.022	0.9986 ± 0.0046	0.45
0.267 ± 0.045	0.9836 ± 0.0071	0.65
0.514 ± 0.051	0.97735 ± 0.00445	0.45
0.312 ± 0.032	0.9655 ± 0.0044	0.55
0.544 ± 0.014	0.96775 ± 0.00705	0.65
0.837 ± 0.053	0.94955 ± 0.00675	0.45
0.966 ± 0.022	0.94955 ± 0.00675	0.65
1.151 ± 0.014	0.9526 ± 0.0045	0.55
1.270 ± 0.011	0.94795 ± 0.00685	0.65
1.533 ± 0.033	0.94155 ± 0.00675	0.65
1.578 ± 0.021	0.924 ± 0.0042	0.55
2.331 ± 0.046	0.90325 ± 0.00655	0.65

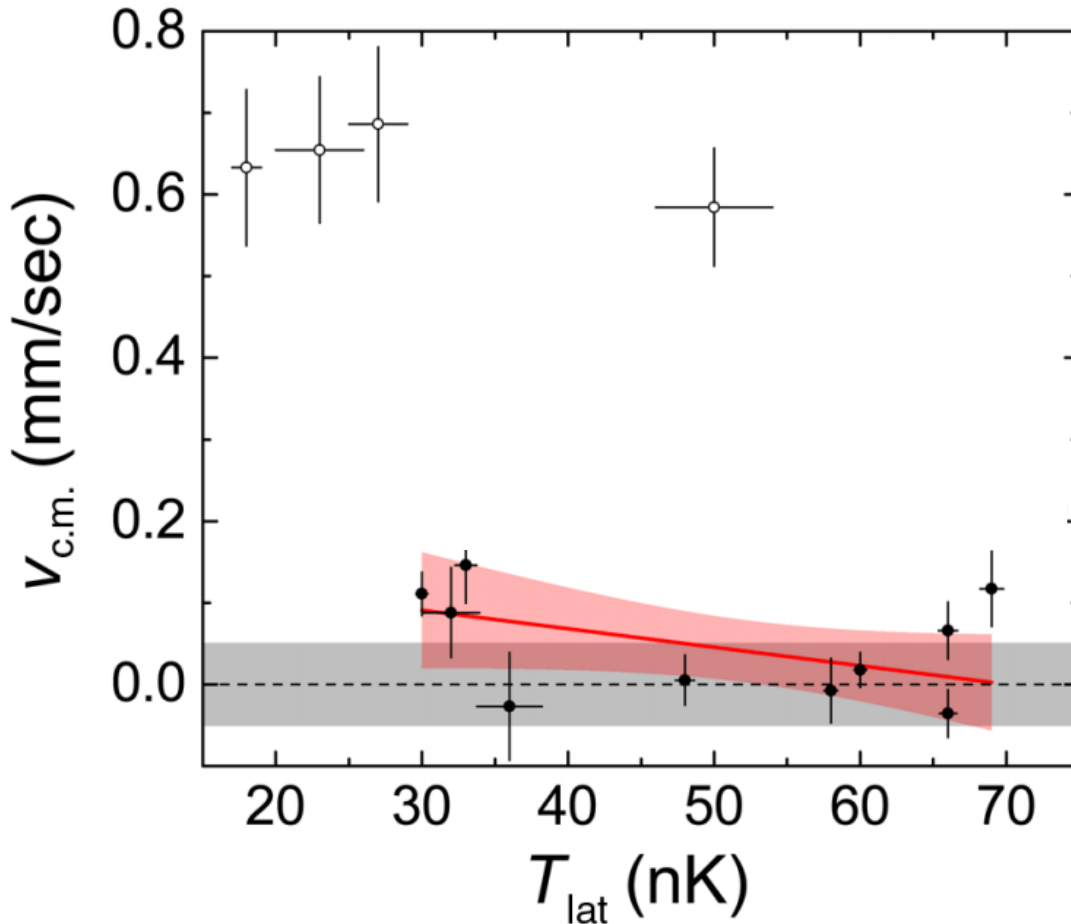
The goal of this experiment was to measure the effect of a heat source in superfluid liquid helium. Helium is a mixture of two isotopes, ^3He and ^4He , with the majority of natural helium being ^4He . Applying heat generates a flow of phonons (i.e., sound waves) that can scatter from the ^3He atoms. Consequently, the liquid ^3He is pushed away from the heater. The density of ^3He is determined by measuring the transmission of a beam of low-energy neutrons. See S. K. Lamoreaux et al., *Europhys. Lett.* **58**, 718 (2002). We invented uncertainties in the quantity P for this homework assignment.

Make a plot of \mathfrak{T} vs. P that includes error bars for each quantity. Don't forget to label the axes and provide units. This table has a mixed set of data. Please plot the data for each temperature using different symbols.

In addition to plotting the data, you should also plot a theory curve $\mathfrak{T} = mP + b$, where $m = -4.77 \times 10^{-2}$ and $b = 0.992$.

Think carefully about how to encode all of the relevant information into the plot in a way that is readily apparent. Pay attention to the size of fonts and line widths: make sure that your plot will be readable if it were published in a journal at a standard column width of 3 in. Using Excel is discouraged. Try Origin (on department computers), MATLAB, Mathematica, or matplotlib in Python.

An example of an appropriate figure drawn from similar data is:



which was reproduced from Phys. Rev. Lett. **114**, 083002 (2015).

2. For this part of the assignment, you will make a plot of the number of articles published on a topic in physics vs. year and a simple illustration of the topic idea. The data should span the years 1970–2015. Pick one of the following topics:

- Qubit
- Superconductivity
- Higgs boson
- Gravitational waves
- Single-molecule fluorescence
- Neutrinos

Use the Web of Knowledge to search on your topic. To access the features you need, you must enter the Web of Knowledge website through the University Library electronic system. Visit <http://www.library.illinois.edu/phx/> to do so. Be sure to include only articles under “Document Types.” On the search results page, you should see an “Analyze Results” link. Use that feature to create the data set that you need.

Create a plot of the number of publications on the topic you chose per year. Choose a format for the plot that you feel best communicates important features of the data. Make sure to label the axes and pay attention to line widths—the figure should be readable if reproduced within a 3-in column.

You can use Excel for this plot if you like. Also, you may wish to try Origin (on department computers), MATLAB, Mathematica, or matplotlib in Python.

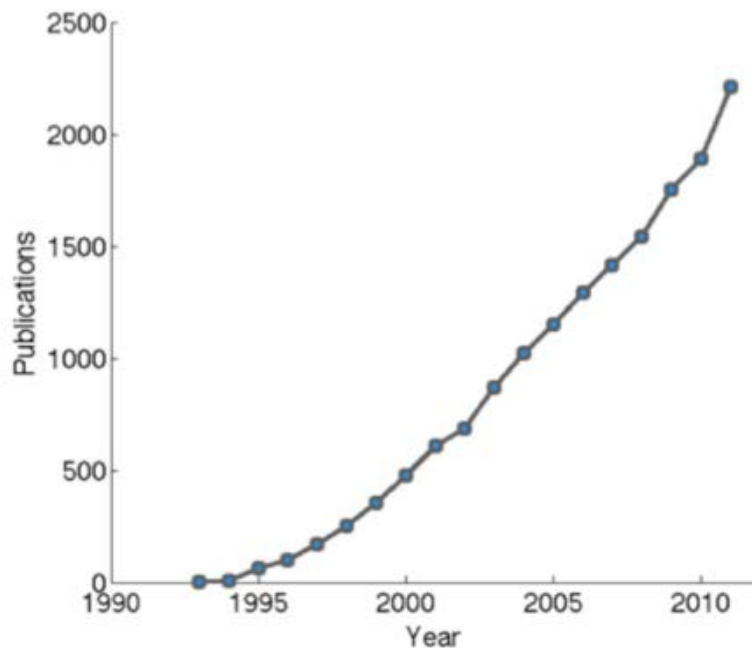
Make a simple line art illustration using vector-format art and file type (.eps, .pdf) that highlights your topic choice. We suggest you use PowerPoint, Inkscape, or Adobe Illustrator so that the illustration remains in a native vector format and is not unintentionally converted to a rasterized format. The illustrations can be color or black and white. Some suggestions for simple illustrations are:

- Qubit: a single particle with spin
- Superconductivity: a (Cooper) pair of electrons
- Higgs boson: an illustration or Feynman diagram for the production of Higgs bosons
- Gravitational waves: a wave on the surface of a liquid or a wave on a “rubber-sheet”
- Single-molecule fluorescence: a glowing molecule
- Neutrinos: an illustration or Feynman diagram for neutrino production beta-decay

Export the illustration as both a vector-format (.eps, .pdf) and rasterized-format (.jpg) file to compare the output.

Write a figure caption that explains what you have plotted and how the data were obtained. If the plot has a significant feature (such as a sudden surge in publications), then comment on why that happened. You may have to do a little research to understand such a feature.

A plot similar to the one you should create looks like:



which was reproduced from <https://leanpub.com/principlesoffmri/read>.

PHYS 496—Fall 2019

Due: **Friday, November 8, 9:00 p.m.** Email your figures in one file to phys496@physics.illinois.edu. Assignments submitted after the deadline will have points deducted and will be ineligible for rewrite points.

Total—150 points