

## Homework Assignment #11, Telling your Story in Figures and Captions

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For this assignment, you will make two figures and write a caption for each. We will supply data for the first figure, but you must 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 #10). Note that the assignment consists of four parts; be sure to do all four!

1. In this part of the assignment, you 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)
$0.203 \pm 0.022$	$0.9986 \pm 0.0046$	0.45
$0.267 \pm 0.045$	$0.9836 \pm 0.0071$	0.65
$0.514 \pm 0.051$	$0.97735 \pm 0.00445$	0.45
$0.312 \pm 0.032$	$0.9655 \pm 0.0044$	0.55
$0.544 \pm 0.014$	$0.96775 \pm 0.00705$	0.65
$0.837 \pm 0.053$	$0.94955 \pm 0.00675$	0.45
$0.966 \pm 0.022$	$0.94955 \pm 0.00675$	0.65
$1.151 \pm 0.014$	$0.9526 \pm 0.0045$	0.55
$1.270 \pm 0.011$	$0.94795 \pm 0.00685$	0.65
$1.533 \pm 0.033$	$0.94155 \pm 0.00675$	0.65
$1.578 \pm 0.021$	$0.924 \pm 0.0042$	0.55
$2.331 \pm 0.046$	$0.90325 \pm 0.00655$	0.65

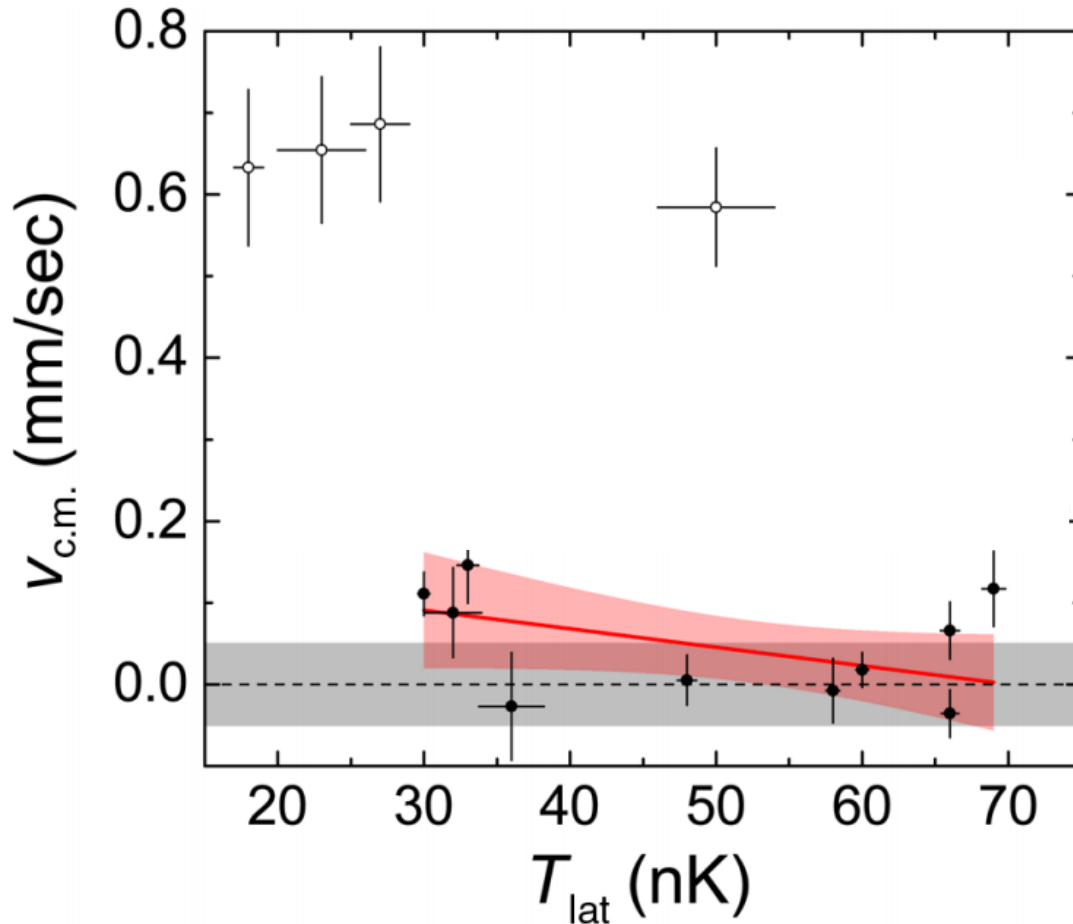
The goal of this experiment was to measure the effect of a heat source in superfluid liquid helium. Helium is a mixture of two isotopes,  $^3\text{He}$  and  $^4\text{He}$ , with the majority of natural helium being  $^4\text{He}$ . Applying heat generates a flow of phonons (i.e., sound waves) that can scatter from the  $^3\text{He}$  atoms. Consequently, the liquid  $^3\text{He}$  is pushed away from the heater. The density of  $^3\text{He}$  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 EWS), 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. **Write a caption** that explains the data that are shown in your figure.

3. For this part of the assignment, you will make a plot of the number of articles published on a topic in physics vs. year. The data should span the years 1960–2020. Pick one of the following topics:

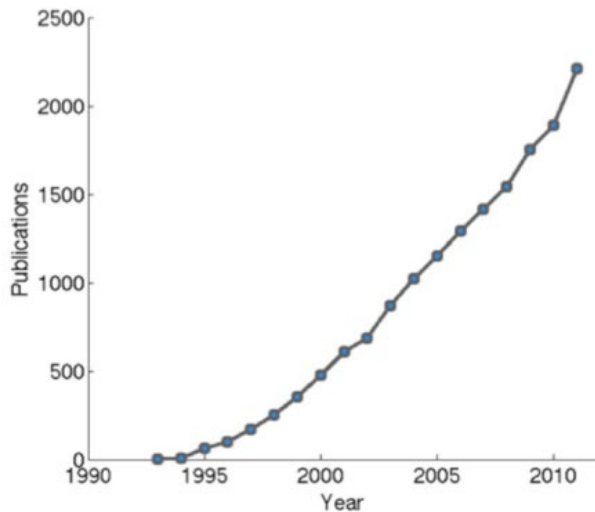
- spintronics
- topological insulators
- quark-gluon plasma
- gravitational waves
- neutron star
- cosmic microwave background

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 vs. year of publication. 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 EWS computers), MATLAB, Mathematica, or matplotlib in Python.

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



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

**4. 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 in one year), then comment on what is responsible for the anomaly. You may have to do a little research to understand such a feature.

Due: **Friday, April 16, 9:00 p.m.** Upload your figures and captions in one file to the [my.physics](https://my.physics) portal. Assignments submitted after the deadline will have points deducted and will be ineligible for rewrite points.

Total—150 points; 50 points for each figure and 25 points for each caption.