Title goes here; Note you are expected to include all sections for write-ups in this template

Author 1, Author 2 and Author 3 (the name of the person who wrote the report comes first, followed by any partners or collaborators)

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Abstract: Other scientists searching for articles will see the title first, then if they are interested, they may read the abstract. This is your second chance to sell what you have (the first being the title) and frame why it is important in approximately 150 words. At minimum, you need to give a brief summary of what you did, quoting values of experimental results if relevant. If there is room you should say why your procedure, experiment, or results are unique. I typically come back to write my abstract after the entire paper has been written.

I. Introduction

Minimum: you need to give the reader a general overview of your objective, how you performed your experiment to obtain that objective (keep it general; don't be to specific, that comes next in section II.), and briefly quote your results. Be general and be brief. Be sure to give any background information or theory if it is needed. Your intended audience is a physics major, not a professor, and certainly not someone who has done the lab before. Note that when including theory, one should minimize the use of equations. Please do not derive equations. If you think a derivation is important, quote the final result and put the details in the appendix. If an equation seems to come out of nowhere, just cite a source where it can be found. You can paraphrase parts of the lab manual or another source and cite it. No direct quotations though. Besides being lame, scientists just don't do that.

Sophisticated: In addition to the above, good introductions answer: So what? Why should anyone read this? What is the big deal about this work, this problem, these results? The author will frame their work in a historical context (what people did before; even just months before), their new method and/or results, and why it is better than previous work. This may not be applicable for all of the labs here since they are "canned" but you should use your liberal arts skills to shoot for a sophisticated intro.

II. Experimental Setup

Some scientists alternatively title this section "Method" or "Procedure". This section describes the experimental setup and procedure so that someone could repeat your experiment. You should not only give the reader the recipe of what you did, but be sure to explain how each part of the experiment fit together. Make sure to **always** include a figure of the experimental setup in this section. I myself sometimes read papers just by skimming to the figure of the experimental setup. This is also the place to include any calibration curves for instrumentation. Contrary to the introduction, this is where you are extremely specific with details. This is where the logic of how you are going to get to your objective really comes together.

III. Results

On its own, this section is boring in the sense that it is cut-and-dry. **Here you display your data, tables, and figures and describe how you arrived at these pretty pictures and numbers. Literally do this!** Choose the figures that tell your story and then concisely describe what is happening in each. You will use language like, "Figure 2. shows the frequency of darts for a given target range. We see that the standard deviation is...." If you didn't do so in the intro, you may have to teach the reader how to interpret the data as you are describing what it is, such as, "A standard deviation of 2 cm means that there is a 68% chance that on another throw, the dart will land $\pm$ 2 cm from the intended target." Do not be afraid to hold the reader's hand. Though you want to be concise, always error on hand-holding. I've rarely heard a reader or scientist complain that a paper was too easy to understand.

In this section you should include sample calculations and/or descriptions of plotting methods and curve fitting. Also, in these labs we will be ascribing uncertainty to all measurements. This section is a good place to describe your method for estimating error, i.e. "the smallest ruling on a ruler reads to 1 mm so we give

an uncertainty of 0.5 mm." One very nice way to write a *Results* section is to leave it "objective" and unbiased in a way it can stand alone so that other readers can make their own conclusions based on facts presented. Scientists don't always do this; they combine results and discussion. This is accepted as well.

Figures

Figures are extremely important. They really say 1000 words and more! They **should be placed within the section most appropriate; not all in one place**. You should **always** have a figure of the experimental setup and place it in that section. The rest will most likely be here in the *Results* section. The only other place to put them is the introduction; sometimes figures are placed in the *Introduction* to help describe theory. I would like figures to be well thought-out, but I do not want you to spend too much time on making them look pretty. After all, we are physicists not graphic designers. The physics department provides Origin. However, you may use any graphics program/interface of your choice. I discourage Excel for graphics since it is a bit limited in this department, but you may use it if this is most comfortable for you and if it allows you to get the job done. See the sample below.

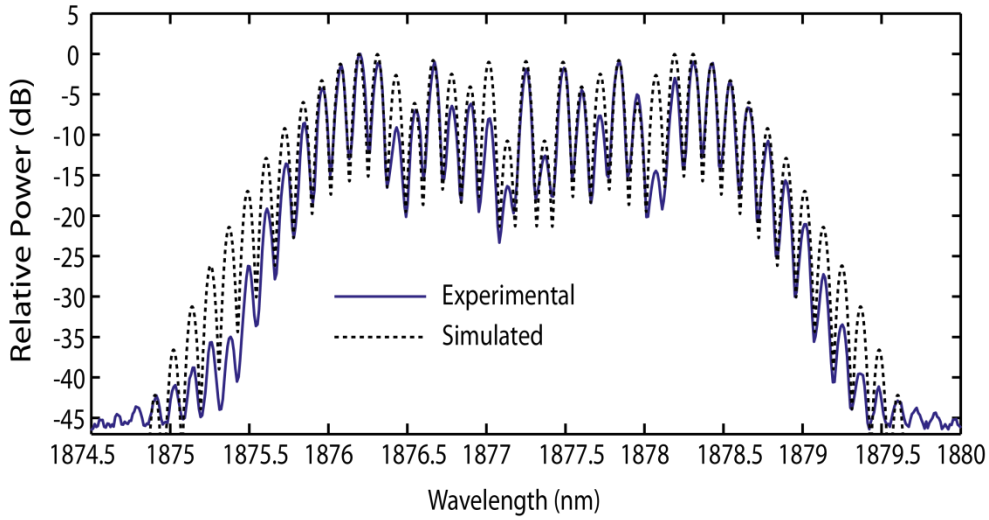

Fig. 2. Solid Blue: Spectrum before the compression fiber as measured by an Ando AQ6375 spectrum analyzer, resolution bandwidth 0.05 nm. Black Dashed: Simulated spectrum.

Figure captions are also a must. They can be as simple as "Fig. 2 Current vs. Voltage", or contain a detailed explanation of what is going on. Just make sure that somewhere in the write-up you cover the necessary detail. It is always nice for a reader if she can decipher your write-up just from the figure and figure captions alone. This doesn't mean you can write crap in your sections, but that it is often wise to give different types of readers multiple ways of understanding your work.

IV. Discussion

This is the second hardest part of a write-up or paper. This is where you make value judgments on your data. Here you say whether you proved your point, whether the errors are small or too large. This is where you explain any unexpected phenomena. This is where you explain to the reader why your method leads you to certain conclusions. **Remember, you are a scientists. Any value judgment must be accompanied with quantitative or analytical reasoning**. These are phrases that will get you zero in this section "The experiment was successful." "The data were good." **Here are the types of sentences you should be writing** instead. "A 0.1 % error from the expected value indicates the experimental method can be trusted..." or "Although theory predicts the data to be linear, we plot a quadratic trend. This can be explained by..."

References

[1] A. Papoulis, *Systems and Transforms with Applications in Optics*. New York: McGraw-Hill, 1968, pp. v-vii, 200-204.

[2] S. A. Akhmanov, A. P. Sukhorukov, and A. S. Chirkin, "Nonstationary phenomena and space-time analogy in nonlinear optics," *Soviet Physics JETP*, vol. 28, pp. 748-757, 1969.

[3] L. F. Mollenauer and C. Xu, "Time-lens timing-jitter compensator in ultra-long haul DWDM dispersion managed soliton transmissions," presented at Conference on Lasers and Electro-Optics, Long Beach, 2002.

[4] "Mighty Ohm Geiger Counter," (URL: http://mightyohm.com/blog/2012/02/tutorial-geiger-counter-data-logging/).

Instructions on references (delete this entire section these are just directions)

For the labs here, most of your citations will come from the introduction section which gives the reader important background on your work and its context. You might only be citing the course book or even just the lab manual for some of the write-ups. Use citations where more background information may be needed, where you have borrowed a technique or information, or have dropped an equation out of thin air. Note the numbers need to be in the text itself such as, " we use a best fit line by method of least squares [1]…" Then the reader knows which sentence/thought goes with which reference at the end of the paper.

Styles vary for different journals. Just pick your favorite scientific journal style and be consistent. I like the IEEE style which gives a lot of information. Some examples of this style are:

Book

[1] A. Papoulis, *Systems and Transforms with Applications in Optics*. New York: McGraw-Hill, 1968, pp. v-vii, 200-204.

Journal Article

[2] S. A. Akhmanov, A. P. Sukhorukov, and A. S. Chirkin, "Nonstationary phenomena and space-time analogy in nonlinear optics," *Soviet Physics JETP*, vol. 28, pp. 748-757, 1969.

Conference Proceeding

[3] L. F. Mollenauer and C. Xu, "Time-lens timing-jitter compensator in ultra-long haul DWDM dispersion managed soliton transmissions," presented at Conference on Lasers and Electro-Optics, Long Beach, 2002.

Website

[4] "Mighty Ohm Geiger Counter," (URL: http://mightyohm.com/blog/2012/02/tutorial-geiger-counter-data-logging/).