Manuscript Title

Author 1 in Alphabetical Order, Author 2, and Research Advisor Name

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The abstract should summarize the papers contents as concisely as possible. It should make the goals of the paper clear, and state the main results or conclusions directly (not merely allude to them vaguely). The abstract should be written so that any physicist, regardless of area of specialization, can read and understand it.

Abstracts must be self-contained. They may not contain references to endnotes.

The **introduction** begins with the key concepts addressed by the paper. In a measurement experiment, this means a review of the meaning measurements in written English (there are typically no equations or symbols in the introduction). The historical context of the measurement should be addressed, reminding the reader about why this experiment is important. You should cite prior work and describe how your paper is connected to it. This piece is important for connecting your research to the body of established work and will be vital for putting your research into a broader context [1]. Citations in our format should appear before the period at the end of a sentence and multiple, related papers may be cited together [2, 3].

The next piece of the paper is to introduce the specific **model** or physics concepts relating to your experiment. You should begin with concepts that would be familiar to any undergraduate student and work from there to the concepts needed to understand the experiment. The driving force behind the theory explanations should be to help the reader understand the methods and results of the experiment.

As you introduce equations, you should first define all variables, such as the mass m of an object, its acceleration $\vec{a}$ and the net force applied to the object that causes the acceleration, $\vec{F}_{\text{net}}$. Then, introduce the equation that relates them together, known as Newton's second law:

$$\vec{F}_{\text{net}} = m\vec{a}. \tag{1}$$

Furthermore, any time you reference an equation in the text, like Eq. (1), make sure you include the appropriate formatting around the equation reference so that it is clear what you are referring to. It is possible to reverse this order and present the formula first, then describe the symbols, though I prefer that you introduce the symbols first.

The model section often includes a figure that helps define the parameters or describe the experiment. All figures should be described in the body of the paper and you should reference the figure in the text. The model figure (see Fig. 1) should help describe your experiment schematically. The figures are automatically placed on the page using the code `[htpb]` . This tells the compiler to put the figure "here", "at the top of the page", "at the bottom of the page", or "on its own page". You should use that code for all your figures. It is almost always better to use a line drawing than to show some kind of picture (which is often harder to understand).

After defining your model for the reader, you next describe the specific experiment **meth-**

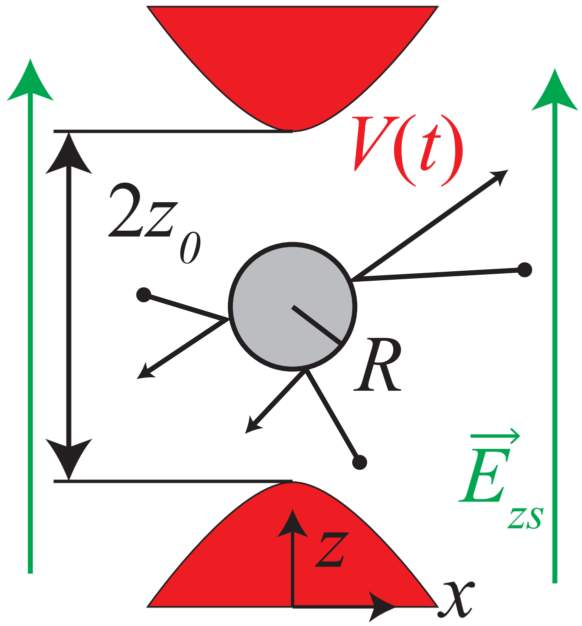

FIG. 1. Model figures must be clearly labeled with a descriptive caption. The caption should describe the meaning of the parameters shown in the figure (such as z_0 and R in this figure). The graphics file must be saved as a PDF with no extra white space. Figures can be drawn in Adobe Illustrator, the page can be set to slightly larger than the drawing, and the file can be saved as a PDF. Note that if you choose to use color in your figures, you should make sure that they still print clearly in grayscale - most journals charge hundreds of dollars extra to print in color (though the color may appear in the digital versions for free).

ods you used to make the measurement. In this part of the paper, you are making the transition from the model formula to the specific details of your actual measurement procedure and equipment. The methods section is not a lab manual, describing a step-by-step reiteration of everything that you did, but is rather an overview of the different parts of the experiment from a conceptual point of view. By reading the methods section, a general reader should be able to gather up equipment that does the same things, begin with the same initial conditions, and be able to repeat your measurements. The methods section will often include diagrams and illustrations that show, in graphical form, key experiment setups as shown in Fig. 2. Each diagram should be an integral part of the description. Each variable and symbol in the diagrams are described in detail in both the methods figure caption as well as in the body of the text.

Once the reader has a good idea of the methods used to take the data, the **data** are

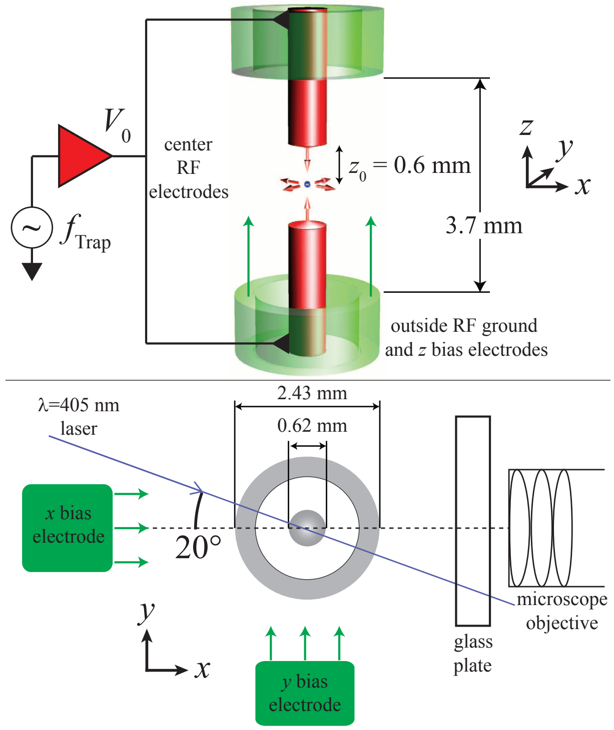

FIG. 2. Method figures must be clearly labeled with a descriptive caption. The caption should describe the action or purpose of the equipment shown in the figure. Include axes and dimensions as necessary. Again, these figures are typically drawn in Adobe Illustrator and saved as PDF files. There should be a clear relationship between your model figure and your methods figure. A reader will often jump from one figure to the next, reading the captions as a quick way of scanning the paper.

then presented, giving the reader the opportunity to assess the quality and validity of the data. The data are presented in what is determined to be the most honest method. This could mean presenting the raw data as well as data that has been processed. It is helpful to the reader to present the data as in Fig. 3 (or a sample of the data) in the format that follows from the methods section. All data figures should be referenced in the text. Any data processing should be fully explained in the introduction as part of the theoretical background of the experiment. All data in a physics paper must have uncertainties associated with them and these are reported following the standard conventions. Data can often be presented graphically, with error bars. These data graphs provide the reader with a good, visual interpretation of the results of the experiment.

The next section is the **analysis** of the data. This often includes the experimentalist's

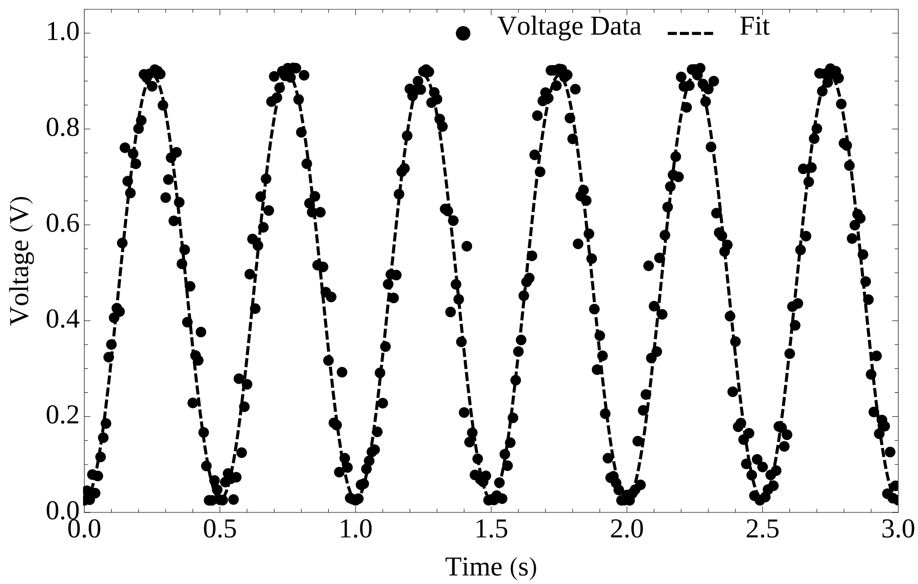

FIG. 3. Data files must also be clearly labeled, axes must be labeled, there must be units on the axes, the data must be in discrete, point form, any fits must be in line form, and if multiple graphs are shown together, there must be a legend (internal on the graph). If a legend does not fit, the different graphs must be identified in the caption. This type of figure can be produced using Mathematica and exported as a PDF. Note: do **NOT** use Logger Pro or Microsoft Excel to produce data figures. The quality of the figures produced by these apps is unacceptable for publication.

interpretation of the meaning of the data. If there are multiple stages of data processing, these will often be described in the analysis section. The physical source and meaning of the uncertainties in the measurements are described in this section.

A scientific paper ends with a **conclusion**. This is a summary of the key concepts covered in the paper, along with a conceptual analysis of the findings of the experiment (no numbers). The conclusion section is also the place to make suggestions for possible improvements on the experiment and suggestions for possible follow-up experiments. Remember that a scientific paper becomes part of an on-going dialog between scientists and will be used by others as a launching point for further studies.

[1] Freeman J. Dyson, "Feynman's proof of the Maxwell equations," Am. J. Phys. **58** (3), 209211 (1990).

[2] D. J. Berkeland, J. D. Miller, J. C. Bergquist, W. M. Itano, and D. J. Wineland, "Minimization of ion micromotion in a Paul trap,", J. Appl. Phys. **83**, 5025–5033 (1998).

[3] E.R. Post, G.A. Popescu, and N. Gershenfeld, "Inertial measurement with trapped particles: A microdynamical system," Appl. Phys. Lett. **96**, 143501-1–3 (2010).