Superconductor Formal Report

Though the experiment was done in groups, the report will be written up individually. This is to allow you each to work on **your** writing skills. Though you are writing the paper, you are encouraged to have others read your paper and give you feedback on it.

You will turn in the report assignments in the following stages.

1. The first thing you will turn in is an annotated bibliography of Bi-Sr-Ca-Cu-O superconductors and Pb-doped Bi-Sr-Ca-Cu-O superconductors. The bibliography will consist of at least five references and the annotations of one paragraph per article summarizing the most important points of the article.

   These articles should focus on the first measurements (∼1986-1990) as these are the closest to the types of measurements we are making. This will comprise 8% of the grade for the paper.

2. The First Report is the best paper you can write. It is to be a polished paper rather than a rough draft. The instructor will read, edit, and grade this version for 40% of your overall paper grade.

3. After you receive the graded first report, you will then have about a week to revise your paper and turn it back in as the Final Report. At the end of that week, you will turn in your final paper, and it will be graded for the remaining 52%. The instructor will be happy to read your paper again before the Final Report due date and give you feedback.

1.0 Grading

Your paper grade will be determined roughly as follows

- Content: completeness, relevancy, and insight – 50%.
- Style: clarity, flow, and appropriateness for genre – 30%.
- Format: (see organization below) – 20%.

2.0 Annotated bibliography instructions

You are to find at least five journal articles regarding measurements of the parameters of Pb-doped BSCCO superconductor ($Bi_{2-x}Pb_xSr_xCa_{y-1}Cu_yO_\delta$ or Bi(Pb)-Sr-Ca-Cu-O). At least three of these papers must be in addition to any used from the list of references below.

Your bibliography will consist of the complete references for these papers accompanied by a paragraph for each one describing the main results reported in that paper.

Note that when you give the name of a journal in a citation it is usually expected that you use a standard abbreviation for that journal (like "Appl. Phys." for the journal "Applied Physics"). You can find a list of standard abbreviations at http://images.webofknowledge.com/images/WOS/A_abrvjt.html. There is another list devoted to just journals in Science and Engineering at http://woodward.library.ubc.ca/research-help/journal-abbreviations.

Below are some sample papers on BSCCO for you to peruse. These links are to the abstracts for the articles. If you are using a computer on BYU campus you should be able to access the full text from the "PDF" or "Download PDF" link on the page. If you are not on campus, you can access the full text by authenticating through the BYU library website (or some other site that has digital subscriptions to the specified journals). You can then access the articles using their links and finding the provided references.

- H. K. Lee, *et al.*, "Preparation and properties of Pb-doped Bi-Sr-Ca-Cu-O superconductors," *J. Appl. Phys.* **66**(4), 1881-1883 (15 August 1989) https://doi.org/10.1063/1.344370
- K. Togano, *et al.*, "Properties of Pb-doped Bi-Sr-Ca-Cu-O superconductors," *Appl. Phys. Lett.* **53**(14), 1329-1331 (3 October 1988) https://doi.org/10.1063/1.100452
- S. M. Green, *et al.*, "Effects of compositional variations on the properties of superconducting $(Bi,Pb)_2Sr_2Ca_2Cu_3O_\delta$," *J. Appl. Phys.* **66**(2), 728-734 (15 July 1989). https://doi.org/10.1063/1.343546

These papers can be useful in finding other papers by looking for papers they have cited or for papers that have cited them. You may find the BYU Library Subject Guide for Physics and Astronomy (`http://guides.lib.byu.edu/physics`) useful in finding other papers. Look under the "Finding Articles/Using Databases" and "Finding Information on the Web" tabs for a wide range of online sources for locating scientific articles.

My favorite index is the "Web of Science" (on the list you get if you click on the tab "Finding Articles/Using Databases") which includes the rather extensive Science Citation Index. It seems to do a better job of finding papers related to physics than others I have tried. Your mileage will vary.

3.0 The formal report

You will write a report that is in the format and style of a journal article. The format

is often a function of the target journal and the particular field. It is expected that you will use a format that is appropriate for your chosen field of study.

3.1 Preparing to write

You may want to consult A Brief Guide to Writing at BYU (`http://writing.byu.edu/brief-guide-writing`) before you begin your paper. It has a lot of good information on writing. Especially read the section on "Writing about Research" (`http://writing.byu.edu/writing-curriculum/brief-guide-writing/writing-research`).

Chapters 8, "Writing and Speaking Skills," and 10, "Presentation and Publication of Papers," in Graduate Research (Fourth Edition), A Guide for Students in the Sciences (Robert V. Smith, Llewellyn D. Densmore, Edward F. Lener, Academic Press, 2016, `http://www.sciencedirect.com/science/book/9780128037492`) include some valuable information on the writing and publishing process.

Also, look over the instructions for preparing a manuscript for AIP journals (`http://publishing.aip.org/authors/preparing-your-manuscript`). There is a link on Learning Suite under `Content` ⇒ `Superconductivity Measurements Lab` ⇒ `The Formal Paper` to this guide. Although this guide is specific to AIP journals, it will give you useful guidelines for a paper intended for nearly any journal. This document also includes a link to guidelines for specific AIP journals such as the Journal of Applied Physics. You may also find the AIP Style Manual (`https://www.physics.byu.edu/courses/experimental/docs/physics240/AIP_Style_4thed.pdf`) useful because it contains extensive information useful in formatting scientific papers (it is considered "out of print" but remains available on the Internet because it is so useful).

Some other style guides that may be useful to you depending on your chosen field of study:

- American Astronomical Society, Astronomical Journal, and Astrophysical Journal
  (`http://journals.aas.org/authors/manuscript.html`)
- American Journal of Physics
  (`http://ajp.dickinson.edu/Contributors/manFormat.html`)
- American Chemical Society
  (`http://pubs.acs.org/isbn/9780841239999`). This can also be found at `https://doi.org/10.1021/bk-2006-STYG`.
- American Geophysical Union
  (`http://publications.agu.org/author-resource-center/`)

- Author guidelines and tools for the IEEE (Institute of Electrical and Electronics Engineers)
  (`http://www.ieee.org/publications_standards/publications/authors/index.html`)
- Journal Publishing Help for the ASME (American Society of Mechanical Engineers)
  (`http://journaltool.asme.org/Help/AuthorHelp/WebHelp/JournalsHelp.htm`)
- American Mathematical Society
  (`http://www.ams.org/publications/authors/authors`)
- Association for Computing Machinery
  (`https://www.acm.org/publications/authors/information-for-authors`)

Refer to "The NIST Guide for the use of the International System of Units" (`https://www.nist.gov/physical-measurement-laboratory/special-publication-811`) for information on how to properly express units in your paper. There is a summary page regarding the use of SI units at "Writing with Metric Units (August 2016)" (`https://www.nist.gov/pml/weights-and-measures-writing-metric-units`).

"Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results" (`https://www.nist.gov/pml/nist-technical-note-1297`) is useful for properly reporting uncertainties in your results.

You can learn a great deal from reading actual scientific journal articles. It is usually best to look at articles from your targeted journal since some aspects of the style will vary between journals.

3.2 Medium and length

The report must be compiled in a digital format (journals rarely accept anything other than digital files now). Figures and graphs must be computer generated. It will be submitted electronically.

Double-space your report to allow for editing and comments. It will likely be between five and seven pages long.

3.3 Audience

The primary audience for this assignment is a scientific peer that has experience in general physics but not specific knowledge about this experiment or the materials and measurement techniques used. The secondary audience is your instructor in the course who will grade the report.

3.4 Content and organization

You should develop a detailed outline for your report following the format laid out below. It is permissible to modify the outline as appropriate for your report and content. This will organize your report in a fashion commonly used for reporting scientific results.

1. Title page containing, at a minimum, the title of the article and the name(s) and affiliation(s) of the author(s).
2. Abstract (which can be put on the title page).

   This is one paragraph stating:

   - The problem or question addressed by the research
   - The most important results
   - The principal conclusions

   You can include a few words about which method you used to get the results, but no details. Don't put the motivation for the research here. Don't review previous research.
3. Introduction

   - A review of the literature describing previous work on the problem you are investigating. You should focus on reviewing the articles that are closest to the work you are presenting.
   - Briefly state the nature and scope of the problem you are investigating. Include the motivation for the investigation and the background physics needed to understand it.
   - Briefly state the methods of your investigation and your principal results. Do not keep the reader in suspense.
4. Experimental (or theoretical/computational) Methods (sometimes Materials and Methods)

   - Description of experimental, computational or theoretical techniques.
   - Details of how techniques were implemented. You must give the reader the details needed to repeat the experiment and get the same results you did; reproducibility is essential for good science.

Do not put results in the methods section.

5. Results

   - Concise, clear presentation of data and observations in words, tables, and graphs.
   - Put each table and graph in a figure containing a table or figure number and caption.

     The caption should be a standalone description of the figure or table. Avoid repetition of figure data or captions in the body of the text.

6. Discussion of Results. This is the often the hardest section to get right. Day recommends the following points: [Robert A. Day, How to write & publish a scientific paper, (Oryx Press, Phoenix, 1998)]

   - Present the principles, relationships, and generalizations shown by the results.
   - *Discuss* the results. Don't recapitulate them.
   - Point out exceptions or lack of correlations and define unsettled points.
   - Show how your results and interpretations agree or contrast with previously published work.
   - Don't be shy to discuss the theoretical implications of your work, as well as possible practical applications.

     Exception: Applications that apply to the field in general and have been previously described should be placed in the introduction.
   - State your conclusions as clearly as possible.
   - Summarize your evidence for each conclusion.

7. References (for articles cited): use a format you've seen in a paper from the field you are writing in or follow the AIP style guide.

   Do not include your annotation paragraphs from the annotated bibliography submitted earlier in the bibliography for your paper.

Illustrations and graphs are often very helpful and sometimes essential in the introduction, methods, results, and discussion. If you have a significant amount of data or need to show relationships, graphs are essential.

Don't leave out the figures just because your paper is getting too long. There are no page charges for papers submitted as part of the class. There is no grade penalty for long papers, but there is a penalty for papers that are inadequate because something is left out.

3.5 Report dos and don'ts

Do describe your experimental techniques in detail. Describe each of the procedures that lead to the results you got. Data is not useful if the procedure used to obtain it is not understood or documented. If there was a significant issue in getting your experiment to work, it should be an issue in your write up. Someone else should be able to reproduce your measurement from your write up and the papers referenced by it.

Do use drawings of your apparatus if appropriate.

Do label tables and graphs. Each table or graph should include units, error bars (if appropriate), a unique figure or table number, and a caption. The caption should be a complete, standalone description of the table or figure without reference to the body of the text.

It is essential that any text on figures be large enough to be legible. The standard usually used is that the text must be at least 8 pt (about 1/8" tall) when the figure is reduced to journal publication size. A common journal size is 8.5 cm or $3\frac{3}{8}$" wide for a double column format (figures are usually printed in a single column although they can be wider in some journals).

Do put units and uncertainties on **all** data.

If you haven't consulted them yet, read the two NIST documents The NIST Guide for the use of the International System of Units (`https://www.nist.gov/physical-measurement-laboratory/special-publication-811`) and Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results (`https://www.nist.gov/pml/nist-technical-note-1297`).

Do carefully review the experimental literature on this material (BiPbSrCaCuO) and particularly those describing measurements similar to those you have made. This careful review makes a huge difference in the quality of the reports.

Do break your experimental section down into subheadings on each component and technique.

Don't write about what you were not able to do or what you wanted to do.

Do focus on what you did.

Don't come out of character and talk about why the lab was designed. Write it like a real journal article.

Don't use long tables of data. Your plots summarize the data. Tables should include only relevant results that cannot be displayed graphically.

Don't make generic statements. "These are good results" or "this needs to be done carefully" are of no help.

Don't include tables or graphs you never refer to by name or number in the article.

Don't make jokes. Your tone should be straightforward and professional. (Do make jokes in talks).

Don't be obsessed with using only passive (3rd person). Use we or I once in a while, particularly when pointing out your main results and conclusions.

Don't structure it like a travelog or personal journal. "We did this, then we did this, and then we did this" is not only painful to read but is rarely the cleanest way to write up your work. In many cases, the order in which things were done is unimportant.

Don't neglect the results section; this is the heart of your report. Do guide your reader through the details of the results in words.

[Modified: January 16, 2019]