Writing Scientific Papers

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Phys 3110
Structure of paper

• Title
• Abstract
• Introduction (& Theory)
• Experimental method
• Results
• Analysis
• Discussion
• Conclusion
• References
Title

• Identifies experiment adequately and briefly, not more than ten words
• Put keywords identifying the work in the title
• Title will be used to classify your work
• Cites author first, lab partner(s) second, course, and date
Abstract

- Briefly summarizes the full report concisely and effectively, ≤ 100 words
  - Enables those who work in the subject to decide whether they want to read the paper
  - Provides a summary for those who have only a general interest in the subject
- Should indicate the general scope, final result with uncertainty, and main conclusion
Introduction

• Establishes concept of experiment
• Establishes context of experiment; Relation of the experiment to any previous work
• States purpose, and hypothesis if appropriate; What is the objective?
• Theory: Includes all equations used, defines all variables
• Introduction should bring reader to the point where he is ready to hear about your experiment
• Aim at a general physicist, not an expert
Constraint on the post-Newtonian parameter $\gamma$ on galactic size scales

...“post-Newtonian gravity parameter $\gamma$ (e.g. [4,5])”...

Fermat time delay surfaces [10,11]. By extremizing the sum of the Shapiro and geometric time delays, one obtains the “lens equation” that relates position in the observed image plane to location in the unobserved and unlensed source plane:

$$\tilde{\theta}_s = \tilde{\theta} - \frac{(1 + \gamma)}{2} \nabla \psi(\tilde{\theta}).$$

(2)

Here, $\tilde{\theta}_s$ is the angular source location, $\tilde{\theta}$ is the angular location of the image, and $\psi(\tilde{\theta})$ is a scaled line-of-sight integral of the Newtonian gravitational potential of the lensing object (see Eq. 48 of [12] for the explicit definition of $\psi$ in this context). The Einstein radius, defined by $\tilde{\theta}_s =$
Experimental Method

- Describes materials & equipment used (in paragraphs, not lists)
- Might show a diagram of the apparatus
- Describes procedures (in paragraphs, not lists)
- Briefly gives enough detail to allow replication of the experiment
- Uses own words, not a copy of the manual
- Amount of detail depends on scope of journal
- Do not aim the paper at other experts using the same apparatus, aim at a general physicist
Results: Measurements

• All necessary results reported, with errors – Instructor should be able to confirm analysis using the data presented

• Do not reproduce the second best data set with the caption “typical set”

• Uses text to describe data.

• When appropriate, use tables or graphs.

• Refer to any tables and/or graphs in text.

• Any tables/graphs have captions/titles, appear in order mentioned in text, and are correctly labeled
Results

“…we normalize the load by the critical energy release rate at the Griffith criterion $G_c$ tabulated in Table I.”

<table>
<thead>
<tr>
<th>TABLE I. Griffith critical load, measured lattice trapping, and lattice-trapping-model parameters for Si (111) fracture.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>$G_c$ (J/m$^2$)</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>$R$</td>
</tr>
<tr>
<td>$s_{bb}$ (Å)</td>
</tr>
<tr>
<td>$s_{eq}$ (Å)</td>
</tr>
</tbody>
</table>

Results

“...Taking account of the nondegeneracy for $n \leq 2$ gives the solid curve in Fig. 1, which includes prominent well known resonances. Including nondegeneracy for $n \leq 4$ [26] gives the dotted curve in Fig. 1.”


FIG. 1. Energy dependence of the differential cross section for $\pi^+$ photoproduction at $\theta = 90^\circ$. The solid curve denotes degeneracy breaking for $n \leq 2$, while the dotted for $n \leq 4$. The empty circles are old data from Ref. [20], and the solid dots are new data from JLab [21].
Diagrams, graphs and tables

• Graphs should be bold and clear, with large labels, and units.
• Tables stand out, so the reader can find the results easily. Include units.
• Figures get a caption below. Tables get a title above.
• Must be referred to in the text, number in order of reference.
Analysis: Calculations

- Show or summarize all necessary calculations— instructor should be able to confirm calculations based on what is discussed
- Refer to equations given in Introduction
- Uses text to describe analysis, refers to any tables and/or graphs
- Explain calculations, for complicated work, give an example
- Include error analysis, explain what error you are using
- Give final result, with error
Discussion

• Discusses scientific content & context of results, and relates them to the objective and/or hypothesis
  – Comparison with other similar measurements
  – Comparison with relevant theories
  – Discussion of the state of the problem in the light of your results
  – Did you get what you expected, within error bars? Why / why not?
  – What did you learn?
  – What could be improved upon?
Organization

• Results, Analysis, and Discussion: 1, 2, or 3 sections
Conclusion: Summary

• The conclusion is the counterpart of the objective in the introduction – did you achieve it?
• Summarize the report
  – What you did
  – Repeat final numerical results, with error
  – Main points of discussion
References

• Every report will have at least one, the lab manual
• Reference for equations, figures, background info…
• Number in order referred to in text
• Use a standard format
• See Sample MS Word report on my web page
• see library course page:
  http://guides.lib.uh.edu/phys3313
• LabWrite, link from my web page
• UH Writing Center
Resources

• Lab Manual
• My web page: Lab Report Resources & Links
  – Sample MS Word report & .tex file
  – library course page: http://guides.lib.uh.edu/phys3313
  – Report Rubric
  – LabWrite
• UH Writing Center
My References

Practical Physics, G.L. Squires, Cambridge University Press