# De La Salle University
# Physics Department Style Guide

2002

Adopted from

Friedman, K., 2001, Ed., *Reviews of Modern Physics Style Guide* (The American Physical Society, College Park, Maryland), 4th Edition.

1990 *AIP Style Manual* (American Institute of Physics, New York), 4th Edition

Waldron, A., Judd, P., and Miller, V., 1993, Eds., *Physical Review Style and Notation Guide* (The American Physical Society, College Park, Maryland)

# De La Salle University Physics Style Guide

## CONTENTS

# De La Salle University Physics Style Guide

## I. INTRODUCTION

This guide is intended to help physics students of De La Salle University who are writing their thesis or dissertation. The decision to adopt a style manual was made with the view of making students learn to write in a style appropriate for publishing in international physics journals. The *AIP Style Manual* covers a good number of physics journals, but they mostly feature short articles, so that the style is not totally suited to an extended work like a thesis or dissertation. Since reviews journal articles best approximate a thesis, it was decided by the Physics department of De La Salle University to come up with a style guide based largely on the *Reviews of Modern Physics Style Guide*. Appropriate adoptions were made from the *AIP Style Manual* and the *Physical Review Style and Notation Guide*.

Information on this guide covers style instructions for the parts of a thesis, for grammar, punctuation, spelling, hyphenation and abbreviation of units. Advice on preparing figures, tables and equations are also given. A short paper on "Writing a Better Scientific Article" is included.

## II. GENERAL INSTRUCTIONS

Manuscripts must be in American English, printed double-spaced throughout, on La Salle paper. Machine print-outs may be included in their original form in the appendix. Use one side of the page only. Text is typed in 12 pt. Times New Roman, and paragraphs are indented. Number all pages consecutively on the upper right corner of the paper, on the same line as the "De La Salle University" head but outside the right margin. Small roman numerals (i, ii, …) is used beginning with the title page up to the list of figures and tables. Hindu-Arabic numerals (1,2,…) is used for the main body of the thesis up to the references.

A thesis proposal generally consists of the following:

> Title Page
> Approval Sheet
> Table of Contents
> Chapter 1: *Introduction*
>        - Background and Motivation of the Study
>        - Objectives of the Study / Statement of the Problem
>        - Scope and Delimitation
>        - Significance of the Study
> Chapter 2: Review of Related Literature
>        Framework of the Study
> Chapter 3: Methodology / Experimental Design

Chapter 4:    Expected Output
Resource Requirement
Timetable

References

and a thesis/dissertation generally contains the following:

a. Title Page
b. Approval Sheet
c. Abstract
d. Acknowledgments
e. Table of Contents
f. List of Figures
g. List of Tables
h. Chapter 1 : Introduction
i. Chapter 2 : Review of Related Literature and Framework of the Study
j. Chapter 3 : Methodology
k. Chapter 4 : Results, Discussion and Analysis
l. Chapter 5 : Summary of Findings, Conclusions and Recommendations
m. Appendices (if necessary)
n. List of Symbols and/or Acronyms (optional)
o. References
p. Supplementary material in CD-ROM

Since the thesis will be going through several drafts, students are advised to use word-processing software like WORD, or typesetting software like Latex. It is also good to have several electronic copies of the draft kept in different places to protect against accidents and computer virus infection.

## A. Title

Begin the first word with a capital letter; thereafter capitalize only proper or trade names and chemical symbols. Words may be used in place of greek symbols in titles. The use of nonstandard abbreviations and acronyms is not allowed. (see appendix for sample title page)

## B. Author(s)

If there are multiple authors, they should be ranged one above the other. Capitalize the first letter of each name, but not the whole name.

## C. Abstract

The abstract should be a concise summary of the subjects treated in the thesis. It is normally used as a basis for indexing and may be published separately in dissertation abstract journal. Therefore it should be completely self-contained (no footnotes or numbered references) and should avoid the use of "I" or "we." Substitute "the author(s)" or passive constructions for the first person. The abstract should consist of no more than 500 words. The first line is not indented.

## D. Acknowledgments

The acknowledgment section follows the abstract and precedes the table of contents. A centered principal heading (level one) is used for this section, but the section is not numbered. Note that "Acknowledgments" is spelled without an *e* between the *g* and the *m*. Acknowledgment of financial support (for funded projects) is listed at the end. Thanks should not be directed to examiners for the performance of their refereeing duties.

## E. Table of Contents

Every titled chapter, section and subsection of the paper should be listed here, using exactly the same wording as is used where it appears in the main body. Unnumbered sections like Acknowledgments and References begin flush with the left margin. Page number for each section and subsection is flushed right.

## F. List of Figures and List of Tables

Every figure and table in the thesis should be listed here, using exactly the same numbering and caption as they appear in the main body. Page number for each figure and table is flushed right.

## G. List of symbols and/or acronyms

The inclusion of a list of symbols is optional. If you choose to have one, it precedes the References and is an unnumbered section. Arrange the list alphabetically, giving the roman alphabet first (all capitals, then all lower case), then the greek alphabet. Each symbol should begin flush with the left-hand margin and be in italics. The definition of each symbol begins ten spaces in from the left margin with a lower-case letter (proper names, of course, should be capitalized). If the full definition will not fit on one line, the additional lines should also begin ten spaces from the left margin.

**III. CHAPTER AND SECTION HEADINGS**

Chapter headings are placed on the same page as the text of the chapter. They are centered at the top of the first page of the chapter. The chapter heading is placed on top of the chapter title. For example,

<div align="center">

CHAPTER 1
## INTRODUCTION

</div>

There are four types or "levels" of section headings. All begin flush with the left-hand margin (not centered) and are set off from the text by two line spaces above and one line space below. No period follows them. The following list shows the four different levels and the appropriate style for each:

Level One
**I.  PRINCIPAL HEADING**

All capital letters, preceded by a roman numeral and a period. Uses a boldface type font.

Level Two
**A.  First subheading**

First word capitalized, preceded by a roman capital letter and a period. Boldface.

Level Three
1.  Second subheading

First word capitalized, preceded by an arabic numeral and a period.

Level Four
*a.  Third subheading.*

First letter capitalized, preceded by a lowercase letter and a period. Italics. Heading must be preceded by a blank line.

## IV. NUMBERING OF FIGURES, TABLES, AND EQUATIONS

### A. Figure numbering

Figures are numbered consecutively throughout the whole thesis (not by chapter or section), using arabic numbers (1, 2, 3, etc.). Parts of figures are labeled (a), (b), (c), etc., with parentheses enclosing the letter. If a figure occurs in an appendix, it should be numbered to continue the sequence from the final figure shown in the main body of the thesis.

When you cite a figure, use the abbreviation "Fig." except at the beginning of a sentence:

As can be seen in Fig. 5, the optimum . . .
Figure 7(a) shows the optimum . . .

Be sure to cite every figure in the text.

### B. Table numbering

Tables are numbered with roman numerals (I, II, III, etc.), in order of appearance in the text. Be sure that there is a citation in the text for every table.

### C. Equation numbering

Equations that are set off from the text (displayed) may be numbered either consecutively throughout the whole thesis or by chapter. To label by chapter, type the arabic numeral of the chapter head, follow this by a decimal point, then give the equation number. The whole is enclosed by parentheses. Thus the first equation in Chapter 2 would be labeled Eq. (2.1), the second would be Eq. (2.2), etc.

Equations in a first or only appendix are numbered (A1), (A2), (A3), etc. Equations in a second appendix are then numbered (B1), (B2), etc. Note that the letter and number are not separated by a space, dash, or period. The equation number is usually placed within parentheses, at the extreme right of the displayed equation, on a level with its bottom line.

When referring to a numbered equation, use the abbreviation "Eq." except at the beginning of a sentence:

It follows from Eq. (31) that . . .
Equation (1.20) illustrates . . .

When referring to more than one equation, give each equation number its own set of parentheses, e.g., "Expanding Eqs. (1.20) - (1.23),  we obtain . . . ."

## V. APPENDICES

Appendices are placed after the main body and before the listing of references. They must have a heading (centered Level One), which may be in a variety of styles, illustrated below:

<div align="center">

**APPENDIX: SURVEY OF RESULTS**

**APPENDIX A: SURVEY OF RESULTS**

**APPENDIX**

</div>

If there are subheadings within an appendix, they are numbered with arabic numbers, in the style of Level Two.

## VI. SUPPLEMENTARY MATERIAL NOT IN APPENDICES

Occasionally authors wish to include in the text material that may not be of interest to all readers, and to indicate that such material may be skipped over by the general reader. If the material is not long enough to warrant an appendix, the author is urged to consider other alternatives–including it as part of the regular text, putting it in a footnote, or omitting it altogether.

Very long tables, raw data (if requested by panel of examiners), computer programs and source codes, multimedia, and color figure files may be put in electronic format and burnt into a CD-ROM, and the reader referred to them by means of a footnote. The CD-ROM is to be inserted in a pocket placed on the inside back cover of the thesis.

## VII. REFERENCES

References are listed alphabetically by author. This enables the reader to scan the list of references easily and to see at a glance when the work of one person or group is represented by several articles. Since the references are not numbered, citations to them in the text must identify them by authors' names and year of publication. This saves the reader time by giving the essential information–author and year–where the work is mentioned, thus sparing the reader the effort of turning to the end of the thesis to decode each reference number.

### A. Citations in the text

The authors and years of individual references may be cited in the text in several ways, all of which employ parentheses. Here are some examples:

(1) The object N 157B in the Large Magellanic Cloud shows a filled center and nonthermal spectrum at both radio and x-ray wavelengths (Clark *et al*., 1982).
(2) The interested reader will find good discussions of much of this work in Potter (1983), Hockney and Eastwood (1991), and Birdsall and Langdon (1995).

(3) The field of nonlinear transport, which had been initiated long before by a few pioneer papers (Landau and Kompanejez, 1934; Davydov, 1936, 1937), then entered a period of rapid development.

(4) The constant *C* can be obtained from Cohen and Keffer (1955; see also Osheroff *et al*., 1980 and Roger, 1980).

In example (1), *et al.* has been used, signifying that there are three or more co-authors. Of course, the names of all co-authors will be given in the list of full references at the end of the paper. However, there are cases in which it would be preferable to name the coauthors in the text as well, for example, if two papers by Clark and co-workers were listed in the references for 1982, one by Clark, Jones, and Smith, and the other by Clark, Lewis, and Jones. These could not be labeled 1982a and 1982b because they are not by the same group.

In example (2), only the year of the reference appears in parentheses. It is unnecessary to repeat the author's name in parentheses when it occurs naturally as part of a sentence.

In example (3), a list of references is given within parentheses. Note that they are arranged chronologically, with the earliest first, and that a semicolon separates one reference from the next. When the list contains more than one work that appeared in the same year, these should be arranged alphabetically by authors' names. Commas separate authors' names from years. When more than one work by the same author is cited, the years are separated by commas. No ``and'' is used before the last citation.

## B. Citations in footnotes

We encourage authors to put long lists of references in footnotes if it would be cumbersome and detrimental to the flow of the article to keep them in the text. Of course, single citations are always made in the text. As footnotes should be notes and not just lists, incorporate your list of citations into a sentence, e.g.,

[1]For historical background on this problem, see Adams and Withey (1952, 1970), . . .
[2]A number of theorists have proposed alternatives to this model which we shall not discuss here. They include . . .

See also Sec. VIII.B on textual footnotes.

## C. Format of full reference entries

Because a thesis is archival and its bibliographies can get heavy use, we attach considerable importance to providing references that are as helpful as possible. To this end we ask our authors to be generous with the information they supply, including names of all co-authors and editors, subtitles of books and conference proceedings, titles of preprints when an article is not yet published, etc. Authors may choose between a standard, short format and a longer format that gives titles of articles and inclusive page numbers. Whichever style is used, all journal entries in the reference section must follow the same format. Examples of both styles are given below.

1. Journal articles

*a. Long format*

Alicki, Robert, John R. Klauder, and Jerzy Lewandowski, 1993, ``Landau-level ground-state degeneracy and its relevance for a general quantization procedure,'' Phys. Rev. A **48**, 2538-2548.

*b. Short format*

Abe, F., *et al.* (CDF Collaboration), 2000, Phys. Rev. Lett. **84**, 5716.

Barrett, R. F., B. A. Robson, and W. Tobocman, 1983, Rev. Mod. Phys. **55**, 155; **56**, 567(E).

Bethe, H. A., 1932, Z. Phys. **76**, 293.

Carraro, C., and M. W. Cole, 1992, J. Low Temp. Phys. **89**, 597.

Einstein, A., B. Podolsky, and N. Rosen, 1935, Phys. Rev. **47**, 777.

The first example shows the longer style, giving both the title of the article, in quotes, and inclusive page numbers. While it is not required, we encourage our authors to provide this information. The remaining examples are in the shorter style.

Note that only the first author's name is inverted. Each author's name is followed by a comma, and the name of the last author is preceded by "and." All coauthors are named for papers with ten or fewer coauthors. When there are eleven or more, they may be represented by *et al.* in italics.

The journal volume number is in boldface. When a journal has more than one section (e.g., Nucl. Phys. A or B), separate the section letter A, B, etc. from the volume number by a space.

The Barrett *et al.* entry shows an original article followed by an erratum that appeared in a later issue. For references requiring more than one line, indent the second and subsequent lines one space. See Appendix H for a list of standard journal abbreviations.

2. Russian journal articles with English journal translations

Maximov, A. V., and V. P. Silin, 1993, Zh. Éksp. Teor. Fiz. **103**, 73 [JETP **76**, 39 (1993)].

   List the translation journal after the original Russian journal; it is not necessary to say that the second reference is a translation. Enclose the translation reference in square brackets. Since translations sometimes appear in a later year than the original, give the year of the translation in parentheses at the end. When translation and original appear in different years, the citation in the text should be to the earlier of the two, i.e., the original Russian journal.

3. Books

Barcons, X., and A. C. Fabian, 1992, Eds., *The X-ray Background* (Cambridge University, Cambridge, England).

Feynman, R. P., and A. R. Hibbs, 1965, *Quantum Mechanics and Path Integrals* (McGraw-Hill, New York).

Geiss, J., 1993, in *Origin and Evolution of the Elements*, edited by N. Prantzos, E. Vangioni-Flam, and M. Cassé (Cambridge University, Cambridge, England), p. 89.

Mathieu, H. J., 1984, in *Thin Film and Depth Profile Analysis*, edited by H. Oeschsner, Topics in Current Physics No. 37 (Springer, Berlin), p. 39.

   When a book is listed under the name(s) of its editor(s), use the abbreviation Ed. (Eds.) after the year. When the reference is to an article in a collection, use the words "edited by" after the title of the collection, and give the page number of the article at the end. Enclose the names of publishers and cities of publication in parentheses. If the book is published in more than one city, the cities of publication should be separated by slashes. The words ``Press,'' ``Verlag,'' etc. should be omitted from the publisher's name.

4. Proceedings

Lehar, F., 1991, in *Proceedings of the 9th International Symposium on High Energy Spin Physics*, Bonn, edited by K.-H. Althoff and W. Meyer (Springer, Berlin), Vol. 1, p. 113.

Lingenfelter, R., and R. Ramaty, 1982, in *The Galactic Center,* AIP Conference Proceedings No. 83, edited by G. R. Riegler and R. D. Blandford (AIP, New York), p. 148.
Matsuoka, N., K. Hatanaka, T. Saito, T. Itahashi, K. Hosono, A. Shimizu, M. Kondo, F. Ohtani, and O. Cynshi, 1983, in *Proceedings of the 1983 RCNP International Symposium on Light Ion Reaction Mechanism*, edited by H. Ogata, T. Kammuri, and I. Katayama (Research Center for Nuclear Physics, Osaka, Japan), p. 527.

   The general treatment of proceedings follows that of books. Proceedings, however, can be much more difficult to locate, making it doubly important that you provide the reader with every possible clue. Spell out *the whole title, including subtitle*, if any, as it appears on the title page.

When the proceedings are part of a series, give the series name and number after the title. Be sure to include the name and city of the publisher. If the proceedings are to be published in a special issue of a journal, say so. Do not abbreviate the words "proceedings" and "international."

5. Theses, preprints, and other references

Below are examples of the correct form for listing theses, preprints, reports, and unpublished work.

Allard, F., 1991, Ph.D. thesis (University of Heidelberg).

There is no need to add "unpublished" to a thesis or report reference.

Polchinsky, J., and E. Witten, 1996, "Evidence for Heterotic Type-I String Duality," preprint hep-th/9510169.

Binette, L., 1984, "Photoionisation models for liners: gas distribution and abundances," European Southern Observatory Scientific Preprint No. 350.

Cowley, C. E., 1998, Phys. Rev. A (in press).

Wagner, Z., 1994, unpublished.

If a preprint exists, but the paper has not yet been accepted for publication, give either the preprint number or the preprint title and institution, to aid the interested reader in obtaining a copy. The preprint title is placed in quotation marks. Do not say, "submitted to . . . ," "in preparation," or "to appear."

When a paper has been accepted by a journal but not yet published, give the journal name followed by "(in press)." Frequently such entries can be updated in proof to include volume and page numbers.

If a preprint of the work is not available, the work should be cited as "unpublished" or "private communication," with the year.

## D. Order of reference list

The reference section is arranged alphabetically by author. When several works by the same author are included, these are arranged chronologically. When more than one work by the same author is listed in the same year, they are distinguished by labeling the first, say, 1996a, the second 1996b, etc.

If all papers were by single authors, the above guidelines would be sufficient. However, multiple authorship introduces the need for a few further distinctions. Consider the following list:

Smith, G. F., 1987

Smith, G. F., 1990

Smith, G. F., 1996

Smith, G. F., H. T. Dietrich, and W. K. Lee, 1998a

Smith, G. F., H. T. Dietrich, and W. K. Lee, 1998b

Smith, G. F., W. K. Lee, and H. Sorenson, 1998

Smith, G. F., W. K. Lee, and A. T. Washington, 1989

Smith, G. F., and L. M. Young, 1988

All works by Smith as a single author are listed first, in chronological order. The remaining references are arranged alphabetically by surname of the second author (Dietrich, Lee, Young). When the first two authors are the same, alphabetize according to the surnames of the third authors (e.g., Sorenson, Washington).

Two works by the same group in the same year are distinguished by labeling the first 1984a and the second 1984b. The work by Smith, Lee, and Sorenson should not be labeled 1998c, because the makeup of the group is different from that of 1998a and 1998b.

Occasionally the use of a and b is extended to groups of 4 or more co-authors that are similar but not identical in makeup. This is done to simplify the task of discriminating among several choices or when the alternative would be a cumbersome citation listing all co-authors in the text.

## VIII. FOOTNOTES

Footnotes may be used in the body of the text (to make short comments about the textual material), and in tables or figures. Note that footnotes are *not* used in the thesis for purely bibliographic purposes, except for long lists (see Sec. VII.B)

### A. Textual footnotes                                                    \footnote{ }

Indicate footnotes in the text by the insertion of superscript numbers, in this manner:

The appearance of these data caused a furor[3] among the theorists.

Acceleration, vibration,[4] temperature gradients, and temperature changes all produce stresses in the active region of the device.

When punctuation is present at the point where a footnote is cited, place the superscript number *after* commas, periods, and quotation marks, but *before* colons and semicolons.

Be cautious about placing a superscript footnote number immediately after quantitative material, where it might be mistaken for an exponent. In such cases, the footnote usually can be cited elsewhere in the sentence; if no other position can be used, spell out the word "footnote" in parentheses (footnote 4), on the line, instead of using a superscript number.

Each note is in the form of a paragraph (i.e., first line indented), beginning with a superscript number one space in from the left-hand margin.

Although simple citations of sources are not treated as footnotes (see instructions for references), bibliographic material may be incorporated in footnotes, as in the following examples:

[1]Their result was also presented at Les Houches by Corbie ¡re (1984).

[2]Mason (1950) gives an alternate method for calculating $c_i$ .

[3]A description of these early experiments can be found in Adams, 1978. The present status of such experiments is discussed in reviews by Stein (1998) and Callaghan (1999).

[4]See Rubbia's comment after G. Myatt's talk at the 1973 Bonn Conference (Myatt, 1974): "The important question in my opinion is whether neutral currents exist or not, not so much the value of the branching ratio"(discussion after Myatt's talk, p. 405).

**B. Notes in tables and figure captions**

Most notes in figure captions and tables are simple references to sources and can be treated in the same way as bibliographic references in the text, i.e., by naming author and year in parentheses.

Examples:

FIG. 1. The $^3$He data compared to the prediction of Maize and Kim (1983): dashed curve, impulse approximation; solid curve, impulse approximation plus MEC.

FIG. 2. Einstein Observatory (HEAO 2) data on the x-ray spectrum of Tycho Brahe's supernova remnant. From Becker *et al*., 1979.

FIG. 3. Typical recorded spectra when argon ions are incident on thick silicon and carbon targets (adapted from Jones *et al*., 1972).

In tables, use lower-case roman letters to identify the footnotes, placing them as superscripts to table entries or headings and placing them on-line when they replace a missing entry. Order the footnote letters consecutively row by row, and not by column.

Example:

TABLE X. Experimental results (Benhar, 1994).

| $\delta(E2/M1)$ | |
| --- | --- |
| Theor.[a] | Expt. |
| −41.0 | − 18 ± 0.3[b] |
| −57.5 | − 10 ± 0.6 |
| 37.3 | |
| 13.7 | c |

[a]Jones *et al*. (1993).
[b]Barclay and Stewart (1990).
[c]Not available.

Remember to include in the reference list at the end of the paper full entries for any sources you cite in a table or figure.

**IX. TABLES**

**A. Table sizes**

Tables will print out the same width as the caption. There are four standard one-page table widths:

(1) narrow (one column, 8.6 cm or 3.4 in.), \narrowtext

(2) wide (two columns, 17.8 cm or 7.0 in), \widetext

(3) medium (1.5 column width, 14 cm or 5.5 in.), \mediumtext

(4) turned table (one-page length turned sideways, 25.4 cm or 10.0 in.).

## B. Table captions

Each table that is not part of the text must have a descriptive caption. It should be as concise as possible. If it is made up of more than one sentence, treat it as a single paragraph.

The caption is positioned above the table. It begins with the word table, in capital letters, followed by the appropriate roman numeral and period, and then a small amount of explanatory text.

Examples:

TABLE I. Spin-orbit parameters.

TABLE II. Calculated $M1$ matrix elements for $^{156}$Gd, $M_{rs}(M1) = \langle S1|M(M1)|r \rangle$ in $10^{-2}$ $\mu_N$ .

## C. Lines and space in tables

A simple table needs lines in only three locations: two lines together at the beginning and end of the table and a single line separating the headings and columns of entries. A more complicated table, one made up of several parts and having more than one set of headings, will need additional space and lines. Extra space running horizontally can be used to distinguish broad groups among the entries.

## D. Headings within tables

Always capitalize the first word or abbreviation in all headings and subheadings. Column headings are separated from the body of the table by a horizontal line. They are usually dropped to the bottom of the heading area. However, units of measure that pertain to each entry in a whole column should be included in parentheses and placed as the last entry in the heading on their own line (sample 1) or spaced off from the heading on the same line (sample 2).

| Sample 1 |
|---|
| Branching ratio (%) |
| 1 |
| 2 |
| 3 |

| $E_x$ (MeV) | $J^\pi$ |
|---|---|
| Sample 2 | |
| 2720 | $2^-$ |
| 411 | $2^-$ |

# X. FIGURES

## A. Designing and labeling figures

(1) Make symbols and lettering in proper scale in relation to the overall figure size. Two sizes for lettering (one for on-line lettering, the other for subscripts, superscripts, and data points) is recommended. Solid or open symbols are easier to read.

(2) Hand lettering is not acceptable.

(3) Make line thickness consistent (solid and dark).

(4) When shading is necessary, use diagonal or crosshatched lines. Follow the same stylistic conventions in the figures as in the rest of the paper. Hyphenation, abbreviations, symbols, and upper- and lowercase letters should be consistent throughout.

(5) Label parts of figures (a), (b), (c), etc.; curves *A*, *B*, *C*, etc.; geometric points, angles, and lines *A*, *B*, *C*, etc.; or *a*, *b*, *c*, etc., as appropriate.

(6) Treat graphs so that they are completely self-explanatory. Label each axis (horizontal and vertical) with the quantity being plotted, including the appropriate units, which should be spaced off and enclosed in parentheses, i.e., $\theta$ (deg). Avoid powers of 10 if possible; instead use the appropriate prefixes of the *Systéme International* (see Table II, Sec. XIII and Appendix G). If powers of 10 cannot be avoided the following form is preferred: $R$ ($10^{-4}$ $\Omega$).

(7) Decimal quantities less than 1 should include a zero to the left of the decimal point, e.g., 0.5.

## B. Identifying figures

Number each figure consecutively with an arabic numeral according to the order in which it is discussed in the paper. It is helpful to identify the top of the figure when this is not obvious from the axes or lettering.

*All figures must be cited in consecutive order in the text*. For example, you could refer to your first figure in one of these ways:

Figure 1 shows experimental results.

Experimental results are shown in Fig. 1.

The results, however, are conflicting (see Fig. 1).

Note that the word figure is written out when it begins a sentence, but it is abbreviated at other times.

## C. Figure captions

Every figure should have a caption, even though it may consist only of an abbreviated title.

Example:

FIG. 1. Schematic drawing of the R110 apparatus. From Camilleri *et al*., 1981.

Give the symbol or describe the curve *before* you give its definition.

Examples:

FIG. 2. Measured and theoretical rotation-rate uncertainty as a function of integration time $\tau$: $\bigcirc$, first harmonic measurement, with the solid line being the corresponding shot noise; $\bullet$, second harmonic measurement, with the dashed line indicating the corresponding shot-noise limit. From Davis and Ezekiel (1981).

FIG. 3. Suppression factor $S$ for magnetic suppression: long-dashed curve, $E$50.1 $E$B; short-dashed curve, $E$510 $E$B; solid curve, $E$51 $E$B.

When two or more figures are grouped together as parts of one figure number, there should be one caption for the group, beginning with a title that applies to all parts, and then proceeding to individual descriptions, as necessary, for parts (a), (b), (c), etc.

Example:

FIG. 4. Regge diagrams for scattering in hadron-hadron collisions: (a) total scattering; (b) elastic scattering; (c) single diffractive scattering.

If you cannot come up with an initial label that applies to all the parts, you should probably give each part its own figure number and its own caption.

Finally, if the figure is from a previously published source, the source should be credited.

## XI. PUNCTUATION

## A. Hyphenation

The purpose of hyphenation is to resolve ambiguity as to which words are being modified in multiword terms containing more than one noun. The basic rule is that words modifying modifiers get hyphenated, but not words modifying nouns that are used as such. For example: consider a heavy-fermion system, composed of heavy fermions. A heavy fermion system (no hyphen) would be quite different: the system is both heavy and
composed of fermions. Certain classes of two-word modifiers are easily recognized. They include the following:

- Quantitative modifiers: three-photon, double-well, many-body, 12-channel, single-particle, zero-mass, three-dimensional.

- Compound modifiers using high, low, large, small, wide, narrow, strong, weak, hard, soft, long, or short: high-energy, low-density, large-angle, weak-coupling, hard-pion, long-range.

- Two-word modifiers in which the second word is a past participle: collision-induced, angle-resolved, Coulomb-corrected, diffusion-limited, mode-locked, pair-correlated, phase-matched, phonon-assisted, space-fixed, vacuum-deposited, valence-excited.

There are some exceptions to the above rule:

(1) Terms that are hyphenated when used as adjectives remain unhyphenated as predicate adjectives, i.e., when they follow a form of the verb "to be." For example,

A block-diagonal matrix is obtained.

The matrix is block diagonal.

(2) The adverb ending "ly" implies that the adjective immediately following is being modified, so no hyphen is needed. Examples: slowly varying, strongly coupled.

(3) Latin prefixes can usually be joined to a word without using a hyphen: nonzero, intermolecular, superconducting, infrared. However, do not close up the two parts if a double letter other than e is produced (semiinfinite, preexisting), if a proper noun is involved (non-Fermi), or if closing up could change the meaning of the word (un-ionized). Chemical prefixes (in italics) should be hyphenated (*cis*-dimethylethylene).

(4) Do not hyphenate written-out names of chemical compounds when they are used as adjectives: sodium iodide crystal, alkali halide crystal.

(5) "Self" words and "free" words should be hyphenated (self-consistent, worry-free), but "like" words and "wise" words are closed up (spacelike, stepwise) unless they become extremely long or cumbersome. "Fold" words are closed up through ten (twofold, tenfold), but hyphenated above ten (11-fold, 100-fold).

To sort a string of modifiers, you can use a combination of hyphens and longer dashes (two-particle–two-hole configuration) or hyphens and a slash (two-particle/two-hole).

## B. Use of the comma

*DLSU Physics* style calls for a comma before "and" at the end of a list. This is known as the "serial comma":

Grant, Komsky, Oswald, and Peters

oscillating, rotating, or stationary

When introducing a variable, do not set it off with commas when it immediately follows the noun that defines it:

The melting temperature $T_m$ is . . . ,

but do use commas when another phrase intervenes:

The melting temperature reported by Green, $T_m$ , is . . .

Use commas on either side of the following: e.g., i.e., for example, in particular, namely, respectively, say, that is.

Do not use commas after thus or therefore.

## C. Use of parentheses

Equation numbers cited in the text should be enclosed within parentheses. To avoid having parentheses within parentheses, use square brackets for the outer pair: [see Eqs. (2) and (3)]. Figure numbers should not be enclosed in parentheses, but parts of the figures should: Figs. 4(a)–4(c).

When citing individual references, the most common form is to name the author, then put the year in parentheses: "Mahan (1996) confirmed that . . ." Lists of references can be enclosed without separate parentheses for each year: (see Jones, 1987, 1992; Armitage, 1993b; Wurtz *et al.*, 1996).

Avoid adjacent parentheses, for example, a definition or acronym followed by a reference:

(hereafter EPR) (Einstein, Podolsky, and Rosen,1935).

Related items can share the same set of parentheses, separated by a semicolon:

(hereafter EPR; Einstein, Podolsky, and Rosen, 1935).

Parenthetical remarks usually do not have closing punctuation inside the parentheses (as you might expect). However, a separate and complete sentence within parentheses, beginning with a capital letter, should have its end punctuation inside: (Armitage took exception to Brown's approach, as we shall see below.)

## D.  Use of the colon

The most frequent misuse of the colon is in introducing equations. A colon should not follow a form of the verb "to be" and it should not come between a verb and its object or between a preposition and its object. Often a displayed equation is the object. Thus the following lead-ins to equations should not have colons, or indeed any end punctuation:

We obtain

The result is

This reduces to

Then the coordinates are given by

Colons may, however, be used to introduce equations when the object has already been stated or the clause completed:

We obtain the following distribution:

The result is a multidimensional gamma function:

Open sets can be characterized as follows:

This produces a power-law series:

A second question concerning the use of colons is whether to capitalize what follows them. The answer may be stated in three parts:

(1) Phrases introduced by a colon do not begin with a capital letter:

Furthermore, the lake has a natural noise center source: a dam.

(2) A complete sentence introduced by a colon may be, but need not be, capitalized:

Finally, the energies of bound surface states are calculated by means of the "effective-Hamiltonian" technique: Let $H_{eff}$ be defined by $E - H_{eff} = G_0(E^{-1} - V)$.

(3) When more than one sentence is introduced by a colon, capitalize the first word:

> In order to tackle Eq. (A5) we introduce the following simplifications and approximations: (1) Each eigenmode in the band is excited by white noise. (2) No eigenmode beyond the band is excited. (3) Because the . . .

## E. Use of the apostrophe

(1) Contractions. Contractions such as don't, haven't, they'll are well established in spoken English, but they have not yet won a place in the pages of physics literature. Please do not use them in your *thesis*.

(2) Plurals. To form the plural of a number, add s: 1980s, tens of eV. To form the plural of a symbol, add 's (apostrophe s): A's, x's. To form the plural of an abbreviation or an acronym, you may add either s or 's: LCAO's or LCAOs.

(3) Possessives. To form the possessive of a name, add 's (apostrophe s), regardless of the number of syllables or final letter: Green's, Jones's, de Gennes's.

Be careful not to create imaginary possessives by adding unneeded apostrophes to terms like Kramers doublet or Higgs field. Although contemporary usage may be moving in the direction of "Green function," the editors of some journals still prefer "Green's function."

## F. Use of exclamation points and italics

It is not the style of a thesis to clamor for its readers' attention. The use of exclamation points and italics for emphasis should be as restrained as possible. Italics should also be used sparingly. It is conventional to italicize terms when they are introduced and defined.

## XII. ABBREVIATIONS AND ACRONYMS

Abbreviations and acronyms should be kept to a minimum. Use only a handful of the best-known or most widely used, keeping in mind that a broad audience including physicists from other subfields will be reading the thesis and should not be forced to learn a code at the same time. Here are a few guidelines to keep in mind.

(1) Define all abbreviations and acronyms the first time you use them.

(2) Do not use an acronym as the subject of a sentence, even though it has been previously defined or is well known. For example, replace ``CDWs provide . . . '' with ``Charge-density waves provide . . . ''

(3) Generally it is unnecessary and distracting to assign a special acronym to a paper, using the initials of its co-authors, and it may be seen as a bid for attention if one is citing one's own work. Only classic papers that are already widely known by such acronyms justify this treatment. A simple citation of the form Smith *et al.* (1997) is less obtrusive than four or five capital letters and takes very little additional effort to type.

(4) When using an abbreviation of a proper name as a superscript or subscript, retain the initial capital letter: $E_{\mathrm{Coul}}$ or $E_{\mathrm{C}}$ for Coulomb.

(5) Do not use multiletter abbreviations as mathematical variables. Use the conventional symbol instead, e.g., $E_k$ , not KE for kinetic energy. An exception is the Reynolds number, conventionally written Re.

(6) Avoid "abbreviations" that have more syllables than the original term, e.g., FW (four syllables) for framework.

## XIII. UNITS

Use the metric system of units. Check *Books in Print* under International System of Units for the most up-to-date listing of these units. A still useful summary was that of Barry N. Taylor, *Guide for the Use of the International System of Units* (SI) *The Metric System* (DIANE Publishing Co., 1995). The following units and abbreviations are standard.

TABLE I. Standard metric units.

| Units | Abbreviations |
| --- | --- |
| ampere | A |
| barn | b |
| becquerel | Bq |
| coulomb | C |
| electron volt | eV |
| farad | f |
| gram | g |
| henry | H |
| herz | Hz |
| kelvin | K |
| meter | m |
| ohm | $\Omega$ |
| pascal | Pa |
| second | s |
| steradian | sr |
| tesla | T |
| volt | V |
| watt | W |
| weber | Wb |

Other units used in the article should be defined in terms of the standard units. The use of historic units that have been superseded in the modern physics literature is discouraged. These include wave numbers for energy, oersteds and gauss for magnetic fields, atmospheres for pressure, and curies for radioactivity.

(1) The number (numeral) is separated from the unit following by a full space, e.g.,

    1.8 MeV.

(2) Most units have a single form for both singular and plural, i.e., 1.0 cm and 2.7 cm.

(3) Most symbols for units are printed in lowercase roman type without periods. Units derived from proper names, however, are written with initial capital letters, i.e., coulomb (C), weber (Wb).

(4) The abbreviated form of a unit must be used after a number given in numerals: 1 cm (not 1 centimeter) but the unit is written out in cases like "a few centimeters."

(5) Decimal multiples or submultiples of units are indicated by the use of prefixes. See Table II below. The combination of prefix and unit symbol is treated as a single symbol. For instance, such a combination can be raised to a power, i.e., $cm^2$. Compound units are written 1 g $cm^2$ or g $cm^2$ $s^{-2}$, with a thin space between unit parts. The form 6 J/$cm^3$/s is ambiguous. Write instead 6 J $cm^{-3}$ $s^{-1}$, if that is what is meant.

TABLE II. Multiplier prefixes of the *Système International.*

| Prefix | Symbol | Factor | Prefix | Symbol | Factor |
|--------|--------|--------|--------|--------|--------|
| centi | c | $10^{-2}$ | | | |
| milli | m | $10^{-3}$ | kilo | k | $10^{3}$ |
| micro | $\mu$ | $10^{-6}$ | mega | M | $10^{6}$ |
| nano | n | $10^{-9}$ | giga | G | $10^{9}$ |
| pico | p | $10^{-12}$ | tera | T | $10^{12}$ |
| femto | f | $10^{-15}$ | peta | P | $10^{15}$ |
| atto | a | $10^{-18}$ | exa | E | $10^{18}$ |

## XIV. MATHEMATICAL MATERIAL

Mathematical symbols must be defined immediately where they are introduced. Exceptions are the fundamental constants: the velocity of light $c$, Planck's constant $\hbar$, the electronic charge $e$, Boltzmann's constant $k$ or $k_B$ , and the electron's mass $m_e$ .

Avoid using the same symbol for two different things. If you think that a list of symbols would be helpful to your readers, you can provide one preceding the references (see Sec. II.G).

### A. Characters

### 1. Character fonts

The italic font is used for mathematical symbols and it is taken care of by the math mode. In addition to variables and constants, the italic font is used for particle symbols, symbols of quantum states, and group-theoretic designations.

In general please use the following hierarchy of fonts for symbols:

TABLE III. Fonts for symbols.

| | |
|--------|--------|
| Lower case: | variables, constants, and ordinary functions |
| Upper case: | matrices and functions |
| Script upper case: | operators |
| Boldface lower case: | three-vectors |
| Boldface upper case: | matrices |

### 2. Diacritical signs

For a list of easily available diacritics see Table IV below. It is possible to make multilevel accents, but placing one sign above a symbol or letter and one below is often clearer. Restrict the number of oversymbols to two. The underline can appear under any configuration.

TABLE IV. Diacritical signs in math.

| Symbol | TeX |
|---|---|
| $\vec{x}$ | $\verb|$\vec{x}$|$ |
| $\tensor{\rm x}$ | $\verb|$\tensor{\rm x}$|$ |
| $\dot x$ | $\verb|$\dot x$|$ |
| $\ddot x$ | $\verb|$\ddot x$|$ |
| $\hat x$ | $\verb|$\hat x$|$ |
| $\tilde x$ | $\verb|$\tilde x$|$ |
| $\bar x$ | $\verb|$\bar x$|$ |
| $\underline x$ | $\verb|$\underline x$|$ |

## 3. Subscripts and superscripts

All available characters can be used as subscripts or superscripts. Position of subscript or superscript is dictated by standard notation. In almost all cases you should set right and left subscripts and superscripts flush against the symbol they accompany (as in the following):

$$R_0^x, \quad {}^{110}\mathrm{Ag}^m, \quad \rho_0^{(N)}, \quad {}^{14}\mathrm{N},$$

$$\int_0^1, \quad \overset{\prime}{\Sigma}, \quad {}^{14}\mathrm{N}_2,$$

$\lim_{l \to \infty}$ (in text).

There are, however, some exceptions to this general rule. Examples appear below:

tensor notation: $g_{\mu\nu}(\phi^z)^{;\alpha}{}_{;\alpha}$

`g_{\mu\nu}(\phi^z)^{;\alpha}}_{;\alpha}\\`

molecular ions: $\mathrm{H}_2{}^+, \mathrm{O}_2{}^-$

`{\rm H}_2{}^+,{\rm O}_2{}^-\\`

footnotes in tables: $E_n{}^a$.

`E_n{}^{\rm a}.`

Presuperscripts or presubscripts are set flush against the symbols they accompany. In addition, it is advisable to insert an extra thin space between a presuperscript or presubscript and a preceding symbol in cases where clarity is questionable, i.e.,

$$8p\sigma \, {}^1\Sigma_u^+ \quad \text{or} \quad d^9s^zp \, {}^3P_2.$$

`$8p\sigma\,^1\Sigma_u^`
`+\~~ {\rm or} \~~ d^9s^zp ^3P_2.$`

The number of levels of subscripts and superscripts attached to a symbol will also affect clarity. Two double levels is generally considered the most complicated combination acceptable, i.e.,

$$M_{b_k^{\dag}}^{\alpha_i^2}$$

$M_{b_k^{\dag}}^{\alpha_i^2}$

$M\_\{b\_k^\{\dag\}\}^\{\alpha\_i^2\}$

When additional indices are needed, insert a comma or thin space and keep the added indices on the same line, i.e.,

$$M_{b_k,d_p}, \quad \sigma_{r,s+1}, \quad \text{or} \quad \sigma_{r\,s+1}.$$

$M\_\{b\_k,d\_p\}, \~ \~ \sigma\_\{r,s+1\},$
$\~ \~ \{\rm or\} \~ \~ \sigma\_\{r\, s+1\}$.

## B. Abbreviations in math

Some abbreviations, such as those for mathematical functions and those used in superscripts or subscripts, require special handling and are discussed below.

## 1. Abbreviations designating mathematical functions

The multiletter abbreviations of mathematical functions are always written in the roman font (i.e., sin). The standard trigonometric functions are cos, cot, sec, sin, and tan. Hyperbolic trigonometric functions add "h" to the end; the preferred notation for inverse functions is $\tan^{-1}$ rather than arctan. The preferred notation for the logarithm to the base $e$ is ln; log without a subscript also denotes the same function.

(a) Roman multiletter abbreviations must be closed up to the argument following and separated from any preceding symbol by a thin space, (\, ), that is,

$$K\cos[Q(z-z_0)],$$

$K\,\cos[Q(z-z+0)],$

$$K\exp[x^2(b_2+b_1)^{-1/2}].$$

$K\,\exp[x^2(b\_2+b\_1)^\{-1/2\}].$

(b) In addition, by convention it is assumed that an argument ends as soon as another function appears, i.e., $\sin x \cos b$, or at a plus or minus sign, i.e., $\sin x + y$, but if other mathematics is involved or there is any ambiguity you should insert bracketing, as in the following examples:

$$\sin[-(x+a)], \quad (\sin x)/a, \quad \text{and}$$
$$\exp[x^2(b_z+b_1)^{-1/2}].$$

(c) To treat a function of a function enclose it in bold round parentheses, i.e.,

$$g(x^2 a^{3/2}(\alpha_1+\alpha_2)^{-1/2}).$$

(d) $e$ and exp (for exponent) notation follow both of the preceding conventions. The choice of which form to use, $e$ or exp, is determined by the number of characters and the complexity of form of the superscript. The $e^x$ form is appropriate when short, simple superscripts would be involved, i.e., $e^z$, whereas $\exp(xx)$ should be used if the superscript form is complex. In the on-line form the argument should be enclosed in bracketing.

## 2. Abbreviations in subscripts and superscripts

Abbreviations in subscripts and superscripts fall into two categories: (1) single-letter and (2) multiletter abbreviations. Most single-letter abbreviations are conventionally printed in the italic font, i.e., $E_C$ where $C$ stands for Coulomb. Multiletter abbreviations are conventionally printed in the roman font whether they represent one or more words, i.e., $E_{\text{lab}}$, where lab stands for laboratory and $E_{\text{HF}}$, where HF stands for Hartree and Fock, two proper names. Please note that you should always capitalize abbreviations that represent proper names.

When you are creating your own abbreviations in text do not put periods in acronyms (whether on line or in subscripts), but do insert them if you are abbreviating words that are headings in a table.

## C. Mathematical expressions

## 1. When to display

Display (1) equations of importance, (2) all equations that are numbered, (3) those that are too long to fit easily in text (over ~ 25 characters), or (4) those that are complicated (contain built-up fractions, matrices, or matrixlike expressions). Consider, also, displaying math that contains multilevel indices, integral, summation, and product signs, with multilevel or complex limits, or any other situation in a formula that creates the need for extra vertical spacing in a text line.

## 2. Punctuation

Even though displayed math is separated by space from the running text it still is a part of that text and needs to be punctuated accordingly. The following is an example. The final result is

$$H_{ij} = \left(\frac{\Omega}{\Delta}\right)^2 \frac{|J|^2}{E_g + \frac{1}{2}(W_c + W_v)} e^{\lambda \mathbf{K} \cdot \mathbf{R}_{ij}}, \tag{1}$$

where

$$\mathbf{K} = \frac{1}{a}(\hat{\mathbf{i}} + \hat{\mathbf{j}} + \hat{\mathbf{k}}) \tag{2}$$

and

$$\lambda = \ln[W_l W_v / (12 E_g)^2]. \tag{3}$$

## 3. Equation "breaking" (multilinear equations)

Mathematical expressions often need to be displayed on two or more lines ("broken") because of the linelength limitations. The best place for a "break" is right before an operator or sign of relation. These signs should begin the next line of the equation. When it is necessary to break a product, begin the continued line with a multiplication sign. Note that the material that comes after a break can and should be aligned so that its relationship to the material on the first line is mathematically correct. Here is an example:

$$N_x(\mathbf{r}) + i N_2(\mathbf{r}) = e^{i\theta(\mathbf{r})}$$
$$= \exp[-ij_x u(\mathbf{r})]. \tag{4}$$

The LaTe$\chi$ version of this is

```
\begin{eqnarray}
N_x({\bf r})+iN_2({\bf r})&=&e^{i\theta ({bf r})}
\nonumber\\        &=&     \exp[-ij_xu({\bf    r})],
\end {eqnarray}
```

Equations that are not displayed, but appear in text may also need to be broken. Basically the same rules apply as when breaking displayed math. Breaking at an operator or sign of relation is best. The operator or sign of relation usually begins the next line of text:

... and their respective displacement vectors are $a\hat{\mathbf{i}}/2$ + $\sqrt{2}a\hat{\mathbf{j}}/2$ and ...

Products are broken with a multiplication sign:

... keep $\delta m \simeq 4$ MeV and choose $\gamma$ $(= -5.46 \times 10^{-3})$ at ...

In addition, you may break in text at a solidus, leaving the numerator and fraction bar on the top line. The denominator will begin the continued line. See an example below:

... the above current is proportional to $T_0(\Delta_1, \Delta_3)^{1/2}/$
$N_2(0)$ if the injection level $G_{ng}\Omega_2^{-1}$ remains ...

## 4. Equation numbering, special situations

Equation numbers are placed flush with the right margin:

$$H_{2m\,2l}(\theta^{(i)}, \theta^{(j)}) = \sqrt{w_i w_j}\,(\sin\theta^{(i)}\sin\theta^{(j)})^{1/2}$$
$$[K_{2m\,2l}(\theta^{(i)}, \theta^{(j)})$$
$$+ K_{2m\,-2l}(\theta^{(i)}, \theta^{(j)})]. \tag{5}$$

Some situations require unique numbering. Please use the forms shown in the following examples when you encounter similar circumstances.

(1) A set of equations of equal importance may be numbered to demonstrate that relationship, e.g., (1a), (1b), and (1c).
(2) A principal equation and subordinate equations (those that define quantities or variables in that equation) may be numbered (1), (1a), and (1b), etc.
(3) If an equation is a variant of a previous equation (it may be separated from the original equation by other equations and/or by text), it may be numbered with the same number as the original and a prime, double prime, etc., as appropriate.

## D. Bracketing

## 1. Grouping sequence

For the purpose of grouping, the preferred sequence of bracketing is {[()]}, working outwards in sets ( ), [ ], and { }. If you have used these three sets and need additional bracketing, begin the sequence again in the same order but in bold print:

$$\{\,[\,(\,\{\,[\,(\,)\,]\,\}\,)\,]\,\}$$
$$\backslash bbox\backslash\{\backslash bbox[\backslash bbox(\backslash\{\ [\ (\ )\ ]\backslash\}\ \backslash bbox)$$
$$\backslash bbox]\ \backslash bbox\backslash\}$$

For grouping situations that contain built-up material and need larger sized bracketing, it is preferable to start again at the beginning of the sequence around the built-up material, i.e.,

$$\left[\left(\frac{(a-2)^{1/2}}{a^2}\right)\left(\frac{(x+2)^{1/2}}{\beta}\right)\right] = 0.$$

## 2. Specific bracket notation

Bracketing (ordered and special) is also used to create specific notation that defines what it encloses. A list of approved specialized notation is included below. When used in an equation along with ordered bracketing, this special kind of bracketing should not alter the regular sequence of bracketing. The special notation $\langle\ \rangle$ in the following equation does not interfere with the sequence of the equation bracketing:

$$\hbar[\langle E-(a+1)\rangle]^{-1}=0.$$

## 3. Specialized notation

| | |
|---|---|
| Plane or set of parallel planes | $(111)$ |
| Direction | $[111]$ |
| Class (group) of symmetry equivalent directions | $\langle 111\rangle$ |
| Class (group) of symmetry equivalent planes | $\{111\}$ |
| Point designated by coordinates | $(x,y,z)$ |
| Lattice position in a unit cell (*not* bracketed; included for your information) | $\frac{1}{2}\frac{1}{2}\frac{1}{2}$ |
| Vector written in components | $(H_z,H_y,H_z)$ |
| Commutator | $[f,g]$ |
| Iterated commutations | $[H_0,[H_0,H_1]]$ |
| Functionals | $F[x]$ |
| Anticommutators | $\{f,g\}$ |
| Sets | $\{x\}$ |
| Absolute values | $|a|$ |
| Determinants | $|x|$ |
| Notation used to indicate at what value of the argument some quantity is to be taken | $|_{x\to\infty}$ |
| Matrices or norms | $\|f\|$ |
| Average or expectation value | $\langle\ \rangle,\langle\ \rangle_{av}$ |
| Dirac bra-ket notation | $\langle\|\|\rangle$ |

**E. Additional style guidelines**

## 1. Placement of limits

In displayed math, limits are treated in the following manner:

$$\sum_{\substack{i,j,k\\i<j<k}}\qquad \backslash sum\_\{\backslash begin\{array\}\{c\}i,j,k\backslash\backslash i{<}j{<}k\backslash end\{array\}\}$$

$$\sum_{n=1}^{\infty}\qquad \backslash sum\_\{n\ =\ 1\}\^\backslash\{\backslash infty\backslash\}$$

$$\sum_{l}{}'\qquad \backslash sum\_\{l\}\{\}\^\backslash\{\backslash prime\backslash\}$$

$$\prod_{n>1}\qquad \backslash prod\_\{n\ >\ 1\}\ \backslash quad$$

$$\int_{-\infty}^{+\infty} \qquad \backslash\,\mathrm{int}\_\{ -\ \backslash\mathrm{infty}\}\,\hat{}\,\{ +\ \backslash\mathrm{infty}\}$$

$$\lim_{a \to 0} \qquad \backslash\,\lim\_\backslash\{\backslash\,\mathrm{alpha}\ \backslash\mathrm{rightarrow}\,0\backslash\}$$

Stacking of limits, seen in the first example, is possible, as is centering. In text, however, limits must be treated as subscripts and superscripts. The second example above should be set $\Sigma_{n=1}^{\infty}$ in text. The stacking in the first example would mean that any math containing that summation should be displayed or be rewritten.

## 2. Fractions

Fractions can be "built up" with a fraction bar,

$$\frac{a+b}{c},$$

"slashed" with a solidus, $(a + b)/c$, or written with a negative exponent, $(a + b)c^{-1}$. In text all fractions must be either slashed or written with a negative exponent. In displayed math all three forms are allowed.

Apply the following guidelines to the mathematics in your compuscript:

(a) Use built-up fractions in matrix notation (instead of the slashed configuration):

$$M_1 = -\begin{pmatrix} \dfrac{\partial^2}{\partial x^2} & 2\theta_0' \dfrac{\partial}{\partial x} \\ \theta_0 \dfrac{\partial}{\partial x} & \theta_0^2 \dfrac{\partial^2}{\partial x^2} \end{pmatrix}.$$

(b) Use built-up fractions (instead of the slashed configuration) in display formulas:

$$H_A(w) = \left[ \frac{1}{2}\left(\frac{Q}{\pi\omega^2}\right)^2 + \frac{c_e^2}{4d} \right]\pi\omega^2 d.$$

(c) Using slashed fractions in subscripts, superscripts, and limits is preferred:

$$\mathcal{N}^{-1/2}.$$

(d) Use slashed or sized fractions in the numerators and denominators of built-up fractions except where excessive bracketing would obscure your meaning or slashing would interfere with continuance of notation:

$$\varphi + \frac{(\beta/6)\varphi}{\gamma + [\beta(\beta-1)/12]\varphi^2} = 0.$$

(e) When slashing fractions, respect the following conventions. In mathematical formulas this is the accepted order of operations:

(1) raising to a power,

(2) multiplication,

(3) division,

(4) addition and subtraction.

According to the same conventions, parentheses indicate that the operations within them are to be performed before what they contain is operated upon. Insert parentheses in ambiguous situations. For example, do not write *a/b/c*; write in an unambiguous form, such as

$(a/b)/c$

or

$a/(b/c)$,

as appropriate.

## 3. Multiplication signs

The primary use of the multiplication sign is to indicate a vector product of three-vectors ($\kappa \times \mathbf{A}$). Do not use it to express a simple product except

(1) when breaking a product from one line to another (described in equation breaking, Sec. XIV.C.3) or

(2) for other cases such as indicating dimensions ($3 \times 3 \times 3$ cm$^3$), magnification ($3\times$), symbols in figures ($\times$'s), or numbers expressed in scientific notation ($5.3 \times 10^2$ MeV).

The center dot also should not be used to mean a simple product. Use the dot to represent inner products of vectors ($\kappa \cdot \mathbf{A}$).

## 4. Mathematical terms

The use of the following standard symbols is recommended.

| | |
|---|---|
| ~ | approximately or varies as |
| ≃ | approximately equal |
| → | tends to |

$\propto$          is proportional to
$O(\ )$          of the order
$A^*$          complex conjugate of $A$
$A^\dagger$          Hermitian conjugate of matrix $A$
$A^T$          transpose of matrix $A$
$\hat{\mathbf{k}}$          unit vector $\mathbf{k}/k$

## 5. Radical signs and overbars

You may use radical signs

(roofed only, $\sqrt{xx}$)

and

overbars $(\overline{xx})$

when they go over material of six or fewer characters that are without superscripts. If the material is longer or has superscripts, alternative notation should be used.

For $\sqrt{xx}$ use $(xx)^{1/2}$

and

for $\overline{xx}$ use $\langle xx \rangle$

or

$\langle xx \rangle_{av}$.

If the overbar means complex conjugate, then $(xx)^*$ should be used. A radical sign (roofed) cannot be used on built-up material, although an overbar can be used.