Physical Review
Style and Notation Guide

Instructions for correct notation and style
in preparation of REVTEX compuscripts and conventional manuscripts

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Physical Review Style and Notation Guide

Anne Waldron, Peggy Judd, and Valerie Miller

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Physical Review Style and Notation Guide

I. INTRODUCTION

This notation guide represents a compendium of general *Physical Review* style rules to help authors when preparing a paper for submittal as a REVTEX compuscript or a conventional manuscript. It is essential that notation be consistent and standardized so that all papers can be processed efficiently.

This guide has been arranged so it can be used as a reference manual. Differences or exceptions for specific journals may exist, and may be conveyed to the author by the appropriate journal editor. Authors should consult the Information for Contributors section published in the first issue of each volume of *Physical Review.* Some of the journals may also have additional instructions for preparing manuscripts on specialized subjects, obtainable from the editor.

II. STYLE INSTRUCTIONS FOR PARTS OF A MANUSCRIPT

The basic parts of a manuscript are discussed below. Those parts which must be included in every manuscript are marked with an asterisk.

A. *Title

Titles are to be simple and concise. Begin the first word with a capital letter; thereafter capitalize only proper or trade names and chemical symbols. The use of nonstandard abbreviations and acronyms is not allowed. Unnecessary words (a, on, an, the, etc.) at the beginning of the title should be dropped.

B. *Author(s) name(s)

It is preferable to use only one form of your name as an author in all of your publications.

C. *Author(s) affiliation(s)

Write out the names and postal addresses of all institutions in full. Include box numbers, apartment numbers, or street numbers only if necessary for effective mail delivery. ZIP codes are required for U.S. addresses. [Note: If you expect to be contacted by readers, provision of a complete mailing address in the bylines (including department) is advantageous.]

D. *Receipt date

The received date indicates the date the manuscript was received by the scientific editor. This date will be verified by the editor and will appear in the printed article.

E. *Abstract

An abstract must accompany each manuscript. The abstract should consist of one paragraph and be completely self-contained. It cannot contain numbered references; incorporate such information into the abstract itself. Use this form:

Further information is available [A. B. Smith, Phys. Rev. A **26**, 107 (1982)].

Displayed equations and tabular material are discouraged. Define all nonstandard symbols and abbreviations.

F. *Physics and Astronomy Classification Scheme (PACS) indexing codes

Each manuscript must be assigned indexing codes which are used in computerized secondary information services. See also *Physical Review Letters*, 14 December 1992, for code indexing information. In general, follow these guidelines.

(1) Choose no more than four index number codes.
(2) Place your principal index code first.
(3) Always choose the lowest-level code available.
(4) Always include the check characters.

All indexing will be verified by the journal scientific editor.

G. *Main body of the paper—sequential organization

The body of the paper (text and math) should be divided into sections with the use of section headings and subheadings. However, headings are not always required; for short papers headings may not be necessary or permitted. Equations, tabular material, figures, and references should also follow a sequential numerical scheme in order to ensure a logical development of subject matter.

1. Types of headings and section-head numbers

The major divisions in a paper are indicated by principal headings [level (1)]. Each major section can be further divided by subheadings [levels (2)–(4)]. Each subdivision of a heading indicates a more specific topic.

The following list indicates the four different types of section headings and the appropriate style for each. In all headings symbols and abbreviations should appear as they would in text. Refer to a recent issue of *Physical Review* for comparison.

Level (1)

I. PRINCIPAL HEADING

Centered heading, all capital letters, preceded by a roman numeral and a period.

Level (2)

A. First subheading

Centered heading, first word capitalized, preceded by a roman capital letter and a period.

Level (3)

1. Second subheading

Centered heading, first word capitalized, all italic, preceded by an arabic numeral and a period.

Level (4)

(a) Third subheading. Text following a paragraph indentation, first word capitalized, all italic, preceded by a lowercase letter or number in parentheses.

2. Reference, figure, and table numbering

In the body of the paper all references, figures, and tables must be cited consecutively in numerical order. Tables are numbered with roman numerals (I, II, III, etc.). Figures use arabic numerals (1, 2, 3, etc.) with (a), (b), (c), etc., to label the parts of figures. Note that parentheses are used to enclose the labels for parts of figures, e.g., Fig. 1(a). For *Physical Review B*, references use numerals as superscripts (Jones[1]) or on line [Jones (Ref. 1) or Jones, Ref. 1]. Superscript numbers are always placed after a comma, period, quotation marks, colon, and semicolon (Jones,[1] Jones.[1] Jones"[1] Jones:[1] Jones;[1]). For *Physical Review A*, *C*, *D*, *E*, and *Letters*, references use on-line numerals in square brackets (Jones [1]); these are spaced away from the preceding word or symbol, and are placed inside punctuation.

3. Equation numbering

Equations that are important, long, complex, or referenced later in the paper are set off from the text (displayed) and may be numbered consecutively with arabic numbers within parentheses [(1), (2), (3), etc.]. These numbers are placed to the extreme right of the equation. For more details, see Sec. IV C.

H. Acknowledgments

The acknowledgment section follows the main body of the paper and precedes any appendixes. One paragraph is suggested, with acknowledgment of financial support listed at the end. A principal heading [level (1)] is used for this section, but the section is not numbered. Dedications, as contrasted to acknowledgments, are not permitted.

I. Appendix(es)

Appendixes are placed after the acknowledgments section and before the listing of references. All appendixes must have a heading [level(1)]. A variety of styles is permitted; examples of each appear below:

APPENDIX

(single appendix, no titles),

APPENDIX A

(more than one appendix, no titles),

APPENDIX: SURVEY OF RESULTS

(single appendix, with title),

APPENDIX A: SURVEY OF RESULTS

(more than one appendix, all must be titled).

Equations in appendixes that are displayed and require numbering are treated separately from those in the main body of the paper. The appendix equations are numbered consecutively [(A1), (A2), (A3), etc.], bearing the label of the appendix in which they appear. In each appendix the equations are numbered separately. For the case of one appendix the same (A1), (A2), (A3) form for numbering equations is used.

J. *Footnotes and reference citations

Footnotes are divided into four categories:

(1) footnotes to introductory information [author(s) and address(es)],

(2) footnotes for references cited in text,

(3) footnotes for short comments relevant to the text material, and

(4) footnotes that are pertinent to a table or figure only.

All four types should be cited where appropriate and should be cited in consecutive numerical order. For *Physical Review B*, and *Letters* types (1)–(3) are incorporated into one consecutive list of references to be placed at the end of the paper. For the other journals, type (1) footnotes are placed instead at the bottom of the page on which they appear. As an option (*Physical Review A, C,* and *D* only), footnotes [types (1) and (3)] may appear separately from the references [type (2)] and be placed at the bottom of the page on which they appear. Type (4) footnotes should be written out completely in the table or figure caption where they are cited. All types of footnotes are discussed in the following instructions. Examples of the recommended form and content for *Physical Review* references are presented in Table I on page 7. For a list of some standard journal abbreviations used, please see the Appendix.

1. Footnotes—introductory

For introductory [type (1)] footnotes use these symbols (always as superscripts): *, †, ‡, §, ||, ¶, **, ††, ‡‡, §§, ||||, ¶¶ (in the order listed), if there are 12 or fewer footnotes. Use lowercase letters a, b, c, etc., if there are 13 or more footnotes. For example, an introductory footnote which refers to an author's name will appear as J. M. Smith* in the author's byline citation and will appear either as the first reference in the listing at the end of the paper or at the bottom of the page on which they appear. Acknowledgments of financial support should not appear as footnotes to the title or an author's name, but rather should be part of the acknowledgment section.

2. Footnotes—reference citations

For *Physical Review B*, reference footnotes [type (2)] are noted in text by the insertion of numerals as either a superscript or on line in this manner:

Smith^2 does not agree with the original values given in Ref. 1.

The use of a superscript is preferred. When that use could possibly cause confusion (i.e., Pb^4), the on-line form should be used [Pb (Ref. 4)]. In the footnote listing at the end of the paper use only the superscript form.

For *Physical Review A*, *C*, *D*, *E*, and *Letters*, reference footnotes [type (2)] are noted in text by on-line arabic numerals in square brackets in this manner: Smith and Jones [3] also measured ....

Reference indicators should be at least one full space from words (not closed up to them as with superscripts). Multiple reference indicators should be set closed up within a single set of brackets: Smith and Jones [1,3,5–8] performed .... Reference indicators should be set inside punctuation: The work of Smith [3], that of Jones [4], and our previous work [5–8] disagree with that of Doe and Roe [13]. When the word "reference" is used in specifying a reference, use the abbreviation (unless at the beginning of a sentence) with the indicator in brackets: ... as was shown in Ref. [4]. Note that use of the following form is also acceptable: ... as was shown in [4].

3. Footnotes—nonparenthetical side remarks

For *Physical Review A, C,* and *D*, footnotes to text material, when cited separately from references, are designated in text by superscript numerals and numbered consecutively, separately from reference numbering, throughout the paper.

4. Footnotes—tables and figures

Type (4) footnotes are those that are pertinent only to a particular figure or table and that do not appear in the final reference list at the end of the paper. A type (4) footnote can appear in the appropriate table or figure caption. Two forms can be used:

FIG. 1. Theoretical data, denoted by △'s, are from J. M. Smith, Phys. Rev. B **26**, 1 (1982).

FIG. 2. Theoretical data, denoted by △'s [J. M. Smith, Phys. Rev. B **26**, 1 (1982)].

Alternatively, a type (4) footnote can be included in a list immediately below the table.

Form:

TABLE X. The data in column 1 [J. M. Smith, Phys. Rev. B **26**, 1 (1982)] are of primary importance. The other ...

1.01	$x = 2.2$	...
2.01	$x = 3.2$[a]	...

[a]R. B. Jones, Phys. Rev. A **26**, 5 (1982).

TABLE I. *Physical Review* has established general forms to make the presentation of reference information as simple and concise as possible. Follow the instructions below and use these forms in the final reference list. Comments pertaining to a particular reference are enclosed in square brackets at the end of some examples. For a list of the standard journal abbreviations, please see the Appendix.

Type	**Entry in final reference list or at bottom of the page**
Introductory type (1)	*Present address: Physics Department, Auburn University, Auburn, AL 36849. †On leave from Brookhaven National Laboratory, Upton, NY 11973. ‡Corresponding author.
Text type (2)	
(a) How to list authors	
One author:	J. M. Smith, Phys. Rev. B **26**, 1 (1982).
Two authors:	J. M. Smith and R. Brown, Phys. Rev. B **26**, 1 (1982).
Three or four authors:	J. M. Smith, R. Brown, and C. Green, Phys. Rev. B **26**, 1 (1982).
Five or more authors (*et al.* optional; use of *et al.* journal specific; note that Phys. Rev. C requires that 10 or fewer authors be listed and *et al.* not be used in such cases)	J. M. Smith *et al.*, Phys. Rev. B **26**, 1 (1982).
(b) How to list sources	
One source:	J. M. Smith, R. Brown, C. Green, and A. White, Phys. Rev. B **26**, 1 (1982).
Two sources:	J. M. Smith, Phys. Rev. B **26**, 1 (1982); Nucl. Phys. **A195**, 1 (1982). [Note that a semicolon is used between sources.]
Three or more sources:	J. M. Smith, Phys. Rev. B **26**, 1 (1982); Nucl. Phys. **A195**, 1 (1982); Phys. Lett. **16A**, 1 (1982).
(c) How to list same author, same source, different volume and page	J. M. Smith, Phys. Rev. B **24**, 3 (1981); **26**, 1 (1982).
(d) How to list same author, same source, same volume number, same year, and different page numbers	J. M. Smith, Phys. Rev. B **26**, 1 (1982); **26**, 6 (1982). [Note that both page numbers are listed separately.]
(e) How to list different authors and different sources	J. M. Smith, Phys. Rev. B **26**, 1 (1982); R. Brown, *Heavy Ions* (Academic, New York, 1982); C. Green, Ph.D. thesis, Brown University, 1980.
(f) How to list different authors, same sources	J. M. Smith, Phys. Rev. B **26**, 1 (1982); R. Brown, *ibid.* **24**, 3 (1981); C. Green, *ibid.* **24**, 22 (1981). [Note that *ibid.* is used instead of repeating the journal name.]
(g) How to list multiple parts in a single footnote	(a) J. M. Smith, Phys. Rev. B **26**, 1 (1982); (b) R. Brown, Nucl. Phys. **A195**, 1 (1982).
(h) Journals	J. M. Smith, Phys. Rev. B **26**, 1 (1982). [published]
	J. M. Smith, Phys. Rev. D (to be published). [accepted for publication]
	J. M. Smith, Phys. Rev. B **26**, 706(E) (1982). [erratum]
	J. M. Smith, Zh. Eksp. Teor. Fiz. **51**, 165 (1966) [Sov. Phys. JETP **24**, 11 (1967)]. [Russian journal reference with English journal translation]

(i) Books	J. M. Smith, *Molecular Dynamics* (Academic, New York, 1980), Vol. 2, p. 20. [published, use italic title; additional information (Vol., Chap., Sec., p., etc.) as appropriate] J. M. Smith, in *Molecular Dynamics*, edited by C. Brown (Academic, New York, 1980). [published, use italic title; for edited works use form "in" and "by"] J. M. Smith, *Molecular Dynamics* (Academic, New York, in press). [in the process of being published, use italic title and the form "in press"]
(j) Proceedings	J. M. Smith, in *Proceedings of the International Conference on Low Temperature Physics, Madison, 1958,* edited by C. Brown (University of Wisconsin, Madison, 1958), p. 201. [published, use italic title; edited form as above] J. M. Smith, in Proceedings of the International Conference on Low Temperature Physics, Madison, 1958, edited by C. Brown (unpublished). [not published, use roman title; edited form as above] J. M. Smith, in *Low Temperature Physics,* proceedings of the International Conference, Madison, Wisconsin, edited by C. Brown (University of Wisconsin, Madison, 1958). [shortened published title, use italic title with descriptive information following; edited form as above]
(k) Reports	J. M. Smith, Brookhaven National Laboratory Report No. 10, 1982 (unpublished). [Most reports are considered to be unpublished. Those reports considered as full publications should be designated without the parenthetical unpublished at the end of the reference.]
(l) Preprints (journal specific)	J. M. Smith, Brookhaven National Laboratory Report No. 110, 1992 (to be published).
(m) Theses	J. M. Smith, Ph.D. thesis, Brown University, 1980.
(n) Others	J. M. Smith (private communication). J. M. Smith (unpublished). J. M. Smith as discussed in A. Jones, Phys. Rev. B **26**, 1 (1982). [cited in another paper] J. M. Smith, computer code CRUX, Bell Laboratories, Murray Hill, NJ, 1972.

Tables may also contain type (2) footnotes which appear in the final reference list. Such footnotes may be cited by letter on line, or may be incorporated with other footnotes mentioned in the table into a listing at the end of the table. Lowercase roman letters are used to identify the footnotes in the table and in the list, i.e., a, b, c, etc. They are in superscript form when they refer to an entry or heading and on line when they replace a missing entry. Order the footnote letters consecutively row by row, and not by column.

Form:

TABLE X. Experimental results (Ref. [6]).

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

[a]Reference [1].
[b]Reference [2].
[c]Not available.

K. Tables

Tabular material of more than approximately four lines should not remain as part of the text. It should be treated as a separate numbered table, complete with a descriptive caption. All such tables must be cited in text and are to be numbered consecutively in order of their appearance in text. Use roman numerals. The following instructions and descriptions of components are included here to assist you in the preparation of tables. Examination of some current issues of *Physical Review* will illustrate a wide variety of tables and will serve to clarify the instructions below.

Extensive tabular material may be deposited in the Physics Auxiliary Publication Service (PAPS). This service, managed by the American Institute of Physics, supplies copies of material that is supplementary to papers published in APS (and other journals) but which may be of too limited reader interest and/or too lengthy to be published in full in the journal. For detailed instructions, query the appropriate journal editor.

1. Sizes

There are several standard types of tables. Each type is determined by its width and/or length. Each type requires captions, lines, and spacing, as well as headings appropriate to its size. It is, therefore, necessary to first estimate what the width and length of a table will be.

There are four standard one-page table widths:

(1) narrow (one column, 8.6 cm or 3.4 in.),
(2) medium (centered, 14 cm or 5.5 in.),
(3) wide (two columns, 17.8 cm or 7.0 in), and
(4) turned table (one-page length turned sideways, 25.4 cm or 10.0 in.).

A turned table requires special handling by the production staff. Please identify it as such in a cover letter.

In addition, to accommodate extremely wide tabular material, tables can read across facing pages (35.6 cm or 14.0 in.). This type of table also requires special handling by the production staff and should be identified in a cover letter. This table requires a duplicate set of wide headings, lines, and a “continued” caption.

Form:

TABLE I. *(Continued).*

A one-page table (narrow, medium, or wide) may not exceed 25.4 cm or 10.0 in. in length or approximately 63 lines. This overall length has to include the caption, opening lines and spacing, headings, entries, closing lines and spacing, and any footnote material connected to the table. If the total length exceeds this limit, the table may be treated in one of the following ways.

(1) A very long, narrow, one-column table can be split and continued in a second column on the same page. It will require a wide caption, a duplicate set of headings, and wide opening and closing lines.

(2) A very long medium or wide table can be continued on the next page or pages. In addition to its first-page caption, headings, etc., it will need a duplicate set of headings, lines, etc., for each additional continued page. It will also require a “continued” caption (see above) for each additional page of the table.

2. Captions

Each table that is not part of the text must have a descriptive caption. It should be as concise as possible. The caption can consist of an abbreviated sentence (without a beginning article and/or verb) punctuated as a complete sentence. If it is made up of more than one sentence, treat it as a single paragraph.

The caption must begin with the word table, in capital letters, followed by the appropriate roman numeral and period, and then a small amount of explanatory text. Displayed math is allowed within the caption, but the use of short mathematical expressions in broken-down form is preferred. Abbreviations and acronyms that pertain to the whole table should be defined in the caption. Those already defined in text need not be defined again.

Form:

TABLE I. Spin-orbit parameters.

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

Sample 1

Branching ratio (%)
1
2
3

Sample 2

E_x (MeV)	J^π
2720	2^-
4141	2^-

3. Lines and space

Lines and space are used to separate and define the integral parts of a table. They aid the eye and group information appropriately.

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. Each set of headings will require a line below it and extra space running horizontally above it to separate it from the preceding part of the table.

Use spacing also for grouping. Clear separation of one column and heading from another is created by inserting extra space running vertically between them.

Extra space running horizontally can be used to distinguish broad groups among the entries. Smaller groupings of related entries can be indicated by the use of a single curly brace or a combination of a single curly brace and extra space.

Tables that require nonstandard treatment will need to be discussed in a cover letter. The production staff will accommodate special handling of tables. As a double check of table setup, please review your author proofs carefully. Check alignment, lines, and spacing to ensure that no distortion of your meaning has occurred. If incorrect placement is evident, carefully correct it on your proof copy.

Use centering or straddle rules to group several subheadings under one main heading.

Form:

	Collimator measurements		
No. of holes	Radius (mm)	$A(r)$ (counts)	Off-axis point correction $[G_p(r)/G_{p'}]$
x	x	x	x
x	x	x	x

Form:

	$e^- + (e^-e^+)$	$p + (p\mu)$	
Parity	±1	$+1$	-1
x	x	x	x
x	x	x	x
x	x	x	x
x	x	x	x

4. Headings

There are two major kinds of headings used in tables:

(1) column headings,

(2) row headings.

Each type may contain or be made up of standard abbreviations. Always capitalize the first word or abbreviation in all headings and subheadings.

(1) 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 a line by itself (sample 1) or spaced off from the heading on the same line (sample 2).

(2) *Row headings* are read from left to right on one line. When used in the heading area they need a diagonal line to separate them from any column headings.

The j heading refers to the 1 2 horizontal row; 1 and 2 in turn are column headings that read down as does the i heading.

Form:

i \ j	1	2
1	0.3601×10^3	-0.5224×10^1
2	-0.2691×10^4	0.5130×10^2
3	0.7733×10^4	0.1717×10^3

In the body of a table, row headings have similar form. They are read left to right with any units of measure enclosed in parentheses and separated by one space on the same line. To continue a row heading or indicate a row subheading, indent the second line.

Form:

xxx	xxx
1. Counting	
a. Counting statistics in Table IV	0.017%
b. Error in counting estimate	0.02%
c. Error from estimate of ^{240}Pu	0.009%

5. Entry lineup

The manner in which table entries are aligned in their columns will greatly affect the readability of a table. For this reason use one or a combination of the following types of alignments.

(1) Flush left. To be used in a situation where the entries are not similar and/or of different lengths. All entries are flush left with the column heading centered over the column.

Form:

Interpretation
$J = 1$ BE triplet
$J = 0$ BE singlet
BE states from splitoff
cf. B_1 in Fig. 2
Second B_1 replica

(2) Center. An alternative to (1). Each entry is centered with the column heading centered.

Form:

Mode
β^-
Stable
β^+
β^-
Stable
β^-

(3) *Lineup by digit and/or decimal.* To be used in a situation where all or most of the entries are numbers. Align according to digit and/or decimal placement.

Form:

Theory	
1	2
9.7	15.6
7.4	7.7
14.9	15.2
24.9	22.9
3.06	3.32
−0.74	−0.93

(4) *Lineup by operator.* To be used in a situation where most entries are similar and have some kind of operator (multiplication, plus, minus signs, etc.) in common.

Form:

1
0.4557×10^1
-0.2051×10^1
$-0.650 \quad \times 10^2$

(5) *Lineup by unit.* To be used when the entries include different units of measurement [see example (a)]. In other cases where all entries include the same unit, the unit designation should be removed from the column entries, enclosed in parentheses, and made part of the column heading [see example (b)]. Lineup will then be by operator, decimal, and/or digit as appropriate.

Form:

(a)

Half-life
41.3 ± 0.1 day
5.37 ± 0.009 day
11.05 ± 0.02 min

(b)

Half-life (day)
41.3 ± 0.1
5.37 ± 0.009
11.05 ± 0.02

(6) *Combination of lineups.* Whenever possible lineups (3), (4), and (5) should be used in conjunction.

Form:

Neutron energy
9840 ± 30 eV
10.34 ± 0.04 keV
10.50 ± 0.02 keV

L. Figures

There are both style and technical considerations when preparing figures as part of an author-prepared paper. Keep the following technical suggestions and basic style requirements in mind when designing and composing figures.

1. Types of figures

(1) Line drawings (original drawing or photograph of drawing). This kind of figure is considered the most desirable. Use black ink on a white background. Submit original or glossy print only.

(2) Continuous tone photograph (photographs that contain variations in tone). *Do not screen.* Submit sharp glossy photographs.

(3) Combination (composite figure, both line drawing or photograph and continuous tone photograph). Prepare as separate figures. Submit two photographs, indicating that they are to be treated as one figure. Include registration marks or instructions. *Do not screen.*

(4) Machine-generated (computer output or material reproduced directly from automatic plotters). Figures of this type are sometimes *not* acceptable because of unsuitable lettering size, lettering quality, or curves that break up when the figure is reduced. Figures must have clear background and unbroken lines with as much black and white contrast as possible.

2. Designing and labeling figures

(1) Prepare figures on standard size paper (21×28 cm or 8.5×11 in.). Larger figures are easily damaged by handling and smaller ones are sometimes overlooked or misplaced.

(2) Size figures for reduction to journal column width, i.e., ∼8.6 cm (∼3.4 in.) or ∼17.8 cm (∼7.0 in.), and single page or less length. The production staff photographically reduces all line drawings and photographs, if they are in proper scale, to three basic sizes to fit within the following limits:
(a) narrow, to fill the width of one column;
(b) wide, to fill two columns; or
(c) centered, with space on either side.
Figures will be treated as narrow unless flagged and identified as wide or centered in a cover letter.

(3) Make symbols, line thickness, and lettering in proper scale in relation to the overall figure size so that reduction will not reduce clarity.

(4) Avoid handlettering. Use of a mechanical device is strongly urged. Two sizes for lettering (one for on-line lettering, the other for subscripts, superscripts, and data points) is strongly recommended. Draw symbols and lettering so that after reduction the smallest of these, such as those used for subscripts, etc., will not be less than 1.5 mm ($\frac{1}{16}$ in.) tall. Consider also that intricate symbols tend to fill in when reduced. Solid or open symbols are easier to read.

(5) Make line thickness consistent (solid and dark). Lines tend to become less distinct when reduced.

(6) When shading is necessary, use diagonal or crosshatched lines.

(7) Figure labeling must be consistent with the rest of the paper. Use the same abbreviations, symbols, and upper- and lowercase letters throughout.

(8) 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.

(9) 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 bracketing, i.e., θ (deg). Do not use powers of 10 if possible; instead use the appropriate prefixes of the *Système International* (see Table II, p. 16). If powers of 10 cannot be avoided the following form is preferred: R (10^{-4} Ω).

3. Identifying figures

Number each figure consecutively with an arabic numeral according to the order in which it is discussed in the paper. Write the figure number and first author's name preferably on the bottom of each figure. If not possible, write them on the back of the figure with a very soft pencil. This will ensure proper matching of figure and text. *All figures must be cited in consecutive order in text.* For example, you could refer to your first figure in one of these ways:

Form:

(a) Figure 1 shows experimental results.

(b) Experimental results are shown in Fig. 1.

Note that the word figure is written out when it begins a sentence, but it is abbreviated at other times. The production staff will place each figure as close as possible to its original citation when designing the final layout of the paper.

4. Figure captions

Give each figure a separate caption. Like a table caption, it should be concise. It may be made up in part of an abbreviated sentence or group of sentences in a single paragraph. It must begin with FIG. (all capital letters), followed by the appropriate arabic numeral and period, and then by the abbreviated explanatory sentence or sentences.

Form:

FIG. 1. Plot of χ^2 against different values of $\mathrm{Re}[f_N^-(0) + f_N^+(0)]$. Solid curves for the x plane; dot-dashed curves for the z plane.

Within the explanatory material of a caption include definitions of all symbols, abbreviations, and acronyms used in the figure that have not been previously defined in text. Also describe separate figure parts or insets.

Form:

FIG. 1. Part of the fluorite structure around an oxygen vacancy; $\circ$, oxygen vacancy; $\bullet$, normal oxygen ion.

FIG. 1. Continuous line: solution of the Lippmann-Schwinger equation (13) with the use of dynamical self-energy of Eq. (5). Broken line: static Coulomb wave function given by Eq. (9) of the text. The inset shows the behavior in the near-surface region.

FIG. 1. Cluster geometries used for (a) substitutional site in bcc Fe, (b) octahedral interstitial site in bcc Fe, (c) tetrahedral interstitial site in bcc Fe, and (d) octahedral interstitial site in fcc Co and Ni. Filled symbols denote hydrogen positions and unfilled symbols show host-atom positions.

III. STYLE INSTRUCTIONS FOR GRAMMAR, PUNCTUATION, SPELLING, HYPHENATION, AND ABBREVIATION OF UNITS

A. Grammar and punctuation

Good grammar and clear punctuation are essential to successful technical writing. Clear, simple sentence structure best presents scientific ideas and mathematical formulas. For a general guide to good grammar, use Nicholson's *Dictionary of American-English Usage.*

Specific modification and adaptation of the basic rules are sometimes required by scientific conventions. In addition, the combination of forms including abstract, text, mathematical formulas, figures, tables, and references also creates the need for special structure and style considerations. Below are guidelines to assist you.

1. Text and math as sentences

(1) Treat the text and mathematical formulas as an entity. Punctuate mathematical expressions as sentences or parts of sentences.

Form:

A slight rearrangement of terms then gives

$$D_s = \bar{\xi}_s X^{-1/2} - b, \tag{14}$$

where

$$X = 4t\chi^2(-\ln t)/\pi^2, \tag{15}$$

$$\bar{\xi}_s = \xi_s/t^{1/2}, \tag{16}$$

and the reduced transition temperature t is defined to be T_c/T_{cs}.

(2) Avoid beginning a sentence with a symbol if the sentence before it has ended with a symbol or number.

2. Use of the comma

(1) Do not surround a symbol with commas or parentheses when it immediately follows the noun that defines it, but do insert the commas or parentheses if another phrase intervenes.

Form:

As the temperatures approached the melting temperature T_m, all ...

As the temperatures approached the melting temperature reported by Green *et al.*, T_m, all ...

(2) Please use the serial (Harvard) comma. See the example below, where the second comma is the serial comma.

Form:

Symmetry requires that $\omega_1 = \omega_2$, $\omega_3 = \omega_4$, and $\omega_5 = \omega_6$.

(3) Place commas around etc., e.g., i.e., viz., namely, for example, that is, say, in particular, and respectively. Do not use commas around cf. or *et al.*

(4) Nonrestrictive clauses should be introduced by "which" and set off by commas.

Form:

The $K = 1$ component, which in this case does not influence the band shape, gives rise to ...

3. Use of parentheses

(1) When inserting a parenthetical remark into a sentence do not punctuate what is within the parentheses.

Form:

Recall that the Brown-Green theory (see Sec. II below) must still be tested.

(2) A completely separate parenthetical remark is punctuated as a regular sentence or group of sentences except that everything including the ending punctuation is enclosed within the bracketing.

Form:

(Recall that the Brown-Green theory is still to be tested.) Again we begin to evaluate ...

(3) Square brackets enclose a phrase that already contains parentheses.

Form:

Recall that the Brown-Green theory [see Eq. (2)] is still to be ...

4. Use of the colon

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

Form:

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.

Form:

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

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

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

Form:

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 ...

(4) Do not use a colon after a form of the verb "to be" or between a verb or a preposition and its object.

Form:

The momenta of the three α particles in the c.m. system are $\mathbf{p}_1$, $\mathbf{p}_2$, and $\mathbf{p}_3$.

New values were obtained for the quantum cyclotron radius, the Debye shielding radius, and the plasma frequency.

B. Spelling and hyphenation guide

In technical writing the proper spelling and hyphenation of words is a controversial point of style. In general, for nontechnical words refer to *Webster's New International Dictionary* if a question of correct form arises. Use the first spelling if there is more than one correct version. A list of general spelling and hyphenation rules follows.

(1) Use American, not British, spellings except in proper names.

(2) When possible, use single, not double consonants in forming endings (e.g., labeled not labelled). However,

if the accent is on the last syllable, then double the consonant, e.g., controlled.

(3) Do not use contractions.

(4) To form the plural of numbers add s (1980s), to symbols add 's (A's), and to abbreviations add 's or s (NMR's or NMRs).

(5) To form the possessive of names add 's (apostrophe s), regardless of the number of syllables or final letter (Green's, Jones's, de Gennes's).

(6) Capitalize adjectives and nouns formed from proper names (Gaussian, Ohmic); however, lowercase the names of units (gauss), well-established particles (boson and fermion, but *not* Pomeron), and minerals (scheelite).

(7) Use small capitals to identify computer program names, designation of ionization states in atomic spectroscopy, and the names of logical operations; e.g., DWUCK, Fe II, and OR.

(8) Avoid hyphens that serve no useful purpose, e.g., cutoff, not cut-off; output, not out-put.

(9) Prefixes and suffixes usually should be closed up (nonradioactive); but do not close them up if a double letter is produced (semi-infinite), when added to a proper noun (non-Fermi), when added to two or more words (non-time-dependent), or if closing up could change the meaning of the word (un-ionized). Chemical prefixes and suffixes should be hyphenated (*cis*-dimethylethylene) and so should numbers above 10 (11-fold, but twofold).

(10) "Self" words, "free" words, and some "half" words should be hyphenated (self-consistent, worry-free, and half-life), but "like" words are closed up (spacelike) unless they become extremely long or cumbersome.

(11) To prevent ambiguity and make reading easier, modifiers made up of two or more words can be hyphenated (wrong-signature points, 8-MeV data). Strings of modifiers can be sorted with a combination of short and long hyphens (two-particle–two-hole configuration). Editorial policy varies on this subject from journal to journal. Check a recent issue of the journal in which you are publishing and query your editor.

(12) A hyphen also can be used as a sorting agent in predicate adjectives of three or more words (... is face-centered-cubic).

(13) Use a hyphen in written-out numbers of two words or more (twenty-five).

(14) Use hyphens in the names of materials such as β-brass.

C. Abbreviation rules

When creating or using abbreviations, keep the following guidelines in mind.

(1) An abbreviation for a single word should be a shortened form of that word. It should be made up of lowercase roman letters and is almost always unpunctuated (obs for observed or av for average).

(2) An abbreviation for a phrase (acronym) should include the initial letters of the words of the phrase in either capital or lowercase roman letters (DWBA for distorted-wave Born approximation, bcc for body-centered-cubic). Always use capital letters if you are abbreviating a proper name (BCS for Bardeen-Cooper-Schrieffer), and when creating acronyms.

(3) When you are using an abbreviation of a proper name as a superscript or subscript, retain the initial capital letter (E_{Coul} or E_C for Coulomb).

(4) Do not use multiletter abbreviations as mathematical variables. Use the conventional symbol instead, e.g., E_K; not KE for kinetic energy.

(5) Abbreviations should be defined the first time they are introduced in text, i.e.,

> ...to describe dislocation-mediated melting of two-dimensional (2D) crystals, we ...

Thereafter it is acceptable to use the abbreviation without definition.

(6) For a list of standard abbreviations appropriate to the specific journal, consult the editor.

D. Units

The use of metric units (of the *Système International*) is preferred. This system is based on the meter, second, kilogram, ampere, kelvin, mole, and candela. [See *The International System of Units*, Natl. Bur. Stand. (U.S.) Spec. Publ. 330 (U.S. GPO, Washington, D.C., 1977).]

(1) 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 $1\ \mathrm{g\,cm^2}$ or $\mathrm{g\,cm^2\,s^{-2}}$, with a thin space between unit parts. The form $6\ \mathrm{J/cm^3/s}$ is ambiguous and unacceptable; write

$$6\ \mathrm{J\,cm^{-3}\,s^{-1}} \quad \text{or} \quad 6\ \mathrm{J/(cm^3\,s)},$$

if that is what is meant.

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

$$1.0\ \mathrm{cm} \quad \text{and} \quad 2.7\ \mathrm{cm}.$$

(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) Units are written in the following forms: The abbreviation must be used after a number given in numerals

$$1\ \mathrm{cm} \quad \text{(not 1 centimeter)}$$

but the unit is written out in cases like

a few centimeters.

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

1.8 MeV

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

Prefix	Symbol	Factor	Prefix	Symbol	Factor
deci	d	10^{-1}	deka	da	10^{1}
centi	c	10^{-2}	hecto	h	10^{2}
milli	m	10^{-3}	kilo	k	10^{3}
micro	μ	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}

Some units are not spaced off from the number,

e.g., 1%, 1°, and 1°C.

(5) For a list of standard symbols for units of measure appropriate to a specific journal, consult the editor.

IV. INSTRUCTIONS FOR COMPOSING MATHEMATICAL MATERIAL

Mathematical material can be difficult to present in a clear, concise manner. By nature it is often complex and this makes specialized treatment a necessity. Conventionally accepted notation and standardized forms are an aid both to the author and reader. It is with this in mind that the following instructions and guidelines have been included.

A. Characters available

1. Alphabets

There are two alphabets used conventionally: Greek and Latin (upper- and lowercase letters of each) in lightface and boldface. The Latin alphabet is available in five letter type fonts: roman (upright), italic (slanted), script (cursive), German (Fraktur), and sans serif (unadorned).

Each alphabet and font has specialized uses. The two main Latin fonts, roman and italic, are used to create a distinction between words and mathematical symbols. Latin letters as mathematical symbols are conventionally printed in the italic font to distinguish them from the text material which is printed in the roman font. Below are listed specific uses for both alphabets and the fonts.

a. Greek alphabet. Letters of the Greek alphabet are used to represent the following: some variables and constants, symbols for particles, some operators, and some units of measure. Note here that the Greek letter, not the word, is commonly used in most situations.

b. Latin alphabet. Roman (upright) font: English words, abbreviations of words, chemical symbols and compounds, most multiletter abbreviations (both on line and as subscripts and superscripts), units of measure, bold three-vector notation (e.g., **k**), most multiletter operators and functions (e.g., exp, ln), modes (e.g., TE, LO), shapes, data-run numbers, figure part labels [e.g., (a), (b), etc.], parts of apparatus, letters in periodic tables, letters in equation numbers [e.g., (1a), (1b)], figures, tables, section headings, section heading letters, and letters in enumerative lists.

Italic (slanted) font: foreign words, words or phrases that indicate emphasis, variables, constants, symbols for particles, most single-letter operators, axes and planes, channels, types (e.g., n,p), bands, geometric points, angles, lines, chemical prefixes, symmetry designations, transitions, critical points, color centers, quantum-state symbols in spectroscopy, and most single-letter abbreviations. In an alloy, the major constituent is italicized, the other chemical symbol is roman as usual, e.g., *Cu*Mn.

Script (cursive) font: variables and operators, constants, matrix elements, and some quarks.

German (Fraktur) font: variables.

Sans serif (unadorned) font: a few variables (S,T in tensor notation), shapes (e.g., L shaped), and a few operators.

Boldface type is reserved for indicating three-vectors and in some special cases matrices. Dyadics are represented by the roman font and appropriate diacritical mark, e.g., $\overleftrightarrow{\mathrm{k}}$.

2. Numbers

Numbers are printed in either the roman or italic font. Use the roman font for all numbers except those in the following situations: (1) numbers in second and third subheadings, (2) numbers in published reference titles. These should be made italic.

3. Symbols

Those symbols listed in Appendix A of the *REVTEX Input Guide*, published concurrently with this guide, are available for your general use. Other special symbols may be available as part of the paste-up procedure. Small Feynman diagrams will be treated as figures and inserted at the paste-up stage. Please discuss your intention to use any nonstandard symbols in a cover letter.

4. Diacritical signs in math

For a list of available diacritics see Table III below. It is possible to make multilevel accents, but placing one sign above a symbol or letter and one below is often more clear. Restrict the number of oversymbols to two. The underline can appear under any configuration. Some combinations may not be permitted by the journal editor.

TABLE III. Diacritical signs in math.

Single level	
$\vec{\mathrm{x}}$	$\hat{x}$
$\overleftrightarrow{\mathrm{x}}$	$\tilde{x}$
$\dot{x}$	$\bar{x}$
$\ddot{x}$	$\underline{x}$

5. 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):

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

$$\int_0^1, \quad \sum{}', \quad {}^{14}\mathrm{N}_2,$$

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

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

tensor notation: $g_{\mu\nu}(\phi^z)^{;\alpha}{}_{;\alpha}$
molecular ions: $\mathrm{H_2}^+, \mathrm{O_2}^-$
footnotes in tables: $E_n{}^{\mathrm{a}}$.

Presuperscripts or presubscripts also are to be 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.,

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

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.,

$$M^{\alpha_i^2}_{b_k^\dagger}$$

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

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

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

Usage of multiletter abbreviations that designate mathematical functions has been standardized. The roman font is to be used, e.g., cos and tan.

(1) Roman multiletter abbreviations must be closed up to the argument following and separated from any preceding symbol by a thin space, i.e.,

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

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

(2) 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:

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

(3) When the argument of a function contains parentheses, enclose it in bold round parentheses, i.e.,

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

(4) 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^{xx} form is appropriate when short, simple superscripts would be involved, i.e., e^z. $\exp(xx)$ 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_{lab}, where lab stands for laboratory (truncated word—lowercase) and E_{HF}, where HF stands for Hartree and Fock (acronym), 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

$$H_{ij} = \left(\frac{\Omega}{\Delta}\right)^2 \frac{|J|^2}{E_g + \frac{1}{2}(W_c + W_v)} e^{\lambda \mathbf{K}\cdot\mathbf{R}_{ij}}, \tag{11}$$

where

$$\mathbf{K} = \frac{1}{a}(\hat{\mathbf{i}} + \hat{\mathbf{j}} + \hat{\mathbf{k}}), \tag{12}$$

and

$$\lambda = \ln[W_l W_v/(12E_g)^2]. \tag{13}$$

3. Equation "breaking" (multilinear equations)

Mathematical expressions often need to be displayed on two or more lines ("broken") because of the line-length limitations of the *Physical Review* standard two-column layout. 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. See examples of breaking displayed math below:

$$\begin{aligned} N_x(\mathbf{r}) + iN_2(\mathbf{r}) &= e^{i\theta(\mathbf{r})} \\ &= \exp[-ij_x u(\mathbf{r})], \end{aligned} \tag{1}$$

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

There are situations where breaking an equation is not possible or appropriate. See the following equation as an example:

$$a_{v,k} = \frac{W_1^{(1)}(x) - 2W_2^{(1)}(x) - \frac{2}{3}W_3^{(1)}(x)}{[W_1^{(0)}(x) + W_1^{(2)}(x)] - 2[W_2^{(0)}(x) + W_2^{(2)}(x)] - \frac{2}{3}[W_3^{(0)}(x) + W_3^{(2)}(x)]}. \tag{3}$$

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 as before and choose γ $(= -5.46$
$\times 10^{-3})$ 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 $G_{\rm ng}\Omega_2^{-1}$ remains ...

4. Equation numbering

Equations must be numbered consecutively. Use arabic numbers and roman letters (for grouping according to relationship). Enclose the number in parentheses, e.g., (1), (1a), (1.1a), etc. The numbering sequence should be either continuous throughout the paper [(1)–(22)] or according to section [(1.1)–(1.22), (2.1)–(2.22)].

Appendix equations are an exception to the rule above. They *must* be numbered separately, and the equation number must include a capital roman letter identifying the appendix. If there is only one appendix the equation numbering is (A1), (A2), (A3), etc. For more than one appendix, each appendix section heading will be labeled and the equation numbering should be (A1), (A2), (A3), etc., (B1), (B2), (B3), etc.

Some situations require unique numbering independent of where they occur in a paper. 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 (one prime means first variation, double prime means second variation, etc.).

Equation numbers are placed flush with the right margin according to standard forms in examples (a)–(f) below:

(a) One-line equation and number:

$$a + b = 0. \tag{1}$$

(b) Broken equation and condition:

$$\begin{aligned} a + b = c + d + e + f + g + h + i + j + k + l \\ + m + n \quad (a = 1). \end{aligned} \tag{1}$$

(c) Two equal equations with one number:

$$\left.\begin{aligned} a + b &= 0, \\ c + d &= 0. \end{aligned}\right. \tag{1}$$

(d) Two equal equations with only one left side and separate numbers:

$$a + b = 0 \tag{1a}$$
$$= x. \tag{1b}$$

(e) One equation with one condition:

$$a + b = 0 \quad (a = 1) \tag{1}$$

or

$$a + b = 0, \quad a = 1 \tag{2}$$

(f) One equation and one condition that will not fit on one line:

$$a_1 + b_2 + c_3 + d_4 + e_5 + f_6 + g_7 + h_8 + i_9 = 0 \qquad (1)$$

$$(a = 1).$$

D. Bracketing

1. Grouping sequence

For the purpose of grouping, the sequence of bracketing preferred for *Physical Review* articles 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:

$$\boldsymbol{\{\,[\,(}\,\{\,[\,(\;)\,]\,\}\,\boldsymbol{)\,]\,\}}$$

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.,

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

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:

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

Ordered bracketing is also used to create specialized notation, e.g., $[L_2, L_3]$ in the equation below:

$$\tfrac{1}{3}\{-i(L_1[L_2, L_3] + T)\} = 0.$$

When there is a mixture of bracketing that orders and defines, the order sequence starts at the beginning with parentheses, skips the specialized notation (in this case, square brackets) and goes on to the next ordered bracket set (curly braces).

There are situations where special bracketing will occur in pairs, i.e.,

$$||r^2 + r^2||^{1/2}, \qquad \langle\langle r^1 + r^2\rangle\rangle_{\rm av}, \qquad \boldsymbol{(}r||f(r)\boldsymbol{)}.$$

The outside bracket set should be printed in bold.

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	$[H_0, [H_0, H_1]]$ or $\boldsymbol{[}H_0, [H_0, H_1]\boldsymbol{]}$
Functionals	$F[x]$
Anticommutators	$\{f, g\}$
Sets	$\{x\}$
Coefficients of fractional parentage	$\{\lvert\sigma_i\rvert\}$
Absolute values	$\lvert a\rvert$
Determinants	$\lvert x\rvert$
Notation used to indicate at what value of the argument some quantity is to be taken	$\rvert_{s\to\infty}$
Matrices or norms	$\lVert f\rVert$
Averages	$\langle\ \rangle$, $\langle\ \rangle_{\rm av}$
Dirac bra-ket notation	$\langle\ \vert\ \vert\ \rangle$ and $(\ \vert\ \vert\ )$,

E. Additional style guidelines

1. Placement of limits

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

$$\sum_{\substack{i,j,k\\ i<j<k}} \quad \sum_{n=1}^{\infty} \quad \sum_{l}{}' \quad \prod_{n>1} \quad \int_{-\infty}^{+\infty} \quad \lim_{\alpha\to 0}$$

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

2. Fractions

(1) Fractions can be "built up" with a fraction bar,

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

(2) "slashed" with a solidus, $(a+b)/c$, or

(3) written with a negative exponent, $(a+b)c^{-1}$.

In standard articles, in text all fractions must be either slashed, cased, or written with a negative exponent. In displayed math all three forms are allowed. In compuscripts sized fractions are acceptable in text and display.

Apply the following guidelines to the mathematics in your compuscript:

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

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

(b) Use built-up fractions (instead of the slashed configuration) if there are three or more simple fractions in a formula:

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

(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 ($\boldsymbol{\kappa} \times \mathbf{A}$). 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. IV C) or

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

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

4. Mathematical terms

The use of the following standard symbols is strongly recommended.

$\approx$	approximately equal
$\propto$	proportional to
$\rightarrow$	tends to
$\sim$	asymptotically equal to
$O(\ )$	of the order
A^*	complex conjugate of A
$A^\dagger$	Hermitian conjugate of matrix A
$\tilde{A}, A^T$	transpose of matrix A
$\hat{\mathbf{k}}$	unit vector $\mathbf{k}/k$

APPENDIX: JOURNAL TITLE ABBREVIATIONS

Most journal names are abbreviated in the list of references that appears at the end of the manuscript. The following list contains the names of many journals commonly cited in the physics research literature. Additional standard abbreviation listings recommended for your use are *Chemical Abstracts Service Source Index* (CASSI) (American Chemical Society, Washington, D.C.) and *Abbreviations of the Names of Scientific Periodicals Reviewed in Mathematical Reviews* (American Mathematical Society, Providence, RI). Note that in the list below the standard journal abbreviation is printed in boldface (**Acc***ounts of* **Chem***ical* **Res***earch*). Add periods to these abbreviated parts as appropriate (Acc. Chem. Res.). *Please note*: Lately, many Russian journals have changed their names. Citations of recent works should reflect these changes.

Acc*ounts of* **Chem***ical* **Res***earch*
Acta Chem*ica* **Scand***inavica*
Acta Crystallogr*aphica*
Acta Crystallogr*aphica,* **Sect***ion* **A***: Crystal Physics, Diffraction, Theoretical and General Crystallography*
Acta Crystallogr*aphica,* **Sect***ion* **B***: Structural Crystallography and Crystal Chemistry*
Acta Math*ematica* **Acad***emiae* **Sci***entiarum* **Hung***aricae*
Acta Metall*urgica*
Acta Oto-Laryngol*ogica*
Acta Phys*ica*
Acta Phys*ica* **Austriaca**
Acta Phys*ica* **Pol***onica*
Acustica
Adv*ances in* **Appl***ied* **Mech***anics*
Adv*ances in* **At***omic and* **Mol***ecular* **Phys***ics*
Adv*ances in* **Chem***ical* **Phys***ics*
Adv*ances in* **Magn***etic* **Reson***ance*
Adv*ances in* **Phys***ics*
Adv*ances in* **Quantum Chem***istry*
AIAA J*ournal*
AIChE J*ournal*
AIP Conf*erence* **Proc***eedings*
Akust*icheskii* **Zh***urnal* [**Sov***iet* **Phys***ics*—**Acoust***ics*]
Am*erican* **J***ournal of* **Phys***ics*
Anal*ytical* **Chem***istry*
Ann*alen der* **Phys***ik* **(Leipzig)**
Ann*ales de* **Chim***ie et de* **Phys***ique*
Ann*ales de* **Geophys***ique*
Ann*ales de l'***Inst***itut* **Henri Poincare**
Ann*ales de l'***Inst***itut* **Henri Poincare,** *Section* **A***: Physique Theorique*
Ann*ales de l'***Inst***itut* **Henri Poincare,** *Section* **B***: Calcul des Probabilites et Statistique*
Ann*ales de* **Phys***ique* **(Paris)**
Ann*als of* **Fluid Dyn***amics*
Ann*als of* **Math***ematics*
Ann*als of* **Otol***ogy,* **Rhinol***ogy, &* **Laryngol***ogy*
Ann*als of* **Phys***ics* **(N***ew* **Y***ork***)**
Annu*al* **Rev***iew of* **Nucl***ear* **Sci***ence*
Appl*ied* **Opt***ics*
Appl*ied* **Phys***ics* **Lett***ers*
Appl*ied* **Spectrosc***opy*
Ark*iv foer* **Fys***ik*
Astron*omical* **J***ournal*
Astron*omicheskii* **Zh***urnal* [**Sov***iet* **Astron***omy*]
Astron*omische* **Nachr***ichten*
Astron*omy and* **Astrophys***ics*
Astrophys*ical* **J***ournal*
Astrophys*ical* **J***ournal,* **Lett***ers to the Editor*
Astrophys*ical* **J***ournal,* **Suppl***ement* **Ser***ies*
Astrophys*ical* **Lett***ers*
At*omic* **Data** *and* **Nucl***ear* **Data Tables**
At*omnaya* **Energ***iya* [**Sov***iet* **J***ournal of* **At***omic* **Energy**]
Aust*ralian* **J***ournal of* **Phys***ics*

Bell Syst*em* **Tech***nical* **J***ournal*
Ber*ichte der* **Bunsenges***ellschaft fuer* **Phys***ikalische* **Chem***ie*
Br*itish* **J***ournal of* **Appl***ied* **Phys***ics*
Bull*etin of the* **Acad***emy of* **Sci***ences of the* **USSR, Phys***ical* **Ser***ies* (translation of *Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya*)
Bull*etin of the* **Am***erican* **Astron***omical* **Soc***iety*
Bull*etin of The* **Am***erican* **Phys***ical* **Soc***iety*
Bull*etin of the* **Astron***omical* **Inst***itutes of the* **Neth***erlands*
Bull*etin of the* **Chem***ical* **Soc***iety of* **J***ap***an**
Bull*etin of the* **Seismol***ogical* **Soc***iety of* **Am***erica*

Can*adian* **J***ournal of* **Chem***istry*
Can*adian* **J***ournal of* **Phys***ics*
Can*adian* **J***ournal of* **Res***earch*
Chem*ical* **Phys***ics*
Chem*ical* **Phys***ics* **Lett***ers*
Chem*ical* **Rev***iews*
Chin*ese* **J***ournal of* **Phys***ics* [translation of *Wuli Xuebao (Acta Physica Sinica)*]
Comments *on* **Astrophys***ics and* **Space Phys***ics*
Comments *on* **At***omic and* **Mol***ecular* **Phys***ics*
Comments *on* **Nucl***ear and* **Part***icle* **Phys***ics*
Comments *on* **Plasma Phys***ics and* **Controlled Fusion**
Comments *on* **Solid State Phys***ics*
Commun*ications in* **Math***ematical* **Phys***ics*
Commun*ications on* **Pure** *and* **Appl***ied* **Math***ematics*
C*omptes* **R***endus Hebdomadaires des Seances de l'***Acad***emie des* **Sci***ences*
C*omptes* **R***endus Hebdomadaires des Seances de l'***Acad***emie des* **Sci***ences,* **Ser***ie* **A***: Sciences Mathematiques*
C*omptes* **R***endus Hebdomadaires des Seances de l'***Acad***emie des* **Sci***ences,* **Ser***ie* **B***: Sciences Physiques*
Cryogenics
Czech*oslovak* **J***ournal of* **Phys***ics*

Discuss*ions of the* **Faraday Soc***iety*

Doklady Akademii Nauk SSSR [Soviet Physics—Doklady]

Earth and Planetary Science Letters
Electronics Letters
Experientia

Fields and Quanta
Fizika Elementarnykh Chastits i Atomnogo Yadra [Soviet Journal of Particles and Nuclei]
Fizika i Tekhnika Poluprovodnikov [Soviet Physics—Semiconductors]
Fizika Metallov i Metallovedenie [Physics of Metals and Metallography (USSR)]
Fizika Nizkikh Temperatur [Soviet Journal of Low Temperature Physics]
Fizika Plazmy [Soviet Journal of Plasma Physics]
Fizika Tverdogo Tela (Leningrad) [Soviet Physics—Solid State]
Fizika (Zagreb)
Fortschritte der Physik
Foundations of Physics

General Relativity and Gravitation
Geochimica et Cosmochimica Acta

Helvetica Chimica Acta
Helvetica Physica Acta
High Temperature (USSR) (translation of *Teplofizika Vysokikh Temperatur*)

IBM Journal of Research and Development
Icarus
IEEE Journal of Quantum Electronics
IEEE Transactions on Antennas and Propagation
IEEE Transactions on Electron Devices
IEEE Transactions on Information Theory
IEEE Transactions on Instrumentation and Measurement
IEEE Transactions on Magnetics
IEEE Transactions on Microwave Theory and Techniques
IEEE Transactions on Nuclear Science
IEEE Transactions on Sonics and Ultrasonics
Industrial and Engineering Chemistry
Infrared Physics
Inorganic Chemistry
Inorganic Materials (USSR) (translation of *Izvestiya Akademii Nauk SSSR, Neorganicheskie Materialy*)
Instruments and Experimental Techniques (USSR) (translation of *Pribory i Tekhnika Eksperimenta*)
International Journal of Magnetism
International Journal of Quantum Chemistry
International Journal of Quantum Chemistry, Part 1
International Journal of Quantum Chemistry, Part 2
International Journal of Theoretical Physics
Izvestiya, Academy of Sciences, USSR, Atmospheric and Oceanic Physics (translation of *Izvestiya Akademii Nauk SSSR, Fizika Atmosfery i Okeana*)
Izvestiya, Academy of Sciences, USSR, Physics of the Solid Earth (translation of *Izvestiya Akademii Nauk SSSR, Fizika Zemli*)
Izvestiya Akademii Nauk SSSR, Fizika Atmosfery i Okeana [Izvestiya, Academy of Sciences, USSR, Atmospheric and Oceanic Physics]
Izvestiya Akademii Nauk SSSR, Fizika Zemli [Izvestiya, Academy of Sciences, USSR, Physics of the Solid Earth]
Izvestiya Akademii Nauk SSSR, Neorganicheskie Materialy [Inorganic Materials (USSR)]
Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya [Bulletin of the Academy of Sciences of the USSR, Physical Series]
Izvestiya Vysshikh Uchebnykh Zavedenii, Fizika [Soviet Physics Journal]
Izvestiya Vysshikh Uchebnykh Zavedenii, Radiofizika [Soviet Radiophysics]

Japanese Journal of Applied Physics
Japanese Journal of Physics
JETP Letters (translation of *Pis'ma v Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki*)
Journal de Chimie Physique
Journal de Physique (Paris)
Journal de Physique et le Radium
Journal of Applied Crystallography
Journal of Applied Physics
Journal of Applied Spectroscopy (USSR) (translation of *Zhurnal Prikladnoi Spektroskopii*)
Journal of Atmospheric and Terrestrial Physics
Journal of Atmospheric Sciences
Journal of Chemical Physics
Journal of Computational Physics
Journal of Crystal Growth
Journal of Fluid Mechanics
Journal of Geophysical Research
Journal of Inorganic and Nuclear Chemistry
Journal of Low Temperature Physics
Journal of Luminescence
Journal of Macromolecular Science, [Part B] Physics
Journal of Mathematical Physics
Journal of Molecular Spectroscopy
Journal of Non-Crystalline Solids
Journal of Nuclear Energy
Journal of Nuclear Energy, Part C: Plasma Physics, Accelerators, Thermonuclear Research
Journal of Nuclear Materials
Journal of Physical and Chemical Reference Data
Journal of Physical Chemistry
Journal of Physics A: General Physics
Journal of Physics and Chemistry of Solids
Journal of Physics B: Atomic and Molecular Physics
Journal of Physics C: Solid State Physics
Journal of Physics D: Applied Physics
Journal of Physics E: Scientific Instruments
Journal of Physics F: Metal Physics
Journal of Physics (Moscow)
Journal of Plasma Physics
Journal of Polymer Science

Journal of Polymer Science, Polymer Letters Edition
Journal of Polymer Science, Polymer Physics Edition
Journal of Quantitative Spectroscopy & Radiative Transfer
Journal of Research of the National Bureau of Standards
Journal of Research of the National Bureau of Standards, Section A: Physics and Chemistry
Journal of Research of the National Bureau of Standards, Section B: Mathematical Sciences
Journal of Research of the National Bureau of Standards, Section C: Engineering and Instrumentation
Journal of Scientific Instruments
Journal of Sound and Vibration
Journal of Speech and Hearing Disorders
Journal of Speech and Hearing Research
Journal of Statistical Physics
Journal of the Acoustical Society of America
Journal of the American Ceramic Society
Journal of the American Chemical Society
Journal of the American Institute of Electrical Engineers
Journal of the Audio Engineering Society
Journal of the Chemical Society
Journal of the Electrochemical Society
Journal of the Mechanics and Physics of Solids
Journal of the Optical Society of America
Journal of the Physical Society of Japan
Journal of Vacuum Science and Technology

Kolloid Zeitschrift & Zeitschrift fuer Polymere
Kongelige Danske Videnskabernes Selskab, Matematsik Fysiske Meddelelser
Kristallografiya [Soviet Physics—Crystallography]
Kvantovaya Elektronika (Moscow) [Soviet Journal of Quantum Electronics]

Laryngoscope
Lettere al Nuovo Cimento
Lick Observatory Bulletin

Materials Research Bulletin
Medical Physics
Memoirs of the Royal Astronomical Society
Molecular Crystals and Liquid Crystals
Molecular Physics
Monthly Notices of the Royal Astronomical Society

National Bureau of Standards (U.S.), Circular
National Bureau of Standards (U.S.), Miscellaneous Publication
National Bureau of Standards (U.S.), Special Publication
Nature (London)
Naturwissenschaften
Nuclear Data, Section A
Nuclear Data, Section B
Nuclear Fusion
Nuclear Instruments
Nuclear Instruments & Methods
Nuclear Physics
Nuclear Physics A
Nuclear Physics B
Nuclear Science and Engineering
Nukleonik
Nuovo Cimento
Nuovo Cimento A
Nuovo Cimento B

Optica Acta
Optics and Spectroscopy (USSR) (translation of Optika i Spektroskopiya)
Optics Communications
Optics Letters
Optics News
Optik (Stuttgart)
Optika i Spectroskopiya [Optics and Spectroscopy (USSR)]
Optiko-Mekhanicheskaya Promyshlennost [Soviet Journal of Optical Technology]

Perception and Psychophysics
Philips Research Reports
Philosophical Magazine
Philosophical Transactions of the Royal Society of London
Philosophical Transactions of the Royal Society of London, Series A: Mathematical and Physical Sciences
Physical Review
Physical Review A: Atomic, Molecular, and Optical Physics
Physical Review B: Solid State
Physical Review C: Nuclear Physics
Physical Review D: Particles and Fields
Physical Review E: Statistical Physics, Plasmas, Fluids, and Related Interdisciplinary Topics
Physical Review Letters
Physica Status Solidi
Physica Status Solidi A: Applied Research
Physica Status Solidi B: Basic Research
Physica (Utrecht)
Physics and Chemistry of Solids
Physics Letters
Physics Letters A
Physics Letters B
Physics (New York)
Physics of Fluids
Physics of Metals and Mettalography (USSR) (translation of Fizika Metallov i Metallovedenie)
Physics Teacher
Physics Today
Physikalische Zeitschrift
Physikalische Zeitschrift der Sowjetunion
Physik der Kondensierten Materie
Pis'ma v Astronomicheskii Zhurnal [Soviet Astronomy Letters]
Pis'ma v Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki [JETP Letters]
Pis'ma v Zhurnal Tekhnicheskoi Fiziki [Soviet Technical Physics Letters]
Planetary and Space Science
Plasma Physics

Pribory i Tekhnika Eksperimenta [Instruments and Experimental Techniques (USSR)]
Proceedings of the Cambridge Philosophical Society
Proceedings of the IEEE
Proceedings of the IRE
Proceedings of the National Academy of Sciences of the United States of America
Proceedings of the Physical Society, London
Proceedings of the Physical Society, London, Section A
Proceedings of the Physical Society, London, Section B
Proceedings of the Royal Society of London
Proceedings of the Royal Society of London, Series A: Mathematical and Physical Sciences
Progress of Theoretical Physics
Publications of the Astronomical Society of the Pacific

Radiation Effects
Radio Engineering and Electronic Physics (USSR) (translation of *Radiotekhnika i Elektronika*)
Radio Engineering and Electronics (USSR) (translation of *Radiotekhnika i Elektronika*)
Radiology
Radio Science
Radiotekhnika i Elektronika [Radio Engineering and Electronic Physics (USSR)]
Radiotekhnika i Elektronika [Radio Engineering and Electronics (USSR)]
RCA Review
Reports on Progress in Physics
Review of Scientific Instruments
Review of Modern Physics
Revue d'Optique, Theorique et Instrumentale
Russian Journal of Physical Chemistry (translation of *Zhurnal Fizicheskoi Khimii*)

Science
Scientific American
Solar Physics
Solid State Communications
Solid-State Electronics
Soviet Astronomy (translation of *Astronomicheskii Zhurnal*)
Soviet Astronomy Letters (translation of *Pis'ma v Astronomicheskii Zhurnal*)
Soviet Journal of Atomic Energy (translation of *Atominaya Energiya*)
Soviet Journal of Low Temperature Physics (translation of *Fizika Nizkikh Temperatur*)
Soviet Journal of Nuclear Physics (translation of *Yadernaya Fizika*)
Soviet Journal of Optical Technology (translation of *Optiko-Mekhanischeskaya Promyshlennost*)
Soviet Journal of Particles and Nuclei (translation of *Fizika Elementarnykh Chastits i Atomnogo Yadra*)
Soviet Journal of Plasma Physics (translation of *Fizika Plazmy*)
Soviet Journal of Quantum Electronics [translation of *Kvantovaya Elektronika (Moscow)*]
Soviet Physics—Acoustics (translation of *Akusticheskii Zhurnal*)
Soviet Physics—Crystallography (translation of *Kristallografiya*)
Soviet Physics—Doklady (translation of *Doklady Akademii Nauk SSSR*)
Soviet Physics—JETP (translation of *Zhurnal Eksperimental'noi i Teoretischeskoi Fiziki*)
Soviet Physics Journal (translation of *Izvestiya Vysshikh Uchebnykh Zavedenii, Fizika*)
Soviet Physics—Semiconductors (translation of *Fizika i Tekhnika Poluprovodnikov*)
Soviet Physics—Solid State [translation of *Fizika Tverdogo Tela (Leningrad)*]
Soviet Physics—Technical Physics (translation of *Zhurnal Tekhnicheskoi Fiziki*)
Soviet Physics—Uspekhi (translation of *Uspekhi Fizicheskikh Nauk*)
Soviet Radiophysics (translation of *Izvestiya Vysshikh Uchebnykh Zavedenii, Radiofizika*)
Soviet Technical Physics Letters (translation of *Pis'ma v Zhurnal Tekhnicheskoi Fiziki*)
Spectrochimica Acta
Spectrochimica Acta, Part A: Molecular Spectroscopy
Spectrochimica Acta, Part B: Atomic Spectroscopy
Surface Science

Teplofizika Vysokikh Temperatur [High Temperature (USSR)]
Tetrahedron
Theoretica Chimica Acta
Thin Solid Films
Transactions of the American Crystallographic Association
Transactions of the American Geophysical Union
Transactions of the American Institute of Mining, Metallurgical and Petroleum Engineers
Transactions of the American Nuclear Society
Transactions of the American Society for Metals
Transactions of the American Society of Mechanical Engineers
Transactions of the British Ceramic Society
Transactions of the Faraday Society
Transactions of the Metallurgical Society of AIME
Transactions of the Society of Rheology

Ukrainian Physics Journal [translation of *Ukrainskii Fizicheskii Zhurnal (Russian Edition)*]
Ukrainskii Fizicheskii Zhurnal (Russian Edition) [Ukrainian Physics Journal]
Ultrasonics
Uspekhi Fizicheskikh Nauk [Soviet Physics—Uspekhi]

Wuli Xuebao (Acta Physica Sinica) [Chinese Journal of Physics]

Yadernaya Fizika [Soviet Journal of Nuclear Physics]

Zeitschrift fuer Analytische Chemie
Zeitschrift fuer Angewandte Physik
Zeitschrift fuer Anorganische und Allgemeine Chemie
Zeitschrift fuer Astrophysik

Z*eitschrift fuer* **Elektrochem***ie*

Z*eitschrift fuer* **Kristallogr***aphie,* **Kristallgeom***etrie,* **Kristallphys***ik,* **Kristallchem***ie*

Z*eitschrift fuer* **Metallk***un***d***e*

Z*eitschrift fuer* **Naturforsch***ung*

Z*eitschrift fuer* **Naturforsch***ung,* **Teil A***: Physik, Physikalische Chemie, Kosmophysik*

Z*eitschrift fuer* **Phys***ik*

Z*eitschrift fuer* **Phys***ik* **A***: Atoms and Nuclei*

Z*eitschrift fuer* **Phys***ik* **B***: Condensed Matter and Quanta*

Z*eitschrift fuer* **Phys***ik* **C***: Particles and Fields*

Z*eitschrift fuer* **Phys***ikalisch-***Chem***ische* **Materialforsch***ung*

Z*eitschrift fuer* **Phys***ikalische* **Chem***ie,* **Abt***eilung* **A***: Chemische Thermodynamik, Kinetik, Elektrochemie, Eigenschaftslehre*

Z*eitschrift fuer* **Phys***ikalische* **Chem***ie,* **Abt***eilung* **B***: Chemie der Elementarprozesse, Aufbau der Materie*

Z*eitschrift fuer* **Phys***ikalische* **Chem***ie* **(Frankfurt am Main)**

Z*eitschrift fuer* **Phys***ikalische* **Chem***ie* **(Leipzig)**

Zh*urnal* **Eksp***erimental'noi i* **Teor***eticheskoi* **Fiz***iki* [**Sov***iet* **Phys***ics*—**JETP**]

Zh*urnal* **Fiz***icheskoi* **Khim***ii* [**Russ***ian* **J***ournal of* **Phys***ical* **Chem***istry*]

Zh*urnal* **Prikl***adnoi* **Spektrosk***opii* [**J***ournal of* **Appl***ied* **Spectrosc***opy* **(USSR)**]

Zh*urnal* **Tekh***nicheskoi* **Fiz***iki* [**Sov***iet* **Phys***ics*—**Tech***nical* **Phys***ics*]