REVTEX Information for APS Authors

Instructions for preparing compuscripts to be submitted to APS journals in the REVTEX 3.1 format

Contents

I. INTRODUCTION

In 1987, the Council of The American Physical Society authorized acceptance of TEX-formatted author-prepared compuscripts to be submitted to *Physical Review A, B, C,* and *D* in machine-readable form. This electronic-submission compuscript program was extended to *Physical Review Letters* in 1992 and to *Reviews of Modern Physics in 1994.*

It is essential that author-prepared input be consistent and standardized so that the compuscripts can be accommodated by the normal production procedures and software. It is only by routinely handling author-prepared files that this method of production is economically feasible.

This input guide contains basic instructions for keyboarding compuscripts using the REVTEX macro package, which works in a LATEX environment. This guide is part of the "REVTEX compuscript toolbox;" other items in the toolbox are the REVTEX macro package (several style files), bibliography tools, a test file, a README file (which contains details regarding installation and copying of the style files), an input template, and an example file. Authors should also consult auxiliary files that give additional information about compuscripts and about correct notation and style practices. These files are available online; cf. Sec. XII.

Compuscripts that do not comply closely with the instructions in the toolbox and the auxiliary files will not be used electronically in the production process.

You may need to supplement this input guide with the standard documentation available for LATEX: namely, the *LATEX User's Guide & Reference Manual*, by Leslie Lamport, published by Addison Wesley. This guide assumes some familiarity with LATEX; specifically the article style. REVTEX version 3.1 is based on article style. The notations `#1`, `#2`, etc. are used throughout this guide to denote user-supplied arguments. Commands will be shown in their full form; i.e., with their mandatory arguments.

Contents of this Guide. In Sec. II we describe procedures for making an original electronic submission to the Editorial Office.

Section III discusses the specifications for file submittal (electronic mail or floppy disk).

Section IV briefly describes author proofs.

In Sec. V we describe in detail several aspects of compuscript creation: the input of front matter and how to switch from galley to preprint style; paragraph formatting, hyphenation, quotes, and text-width issues; section headings; basic input for in-text math and displayed equations; special character issues; footnotes and references; figure captions; and tables.

In Sec. VI we describe the various numbering and cross-referencing features of REVTEX using the available commands; these features can be used to label and cross-reference equations, figures, tables, references, and section heads.

Section VII discusses font selection schemes, support for AMSFonts, and extra symbols available in REVTEX 3.1

Section VIII itemizes the differences between v2.x and v3.1 of REVTEX, for current users of v2.x, along with differences between LATEX article style and REVTEX 3.1.

Authors who have never participated in the compuscript program may wish to read Sec. IX and Sec. X at this point. There we give a brief overview of the production compuscript-conversion program and answer some frequently asked author questions.

Section XII lists the people and places to contact if you have questions about any services described herein. To obtain the most proper and expedient answer to your question, please consult this section before calling or e-mailing the APS.

Appendix A gives a complete listing of symbols and characters available with REVTEX v3.1.

Appendix B is a handy list of some necessary commands that will be found in a REVTEX compuscript. This command list supplements the *LATEX User's Guide & Reference Manual.*

Output for Appendixes A and B can be obtained by running the file manend.tex through LATEX.

Unless specified in Section XII, questions regarding this input guide should be directed to REVTEX Support, The American Physical Society, 1 Research Rd. Box 9000, Ridge, NY 11961-9000.

Note on participating journals. The compuscript program is open to all authors in *Physical Review A, B, C, D, E; Physical Review Letters* and *Reviews of Modern Physics*.

II. GENERAL COMPUSCRIPT SUBMISSION PROCEDURES

When the REVTEX compuscript (preprint style) is ready to go, it should should be submitted to the Editorial Office in conformance with the procedures printed in the first issue of each volume of *Physical Review A, B, C, D, E,* or *L* or in the back of each issue of *Reviews of Modern Physics*. The following procedures are those unique to compuscript processing.

Papers intended for the compuscript production program should be originally submitted and then always resubmitted by electronic mail or by DOS-formatted disk. (See details below.) Avoid resubmission by conventional means (paper, postal mail); continue to use one of the electronic modes.

When a compuscript is changed in response to recommendations and criticisms from the review process, or to present other corrections and author revisions, the full file should be resubmitted. Please include a summary of the changes made, as well as any rebuttal to reviewer comments; state whether or not figures have been modified. Any new or revised figures should be forwarded as described below.

A. Electronic mail submissions

Submissions and inquiries should be sent via electronic mail to the appropriate address given below.

Journal	Internet address
PR A–E	`prXtex@aps.org`[a]
PR Letters	`prltex@aps.org`
RMP	`rmptex@aps.org`

[a] Where X is a,b,c,d,or e

Files must be accompanied by a cover message stating to which journal the paper is submitted and must provide a conventional mailing address. The manuscript accession code, if any, should be included for resubmissions. The cover message can be in the form of comments at the head of the file(s).

All of the textual material of the paper (including tables, captions, etc.) should be in electronic form. The file must be in ASCII containing no control codes, with line lengths of 80 characters or less. The file should produce double-spaced output (three lines per inch and at least 6 mm white space between lines). Seperate electronic figure files should be coded in PostScript (one figure per file).

Editorial processing of an electronic-mail submission cannot begin until at least review-quality copies of the figures are received. Sending scanner-reproducible journal-quality figures immediately by overnight mail will meet this need, as will electronic-mail transmission (one figure per file) of PostScript-formatted figures. Alternatively, for Physical Review Letters, review-quality figures can be forwarded by FAX to 516-591-4141, while the "originals" are sent by conventional or overnight mail as soon as possible. Please mark the FAX transmission as being part of an electronic-mail submission.

If the transmission of the computer file and the figures has been successful, the Editorial Office sends an acknowledgment by electronic mail. If any problems are encountered, you are contacted immediately, again by electronic mail, and informed of the problem. If you do not receive either message within 24 hours, you can assume that your file was never received.

Copies of the manuscript *must not* be sent by conventional mail unless there has been an unsuccessful transmission.

B. Floppy disk submissions

Compuscripts may also be submitted or resubmitted on a DOS-formatted floppy disk. The disk should be accompanied by a cover letter stating to which journal the paper is being submitted, and a conventional mailing address should be provided. A single copy of the manuscript should also be enclosed. This single copy will only be used for processing if we are unable to generate output from the disk submitted.

Floppy disks should be standard $5\frac{1}{4}$- or $3\frac{1}{2}$-inch diameter, and should be mailed in a protective envelope to avoid possible damage to the files.

III. FILE TRANSMISSION SPECIFICATIONS

Please see Sec. II for important submittal procedures.

Compuscripts should be transmitted (1) via electronic mail or (2) on a DOS-formatted floppy disk. The floppy should be labeled to indicate the name of the author, the name of the file on the disk, and the return address of the submitting author.

The electronic submission may be as a single large file (preferred), e.g., BB1010, or as a series of separately named files, e.g., BB1010, BB1010caps, BB1010tabs. The code number of the compuscript does not have to be used as the file name or names; smithpaper, smithcaps, smithfigs, etc., will suffice.

Upon receipt of the file(s) by the Editorial Office, the contents will be concatenated if needed. The compuscript file, and figure files if any, will then be evaluated for various potential problems and compliance with the input instructions. The author may be advised of technical problems, and asked to submit a proper file.

All e-mail receipts will be acknowledged.

IV. PRODUCTION OF AUTHOR PROOFS

When/if a manuscript is accepted for publication, the manuscript and the compuscript file will be forwarded from the Editorial Office to the production group. The compuscript file undergoes software conversion into the Xyvision/SGML page composition system. Otherwise, standard procedures and schedule for production will be in effect, and the author will receive the correspondence associated with traditional manuscript publication. The manuscript will be returned to the author with the page proofs. The manuscript will be thoroughly marked to indicate where file changes were needed, and the author will be responsible for a thorough reading of the proofs.

Note: For *Physical Review Letters*, page copies are sent by FAX.

Although the author has assumed the responsibilities of keyboarding and proofreading, the production staff will still perform a quality check of the article and will insert editorial style changes. Other changes may be necessary as a result of the compuscript-conversion step. The changes are made to the Xyvision/SGML file at the production site. If their number is seen to be high it may be more efficient for the production group to proceed by rekeyboarding, and this is done. We do not ask the author to make changes to the compuscript file at this stage.

Page proofs should be carefully checked. Return the corrected proofs to the address indicated on the cover sheet; the necessary corrections will be handled by the production staff. An electronic file should *not* be sent at this stage.

V. COMPUSCRIPT INSTRUCTIONS

Author-prepared compuscripts should include the following parts (preferably) in this order: title, author, address, abstract, suggested PACS numbers (use current Physics and Astronomy Classification Scheme), main manuscript body, references, figure captions, and tables. The production staff will add verified PACS numbers and manuscript receipt date. Specific instructions pertaining to various parts of the compuscript are listed below as well as a short annotated example of compuscript input. Proper tagging commands (macros) and coding are indicated where necessary.

In general, compuscripts should not contain any author-defined macros. However, macros which are simple text substitutions can be "expanded" by the production software. More complicated macros will create problems when the file is converted and must be avoided. See Sec. X for further information.

This guide assumes some familiarity with LaTeX; specifically the article style. REVTEX version 3.1 is based on article style. The notations `#1`, `#2`, etc. are used throughout this guide to denote user-supplied arguments. Commands will be shown in their full form; i.e., with their mandatory arguments.

Authors should also print the file apssamp.tex and compare the input for further instruction and detailed examples. This guide and the sample file depend upon each other to cover all features of REVTEX. The file template.aps may be copied to another name to use as a basis for creating a new REVTEX file.

A. Galley style and preprint style

The REVTEX macro package has been developed to accommodate the preprint needs of the author as well as the production needs of the APS. If you use REVTEX to prepare a manuscript for electronic submission to the Editorial Office and participation in the compuscript program, please follow these steps: (a) Review the galley-format output (the default style), which mimics final journal output. Carefully check the content of text, equations, references, captions (and figures), and tables, as if reading the journal. This format is often preferred for distribution of preliminary versions to colleagues. (b) In the case of papers subject to length restrictions, estimate the overall length by directly measuring the journal text. Add in the space that will be occupied by any figures (at their final reduction). On the journal page, the two-column area available for text and figures is nominally 9.5 in. (24 cm) deep; nominally 6 text lines occupy 1 in. of vertical space. Alternatively, produce mock page output by using the [twocolumn] documentstyle option, and perhaps even include EPS figures. (c) Switch to preprint style (see below) and review the output, which is at a larger type size. It is this format that is presented to reviewers and used by editorial staff. Check that equations and tables remain satisfactory. A REVTEX facility for "squeezing" preprint-style tables is described later. (d) Submit the preprint-style file electronically to the Editorial Offices.

Galley style, is produced by the following front matter:

```
\documentstyle[aps]{revtex}
\begin{document}
```

Galley style activates the width-changing commands and centers equations by default. Commands to place equations flush left or flush right are enabled in galley style, but are not normally needed. Note, however, that galley style produces output that only mimics the final journal output. Actual formatting and layout details of the final journal pages are applied by production software, not necessarily the coding in the author-prepared compuscript file or in the REVTEX macros.

The editors of *Physical Review* require the traditional form of manuscript for the review process: large typeface for legibility and ease of review; adequate space between typed lines and wide margins, for editor and reviewer marks and comments. This **preprint style** can be obtained with the following front matter:

```
\documentstyle[preprint,aps]{revtex}
\begin{document}
```

Preprint style gives a constant-width output with equations centered.

B. Style options

The main style is `revtex`, and `aps` is a mandatory style option for papers to be submitted to the APS. Other style options include `eqsecnum` (to number equations by section), `preprint` (to get double-spaced output for submission purposes), `tighten` (to get single-spaced output with the preprint style), and `amsfonts` and `amssymb` (see Sec. VII). There are also style options for each APS journal: `pra`, `prb`, `prc`, `prd`, `pre`, `prl`, and `rmp` for *Physical Review A*, *B*, *C*, *D*, *E*, *Letters*, and *Reviews of Modern Physics* respectively. `pra` is the default. The `prb` option gives superscript reference citations, as is the style for *Physical Review B*. The `prl` option yields the slightly different line spacing of *Letters* (use for accurate length estimates). Other than this, there are no substantial differences in the journal options. Please do not use the `prb` option unless you will be submitting to *Physical Review B*. The `floats` style option enables LaTeX-style floating figures and tables—it is for an author's personal use, and is *not* for use with files to be submitted to the APS. All files submitted to the APS should have figures and tables at the end of the file. Other arrangements may not be accommodated by the compuscript program. Similarly, the twocolumn style option is for personal use, and not for use in submitted files.

C. Front matter

The typical file will start off with a LaTeX documentstyle line and begin the document:

```
\documentstyle[pra,aps]{revtex}
\begin{document}
```

Next comes the `\draft` command, which instructs REVTEX to print out the suggested PACS numbers from the `\pacs{#1}` command:

```
\draft
```

The title is entered with the `\title{#1}` command:

```
\title{The title of the paper goes here}
```

Now the author(s) and address(es) are entered:

```
\author{Jackson P. Jones}
\address{321 Main Street, Everville,
         Illinois 12345-6789}
```

The `\author{#1}` and `\address{#1}` commands may be repeated as a pair. Bottom-of-page footnotes to the author may be set using LaTeX's normal `\thanks{#1}` command. LaTeX's normal footnote commands are also enabled for use in REVTEX. Bottom-of-page footnotes of any kind should only be used by authors publishing in a journal that allows such footnotes (e.g., *Physical Review C* and *D*). Use recent issues of the particular journal as a guide. If unsure, use endnotes instead of footnotes (see Sec. V J.).

The `\date{#1}` command can optionally be entered if the author wishes to have dates print on the manuscript. `#1` represents the date of receipt at the Editorial Office. This date will be inserted at the production site. Using `\today` will cause LaTeX to insert the current date whenever the file is run:

```
\date{\today}
```

The `\maketitle` command must be entered just before the abstract. Don't forget this command or the title, author(s), address(es), and date will not print!

```
\maketitle
```

Now enter the abstract in the abstract environment:

```
\begin{abstract}
In this paper we show the result of . . .
\end{abstract}
```

The final piece of the front matter is the `\pacs{#1}` command. This should be included even if `#1` is empty.

```
\pacs{23.23.+x, 56.65.Dy}
```

D. Section headings

Section headings are input as in LaTeX. The output is similar, with a few extra features.

Four levels of headings are provided in REVTEX: `\section{#1}`, `\subsection{#1}`, `\subsubsection{#1}`, and `\paragraph{#1}`. Use the star form of the command to suppress the automatic numbering; e.g.,

```
\section*{Introduction}
```

To label a section heading for cross referencing use the `\label{#1}` command *after* the heading; e.g.,

```
\section{Introduction}
\label{sec:intro}
```

All text in the `\section{#1}` command is automatically set uppercase. If a lowercase letter is needed, just use `\lowercase{x}`. For example, to use "He" for helium in a `\section{#1}` command, type `H\lowercase{e}` in `#1`.

The `\appendix` command signals that all following sections are appendixes, so `\section{#1}` after `\appendix` will set `#1` as an appendix heading. `#1` may be empty. If only one appendix is used, use a `\section*{#1}` command to suppress the appendix letter in the section heading.

Use `\protect\\` to force a line break in a section heading. (Fragile commands must be protected in section headings and captions, and `\\` is a fragile command.)

Note: For *Physical Review Letters,* if there are to be section headings, use only the fourth-level type, `\paragraph{#1}`. Use the "star form" of the command (`\paragraph*{#1}`) to avoid the numbering that is normally attached [(a), (b), . . .].

E. Text

Paragraphs always begin with a blank input line. **Do not hyphenate** words at the end of a line; TEX will do this. Continue to hyphenate modifiers within a line of text, e.g., "author-prepared copy."

Use curly quotes for quotation marks around quoted text (` ``xxx'' `) not straight quotes (`"xxx"`). [For opening quotes, this is two octal 140 characters (hex 60); for closing quotes, this is two octal 047 (hex 27) characters.]

There are two commands that control the width of the text across the page in the galley style; `\narrowtext` will set the column width to $3\frac{3}{8}$ in., and the `\widetext` command will set the text 7 in. wide. The `\widetext` command may be needed to set very long equations. See the section on displayed math, below.

Neither `\narrowtext` or `\widetext` have any effect on the output if the front matter calls for the preprint style. The preprint style is a uniform 6.5 in. throughout.

Don't use `\smallskip`, `\bigskip`, or any other vertical motion commands. Horizontal motion commands should be unnecessary as well.

LaTeX's normal footnote commands are enabled for use in REVTEX, but should only be used by authors publishing in a journal that allows bottom-of-page footnotes. Use recent issues of the particular journal as a guide.

F. Math in text

APS uses the normal delimiter $ for any TEX in-line math, e.g.,

the quantity a^{z}

is obtained from the input

```
the quantity $a^{z}$
```

TEX will assume that you want a superscript or subscript to consist of the first *token* (generally a single character or command) following the ^ or _, *unless* you use curly brackets to delimit a subscript/superscript. It is safest to use the curly brackets if unsure. We have followed this convention in this guide. Again, don't use any vertical motion commands in math; horizontal motion commands should be unnecessary as well.

G. Text in math

There are times when an author needs to insert text into math. The `\rm` command only switches to the Roman font for math letters. It does not, for example, let you print a normal text hyphen: `${\rm e-p}$` gives "$\mathrm{e-p}$". Using an `\mbox{#1}` will give you normal text, including a hyphen, but will not scale correctly in superscripts: `$x_{\mbox{e-p}}$` gives "$x_{\mbox{e-p}}$". The `\text{#1}` command will solve both problems. It gives you regular text *and* scales correctly in superscripts: `$y=x \text{ for } x_{\text{e-p}}$` gives "$y=x \text{ for } x_{\text{e-p}}$".

H. Displayed equations

The most common (and preferred) type of displayed equation in *The APS Journals* is a **single-line equation, with an equation number on the same line**. Try to set as many equations as you can in this way.

Equations are now normally set centered in the column width for APS style with REVTEX. Setting the equation number is taken care of by REVTEX—the number will be set below the equation if necessary. Breaking the equation into multiline format may be necessary for very long equations. The `eqnarray` environment is used for this purpose. Do not use plain array for this purpose.

Break at a sign of relation or an operator sign; the sign (e.g., $=$, $+$, $\times$) begins the next line of the equation. Specify (using `&&`) a proper indent or alignment of the line following the break; e.g., $+$, $-$, $\times$ should line up to the right of an $=$ above, not directly under it. A multiline equation centers as a unit. Use a separate `equation` or `eqnarray` environment (`\begin{#1}`-`\end{#1}` command pair) for *each* single-line equation or multiline equation. Short displayed equations that can appear together on a single line may be placed in one equation environment.

In galley style, if an equation needs to be broken into many lines, it is suggested that it be set in a wide column for ease of reading, using the `\widetext` command. The author should return to `\narrowtext` as soon as possible after one or more very long equations, but short pieces of narrow text and/or math between nearly contiguous wide sections should be left wide and incorporated into the surrounding wide sections.

In apssamp.tex, we have illustrated how to obtain each of the above.

1. Numbering displayed equations

The REVTEX macro package allows two methods for numbering equations: you can assign your own equation numbers or you can allow REVTEX to number for you.

Use the command `\eqnum{#1}` to number your own equations. You can also use this command to produce a specific equation number not normally obtainable; ($1'$), for example. Numbers assigned by `\eqnum{#1}` are completely independent of the automatic numbering.

For automatically numbered single-line and multiline equations, use the `equation` and `eqnarray` environments. You can use the `\[`,`\]` commands and the `eqnarray*` environment for unnumbered single-line and multiline equations, respectively. The command `\nonumber` will suppress the numbering on a single line of an eqnarray.

If you wish a series of equations to be a lettered sequence, e.g., (3a), (3b), and (3c), just include the equation(s) or eqnarray(s) within the `mathletters` environment.

Finally, to have REVTEX number equations by section, use the `eqsecnum` style option.

See apssamp.tex to see examples of how all this works.

2. Cross-referencing displayed equations

Authors will probably not cross-reference every equation in text. When a numbered equation needs to be referred to in text by its number, the `\label{#1}` and `\ref{#1}` commands should be used. The `\label{#1}` command is used within the equation or the eqnarray line to be referenced:

input:

```
\begin{equation}
A=B \label{pauli}
\end{equation}
 ... It follows from Eq.\ (\ref{pauli})
that this is the case ...
```

output:

$$A = B \tag{1}$$

... It follows from Eq. (1) that this is the case ...

Please note the parentheses surrounding the command. They are necessary for proper output. You can also label individual lines in an eqnarray. Numbers produced with `\eqnum{#1}` can also be cross-referenced: just follow the `\eqnum{#1}` command with a `\label{#1}` command.

Using a `\label{#1}` after `\begin{mathletters}` will allow you to reference the *general* number of the equations in the `mathletters` environment. For example, if

```
\begin{mathletters}
\label{allequations} % notice location
\begin{equation}
E=mc^2,\label{equationa}
\end{equation}
\begin{equation}
E=mc^2,\label{equationb}
\end{equation}
\begin{equation}
```

```
E=mc^2,\label{equationc}
\end{equation}
\end{mathletters}
```

gives the output

$$E = mc^2, \tag{2a}$$

$$E = mc^2, \tag{2b}$$

$$E = mc^2, \tag{2c}$$

then `Eq.\ (\ref{allequations})` gives "Eq. (2)".

Note: incorrect cross-referencing will result if `\label{#1}` is used in an unnumbered single line equation (i.e., within the `\[` and `\]` commands), or if `\label{#1}` is used on a line of an eqnarray that is not being numbered (i.e., a line that has a `\nonumber`).

Please see Sec. VI for further information about cross-referencing.

I. Special characters

Authors should avoid the use of specially designed "define characters" and choose symbols from those shown in the *LaTeX User's Guide & Reference Manual.* There is no guarantee that a specially designed definition will be supported by the conversion software and in the production environment. If a special symbol is required and not listed in the *LaTeX User's Guide & Reference Manual*, please request special consideration in the cover letter accompanying the file submittal. The copyeditor will make note of it and the production staff will attempt to accommodate the author. Unusual characters are subject to approval by the editor.

See Appendix A for a list of normal LaTeX symbols, a list of symbols available when the `amsfonts` and `amssymb` options are used, and a list of extra symbols made available by REVTEX.

J. Endnotes and references

The list of references should appear after the main body of the paper. Please refer to the *Physical Review Style and Notation Guide* or the *The Reviews of Modern Physics Style Guide*, as well as recent issues of the journal for current style. apssamp.tex shows examples of a variety of reference entries, e.g., byline, journal, book, and private communication. Remember to include a space (or hyphen) between author-name initials and between initial and surname.

The style for references in *Reviews of Modern Physics* is different from that of *Physical Review.* An RMP compuscript author shoud use the Harvard bibliographic style and citations commands. Please consult the information provided at that journal's World Wide Web home page, `http://www.phys.washington.edu/~rmp/`. The `harvard.sty` package is available there.

References will be listed in the reference section using the `\bibitem{#1}` command (for RMP, it will be the `\harvarditem` command), and they will be cited in text using the `\cite{#1}` command.

A cite command that has a list of references will be output with consecutive reference numbers collapsed; e.g., [1,2,3,5,7,8,9] will be output as [1–3,5,7–9]. No ordering will be done, so [1,3,2,4] will be output as [1,3,2,4]. If you use a `\cite{#1}` command with a long list of tags, you may need to split the list over more than one line. Use a % character immediately following a comma to make sure that you do not get unwanted spaces:

```
. . . as shown in \cite{a,b,c,d,e,f,g,h,i,j,%
k,l,m,n,o,p,q,r,s,t,u,v,w,x,y,z}
```

Note the % inserted after the comma on the first line. This ensures that the entire list will be processed correctly.

A byline endnote and the first reference cited may appear in the reference section like this:

```
\begin{references}
\bibitem[*]{AAAuth}Present Address: Brookhaven
National Laboratory, Upton, New York, 11973.
\bibitem{tal82}Y. Tal and L. J. Bartolotti,
J. Chem. Phys. {\bf 76}, 4056 (1982).
\end{references}
```

The `[*]` represents an optional, author-specified endnote symbol. If an endnote symbol is not present, REVTEX will assign the next available reference number.

`AAAuth` and `tal82` are tags; they can be any string of letters and numbers that you will easily associate with the reference. The tag will be used in text to tell TEX what reference you want to cite. See the example below.

input:

```
This has been noted previously \cite{tal82}.
```

output:

This has been noted previously [1].

Input for an author name with a byline endnote is similar, but the output is different:

input:

```
\author{A. A. Author\cite{AAAuth}}
```

output:

A. A. Author*

(See the Style Guides for details on proper usage of byline endnotes.) Output (galley style) in the reference section for the endnote and reference samples above will look like this:

---

* Present Address: Brookhaven National Laboratory, Upton, New York, 11973.

[1] Y. Tal and L. J. Bartolotti, J. Chem. Phys. **76**, 4056 (1982).

Since *Physical Review B* uses superscript reference citations, authors will need a special command to get online citations when the `prb` style option is in effect. The command `\onlinecite{#1}` can be used for this purpose. For example, if the `prb` style option is in effect, `Ref.\ \onlinecite{tal82}` will give the output "Ref. 1".

It should be mentioned that the normal LATEX `thebibliography` environment will also work in REVTEX.

There are also several tools for creating reference sections: prsty.bst, rmp.bst and reftest.tex.

prsty.bst is a BIBTEX style file that will output references in *Physical Review* style. Using rmp.bst, and harvard.sty, yields *Reviews of Modern Physics* style. You should now be able to use the normal LATEX/BIBTEX commands (`\bibliographystyle{#1}` and `\bibliography{#1}`) in lieu of typing in the references environment by hand. If you do this, you must of course *make sure* that you keep the correct references with the main file when you submit it. For the sake of simplicity, it is better if the Editorial Office receive a single file, especially in the case of an electronic submission. With these concerns in mind, it is better to just comment out the two bibliography commands and input the .bbl file directly into your main file just before submitting it. It should run correctly this way. Please *do not* send .bib or .bst files to the Editorial Office.

There is also a tool for authors that prepare their bibliographies by hand. It is called reftest.tex. It will check to make sure that you (1) have no uncited references, (2) have no undefined citations, and (3) have your references in the same order as your citations. These are all requirements in *Physical Review* style. This can only work if you use LATEX's `\bibitem{#1}` and `\cite{#1}` mechanisms. You just need to run reftest through LATEX. For example, suppose you want to check the references for the file test.tex. You would first run test.tex through LATEX as usual. This creates an up-to-date auxiliary file, which is what reftest uses to analyze your references. Then run LATEX on reftest. You will be prompted for the name of the file you wish to check (without the extension). Answer `test` at the prompt (not `test.tex` or `test.aux`). You will receive some messages on your screen and in the log file (reftest.log) that tell you if there are any problems. You can also preview or print the file reftest.dvi. If your references are out of order, the correct order will be given only in reftest.dvi, not through messages on the screen. Using reftest, an author can put the citations in the correct order once, after writing the paper, by using the correct order printed by reftest.

Quick guide to references: (*Physical Review Style*)

- The `\bibitem{#1}` command begins a reference.
- References should be listed in the reference section in the order in which they are first cited in the text. (See next item.)
- References will automatically be numbered by REVTEX in the order in which they occur in the reference section, unless the author provides his/her own label.
- The `#1` in `\bibitem{#1}` is a tag; it can be any string of letters and numbers that you will easily associate with the reference. This tag will be used in text (with the `\cite{#1}` command) to tell REVTEX what reference you want to cite.
- Anynotes to the byline should precede the references and should not be numbered. Provide a label in square brackets: e.g., `\bibitem[*]{byline}`. For *Physical Review A, B, C, D, E,* and *L,* use `[*]`, `[\dagger]`, `[\ddagger]`, `[\S]`, `[\P]`, `[\|]`, `[**]`, `[\dagger\dagger]`, `[\ddagger\ddagger]`, `[\S\S]`, `[\P\P]`, `[\|\|]` in the order listed. This conforms to the requirements detailed in the *Physical Review Style and Notation Guide.*

K. Figure captions

Figure captions are a part of the compuscript and should appear after the references. They should be input sequentially in the order in which they are cited in the text; LATEX will label and number the captions FIG. 1, FIG. 2, etc.

Note below the use of the `\label{#1}` command; this is used to cross-reference figures in text. The `\label{#1}` command should be inserted inside or after the figure caption, but before the end of the figure environment.

input:

```
\begin{figure}
\caption{Text of first caption.}
\label{fig1}
```

```
\end{figure}

\begin{figure}
\caption{This is the second caption:
comparison of the differential cross
sections for the subprocess $qg \rightarrow
qggg$ of our approximation (dotted line)
versus the approximation of Maxwell together
with the use of the effective structure
function approximation(solid line).}
\label{fig2}
\end{figure}
```

output:

FIG. 1. Text of first caption.

FIG. 2. This is the second caption: comparison of the differential cross sections for the subprocess $qg \rightarrow qggg$ of our approximation (dotted line) versus the approximation of Maxwell together with the use of the effective structure function approximation(solid line).

Figures are cited in text with the use of the `\ref{#1}` command:

input:

```
...It can be seen from Fig.\ \ref{fig1} that
the data are inconsistent with this
conclusion...
```

output:

...It can be seen from Fig. 1 that the data are inconsistent with this conclusion...

Further information on cross-referencing can be found in Sec. VI.

Figures in REVTEX do not normally float. The `floats` style option restores floating behavior for figures and tables. (This option has been added for the author's personal use. It should not be used in any file destined for submission to the APS.)

Figures and illustrations are submitted as originals or glossy prints. Follow the rules in the *Style Guides* for style and specifications.

PostScript image files may be submitted electronically (one figure per file, seperate from compuscript file).

L. Tables

Tables are a part of the compuscript and should appear at the end of the file. Every table must have a complete caption and the correct number of descriptive column headings. Tables may be narrow (8.6 cm or 3.4 in. wide), medium (14 cm or 5.5 in. wide), or wide (17.8 cm or 7.0 in. wide), in galley style. An example of each appears in the sample compuscript input. The final tables will be sized by the production compostion system to be set narrow, medium, or wide (according to the number of columns, type of material, etc.). (When using the preprint style for REVTEX, all tables will be set 6.5 in. wide. REVTEX will ignore `\narrowtext`, `\mediumtext`, and `\widetext` commands if the front matter of the file calls for the preprint style.)

Each table must begin with `\begin{table}`, and end with `\end{table}`. Follow current journal style concerning placement of table lines. (See examples in this guide and recent issues of the journal.) The table commands will set double horizontal lines appearing at the beginning and end of the table; a single horizontal rule should be set after the column headings with the use of the `\hline` command. Extra sets of column headings within the table will require another `\hline` to separate the headings from the column entries. Do not insert any other horizontal or vertical lines in the body of the table.

Since tables are automatically numbered, the `\label{#1}` command is used with the `\ref{#1}` command to cite tables in text. The `\label{#1}` command should appear after the `\caption{#1}` command and before the `\end{table}` command.

Some special table considerations:

- *Numerical columns* should align on the decimal point (or decimal points if more than one is is present). The column specifier "d," should be used for simple numeric data with a *single* decimal point. Material without a decimal point is simply centered. Notes: entries that start with a decimal point (e.g., `.003`) will not be aligned by the decimal point; you should add a prezero to align the number correctly (e.g., `0.003`). The prezero is also editorial style! Additionally, the entry is typeset in separate parts separated by any decimal point(s) present, so parts of the entry to the left and right of a decimal point must be able to be typeset separately. For example, `$-1.23$` will not work in a `d` column. You will get a "missing \$" error because `$-1` is typeset separately from `23$`. Use instead `$-$1.23`. If multiple decimal points are present then the last is used for alignment. To escape from the `d` column use `\multicolumn` as usual. See apssamp.tex for examples.
- Use \$ delimiters for all math in a table (no displayed equation commands).
- *Footnotes* in a table must be labeled a, b, c, etc. Tablenote commands that act just like regular footnotes have been added. See apssamp.tex for examples and explanations of use.

- *Extra wide tables* that will not fit into the 17.8-cm or 7.0-in. designation can be manipulated by the production composition system to produce a turned table that will appear lengthwise on a page. A cover letter requesting this special handling should accompany file submittal. The author can use the `\squeezetable` command with tables that do not fit on the page. This command will make the fonts in the body of the table smaller, allowing larger tables to fit onto the page.

Tables in REVTEX do not normally float. The `floats` style option restores floating behavior for figures and tables. Tables in REVTEX will break across pages if they are more than a full page in length, unless the `floats` option has been selected. (The `floats` option has been added for the author's personal use. It should not be used in any file destined for submission to the APS.)

VI. CROSS-REFERENCING

REVTEX has built-in features for labeling and cross-referencing of section headings, equations, tables, and figures. This section contains a simplified explanation of cross-referencing features. The format for using these features with section headings, equations, tables, and figures is discussed in the appropriate section.

Cross-referencing depends upon the use of "tags," which are defined by the user. The `\label{#1}` command is used to identify tags for REVTEX. Tags are strings of characters that serve to label section headings, equations, tables, and figures, so that you don't need to know what number REVTEX has assigned to the item in order to talk about it in text.

You will need to LATEX the original file more than once to ensure that the tags have been properly linked to appropriate numbers. If you add any tags, you will need to LATEX more than once in subsequent work sessions: LATEX will display an error message that ends with `... Rerun to get cross-references right`. If you see that message, LATEX the file again. If the error message appears after two LATEXings, please check your labels; you probably have referred to an item in text without tagging the item.

You may not need to know (or care to know) all about what REVTEX is doing for autonumbering; however, you may want to know that when you LATEX the file for the first time, an auxiliary file with the `.aux` filename extension will be created that connects numbers with their tags. Subsequent LATEXing accesses the auxiliary file to put the proper number in the text.

VII. FONTS

Fonts are complicated. REVTEX has been set up to give good results on all LATEX installations, but no guarantee can be given that you will be able to access all the font options—memory and font restrictions vary in TEX implementations and computers.

A. Font selection schemes (OFSS and NFSS)

The font-selection scheme (FSS) that LATEX normally uses is somewhat limited. This is known as the Old Font Selection Scheme (OFSS). A new scheme has been written and distributed by Frank Mittelbach and Rainer Schöpf—the so-called New Font Selection Scheme (NFSS). When you run a file with REVTEX you will see a message telling you which FSS you are running on, right after the file aps.sty is read in. Several font problems have been addressed in REVTEX itself so it is not very important which FSS you use, since REVTEX has been written to run equally well on either FSS. It should be said that, in general, an NFSS installation is more capable than an OFSS installation.

At this time we are only supporting the NFSS if it is used with oldlfont.sty. This makes the NFSS use the same font-selection macros as the OFSS. If you use the NFSS and `${\bf ABC}$` gives boldface letters, then you are using oldlfont.sty. Here is the output of `${\bf ABC}$`: $\mathbf{ABC}$.

B. Using bold symbols in math: \bbox{#1} and the amsfonts option

If you use regular LATEX with the OFSS, then you will probably get incorrectly sized letters if you use `\bf` in a superscript. For example, both letters in the output from `${\bf x}^{\bf x}$` are the same size. This problem has been corrected if you run REVTEX on the OFSS.

There are also problems if you try to get bold math symbols in LATEX. The solution given by the *LATEX User's Guide & Reference Manual* is to use `\mbox{\boldmath$#1$}` where `#1` is the symbol to be set bold. There are problems with this approach. On the average LATEX setup with the OFSS you only use this for `\cal`, lowercase Greek letters, curly brackets, and other miscellaneous symbols. You will not be able to get these characters in the correct size in a superscript, either. If you use the NFSS you will also be able to set digits, uppercase Greek letters, parentheses, and square brackets in boldface using `\boldmath`, but you will still not get them in the correct size for superscripts.

The REVTEX command `\bbox{#1}` will make `#1` bold in math mode, but it will first make sure that it is the correct size, even in superscripts. If the correct font in the correct size is not available then you get `#1` at the correct size in lightface and LATEX will issue a warning that says "`No \boldmath typeface in this size . . .`".

So the `\bbox{#1}` command will give bold output of `#1` in math mode. You can use it to get bold greek characters—upper- and lowercase—and other symbols. It is still easier to use `\bf` to get upright Latin letters in boldface. How much comes out bold and in how many places you get bold output depends on how many fonts you have installed. Using the `amsfonts` option will automatically use the extra AMS Computer Modern math and symbol fonts for bold in superscripts and smaller sizes, if you have installed the AMSFonts. The following will come out bold in bboxes: normal math italic letters, numbers, Greek letters (uppercase and lowercase), small bracketing and operators, and `\cal`.

If you use only on-line bold math symbols there is no advantage to using `\mbox{\boldmath$#1$}`. If you use superscript bold math symbols then you need the AMSFonts installed and the `amsfonts` style option to see bold, but the symbols will be in the correct size and will come out bold at the APS. Overall, it seems better to use `\bbox{#1}` everywhere.

Note that `\bbox{#1}` is a fragile command.

C. Extra typefaces in math: `amsfonts` option

In addition to the extra bold capabilities you get in math with the `amsfonts` option, you also gain access to the Fraktur and Blackboard Bold typefaces. You select these with normal font-switching commands: `${\frak G}$` gives a Fraktur "G" and `${\Bbb Z}$` gives a Blackboard Bold "Z". Fraktur will become bold in a bbox; there is no bold version of Blackboard Bold. If you have the AMSFonts installed and have the `amsfonts` option selected, example output can be found in Appendix A.

D. Extra symbols in math: `amssymb` option

Many new symbols are available to you if you have the AMSFonts installed. The `amssymb` style option gives you all the font capabilities of the `amsfonts` style option and further defines the commands to get the symbols shown in Appendix A. See Appendix A for examples of the symbols and instructions on use. These characters will scale correctly in different areas of the paper and in superscripts. Note that the symbols and typefaces in Appendix A will not be printed unless you have the AMSFonts installed and have selected either the `amsfonts` or `amssymb` style option.

E. AMSFonts

The AMSFonts are fonts that were developed and are now made available free of charge by the American Mathematical Society. The METAFONT source files for these fonts are freely available, as are precompiled .pk files, for those with Internet ftp capabilities. There are two style options that can be used to access the AMSFonts: `amsfonts` and `amssymb`. Not distributed with REVTeX are the files amsfonts.sty and amssymb.sty from the AMS's AMS-LaTeX distribution. These files are called in by REVTeX to give you access to the AMSFonts when the NFSS is in effect; REVTeX itself will do the work necessary to allow access when the OFSS is in effect.

The `amsfonts` option will define the `\frak` and `\Bbb` commands to switch to the Fraktur and Blackboard Bold fonts, respectively. Fraktur characters will come out bold in a bbox, Blackboard Bold will not. The `amsfonts` option also adds support for bold math letters and symbols in smaller sizes in galley style and in superscripts when a `\bbox{#1}` is used. For example, `$^{\bbox{\pi}}$` gives a bold lowercase pi in the superscript position. `amssymb` gives the capabilities of the `amsfonts` option and additionally defines many new characters for use in math. Here are the fonts you need to have installed for the `amsfonts` and `amssymb` options:

1. msam5, msam6, msam7, msam8, msam9, and msam10 at their normal (unmagnified) sizes, and msam10 at magsteps $\frac{1}{2}$,1,2.
2. msbm5, msbm6, msbm7, msbm8, msbm9, and msbm10 at their normal (unmagnified) sizes, and msbm10 at magsteps $\frac{1}{2}$,1,2.
3. eufm5, eufm6, eufm7, eufm8, eufm9, and eufm10 at their normal (unmagnified) sizes, and eufm10 at magsteps $\frac{1}{2}$,1,2.
4. eufb5, eufb6, eufb7, eufb8, eufb9, and eufb10 at their normal (unmagnified) sizes, and eufb10 at magsteps $\frac{1}{2}$,1,2.
5. cmmib5, cmmib6, cmmib7, cmmib8, cmmib9, and cmmib10 at their normal (unmagnified) sizes, and cmmib10 at magsteps $\frac{1}{2}$,1,2.
6. cmbsy5, cmbsy6, cmbsy7, cmbsy8, cmbsy9, and cmbsy10 at their normal (unmagnified) sizes, and cmbsy10 at magsteps $\frac{1}{2}$,1,2.

The following table shows only the REVTeX requirements for a *minimal* AMSFonts installation; i.e., one that will function correctly at normal sizes. "Normal sizes" means the sizes one gets automatically in REVTeX without using LaTeX's explicit size-changing commands. (It may be worth installing the fonts at larger sizes if you use the NFSS, for uses other than REVTeX.)

TABLE I. Minimum fonts and resolutions required for a 300-dpi installation of AMSFonts for use of the `amsfonts` and `amssymb` style options at normal REVTEX sizes.

Font	Resolution(s)
msam5	300
msam6	300
msam7	300
msam8	300
msam9	300
msam10	300,329,360,432
msbm5	300
msbm6	300
msbm7	300
msbm8	300
msbm9	300
msbm10	300,329,360,432
eufm5	300
eufm6	300
eufm7	300
eufm8	300
eufm9	300
eufm10	300,329,360,432
eufb5	300
eufb6	300
eufb7	300
eufb8	300
eufb9	300
eufb10	300,329,360,432
cmbsy5	300
cmbsy6	300
cmbsy7	300
cmbsy8	300
cmbsy9	300
cmbsy10	300,329,360,432
cmmib5	300
cmmib6	300
cmmib7	300
cmmib8	300
cmmib9	300
cmmib10	300,329,360,432

REVTEX does not support the use of the extra Euler fonts (the AMSFonts starting with `eur` or `eus`) or the Cyrillic fonts (the AMSFonts starting with `w`).

In addition, if you are using the NFSS you will need to have the files amsfonts.sty and amssymb.sty from the AMS-LATEX distribution. See Sec. VII A for an explanation of what the NFSS is.

VIII. INSTALLING REVTEX 3.1

Files in the complete REVTeX 3.1 distribution:
(a) the general files:

```
README
revtex.sty
manintro.tex
manend.tex
```

(b) APS-specific files

```
aps.sty
aps10.sty
aps12.sty
rmp.sty
prabib.sty
prbbib.sty
template.aps
manaps.tex
apssamp.tex
prsty.bst
reftest.tex
```

You must have TEX and LATEX running to use these macros. All macros run on a standard LATEX2.09 format. If LATEX2e is used, it must be run in "compatibility" mode.

Installing to just test the macros can be accomplished by copying all the files into an unused directory, then changing to that directory. All the files and facilities of REVTEX should then be usable while you are in that directory.

A more permanent installation would usually mean installing the .sty files and reftest.tex files into the directory where TEX usually looks for input files, the .bst files where BIBTEX usually looks for its style files, and the the rest of the files into a REVTEX working directory or a public directory, depending on your system setup. Care should be taken to avoid writing over files already present. The files in the REVTEX package have been named to help avoid this problem, but there can be no guarantee that our filenames are unique (e.g., README).

If you are upgrading an older version of REVTEX (<3.1), the files from the old version should be deleted first. Here is a list of the older files:

```
     readme
(make sure you only delete the REVTeX readme!)
     revtex.sty
     aps.sty
     aps10.sty
     aps12.sty
     preprint.sty
     eqsecnum.sty
     smplea.tex
     smpleb.tex
     smplec.tex
     apguide.tex
```

The next thing you need to do is run LATEX on the appropriate user guide(s). Run manintro.tex, manaps.tex, and manend.tex. Collecting the output together in this order will provide a complete user guide for APS authors. Running manaip.tex and manosa.tex will give you the chapters for AIP and OSA authors.

If needed, consult a local LATEX user or system support person for information on how to run LATEX and print its output on your local system.

Before you report an error please check that

- the error isn't caused by obsolete versions of other software. LaTeX from 1986 is a good candidate.
- you use an original version of the package.

If you think you have found a genuine bug please report it, together with the following information:

- version of the REVTEX file(s)
- version (date!) of your LaTeX
- a short test file showing the behavior with all unnecessary coding removed. The log file showing the problem might also help.

Errors should be reported to the support person listed in Sec. XII.

A. Differences between REVTEX v3.1 and LaTeX article style

1. The documentstyle is different. The main style is `revtex`, and `aps` is a mandatory style option for APS authors. Other style options are `eqsecnum` (to number equations by section), `preprint` (to get double-spaced output for submission purposes), `tighten` (to get single-spaced output with the preprint option), and `amsfonts` and `amssymb` (for extra font capabilities, see Sec. VII). There are also style options for each APS journal: `pra`, `prb`, `prc`, `prd`, `pre`, `prl`, and `rmp` for *Physical Review A*, *B*, *C*, *D*, *E*, *Letters*, and *Reviews of Modern Physics* respectively. `pra` is the default. The `prb` option gives superscript reference citations, as is the style for *Physical Review B*. Other than this, there are no substantial differences in the journal options. Please do not use the `prb` option unless you will be submitting to *Physical Review B*. The `prl` option yields a slightly different line spacing for accurate PRL length estimates. The `floats` style option enables LaTeX-style floating figures and tables—it is *not* for use with files to be submitted to the APS. Similarly, the twocolumn style option is for personal use, and not for use in submitted files.

2. The beginning of a file is different in REVTEX. The top of a typical paper might look like (cf. template.aps)

```
\documentstyle[pra,aps]{revtex}
\begin{document}
\draft
\title{Title here}
\author{Author(s) here}
\address{Address(es) here}
\author{Another author(s) here}
\address{Another address(es) here}
\date{\today}
\maketitle
\begin{abstract}
Abstract here.
\end{abstract}
\pacs{PACS numbers here}
```

   Note the `\draft`, `\address{#1}`, and `\pacs{#1}` commands. See Sec. V C for details.

3. Figures and tables are input the same as in LaTeX. Tables can be over 1 page long and will break automatically across pages. Figures and tables do not float unless you use the `floats` option. While floats can be re-enabled by use of the `floats` style option, you *cannot* use this for files that you submit to the APS; it is added for your personal use. Floating tables and figures will not break across pages. All tables expand to fill the column width.

4. The `\text{#1}` command will print `#1` as regular text output in math. In particular, you will get hyphens instead of minus signs. Used in a superscript, you will get the correct size. See Sec. V G.

5. Using a `\label{#1}` after `\begin{mathletters}` will allow you to reference the *general* number of the equations in the `mathletters` environment. For example, if

```
\begin{mathletters}
\label{alleqs}  % observe location
\begin{equation}
E=mc^2,\label{eqa}
\end{equation}
\begin{equation}
E=mc^2,\label{eqb}
\end{equation}
\begin{equation}
E=mc^2,\label{eqc}
\end{equation}
\end{mathletters}
```

   gives the output

$$E = mc^2, \tag{3a}$$

$$E = mc^2, \tag{3b}$$

$$E = mc^2, \tag{3c}$$

   then `Eq.\ (\ref{alleqs})` gives "Eq. (3)".

6. When you use the `\bf` command in superscripts, you will get a correctly sized character.

7. There are commands `\tablenote{#1}`, `\tablenotetext{#1}`, and `\tablenotemark{#1}`. These commands work in direct analogy to the regular footnoting commands in LATEX. They should be used only in tables, and the notes will come out at the bottom of the table in which they appear. See apssamp.tex for instructions and examples.

8. There is a new letter for specifying columns in tabular environments. Using `d` in a tabular specification will create a column centered on the decimal points of the entries. See Sec. V L for details; see apssamp.tex for examples.

9. Extra diacritics are available: `\tensor` (double-headed overarrow), `\overdots` (triple overdots), `\overstar` (star), `\overcirc` (circle), `\loarrow` (left-going overarrow), and `\roarrow` (right-going overarrow). They scale correctly in superscripts. See Appendix A for examples.

10. `\case{#1}{#2}` will give text-style fractions (smaller) in display-style math.

11. There are BIBTEX style files, `prsty.bst`, `rmp.bst`, that can be used to prepare bibliographies automatically, as explained in Lamport's book.

12. There is also a tool for authors that prepare their bibliographies by hand. It is called reftest.tex. It will check to make sure that you (1) have no uncited bibitems, (2) have no undefined citations, and (3) have your bibitems in the same order as your citations. These are all requirements in *Physical Review* style. See Sec. V J.

13. The LATEX command `\extracolsep{#1}` sets extra intercolumn spacing, but this extra spacing has already been set in REVTEX to allow the columns in the table to expand out to fill the text width. Therefore, `\extracolsep{#1}` will not work in REVTEX. Use the `@{#1}` command to specify spacing between two adjacent columns, for personal files. See Appendix C.9.2 of Lamport for a full explanation of `@{#1}`. An example has been given in apssamp.tex. Note that final journal table layout is set by production software.

14. We intend for REVTEX to be as compatible as possible with LATEX, including features we (APS) do not require at this time, such as `\twocolumn`, `floats`, etc. You *cannot* use these for files that you submit to the APS; they are added for your personal use. Please let us know of any other incompatibilities.

15. You should be able to use either the OFSS or NFSS with these macros, with similar results (the NFSS may give you more fonts in some areas, depending what your setup is). We are only supporting the NFSS with `oldlfont.sty` active. Please let us know if you have any problems in this area. And don't worry if you don't know what the OFSS and NFSS are. (See Sec. VII if you are curious.)

B. Differences between REVTEX v3.1 and REVTEX v<3.0

There are few differences between REVTEX v3.1 and v3.0:

1. No difference in basic macro functionality.
2. Support for the same "tag set".
3. Version 3.1 remains LATEX2.09 compliant.
4. A new publisher has been added to the program, SEG.
5. A new APS journal has been added, *Reviews of Modern Physics*.
6. New/revised style files have been added to the toolbox.
7. Documentation has been updated.

Here are the differences between REVTEX v3.1 and versions <3.0.

1. The `\documentstyle` is different. The main style is now `revtex`, and `aps` is a mandatory style option for APS authors. Other style options are `eqsecnum` (to number equations by section), `preprint` (to get double-spaced output for submission purposes), `tighten` (to get single-spaced output with the preprint option), and `amsfonts` and `amssymb` (see below). There are also style options for each APS journal: `pra`, `prb`, `prc`, `prd`, `pre`, `prl`, and `rmp` for *Physical Review A*, *B*, *C*, *D*, *E*, *Letters*, and *Reviews of Modern Physics*, respectively. `pra` is the default. The `prb` option gives superscript reference citations, as is the style for *Physical Review B*. Other than this, there are no substantial differences in the journal options. Please do not use the `prb` option unless you will be submitting to *Physical Review B*. The `prl` option yields a slightly different line spacing for accurate PRL length estimates. The `floats` style option enables LATEX-style floating figures and tables—it is *not* for use with files to be submitted to the APS. Similarly the twocolumn style option is for personal use, and not for use in submitted files.

2. The beginning of a file is different in v3.1. It is more like LATEX's article style. See Sec. V C and template.aps for details.

3. The `\tightenlines` command is now called `\tighten`. The `tighten` style option can be used to get a single-spaced preprint.

4. You can now use the `\label{#1}` command after `\begin{mathletters}`. This allows you to reference the *general* number of the equations in the `mathletters` environment. For example, if

```
\begin{mathletters}
\label{eq:all} % note location
\begin{equation}
E=mc^2,\label{eq:a}
\end{equation}
\begin{equation}
E=mc^2,\label{eq:b}
\end{equation}
\begin{equation}
E=mc^2,\label{eq:c}
\end{equation}
\end{mathletters}
```

gives the output

$$E = mc^2, \tag{4a}$$

$$E = mc^2, \tag{4b}$$

$$E = mc^2, \tag{4c}$$

then `Eq.\ (\ref{eq:all})` gives "Eq. (4)".

5. The `\nonum` command is no longer used. You can get unnumbered section headings by using the "star form" of the command; e.g.,

```
\section*{Unnumbered section}
```

This is normal LaTeX practice. Appendix headings used to be set with the `\appendix{#1}` and `\unletteredappendix{#1}` commands. The normal LaTeX convention is now used: When you wish to start the appendix(es) use the `\appendix` command (no argument). Then `\section{#1}` will give an appendix heading and `\section*{#1}` gives an unlettered appendix. All numbering, labeling, and cross-referencing remain the same.

6. Figure captions should be input as in LaTeX. The syntax is exactly the same as in LaTeX; e.g.,

```
\begin{figure}
\caption{Here is the caption.\label{xxx}}
\end{figure}
```

Note that the label can be inside the caption or after it, as long as it is inside the figure environment and does not come before the caption.

7. All the normal LaTeX rules about fragile commands in moving arguments apply. Especially in figure and table captions, where REVTEX users have not had to worry until now. An error of

```
! Argument of \@caption has an extra }
```

generally indicates that a command in a caption must be preceded by the `\protect` command. `\protect` will need to be used much more often, unfortunately. Specifically, `\\` and `\ref`, along with other fragile commands, will need to be protected in section heads and captions.

8. Equations and eqnarrays center in the column width, instead of appearing indented. The `\FL` and `\FR` commands still flush equations left and right, repectively, in the column, but should be needed only occasionally. This mimics the style of how the equations will appear in the journal.

9. The AMSFonts are supported through the `amsfonts` and `amssymb` style options. These work similar on both LaTeX's normal font macros (OFSS) and the so-called NFSS. You do not need to know what the OFSS and NFSS are. (See Sec. VII if you are curious.)

   The `amsfonts` option will define the `\frak` and `\Bbb` commands to switch to the Fraktur and Blackboard Bold fonts, respectively. Fraktur characters will come out bold in a bbox (see below), Blackboard Bold will not. The `amsfonts` option also adds support for bold math letters and symbols in smaller sizes in galley style and in superscripts when a bbox is used. For example, `$^{\bbox{\pi}}$` gives a bold lowercase pi in the superscript position. `\bbox{#1}` is explained below.

   The `amssymb` option gives all the capabilities of the `amsfonts` option, but also defines names for all the extra symbols in the AMSFonts.

   See Sec. VII for font details.

10. The `\bbox{#1}` command will give bold output of `#1` in math mode. You can use it to get bold greek characters—upper- and lowercase—and other symbols. It is still easier to use `\bf` to get upright Latin letters in boldface. How much comes out bold and in how many places you get bold output depends on how many fonts you have installed. Using the `amsfonts` option will automatically enable bold Fraktur in a bbox and will use the extra AMS Computer Modern math and symbol fonts for bold in superscripts and smaller sizes. The following will

come out bold in bboxes: normal math italic letters, numbers, Greek letters (uppercase and lowercase), small bracketing and operators, `\cal`, and `\frak`. See Sec. VII B.

11. The `\text{#1}` command will print `#1` as regular text output in math. In particular, you will get hyphens instead of minus signs. Used in a superscript, you will get the correct size. See Sec. V G.

12. When you use the `\bf` command in superscripts, you will get a correctly sized character.

13. The `/` in the `\case` command is now optional. Either `\case{1}/{2}` or `\case{1}{2}` will work. Our hope is that the latter, more usual construct will become the norm.

14. There are commands `\tablenote{#1}`, `\tablenotetext{#1}`, and `\tablenotemark{#1}`. These commands work in direct analogy to the regular footnoting commands in LATEX. They should be used only in tables, and the notes will come out at the bottom of the table in which they appear. See apssamp.tex for instructions and examples.

15. There is a new letter for specifying columns in tabular environments. Using `d` in a tabular specification will create a column centered on the decimal points of the entries. See Sec. V L for details; see apssamp.tex for examples. `\dec` and `\setdec` should not be used.

16. The symbols $\lesssim, \gtrsim$ were called `\alt`,`\agt` in previous versions of REVTEX. These symbols are now called `\lesssim` and `\gtrsim`, for compatibility with normal AMSFonts notation.

17. Extra diacritics are available: `\tensor` (double-headed overarrow), `\overdots` (triple overdots), `\overstar` (star), `\overcirc` (circle), `\loarrow` (left-going overarrow), and `\roarrow` (right-going overarrow). They scale correctly in superscripts. See Appendix A for examples.

18. There are BIBTEX style files, `prsty.bst`, `rmp.bst`, that can be used to prepare bibliographies automatically, as explained in Lamport's book.

19. There is also a tool for authors that prepare their bibliographies by hand. It is called reftest.tex. It will check to make sure that you (1) have no uncited bibitems, (2) have no undefined citations, and (3) have your bibitems in the same order as your citations. These are all requirements in *Physical Review* style. This can only work if you use LATEX's `\bibitem` and `\cite` mechanisms. See Sec. V J.

20. We have intended for REVTEX to be as compatible as possible with LATEX, including features we (APS) do not require at this time such as `\twocolumn`, `floats`, etc. You *cannot* use these for files that you submit to the APS; they are added for your personal use. Please let us know of any incompatibilities.

21. You should be able to use either the OFSS or NFSS with these macros, with similar results (the NFSS may give you more fonts in some areas, depending what your setup is). We are only supporting the NFSS with `oldlfont.sty` active. Please let us know if you have any problems in this area. And don't worry if you don't know what the OFSS and NFSS are. (See Sec. VII if you are curious.)

C. Running an older REVTEX file under REVTEX v3.1

Version 3.0 files will in their current form.

If you have version 2.x files that you wish to run with v3.1, use the `version2` style option.

If you have a file formatted with version 1.x, first delete the optional arguments to the bibitem commands. That is, `\bibitem[1]{firstref}` would become `\bibitem{firstref}`, etc. Then use the `version2` style option to run the paper. This means a documentstyle line of

```
\documentstyle[version2,aps]{revtex}
```

D. Converting a REVTEX v2.x file to REVTEX v3.1

To change a file over from v2.x to run with v3.1, you need to make the following changes. If you have a file formatted with version 1.x, first delete the optional arguments to the `\bibitem` commands. That is, `\bibitem[1]{firstref}` would become `\bibitem{firstref}`, etc. Then make the following changes.

```
\documentstyle[revtex]{aps}
```

becomes

```
\documentstyle[aps]{revtex}
```

The `preprint` and `eqsecnum` options work the same as before.

```
\tightenlines
```

becomes

```
\tighten
```

```
$\alt$ and $\agt$
```

become

```
$\lesssim$ and $\gtrsim$
```

```
\begin{title}
XXX
\end{title}
```

becomes

```
\title{XXX}
```

```
\begin{instit}
XXX
\end{instit}
```

becomes

```
\address{XXX}
```

```
\receipt{XXX}
```

becomes

```
\date{XXX}
```

`\maketitle` should be added just before the `\begin{abstract}` command is entered.

```
\figure{XXX\label{YYY}}
```

becomes

```
\begin{figure}
\caption{XXX\label{YYY}}
\end{figure}
```

Tablenotes should be converted over to run correctly. The first three `\tablenotes{#1}` commands would be treated as follows:

```
\tablenotes{$^{\rm a}$Tablenote a.}
\tablenotes{$^{\rm b}$Tablenote b.}
\tablenotes{$^{\rm c}$Tablenote c.}
```

becomes

```
\tablenotetext[1]{Tablenote a.}
\tablenotetext[2]{Tablenote b.}
\tablenotetext[3]{Tablenote c.}
```

Further tablenotes should be treated similarly. This should allow older tables to run correctly. There is much greater capability in the new tablenote macros, however. See apssamp.tex for examples and explanations.

```
\nonum\section{XXX}
```

becomes

```
\section*{XXX}
```

Note that there should only be one `\unletteredappendix` command in any file.

```
\unletteredappendix{XXX}
```

becomes

```
\appendix
\section*{XXX}
```

Note that there may be more than one `\appendix` command in any file. The first occurrence should be treated as follows:

```
\appendix{XXX}
```

becomes

```
\appendix
\section{XXX}
```

Subsequent occurrences should be treated as follows:

```
\appendix{XXX}
```

becomes

```
\section{XXX}
```

IX. FAST FACTS FOR NEW PARTICIPANTS

Since 1980 the American Physical Society has been accepting computer files from authors and using those files ("compuscripts") in the preparation of their papers. In 1987 a research and development effort was launched to expand this service to include TEX-formatted compuscripts. We have been publishing TEX compuscripts since 1988.

Benefits to Author and Publisher. REVTEX is one of the acceptable electronic-submission formats that earns an APS publication-charge discount for authors. It is currently the only format that routinely undergoes direct software conversion into APS's Xyvision/SGML production files, avoiding rekeyboarding. Not only does this yield a small savings for APS, it also maximizes author control of text-content keystrokes and thereby minimizes author effort in checking author proofs. Furthermore, the macros are supported by several other physics publishers, so REVTEX has utility for non-APS electronic submissions as well. REVTEX attempts to meet both publisher and author needs, strtiking a balance between requirements that sometimes conflict. It addresses the tagging needs of production; by staying closely compatible with LATEX, it can also be useful to an author for presubmission presentation and for non-APS submissions more generally.

How to Qualify: Use REVTEX Macro Package. The APS has developed a "compuscript toolbox," which is composed of LATEX macros, (style files), *The REVTEX Input Guide*, bibliography tools, an input template and example file, and instructions for using the software and on how to properly prepare a compuscript for the APS program. Auxiliary files, e.g. editorial style and notation guides, are available online and compliment the toolbox (cf. XII).

Which Journals are Participants? Papers submitted to all the journals, *Physical Review A, B, C, D, E, Letters,* or *Reviews of Modern Physics* may qualify.

Media for Compuscripts. We can process files received via electronic mail or on DOS-formatted floppy disk.

How to Participate. Make the original submission of your REVTEX compuscript to the Editorial Office via electronic mail or DOS-formatted floppy disk. We will contact you to confirm file qualification. During the review process, resubmit in one of the electronic modes; do *not* resubmit by conventional means.

Obtaining the Toolbox and More Information. Contact

REVTEX Support
The American Physical Society
1 Research Rd. Box 9000
Ridge, New York 11961-9000

Telephone: (516) 591-4000
FAX: (516) 591-4141
E-mail address: `mis@aps.org` (Internet)

X. COMMON AUTHOR QUESTIONS

Page Charges. Historically, page charges for compuscripts have fluctuated. The Council has, at various points over the history of the program, voted for reduced page charges, the elimination of page charges, and full page charges for compuscripts.

The current APS policy is to request a **discounted** publication charge for articles submitted electronically to the *Physical Review* and *Letters* journals, provided they are in an acceptable file format and are printable/displayable at the Editorial Office. (*Reviews of Modern Physics* does not request publication charges.) The discounts are journal specific. See a journal's inside front cover for exact charges or visit their World Wide Web home page via the URL http://publish.aps.org/.

Acceptable file formats for electronic submissions are, at the moment, REVTEX (preferred), LATEX, Plain TEX.

Compuscripts versus Electronic Submissions. Electronic Submissions are manuscript files that can be used electronically in the APS editorial-review process. They are described in the preceeding paragraph. Compuscripts are electronic submissions that also meet the requirements for the APS production process; i.e., they have the correct tagging and coding (REVTEX!) to undergo direct software translation into a useable Xyvision/SGML production file. Compuscripts garner no additional discount for authors. Plain TEX and "non-REVTEX" LATEX files do not offer the standard coding needed for the conversion.

Publication Schedule. The normal edtorial-review and production schedules apply to electronic submissions and compuscripts.

Compuscript Conversion. APS production files are in Xyvision or SGML format. The files are created via original keyboarding according to conventional manuscripts or via translation of an author's REVTEX file. It is no longer the case that REVTEX files serve as the actual production file that produces the final journal output.

For journal page composition, any low-level format coding in a compuscript file is effectively ignored in the conversion to the production file. Such is the nature of the SGML scheme: separation of the logical structioral elements (tagged items) of a document from the specification for the formatted output of the document content. The compuscript serves to code the elements; production composition software applies APS-standard format specificaitons. Extensive coding for low-level formatting details in a compuscript file may foil the translation process, and should be avoided.

Macros. Some authors use specialized definitions, or custom macros, in their files. These definitions serve different purposes: some macros save the author from typing a long character string repetitively (Type 1), and some macros act as commands to the TEX program (Type 2).

Type-1 macros enable the author to define a frequently occurring string of characters as a shorter string, in order to save typing time. These "keystroke-saving" macros are now acceptable for APS compuscripts. They will be globally expanded by the compuscript conversion software. If the resulting code otherwise meets the requirements for APS compuscript files, all should be well. The expansion should not lead to low-level formatting. Avoid recursive definitions; include the Type-1 macros at the beginning of the file, before the `\begin{document}` line; include only those used within the given compuscript file. Refer to the Compuscript Booklets (cf. XII) for more details.

Type-2 macros enable the author to give commands to the TEX program. Authors need to do this when the macro package they are using does not contain a command that they need and/or they are effecting low-level formatting.

Type-2 macros frequently occur in LATEX compuscripts. This is because the macros do not provide for certain elements of APS style; for instance, letters in equation numbers. Authors who are using LATEX to compose their compuscripts would need to develop a command that would number their equations (1a), (1b), etc.

Type-2 macros should not occur in REVTEX compuscripts. The REVTEX macros ideally represent a complete command set, allowing the author to do anything that APS edtorial style allows.

Type-2 macros are not easy to remove; therefore files containing them will be ineligible for the compuscript program.

XI. TROUBLESHOOTING AND OTHER QUESTIONS

This section is intended to help authors with problems and common questions that arise when using REVTEX.

Question: Where are the appendixes that are mentioned in the text of this document? You need to run the file manend.tex through LATEX. Also, you may elect to try a documentstyle with either the `amsfonts` or `amssymb` option selected, if you have the AMSFonts installed and the correct $\mathcal{AMS}$-LATEX files (if needed). See Sec. VII for details on these options.

Question: REVTEX types out information about the NFSS (or OFSS). What does this mean? This is simply information to let you know which FSS you are running on. Normally this information is not important. (See Sec. VII if you are curious.)

Question: How do I get lowercase letters in the `\section{#1}` command? All text in the `\section{#1}` command is automatically set uppercase. If a lowercase letter is needed, just use `\lowercase{x}`. For example, to use "He" for helium in a `\section{#1}` command, type `H\lowercase{e}` in `#1`. This also works in math mode: `$\lowercase{e}^2$` in a `\section{#1}` command will output e^2.

Problem: I am getting error messages on the lines of my `\section{#1}`, `\subsection{#1}`, `\subsubsection{#1}`, or `\caption{#1}` commands, and I can't understand why! You may have a so-called "fragile" command in a section heading or caption. This is solved in LATEX by immediately preceding the fragile command with `\protect`. Some common fragile commands include:

```
\cite{#1}
\onlinecite{#1}
\ref{#1}
\sqrt{#1}
\openone
\lesssim
\gtrsim
\\
\newline
\bbox{#1}
```

So, if you have one of these commands, or another fragile command (check Lamport's book), just precede them with `\protect` and try running the file again. For example, if you have

```
\section{The next result: $\sqrt{-1}$}
```

just change it to

```
\section{The next result: $\protect\sqrt{-1}$}
```

Problem: I have tables that do not fit into the preprint width. Try putting the `\squeezetable` command right after the `\begin{table}` command. This will reduce the size of the type in the body of the table, thus allowing more data to fit.

Problem: TEX (or my device driver) runs out of font space. Try removing the `amsfonts` and `amssymb` style options. TEX implementations vary, and some implementations will be unable to provide the resources needed to run these options.

Problem: TEX runs out of string space (`pool_size` is too small). Remove the `amssymb` style option. It defines hundreds of symbol names. Some TEX implementations will be unable to provide the resources needed to run this option.

Problem: (a) The text immediately following an equation is "outdented". That is, indented into the margin. (b) I get a `missing }` error in the references, but the input is OK. If I let TEX run through, the output is OK, too. REVTEX is having a bad interaction with an older version of LATEX. Upgrading to a newer LATEX has cured these problems in the past.

Problem: One of my equations (or more) is not being cross-referenced correctly. Make sure that you have run LATEX at least twice since the equation numbering was last disturbed by an input change. Also note that incorrect cross-referencing will result if `\label{#1}` is used in an unnumbered single line equation (i.e., within the `\[` and `\]` commands), or if `\label{#1}` is used on a line of an eqnarray that is not being numbered (i.e., a line that has a `\nonumber`).

Problem: I get a LATEX message at the end of the run that tells me that the references may have changed, no matter how many times I run LATEX. Make sure that you have not used the same tag to label two different things. This will produce this effect, but will also produce a warning during the run and is therefore easy to detect. Also make sure that you have not used the same tag for two different bibitems. That is, make sure that two different `\bibitem{#1}` commands do not use the same text for `#1`. You will probably *not* get a warning for this, so this a more subtle error.

XII. CONTACTS; RESOURCES

REVTEX questions/technical support[a]

REVTEX Support, `mis@aps.org`

Electronic mail submissions (manuscripts, PostScript figures)

Physical Review A,B,C,D,E: `prXtex@aps.org` [b]
Physical Review Letters: `prltex@aps.org` [b]
Where X is a,b,c,d or e
Reviews of Modern Physics: `rmptex@aps.org` [c]

Manuscript status queries[b]

Physical Review A,B,C,D,E: `prX@aps.org` [b]
Physical Review Letters: `prl@aps.org` [b]
Where X is a,b,c,d or e
Reviews of Modern Physics: `rmp@phys.washington.edu` [c]

Electronic Authors Status Inquiry System [b]

Physical Review and *Letters*:
`http://publish.aps.org/STATUS/status.html`

Compuscript questions[a]

REVTEX Support

REVTEX project development questions[a]

REVTeX Support

REVTEX update list[a]

REVTEX Support, `mis@aps.org`

APS Journals home page

(links to *Physical Review, Letters,* and *Reviews of Modern Physics*
`http://publish.aps.org/`

APS ftp archives (`ftp://aps.org/pub/`

REVTEX toolbox: `ftp://aps.org/revtex`
Auxiliary files: (in directory /pub/jrnls/):
Physical Review Style and Notation Guide
(also for PRL)- `style_guide.ps (.tex)`
Reviews of Modern Physics Style Guide-
`rmp_style_guide.ps (.tex)`
PR Electronic-Submission Compuscript Program-
`compu_inform_pr.asc (.tex, .ps)`
PRL Electronic-Submission Compuscript Program-
`compu_inform_prl.asc (.tex, .ps)`
Electronic Submissions Checklist -
`elec_sub.asc (.tex, .ps)`
Information for Contributors-
`info_con_prX.ps`
(where X is a, b, c, d, e, or l)

[a]REVTEX Support, The American Physical Society, 1 Research Rd. Box 9000, Ridge, NY 11961-9000 [FAX: (516)591-4141; Phone: (516)591-4000].
[b]Editorial Offices, The American Physical Society 1 Research Road, Box 9000, Ridge, NY 11961-9000 .
[c]Reviews of Modern Physics, Department of Physics, University of Washington, Box 351560, Seattle, WA 98195-1560 [FAX: (206)685-2391].

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