REVTeX 4 Author's Guide

American Physical Society*
1 Research Road, Ridge, NY 11961
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Contents

1. INTRODUCTION

This is the author's guide to REVTeX 4, the preferred submission format for all APS journals. This guide is intended to be a concise introduction to REVTeX 4. The documentation has been separated out into smaller units to make it easier to locate essential information.

The following documentation is also part of the APS REVTeX 4 distribution. Updated versions of these will be maintained at the REVTeX 4 homepage located at `http://publish.aps.org/revtex4/`.

- *APS Compuscript Guide for REVTeX 4*
- *REVTeX 4 Command and Options Summary*
- *REVTeX 4 BibTeX Guide*
- *Differences between REVTeX 4 and REVTeX 3*

*Electronic address: `revtex@aps.org`

This guide assumes a working REVTeX 4 installation. Please see the installation guide included with the distribution.

The REVTeX system for LaTeX began its development in 1986 and has gone through three major revisions since then. All versions prior to REVTeX 4 were based on LaTeX2.09 and, until now, REVTeX did not keep pace with the advances of the LaTeX community and thus became inconvenient to work with. REVTeX 4 is designed to remedy this by incorporating the following design goals:

- Make REVTeX fully compatible with LaTeX 2_ε; it is now a LaTeX 2_ε document class, similar in function to the standard `article` class.
- Rely on standard LaTeX 2_ε packages for common tasks, e.g, `graphicx`, `color`, and `hyperref`.
- Add or improve macros to support translation to tagged formats such as XML and SGML. This added markup will be key to enhancing the peer-review process and lowering production costs.
- Provide a closer approximation to the typesetting style used in *Physical Review*.
- Incorporate new features, such as hypertext, to make REVTeX a convenient and desirable e-print format.
- Relax the restrictions in REVTeX that had only been necessary for typesetting journal camera-ready copy.

To meet these goals, REVTeX 4 is a complete rewrite with an emphasis on maintainability so that it will be easier to provide enhancements.

The REVTeX 4 distribution includes both a template (`template.aps`) and a sample document (`apssamp.tex`). The template is a good starting point for a manuscript. In the following sections are instructions that should be sufficient for creating a paper using REVTeX 4.

1.1. Submitting to APS Journals

Authors using REVTeX 4 to prepare a manuscript for submission to *Physical Review* or *Reviews of Modern Physics* must also read the companion document *APS Compuscript Guide for REVTeX 4* distributed with REVTeX and follow the guidelines detailed there.

Further information about the compuscript program of the American Physical Society may be found at `http://publish.aps.org/ESUB/`.

1.2. Contact Information

Any bugs, problems, or inconsistencies should reported to REVTeX support at `revtex@aps.org`. Reports should include information on the error and a *small* sample document that manifests the problem if possible (please don't send large files!).

2. SOME LaTeX 2_ε BASICS

A primary design goal of REVTeX 4 was to make it as compatible with standard LaTeX 2_ε as possible so that authors may take advantage of all that LaTeX 2_ε offers. In keeping with this goal, much of the special formatting that was built in to earlier versions of REVTeX is now accomplished through standard LaTeX 2_ε macros or packages. The books in the bibliography provide extensive coverage of all topics pertaining to preparing documents under LaTeX 2_ε. They are highly recommended.

To accomplish its goals, REVTeX 4 must sometimes patch the underlying LaTeX kernel. This means that REVTeX 4 requires a fairly recent version of LaTeX 2_ε. Versions prior to 1996/12/01 may not work correctly. REVTeX 4 will be maintained to be compatible with future versions of LaTeX 2_ε.

2.1. Useful LaTeX 2_ε Markup

LaTeX 2_ε markup is the preferred way to accomplish many basic tasks.

Fonts

Because REVTeX 4 is based upon LaTeX 2_ε, it inherits all of the macros used for controlling fonts. Of particular importance are the LaTeX 2_ε macros `\textit`, `\textbf`, `\texttt` for changing to an italic, bold, or typewriter font respectively. One should always use these macros rather than the lower-level TeX macros `\it`, `\bf`, and `\tt`. The LaTeX 2_ε macros offer improvements such as better italic correction and scaling in super- and subscripts for example. Table I summarizes the font selection commands in LaTeX 2_ε.

User-defined macros

LaTeX 2_ε provides several macros that enable users to easily create new macros for use in their manuscripts:

- `\newcommand{`⟨*command*⟩`}[`⟨*narg*⟩`][`⟨*opt*⟩`]{`⟨*def*⟩`}`
- `\newcommand*{`⟨*command*⟩`}[`⟨*narg*⟩`][`⟨*opt*⟩`]{`⟨*def*⟩`}`
- `\renewcommand{`⟨*command*⟩`}[`⟨*narg*⟩`][`⟨*opt*⟩`]{`⟨*def*⟩`}`
- `\renewcommand*{`⟨*command*⟩`}[`⟨*narg*⟩`][`⟨*opt*⟩`]{`⟨*def*⟩`}`
- `\providecommand{`⟨*command*⟩`}[`⟨*narg*⟩`][`⟨*opt*⟩`]{`⟨*def*⟩`}`
- `\providecommand*{`⟨*command*⟩`}[`⟨*narg*⟩`][`⟨*opt*⟩`]{`⟨*def*⟩`}`

TABLE I: LaTeX 2ε font commands

Font command	Explanation
Text Fonts	
`\textit{⟨text⟩}`	Italics
`\textbf{⟨text⟩}`	Boldface
`\texttt{⟨text⟩}`	Typewriter
`\textrm{⟨text⟩}`	Roman
`\textsl{⟨text⟩}`	Slanted
`\textsf{⟨text⟩}`	Sans Serif
`\textsc{⟨text⟩}`	Small Caps
`\textmd{⟨text⟩}`	Medium Series
`\textnormal{⟨text⟩}`	Normal Series
`\textup{⟨text⟩}`	Upright Series
Math Fonts	
`\mathit{⟨text⟩}`	Math Italics
`\mathbf{⟨text⟩}`	Math Boldface
`\mathtt{⟨text⟩}`	Math Typewriter
`\mathsf{⟨text⟩}`	Math Sans Serif
`\mathcal{⟨text⟩}`	Calligraphic
`\mathnormal{⟨text⟩}`	Math Normal
`\bm{⟨text⟩}`	Bold math for Greek letters and other symbols
`\mathfrak{⟨text⟩}`[a]	Fraktur
`\mathbb{⟨text⟩}`[a]	Blackboard Bold

[a]Requires `amsfonts` or `amssymb` class option

Here ⟨*command*⟩ is the name of the macro being defined, ⟨*narg*⟩ is the number of arguments the macro takes, ⟨*opt*⟩ are optional default values for the arguments, and ⟨*def*⟩ is the actually macro definiton. `\newcommand` creates a new macro, `\renewcommand` redefines a previously defined macro, and `\providecommand` will define a macro only if it hasn't been defined previously. The *-ed versions are an optimization that indicates that the macro arguments will always be "short" arguments. This is almost always the case, so the *-ed versions should be used whenver possible.

The use of these macros is preferred over using plain TeX's low-level macros such as `\def`,`\edef`, and `\gdef`. APS authors must follow the *APS Compuscript Guide for REVTeX 4* when defining macros.

Symbols

LaTeX 2ε has added some convenient commands for some special symbols and effects. These are summarized in Table II. See [3] for details.

LaTeX 2ε also removed some symbols that were previously automatically available in LaTeX2.09. These symbols are now contained in a separate package `latexsym`.

TABLE II: LaTeX 2ε commands for special symbols and effects

Command	Symbol/Effect
`\textemdash`	—
`\textendash`	–
`\textexclamdown`	¡
`\textquestiondown`	¿
`\textquotedblleft`	“
`\textquotedblright`	”
`\textquoteleft`	‘
`\textquoteright`	’
`\textbullet`	•
`\textperiodcentered`	·
`\textvisiblespace`	␣
`\textcompworkmark`	Break a ligature
`\textcircled{⟨char⟩}`	Circle a character

To use these symbols, include the package using:

```
\usepackage{latexsym}
```

2.2. Using LaTeX 2ε packages with REVTeX

Many LaTeX 2ε packages are available, for instance, on CTAN at `ftp://ctan.tug.org/tex-archive/macros/latex/required/` and at `ftp://ctan.tug.org/tex-archive/macros/latex/contrib/` or may be available on other distribution media, such as the TeX Live CD-ROM `http://www.tug.org/texlive/`. Some of these packages are automatically loaded by REVTeX 4 when certain class options are invoked and are, thus, "required". They will either be distributed with REVTeX or are already included with a standard LaTeX 2ε distribution.

Required packages are automatically loaded by REVTeX on an as-needed basis. Other packages should be loaded using the `\usepackage` command. To load the `hyperref` package, the document preamble might look like:

```
\documentclass{revtex}
\usepackage{hyperref}
```

Some common (and very useful) LaTeX 2ε packages are *a priori* important enough that REVTeX 4 has been designed to be specifically compatible with them. A bug stemming from the use of one of these packages in conjunction with any of the APS journals may be reported by contacting REVTeX support.

AMS packages REVTeX 4 is compatible with and depends upon the AMS packages `amsfonts`, `amssymb`, and `amsmath`. In fact, REVTeX 4 requires use of these packages to accomplish some common tasks. See Section 6 for more. REVTEX 4 requires version 2.0 or higher of the AMS-LATEX package.

array and dcolumn The `array` and `dcolumn` packages are part of LATEX's required suite of packages. `dcolumn` is required to align table columns on decimal points (and it in turn depends upon the `array` package).

longtable `longtable.sty` may be used for large tables that will span more than one page. REVTEX 4 dynamically applies patches to longtable.sty so that it will work in two-column mode.

hyperref `hyperref.sty` is a package by Sebastian Rahtz that is used for putting hypertext links into LATEX 2ε documents. REVTEX 4 has hooks to allow e-mail addresses and URL's to become hyperlinks if `hyperref` is loaded.

Other packages will conflict with REVTEX 4 and should be avoided. Usually such a conflict arises because the package adds enhancements that REVTEX 4 already includes. Here are some common packages that clash with REVTEX 4:

multicol `multicol.sty` is a package by Frank Mittelbach that adds support for multiple columns. In fact, early versions of REVTEX 4 used `multicol.sty` for precisely this. However, to improve the handling of floats, REVTEX 4 now has its own macros for two-column layout. Thus, it is not necessary to use `multicol.sty`.

cite Donald Arseneau's `cite.sty` is often used to provide support for sorting a `\cite` command's arguments into numerical order and to collapse consecutive runs of reference numbers. REVTEX 4 has this functionality built-in already via the `natbib` package.

endfloat The same functionality can be accomplished using the `endfloats` class option.

float REVTEX 4 already contains a lot of this functionality.

3. THE DOCUMENT PREAMBLE

The preamble of a LATEX document is the set of commands that precede the `\begin{document}` line. It contains a `\documentclass` line to load the REVTEX 4 class (*i. e.*, all of the REVTEX 4 macro definitions), `\usepackage` macros to load other macro packages, and other macro definitions.

3.1. The *documentclass* line

The basic formatting of the manuscript is controlled by setting *class options* using `\documentclass[`⟨*options*⟩`]{revtex4}`. The macro `\documentclass` replaces the `\documentstyle` macro of LATEX2.09. The optional arguments that appear in the square brackets control the layout of the document. At this point, one only needs to choose a journal style (`pra`, `prb`, `prc`, `prd`, `pre`, `prl`, `prstab`, and `rmp`) and either `preprint` or `twocolumn`. Usually, one would want to use `preprint` for draft papers. `twocolumn` gives the *Physical Review* look and feel. Paper size options are also available as well. In particular, `a4paper` is available as well as the rest of the standard LATEX paper sizes. A full list of class options is given in the *REVTEX 4 Command and Options Summary*.

3.2. Loading other packages

Other packages may be loaded into a REVTEX 4 document by using the standard LATEX 2ε `\usepackage` command. For instance, to load the `graphics` package, one would use `\usepackage{graphics}`.

4. THE FRONT MATTER

After choosing the basic look and feel of the document by selecting the appropriate class options and loading in whatever other macros are needed, one is ready to move on to creating a new manuscript. After the preamble, be sure to put in a `\begin{document}` line (and put in an `\end{document}` as well). This section describes the macros REVTEX 4 provides for formatting the front matter of the article. The behavior and usage of these macros can be quite different from those provided in either REVTEX 3 or LATEX 2ε. See the included document *Differences between REVTEX 4 and REVTEX 3* for an overview of these differences.

4.1. Setting the title

The title of the manuscript is simply specified by using the `\title{title}` macro. A `\\` may be used to put a line break in a long title.

4.2. Specifying a date

The `\date{`⟨*date*⟩`}` command outputs the date on the manuscript. Using `\today` will cause LATEX to insert the current date whenever the file is run:

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

4.3. Specifying authors and affiliations

The macros for specifying authors and their affiliations have changed significantly for REVTEX 4. They have been improved to save labor for authors and in production. Authors and affiliations are arranged into groupings called, appropriately enough, *author groups*. Each author group is a set of authors who share the same set of affiliations. Author names are specified with the `\author` macro while affiliations (or addresses) are specified with the `\affiliation` macro. Author groups are specified by sequences of `\author` macros followed by `\affiliation` macros. An `\affiliation` macro applies to all previously specified `\author` macros which don't already have an affiliation supplied.

For example, if Bugs Bunny and Roger Rabbit are both at Looney Tune Studios, while Mickey Mouse is at Disney World, the markup would be:

```
\author{Bugs Bunny}
\author{Roger Rabbit}
\affiliation{Looney Tune Studios}
\author{Mickey Mouse}
\affiliation{Disney World}
```

The default is to display this as

Bugs Bunny and Roger Rabbit
Looney Tune Studios
Mickey Mouse
Disney World

This layout style for displaying authors and their affiliations is chosen by selecting the class option `groupedaddress`. This option is the default for all APS journal styles, so it does not need to be specified explicitly. The other major way of displaying this information is to use superscripts on the authors and affiliations. This can be accomplished by selecting the class option `superscriptaddress`. To achieve the display

Bugs Bunny,[1] Roger Rabbit,[1,2] and Mickey Mouse[2]
[1]*Looney Tune Studios*
[2]*Disney World*

one would use the markup

```
\author{Bugs Bunny}
\affiliation{Looney Tune Studios}
\author{Roger Rabbit}
\affiliation{Looney Tune Studios}
\affiliation{Disney World}
\author{Mickey Mouse}
\affiliation{Disney World}
```

Note that REVTEX 4 takes care of any commas and *and*'s that join the author names together and font selection, as well as any superscript numbering. Only the author names and affiliations should be given within their respective macros.

There is a third class option, `unsortedaddress`, for controlling author/affiliation display. The default `groupedaddress` will actually sort authors into the approriate author groups if one chooses to specify an affiliation for each author. The markup:

```
\author{Bugs Bunny}
\affiliation{Looney Tune Studios}
\author{Mickey Mouse}
\affiliation{Disney World}
\author{Roger Rabbit}
\affiliation{Looney Tune Studios}
```

will result in the same display as for the first case given above even though Roger Rabbit is specified after Mickey Mouse. To avoid Roger Rabbit being moved into the same author group as Bugs Bunny, use the `unsortedaddress` option instead. In general, it is safest to list authors in the order they should appear and specify affiliations for multiple authors rather than one at a time. This will afford the most independence for choosing the display option. Finally, it should be mentioned that the affiliations for the `superscriptaddress` are presented and numbered in the order that they are encountered. These means that the order will usually follow the order of the authors. An alternative ordering can be forced by including a list of `\affiliation` commands before the first `\author` in the desired order. Then use the exact same text for each affilation when specifying them for each author.

If an author doesn't have an affiliation, the `\noaffiliation` macro may be used in the place of an `\affiliation` macro.

Collaborations

A collaboration name can be specified with the `\collaboration` macro. This is very similar to the `\author` macro, but it can only be used with the class option `superscriptaddress`. The `\collaboration` macro should appear at the end of the list of authors. The collaboration name will be appear centered in parentheses between the list of authors and the list of affiliations. Because collaborations don't normally have affiliations, one needs to follow the `\collaboration` with `\noaffiliation`.

Footnotes for authors, collaborations, affiliations or title

Often one wants to specify additional information associated with an author, collaboration, or affiliation such an e-mail address, an alternate affiliation, or some other ancillary information. REVTEX 4 introduces several new macros just for this purpose. They are:

- `\email[`⟨*optional text*⟩`]{`e-mail address`}`

- `\homepage[`⟨*optional text*⟩`]{`URL`}`
- `\altaffiliation[`⟨*optional text*⟩`]{`affiliation`}`
- `\thanks{`miscellaneous text`}`

In the first three, the *optional text* will be prepended before the actual information specified in the required argument. `\email` and `\homepage` each have a default text for their optional arguments ('Electronic address:' and 'URL:' respectively). The `\thanks` macro should only be used if one of the other three do not apply. Any author name can have multiple occurences of these four macros. Note that unlike the `\affiliation` macro, these macros only apply to the `\author` that directly precedes it. Any `\affiliation` *must* follow the other author-specific macros. A typical usage might be as follows:

```
\author{Bugs Bunny}
\email[E-mail me at: ]{bugs@looney.com}
\homepage[Visit: ]{http://looney.com/}
\altaffiliation[Permanent address: ]
                          {Warner Brothers}
\affiliation{Looney Tunes}
```

This would result in the footnote "E-mail me at: `bugs@looney.com`, Visit: `http://looney.com/`, Permanent address: Warner Brothers" being attached to Bugs Bunny. Note that:

- Only an e-mail address, URL, or affiliation should go in the required argument in the curly braces.
- The font is automatically taken care of.
- An explicit space is needed at the end of the optional text if one is desired in the output.
- Use the optional arguments to provide customized text only if there is a good reason to.

The `\collaboration`, `\affiliation`, or even `\title` can also have footnotes attached via these commands. If any ancillary data (`\thanks`, `\email`, `\homepage`, or `\altaffiliation`) are given in the wrong context (e.g., before any `\title`, `\author`, `\collaboration`, or `\affiliation` command has been given), then a warning is given in the TEX log, and the command is ignored.

Duplicate sets of ancillary data are merged, giving rise to a single shared footnote. However, this only applies if the ancillary data are identical: even the order of the commands specifying the data must be identical. Thus, for example, two authors can share a single footnote indicating a group e-mail address.

Duplicate `\affiliation` commands may be given in the course of the front matter, without the danger of producing extraneous affiliations on the title page. However, ancillary data should be specified for only the first instance of any particular institution's `\affiliation` command; a later instance with different ancillary data will result in a warning in the TEX log.

It is preferable to arrange authors into sets. Within each set all the authors share the same group of affiliations. For each author, give the `\author` (and appropriate ancillary data), then follow this author group with the needed group of `\affiliation` commands.

If affiliations have been listed before the first `\author` macro to ensure a particular ordering, be sure that any later `\affiliation` command for the given institution is an exact copy of the first, and also ensure that no ancillary data is given in these later instances.

Each APS journal has a default behavior for the placement of these ancillary information footnotes. The `prb` option puts all such footnotes at the start of the bibliography while the other journal styles display them on the first page. One can override a journal style's default behavior by specifying explicitly the class option `bibnotes` (puts the footnotes at the start of the bibliography) or `nobibnotes` (puts them on the first page).

Specifying first names and surnames

Many APS authors have names in which either the surname appears first or in which the surname is made up of more than one name. To ensure that such names are accurately captured for indexing and other purposes, the `\surname` macro should be used to indicate which portion of a name is the surname. Similarly, there is a `\firstname` macro as well, although usage of `\surname` should be sufficient. If an author's surname is a single name and written last, it is not necessary to use these macros. These macros do nothing but indicate how a name should be indexed. Here are some examples;

```
\author{Andrew \surname{Lloyd Weber}}
\author{\surname{Mao} Tse-Tung}
```

4.4. The abstract

An abstract for a paper is specified by using the `abstract` environment:

```
\begin{abstract}
Text of abstract
\end{abstract}
```

Note that in REVTEX 4 the abstract must be specified before the `\maketitle` command and there is no need to embed it in an explicit minipage environment.

4.5. PACS codes

APS authors are asked to supply suggested PACS codes with their submissions. The `\pacs` macro is provided as a way to do this:

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

The actual display of the PACS numbers below the abstract is controlled by two class options: `showpacs` and `noshowpacs`. In particular, this is now independent of the `preprint` option. `showpacs` must be explicitly included in the class options to display the PACS codes.

4.6. Keywords

A `\keywords` macro may also be used to indicate keywords for the article.

```
\keywords{nuclear form; yrast level}
```

This will be displayed below the abstract and PACS (if supplied). Like PACS codes, the actual display of the the keywords is controlled by two classoptions: `showkeys` and `noshowkeys`. An explicit `showkeys` must be included in the `\documentclass` line to display the keywords.

4.7. Institutional report numbers

Institutional report numbers can be specified using the `\preprint` macro. These will be displayed in the upper lefthand corner of the first page. Multiple `\preprint` macros maybe supplied (space is limited though, so only three or less may actually fit).

4.8. maketitle

After specifying the title, authors, affiliations, abstract, PACS codes, and report numbers, the final step for formatting the front matter of the manuscript is to execute the `\maketitle` macro by simply including it:

```
\maketitle
```

The `\maketitle` macro must follow all of the macros listed above. The macro will format the front matter in accordance with the various class options that were specified in the `\documentclass` line (either implicitly through defaults or explicitly).

5. THE BODY OF THE PAPER

For typesetting the body of a paper, REVTeX 4 relies heavily on standard LaTeX 2_ε and other packages (particulary those that are part of AMS-LaTeX). Users unfamiliar with these packages should read the following sections carefully.

5.1. Section headings

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

Four levels of headings are available in REVTeX:

```
\section{⟨title text⟩}
\subsection{⟨title text⟩}
\subsubsection{⟨title text⟩}
\paragraph{⟨title text⟩}
```

Use the starred form of the command to suppress the automatic numbering; e.g.,

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

To label a section heading for cross referencing, best practice is to place the `\label{`⟨*key*⟩`}` within the argument specifying the heading:

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

In the some journal substyles, such as those of the APS, all text in the `\section` command is automatically set uppercase. If a lowercase letter is needed, use `\lowercase{x}`. For example, to use "He" for helium in a `\section{`⟨*title text*⟩`}` command, type `H\lowercase{e}` in `{`⟨*title text*⟩`}`.

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

5.2. Paragraphs and General Text

Paragraphs always end with a blank input line. Because TeX automatically calculates linebreaks and word hyphenation in a paragraph, it is not necessary to force linebreaks or hyphenation. Of course, compound words should still be explicitly hyphenated, e.g., "author-prepared copy."

Use directional quotes for quotation marks around quoted text (` ``xxx'' `), not straight double quotes (`"xxx"`). For opening quotes, use one or two backquotes; for closing quotes, use one or two forward quotes (apostrophes).

5.3. One-column vs. two-column

One of the hallmarks of *Physical Review* is its two-column formatting and so one of the REVTeX 4 design goals is to make it easier to acheive the *Physical Review* look and feel. In particular, the `twocolumn` option will take care of formatting the front matter (including the abstract) as a single column. REVTeX 4 has its own built-in two-column formatting macros to provide well-balanced columns as well as reasonable control over the placement of floats in either one- or two-column modes.

Occasionally it is necessary to change the formatting from two-column to one-column to better accomodate very long equations that are more easily read when typeset to the full width of the page. This is accomplished using the `widetext` environment:

```
\begin{widetext}
long equation goes here
\end{widetext}
```

In two-column mode, this will temporarily return to one-column mode, balancing the text before the environment into two short columns, and returning to two-column mode after the environment has finished. REVTEX 4 will also add horizontal rules to guide the reader's eye through what may otherwise be a confusing break in the flow of text. The `widetext` environment has no effect on the output under the `preprint` class option because this already uses one-column formatting.

Use of the `widetext` environment should be restricted to the bare minimum of text that needs to be typeset this way. However short pieces of paragraph text and/or math between nearly contiguous wide equations should be incorporated into the surrounding wide sections.

Low-level control over the column grid can be accomplished with the `\onecolumngrid` and `\twocolumngrid` commands. Using these, one can avoid the horizontal rules added by `widetext`. These commands should only be used if absolutely necessary. Wide figures and tables should be accomodated using the proper `*` environments.

5.4. Cross-referencing

REVTEX inherits the LATEX 2_ε features for labeling and cross-referencing section headings, equations, tables, and figures. This section contains a simplified explanation of these cross-referencing features. The proper usage in the context of section headings, equations, tables, and figures is discussed in the appropriate sections.

Cross-referencing depends upon the use of "tags," which are defined by the user. The `\label{`⟨*key*⟩`}` command is used to identify tags for REVTEX. Tags are strings of characters that serve to label section headings, equations, tables, and figures that replace explicit, by-hand numbering.

Files that use cross-referencing (and almost all manuscripts do) need to be processed through REVTEX at least twice to ensure that the tags have been properly linked to appropriate numbers. If any tags are added in subsequent editing sessions, LATEX will display a warning message in the log file that ends with `... Rerun to get cross-references right`. Running the file through REVTEX again (possibly more than once) will resolve the cross-references. If the error message persists, check the labels; the same `{`⟨*key*⟩`}` may have been used to label more than one object.

Another LATEX warning is `There were undefined references`, which indicates the use of a key in a `\ref` without ever using it in a `\label` statement.

REVTEX performs autonumbering exactly as in standard LATEX. When the file is processed for the first time, LATEX creates an auxiliary file (with the `.aux` extension) that records the value of each ⟨*key*⟩. Each subsequent run retrieves the proper number from the auxiliary file and updates the auxiliary file. At the end of each run, any change in the value of a ⟨*key*⟩ produces a LATEX warning message.

Note that with footnotes appearing in the bibliography, extra passes of LATEX may be needed to resolve all cross-references. For instance, putting a `\cite` inside a `\footnote` will require at least three passes.

Using the `hyperref` package to create hyperlinked PDF files will cause reference ranges to be expanded to list every reference in the range. This behavior can be avoided by using the `hypernat` package available from `www.ctan.org`.

5.5. Acknowledgments

Use the `acknowledgments` environment for an acknowledgments section. Depending on the journal substyle, this element may be formatted as an unnumbered section title *Acknowledgments* or simply as a paragraph. Please note the spelling of "acknowledgments".

```
\begin{acknowlegments}
The authors would like to thank...
\end{acknowlegments}
```

5.6. Appendices

The `\appendix` command signals that all following sections are appendices, so `\section{`⟨*title text*⟩`}` after `\appendix` will set `{`⟨*title text*⟩`}` as an appendix heading (an empty `{`⟨*title text*⟩`}` is permitted). For a single appendix, use a `\appendix*` followed by `\section{`⟨*title text*⟩`}` command to suppress the appendix letter in the section heading.

6. MATH AND EQUATIONS

6.1. Math in text

Not surprisingly, REVTEX uses the TEX math `$` delimiters for math embedded in text. For example, `$a^{z}$`

give a^z. Within math mode, use `^{`⟨*math*⟩`}` for superscripts and `_{`⟨*math*⟩`}` for subscripts. If the braces after the `^` are omitted, TEX will superscript the next *token* (generally a single character or command). Thus it is safest to use explicit braces `{}`.

As with text, math should not require extensive explicit vertical or horzontal motion commands, because TEX calculates math spacing itself automatically. In particular, explicit spacing around relations (e.g., $=$) or operators (e.g., $+$) should be unnecessary. These suggestions notwithstanding, some fine-tuning of math is required in specific cases, see Chapter 18 in the TEXbook[1].

6.2. Text in math

There are times when normal, non-italic text needs to be inserted into a math expression. The `\text{`⟨*text*⟩`}` command is the preferred method of accomplishing this. It produces regular text *and* scales correctly in superscripts: `$y=x \text{ for } x_{\text{e-p}}$` gives "$y = x \text{ for } x_{\text{e-p}}$". To use the `\text` command, the `amsmath` package must be loaded: include a `\usepackage{amsmath}` command in the document preamble or use the class option `amsmath`. Please note that REVTEX 4 requires version 2.0 or higher of `amsmath`.

Other common alternatives may be less desirable. Using the standard LATEX 2ε `\mbox{`⟨*text*⟩`}` will give normal text, including a hyphen, but will not scale correctly in superscripts: `$x_{\mbox{e-p}}$` gives "$x_{\mbox{e-p}}$". The `\rm` command only switches to Roman font for math letters. It does not, for example, handle hyphens correctly: `$$x_{\rm{e-p}}$` gives "$x_{\rm{e-p}}$". But note that `\textrm`, it does work: `$x_{\textrm{e-p}}$` gives "$x_{\textrm{e-p}}$".

6.3. Displayed equations

Equations are set centered in the column width or flush left depending on the selected journal substyle.

For the simplest type of displayed equation, a numbered, one-line equation, use the `equation` environment. REVTEX takes care of the equation number—the number will be set below the equation if necessary. Use `\[`...`\]` for a single, one-line unnumbered display equation.

Use the `eqnarray` environment when more than one consecutive equation occurs, putting each equation in a separate row of the environment, and using `\nonumber` before the row end (`\\`) to suppress the equation number where necessary. If the equations are related to each other, align each on the respective relation operator (such as $=$).

When an equation is broken over lines or is continued over multiple relation operators, it is called a multi-line or continued equation, respectively; here, too, use the `eqnarray` environment.

For a continued equation, align each row on the relation operator just as with multiple equations, and use the `\nonumber` command to suppress auto-numbering on broken lines. Also, use the starred form of the row end (`\\*`) to prevent a pagebreak at that juncture.

Short displayed equations that can appear together on a single line separated by `\qquad` space may be placed in a single `equation` environment.

As explained in Section 5.3, occasionally in two-column mode a long equation, in order to fit it in the narrow column width, would need to be broken into so many lines that it would affect readibility. Set it in a wide column using the `widetext` environment. Then return to the normal text width as soon as possible.

The sample file `apssamp.tex` illustrates how to obtain each of the above effects.

6.4. Numbering displayed equations

REVTEX 4 automatically numbers equations. For single-line and multi-line equations, use the `equation` and `eqnarray` environments as described above. For unnumbered single-line equations, use the `\[`...`\]` construction. The command `\nonumber` will suppress the numbering on a single line of an `eqnarray`. For a multi-line equation with no equation numbers at all, use the `eqnarray*` environment.

A series of equations can be a labeled with a lettered sequence, e.g., (3a), (3b), and (3c), by putting the respective `equation` or `eqnarray` environment within a `subequations` environment. The `amsmath` package (can be loaded with the `amsmath` class option) is required for this.

Use the command `\tag{`⟨*number*⟩`}` to produce an idiosyncratic equation number: (1′), for example. Numbers assigned by `\tag` are completely independent of REVTEX's automatic numbering. The package `amsmath` is required for using the `\tag` command.

To have REVTEX reset the equation numbers at the start of each section, use the `eqsecnum` class option in the document preamble.

See the sample file `apssamp.tex` for some examples.

6.5. Cross-referencing displayed equations

To refer to a numbered equation, use the `\label{`⟨*key*⟩`}` and `\ref{`⟨*key*⟩`}` commands. The `\label{`⟨*key*⟩`}` command is used within the referenced equation (on the desired line of the `eqnarray`, if a multi-line equation):

```
\begin{equation}
```

```
 A=B \label{pauli}
\end{equation}
 ... It follows from Eq.~(\ref{pauli})
that this is the case ...
\begin{eqnarray}
 A & = &B,\label{pauli2}\\
 A'& = &B'
\end{eqnarray}
```

gives

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

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

$$\begin{aligned} A &= B, \quad (2)\\ A' &= B' \quad (3)\end{aligned}$$

Please note the parentheses surrounding the `\ref` command. These are *not* provided automatically and, thus, must be explicitly incorporated.

Numbers produced with `\tag` can also be cross-referenced by adding a `\label` command after the `\tag` command.

Using a `\label` after `\begin{subequations}` to reference the *general* number of the equations in the `subequations` environment. For example, if

```
\begin{subequations}
 \label{allequations} % notice location
 \begin{eqnarray}
  E&=&mc^2,\label{equationa}
 \\
  E&=&mc^2,\label{equationb}
 \\
  E&=&mc^2,\label{equationc}
 \end{eqnarray}
\end{subequations}
```

gives the output

$$\begin{aligned} E &= mc^2, \quad (4a)\\ E &= mc^2, \quad (4b)\\ E &= mc^2, \quad (4c)\end{aligned}$$

then `Eq.~(\ref{allequations})` gives "Eq. (4)".

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

6.6. Using the AMS packages amsfonts, amssymb, and amsmath

The American Mathematical Society's AMS-LaTeX packages provided extra fonts, symbols, and math markup that are quite convenient. REVTeX 4 supports the use of these packages directly. To use the `amsfonts`, `amssymb`, and `amsmath` class options, AMS-LaTeX (and perhaps the additional AMS fonts) will need to be installed. Please note the REVTeX 4 requires version 2.0 or higher of AMS-LaTeX. These packages can be downloaded from `http://www.ams.org/tex/`.

There are two class options for accessing the AMS fonts: `amsfonts` and `amssymb`. The `amsfonts` option defines the `\mathfrak` and `\mathbb` commands to switch to the Fraktur and Blackboard Bold fonts, respectively. These fonts are selected with the `\mathfrak` and `\mathbb` font-switching commands: `${\mathfrak{G}}$` gives a Fraktur "$\mathfrak{G}$" and `${\mathbb{Z}}$` gives a Blackboard Bold "$\mathbb{Z}$". REVTeX does not currently support the use of the extra Euler fonts (the AMS fonts starting with `eur` or `eus`) or the Cyrillic fonts (the AMS fonts starting with `w`).

The `amssymb` class option gives all the font capabilities of the `amsfonts` class option and further defines the commands for many commonly used math symbols. These symbols will scale correctly in superscripts and other places. See the AMS-LaTeX documentation for the complete list of symbols available.

6.7. Bold symbols in math

REVTeX 4 uses the standard LaTeX 2ε Bold Math (`bm`) package as the basis for creating bold symbols in math mode. As usual, this requires an explicit `\usepackage{bm}` in the document preamble. The command `\bm{`⟨*symbol*⟩`}` makes `{`⟨*symbol*⟩`}` bold in math mode, ensuring that it is the correct size, even in superscripts. If the correct font in the correct size is not available then result is the `{`⟨*symbol*⟩`}` set at the correct size in lightface and a LaTeX 2ε warning that says "`No boldmath typeface in this size`...". Most bold special characters will require that the AMS fonts be installed and the `amsfonts` class option be invoked.

`\bm` is the proper means to get bold Greek characters—upper- and lowercase—and other symbols. The following will come out bold with `\bm`: normal math italic letters, numbers, Greek letters (uppercase and lowercase), small bracketing and operators, and `\mathcal`. Fraktur characters will come out bold in a `\bm`; however, Blackboard Bold requires using the `\mathbb`command rather than `\bm`. The `amsfonts` option adds support for bold math letters and symbols in smaller sizes and in superscripts when a `\bm{`⟨*symbol*⟩`}` is used. For example, `$\pi^{\bm{\pi}}$` gives a bold lowercase pi in the superscript position: $\pi^{\boldsymbol{\pi}}$.

Note that `\bm{`⟨*math*⟩`}` is a fragile command and, thus, should be preceded by `\protect` in commands with moving arguments.

7. FOOTNOTES

LaTeX's standard `\footnote` command is available in REVTeX 4. The footnote text can either appear at the bottom of a page or as part of the bibliography (in order, after the rest of the references). This choice can be controlled by two class options: `footinbib` and `nofootinbib`. REVTeX 4 defaults to the former. Specific journal options may select a different value than the default. Note that in the latter case, the argument of the `\footnote` command is a moving argument in the sense of the *LaTeX User's Guide & Reference Manual*, Appendix C.1.3: any fragile command within that argument must be preceded by a `\protect` command.

The `\footnote` macro *should not* be used in the front matter for indicating author/affiliation relationships or to provide additional information about authors (such as an e-mail address). See Section 4.3 for the proper way to do this.

Finally, footnotes that appear in tables behave differently. They will be typeset as part of the table itself. See Section 10.2 for details.

8. CITATIONS AND REFERENCES

In keeping with the REVTeX 4 design goal of making it easier to extract tagged information from a manuscript, new macros and BibTeX style files have been added to provide better markup. Furthermore, these have been built upon some widely-used LaTeX packages in line with the design goal of making use of the existing packages where possible. The two main external packages that are of concern here are Patrick Daly's `natbib` citation package and his `custom-bib` tool kit for building new BibTeX style files.

From an author's point of view, all this means is that a proper REVTeX 4 installation requires having `natbib` (version 7 or higher) installed. It also means that the full set of `natbib` functionality is available from within REVTeX 4 (but see the *APS Compuscript Guide for REVTeX 4* for restrictions). The `natbib` documentation contains many exmaples; see in particular the included `natnotes.tex` file for a convenient summary.

As in standard LaTeX, references are cited in text using the `\cite{`⟨*key*⟩`}` command and are listed in the bibliography using the `\bibitem{`⟨*key*⟩`}` command. The `\cite` macro enables REVTeX 4 to automatically number the references in the manuscript.

A typical example might be:

```
String theory\cite{GSW} attempts to
provide a theory of everything.
```

The corresponding `\bibitem` would be:

```
\bibitem{GSW} M.~Greene, J.~Schwarz, and
E.~Witten, \textit{Superstring Theory:
Introduction}, (Cambridge University
Press, London, 1985).
```

Journals differ in how the `\cite` will be displayed. Most APS journals display the citation in-line, as a number, enclosed in square brackets, *e. g.*, "String theory[1] attempts. . . ." Other journals (most notably *Physical Review B*) instead use a number in a superscript: "String theory[1] attempts. . . ." Selecting the journal substyle using a class option (such as `prb`) will invoke the appropriate style. In journal substyles using superscripts, the macro the `\onlinecite{`⟨*key*⟩`}` is necessary to get the number to appear on the baseline. For example, "String theory (see, for example, `Ref.~\onlinecite{GSW}`)" will give the output "String theory (see, for example, Ref. 1)."

The `\onlinecite` command has the same semantics as `natbib`'s `\citealp` command.

A `\cite` command with multiple keys is formatted with consecutive reference numbers collapsed; e.g., [1,2,3,5] will be output as [1–3,5]. To split the list over more than one line, use a `%` character immediately following a comma:

```
. . .  \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}
```

The `%` avoids unwanted spaces.

8.1. Author/Year (Non-numeric) Citations

Reviews of Modern Physics uses a citation style based on the first author's last name and the year of the reference rather than a simple number. Support for this style of citing references is the primary reason REVTeX 4 uses the `natbib` package. `natbib` uses an optional argument to the `\bibitem` macro to specify what text to use for the `\cite` text:

`\bibitem[`⟨*short-name*⟩`(`⟨*year*⟩`)`⟨*long-name*⟩`]`

where ⟨*short-name*⟩ is the author name used in a parenthetical citation, ⟨*long-name*⟩ that used in a textual citation, and ⟨*year*⟩ is the year. More concretely, the `\bibitem` example above would appear as

```
\bibitem[Greene et al.(1985)Green,
Schwarz, and Witten]{GSW}
M.~Greene, J.~Schwarz, and E.~Witten,
\textit{Superstring Theory},
(Cambridge Press, London, 1985).
```

When the citation constitutes part of the grammar of the sentence, the `\textcite{`⟨*key*⟩`}` command may be used (analogous to the `\onlinecite` command above). Both `\textcite` and `\onlinecite` are built upon `natbib`'s rich repertoire of macros (`\citep`, `\citet`, etc.). These macros are available in REVTeX 4;

however, APS authors must follow the *APS Compuscript Guide for REVTEX 4* guidelines regarding `natbib`'s macros.

8.2. Using BibTEX

The `\bibitem` entries can be coded by hand as above, of course, but the use of BIBTEX with the new style files provided with REVTEX 4 makes it particularly simple to generate marked-up references that can, for instance, take advantage of packages like `hyperref` for linking. They also save the trouble of having to specify formatting like the italics for the book title in the above example. And, for those wishing to use author/year citations, BIBTEX will automatically generate the appropriate optional arguments for the `\bibitem` commands.

BIBTEX is an adjunct to LATEX that aids in the preparation of bibliographies. BIBTEX allows authors to build up a database or collection of bibliography entries that may be used for many manuscripts. A BIBTEX style file then specifies how to transform the entries into a proper `\bibitem` for a particular journal. Here we give a brief summary of how to get started with BIBTEX. More details can be found in the *REVTEX 4 BIBTEX Guide* included in the distribution or in the LaTeX books listed in the references.

Selecting a journal style by using an appropriate class option will automatically select the correct BIBTEX style file. For all of the *Physical Review* journals, this is `apsrev.bst`, while for *Reviews of Modern Physics* this is `apsrmp.bst`. The selection can be overridden by specifying an alternative `.bst` file using the standard LATEX 2_ε `\bibliographystyle` macro. This must appear in the preamble before the `\begin{document}` line in REVTEX 4 (this differs from standard LATEX).

The BIBTEX database files will contain entries such as:

```
@Book{GSW,
  author=``M. Greene, J. Schwarz,
          E. Witten'',
  title=``Superstring theory:
         Introduction'',
  publisher=``Cambridge University
         Press'',
  address=``London'',
  year=``1985''
}
```

There are entry formats for articles, technical reports, e-prints, theses, books, proceedings, and articles that appear in books or proceedings. The `apsrev` and `apsrmp` styles provided with REVTEX 4 also allows URL's and e-print identifiers to be specified for any of the different entry types. There is also an additional "collaboration" field that can be used in addition to "author".

To actually create the bibliography in the manuscript, the `\bibliography{`⟨*bib files*⟩`}` macro is used. Here ⟨*bib files*⟩ is a comma-separated list of BIBTEX bibliography database files, each with the `.bib` extension. The `\bibliography` macro should be placed at the location where the references are to appear (usually after the main body of the paper). When the manuscript is processed with LATEX for the first time, the keys corresponding for the `\cite` macros used in the manuscript are written out to the `.aux` file. Then BIBTEX should be run (if the manuscript is called `paper.tex`, the command would be `bibtex paper`. This will produce a `.bbl` file containing all of the `\bibitem`'s for the manuscript. Subsequent runs of LATEX 2_ε will call this file in to resolve the references. LATEX 2_ε should be run repeatedly until all references are resolved.

The BIBTEX-produced `\bibitem`'s created using the `apsrev` and `apsrmp` appear considerably more complex than the example given above. This is because the style files add in `\bibinfo`, `\bibnamefont`, `\eprint`, and `\url` macros for specifying additional formatting and tagging. The `\bibinfo` macro is mostly a do-nothing macro that serves merely to tag the information with the field information from the original entry in the BIBTEX database. The `\eprint` and `\url` macros can be used to create the appropriate hyperlinks in target formats such as PDF.

For more information on using BIBTEX with LATEX, see Sections 4.3.1 and C.11.3 of the *LATEX User's Guide & Reference Manual*[2], Section 13.2 of [4], or the online BIBTEX manual `http://ctan.tug.org/tex-archive/biblio/bibtex/distribs/doc/btxdoc.tex`.

9. FIGURES AND ARTWORK

Figures may be included into a REVTEX 4 manuscript by using the standard LATEX 2_ε macros. It should be noted that LATEX 2_ε includes several powerful packages for including the files in various formats. The two main packages are `graphics` and `graphicx`. Both offer a macro called `\includegraphics[`⟨*args*⟩`]{`⟨*filename*⟩`}`; they mainly differ in how arguments for controlling figure scaling, translation, and orientation are specified. Old LATEX2.09 interfaces such as `epsfig` have been re-implemented on top of these packages. For more information on the enhancements of the `graphicx` package, see [5] or `ftp://ctan.tug.org/tex-archive/macros/latex/required/graphics/grfguide.ps`. REVTEX 4 no longer has the `epsf` class option, though the `epsfig` package provides a similar interface.

The `figure` environment should be used to add a caption to the figure and to allow LATEX to number and place the figures where they fit best. LATEX will label and automatically number the captions FIG. 1, FIG. 2, etc. For example:

```
\begin{figure}
```

```
 \includegraphics{fig1.eps}
 \caption{\label{fig1}Text of first caption.}
\end{figure}
```

Note how the `\label{⟨key⟩}` command is used to cross-reference figures in text. The `\label{⟨key⟩}` command should be inserted inside the figure caption. As usual, the `\ref{⟨key⟩}` macro can then by used to refer to the label: "As depicted in FIG.~`\ref{fig1}`...".

Figures are normally set to the width of the column in which they are placed. This means that in two-column mode, the figure will be placed in a single, narrow column. For wide figures, the `\figure*` environment should be used instead. This will place the figure across both columns (the figure usually will appear either at the top or the bottom of the following page).

Captions less than one line long are centered under the figure, otherwise they span the width of the figure.

Note that is unnecessary (and undesirable) to use explicit centering commands inside the float environments.

10. TABLES

Tables are very similar to figures. They should be input using the `table` environment as detailed below, and LaTeX will label and number the captions TABLE 1, TABLE 2, etc. (or in whatever format required by the chosen journal substyle). Tables without captions won't be numbered.

Each table must begin with `\begin{table}`, end with `\end{table}`. A caption can be specified using the `\caption{⟨text⟩}` command. Captions less than one line long are centered under the figure, otherwise they span the width of the figure. To refer to the table via cross-referencing, a `\label{⟨key⟩}` command should appear within the `\caption`. Use the `\ref{⟨key⟩}` command to cite tables in text. The `table` environment will set the table to the width of the column. Thus, in two-column mode, the table will confined to a single column. To set a table to the full width of the page, rather than the column, use the `table*` environment.

The heart of the table is the `tabular` environment. This will behave for the most part as in standard LaTeX 2_ε (please refer to Section 3.6.3 and Appendix C.10.2 of the *LaTeX User's Guide & Reference Manual* for more details about the `tabular` environment). Note that REVTeX 4 no longer automatically adds double (Scotch) rules around tables. Nor does the `tabular` environment set various table parameters for column spacing as before. Instead, a new environment `ruledtabular` provides this functionality. This environment should surround the `tabular` environment:

```
\begin{table}
\caption{\label{<key>}....}
\begin{ruledtabular}
\begin{tabular}
...
\end{tabular}
\end{ruledtabular}
\end{table}
```

A basic table looks as follows:

```
\begin{table}
\caption{\label{tab:example}Text of table caption.}
\begin{ruledtabular}
\begin{tabular}{ll}
  Heading 1 & Heading 2\\
  Cell 1 & Cell 2\\
\end{tabular}
\end{ruledtabular}
\end{table}
```

The `quasitable` environment is no longer in REVTeX 4. The standard `tabular` environment can be used instead because it no longer puts in the double rules.

10.1. Aligning on a decimal point

Numerical columns should align on the decimal point (or decimal points if more than one is is present). This is accomplished by again using a standard LaTeX 2_ε package, `dcolumn` which must be loaded in the manuscript's preamble:

```
\usepackage{dcolumn}
```

Once this package is loaded, the column specifier '`d`' can be used in the table's `tabular{⟨preamble⟩}` enviroment preamble. The '`d`' should be used for simple numeric data with a single decimal point. The entry of a `d` column is typeset in math mode; do not insert any `$` math delimiters into a '`d`' column. Items without a decimal point are simply set in math mode, centered. If text is required in the column, use `\text` or `\mbox` as appropriate. If multiple decimal points are present then the last is used for alignment. To escape from the '`d`' column use `\multicolumn` as usual. See the sample file `apssamp.tex` for examples.

10.2. Footnotes in Tables

Footnotes in a table are labeled *a*, *b*, *c*, etc. They can be specified by using the LaTeX `\footnote` command. Furthermore, `\footnotemark` and `\footnotetext` can be used so that multiple entries can to refer to the same footnote. The footnotes for a table are typeset at the bottom of the table, rather than at the bottom of the page or at the end of the references. The arguments for `\footnotemark` and `\footnotetext` should be numbers 1, 2, ... The journal style will convert these to letters.

See sample file `apssamp.tex` for examples and explanations of use.

10.3. Dealing with Long Tables

By default, tables are set in a smaller size than the text body (`\small`). The `\squeezetable` declaration makes the table font smaller still (`\scriptsize`). Thus, putting the `\squeezetable` command before the `\begin{table}` line in a table will reduce the font size. If this isn't sufficient to fit the table on a page, the standard LaTeX 2ε `longtable` package may be used. The scope of the `\squeezetable` command must be limited by enclosing it with a group:

```
\begingroup
\squeezetable
\begin{table}
[...]
\end{table}
\endgroup
```

Tables are normally set to the width of the column in which they are placed. This means that in two-column mode, the table will be placed in a single, narrow column. For wide tables, the `\table*` environment should be used instead. This will place the table across both columns (the table usually will appear either at the top or the bottom of the following page).

Under REVTeX 3, tables automatically break across pages; REVTeX 4 provides some of this functionality. However, this requires adding to the table a float placement option of [H] (meaning put the table "here" and effectively "unfloating" the table) to the `\begin{table}` command. The commands `\\*` and `\samepage` can be used to control where the page breaks occur (these are the same as for the `eqnarray` environment).

Long tables are more robustly handled by using the `longtable.sty` package included with the standard LaTeX 2ε distribution (put `\usepackage{longtable}` in the preamble). This package gives precise control over the layout of the table. The REVTeX 4 package contains patches that enable the `longtable` package to work in two-column mode. Of course, a table set in two-column mode needs to be narrow enough to fit within the column. Otherwise, the columns may overlap. REVTeX 4 provides an additional environment `longtable*` which allows a longtable to span the whole page width. Currently, the `longtable*` and `ruledtabular` environments are incompatible. In order to get the double (Scotch) rule, it is necessary to add the `\hline\hline` manually (or define `\endfirsthead` and `\endlastfoot` appropriately). For more documentation on the `longtable` environment and on the package options of the `longtable` package, please see the documentation available at `ftp://ctan.tug.org/macros/latex/required/tools/longtable.dtx` or refer to [4].

11. PLACEMENT OF FIGURES, TABLES, AND OTHER FLOATS

By default, figures and tables (and any other "floating" environments defined by other packages) float to the top or bottom of the page using the standard LaTeX float placement mechanism. Initially, each `figure` or `table` environment should be put immediately following its first reference in the text; this will usually result in satisfactory placement on the page. An optional argument for either environment adjusts the float placement. For example:

```
\begin{figure}[⟨placement⟩]
...
\end{figure}
```

where ⟨*placement*⟩ can be any combination of `htbp!`, signifying "here", "top", "bottom", "page", and "as soon as possible", respectively. The same placement argument may be added to a `\begin{table}`. For more details about float placement, see the instructions in the *LaTeX User's Guide & Reference Manual*, Appendix C.9.1.

In two-column mode, a page may contain both a `widetext` environment and a float. REVTeX 4 may not always be able to automatically put the float in the optimal place. For instance, a float may be placed at the bottom of a column just before the `widetext` begins. To workaround this, try moving the float environment below the `widetext` environment. Alternative ⟨*placements*⟩ may also alleviate the problem.

`figure` and `table` environments should not be enclosed in a `widetext` environment to make them span the page to accomodate wide figures or tables. Rather, the `figure*` or `table*` environments should be used instead.

Sometimes in LaTeX the float placement mechanism breaks down and a float can't be placed. Such a "stuck" float may mean that it and all floats that follow are moved to the end of the job (and if there are too many of floats, the fatal error `Too many unprocessed floats` will occur). REVTeX 4 provides the class option `floatfix` which attempts to invoke emergency float processing to avoid creating a "stuck" float. REVTeX 4 will provide a message suggesting the use of `floatfix`. If `floatfix` doesn't work or if the resulting positioning of the float is poor, the float should be repositioned by hand.

REVTeX 4 offers an additional possibility for placing the floats. By using the either the `endfloats` or the `endfloats*` class option all floats may be held back (using an external file) and then set elsewhere in the document using the the commands `\printtables` and `\printfigures`, placed where the tables and figures are to be printed (usually at the end of the document). (This is similar to the standard `\printindex` command). Using a *-form of the commands (`\printfigures*` and `\printtables*`) will begin the figures or tables on a new page. Alternatively, the option `endfloats*` may be used to change the behavior of the non-*-forms so that every float will appear on a separate page at the end.

Without one of the `endfloats` class options, these float placement commands are silently ignored, so it is always safe to use them. If one of the `endfloats` class options is given, but the `\printtables` command is missing, the tables will be printed at the end of the document. Likewise, if `\printfigures` is missing, the figures will be printed at the end of the document. Therefore it is also safe to omit these commands as long as REVTEX's default choices for ordering figures and tables are satisfactory.

The `endfloats` option (or perhaps some journal substyle that invokes it), requires explicit `\begin{figure}`, `\end{figure}`, `\begin{table}`, and `\end{table}` lines. In particular, do *not* define typing shortcuts for table and figure environments, such as

```
\def\bt{\begin{table}}% Incompatible!
\def\et{\end{table}}%
```

Please note that it is generally undesirable to have all floats moved to the end of the manuscript. APS no longer requires this for submissions. In fact, the editors and referees will have an easier time reading the paper if the floats are set in their normal positions.

12. ROTATING FLOATS

Often a figure or table is too wide to be typeset in the standard orientation and it is necessary to rotate the float 90 degrees. REVTEX 4 provides a new environment `turnpage` as an easy means to accomplish this. The `turnpage` environment depends on one of the packages `graphics` or `graphicx` being loaded. To use the `turnpage` environment, simply enclose the `figure` or `table` environment with the `turnpage` environment:

```
\documentclass[...]{revtex4}
\usepackage{graphicx}
[...]
\begin{turnpage}
\begin{figure} or \begin{table}
[...]
\end{figure} or \end{table}
\end{turnpage}
```

A turnpage float will be typeset on a page by itself. Currently, there is no mechanism for breaking such a float across multiple pages.

TABLE III: Special REVTEX 4 symbols, accents, and boldfaced parentheses defined in `revsymb.sty`

`\lambdabar`	$\lambdabar$	`\openone`	$\openone$
`\altsuccsim`	$\altsuccsim$	`\altprecsim`	$\altprecsim$
`\alt`	$\alt$	`\agt`	$\agt$
`\tensor x`	$\tensor{x}$	`\overstar x`	$\overstar{x}$
`\loarrow x`	$\loarrow{x}$	`\roarrow x`	$\roarrow{x}$
`\biglb ( \bigrb)`	$\biglb(\bigrb)$	`\Biglb ( \Bigrb)`	$\Biglb(\Bigrb)$
`\bigglb ( \biggrb)`	$\bigglb(\biggrb)$	`\Bigglb ( \Biggrb )`	$\Bigglb(\Biggrb)$

13. REVTEX 4 SYMBOLS AND THE REVSYMB PACKAGE

Symbols made available in earlier versions of REVTEX are defined in a separate package, `revsymb`, so that they may be used with other classes. This might be useful if, say, copying text from a REVTEX document to a non-REVTEX document. REVTEX 4 automatically includes these symbols so it is not necessary to explicitly call them in with a `\usepackage` statement.

Table III summarizes the symbols defined in this package. Note that `\overcirc`, `\overdots`, and `\corresponds` are no longer in REVTEX 4. Use `\mathring` (standard in LaTeX 2_ε), `\dddot` (with the `amsmath` package loaded), and `\triangleq` (with the `amssymb` class option) respectively. `\succsim`, `\precsim`, `\lesssim`, and `\gtrsim` are also defined either in `amsmath` or `amssymb`. The AMS versions of these commands will be used if the appropriate AMS package is loaded.

14. OTHER REVTEX 4 FEATURES

14.1. Job-specific Override Files

REVTEX 4 allows manuscript-specific macro definitions to be put in a file separate from the main TEX file. One merely creates a file with the same basename as the TEX file, but with the extension '.rty'. Thus, if the TEX file is names man.tex, the macro definitions would go in man.rty. Note that the .rty file should be in the same directory as the TEX file. APS authors should follow the guidelines in the *APS Compuscript Guide for REVTEX 4* when submitting.

[1] D.E. Knuth, *The TEXbook*, (Addison-Wesley, Reading, MA, 1986).

[2] L. Lamport, *LaTeX, a Document Preparation System*, (Addison-Wesley, Reading, MA, 1996).
[3] H. Kopka and P. Daly, *A Guide to LaTeX 2_ε*, (Addison-Wesley, Reading, MA, 1995).
[4] M. Goosens, F. Mittelbach, and A. Samarin, *The LaTeX Companion*, (Addison-Wesley, Reading, MA, 1994).
[5] M. Goossens, S. Rahtz, and F. Mittelbach, *The LaTeX Graphics Companion*, (Addison-Wesley, Reading, MA, 1997).
[6] S. Rahtz, M. Goossens, *et al.*,*The LaTeX Web Companion*, (Addison-Wesley, Reading, MA, 1999).