The AASTeX Macros for Manuscript Preparation

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1. Introduction

The AAS has developed an author markup package to assist authors in preparing manuscripts that are intended for submission to the AAS-affiliated journals, or to other journals that wish to use it, such as the PASP. The most important aspect of the AASTeX package is that it defines the set of commands (called *markup*) that can be used to identify the structural elements of papers. When articles are marked up using this set of standard commands, the papers may also be submitted electronically to the editorial offices, with the ultimate goal being electronic generation of the journals themselves.

This guide contains basic instructions for creating manuscripts using the AASTeX markup package, which functions as substyles to the standard LaTeX `article` style. Authors are expected to be familiar with the editorial requirements of the journals so that they can make appropriate submissions, as well as to have at least a rudimentary knowledge of LaTeX (for instance, knowing how to set up equations using LaTeX commands). A number of useful publications about LaTeX (and TeX) are listed in the reference section of this guide.

Authors who wish to submit papers electronically to the ApJ, the ApJ Letters, or the AJ *must* **use the AASTeX markup package as described in this guide.** The package is an **option** for PASP submissions at this time.

2. The AASTeX Package and Electronic Submissions

Information about acquiring the AASTeX package will be mailed to you electronically if you send an empty e-mail message (some local mailers require a short subject line) to `aastex-instruct@aas.org`.

For purposes of producing paper output, the AASTeX package contains a number of LaTeX style files that produce variously formatted pages. There is a "manuscript" style, two "preprint" styles, and two "deluxetable" styles. The manuscript style (`aasms4.sty`) is used for papers that are submitted to the AAS journals and the PASP for review. The preprint styles render articles in a compact form that may be suitable for distribution among colleagues. The deluxetable styles are used by authors who wish to submit "camera-ready" tables to the journals for publication. See Sections 6 and 7 for further details about the contents of the AASTeX package.

Electronic submission instructions for the various journals are also available electronically. Send an empty e-mail message to the appropriate address below.

ApJ	apj-instruct@aas.org
ApJ Letters	apjlett-instruct@aas.org
AJ	aj-instruct@aas.org
PASP	pasp-instruct@aas.org

The AAS provides user support for the AASTeX package and for other aspects of electronic submission to the journals. This support is available electronically by sending e-mail to `aastex-help@aas.org`.

3. Command Descriptions for Journal Submissions

This section describes the commands in the AASTeX package that an author might enter in a manuscript that is being prepared for **electronic** submission to one of the journals. The commands will be described in roughly the same order as they would appear in a manuscript. The reader will also find it helpful to examine the sample files (`sample1.tex` and `sample2.tex`) that are distributed with the package. Authors are reminded to check the electronic submission procedures and the instructions to authors for the appropriate journals.

3.1. Preamble

In LaTeX manuscripts, the preamble is that portion of the file before the `\begin{document}` command.

3.1.1. Getting Started

The first piece of markup in the manuscript must declare the overall style of the document. Any commands that appear before this markup will be ignored.

```
\documentstyle[12pt,aasms4]{article}
```

This specifies the main style to be the `article` style using twelve point fonts, with modifications and additions for the `aasms4` substyle. The `aasms4` substyle will issue a warning message if the font size is smaller than twelve points, and the size will be set to twelve points; the file will still be processed.

The `aasms4` style must be used for the main body of the manuscript. The paper copy produced by this style file will be double-spaced. Any tables included in the main body of the manuscript will also be double-spaced.

Other styles are available, which will be discussed later in this guide (see Section 6).

3.1.2. Defining New Commands

The AASTEX package supports author-defined commands using `\newcommand` and `\def`. These definitions should be placed in the document preamble only. The remainder of this section refers to manuscripts submitted electronically to the ApJ or the ApJ Letters; other users of the package may skip to the next section.

Manuscripts submitted electronically to the ApJ or the ApJ Letters are translated to a language called SGML. In general, author-defined commands that are abbreviations are acceptable and can be translated; commands that attempt to define new symbols (e.g., `\newcommand{\lte}{\lower 0.5ex\hbox{${}\buildrel<\over\sim{}$}}`) will not translate correctly. In creating new commands authors are encouraged to use `\newcommand` rather than the `\def` command.

Authors who need additional symbols not found in LaTeX or AASTEX may use the AMS symbol definitions and fonts that are discussed in Appendix B. If it is not feasible to use the AMS fonts, authors may create their own symbols via `\newcommand` provided that the symbol is given exactly the same name as in the AMS fonts. This works because author-defined commands with names that match AMS symbol names will be translated as if they were references to the AMS symbols, regardless of the author's own definition.

Author-defined commands that use any of the commands listed below are unlikely to translate correctly: `\hskip`, `\vskip`, `\raise`, `\raisebox`, `\lower`, `\rlap`, `\kern`, `\lineskip`, `\baselineskip`, `\char`, `\mathchar`, `\mathcode`, `\buildref`, and `\mathrel`.

Authors submitting manuscripts electronically to the ApJ and ApJ Letters will have their manuscripts screened by the Production Office at the University of Chicago Press, and a screening report will be returned to the authors along with the referees' comments. Any definitions or commands that would cause problems in translation to SGML will be identified in the screening report and must be fixed by the author if the electronic file is to be processed successfully.

3.1.3. Editorial Information

A number of markup commands are available for the editorial offices to record the publication history and slug-line data for each manuscript. These commands should be commented out by the author if they appear in a template copy. At this point authors may wish to skip to the next section.

```
\received{RECEIPT DATE}
\revised{REVISION DATE}
\accepted{ACCEPT DATE}
\cpright{type}{year}

\journalid{VOL}{JOURNAL DATE}
\articleid{START PAGE}{END PAGE}
\paperid{MANUSCRIPT ID}

\cpright{TYPE}{YEAR}
\ccc{CODE}
```

Copyright information is specified through the commands `\cpright` and `\ccc`. The "type" of copyright and the corresponding year are given in `\cpright`; valid copyright types are as follows.

`AAS`	Copyright has been assigned to the AAS.
`ASP`	Copyright has been assigned to the ASP.
`PD`	The article is in the public domain.
`none`	No copyright is claimed for the article.

The copyright type is case sensitive, so the type string must be entered exactly as given above. The Copyright Clearing Center code may be given in the `\ccc` command; the code is taken as regular text, so any special characters, notably '$', must be properly specified.

3.1.4. Short Comment on Title Page

Authors who wish to include a short remark on the title page, such as the name and date of the journal in which an article has been scheduled, may do so with the following command.

```
\slugcomment{TEXT}
```

In the `aasms4` style, such comments appear on the title page after the title and authors; in the `aaspp4` style, they are placed at the upper right corner of the title page.

3.1.5. Running Heads

Authors are invited to supply running head information. There are generally two different kinds of data in running heads; the left head contains an author list (last names, possibly truncated as "et al."), while the right head is an abbreviated form of the paper title. This running head information will not be appear on the printed page.

```
\lefthead{TEXT}
\righthead{TEXT}
```

Editors and publishers impose varying requirements on the brevity of these data. A good rule of thumb is to limit the list of authors to three, otherwise use et al., and limit the short form of the title to 44 characters. The editors may choose to modify the author-supplied running heads.

3.2. Starting the Main Body

None of the markup that appears in the preamble actually typesets anything; the preamble is only a control section. The author must include a

```
\begin{document}
```

command to identify the beginning of the main textual portion of the manuscript.

3.3. Title and Author Information

Title and author identification are by way of the markup commands `\title` and `\author`. The author's principal affiliation is specified with a separate command `\affil`. Each `\author` command should be followed by a corresponding `\affil`.

```
\title{LUCID TEXT}
\author{NAME(S)}
\affil{AFFILIATION}
\authoraddr{ADDRESS}
\and
```

Line breaks are permitted in the title if the author wishes to specify them with the \\ command. Long titles will be broken automatically, so the \\ markup is not required. If the title is explicitly broken over several lines, the preferred style for titles in AAS and ASP journals is the so-called "inverted pyramid" style. In this style, the longest line is the first (or top) line, and each succeeding line is shorter. The text of the title should be entered in mixed case; it will be converted to uppercase by the publisher. Footnotes are permissible in titles; be careful to ensure that alternate affiliations (see below) are properly numbered if a footnote to the title is specified.

Authors' names are given in `\author` commands, and should be entered in mixed case. Names that appear together in the author list for authors who have the same primary affiliation should be specified in a single `\author` command. Each author group (`\author` command) should be followed by an `\affil` command, giving the principal affiliation of that author. Physical and postal address information for the institution specified may be included with its name. The address can be broken over several lines by using the \\ command to indicate the line breaks. Usually, however, postal information will fit on one line. When there is more than one `\author` command, the last one should be preceded by an `\and` command.

When there is a lengthy author list, all authors' names may be specified in a single `\author` command, with affiliations specified using the `\altaffilmark` mechanism described below. In this case, no `\affil` commands would be used, and the affiliations would all be listed in a footnote block at the bottom of the title page. The style file performs this formatting.

Postal addresses for individual authors may be specified in `\authoraddr` commands. This command does not produce any formatted text in most AASTeX styles and can be used to specify the corresponding address of the first author for purposes of editorial communication.

Authors often have affiliations in addition to their principal employer, and these are specified with the `\altaffilmark` and `\altaffiltext` commands. These behave like the `\footnotemark` and `\footnotetext` commands of LaTeX, except there are no optional arguments in the AASTeX commands. `\altaffilmark` is appended to author's names in the `\author` lists and generates superscript identification numbers. The text for the individual alternate affiliations is generated by the `\altaffiltext` command.

```
\altaffilmark{KEY NUMBER(S)}
\altaffiltext{NUMERICAL KEY}{TEXT}
```

It is up to the author to make sure that `\altaffilmark` numbers attached to authors' names correspond to the correct alternate affiliation, i.e., that each KEY NUMBER matches the NUMERICAL KEY for the corresponding TEXT.

3.4. Abstract

The paper abstract should be enclosed in an `abstract` environment.

```
\begin{abstract}
abstract text
\end{abstract}
```

3.5. Keywords

Keywords, subject headings, etc., are accommodated as a single piece of text.

```
\keywords{TEXT}
```

If authors supply keywords they must be delimited by the appropriate punctuation required by the journal. Keywords should be specified in alphabetical order. The `\keywords` command supplies the proper leading text ("Keywords:", "Subject headings:", etc.), according to the style.

The list of keywords used by the ApJ and the ApJ Letters are in the file `keywords.apj` in the directory `pubs/aastex-misc` on the anonymous ftp node `aas.org`.

3.6. Comments to Editors

Authors may make notes or comments to the editors with the `\notetoeditor{TEXT}` command. This command will behave like a footnote and appear on the bottom of the page, e.g., ^{E1}: NOTE TO THE EDITOR: `<TEXT>`. Output to the printed page is produced with the `aasms4.sty` file only.

```
\notetoeditor{TEXT}
```

3.7. Sections

The `article` style for AASTEX manuscripts supports four levels of sectioning.

```
\section{HEADING}
\subsection{HEADING}
\subsubsection{HEADING}
\paragraph{HEADING}
```

Section headings should be given in mixed case. Note that these commands delimit sections by marking the *beginning* of each section; there are not separate commands to identify the ends.

3.8. Figure and Table Placement

Generally figures and tables are not "placed" in the text of the document where an author would like them to appear physically, but rather follow the main body of the text. However, authors may indicate to the editors the preferred placement of these items in the text by use of the `\place*` commands.

```
\placetable{KEY}
\placefigure{KEY}
```

The `\place*{KEY}` commands are similar to the `\ref` command in LaTeX and require corresponding `\label` commands to link them to the proper elements for assisting the editors. The `\label{KEY}` command may be included in a `\figcaption` command used to produce figure captions on the figure caption page or in a `\caption` command used in the figure environment (see Sections 3.15 and 5); in a `\tablecaption` command in the deluxetable environment (see Section 3.13.1), or in a `\caption` command in a LaTeX table environment.

On the printed page the `\place*` commands will print a short message to the editor about figure and table placements when used with the `aasms4.sty` file. Nothing will be printed with the other style files.

3.9. Acknowledgments

In addition, AASTEX manuscript styles support an `\acknowledgments` section.

```
\acknowledgments
```

In the AASTEX substyles, acknowledgments are set off from the concluding main body text simply by vertical space (no heading or type size change).

3.10. Appendices

When one or more appendices are needed in a paper, the end of the main body text must be marked.

```
\appendix
```

Note that the `\appendix` command has no arguments; sections in the appendix must be headed with `\section` commands containing the section headings, as described earlier. The `\appendix` command takes care of a number of internal housekeeping concerns, such as identifying sections with letters instead of numerals, resetting the equation counter, etc.

3.11. Citations

Two options are available for marking citations within a manuscript. The `\cite` command is used in conjunction with `thebibliography`.

```
\cite{KEY}
```

LaTeX's `thebibliography` environment allows authors to identify references symbolically using unique keys (the author makes these up). If this mechanism is used, the KEY given in the `\cite` command must correspond to a KEY given in a `\bibitem` command in the `thebibliography` environment. The `LABEL` in the

`\bibitem` command is used as the citation in the text. See Section 3.14.1.

The conventional method used by authors to manage the citations and reference list in a paper has often been a manual one. These authors can use the `references` environment and `\markcite` command.

```
\markcite{KEY}
```

The KEY supplied in the `\markcite` command must match the key used by the `\reference` command for the corresponding reference in the `references` environment. The `\markcite` command is only used to point to the proper reference in the reference list—the actual citation must be supplied by the author as part of the running text. See Section 3.14.2.

The use of the `references` environment and the `\markcite` command has changed with the v4.0 release of the AASTeX package and is not backward or forward compatible with v3.0.

3.12. Equations

Displayed equations can be typeset in many ways using the standard displayed math environments of LaTeX; these three are probably of greatest use.

```
\begin{displaymath}
\end{displaymath}
\begin{equation}
\end{equation}
\begin{eqnarray}
\end{eqnarray}
```

The `displaymath` environment will break out a single, unnumbered formula. The same formula will appear the same if it is set in an `equation` environment, except it will be autonumbered by LaTeX. In order to set several formulæ in which vertical alignment is required or to display a long equation across multiple lines, the `eqnarray` environment should be used.

Authors occasionally wish to group related equations together and identify them with letters appended to the same equation number, as opposed to having each with a separate numeral. When this is desired, such related equations should still be set in `equation` or `eqnarray` environments (whichever is appropriate may be used), and this grouping should be placed within a `mathletters` environment.

`\begin{mathletters}`
`equation` *or* `eqnarray` *environment(s)*
`\end{mathletters}`

It is possible to override LaTeX's automatic numbering within `equation` or `eqnarray` environments.

```
\eqnum{TEXT}
```

When `\eqnum` is specified inside an `equation` environment, or on a particular equation within an `eqnarray`, the text supplied as an argument to `\eqnum` is used as the equation identifier. LaTeX's equation counter is *not* incremented when `\eqnum` is used. `\eqnum` must be used *inside* the environment.

When unnumbered equations are desired, authors can use either the `displaymath` environment (for single displayed equations) or place a `\nonumber` command before the equation delimiter (`\\`) in a particular equation in an `eqnarray`. LaTeX's equation counter is *not* incremented when `\nonumber` is used.

If, as a consequence of the use of `\eqnum` or `\nonumber`, LaTeX's equation counter gets out of the author's intended sequence, the counter may be reset to a particular value.

```
\setcounter{equation}{NUMBER}
```

The equation counter should be set to the number corresponding to the last equation that was formatted, so it is most appropriate for this command to appear immediately after an `equation` or `eqnarray` environment ends. `\setcounter{equation}` must be used *outside* the math environments.

3.13. Tables

There is support in the AASTeX package for tables via two mechanisms: LaTeX's standard `table` and `tabular` environments, and a `deluxetable` environment that facilitates the formatting of tabular (particularly lengthy tabular) material. Tables may be marked up using either mechanism although the `deluxetable` environment is preferred. Authors should *not* use the LaTeX `tabbing` environment or the `\hline` command for electronic submissions.

LaTeX permits the preparation of fairly complex tables with arbitrary spacing, straddle heads and rules, and the like. Authors who need to specify complicated column headings and so forth are advised to consult the LaTeX manual (Lamport 1985) for details. Most of the capabilities are applicable to AASTeX's `deluxetable` environment as well as LaTeX's `tabular`.

Authors should be aware that all tables produced using the `aasms4` style will be double-spaced. If single-spaced, or "camera-ready" tables are required, then an alternate style file must be used for the tables only (see Section 4).

3.13.1. *The* `deluxetable` *Environment*

This section describes the use of the `deluxetable` environment. There are several desiderata that are somewhat above and beyond LaTeX's `tabular` environment that facilitate the formatting of such tables. Among these are breaking long tables across pages, using footnotes in a table, specifying comments and references for tables, etc.

The `deluxetable` environment is delimited by LaTeX's familiar `\begin` and `\end` constructs.

```
\begin{deluxetable}{COLS}
\end{deluxetable}
```

COLS specifies the justification for each column. One of the letters 'l', 'c', or 'r' is given for each column, indicating left, center, or right justification. Authors are referred to the LaTeX manual (Lamport 1985) for further information.

There are several items in a `deluxetable` environment that must be given before the data for the table.

```
\small
\footnotesize
\scriptsize
\tablewidth{DIMEN}
\tablenum{TEXT}
\tablecaption{TEXT \label{KEY}}
```

If a table is too wide for the printed page, it is permissible to change the font size within the `deluxetable` environment using the `\small` (11pt), the `\footnotesize` (10pt) or the `\scriptsize` (8pt) command.

The width of a deluxetable is defined by `\tablewidth`; the default width, if this command is omitted, is the width of the body text. The table can be set to its natural width by specifying a DIMEN of 0pt. Long tables may have a natural width that is different for each page. The natural width for each page will be printed to the log file during processing; authors may then define a fixed table width based on this information giving the tables a more uniform appearance across the pages.

It is possible to override LaTeX's automatic numbering within the `deluxetable` environment. When `\tablenum` is specified inside a `deluxetable` environment, the text supplied as an argument to `\tablenum` is used as the table identifier. LaTeX's equation counter is *not* incremented when `\tablenum` is used. `\tablenum` must be used *inside* the `deluxetable` environment and before the `\tablecaption` command.

The caption (actually, the title) of the table is specified in `\tablecaption`. The intent is for the text of `\tablecaption` to be brief; explanatory notes may be specified in the end notes to the table (`\tablecomments`, see below). If the caption does not appear centered on the table after processing, then specify the width of the table explicitly in the `\tablewidth` command and rerun LaTeX on the file.

The KEY in the `label` command should be the same KEY used in the `\placetable{KEY}` command used to call out the preferred location of the table in the text. The `label` command, if used, must be included in the `\tablecaption` command.

```
\tablehead{TEXT}
\colhead{HEADING}
```

Column headings are specified within `\tablehead`. Within `\tablehead`, each column heading can be given in a `\colhead`, which will ensure that the heading is centered on the natural width of the column; this is the typical disposition of column headings, and the use of `\colhead` is encouraged. There should be a heading for each column, so there should be as many `\colhead` commands in the `\tablehead` as there are data columns. If more complicated column headings are required, any valid `tabular` commands that constitute a proper head line for the table may be used. Consult the LaTeX manual (Lamport 1985) for details about using the `tabular` environment to prepare tables.

The `\tablecolumns{NUM}` command is necessary if the author has multiline column headings produced by `\tablehead` or other LaTeXcommands and is using either the `\cutinhead` or `\sidehead` markup (see below). The `NUM` is set to the true number of columns in the table, and the command must come before the `\startdata` command.

```
\tablecolumns{NUM}
```

See the `complext.tex` file in the AASTeX package for an example of a more complex table format using the `\tablecolumn` command.

Column alignment within the data columns can be adjusted with the TeX `\phantom{STRING}` command, where `STRING` can be any character representation, e.g., `\phantom{$\arcmin$}`. A blank character of width `STRING` is then inserted in the table. Three characters have been predefined for this purpose as well as a shorter version of the generic `phantom` command:

`\phn`	phantom numeral 0-9
`\phd`	phantom decimal point
`\phs`	phantom plus or minus sign
`\phm{STRING}`	generic phantom command

It is possible that a complicated table heading will overflow the vertical space allotted for the table heading. The fraction of the page allocated for the table heading may be changed with `\tableheadfrac`. The NUM argument to `\tableheadfrac` should be the decimal fraction of the page used for heading information. The default value is 0.1, meaning that 10% of the page height is reserved for the table heading. It should rarely be necessary to change this value.

```
\tableheadfrac{NUM}
```

After the table title and column headings are specified, data lines can be entered. The data lines are within two "data" commands. Data elements within a row of the table are separated with & (ampersand) characters. The end of each row is indicated with `\nl`.

`\startdata`
data lines
`\enddata`

```
\nl
\tablevspace{DIMEN}
```

Extra vertical space can be inserted between rows with a `\tablevspace` command; the argument is a dimension and may be specified in any units that are legitimate in LaTeX.

```
\tablebreak
\nodata
```

If a page break needs to be forced in a deluxetable, `\tablebreak` should be used instead of `\nl`. This is sometimes necessary when several rows of data are associated with a single object or item; such logical groupings should not be broken across pages, and `\tablebreak` can be used to ensure that the page breaks are reasonable in these cases.

The journals often require that elements for which there are no data be explicitly marked. This is to differentiate such elements from blank elements, which are frequently interpreted as implicitly repeating the entry in the corresponding element in the row preceding. Data elements for which there are no data should contain a `\nodata` command; an appropriate symbol will be placed in that data element.

Within the deluxetable body, two kinds of "specialty" heads are recognized. A cut-in head is a piece of text that is centered on the table width; it is spaced above and below from the data rows that precede and follow it, and there may be rules associated, depending on the journal or manuscript style. All of these formatting particulars are managed by the style files. The author need only specify the text to be centered with a `\cutinhead` command. Similarly, a side head is a piece of text that is left-justified.

```
\cutinhead{TEXT}
\sidehead{TEXT}
```

Table footnotes (more properly, table *endnotes*) may be used in the `deluxetable` environment; their use is described in detail in the section on *Table Footnotes*, below. These notes must follow the `\enddata` command. The markup commands for such endnotes are as follows.

```
\enddata
\tablenotemark{KEY LETTER(S)}
\tablenotetext{ALPHA KEY}{TEXT}
\tablecomment{TEXT}
\tablerefs{TEXT}
```

3.13.2. The `table` *Environment*

Tables may be marked and composed using the standard LaTeX tools for tables, although the use of the `deluxetable` environment is encouraged. Tables should appear in `table` environments.

```
\begin{table}
\end{table}
```

The `table` environment encloses not only the tabular material but also any title (caption) or footnote information associated with the table.

Titles or captions for tables are indicated with

```
\caption{TEXT  \label{KEY}}
```

Tables will be identified with arabic numerals, e.g., "Table 2"; the identifying text, including the number, is generated automatically by `\caption` within the `table` environment. The KEY in the `label` command should correspond to the KEY used in the `\placetable{KEY}` command used to identify the placement of the table in the text.

Tabular information is typeset within the `tabular` environment:

```
\begin{tabular}{COLS}
\end{tabular}
```

where COLS specifies the justification for each column. One of the letters 'l', 'c', or 'r' is given for each column, indicating left, center, or right justification. Consult the

LaTeX manual (Lamport 1985) for details about using the `tabular` environment to prepare tables. A `tabular` table must appear within a `table` environment. And there should be only one `tabular` table per `table` environment. If the journal requests manuscripts with only one table per page, the author may need to insert a `\clearpage` command after especially short tables.

There is a `\tableline` command for use in `tabular` environments.

```
\tableline
```

This command produces the horizontal rule(s) between the column headings and the body of the table. Authors are discouraged from using any `\hlines` themselves; vertical rules are typically forbidden by editorial preference.

It is possible to override LaTeX's automatic numbering within the `table` environment.

```
\tablenum{TEXT}
```

When `\tablenum` is specified inside a `table` environment, the text supplied as an argument to `\tablenum` is used as the table identifier. LaTeX's equation counter is *not* incremented when `\tablenum` is used. `\tablenum` must be used *inside* the `table` environment.

3.13.3. Table Footnotes

AASTeX supports footnotes (endnotes) that are associated with tables; this support applies to both the `deluxetable` environment and the standard LaTeX `table` environment. Footnotes for tables are usually identified by lowercase letters rather than numbers. Marking and assigning associated text is achieved with the `\tablenotemark` and `\tablenotetext` commands, in which the note identifier is required (cf. `\altaffilmark` and `\altaffiltext`). The `\tablenotetext` *must* be specified before the enclosing `\end{table}`, since the text of notes to tables are displayed by that command.

```
\tablenotemark{KEY LETTER(S)}
\tablenotetext{ALPHA KEY}{TEXT}
```

Note that the KEY LETTER should be the same as the ALPHA KEY for the corresponding TEXT. It is the responsibility of the author to make the correspondence correct.

AASTeX also supports special kinds of table endnotes. Sometimes authors tabulate materials which have corresponding references, and it may be desirable to associate these references with the table rather than (or in addition to) the formal reference list. Occasionally, authors wish to append a short paragraph of explanatory notes that pertain to the entire table, but which are different than the caption.

```
\tablerefs{REFERENCE LIST}
\tablecomments{TEXT}
```

The table endnotes are coupled to the table in which they occur, rather than being associated with a particular page, and they are printed with the table (relatively close to the caption) instead of appearing at the extreme bottom of the page. This is done to ensure that the notes wind up on the same page as the table, since tables are floats and can migrate from one page to another.

3.14. Bibliography

Observe that the *bibliographic data* supplied by the author must conform to the standards of the journal. We have elected not to burden authors with tedious markup commands to delimit the bibliographic fields because many of the journals we have targeted in this project have agreed to reduce typographic overhead (bolding, italicizing, etc.) in reference lists (Abt 1990). It is the responsibility of the author to arrange these fields in the proper order with the correct punctuation; the information will be typeset as is, i.e., in roman with no size or style changes.

An identifier denoting that the article was prepared with the AASTeX package appears as a footnote on the last page of references.

Authors has two options for marking citations in the text and providing the associated reference lists.

3.14.1. The `thebibliography` *Environment*

Authors are encouraged to use the semantics of LaTeX's `thebibliography` environment, marking citations with `\cite` and associating references with them via `\bibitem`. The `\cite`-`\bibitem` mechanism associates citations and references symbolically while maintaining proper citation syntax within the paper. The author must create the citation label for each reference in proper journal format in the `\bibitem` command.

```
\begin{thebibliography}{DUM}
\bibitem[LABEL]{KEY} bibliographic data
      .
      .
\end{thebibliography}
```

where LABEL must adhere to journal standards, e.g., "Abt 1986". The value of LABEL is then inserted into the body of the text at the place of the `\cite` command during the processing. The argument DUM to `thebibliography` environment is not used by the AASTEX package. Note that it is not possible to use `\bibitem`s within the `references` environment, nor will `\cite` commands work properly in the main body if `\bibitem`s are not properly specified. This technique can be a bit tricky, and there are limitations on the way that the citation LABEL is formatted.

Citation management can be complex, and systems have been developed to assist authors in preparing bibliographies. The program that manages references within the TEX family is called BIBTEX, and it is designed to work in conjunction with the citation and reference list capabilities of LATEX. Authors are advised to consult the LATEX manual (Lamport 1985). The AASTEX package has no additional support for BIBTEX.

3.14.2. The `references` *Environment*

Many authors are comfortable with the standard process of entering citations in the proper format directly in the body of an article and then organizing the reference list themselves. Such authors would use `\markcite{KEY}` in the text before the citation, e.g., `...as discussed by Marlow \markcite{a3} (1993)`, and then employ the `references` environment for the reference list, where each reference is preceded by a `\reference{KEY}` command, e.g., `\reference{a3} Marlow, R. 1993, \nat, 445, 12`. The `\markcite{KEY}` command indicates in the text where a certain reference in the reference list is used; the author must still supply the correct citation. The `references` environment simply sets off the list of references and adjusts spacing parameters.

```
\begin{references}
\reference{KEY} bibliographic data
    .
    .
\end{references}
```

The implementation of the `\markcite-\reference` markup has changed with the v4.0 release of the AASTEX package. Its use is not backward or forward compatible with v3.0.

3.14.3. Abbreviations for Journals

There are markup commands for many of the oft-referenced journals so that authors may use the markup names as a shorthand rather than having to look up a particular journal's specific abbreviation. In principle, all the journals should be using the same abbreviations as well, but it is fair to anticipate some changes in the specific abbreviations before a system is finally settled on. As long as these commands are kept up to date, authors need not be concerned about such editorial preferences and changes.

`\araa`	Annual Review of Astronomy and Astrophysics
`\ao`	Applied Optics
`\aj`	Astronomical Journal
`\azh`	Astronomicheskii Zhurnal
`\aap`	Astronomy and Astrophysics
`\aapr`	Astronomy and Astrophysics Reviews
`\apj`	Astrophysical Journal
`\apjl`	——, Letters to the Editor
`\apjs`	——, Supplement Series
`\aplett`	Astrophysics Letters
`\apspr`	Astrophysics Space Physics Research
`\apss`	Astrophysics and Space Science
`\aaps`	——, Supplement Series
`\baas`	Bulletin of the AAS
`\bain`	Bulletin Astronomical Inst. Netherlands
`\gca`	Geochimica Cosmochimica Acta
`\grl`	Geophysics Research Letters
`\iaucirc`	IAU Circular
`\jcp`	Journal of Chemical Physics
`\jgr`	Journal of Geophysics Research
`\jrasc`	Journal of the RAS of Canada
`\memras`	Memoirs of the RAS
`\mnras`	Monthly Notices of the RAS
`\nat`	Nature
`\nphysa`	Nuclear Physics A
`\physscr`	Physica Scripta
`\pra`	Physical Review A: General Physics
`\prb`	Physical Review B: Solid State
`\prc`	Physical Review C:
`\prd`	Physical Review D:
`\pre`	Physical Review E:
`\prl`	Physical Review Letters
`\physrep`	Physics Reports
`\planss`	Planetary Space Science
`\procspie`	Proceedings of the SPIE
`\pasj`	Publications of the ASJ
`\pasp`	Publications of the ASP
`\qjras`	Quarterly Journal of the RAS
`\skytel`	Sky and Telescope
`\solphys`	Solar Physics

3.15. Figure Captions

Figure captions or legends are included in the manuscript on a separate page using the `\figcaption` command for each figure in the paper.

```
\newpage
\figcaption[FILENAME]{TEXT \label{KEY}}
```

The optional argument, FILENAME, can be used to identify the PostScript file for the corresponding figure, e.g., graph.eps; TEXT refers to the caption for that figure.

The KEY in the `label` command refers to the KEY in the `\place*{KEY}` command used to identify the placement of the figure in the manuscript (see Section 3.8).

When the `\figcaption` command is used, the figure identification, e.g., "Figure 1," is generated automatically by the command itself.

Some journals may accept figures placed in the `figure` environment (see Section 5) if the manuscript is being submitted electronically. Please check the appropriate electronic submission instructions for your target journal.

3.16. Miscellaneous

When discussing atomic species, ionization levels can be indicated with the following command.

```
\ion{ELEMENT}{LEVEL}
```

The ionization state is specified as the second argument, and should be given as a numeral. For example, Ca III is specified by typing `\ion{Ca}{3}`.

AASTEX contains two commands that permit authors to specify alternate forms for fractions. Authors submitting manuscripts electronically will generally find it unnecessary to use any markup other than the standard LATEX `\frac`.

```
\case{NUM}{DENOM}
\slantfrac{NUM}{DENOM}
```

LATEX will set fractions in displayed math as built-up fractions; it is sometimes desirable to use case fractions in displayed equations. In such instances, one should use `\case` rather than `\frac`. Occasionally, authors wish to typeset fractions with a solidus but in which the type size is reduced and the numerals are oriented diagonally. In this case, `\slantfrac` should be used instead of `\frac`. Note that this is different from a shilled fraction, which authors can produce without any special markup.

Built-up	`\frac{1}{2}`	$\frac{1}{2}$
Case	`\case{1}{2}`	$\tfrac{1}{2}$
Slant	`\slantfrac{1}{2}`	${}^1/_2$
Shilled	1/2	1/2

The AASTEX package also contains a collection of assorted macros for special symbols (or abbreviations) that authors tend to work out for themselves anyway. Some of the definitions come from the *A&A* package (Springer 1989); some are contributions from individuals. We have tried to select a tractable number that were useful and also somewhat difficult to get right because fussy kerning or some such is required.

`\arcdeg`	$^\circ$	`\sq`	$\square$
`\sun`	$\odot$	`\earth`	$\oplus$
`\arcmin`	$'$	`\arcsec`	$''$
`\fd`	$\overset{\mathrm{d}}{.}$	`\fh`	$\overset{\mathrm{h}}{.}$
`\fm`	$\overset{\mathrm{m}}{.}$	`\fs`	$\overset{\mathrm{s}}{.}$
`\fdg`	$\overset{\circ}{.}$	`\farcm`	$\overset{\prime}{.}$
`\farcs`	$\overset{\prime\prime}{.}$	`\fp`	$\overset{\mathrm{p}}{.}$
`\micron`	μm		
`\onehalf`	${}^1/_2$	`\ubvr`	*UBVR*
`\onethird`	${}^1/_3$	`\ub`	$U-B$
`\twothirds`	${}^2/_3$	`\bv`	$B-V$
`\onequarter`	${}^1/_4$	`\vr`	$V-R$
`\threequarters`	${}^3/_4$	`\ur`	$U-R$
`$\lesssim$`	$\lesssim$	`$\gtrsim$`	$\gtrsim$

Most of these commands can be used in running text as well as when setting mathematical expressions. `\lesssim` and `\gtrsim` can only be used in math mode, which is sensible since they are relations. It is possible to use `\earth` and `\sun` as subscripts, e.g., `$1.4 M_{\sun}$` yields $1.4 M_\odot$.

3.17. Concluding the File

The last command in the electronic manuscript file should be the

```
\end{document}
```

command, which appears after all the material in the paper. This command directs the formatter to perform assorted termination activities and finish processing.

4. Camera-ready Tables

Long tables that are prepared as "camera-ready" and submitted on paper will require the use of a `deluxetable` substyle file.

There are special LATEX substyle options within the AASTEX package which authors can use to produce deluxetable output suitable for photographic reproduction in specific AAS and ASP journals; these are the `aj_pt4` and `apjpt4` substyles.

```
\documentstyle[aj_pt4]{article}
\documentstyle[apjpt4]{article}
```

When tabular material is prepared with one of these style files, the pages produced will be suitable for submission to the journal as camera-ready "art." These special styles are intended for producing deluxetables *only*; manuscripts should *not* be formatted with the `aj_pt4` or the `apjpt4` substyle. See the example files `samp2tbl.tex`, `samptbls.tex`, and `complext.tex` in the AASTEX package.

In general, the same markup commands apply to these tables as were described earlier for the `deluxetable` environment (see Section 3.13.1). The commands `\small`, `\footnotesize`, and `\scriptsize` are not permitted, however.

If the table is too wide for the page, the `\ptlandscape` command may be used to format the table in landscape mode; this command must be issued **before** the `\begin{deluxetable}` command. The author must remember to print the table using the landscape option in the *dvi* print program, e.g., `dvips -t landscape`.

These special substyle options for tables, `aj_pt4.sty` and `apjpt4.sty`, may also be used to produce tables that are not meant to be "camera-ready" but are too wide to fit on a page even after using the techniques described in Section 3.13.1. The author could use the `\ptlandscape` option but double-space the table as required for normal manuscript submission.

```
\ptlandscape
\begin{deluxetable}
\doublespace
```

Authors may reference these external tables from within their main manuscript file with the `\ref{KEY}` command by using the `\dummytable` command within the table environment as part of their main manuscript file.

```
\begin{table}
\dummytable\label{KEY}
\end{table}
```

5. Figures

At this time, the most widely used means of including figures or other types of nontextual data in electronic manuscripts is to generate such files as PostScript.[1]

For manuscripts that are submitted electronically the figures or PostScript files are generally sent as individual files to the editors and are not included as part of the main body of text. The legends or captions for these files are included in the main body of the text, however, on a separate page with specific formats (see Section 3.15). Authors are referred to the submission instructions for the appropriate journals if PostScript figures are to be submitted along with an electronically submitted manuscript.

If the author wishes the PostScript figures to be included in the pages being produced, it is necessary to use the *dvips* program. This program is available via anonymous ftp from `labrea.stanford.edu`. It is also necessary that the graphics files being included conform to the Encapsulated PostScript standard (Adobe 1990). Encapsulated PostScript will be referred to as 'EPS' in what follows.

There are several commands associated with including EPS files in AASTEX manuscripts, and these should be placed within a `figure` environment.

```
\begin{figure}
\figurenum{TEXT}
\epsscale{NUM}
\plotone{EPSFILE}
\plottwo{EPSFILE}{EPSFILE}
\plotfiddle{EPSFILE}{VSIZE}
    {ROT}{HSF}{VSF}{HTRANS}{VTRANS}
\caption{TEXT}
\end{figure}
```

When `\figurenum` is specified inside a `figure` environment, the text supplied as an argument to `\figurenum` is used as the figure identifier. LaTeX's figure counter is *not* incremented when `\figurenum` is used. `\figurenum` must be used *inside* the `figure` environment.

`\plotone` inserts the graphic in the named EPSFILE, scaled (in both dimensions) so that the horizontal dimension fits in the body text width; the vertical dimension is scaled to maintain the aspect ratio. `\plottwo` inserts two plots next to each other. Scale factors are determined automatically from information in the EPS file.

The automatic scaling may be overridden with the command `\epsscale{NUM}`, where NUM is in decimal units, i.e., 0.80.

For the adventuresome, there is also `\plotfiddle`, which can be used to override the automatic figure placement, scaling, and rotation. When this method is used, the author must specify the *vertical* space allotment for the graphic (see `VSIZE` below). The scaling and placement of the figure are controlled by these parameters:

[1]PostScript is a registered trademark of Adobe Systems Incorporated.

`VSIZE`	vertical white space to allow for plot (LaTeX dimension)
`ROT`	rotation angle (degrees)
`HSF`	horizontal scale (percentage)
`VSF`	vertical scale (percentage)
`HTRANS`	horizontal translation (PS points)
`VTRANS`	vertical translation (PS points)

PostScript points are 1/72 inches, so an HTRANS of 72 moves the graphic 1 inch to the right. The PostScript reference point is the lower left corner of the page, so a VTRANS of 72 moves the graphic *up* 1 inch.

There is an upper limit of seven `\begin...\end` figure environments per page.

Footnotes are *not* supported for figures.

6. Alternate Style Options

It is not the objective of the AASTeX project to develop LaTeX styles that produce pages that mimic the appearance of specific journals. Since this is the case, we have chosen to provide several format options within the preprint styles themselves so that output format can be varied. The `aaspp4` substyle offers a single-spaced alternative for manuscripts, for instance. The `aaspp4` substyle is similar to the manuscript style, but it is single-spaced, and it is possible to use a smaller typeface. For institutional purposes, it may be preferable for preprints to be set in two columns, have running heads, etc. The `aas2pp4` substyle may be used instead to produce two-column pages. This style can be used as is, but it can also serve as a point of departure for LaTeX style writers at institutions that want preprints of this general nature. These two style options are discussed further below.

The preparation of "plano tables" (camera-ready, or *planographic*) is possible by using one of the style files `aj_pt4` or `apjpt4`. These styles produce tables in formats suitable for the AJ and the ApJ, respectively; the `aj_pt4` style could be used to create camera-ready tables for the PASP as well. These styles are intended primarily for the production of tables that the author wishes to submit camera-ready; they are not to be used for producing manuscript pages.

The `eqsecnum` style file can be used to modify the way equations are numbered. Normally, equations are just numbered sequentially through the entire paper. If `eqsecnum` appears in the `documentstyle` command, equation numbers will be sequential through each section and will be formatted "(sec-eqn)," where "sec" is the current section number and "eqn" is the number of the equation within that section. The `eqsecnum` option can be used with the manuscript or preprint substyle files. For example,

```
\documentstyle[11pt,eqsecnum,aaspp4]
    {article}
```

A `flushrt.sty` file option is available for authors that prefer to have their margins left and right justified. The `aas2pp4` style option is flush right by default, but the `aasms4` and `aaspp4` style options are ragged right by default.

```
\documentstyle[11pt,eqsecnum,aaspp4,flushrt]
    {article}
```

6.1. Preprint format

A single-column preprint format can be specified with the `aaspp4` substyle option.

```
\documentstyle[11pt,aaspp4]{article}
```

The size of the typeface used is under author control by way of LaTeX's `NNpt` article substyles (where `NN` is 10, 11, or 12). Use of 10 point type is not recommended with the `aaspp4` style.

Authors may wish to adjust vertical spacing within a preprint, for instance, double-spacing text while single-spacing tables. Authors who want to alternate between single and double spacing in the manuscript may use the following commands.

```
\singlespace
\doublespace
```

`\singlespace` sets the vertical spacing to a smaller value, while `\doublespace` causes double-spacing.

6.2. Two-column format

The `aas2pp4` substyle has the principal function of setting up two-column output.

```
\documentstyle[aas2pp4]{article}
```

Although it is quite obvious, it is important to remember that text lines are considerably shorter when two of them are typeset side by side on a page. Long equations, wide tables and figures, and the like, may not typeset in this format without some adjustments. The expenditure of great effort to adapt copy and markup for two-column pages is probably counterproductive. Remember that the main goal of this package at this point is to produce "correct" draft (or referee) format pages; it is the responsibility of the editors and publishers to produce publication format papers for the journals.

The aas2pp4 substyle does not impose a format for the article's front matter, although there is often merit in setting the title, author, abstract, and keyword material on a separate page at full text width. The author may supply the \twocolumn command wherever desired.

```
\twocolumn
```

Note that the two-column format begins at the point \twocolumn appears in the text, and if that point is before the front matter, title and author and so forth will be typeset in two-column mode along with the rest of the paper; that is how this manual is prepared, for example. For purposes of producing "pretty" output, it is probably desirable to put the \twocolumn command after the abstract and keywords, just before the body of the paper. If \twocolumn is not specified explicitly in aas2pp4 style documents, the introductory material of the paper will be set in one-column mode; the first \section command (presumably demarcating the beginning of the main body of the article) will engage the two-column mode.

7. Additional documentation

The preceding detailed explanation of the markup commands in this package has certain merit, but many authors will prefer to examine the sample papers that are included with the style files. The files of interest are described below.

The file sample1.tex is a paper prepared with the AASTEX package utilizing a minimal amount of markup. The most salient thing to observe about this example is that, apart from the document style declarations, no formatting instructions are given in the file.

A more comprehensive example requiring nearly all of the capabilities of the package (in terms of markup as well as formatting) is in sample2.tex. This file is annotated with comments that describe the purpose of most of the markup. sample2.tex has three tables: one marked up using the deluxetable environment; another table using the LATEX table environment; and the third table, samp2tbl.tex, produced as a camera-ready table using either the apjpt4 or aj_pt4 style files.

A more complex example of the deluxetable environment is presented as a camera-ready table in the file complext.tex.

A set of three tables prepared as "deluxe" tables are contained in the files table1.tex, table2.tex, and table3.tex. They can be formatted by running LATEX on the samptbls.tex file, into which they are included. The document style in samptbls.tex is apjpt4 in the distribution, but this can be changed to aj_pt4 to see the effects of differing requirements among journals. Page breaks are explicitly indicated in table1.tex, and they are set for the ApJ style; due to the different type size used in the AJ, the pages break somewhat erratically when the aj_pt4 style is used. It is left as an exercise to the reader to make sense of this.

This user guide (aastex.tex) is also marked up with the AASTEX package, although it is not exemplary as a scientific paper.

A number of the markup commands described in the preceding sections are standard LATEX commands, and the reader who is unfamiliar with their syntax is referred to the LATEX manual (Lamport 1985) or another guide by Hahn (Hahn 1993) for details. A crib sheet listing all the LATEX commands (and some pertinent plain TEX commands) with short descriptions of each is published by the TEX Users Group (Botway and Biemesderfer 1989).

Authors who wish to know the ins and outs of TEX itself should read the *TEXbook* (Knuth 1984), probably more than once. There is a good deal of information about typography in general in this source. Many details of mathematical typography are discussed in a book by Swanson (1971).

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This 2-column preprint was prepared with the AAS LATEX macros v4.0.

A. Some Helpful TeX Hints

In the sections that follow, we review some essential procedures that must be followed when preparing TeX input.

A.1. Running text

Printing is different from typewriting, and TeX is different from other word processing tools. This section consists of reminders (admonitions) about things that require special attention so that TeX can format the input properly.

- The ends of words and sentences are marked by white space, and it does not matter how many spaces are typed; one is as good as 100. TeX treats the end of a line in the input file as a space.
- Paragraphs are separated by blank lines. Do not hyphenate words in the input file; TeX takes care of hyphenation automatically. Continue to hyphenate modifiers within a line of text, e.g., "author-prepared copy."
- Quotation marks should be typed as pairs of opening and closing single quotes, e.g., `` ``quoted text'' ``; do not use double quotes (`"bad form"`).
- Do not underline. In printing, text is emphasized by changing the type style, usually to *slanted* or *italic* type.
- A number of common characters are interpreted as commands, and these must be entered specially, by preceding them with a backslash (\): $ & % # { and } must be typed `\$ \& \% \# \{` and `\}`.
- Authors should refrain from adding vertical or horizontal space. Concentrate on the content of the document and identifying its components with the structural markup commands.

A.2. Math

Mathematical expressions that are part of the running text are delimited by a single dollar sign ($), e.g., `$\pi r^2$` yields πr^2. To get the appropriately sized superscript or subscript in the roman font, use the `\rm` command, e.g., `$J_{\rm HF}(t)$` produces $J_{\rm HF}(t)$.

Displayed equations can be delimited in several ways. The most concise markup is to bracket the equation between `\[` and `\]` commands, which is equivalent to placing the formula in a `displaymath` environment. These markup commands will produce *unnumbered* equations.

Numbered equations can be typeset by typing the formula in an `equation` environment. A series of related equations that need vertical alignment, e.g., a derivation for which alignment on the equal sign (=) is desired, can be typeset in an `eqnarray` environment.

While it is possible for authors to assign their own equation numbers, it is easier to let LaTeX number them automatically. By default, LaTeX will number equations sequentially from the beginning of the paper to the end.

It is sometimes appropriate for equation numbering sequences to carry through sections of the paper only. Equations can be numbered (*sec-eqn*) by placing the command `\eqsecnum` in the preamble of the document.

A.3. Tables

Tables are notoriously difficult to compose, and great care and patience are usually required before tabular information can be typeset satisfactorily. Tables should be placed in separate table environments, i.e., the tabular material must be enclosed within `\begin{table}` and `\end{table}` commands. Tables should have a title or caption and the correct number of descriptive column headings. A single horizontal rule should be set after the column headings with the `\tableline` command. Do not insert any other horizontal or vertical lines in the body of the table.

The `deluxetable` environment is intended to make it easier to prepare camera-ready tables, although authors are encouraged to use the `deluxetable` environment for *all* tables. Authors who are using the deluxetable styles to prepare camera-ready tables are urged to read the `deluxetable` section (section 3.13.1) carefully and to look at the many example files in the distribution.

Notes in tables should be marked by `\tablenotemark`; corresponding text should appear in a `\tablenotetext` command.

A.4. Cross-referencing

Cross-referencing equations, tables, and figures in text depends upon the use of "keys," which are defined by the user. The `\label` command is used to define cross-reference keys for LaTeX; `\ref` is used to refer to them. Keys are simply text strings that serve to label equations, tables, and figures, so that they may be referred to symbolically in the text. Authors should place `\label` commands immediately after the markup command that starts the structure being referenced. For figure and table captions, place the `\label` command *inside* the `\caption`, `\tablecaption` or `\figcaption` commands, e.g., `\tablecaption{This is a caption.\label{tab1 }}`. References to page numbers should *not* be made.

LaTeX keeps track of autonumbered counters and cross-reference information by maintaining an auxiliary file in the same working directory as the source file. The auxiliary file will have an extension of `.aux`. This file should not be deleted, since subsequent LaTeX processing uses the auxiliary data to resolve references, etc.

The auxiliary file mechanism makes it necessary to run LaTeX on a given source file more than once to ensure that the cross-reference information has been properly resolved. This is most evident when changes are made that affect the number or the placement of equations, tables, and the like. LaTeX will typically issue a warning message that advises the user to "rerun to get cross-references right," in which case, LaTeX should be run again. If the error message appears after two successive LaTeX runs, it is likely that a reference has been made to an undefined label.

B. AMS Symbols

Authors are permitted to use the American Mathematical Society extra symbol fonts, in addition to the special symbols provided by LaTeX (see below). The `amssym` substyle file must be included as an argument to the `documentstyle` command if the AMS symbols are to be used.

```
\documentstyle[aasms4,amssym]{article}
```

The file `ams.ps`, included with the AASTeX macro package, contains a list of the AMS extra symbol fonts that authors might find useful; this is a PostScript file that can be printed to a local PostScript printer—use 'lpr' in Unix—and does not require the AMS symbols to be installed locally.

The AMS symbols are not distributed as part of the AASTeX macro package or as part of the TeX distribution, so authors will need to check with their local TeX administrators to see if these symbols are available for their use. The AMS symbols can be obtained from the American Mathematical Society by anonymous ftp by connecting to `ftp.shsu.edu` and looking in the directory `tex-archive/fonts/ams`. The `amssym` style file assumes that the files `amssym.def` and `amssym.tex` are in the directory in which the local implementation of TeX looks for input files.

If the AMS fonts and symbols have not been installed locally it is still possible to use them in manuscripts that will be submitted electronically—the local copy of the manuscript will not contain these fonts but the copies produced at the editorial offices and at the Production Offices will be correct.

C. Special symbols

The LaTeX language has a wide variety of special symbols for which markup commands have already been defined. These range from diacritics to exotic mathematical operators.

This section groups LaTeX's symbols together more or less according to function. Some of these symbols are primarily for use in text; most of them are mathematical symbols and can only be used in LaTeX's math mode. These tables are excerpted from the LaTeX Command Summary (Botway 1989).

Table C1: Text-mode accents

ò	`\`{o}`	ō	`\={o}`	o͡o	`\t{oo}`
ó	`\'{o}`	ȯ	`\.{o}`	o̧	`\c{o}`
ô	`\^{o}`	ŏ	`\u{o}`	ọ	`\d{o}`
ö	`\"{o}`	ǒ	`\v{o}`	o̲	`\b{o}`
õ	`\~{o}`	ő	`\H{o}`		

Table C2: National symbols

œ	`\oe`	å	`\aa`	ł	`\l`
Œ	`\OE`	Å	`\AA`	Ł	`\L`
æ	`\ae`	ø	`\o`	ß	`\ss`
Æ	`\AE`	Ø	`\O`		

Table C3: Miscellaneous symbols

†	`\dag`	§	`\S`	©	`\copyright`
‡	`\ddag`	¶	`\P`	£	`\pounds`
#	`\#`	$	`\$`	%	`\%`
&	`\&`	_	`\_`		
{	`\{`	}	`\}`		

Table C4: Math-mode accents

$\hat{a}$	`\hat{a}`	$\dot{a}$	`\dot{a}`
$\check{a}$	`\check{a}`	$\ddot{a}$	`\ddot{a}`
$\tilde{a}$	`\tilde{a}`	$\breve{a}$	`\breve{a}`
$\acute{a}$	`\acute{a}`	$\bar{a}$	`\bar{a}`
$\grave{a}$	`\grave{a}`	$\vec{a}$	`\vec{a}`

Table C5: Greek letters (math mode)

α	`\alpha`	ν	`\nu`
β	`\beta`	ξ	`\xi`
γ	`\gamma`	o	`o`
δ	`\delta`	π	`\pi`
ϵ	`\epsilon`	ρ	`\rho`
ζ	`\zeta`	σ	`\sigma`
η	`\eta`	τ	`\tau`
θ	`\theta`	υ	`\upsilon`
ι	`\iota`	ϕ	`\phi`
κ	`\kappa`	χ	`\chi`
λ	`\lambda`	ψ	`\psi`
μ	`\mu`	ω	`\omega`
ε	`\varepsilon`	ς	`\varsigma`
ϑ	`\vartheta`	φ	`\varphi`
ϱ	`\varrho`		
Γ	`\Gamma`	Σ	`\Sigma`
Δ	`\Delta`	Υ	`\Upsilon`
Θ	`\Theta`	Φ	`\Phi`
Λ	`\Lambda`	Ψ	`\Psi`
Ξ	`\Xi`	Ω	`\Omega`
Π	`\Pi`		

Table C6: Binary operations (math mode)

$\pm$	`\pm`	$\cap$	`\cap`
$\mp$	`\mp`	$\cup$	`\cup`
$\setminus$	`\setminus`	$\uplus$	`\uplus`
$\cdot$	`\cdot`	$\sqcap$	`\sqcap`
$\times$	`\times`	$\sqcup$	`\sqcup`
$\ast$	`\ast`	$\triangleleft$	`\triangleleft`
$\star$	`\star`	$\triangleright$	`\triangleright`
$\diamond$	`\diamond`	$\wr$	`\wr`
$\circ$	`\circ`	$\bigcirc$	`\bigcirc`
$\bullet$	`\bullet`	$\bigtriangleup$	`\bigtriangleup`
$\div$	`\div`	$\bigtriangledown$	`\bigtriangledown`
$\lhd$	`\lhd`	$\rhd$	`\rhd`
$\vee$	`\vee`	$\odot$	`\odot`
$\wedge$	`\wedge`	$\dagger$	`\dagger`
$\oplus$	`\oplus`	$\ddagger$	`\ddagger`
$\ominus$	`\ominus`	$\amalg$	`\amalg`
$\otimes$	`\otimes`	$\unlhd$	`\unlhd`
$\oslash$	`\oslash`	$\unrhd$	`\unrhd`

Table C7: Relations (math mode)

$\leq$	`\leq`	$\geq$	`\geq`
$\prec$	`\prec`	$\succ$	`\succ`
$\preceq$	`\preceq`	$\succeq$	`\succeq`
$\ll$	`\ll`	$\gg$	`\gg`
$\subset$	`\subset`	$\supset$	`\supset`
$\subseteq$	`\subseteq`	$\supseteq$	`\supseteq`
$\sqsubset$	`\sqsubset`	$\sqsupset$	`\sqsupset`
$\sqsubseteq$	`\sqsubseteq`	$\sqsupseteq$	`\sqsupseteq`
$\in$	`\in`	$\ni$	`\ni`
$\vdash$	`\vdash`	$\dashv$	`\dashv`
$\smile$	`\smile`	$\mid$	`\mid`
$\frown$	`\frown`	$\parallel$	`\parallel`
$\neq$	`\neq`	$\perp$	`\perp`
$\equiv$	`\equiv`	$\cong$	`\cong`
$\sim$	`\sim`	$\bowtie$	`\bowtie`
$\simeq$	`\simeq`	$\propto$	`\propto`
$\asymp$	`\asymp`	$\models$	`\models`
$\approx$	`\approx`	$\doteq$	`\doteq`
		$\Join$	`\Join`

Table C8: Variable-sized symbols (math mode)

$\textstyle\sum$	$\displaystyle\sum$	`\sum`	$\textstyle\bigcap$	$\displaystyle\bigcap$	`\bigcap`
$\textstyle\prod$	$\displaystyle\prod$	`\prod`	$\textstyle\bigcup$	$\displaystyle\bigcup$	`\bigcup`
$\textstyle\coprod$	$\displaystyle\coprod$	`\coprod`	$\textstyle\bigsqcup$	$\displaystyle\bigsqcup$	`\bigsqcup`
$\textstyle\int$	$\displaystyle\int$	`\int`	$\textstyle\bigvee$	$\displaystyle\bigvee$	`\bigvee`
$\textstyle\oint$	$\displaystyle\oint$	`\oint`	$\textstyle\bigwedge$	$\displaystyle\bigwedge$	`\bigwedge`
$\textstyle\bigodot$	$\displaystyle\bigodot$	`\bigodot`	$\textstyle\bigotimes$	$\displaystyle\bigotimes$	`\bigotimes`
$\textstyle\bigoplus$	$\displaystyle\bigoplus$	`\bigoplus`	$\textstyle\biguplus$	$\displaystyle\biguplus$	`\biguplus`

Table C9: Delimiters (math mode)

$($	`(`	$)$	`)`
$[$	`[`	$]$	`]`
$\{$	`\{`	$\}$	`\}`
$\lfloor$	`\lfloor`	$\rfloor$	`\rfloor`
$\lceil$	`\lceil`	$\rceil$	`\rceil`
$\langle$	`\langle`	$\rangle$	`\rangle`
$/$	`/`	$\backslash$	`\backslash`
$\vert$	`\vert`	$\Vert$	`\Vert`
$\uparrow$	`\uparrow`	$\Uparrow$	`\Uparrow`
$\downarrow$	`\downarrow`	$\Downarrow$	`\Downarrow`
$\updownarrow$	`\updownarrow`	$\Updownarrow$	`\Updownarrow`

Table C10: Function names (math mode)

`\arccos`	`\csc`	`\ker`	`\min`
`\arcsin`	`\deg`	`\lg`	`\Pr`
`\arctan`	`\det`	`\lim`	`\sec`
`\arg`	`\dim`	`\liminf`	`\sin`
`\cos`	`\exp`	`\limsup`	`\sinh`
`\cosh`	`\gcd`	`\ln`	`\sup`
`\cot`	`\hom`	`\log`	`\tan`
`\coth`	`\inf`	`\max`	`\tanh`

Table C11: Arrows (math mode)

$\leftarrow$	`\leftarrow`	$\longleftarrow$	`\longleftarrow`
$\Leftarrow$	`\Leftarrow`	$\Longleftarrow$	`\Longleftarrow`
$\rightarrow$	`\rightarrow`	$\longrightarrow$	`\longrightarrow`
$\Rightarrow$	`\Rightarrow`	$\Longrightarrow$	`\Longrightarrow`
$\leftrightarrow$	`\leftrightarrow`	$\longleftrightarrow$	`\longleftrightarrow`
$\Leftrightarrow$	`\Leftrightarrow`	$\Longleftrightarrow$	`\Longleftrightarrow`
$\mapsto$	`\mapsto`	$\longmapsto$	`\longmapsto`
$\hookleftarrow$	`\hookleftarrow`	$\hookrightarrow$	`\hookrightarrow`
$\leftharpoonup$	`\leftharpoonup`	$\rightharpoonup$	`\rightharpoonup`
$\leftharpoondown$	`\leftharpoondown`	$\rightharpoondown$	`\rightharpoondown`
$\rightleftharpoons$	`\rightleftharpoons`	$\leadsto$	`\leadsto`
$\uparrow$	`\uparrow`	$\Updownarrow$	`\Updownarrow`
$\Uparrow$	`\Uparrow`	$\nearrow$	`\nearrow`
$\downarrow$	`\downarrow`	$\searrow$	`\searrow`
$\Downarrow$	`\Downarrow`	$\swarrow$	`\swarrow`
$\updownarrow$	`\updownarrow`	$\nwarrow$	`\nwarrow`

Table C12: Miscellaneous symbols (math mode)

$\aleph$	`\aleph`	$\prime$	`\prime`
$\hbar$	`\hbar`	$\emptyset$	`\emptyset`
$\imath$	`\imath`	∇	`\nabla`
$\jmath$	`\jmath`	$\surd$	`\surd`
ℓ	`\ell`	$\top$	`\top`
$\wp$	`\wp`	$\bot$	`\bot`
$\Re$	`\Re`	$\|$	`|`
$\Im$	`\Im`	$\angle$	`\angle`
∂	`\partial`	$\triangle$	`\triangle`
∞	`\infty`	$\backslash$	`\backslash`
$\Box$	`\Box`	$\Diamond$	`\Diamond`
$\forall$	`\forall`	$\sharp$	`\sharp`
$\exists$	`\exists`	$\clubsuit$	`\clubsuit`
$\neg$	`\neg`	$\diamondsuit$	`\diamondsuit`
$\flat$	`\flat`	$\heartsuit$	`\heartsuit`
$\natural$	`\natural`	$\spadesuit$	`\spadesuit`
$\mho$	`\mho`		