The AASTEX LaTeX 2ε Macros for Manuscript Preparation

Contents

1. Introduction

The American Astronomical Society (AAS) has developed a markup package to assist authors in preparing manuscripts intended for submission to AAS-affiliated journals, as well as to other journals that will accept AASTEX manuscripts.

The most important aspect of the AASTEX package is that it defines the set of commands, or markup, that can be used to identify the structural elements of papers. When articles are marked up using this set of standard commands, they may then be submitted electronically to the editorial offices and fed into the electronic production of the journals.

This guide contains basic instructions for creating manuscripts using the AASTEX markup package. Authors are expected to be familiar with the editorial requirements of the journals so that they can make appropriate submissions; they should also have a basic 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, AJ, or PASP are strongly encouraged use the AASTEX markup package as described in this guide.

2. AASTEX Article Markup

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 that are distributed with the package and to consult the information available on the AASTeX Web site located at http://www.journals.uchicago.edu/AAS/AASTeX. Authors are also reminded to review the instruc-

tions to authors and electronic submissions guidelines for the specific journals to which they submit their papers.

2.1. Preamble

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

2.1.1. Getting Started

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

> `\documentclass{aastex}`

This specifies the document class as `aastex` with the default style (`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 substyles are available. They are discussed in § **??**.

2.1.2. Defining New Commands

AASTEX allows authors to define their own commands with LaTeX's `\newcommand`. (Authors should not use the plain TeX `\def` command in AAS journal submissions.) Authors' `\newcommand` definitions must be placed in the document preamble.

In general, author-defined commands that are abbreviations or shorthands, for instance,

> `\newcommand{\lte}{local thermodynamic equilibrium}`

, are acceptable and can be easily handled by journal offices and publishers during data conversion. However, abbreviations that attempt to define new symbols by using LaTeX commands for repositioning text tend to cause problems in the publication process and should be avoided.

In particular, author-defined commands that use any of the commands listed below are apt to cause problems during data conversion.

```
\hskip, \vskip, \raise, \raisebox,
\lower, \rlap, \kern, \lineskip,
\char, \mathchar, \mathcode, \buildref,
\mathrel, \baselineskip
```

Consequently, authors are strongly discouraged from using them.

Extra symbols are defined for AASTEX, some specifically for an astronomical context, others more broadly used in math and physics. In particular, the AMS has additional symbol fonts that are available in a standard LaTeX package (`amssymb`). All of these symbols are depicted in the additional symbosl tables supplied with the package and on the AASTEX Web site.

Before defining a new symbol command, authors are advised to consult these tables to see whether the symbol they need already exists. If it does, they should use the corresponding markup command. Authors should *not* redefine existing command names. When one of these commands is encountered in an electronic manuscript submitted to a journal, an author's redefinition will be ignored and the originally-defined command used.

2.1.3. Editorial Information

A number of markup commands are available for editorial office use in recording the publication history for each manuscript. These commands should be used by the editorial and production offices only.

```
\received{⟨receipt date⟩}
\revised{⟨revision date⟩}
\accepted{⟨acceptance date⟩}

\ccc{⟨code⟩}
\cpright{⟨type⟩}{⟨year⟩}
```

Copyright information should be specified with 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 escaped as appropriate.

2.1.4. 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 to which an article has been submitted, may do so with the following command.

```
\slugcomment{⟨text⟩}
```

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

2.1.5. Running Heads

Authors are invited to supply running head information using the following commands.

```
\shorttitle{⟨text⟩}
\shortauthors{⟨text⟩}
```

Two different kinds of data are generally supplied 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 appear on the LaTeX-printed page but will be passed through to copy editing staff for inclusion in the published version.

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 or else use "et al.," and to limit the short form of the title to 40–45 characters. The editors may choose to modify the author-supplied running heads.

2.2. Starting the Main Body

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

```
\begin{document}
```

command to identify the beginning of the main, typeset portion of the manuscript.

2.3. Title and Author Information

Authors should use the `\title` and `\author` commands to specify title and author information and the `\affil` command to indicate the author's primary affiliation. Each `\author` command should be followed by a corresponding `\affil` and optional `\email` command.

```
\title{⟨text⟩}
\author{⟨name(s)⟩}
\affil{⟨affiliation⟩}
\affil{⟨address⟩}
\email{⟨e-mail address⟩}
\and
```

Line breaks may be inserted in the title 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 printed in upper case or mixed case according to the style of the publication. 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 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 should be followed by an `\affil` command giving the principle affiliation of those authors. Physical and postal address information for the specified institution may be included with `\affil`. The address can be broken over several lines 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 final one should be preceded by the `\and` command.

Authors often have affiliations in addition to their principle employer. These alternate affiliations may be specified with the `\altaffilmark` and `\altaffiltext` commands. These behave like the `\footnotemark` and `\footnotetext` commands of LaTeX except that they do not take optional arguments. `\altaffilmark` is appended to authors' names in the `\author` list 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 each ⟨key number⟩ in his or her `\altaffilmark` matches the ⟨numerical key⟩ for the corresponding `\altaffiltext`.

When there is a lengthy author list, all author names may be specified in a single `\author` command with affiliations specified using the `\altaffilmark` mechanism. In these cases, no `\affil` commands are used, and in print, the affiliations would all be listed in a footnote block at the bottom of the title page.

2.4. Abstract

A paper's abstract should be marked with the `abstract` environment.

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

If an author is using the `preprint2` style, and the abstract is too long to fit on the title page, the `longabstract` option may be used in the `documentclass` to break the abstract to a new page.

```
\documentclass[preprint2,longabstract]{aastex}
```

Note that authors should use the `longabstract` option only in `preprint2` mode and only when the abstract is too long to fit on the title page.

2.5. Keywords

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

```
\keywords{⟨text⟩}
```

If authors supply keywords, they must be delimited by whatever punctuation is required by the journal. They should be specified in alphabetical order. The `\keywords` command will print the proper leading text—"Keywords:," "Subject headings:," etc.—according to journal style.

2.6. Comments to Editors

Authors may make notes or comments to the copy editor with the `\notetoeditor` command.

> `\notetoeditor{⟨text⟩}`

This command behaves like a footnote. Output to the printed page is produced only in the `manuscript` style.

2.7. Sections

AASTeX supports four levels of section headings.

> `\section{⟨heading⟩}`
> `\subsection{⟨heading⟩}`
> `\subsubsection{⟨heading⟩}`
> `\paragraph{⟨heading⟩}`

Section headings should be given in upper case or mixed case, depending on the style of the journal. Note that these commands delimit sections by marking the *beginning* of each section; there are no separate commands to mark the ends.

2.8. Figure and Table Placement

When preparing a manuscript for submission to an AAS journal, figures and tables do not generally need to be "placed" in the text of the document where an author would like them to appear but rather may simply follow the main body of the text. However, authors may indicate to the editors the preferred placement of these items 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.

When used in the `manuscript` style, the `\place*` commands will print a short message to the editor about figure or table placement. In the other styles, nothing is printed.

2.9. Acknowledgments

AASTeX supports an `\acknowledgments` section.

> `\acknowledgments`
> ⟨*acknowledgments text*⟩

In the AASTeX styles, acknowledgments are set off from the conclusion of the body with vertical space. Note the acknowledgments command takes no arguments.

2.10. Facilities

To help organizations obtain information on the effectiveness of their telescopes, the AAS has created a group of keywords for telescope facilities. Using a common set of keywords will make searches for this information significantly easier and more accurate. In addition, the use of facility keywords will be useful for linking papers that utilize the same telescopes together within the framework of the Virtual Observatory. A facilities keyword list is available through a link at the AASTeX Web page, http://www.journals.uchicago.edu/AAS/AASTeX.

The facilities list should appear after the acknowledgments section.

> `Facilities: \facility{⟨facility ID⟩},`
> `    \facility{⟨facility ID⟩},`
> `    \facility{⟨facility ID⟩}, ...`

As part of the *facility ID* argument, the author may also include the name of the instrument in parentheses, e.g. `\facility{HST(WFPC2)}` or `\facility{MMT(Blue channel spectrograph)}`. There is no limit to the number of facility keywords that may be included in a paper.

2.11. Appendices

When one or more appendices are needed in a paper, the point where the main body text ends and the appendix begins should be marked with the `\appendix` command.

> `\section{⟨body section⟩}`
> `\appendix`
> `\section{⟨appendix section⟩}`

The `\appendix` command takes care of a number of internal housekeeping concerns, such as identifying sections with letters instead of numerals, and resetting the equation counter. Note that the `\appendix` command takes no arguments. Sections in the appendix should be headed with `\section` commands.

2.12. Equations

Display equations can be typeset in LaTeX in a number of ways. The following three are probably of greatest use in AASTeX.

```
\begin{displaymath}
\end{displaymath}

\begin{equation}
\end{equation}

\begin{eqnarray}
\end{eqnarray}
```

The `displaymath` environment will break out a single, unnumbered formula. The `equation` environment does the same thing except that the equation is autonumbered by LaTeX. To set several formulæ in which vertical alignment is required, or to display a long equation across multiple lines, use the `eqnarray` environment. Each line of the `eqnarray` will be numbered unless a `\nonumber` command is inserted before the equation line delimiter (`\\`). LaTeX's equation counter is *not* incremented when `\nonumber` is used.

Authors may occasionally wish to group related equations together and identify them with letters appended to the equation number. When this is desired, such related equations should still be set in `equation` or `eqnarray` environments, whichever is appropriate, and then grouped within the `mathletters` environment.

```
\begin{mathletters}
⟨equation⟩ or ⟨eqnarray⟩
\end{mathletters}
```

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

$$\text{\textbackslash eqnum}\{\langle text\rangle\}$$

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 math environment.

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

$$\text{\textbackslash setcounter}\{\text{equation}\}\{\langle number\rangle\}$$

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

The `eqsecnum` style file can also be used to modify the way equations are numbered. See § **??** for details.

2.13. Citations and Bibliography

Two options are available for marking citations and formatting reference lists: the standard LaTeX `thebibliography` environment, and the AASTeX `references` environment. Authors are strongly encouraged to use `thebibliography` in their electronic submissions.

Please note that the bibliographic data supplied by the author in the reference list must conform to the standards of the journal. Many of the journals that accept AASTeX agreed to reduce typographic overhead, bold, italic, etc., in reference lists (**?**), and the AAS has elected not to burden authors with tedious markup commands to delimit the bibliographic fields. Instead, citations will be typeset in roman with no size or style changes. It is the responsibility of the author to arrange the required bibliographic fields in the proper order with the correct punctuation, according to journal style.

2.13.1. The `thebibliography` Environment

The preferred method for reference management is to use LaTeX's `thebibliography` environment, marking citations in the body of the paper with `\citep` or `\citet` and associating references with them using `\bibitem`. The `\cite`-`\bibitem` mechanism associates citations and references symbolically while maintaining proper citation syntax within the paper. In the `\bibitem` command, the author should specify citation data inside square brackets and a citation key in curly braces for each reference. (The `\bibitem` command is described in detail in the next section.)

```
\begin{thebibliography}{⟨dummy⟩}
\bibitem[⟨cite data⟩]{⟨key⟩} ⟨bibliographic data⟩
    .
    .
\end{thebibliography}
```

Note that the argument ⟨*dummy*⟩ to the start command of the environment is not used in the AASTₑX package, but it is included to be consistent with the syntax of standard LᴬTₑX. It is acceptable to simply insert an empty pair of curly braces at the end of the `\begin{thebibliography}` command.

2.13.2. *Specifying Bibliographic and Citation Information*

AASTₑX uses the `natbib` package (**?**) for citation management. The `natbib` package reimplements LᴬTₑX's `\cite` command, offering greater flexibility for managing citations in the author-year form.

When using `natbib`, bibliographic data are defined in `\bibitem` commands.

```
\bibitem[⟨author⟩(⟨year⟩)]{⟨key⟩}
        ⟨bibliographic data⟩
```

The square-bracketed argument of the `\bibitem` contains the ⟨*author*⟩ portion of the citation followed by the ⟨*year*⟩ set off in parentheses. The parentheses are important—`natbib` uses them to determine the year portion of the citation—so be sure to include them. The argument ⟨*key*⟩ in curly braces is the code name by which the citation is referenced in the text.

When placing citations in the text, the author should use either a `\citep` or a `\citet` command.

```
\citep{⟨key(s)⟩}
\citet{⟨key(s)⟩}
```

The `\citep` command produces a citation that is entirely set off by parentheses, e.g. "(Cox 1995)," while `\citet` permits the author's name to form part of the text, e.g. "Cox (1995)." The plain LᴬTₑX `\cite` command behaves like `\citet`.

The citation ⟨*key*⟩ must correspond to the ⟨*key*⟩ in a `\bibitem` command. During processing, information from the square-bracketed argument of the key's `\bibitem` is inserted in the text at the location of the `\cite` command. Multiple citation keys are separated by commas, e.g., `\citep{knuth84,cox95,lamport94}`.

`\citep` and `\citet` each take optional arguments that specify extra text to be appended to the citation label. Text in the first set of square brackets will appear before the cite while text in the second set will appear after it. For instance, `\citep[chap. 2]{jon90}` would produce the citation "(Jones et al., 1990, chap. 2)," `\citep[see][]{jon90}` would produce "(see Jones et al, 1990)," and `\citep[see][chap. 2]{jon90}` would print "(see Jones et al., 1990, chap. 2)." In addition, the * form of the cite commands will print the full author list instead of the abbreviated form.

The syntax discussed above should be sufficient for the vast majority of cases; however, AASTₑX does use the full `natbib` implementation, so many more syntax options are available. For details on the full range of `natbib` citation options, see the section on using `natbib` on the AASTₑX Web site and the `natbib` package documentation.

It is not possible to use `\bibitem` within AASTₑX's `references` environment (§ **??**), nor will `\cite` commands work properly in the main body if `\bibitem` commands are absent.

2.13.3. *The `references` Environment*

Some authors might prefer to enter citations directly into the body of an article. If so, the `references` environment may be used to format the reference list. The `references` environment simply sets off the list of references and adjusts spacing parameters.

```
\begin{references}
\reference{⟨key⟩} ⟨bibliographic data⟩
    .
    .
\end{references}
```

While the `references` environment remains supported in AASTₑX, we anticipate that authors will prefer the stronger capabilities of the standard LᴬTₑX `thebibliography` commands as extended by `natbib`.

2.13.4. Abbreviations for Journal Names

AASTeX commands are available for many of the most–frequently-referenced journals so that authors may use the markup rather than having to look up a particular journal's abbreviation. In principle, all the journals should be using the same abbreviations, but it is fair to anticipate some changes in the specific abbreviations before a system is finally settled on. If authors use the journal macros, they need not worry about changes to journal style governing abbreviations in citations. A listing of the current abbreviation macros appears in Table **??**.

2.14. Figures

2.14.1. Electronic Art

If an author wishes to embed graphics in a manuscript, it is necessary that the graphics files conform to the Encapsulated PostScript (EPS) standard (**?**). The author must also have an appropriate DVI translator, one that targets PostScript output devices. (Detailed information on preparing and submitting electronic art is available in the submissions instructions for the journals.)

Several commands are available for including EPS files in AASTeX manuscripts. They should be placed within the `figure` environment.

```
\begin{figure}
\figurenum{⟨text⟩}
\epsscale{⟨num⟩}
\plotone{⟨epsfile⟩}
\plottwo{⟨epsfile⟩}{⟨epsfile⟩}
\caption{⟨text⟩}
\end{figure}
```

When `\figurenum` is specified inside the `figure` environment, the text supplied as an argument to `\figurenum` will be 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 EPS file, scaled so that the horizontal dimension fits the width of the body text; 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.

Table 1: Abbreviations for Journal Names

`\araa`	Annual Review of Astronomy and Astrophysics
`\actaa`	Acta Astronomica
`\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 and Communications
`\apspr`	Astrophysics Space Physics Research
`\apss`	Astrophysics and Space Science
`\aaps`	——, Supplement Series
`\baas`	Bulletin of the AAS
`\bain`	Bulletin Astronomical Inst. Netherlands
`\caa`	Chinese Astronomy and Astrophysics
`\cjaa`	Chinese Journal of Astronomy and Astrophysics
`\fcp`	Fundamental Cosmic Physics
`\gca`	Geochimica Cosmochimica Acta
`\grl`	Geophysics Research Letters
`\iaucirc`	IAU Circular
`\icarus`	Icarus
`\jcp`	Journal of Chemical Physics
`\jgr`	Journal of Geophysical Research
`\jcap`	Journal of Cosmology and Astroparticle Physics
`\jqsrt`	Journal of Quantitative Specstroscopy and Radiative Transfer
`\jrasc`	Journal of the RAS of Canada
`\memras`	Memoirs of the RAS
`\memsai`	Mem. Societa Astronomica Italiana
`\mnras`	Monthly Notices of the RAS
`\na`	New Astronomy
`\nar`	New Astronomy Review
`\nat`	Nature
`\nphysa`	Nuclear Physics A
`\physscr`	Physica Scripta
`\pra`	Physical Review A
`\prb`	Physical Review B
`\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
`\pasa`	Publications of the ASA
`\pasj`	Publications of the ASJ
`\pasp`	Publications of the ASP
`\qjras`	Quarterly Journal of the RAS
`\rmxaa`	Revista Mexicana de Astronomia y Astrofisica
`\skytel`	Sky and Telescope
`\solphys`	Solar Physics
`\ssr`	Space Science Reviews
`\sovast`	Soviet Astronomy
`\zap`	Zeitschrift fuer Astrophysik

The automatic scaling may be overridden with the command `\epsscale{⟨num⟩}`, where ⟨num⟩ is a scaling factor in decimal units, e.g., 0.80.

The `\plotone` and `\plottwo` macros are invocations of the graphicx `\includegraphics` command. In most instances, using `\plotone` or `\plottwo` should work for placing figures in AASTEX documents. However, if more flexibility is needed, the `\includegraphics` command may be invoked directly. For instance, to rotate an image by 90 degrees, use

`\includegraphics[angle=90]{⟨epsfile⟩}`

See the `graphicx` package documentation or the AASTEX Web site for a complete list of the available arguments to `\includegraphics`.

Authors are strongly encouraged to use `\plotone`, `\plottwo`, or `\includegraphics` to place their EPS figures. However, as of the current release, the old `\plotfiddle` macro from v4.0 has been reintroduced and may be used if the desired figure placement cannot be achieved with one of the methods above. The syntax of the command is

`\plotfiddle{⟨epsfile⟩}{⟨vsize⟩}{⟨rot⟩}{⟨hsf⟩}`
`{⟨vsf⟩}{⟨htrans⟩}{⟨vtrans⟩}`

where the arguments are

epsfile	name of the EPS file
vsize	vertical white space to allow for plot (LATEX dimension)
rot	rotation angle (degrees)
hsf	horizontal width of scaled figure (PS points)
vsf	vertical height of scaled figure (PS points)
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. Note that the ⟨vtrans⟩ argument is discarded in the reimplented macro and is included only for backward compatibility with AASTEX v4.0.

2.14.2. Figure Captions

Regardless of whether an author includes electronic art in a manuscript, figure captions, or legends, should be provided. If art is included in the document, use the `\caption` command within the `figure` environment. If electronic art is not included, figure captions may be grouped together at the end of the document using `\figcaption`.

`\figcaption[⟨filename⟩]{⟨text⟩\label{⟨key⟩}}`

The optional argument, ⟨filename⟩, can be used to identify the file for the corresponding figure; ⟨text⟩ refers to the caption for that figure. The author may provide a `\label` with a unique ⟨key⟩ for cross-referencing purposes.

When the `\figcaption` command is used, the figure identification label, e.g., "Figure 1," is generated automatically by the command itself, so there is no need to key this information. There is an upper limit of seven figure captions per page. Footnotes are *not* supported for figures.

2.15. Tables

There is support in the AASTEX package for tables via two mechanisms: LATEX's standard `table` environment, and the `deluxetable` environment, which allows for the formatting of lengthy tabular material. Tables may be marked up using either mechanism, although use of `deluxetable` is preferred. Authors should *not* use the LATEX `tabbing` environment when preparing electronic submissions.

2.15.1. The deluxetable Environment

Authors are encouraged to use the `deluxetable` environment to format their tables since it automatically handles many formatting tasks, including table numbering and insertion of horizontal rules. It also provides mechanisms for breaking tables and controlling width and vertical spacing that are unavailable in the LATEX `tabular` environment.

The `deluxetable` environment is delimited by LATEX's familiar `\begin` and `\end` constructs. The content consists of preamble commands and table data, the latter delimited by `\startdata` and `\enddata`.

```
\begin{deluxetable}{⟨cols⟩}
⟨preamble commands⟩
\startdata
⟨table data⟩
\enddata
\end{deluxetable}
```

The argument ⟨*cols*⟩ specifies the justification for each column. An alignment token, "l," "c," or "r," is given for each column, indicating flush left, centered, or flush right.

2.15.2. Preamble to the `deluxetable`

There are several commands in the `deluxetable` environment that must be given in the preamble.

```
\tabletypesize{⟨font size command⟩}
\rotate
\tablewidth{⟨dimen⟩}
\tablenum{⟨text⟩}
\tablecolumns{⟨num⟩}
\tablecaption{⟨text⟩\label{⟨key⟩}}
\tablehead{⟨text⟩}
```

If a table is too wide for the printed page, the font size of the table can be cahnged with the `\tabletypesize` command, which takes as an argument one of the the font size change commands: `\small` (11pt), `\footnotesize` (10pt), or `\scriptsize` (8pt).

To force a table to be set in landscape orientation, use the `\rotate` command. Note that most DVI previewers will not properly render rotated `deluxetable` output, so in order to see what the table looks like, it must be output to PostScript and viewed there.

The width of a deluxetable is defined by `\tablewidth`. If this command is omitted, the default width is the width of the page. The table can be set to its natural width by specifying a dimension 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 use this log information to define a fixed table width in order to give the table a more uniform appearance across pages.

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

The caption (actually, the title) of the table is specified in `\tablecaption`. The text of `\tablecaption` should be brief; explanatory notes

should be specified in the end notes to the table (see §**??** below). If the caption does not appear centered above the table after processing, then specify the width of the table explicitly with the `\tablewidth` command and rerun LaTeX on the file. If an author supplies a `\label` for cross-referencing purposes, this, too, should be included in the `\tablecaption`.

Column headings are specified with `\tablehead`. Within the `\tablehead`, each column heading should be given in a `\colhead`, which will ensure that the heading is centered on the natural width of the column. There should be a heading for each column so that there are as many `\colhead` commands in the `\tablehead` as there are data columns.

```
\tablehead{
\colhead{⟨heading⟩} & \colhead{⟨heading⟩}}
```

If more complicated column headings are required, any valid `tabular` command that constitutes a proper head line in a LaTeX table may be used. For example, the `\multicolumn` command below would create a table head with text centered over five columns.

```
\multicolumn{5}{c}{⟨text⟩}
```

Consult **?** or **?** for further details on the available table commands.

The `\tablecolumns{⟨num⟩}` command is necessary if an author has multi-line column headings produced by `\tablehead` or other LaTeX commands and is using either the `\cutinhead` or `\sidehead` markup (see below). The ⟨*num*⟩ argument should be set to the true number of columns in the table. The command must come before the `\startdata` command.

2.15.3. Content of the `deluxetable`

After the table title and column headings have been specified, data rows can be entered. Data rows are delimited with the `\startdata` and `\enddata` commands. The end of each row is indicated with the standard LaTeX `\\` command. Data cells within a row are separated with & (ampersand) characters.

```
\startdata
⟨data line⟩\\
```

```
⟨cell⟩&⟨cell⟩&⟨cell⟩\\
⟨more data lines⟩\\
\enddata
```

Column alignment within the data columns can be adjusted with the TEX `\phantom{⟨string⟩}` command, where ⟨string⟩ can be any character, e.g., `\phantom{$\arcmin$}`. A blank character of width ⟨string⟩ is then inserted in the table. Four commands have been predefined for this purpose.

`\phn`	phantom numeral 0-9
`\phd`	phantom decimal point
`\phs`	phantom ± sign
`\phm{⟨string⟩}`	generic phantom

Extra vertical space can be inserted between rows with an optional argument to the `\\` command.

```
\\[⟨dimen⟩]
```

The argument is a dimension and may be specified in any units that are legitimate in LATEX.

In a table, it may happen that several rows of data are associated with a single object or item. Such logical groupings should not be broken across pages. In these cases, the `\tablebreak` command may be used to force a page break at the desired point.

```
⟨table row⟩\\
\tablebreak
⟨next table row⟩\\
```

This command can be used any time that the default `deluxetable` page breaks need to be overridden.

Journals often require that table cells that contain no data be explicitly marked. This is to differentiate such cells from blank cells, which are frequently interpreted as implicitly repeating the entry in the corresponding cell in the row preceding. Table cells for which there are no data should contain a `\nodata` command.

```
\nodata
```

Within the `deluxetable` body, two kinds of special heads are allowed, `\cutinhead` and `\sidehead`. A cut-in head is a piece of text centered across the width of the table. It is spaced above and below from the data rows that precede

and follow it and will appear set off by rules in the LATEX output. Similarly, the command for a side head produces a row spanning the width of the table but with the text left justified.

```
\cutinhead{⟨text⟩}
\sidehead{⟨text⟩}
```

Table footnotes (more properly, table *end notes*) may also be used in the `deluxetable` environment. Their use is described in detail in §**??**.

2.15.4. The `table` Environment

Authors may also compose tables using the `table` environment.

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

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

Titles, or captions, for tables are indicated with a `\caption` command

```
\caption{⟨text⟩\label{⟨key⟩}}
```

A table label, e.g. "Table 2," is generated automatically by `\caption`. The author may provide a `\label` in the caption with a unique ⟨key⟩ for cross-referencing purposes.

The table body should appear within the `tabular` environment.

```
\begin{tabular}{⟨cols⟩}
\end{tabular}
```

The alignment tokens in ⟨cols⟩ specify the justification for each column. The letters "l," "c," or "r" is given for each column, indicating left, center, or right justification. Consult **?** for details about using the `tabular` environment to prepare tables.

Each `tabular` table must appear within a `table` environment. 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.

Use the `\tableline` command to insert horizontal rules in the `tabular` environment.

```
\tableline
```

The use of vertical rules should be avoided.

As with the `deluxetable` environment, it is possible to override LaTeX's automatic numbering within the `table` environment using `\tablenum`. `\tablenum` must be used *inside* the `table` environment.

2.15.5. Table End Notes

AASTeX supports footnotes and end notes within 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. Use the `\tablenotemark` and `\tablenotetext` commands to supply table footnotes. As with `\altaffilmark` and `\altaffiltext`, a note label, usually a letter, is required.

```
\tablenotemark{⟨key letter(s)⟩}
\tablenotetext{⟨alpha key⟩}{⟨text⟩}
```

The ⟨*key letter*⟩ of the `\tablenotemark` should be the same as the ⟨*alpha key*⟩ for the corresponding ⟨*text*⟩. It is the responsibility of the author to make the correspondence correct.

Sometimes authors tabulate materials that have corresponding references and may want to associate these references with the table. Authors may also wish to append a short paragraph of explanatory notes that pertain to the entire table. These elements should be specified with the commands below.

```
\tablerefs{⟨reference list⟩}
\tablecomments{⟨text⟩}
```

The `\tablenotetext`, `\tablecomments`, and `\tablerefs` commands *must* be specified after the `\end{tabular}` or `\enddata` and before the closing `\end{table}` or `\end{deluxetable}`.

2.16. Supplemental Materials

For many years now, authors have been taking advantage of the AAS journals' ability to post supplemental materials with their papers in the electronic editions. Even though each paper must stand on its own scientifically without the supplements, these materials are reviewed in the peer review process and should be included in initial manuscript submissions. As with regular figures and tables, papers with online only data must reference each electronic object in the main text and include an explanation of what the reader will find in the electronic edition.

The four most popular types of supplemental materials are machine-readable tables, online color figures, online-only figures, and animations. Please see each journal's Web site for details on what types of supplemental materials are acceptable, how to submit these materials, author tools for preparing them, and their associated costs.

2.16.1. Machine-readable Tables

Online-only tables submitted to AAS journals are converted to a machine-readable format for presentation in the electronic edition. Machine-readable tables have two parts: the formatted ASCII data and a metadata header that provides format, units, and short explanations of each column of data. This structure is designed to provide maximum flexibility and ease of use for readers who wish to further manipulate the data with their own computer programs or with software like Excel.

For each machine-readable table, the author should include a short sample version of the table in his or her LaTeX submission. This sample version will appear in the print edition as well as in HTML in the electronic edition. The sample table should be 5 to 15 lines long. It should include a table note at the end with text indicating that a machine-readable version will be available in the electronic edition. For instance,

```
\tablecomments{Table 1 is
published in its entirety in
the electronic edition of
the Astrophysical Journal.
A portion is shown here
for guidance regarding its
form and content.}
```

Each example table must be cited and numbered as if it were a fully printed table.

2.16.2. Online Color Figures

For some journals, authors may submit figures that will appear in black and white in the print edi-

tion of a journal but in color in the electronic edition. In these cases, authors must submit separate black and white and RGB color versions of each figure labelled according to the file-naming conventions required for the publication. For the benefit of print journal readers, figure captions should be written with the color information placed inside parentheses, for instance, "The dotted line (colored blue in electronic edition) is the $H_o = 75$ km s-1 Mpc-1 model," and should include a note directing the reader to "See the electronic edition of the Journal for a color version of this figure."

2.16.3. Online-only Figures

This feature is mainly useful for articles that contain large compendia of identification charts and other supplemental graphic material that need not be printed in full in the paper journal. Online-only figures are intended to provide supplemental information that is not critical to the scientific content of the article but that might nonetheless be of interest to the reader.

Online-only figures must be mentioned explicitly by number and appear in correct numerical order in the body of the text. At least one figure in a series must be displayed as an example figure for the print edition. The caption should carry a message indicating that more figures are available in the electronic edition—for instance, "Plots for all sources are available in the electronic edition of the journal." Enough information must be included in the figure caption for readers of the print edition to determine what is contained in the online-only figures.

2.16.4. Animations

Currently, only animations in the MPEG format are accepted by the AAS journals. Authors must supply a still frame from the animation in EPS format marked up like a regular figure that will serve as an example for the reader. They should include text in the caption for the still frame indicating that an animation is available electronically. For instance, "This figure is also available as an mpeg animation in the electronic edition of the *Astrophysical Journal.*" As with online-only figures, authors must include enough information in the figure caption for readers of the print edition to determine what the animation il-

lustrates.

2.17. Miscellaneous

2.17.1. Celestial Objects and Data Sets

Authors who wish to have the most important objects in their paper linked to a data center in the electronic edition may do so using the

$$\texttt{\textbackslash objectname[}\langle \textit{catalog ID}\rangle\texttt{]\{}\langle \textit{text}\rangle\texttt{\}}$$

macro, or its alias \object. The text contained in the required argument will be printed in the paper and will serve as a link anchor in the electronic edition. The catalog ID given as an optional argument will be carried through as the identification key in the link to a data center. Note that links will only be activated if the name provided in the argument is recognized by a participating data center. It is the author's responsibility to use the correct identifier.

Similar markup is available for linking to data sets hosted at participating data centers.

$$\texttt{\textbackslash dataset[}\langle \textit{catalog ID}\rangle\texttt{]\{}\langle \textit{text}\rangle\texttt{\}}$$

In the paper, the text in the required argument will be printed while the the catalog ID value will be passed through to form links to data centers.

When an article contains \object or \dataset commands, the publisher will be able to use the markup to pass along a list of objects and data sets used in the paper to database personnel. Software can then be used to construct links to those databases. Please check with each journal's Web site for instructions on how to determine the object and data set identifiers, the location of verifications tools, and information on where in the paper these macros can best be used.

2.17.2. Ionic Species and Chemical Bonds

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

$$\texttt{\textbackslash ion\{}\langle \textit{element}\rangle\texttt{\}\{}\langle \textit{level}\rangle\texttt{\}}$$

The ionization state is specified as the second argument and should be given as a numeral. For example, "Ca III" would be marked up as \ion{Ca}{3}.

For single, double, and triple chemical bonds, use the following macros.

```
\sbond
\dbond
\tbond
```

2.17.3. Fractions

AASTEX contains commands that permit authors to specify alternate forms for fractions. LaTeX will set fractions in displayed math as built-up fractions; however, it is sometimes desirable to use case fractions in displayed equations. In such instances, one should use `\case` rather than `\frac`. Note, however, that authors submitting manuscripts electronically to AAS journals should generally find it unnecessary to use any markup other than the standard LaTeX `\frac`.

Built-up	`\frac{1}{2}`	$\frac{1}{2}$
Case	`\case{1}{2}`	$\frac{1}{2}$
Shilled	`1/2`	1/2

2.17.4. Astronomical Symbols

As mentioned earlier, the AASTEX package contains a collection of assorted macros for symbols and abbreviations specific to an astronomical context. These are commonly useful and also somewhat difficult for authors to produce themselves because fussy kerning is required. See the symbols pages provided with the package distribution. Most of these commands can be used in both running text and math. However, `\lesssim` and `\gtrsim` can only be used in math mode.

2.17.5. Hypertext Constructs

The `\anchor` command is a general-purpose hypertext link tag, associating ⟨*text*⟩ in the manuscript with the specified resource (⟨*href*⟩).

`\anchor{`⟨*href*⟩`}{`⟨*text*⟩`}`

⟨*href*⟩ should be specified as a *full* URI, including the `scheme:` designator (`http:`, `ftp:`, etc.).

The `\url` command supports the special case where an author wishes to express a URL in the text.

`\url{`⟨*text*⟩`}`

The `\email` command is used to identify e-mail addresses anywhere in the manuscript. The text

of the argument is the e-mail address. Please do *not* prepend the `mailto:` part.

`\email{`⟨*address*⟩`}`

This command should be used to indicate authors' e-mail addresses in author lists at the beginning of manuscripts.

2.18. Concluding the File

The last command in the electronic manuscript file should be the

`\end{document}`

command, which must appear after all the material in the paper. This command directs the formatter to finish processing the manuscript.

3. Style Options

3.1. Manuscript Style

The default style option is the `manuscript` style. This style will produce double-spaced pages printed in a single column at the width of the page.

3.2. Preprints

Two preprint styles are available. The `preprint` style is similar to the `manuscript` style, but it is single-spaced and fully justified. The `preprint2` style produces a two-column preprint.

3.2.1. Single-column Preprint

A single-column preprint format may be specified with the `preprint` style option.

`\documentclass[preprint]{aastex}`

The size of the typeface used is under author control by way of LaTeX's ⟨*nn*⟩`pt` class options (where ⟨*nn*⟩ is 10, 11, or 12). Use of 10 point type is not recommended with the `preprint` style.

3.2.2. Two-column Preprint

The `preprint2` style has the principle function of providing two-column formatting.

`\documentclass[preprint2]{aastex}`

It is important to remember that text lines are considerably shorter when two columns 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 counterproductive. Remember that the main goal of this package is to produce draft-, or referee-, format pages. It is the responsibility of the editors and publishers to produce publication-format papers for the journals.

The `preprint2` style sets the article's front matter—the title, author, abstract, and keyword material—on a separate page at full text width. The body of the article is set in a two-column page grid, the appendices in a one-column page grid, and the bibliography in a two-column page grid. (This manual was prepared using the `preprint2` style.)

The author may supply LaTeX's `\twocolumn` or `\onecolumn` commands whenever desired. Be aware, however, that using explicit column-switching commands can cause formatting problems.

3.3. The `eqsecnum` Style

The `eqsecnum` style file can be used to modify the way equations are numbered.

```
\documentclass[eqsecnum]{aastex}
```

Normally, equations are numbered sequentially through the entire paper, starting over at "(A1)" if there is an appendix. If `eqsecnum` appears in the `documentclass` 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.

3.4. The `flushrt` Style

A `flushrt` style option is available for authors that prefer to have their margins left and right justified.

```
\documentclass[eqsecnum,flushrt]{aastex}
```

Note the `preprint` and `preprint2` styles are already flush right by default.

4. Additional Documentation

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

A comprehensive example employing nearly all of the capabilities of the package (in terms of markup as well as formatting) is in `sample.tex`. This file is annotated with comments that describe the purpose of most of the markup. `sample.tex` includes three tables: two marked up using the `deluxetable` environment and another table using the LaTeX `table` environment.

In `table.tex`, a complex but short example of the `deluxetable` environment demonstrates some of the techniques that can be used to generate complex column headings and to align variable-width columns. Here the LaTeX `\multicolumn` command is used to span a heading over several columns. When `\multicolumn` is used along with the `\cutinhead` command, the `\tablecolumns` command must be used to specify the number of columns in the table—otherwise the `\cutinhead` command will not work properly. This table also makes use of the `\phn` command to better align some of the columns.

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

Many of the markup commands described in the preceding sections are standard LaTeX commands. The reader who is unfamiliar with their syntax is referred to the LaTeX references works cited in the bibliography, in particular **?** and **?**.

Authors who wish to know the ins and outs of TeX itself should read the *TeXbook* (**?**). This resource contains a good deal of information about typography in general. Many details of mathematical typography are discussed in *Mathematics into Type* by **?**.

5. Acknowledgments

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