

# Template AAST<sub>E</sub>XArticle with Examples: v6.3.1\*

GREG J. SCHWARZ <sup>1</sup>, AUGUST MUENCH,<sup>1</sup>

(AAS JOURNALS DATA EDITORS)

F.X TIMMES,<sup>2,3</sup> AMY HENDRICKSON,<sup>4,†</sup> JULIE STEFFEN,<sup>5,1</sup>

<sup>1</sup>*American Astronomical Society*

*1667 K Street NW, Suite 800*

*Washington, DC 20006, USA*

<sup>2</sup>*Arizona State University*

<sup>3</sup>*AAS Journals Associate Editor-in-Chief*

<sup>4</sup>*TeXnology Inc.*

<sup>5</sup>*AAS Director of Publishing*

## ABSTRACT

This example manuscript is intended to serve as a tutorial and template for authors to use when writing their own AAS Journal articles. The manuscript includes a history of AAST<sub>E</sub>X and includes figure and table examples to illustrate these features. Information on features not explicitly mentioned in the article can be viewed in the manuscript comments or more extensive online documentation. Authors are welcome replace the text, tables, figures, and bibliography with their own and submit the resulting manuscript to the AAS Journals peer review system. The first lesson in the tutorial is to remind authors that the AAS Journals, the Astrophysical Journal (ApJ), the Astrophysical Journal Letters (ApJL), the Astronomical Journal (AJ), and the Planetary Science Journal (PSJ) all have a 250 word limit for the abstract<sup>a)</sup>. If you exceed this length the Editorial office will ask you to shorten it. This abstract has 161 words.

*Keywords:* Classical Novae (251) — Ultraviolet astronomy(1736) — History of astronomy(1868) — Interdisciplinary astronomy(804)

## 1. INTRODUCTION

La<sub>T</sub>E<sub>X</sub><sup>1</sup> is a document markup language that is particularly well suited for the publication of mathematical and scientific articles (Lamport 1994). La<sub>T</sub>E<sub>X</sub> was written in 1985 by Leslie Lamport who based it on the T<sub>E</sub>X typesetting language which itself was created by Donald E. Knuth in 1978. In 1988 a suite of La<sub>T</sub>E<sub>X</sub> macros were developed to investigate electronic submission and publication of AAS Journal articles (Hanisch & Biemesderfer 1989). Shortly afterwards, Chris Biemesderfer merged these macros and more into a La<sub>T</sub>E<sub>X</sub> 2.08 style file called AAST<sub>E</sub>X. These early AAST<sub>E</sub>X versions introduced many common commands and practices that authors take for granted today. Substantial revisions were made by Lee Brotzman and Pierre Landau when the package was updated to v4.0. AASTeX v5.0, written in 1995 by Arthur Ogawa, upgraded to La<sub>T</sub>E<sub>X</sub> 2e which uses the document class in lieu of a style file. Other improvements to version 5 included hypertext support, landscape deluxetables and improved figure support to facilitate electronic submission. AAST<sub>E</sub>X v5.2 was released in 2005 and introduced additional graphics support plus new mark up to identifier astronomical objects, datasets and facilities.

In 1996 Maxim Markevitch modified the AAS preprint style file, aaspp4.sty, to closely emulate the very tight, two column style of a typeset Astrophysical Journal article. The result was emulateapj.sty. A year later Alexey Vikhlinin

\* Released on March, 1st, 2021

<sup>a)</sup> Abstracts for Research Notes of the American Astronomical Society (RNAAS) are limited to 150 words

<sup>†</sup> AASTeX v6+ programmer

<sup>1</sup> <http://www.latex-project.org/>

took over development and maintenance. In 2001 he converted `emulateapj` into a class file in LaTeX 2e and in 2003 Vikhlinin completely rewrote `emulateapj` based on the APS Journal's RevTeX class.

During this time `emulateapj` gained growing acceptance in the astronomical community as it filled an author need to obtain an approximate number of manuscript pages prior to submission for cost and length estimates. The tighter typeset also had the added advantage of saving paper when printing out hard copies.

Even though author publication charges are no longer based on print pages<sup>2</sup> the `emulateapj` class file has proven to be extremely popular with AAS Journal authors. An analysis of submitted LaTeX manuscripts in 2015 revealed that ~65% either called `emulateapj` or have a commented `emulateapj` classfile call indicating it was used at some stage of the manuscript construction. Clearly authors want to have access to a tightly typeset version of the article when corresponding with co-authors and for preprint submissions.

When planning the next AASTeX release the popularity of `emulateapj` played an important roll in the decision to drop the old base code and adopt and modify `emulateapj` for AASTeX v6.+ instead. The change brings AASTeX inline with what the majority of authors are already using while still delivering new and improved features. AASTeX v6.0 through v6.31 were written by Amy Hendrickson. The release dates were January 2016 (v6.0), October 2016 (v6.1), January 2018 (v6.2), June 2019 (v6.3), and March 2020 (v6.31) respectively.

The rest of this article provides information and examples on how to create your own AAS Journal manuscript with v6.31. The next section describes the different manuscript styles available and how they differ from past releases. Section 3 describes table and figure placement. Specific examples of a table, Section 3.1, and a figure, Section 3.2, are also provided. The last section, 4, shows how recognize software and external data as first class references in the manuscript bibliography. An appendix is included for additional information readers might find useful. More documentation is embedded in the comments of this LaTeX file and in the online documentation at <http://journals.aas.org/authors/aastex.html>.

## 2. MANUSCRIPT STYLES

The default style in AASTeX v6.31 is a tight single column style, e.g. 10 point font, single spaced. The single column style is very useful for article with wide equations. It is also the easiest to style to work with since figures and tables, see Section 3, will span the entire page, reducing the need for address float sizing.

To invoke a two column style similar to the what is produced in the published PDF copy use

```
\documentclass[twocolumn]{aastex631}.
```

Note that in the two column style figures and tables will only span one column unless specifically ordered across both with the “\*” flag, e.g.

```
\begin{figure*} ... \end{figure*},
\begin{table*} ... \end{table*}, and
\begin{deluxetable*} ... \end{deluxetable*}.
```

This option is ignored in the onecolumn style.

Some other style options are outlined in the commented sections of this article. Any combination of style options can be used.

Authors are required to provide line numbering in the manuscript. Line numbering makes it easier for the review to references specific places in the manuscript. This functionality has been built into AASTeX since v6.0. The `linenumbers` style option invokes the `lineno` style file to number each article line in the left margin.

There is also a new `modern` option that uses a Daniel Foreman-Mackey and David Hogg design to produce stylish, single column output that has wider left and right margins. It is designed to have fewer words per line to improve reader retention. It also looks better on devices with smaller displays such as smart phones.

The `anonymous` option will prevent the author and affiliations from being shown in the compiled pdf copy. This option allows the author to keep this critical information in the latex file but prevent the reviewer from seeing it during peer review if dual anonymous review (DAR) is requested. Likewise, acknowledgments can also be hidden if

<sup>2</sup> see Section C in the Appendix for more details about how current article costs are calculated.

placed in the new `\begin{acknowledgments} ... \end{acknowledgments}` environment. The use of this option is highly recommended for PSJ submissions. Advice for anonymizing your manuscript for DAR is provided at <https://journals.aas.org/manuscript-preparation/#dar>.

### 3. FLOATS

Floats are non-text items that generally can not be split over a page. They also have captions and can be numbered for reference. Primarily these are figures and tables but authors can define their own. LaTeX tries to place a float where indicated in the manuscript but will move it later if there is not enough room at that location, hence the term “float”.

Authors are encouraged to embed their tables and figures within the text as they are mentioned. Please do not place the figures and text at the end of the article as was the old practice. Editors and the vast majority of referees find it much easier to read a manuscript with embedded figures and tables.

Depending on the number of floats and the particular amount of text and equations present in a manuscript the ultimate location of any specific float can be hard to predict prior to compilation. It is recommended that authors not spend significant time trying to get float placement perfect for peer review. The AAS Journal’s publisher has sophisticated typesetting software that will produce the optimal layout during production.

Note that authors of Research Notes are only allowed one float, either one table or one figure.

For authors that do want to take the time to optimize the locations of their floats there are some techniques that can be used. The simplest solution is to place a float earlier in the text to get the position right but this option will break down if the manuscript is altered. A better method is to force LaTeX to place a float in a general area with the use of the optional `[placement specifier]` parameter for figures and tables. This parameter goes after `\begin{figure}`, `\begin{table}`, and `\begin{deluxetable}`. The main arguments the specifier takes are “h”, “t”, “b”, and “!”. These tell LaTeX to place the float here (or as close as possible to this location as possible), at the top of the page, and at the bottom of the page. The last argument, “!”, tells LaTeX to override its internal method of calculating the float position. A sequence of rules can be created by using multiple arguments. For example, `\begin{figure}[htb!]` tells LaTeX to try the current location first, then the top of the page and finally the bottom of the page without regard to what it thinks the proper position should be. Many of the tables and figures in this article use a placement specifier to set their positions.

Note that the LaTeX `tabular` environment is not a float. Only when a `tabular` is surrounded by `\begin{table} ... \end{table}` is it a true float and the rules and suggestions above apply.

In AASTeX v6.31 all `deluxetables` are float tables and thus if they are longer than a page will spill off the bottom. Long `deluxetables` should begin with the `\startlongtable` command. This initiates a `longtable` environment. Authors might have to use `\clearpage` to isolate a long table or optimally place it within the surrounding text.

#### 3.1. Tables

Tables can be constructed with LaTeX’s standard table environment or the AASTeX’s `deluxetable` environment. The `deluxetable` construct handles long tables better but has a larger overhead due to the greater amount of defined mark up used set up and manipulate the table structure. The choice of which to use is up to the author.

Tables longer than 250 data lines and complex tables should only have a short example table with the full data set available in the machine readable format. The machine readable table will be available in the HTML version of the article with just a short example in the PDF. Authors are required to indicate in the table comments that the data in machine readable format in the full article. Authors are encouraged to create their own machine readable tables using the online tool at <http://authortools.aas.org/MRT/upload.html> but the data editors will review and edit all submissions prior to publication.

Full details on how to create the different types of tables are given in the AASTeX guidelines at <http://journals.aas.org/authors/aastex.html>

##### 3.1.1. Splitting a table into multiple horizontal components

Since the AAS Journals are now all electronic with no print version there is no reason why tables can not be as wide as authors need them to be. However, there are some artificial limitations based on the width of a print page. The old way around this limitation was to rotate into landscape mode and use the smallest available table font sizes, e.g. `\tablewidth`, to get the table to fit. Unfortunately, this was not always enough but now there is a new way to

**Table 1.** Measurements of Emission Lines: two breaks

Model	Component	Shift (km s <sup>-1</sup> )	FWHM (km s <sup>-1</sup> )	Flux (10 <sup>-17</sup> erg s <sup>-1</sup> cm <sup>-2</sup> )
(1)	(2)	(3)	(4)	(5)
Model 1	BELs	-97.13	9117±38	1033±33
	IELs	-4049.123	1974±22	2495±30
	NELs	...	641±4	449±23
Model 2	BELs	-85	8991±41	988±29
	IELs	-51000	2025±26	2494±32
	NELs	52	637±10	477±17

N V	Si IV	C IV	Mg II	H $\gamma$
(6)	(7)	(8)	(9)	(10)
< 35	< 166	637±31	1951±26	991±30
< 42	< 109	995±186	83±30	75±23
< 6	< 9	—	275±18	150±11
< 24	< 173	623±28	1945±29	989±27
< 37	< 124	1005±190	72±28	72±21
< 4	< 8	—	278±17	153±10

H $\beta$	H $\alpha$	He I	Pa $\gamma$
(11)	(12)	(13)	(14)
3502±42	20285±80	2025±116	1289±107
130±25	357±94	194±64	36±23
313±12	958±43	318±34	151±17
3498±37	20288±73	2047±143	1376±167
113±18	271±85	205±72	34±21
317±15	969±40	325±37	147±22

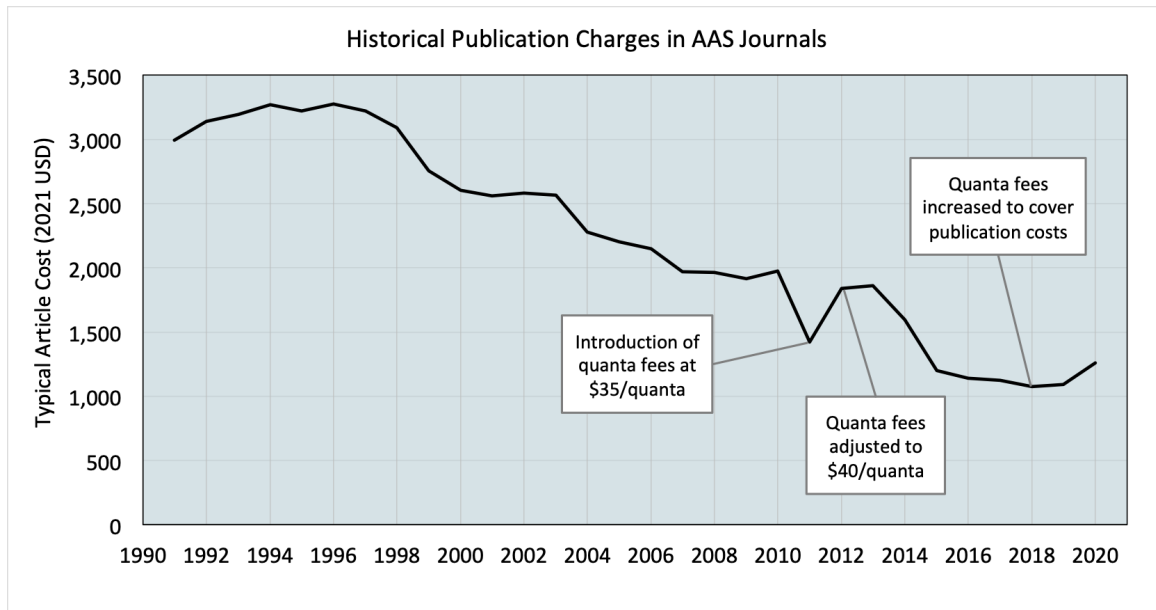
NOTE—This is an example of how to split a deluxetable. You can split any table with this command into two or three parts. The location of the split is given by the author based on the placement of the “B” indicators in the column identifier preamble. For more information please look at the new AAST<sub>E</sub>X instructions.

break a table into two or three components so that it flows down a page by invoking a new table type, splittabular or splitdeluxetable. Within these tables a new “B” column separator is introduced. Much like the vertical bar option, “|”, that produces a vertical table lines the new “B” separator indicates where to Break a table. Up to two “B”s may be included.

Table 1 shows how to split a wide deluxetable into three parts with the `\splitdeluxetable` command. The `\colnumbers` option is on to show how the automatic column numbering carries through the second table component.

### 3.2. Figures

Authors can include a wide number of different graphics with their articles but encapsulated postscript (EPS) or portable document format (PDF) are encouraged. These range from general figures all authors are familiar with to new enhanced graphics that can only be fully experienced in HTML. The later include figure sets, animations and interactive figures. All enhanced graphics require a static two dimensional representation in the manuscript to serve as the example for the reader. All figures should include detailed and descriptive captions. These captions are absolutely critical for readers for whom the enhanced figure is inaccessible either due to a disability or offline access.



**Figure 1.** The cost for an author to publish an article has trended downward over time. This figure shows the average cost of an article from 1990 to 2020 in 2021 adjusted dollars.

Figure 1 shows the changes in the author publication charges (APCs) from 1990 to 2020 in the AAS Journals. The primary command for creating figures is the `\includegraphics` command. Full details can be found [https://en.wikibooks.org/wiki/LaTeX/Importing\\_Graphics#Including\\_graphics](https://en.wikibooks.org/wiki/LaTeX/Importing_Graphics#Including_graphics).

### 3.3. Enhanced graphics

Enhanced graphics have an example figure to serve as an example for the reader and the full graphical item available in the published HTML article. This includes Figure sets, animations, and interactive figures. The Astronomy Image Explorer (<http://www.astroexplorer.org/>) provides access to all the figures published in the AAS Journals since they offered an electronic version which was in the mid 1990s. You can filter image searches by specific terms, year, journal, or type. The type filter is particularly useful for finding all published enhanced graphics. As of May 2022 there are over 4500 videos, 1600 figure sets, and 125 interactive figures. Authors should review the AASTeX guidebook at <http://journals.aas.org/authors/aastex/aasguide.html> to see how to represent these enhanced graphics in their own manuscripts.

## 4. SOFTWARE AND THIRD PARTY DATA REPOSITORY CITATIONS

The AAS Journals would like to encourage authors to change software and third party data repository references from the current standard of a footnote to a first class citation in the bibliography. As a bibliographic citation these important references will be more easily captured and credit will be given to the appropriate people.

The first step to making this happen is to have the data or software in a long term repository that has made these items available via a persistent identifier like a Digital Object Identifier (DOI). A list of repositories that satisfy this criteria plus each one's pros and cons are given at <https://github.com/AASJournals/Tutorials/tree/master/Repositories>.

In the bibliography the format for data or code follows this format:

author year, title, version, publisher, prefix:identifier

Corrales (2015) provides a example of how the citation in the article references the external code at <https://doi.org/10.5281/zenodo.15991>. Unfortunately, bibtex does not have specific bibtex entries for these types of references so the “@misc” type should be used. The Repository tutorial explains how to code the “@misc” type correctly. The most recent aasjournal.bst file, available with AASTeX v6, will output bibtex “@misc” type properly.

We thank all the people that have made this AASTeX what it is today. This includes but not limited to Bob Hanisch, Chris Biemesderfer, Lee Brotzman, Pierre Landau, Arthur Ogawa, Maxim Markevitch, Alexey Vikhlinin and Amy Hendrickson. Also special thanks to David Hogg and Daniel Foreman-Mackey for the new "modern" style design. Considerable help was provided via bug reports and hacks from numerous people including Patricio Cubillos, Alex Drlica-Wagner, Sean Lake, Michele Bannister, Peter Williams, and Jonathan Gagne.

*Facilities:* HST(STIS), Swift(XRT and UVOT), AAVSO, CTIO:1.3m, CTIO:1.5m,CXO

*Software:* astropy (Astropy Collaboration et al. 2013, 2018), Cloudy (Ferland et al. 2013), Source Extractor (Bertin & Arnouts 1996)

## APPENDIX

### A. APPENDIX INFORMATION

Appendices can be broken into separate sections just like in the main text. The only difference is that each appendix section is indexed by a letter (A, B, C, etc.) instead of a number. Likewise numbered equations have the section letter appended. Here is an equation as an example.

$$I = \frac{1}{1 + d_1^{P(1+d_2)}} \quad (\text{A1})$$

Appendix tables and figures should not be numbered like equations. Instead they should continue the sequence from the main article body.

### B. GOLD OPEN ACCESS

As of January 1st, 2022, all of the AAS Journals articles became open access, meaning that all content, past, present and future, is available to anyone to read and download. A page containing frequently asked questions is available at <https://journals.aas.org/oa/>.

### C. AUTHOR PUBLICATION CHARGES

In April 2011 the traditional way of calculating author charges based on the number of printed pages was changed. The reason for the change was due to a recognition of the growing number of article items that could not be represented in print. Now author charges are determined by a number of digital "quanta". A single quantum is 350 words, one figure, one table, and one enhanced digital item. For the latter this includes machine readable tables, figure sets, animations, and interactive figures. The current cost for the different quanta types is available at [https://journals.aas.org/article-charges-and-copyright/#author\\_publication\\_charges](https://journals.aas.org/article-charges-and-copyright/#author_publication_charges). Authors may use the online length calculator to get an estimate of the number of word and float quanta in their manuscript. The calculator is located at <https://authortools.aas.org/Quanta/newlatexwordcount.html>.

### D. ROTATING TABLES

The process of rotating tables into landscape mode is slightly different in AASTeXv6.31. Instead of the `\rotate` command, a new environment has been created to handle this task. To place a single page table in a landscape mode start the table portion with `\begin{rotatetable}` and end with `\end{rotatetable}`.

Tables that exceed a print page take a slightly different environment since both rotation and long table printing are required. In these cases start with `\begin{longrotatetable}` and end with `\end{longrotatetable}`. Table ?? is an example of a multi-page, rotated table. The `\movetabledown` command can be used to help center extremely wide, landscape tables. The command `\movetabledown=1in` will move any rotated table down 1 inch.

A handy "cheat sheet" that provides the necessary LaTeX to produce 17 different types of tables is available at [http://journals.aas.org/authors/aastex/aasguide.html#table\\_cheat\\_sheet](http://journals.aas.org/authors/aastex/aasguide.html#table_cheat_sheet).

E. USING CHINESE, JAPANESE, AND KOREAN CHARACTERS

Authors have the option to include names in Chinese, Japanese, or Korean (CJK) characters in addition to the English name. The names will be displayed in parentheses after the English name. The way to do this in AASTeX is to use the CJK package available at <https://ctan.org/pkg/cjk?lang=en>. Further details on how to implement this and solutions for common problems, please go to <https://journals.aas.org/nonroman/>.

REFERENCES

<p>221 Astropy Collaboration, Robitaille, T. P., Tollerud, E. J.,  222 et al. 2013, A&amp;A, 558, A33,  223 doi: <a href="https://doi.org/10.1051/0004-6361/201322068">10.1051/0004-6361/201322068</a>  224 Astropy Collaboration, Price-Whelan, A. M., Sipőcz, B. M.,  225 et al. 2018, AJ, 156, 123, doi: <a href="https://doi.org/10.3847/1538-3881/aabc4f">10.3847/1538-3881/aabc4f</a>  226 Bertin, E., &amp; Arnouts, S. 1996, A&amp;AS, 117, 393,  227 doi: <a href="https://doi.org/10.1051/aas:1996164">10.1051/aas:1996164</a></p>	<p>228 Corrales, L. 2015, ApJ, 805, 23,  229 doi: <a href="https://doi.org/10.1088/0004-637X/805/1/23">10.1088/0004-637X/805/1/23</a>  230 Ferland, G. J., Porter, R. L., van Hoof, P. A. M., et al.  231 2013, RMxAA, 49, 137. <a href="https://arxiv.org/abs/1302.4485">https://arxiv.org/abs/1302.4485</a>  232 Hanisch, R. J., &amp; Biemesderfer, C. D. 1989, in BAAS, 780  233 Lamport, L. 1994, LaTeX: A Document Preparation  234 System, 2nd edn. (Addison-Wesley Professional)</p>
--	--