

# The Title Goes Here with Each Initial Letter Capitalized

Author's Name,<sup>1, a)</sup> Author's Name,<sup>1, b)</sup> and Another's Name<sup>2, 3, c)</sup>

- 1) *Replace this text with an author's affiliation (use complete addresses, including country name or code).*
- 2) *Second institution and/or address*
- 3) *You would list an author's second affiliation (if applicable) here.*
  - a) *Corresponding author: first.author@insitution.edu*
  - b) *Electronic mail: second.author@institution.edu.*
  - c) *Electronic mail: third.author@anotherinstitution.edu*

**Abstract.** An article usually includes an abstract, a concise summary of the work covered at length in the main body of the article. It is used for secondary publications and for information retrieval purposes.

## FIRST-LEVEL HEADING: THE LINE BREAK WAS FORCED via \\

This sample document demonstrates proper use of REVTEX 4.1 (and L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub>) in manuscripts prepared for submission to AIP conference proceedings. Further information can be found in the documentation included in the distribution or available at <http://authors.aip.org> and in the documentation for REVTEX 4.1 itself.

When commands are referred to in this example file, they are always shown with their required arguments, using

normal TEX format. In this format, #1, #2, etc. stand for required author-supplied arguments to commands. For example, in `\section{#1}` the #1 stands for the title text of the author's section heading, and in `\title{#1}` the #1 stands for the title text of the paper.

Line breaks in section headings at all levels can be introduced using `\\`. A blank input line tells TEX that the paragraph has ended.

## Second-level heading: Formatting

This file may be formatted in both the preprint (the default) and reprint styles; the latter format may be used to mimic final journal output. Either format may be used for submission purposes. Hence, it is essential that authors check that their manuscripts format acceptably under preprint. Manuscripts submitted to AIP that do not format correctly under the preprint option may be delayed in both the editorial and production processes.

## Third-level heading: Citations and Footnotes

Citations in text refer to entries in the Bibliography; they use the commands `\cite{#1}` or `\onlinecite{#1}`. Because REVTEX uses the natbib package of Patrick Daly, its entire repertoire of commands are available in your document; see the natbib documentation for further details. The argument of `\cite` is a comma-separated list of *keys*; a key may consist of letters and numerals.

By default, citations are numerical; [1] author-year citations are an option. To give a textual citation, use `\onlinecite{#1}`: (Refs. 2, 3, and 4). REVTEX "collapses" lists of consecutive numerical citations when appropriate. REVTEX provides the ability to properly punctuate textual citations in author-year style; this facility works correctly with numerical citations only with natbib's compress option turned off. To illustrate, we cite several together [1, 2, 3, 5], and once again (Refs. 1, 3, 4, and 5). Note that, when numerical citations are used, the references were sorted into the same order they appear in the bibliography.

A reference within the bibliography is specified with a `\bibitem{#1}` command, where the argument is the citation key mentioned above. `\bibitem{#1}` commands may be crafted by hand or, preferably, generated by using BibTEX. The AIP styles for REVTEX 4 include BibTEX style files aipnum.bst and aipauth.bst, appropriate for numbered and author-year bibliographies, respectively. REVTEX 4 will automatically choose the style appropriate for

the document's selected class options: the default is numerical, and you obtain the author-year style by specifying a class option of `author-year`.

This sample file demonstrates a simple use of the BibTEX tool via a `\bibliography` command referencing the `aipsamp.bib` file. Running BibTEX (in this case `bibtex aipsamp`) after the first pass of L<sup>A</sup>T<sub>E</sub>X produces the file `aipsamp.bbl` which contains the automatically formatted `\bibitem` commands (including extra markup information via `\bibinfo` commands). If not using BibTEX, the `thebibliography` environment should be used instead.

*Fourth-level heading is run in.* Footnotes are produced using the `\footnote{#1}` command. Numerical style citations put footnotes into the bibliography [6]. Author-year and numerical author-year citation styles (each for its own reason) cannot use this method. Note: due to the method used to place footnotes in the bibliography, you must re-run BibTeX every time you change any of your document's footnotes.

## MATH AND EQUATIONS

Inline math may be typeset using the `$` delimiters. Bold math symbols may be achieved using the `bm` package and the `\bm{#1}` command it supplies. For instance, a bold  $\alpha$  can be typeset as `$\bm{\alpha}$` giving  $\alpha$ . Fraktur and Blackboard (or open face or double struck) characters should be typeset using the `\mathfrak{#1}` and `\mathbb{#1}` commands respectively. Both are supplied by the `amssymb` package. For example, `$\mathbb{R}$` gives  $\mathbb{R}$  and `$\mathfrak{G}$` gives  $\mathfrak{G}$ .

In L<sup>A</sup>T<sub>E</sub>X there are many different ways to display equations, and a few preferred ways are noted below. Displayed math will center by default. Use the class option `fleqn` to flush equations left.

Below we have numbered single-line equations, the most common kind:

$$\chi_+(p) = 4 [2|\mathbf{p}|(|\mathbf{p}| + p_z)]^{-1/2} |\mathbf{p}| + p_z, \quad (2)$$

$$\frac{1234567890abc123}{\beta\gamma\delta 1234556a\beta} \sum_a$$

$$1 \qquad A^b.$$

Note the open one in Eq. (2).

Not all numbered equations will fit within the text width this way. The equation number will move down automatically if it cannot fit on the same line with a one-line equation:

$$ab12345678abc123456abcde f a\beta\gamma\delta 1234556a\beta \sum_a 1234567890abcde f ghi \quad (3)$$

$$jklmnopqrstuvwxyz123456789$$

When the `\label{#1}` command is used [cf. input for Eq. (2)], the equation can be referred to in text without knowing the equation number that TEX will assign to it. Just use `\ref{#1}`, where `#1` is the same name that used in the `\label{#1}` command.

Unnumbered single-line equations can be typeset using the `\[, \]` format:

$$g^+g^+ \rightarrow g^+g^+g^+g^+ \dots, \quad q^+q^+ \rightarrow q^+g^+g^+ \dots$$

### Multiline equations

Multiline equations are obtained by using the `eqnarray` environment. Use the `\nonumber` command at the end of each line to avoid assigning a number:

$$M = ig_x^2 (4E_1E_2)^{1/2} (l^2)^{-1} \delta_{\sigma, -\sigma} (g_i^e)^2 \chi_{-\sigma}(p_2) \times [\varepsilon_i \varepsilon_i]_{\sigma^1} \chi_{\sigma^1}(p_1), \quad (4)$$

$$g \quad s \quad \sum |M^{\text{viol}}|^2 = g^{2n-4} (Q^2)^{N^{n-2}(N^2-1)} \quad c^f. \quad (5)$$

$$\times \sum! \frac{1}{S_{12}} \frac{1}{S_{12}} \quad i < j \quad \text{perm} \quad \tau \quad \mathbb{P}$$

**TABLE I.** This table illustrates left-aligned, centered, and right-aligned columns. Note that REVTEX 4 adjusts the intercolumn spacing so that the table fills the entire width of the text. Table captions are numbered automatically.

Left <sup>a</sup>	Centered <sup>b</sup>	Right
1	2	3
10	20	30
100	200	300

<sup>a</sup> Note a.  
<sup>b</sup> Note b.

**Note:** Do not use `\label{#1}` on a line of a multiline equation if `\nonumber` is also used on that line. Incorrect cross-referencing will result. Notice the use `\text{#1}` for using a Roman font within a math environment.

To set a multiline equation without *any* equation numbers, use the `\begin{eqnarray*}`, `\end{eqnarray*}` format:

$$\sum |M_g^{\rm viol}|^2 = g_S^{2n-4} (Q^2)^{N^{n-2} (N^2 - 1)} \times \sum_{\substack{g \in G \\ g \neq 1}} \sum_{\substack{\text{perm} \\ S_1, S_2, S_3, S_4}} \frac{1}{S_1 S_2 S_3 S_4} \frac{1}{S_1} \dots$$

To obtain numbers not normally produced by the automatic numbering system, use the `\tag{#1}` command, where #1 is the desired equation number. For example, to get an equation number of (5.1),

$$g^+g^+ \rightarrow g^+g^+g^+g^+ \dots, \quad q^+q^+ \rightarrow q^+g^+g^+ \dots \tag{5.1'}$$

A few notes on `\tag{#1}`. `\tag{#1}` requires `amsmath`. The `\tag{#1}` must come before the `\label{#1}`, if any. The numbering set with `\tag{#1}` is *transparent* to the automatic numbering in REVTEX; therefore, the number must be known ahead of time, and it must be manually adjusted if other equations are added. `\tag{#1}` works with both single-line and multiline equations. `\tag{#1}` should only be used in exceptional case - do not use it to number all equations in a paper.

Enclosing single-line and multiline equations in `\begin{subequations}` and `\end{subequations}` will produce a set of equations that are “numbered” with letters, as shown in Eqs. (6a) and (6b) below:

$$\begin{aligned} abc123456abcde f \\ a\beta\gamma\delta \ 1234556a\beta \\ 1 \sum_a \\ A \end{aligned} \tag{6a}$$

$$\begin{aligned} M = & i g_{\chi}^2 (4 E_1 E_2)^{1/2} (l^2)^{-1} (g^e)_{\sigma}^2 \chi_{-\sigma} (p_2) \\ & \times [\varepsilon_i]_{\sigma^1} \chi_{\sigma^1} (p_1). \end{aligned} \tag{6b}$$

Putting a `\label{#1}` command right after the `\begin{subequations}`, allows one to reference all the equations in a subequations environment. For example, the equations in the preceding subequations environment were Eqs. (6).

### CROSS-REFERENCING

REVTEX will automatically number sections, equations, figure captions, and tables. In order to reference them in text, use the `\label{#1}` and `\ref{#1}` commands. To reference a particular page, use the `\pageref{#1}` command.

The `\label{#1}` should appear in a section heading, within an equation, or in a table or figure caption. The `\ref{#1}` command is used in the text where the citation is to be displayed. Some examples: Section on page 1, Table I, and Fig. 1.

### FIGURES AND TABLES

Figures and tables are typically “floats”; L<sup>A</sup>T<sub>E</sub>X determines their final position via placement rules. L<sup>A</sup>T<sub>E</sub>X isn’t

always successful in automatically placing floats where you wish them.

## Test Figure

**FIGURE 1.** A figure caption. The figure captions are automatically numbered.

**TABLE II.** Numbers in columns Three–Five have been aligned by using the “d” column specifier (requires the `dcolumn` package). Non-numeric entries (those entries without a “.”) in a “d” column are aligned on the decimal point. Use the “D” specifier for more complex layouts.

One	Two	Three	Four	Five
one	two	three	four	five
He	2	2.77234	45672.	0.69
C <sup>a</sup>	C <sup>b</sup>	12537.64	37.66345	86.37

<sup>a</sup> Some tables require footnotes.

<sup>b</sup> Some tables need more than one footnote.

Figures are marked up with the `figure` environment, the content of which imports the image (`\includegraphics`) followed by the figure caption (`\caption`). The argument of the latter command should itself contain a `\label` command if you wish to refer to your figure with `\ref`.

Import your image using either the `graphics` or `graphicx` packages. Both of these packages define the `\includegraphics{#1}` command, but they differ in the optional arguments for specifying the orientation, scaling, and translation of the figure. Fig. 1 is an example of this.

The analog of the `figure` environment is `table`, which uses the same `\caption` command. However, you should type your caption command first within the `table`, instead of last as you did for `figure`.

The heart of any table is the `tabular` environment, which represents the table content as a (vertical) sequence of table rows, each containing a (horizontal) sequence of table cells. Cells are separated by the `&` character; the row terminates with `\\`. The required argument for the `tabular` environment specifies how data are displayed in each of the columns. For instance, a column may be centered (c), left-justified (l), right-justified (r), or aligned on a decimal point (d). (Table II illustrates the use of decimal column alignment.)

Extra column-spacing may be specified as well, although REVTeX 4 sets this spacing so that the columns fill the width of the table. Horizontal rules are typeset using the `\hline` command. The doubled (or Scotch) rules that appear at the top and bottom of a table can be achieved by enclosing the `tabular` environment within a `ruledtabular` environment. Rows whose columns span multiple columns can be typeset using LATEX’s `\multicolumn{#1}{#2}{#3}` command (for example, see the first row of Table III).

**TABLE III.** This table demonstrates the use of `\multicolumn` in rows with entries that span more than one column.

4*h*

4*h*

<sup>a</sup> The  $z$  parameter of these positions is  $z \sim \frac{1}{4}$ .

<sup>b</sup> This is a footnote in a table. It is supposed to set on the full width of the page, just as the caption does.



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