Paper Title

Your Name[a,b], **Flip Tanedo**[a] and **Tu Nombre**[b,c]

your.name@ucr.edu, flip.tanedo@ucr.edu, tu.nombre@ucr.edu

[a] *Department of Physics & Astronomy, University of California, Riverside,* CA 92521 USA
[b] *Department of Physics, University of Somewhere, Elsewhere,* CA 99999 USA
[c] *CERN, Theoretical Physics Department, CH-1211 Geneva 23, Switzerland*

Abstract

This is a simple template for my papers. It's not very different from the plain article style, but it has most of the macros I use pre-written.

1 Introduction **2**

2 Common environments **2**
2.1 Figures: floating and wrapped . . . 3
2.2 Figures in Equation Environments . . . 4
2.3 Best practices for tables . . . 4

3 Labels and cleveref **4**
3.1 `cleveref` . . . 4
3.2 Sub-equations . . . 5
3.3 Referring to Equations . . . 5

4 Macros **5**
4.1 Modest capitalization . . . 5
4.2 Macros for Collaboration . . . 6
4.3 `xspace` . . . 7

5 Mathematics and Physics **7**
5.1 Environments . . . 7
5.2 Text and Math: super- and subscripts . . . 7
5.3 Units and spacing . . . 8
5.4 Upright characters . . . 8
5.5 Absolute Values . . . 9
5.6 Vector notation . . . 9
5.7 Miscellaneous . . . 9

6 Space **10**
6.1 Kerning: spacing between characters . . . 10
6.2 Manual Spacing . . . 10
6.3 Ties create non-breaking spaces . . . 10
6.4 Underlined space . . . 11

7 Some Best Practices **11**
7.1 LaTeX in a title 11
7.2 Ranges 11
7.3 References 11

8 Neat examples **12**

9 Teaching Examples **12**

1 Introduction

This is a template for my papers and lecture notes. The sample file includes LaTeX snippets for common components of such documents. It also includes some (opinionated) suggestions for best practices when preparing a LaTeX document.

There are now three templates:

1. `sample_paper.tex`: (this document) for papers.
2. `sample_shortnote.tex`: for quick notes; no author list, no bibliography, no hassle.
3. `sample_lecturenotes.tex`: a hefty framework for writing extended lecture notes that can be printed and used as a textbook. Features: chapter/section, large margins for comments, BibLaTeX citations as footnotes, chapter appendices.
4. `sample_nicedocument.tex`: a professional document that uses local fonts (XeLaTeX), colors, and a nice footer. Useful for job applications.

There is example text located in `./examples/`. These include common chunks of code and commentary on best practices.

Example *Lorem Ipsum* text Fusce mauris. Vestibulum luctus nibh at lectus. Sed bibendum, nulla a faucibus semper, leo velit ultricies tellus, ac venenatis arcu wisi vel nisl. Vestibulum diam. Aliquam pellentesque, augue quis sagittis posuere, turpis lacus congue quam, in hendrerit risus eros eget felis. Maecenas eget erat in sapien mattis porttitor. Vestibulum porttitor. Nulla facilisi. Sed a turpis eu lacus commodo facilisis. Morbi fringilla, wisi in dignissim interdum, justo lectus sagittis dui, et vehicula libero dui cursus dui. Mauris tempor ligula sed lacus. Duis cursus enim ut augue. Cras ac magna. Cras nulla. Nulla egestas. Curabitur a leo. Quisque egestas wisi eget nunc. Nam feugiat lacus vel est. Curabitur consectetuer.

2 Common environments

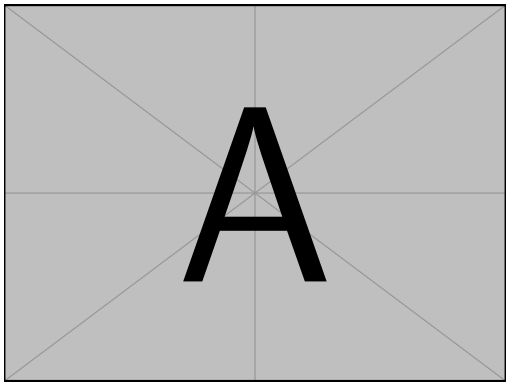
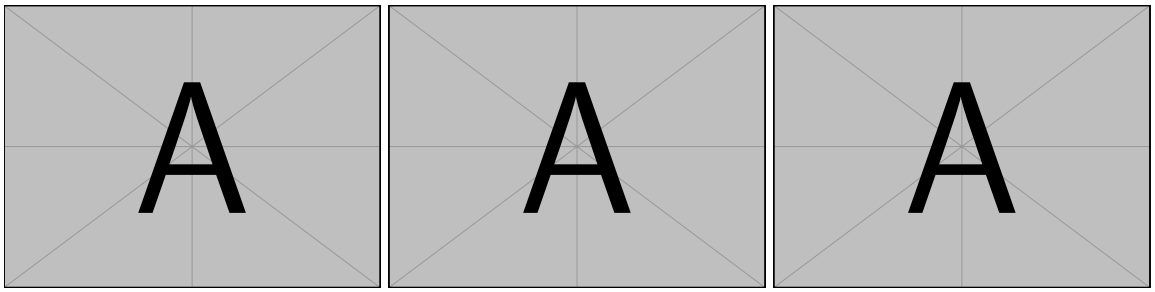


Fig. 1: The figure environment shows up often. Here's a trick for footnotes in a floating caption.[1]



(a) First subfig **(b)** Second subfig **(c)** Third subfig

Fig. 2: Here's how to use subfigures

2.1 Figures: floating and wrapped

Use `\centering` rather than the `center` environment in figure environments to avoid adding extra vertical space.[2]

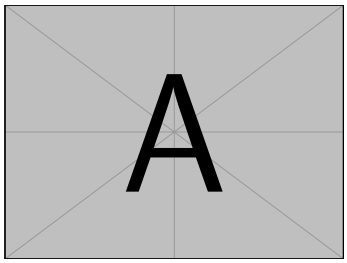


Fig. 3: via `wrapfigure`.

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

[1] Use the command `footnotemark` inside the caption then the command `footnotetext` just outside the environment. This requires the caption to have an optional argument that contains the text that should show up in a list of figures.

[2] https://tex.stackexchange.com/a/23653/8094

Element	Core MF	Mantle MF	$C_{\text{cap}}^{N}(\text{s}^{-1})$
Iron	0.855	0.0626	9.43×10^{7}
Nickel	0.052	0.00196	7.10×10^{6}
Silicon	0.06	0.210	2.24×10^{6}
Magnesium	0	0.228	1.05×10^{6}

Table 1: Mass fractions of the Earth's core and mantle.

2.2 Figures in Equation Environments

A trick with:

```
\eqfig{\includegraphics[width=.1\textwidth]{{example-image-a}}}
```

This is a command that we define in `FlipMacros.tex`. It is shorthand for

```
\vcenter{ \hbox{ \includegraphics[width=.1\textwidth]{{example-image-a}} } }
```

and it allows us to include figures in equations:



$$= ig\gamma^{\mu} \ . \tag{2.1}$$



$$= g\gamma^{\mu}\gamma^{5} \ . \tag{2.2}$$



$$= ig \ . \tag{2.3}$$



$$= g\gamma^{5} \ . \tag{2.4}$$

This is great for Feynman diagrams.

2.3 Best practices for tables

See Table 1.

3 Labels and cleveref

3.1 `cleveref`

`cleveref` is a handy package when referring to ranges of equations.

- Using `amsmath.sty`'s `eqref`: (2.4)

- Using `cleverefs`'s `cref`: (2.4)

For a range of equations:

- Using `amsmath.sty`'s `eqref`: (2.1) – (2.4)
- Using `cleverefs`'s `crefrange`: (2.1–2.4)

For several equations with the range done automatically:

- Using `amsmath.sty`'s `eqref`: (2.1), (2.2), (2.3), (2.4)
- Using `cleverefs`'s `cref`: (2.1–2.4)

`cleveref` automatically identifies the type of object it is referring to. Thus you can use `\cref` to refer to any label, for example footnote 2. You can use `\Cref` to have a capitalized the cross reference name. For example: the sections above are Sections 2.2, 2.3, 3.1 and 4. We call `cleveref` in `./FlipTemplate/FlipPreambleEnd.tex`.

3.2 Sub-equations

One can also wrap a `align` environment with a `subequations` environment. The `subequations` environment can be given a label. For example,

$$a = \pi \tag{3.1a}$$
$$b = \mathrm{e}^{\mathrm{i}\pi} \quad . \tag{3.1b}$$

where we can now refer to the pair of equations (3.1) or simply one of the equations, (3.1b). This also works in `cleveref`: (3.1) and (3.1b).

3.3 Referring to Equations

One style suggestion is to use parentheses to refer to an equation with no additional modifiers *except* at the beginning of a sentence.[3] For example: "The second term in (3)..." and "Equation (3) has two terms..." We implement this in the options for `cleverref` in `./FlipTemplate/FlipPreambleEnd.tex`.

4 Macros

4.1 Modest capitalization

Small caps are useful when your text contains acronyms and you do not want them to visually imply emphasis. In other words, we can use them as 'not shouting' capitalization. We define a macro `acro` for this purpose. The default is for `acro` to be a wrapper for `\scalefont{.95}`. Here is an example:

[3] https://academia.stackexchange.com/a/21793

- AdS in 5D at the LHC.[4] (using `acro`)
- AdS in 5D at the LHC.[5] (no `acro`)
- AdS in 5D at the LHC.[6] (using `small`, footnote is messed up)

The default Computer Modern font leads to harmless warnings when using the `\scalefnt` package. You can remove these by calling the `anyfontsize` package. To change the font scaling, modify the following line in `FlipMacros.tex`:

```
\newcommand\acro[1]{{\scalefont{.95}{#1}}}
```

Reasonable choices are between .9 and .95. It is a standard practice to use small caps for acronyms and initialisms [1]. The *New York Times* uses small caps for acronyms longer than three letters, but I find that in physics we have so many three-letter acronyms that a more aggressive use of small caps for all acronyms and initialisms helps with readability.

4.2 Macros for Collaboration

There are many ways to add notes when collaborating on a document. I like in-line notes with an author name and a color. [**Flip**: This is an example of a comment.] It is also useful to have a macro for highlighting new text and for proposing the removal of old text.[7]

[**New**: I fixed the equation:

$$a = b^2 \tag{4.1}$$

It has label `eq:samename`.]

[**Removed**: Here is an equation:

$$a = b \tag{4.2}$$

It has label `eq:samename`.]

This is essentially a manual version of the `latexdiff` command. This command can be notoriously fussy around math environments. I personally advocate for using `git`-related tools to quickly identifying where a version was edited and then using tags to identify edits that need to be highlighted for further discussion. One nice thing about the `remove` tag above is that it also strips any `labels` so that there are no 'multiply defined label' warnings and one can uniquely refer to a single equation, (4.1).

Flip Comment

This is an extended comment that shows up as a text box. I might use this to make some ponderous point about why I think my version of a draft paragraph is more appropriate than yours.

Custom Title

You can also define boxes that take customized titles.

[4] AdS in 5D at the LHC

[5] AdS in 5D at the LHC.

[6] AdS in 5D at the LHC. (Note `small` is larger than `footnotesize`.)

[7] Git does this automatically at the level of source code. `LaTeXDiff` ostensibly does this automatically, but is prone to compile errors and is notoriously difficult to troubleshoot.

4.3 xspace

The `\xspace` command is useful at the end of a macro. It stands for: "insert a space if and only if there is supposed to be a space." It can be useful for spacing with user-defined macros. Consider the following examples:

- Without `xspace`: LaTeXtypesetting...
- With `xspace`: LaTeX typesetting...
- Without `xspace`: Typeset with LaTeX.
- With `xspace`: Typeset with LaTeX.

However, one should consider `\xspace` depreciated. The results can be unreliable.[8] For example, one could define `\newcommand{\test}{{test}\xspace}`, note the extra pair of braces in the definition. Even though there is an `\xspace`, this command will fail to place a space between `\test \test`. This type of problem shows up for me because I have a macro `\acro{}` for making acronyms smaller. If I define a shortcut `\newcommand{\DM}{\acro{DM}}` then there is no space between `\DM \test`. The result is: DMtest.

The suggested practice is to end your commands with empty braces or a slash: `\DM{}` or `\DM\`. All spacing works out as intended.

- `\DM{} Halo` produces DM Halo
- `\LaTeX Fails.` produces LaTeXFails.
- `\LaTeX{} Works.` produces LaTeX Works.

5 Mathematics and Physics

5.1 Environments

Use the `align` environment instead of `eqnarray`, see the TeXblog discussion[9]. The double dollar sign notation for `displaymath` is depreciated.[10] The suggested alternative is `\[` and `\]`, though this is rather annoying. As a default I always use `align`.

Single dollar sign `$` notation is also depreciated relative to `\(` and `\)` for inline text. However, I am stubborn about keeping in-line text as simple as possible. The dollar sign is a single character and it is visually easier to identify as a delimiter for math mode. I thus continue using single dollar signs for inline mathematics.

5.2 Text and Math: super- and subscripts

Use the `text` command to insert text into math environments. For subscripts use `textnormal`. We use the `textnormal` command for super- or subscripts rather than the `text` command because this automatically uses the correct size. Otherwise, subscripts might be oddly large—for example, when writing x_{min} in a footnote, the min might not know that needs to be smaller

[8] https://tex.stackexchange.com/a/86620/8094
[9] https://texblog.net/latex-archive/maths/eqnarray-align-environment/
[10] https://tex.stackexchange.com/questions/503/why-is-preferable-to

than it would be in the main text. In `FlipMacros.tex` we redefine `\text` to be `\textnormal` so that you can simply write `\text`.

One place this shows up is if you have a subscript that is not a mathematical variable. For example, x_a makes sense for the value of x at point a, but x_b should be used if the 'b' is shorthand for boundary. Similarly, E_max for the maximum energy, rather than E_{max}.

5.3 Units and spacing

Use a tie (`~`) to enforce a non-breaking short space between a number and its units: 0.5 MeV is written as `$0.5~\text{MeV}$`. Units should not be italicized. If you want to be svelte you can use a thin space (`\,`). Some people like the `siunitx` package; I find it a little cumbersome for that it is, especially given that I usually write in natural units. The Physical Review Style Guide suggests a space (which I take to be a tie) between a number and its unit and a thin space between consecutive units:

$$6 \times 10^{-34}\ \text{m}^2\,\text{kg/s} \tag{5.1}$$

is written as `6\times 10^{-34}~\text{m}^2\,\text{kg}/\text{s}`.

Some care is required for spacing with math operators[11]. Here's a guideline for how to use different bits of manual spacing[12].

5.4 Upright characters

These come from the ISO 80000 standards for typesetting mathematics and physics.[13] It is not obvious to me that these are applicable to the typographical culture of physics, but the most important thing is to be consistent.

- Units are always upright, µm is a micrometer. You can use various unit packages to do this automatically.
- The base of the natural logarithm is upright $\mathrm{e}^{i\pi}$ versus $e^{i\pi}$. The best physics argument is to avoid confusion between the exponential e and the electric coupling $\alpha = e^2/4\pi$.[14]
- The differential is an operator so it should be upright. I have macros for this: dx vs. $\mathrm{d}x$ and $đp$ vs. $\text{đ}p$. The `physics` package has macros for this.
- You could also do this for the imaginary number: $a + \mathrm{i}b = \mathrm{e}^{\mathrm{i}\theta}$. This one is a little trickier to get the spacing right. We use `\newcommand{\I}{\operatorname{i}\mkern-2mu}`.
- You can use `\DeclareMathOperator` to define upright Roman letters that should be treated as a single operator like sin. This also automatically fixes the spacing after the operator contextually depending on whether the next character is understood as an argument, $\sin x$, or a group $\sin(ax)$.

[11] https://tex.stackexchange.com/a/35585/8094
[12] https://tex.stackexchange.com/questions/25810/when-one-should-use-spacing-line-quad-or
[13] See discussion in https://tex.stackexchange.com/q/14821/8094
[14] I thank Matt Reece for pointing this out to me.

There is a historical discussion on `hsm.stackexchange`[15]. For all of these, it helps to define macros. This makes it easy to change the style when you have a co-author who strongly disagrees.

5.5 Absolute Values

We define a macro `\abs{}` to invoke `amsmath`'s `\lvert` and `\rvert` commands for automatically sizing the left- and right-bars of an absolute value. Examples:

$$|x| \qquad \left|\frac{x}{y}\right| \qquad \left|\int \mathrm{d}x\; e^{ipx}\right| \qquad \int \mathrm{d}x\; \left|e^{ipx}\right| \;. \tag{5.2}$$

If you want to be fancier, you can use `mathtools`[16] to define custom delimiters. For example: `\DeclarePairedDelimiter{\abs}{|}{|}` .

5.6 Vector notation

- Vector $\mathbf{v}$ and dual vector $\underset{\sim}{\mathbf{w}}$. Also $|v\rangle$ and $\langle w|$.
- Transpose: The ISO 80000 standard has suggestions. A^T vs $A^\top$ vs A^T. I personally prefer A^T.
- I have an `\aij{}{}` macro for tensors. For example: `M\aij{i}{j}` gives $M^i{}_j$.

5.7 Miscellaneous

- Use | instead of pipe for conditions: $p(x \mid y)$ versus $p(x|y)$.
- **Textual subscripts**: sometimes you have a subscript that is not an index, but shorthand for something textual. For example, the Green's function with Dirichlet boundary conditions is G_D. The subscript is upright, not italicized, G_D. Use the `textnormal` command rather than the `text` command since this will automatically use the correct size. Comparison: G_D, G_D.
- Arrows with text under them: `xrightarrow` in the `amsmath` package. The square bracketed argument is under, the curly bracketed argument is over. Example: $\xrightarrow[\text{low}]{\text{hi}}$.
- We can use the $\coloneqq$ symbol, defined as a macro[17] `\defeq`, to denote assignment . The macro typesets the symbol so that the dots are the same size and aligned with the lines. In pedagogical writing, it may be useful to distinguish between equality $=$, assignment $\coloneqq$, and tautology $\equiv$. At least that is how I use these.[18]

[15] https://hsm.stackexchange.com/questions/6727/fracdydx-versus-frac-mathrm-dy-mathrm-dx
[16] https://tex.stackexchange.com/a/35585/8094
[17] https://tex.stackexchange.com/a/4881/8094
[18] Arnold Arons brings up equal signs in *Teaching Introductory Physics*, Chapter 3.23. I prefer $\coloneqq$ for definitions because it shows the asymmetry of the relation. The statement $a \coloneqq b$ means that a is defined to be b. The equal sign $=$ is symmetric in appearance and in meaning: a and b are the same. I use $a \equiv b$ sparingly to mean a and b are *obviously* the same but in a way that is not necessarily derived mathematically.

6 Space

6.1 Kerning: spacing between characters

Math operators have a natural spacing before and after depending on the context. In the following example, spaces indicate that the coefficient a multiplies the logarithm of b:

$$a \log b \qquad\qquad a \log(bc) \tag{6.1}$$

The space on either side of log indicate that log is a mathematical operator. The second example still has the space between a and log, but has no space between log and (bc) because the parenthesis belongs to the mathematical function.[19] You can use `\DeclareMathOperator` for functions that are not built in.

Using `\left(` and `\right)` will automatically size parentheses, but can mess up kerning:

$$f(x)f\left(x\right)f(x) \qquad\qquad \cos(x)\cos\left(x\right)\cos\left(x\right)\cos(x)\ . \tag{6.2}$$

The crude way to fix this is to put braces around the parentheses: `{\left(x\right)}`.[20]. However, if the parenthesis is attached to a mathematical operators, the operator must also be surrounded by braces: `{\cos}`. In the examples above, you can see the effect of the braces on the spacing on either side.

6.2 Manual Spacing

LaTeX has commands for manually inserting spacing:

- `\,` thin space
- `\:` medium space
- `\;` thick space
- `\!` thin negative space.

The negative space can be helpful for manually adjusting the kerning for large parentheses raised to a power:

$$\left(\frac{\pi}{\sum_{i=1}^{n} x^i}\right)^{d+1} \qquad\qquad \left(\frac{\pi}{\sum_{i=1}^{n} x^i}\right)^{d+1}\ . \tag{6.3}$$

On the right we use `\right)^{\!d+1}`.

6.3 Ties create non-breaking spaces

LaTeX interprets periods as full stops (end of a sentence). It places extra space after the full stop. Use a **normal space** right after the period, `.\ ` ("slash space") to tell LaTeX that a

[19] Example from https://tex.stackexchange.com/a/140647

[20] https://tex.stackexchange.com/a/2610/8094

period is not a full stop and that it should insert insert a normal space not a double space.[21] Mr. Roboto versus Mr. Roboto.

A related construction is a **tie** (tilde). This gives **non-breaking space** which is a normal space that LaTeX interprets as 'part of the word'. This means that line breaks should not occur along the non-breaking space. You can also use ties this whenever you want to prevent a line break between words. LaTeX interprets the tied words as a single word. Ties are also standard for citations: `Tanedo et al.~\cite{citation}`.

6.4 Underlined space

An example that comes up surprisingly often is the command `\textvisiblespace` which produce an explicit space character:␣.

There is a neat macro one can define, `\Vtextvisiblespace[1em]` that lets you write longer visible spaces:␣ and ␣.

7 Some Best Practices

7.1 LaTeX in a title

When using LaTeX code in a section title, use the `texorpdfstring` command to define an UTF-8 string that the pdf can use for bookmarks. If you do not do this, there are annoying compilation warnings.

7.2 Ranges

Hyphens, en dashes, em dashes, and minus signs in math mode are all grammatically different.

- En dashes replace hyphens in a compound adjective where one of the elements is a two-word compound: 'post–Cold War era.'[22]
- En dashes are used for combinations of two names in place of the word 'and.' For example, Randall–Sundrum model.
- For compound names of a single person, use a hyphen: Levi-Civita.
- A minus sign should be typeset in math mode, -1.

The choice between a hyphen and en dash can be tricky. For example APS seems to prefer "anti–de Sitter" with an en dash, whereas others prefer a hyphen.[23]

7.3 References

Use BibTeX. There are any number of BibTeX managers. One that I like is Yuji Tachikawa's `spires.app`[24]; it links directly to the inSpire HEP database. For styling, I recommend Jacques

[21] The double space is sometimes considered old fashioned. You can use `frenchspacing` in your document to turn off the double space after a full stop.

[22] From https://www.merriam-webster.com/words-at-play/em-dash-en-dash-how-to-use

[23] See 1 Jan '23: https://en.wikipedia.org/wiki/Talk:Anti-de_Sitter_space.

[24] https://member.ipmu.jp/yuji.tachikawa/spires/

Distler's `utcaps.bst` which is a nice format that automatically inserts a hyper link to the `arXiv` version of a paper. If yo are fancy you may use BibLaTeX.

Standard citation managers with BibTeX capability make a big deal about assigning unique BibTeX citation keys to each reference. This can be tedious if you have to collaborate with someone else who has made up their own citation keys. Fortunately, in my field there is a single recognized database, inSpire[25], that assigns a unique BibTeXentry for papers. This means that it is good practice to select keys as follows:

- If it exists, use the inSpire key. Tools like `spires.app` default to this key.
- If inSpire does not have the reference, use NASA/ADS.
- If neither of those databases has the references, find a simple algorithm that all of your coauthors can agree upon.

Items in the third category are usually books and websites.

8 Neat examples

Suppose you would like to repeat and equation reference,

$$e^{i\pi} = -1 \ . \tag{8.1}$$

Remember that equation above? Let's write it again,

$$e^{i\pi} = -1 \ . \tag{8.1}$$

Observe that these have the same equation number. Instead of `label` we use `tag` with argument `ref`.

9 Teaching Examples

For lecture notes it is useful to have some framed environments to highlight examples and exercises. In the past I have used `framed` and `mdframed`. I think `tcolorbox` may be the best option now.

Theorem 9.1 (Flip's Theorem)**.** This is an example theorem.

Example 9.1 (Flip's Example)**.** This is an example of an example

[25] `https://inspirehep.net`; see also NASA/ADS for astronomy.

Exercise 9.1 (Solving a differential equation)**.** Solve the following differential equation.

Can you solve Exercise 9.1?

Acknowledgments

PT thanks *your name here* for useful comments and discussions. PT thanks the Aspen Center for Physics (NSF grant #1066293) for its hospitality during a period where part of this work was completed. PT is supported by a NSF CAREER award (#2045333).

References

[1] R. Bringhurst, *The Elements of Typographic Style*. Hartley & Marks, 2012.