Solar Physics
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Article preparation guidelines

Solar Physics

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Abstract This is an example paper for manuscripts for the journal *Solar Physics*. It contains the basic commands to write an article as well as some explanations for defining equations, figures, tables, and references. The abstract should be one paragraph long. It should summarize the results of the article, with just enough background to clearly state the problem being addressed. Please do not just repeat text from the introduction and conclusion. Any references should be fully expanded, as the abstract can appear without the full article, and its reference list; *e.g.* Dupont, Schmidt, and Koutny (*Solar Phys.* **323**, 965, 2007). Please make sure that the language of the article has been reviewed by a scientist fluent in English, or an editorial professional. Check that all of the citations in the text are in the reference list at the end, and that there are not extraneous references, preferably by using BibTeX. If you do not run a spell check on your article, do not expect your reader to believe that you were any more careful in your science. Choose your keywords from the list provided in the file `SOLA_keyword_list.txt`.

Keywords: Flares, Dynamics; Helicity, Magnetic; Magnetic fields, Corona

1. Introduction

This file describes the use of special LaTeX features, useful to format an article for *Solar Physics*. It is only a complement to the LaTeX and BibTeX documentation. It is designed to be used as an example article giving the general commands. When compiled with LaTeX (see Section 3.5 for BibTeX compilation), it provides some practical guidance on the main useful features. More information is included within this file, but commented out (with a %). Un-commenting the LaTeX commands permits one to show their results in the compiled file.

Section 2 gives examples and some general information to aid writing text with citations (Section 2.1) and defining labels (Section 2.2). Section 3 gives examples of equations (Section 3.1), figures (Section 3.2), and tables (Section 3.3). It continues by describing the inclusion of labeled references (Section 3.4) and suggestions for an easy construction of a list of references (Section 3.5). An

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appendix is shown as a particular section (Appendix A), which can contain figures and tables (Figure 4, Table 3). There is a list of abbreviations used for the main journals (see the beginning of this `.tex` file, or the companion `SOLA_example_labels.tex` file, for the definition of the LaTeX commands. Our conclusions are given in Section 4.

2. General Text

2.1. Text with Citations

This section gives an example of text with references included with the `\cite{}` and `\opencite{}` commands (see Section 3.4 for more commands).

Magnetic helicity quantifies how the magnetic field is sheared and/or twisted compared to its lowest energy state (potential field). Observations of sheared, and even helical, magnetic structures in the photosphere, corona and solar wind have attracted considerable attention, with the consequent interest in magnetic helicity studies (see reviews by Brown, Canfield, and Pevtsov, 1999, and, Berger, 2003). Stressed magnetic fields are often observed in association with flares, eruptive filaments, and coronal mass ejections (CMEs), but the precise role of magnetic helicity in such activity events still needs to be clarified.

Magnetic helicity plays a key role in magnetohydrodynamics (MHD) because it is almost preserved on a timescale less than the global diffusion timescale (Berger, 1984, 2003). Its conservation defines a constraint on the magnetic field evolution; in particular a stressed magnetic field with finite total helicity cannot relax to a potential field. Thus magnetic helicity is at the heart of several MHD relaxation theories, for example of coronal heating (Heyvaerts and Priest, 1984) but also of flares (Kusano *et al.*, 2004; Melrose, 2004). The permanent accumulation of helicity in the corona could be vital to the origin of CMEs (Rust, 1994; Low, 1997). In the convection zone, the accumulation of helicity in large scales limits the efficiency of the dynamo, thus the conservation of magnetic helicity is responsible for dynamo saturation, the so-called α-effect quenching (Brandenburg, 2001).

2.2. Importance of Using Labels

LaTeX defines labels for many features like sections, equations, figures, tables, and citations. The systematic use of these labels greatly facilitates the writing of a scientific article (even if it may appear as more extra work at the beginning). Indeed, it permits one to re-number or re-order automatically the features during the compilation (*e.g.* when adding or moving a section). It also permits one to cross check automatically whether the citations have been included in the bibliography list.

Labels are powerful but their use can be cumbersome if some clear logic is not used in defining them since one can easily forget the exact defined label (*e.g.* case sensitive). A label should be simple while reflecting precisely what it refers to. It is very helpful to create a small auxiliary file where all these labels are kept (see the `SOLA_example_labels.tex` accompanying the present file). It also provides a roadmap of the paper with the list of the sections and subsections with the equations introduced in each. Including the full command (*e.g.* `Section~\ref{S-labels}`) permits one to do a simple copy/paste when needed (rather than moving through the `.tex` file looking for the definition of the label). It is also useful that `SOLA_example_labels.tex` file contains the copy of the new commands, as well as the citation commands. For references, the simple convention of concatenating the first author's name and the year (and eventually a letter), is simple enough to be easily remembered.

3. Including Special Features

3.1. Examples of Equations

Here are a few examples of equations. It is useful to define a new command when a combination of symbols is present at several locations, for example:
`\renewcommand{\vec}[1]{{\mathbf #1}}` (see the beginning of present `.tex` file for more examples). The mathematics style is to set operators such as "d", "ln", "log", "curl", *etc.* in roman, not italic.

3.1.1. Simple Equations

The magnetic helicity of the magnetic field ($\mathbf{B}$) fully contained within a volume $\mathcal{V}$ is (Elsasser, 1956):

$$H^{\mathrm{closed}} = \int_{\mathcal{V}} \mathbf{A} \cdot \mathbf{B} \; \mathrm{d}^3 x \, . \tag{1}$$

3.1.2. Array of Equations

The vector potential ($\mathbf{A}$) can be written as a function of $\mathbf{B}$ within the Coulomb gauge:

$$\begin{aligned} \mathbf{A}(\mathbf{x}) &= \mu_0 \int_{\mathcal{V}} \frac{\mathbf{j}(\mathbf{x}')}{|\mathbf{x}-\mathbf{x}'|} \; \mathrm{d}^3 x' \\ &= \frac{1}{4\pi} \int \mathbf{B}(\mathbf{x}') \times \frac{(\mathbf{x}-\mathbf{x}')}{|\mathbf{x}-\mathbf{x}'|^3} \; \mathrm{d}^3 x' \, . \end{aligned} \tag{2}$$

Then the magnetic helicity can be written as a function of $\mathbf{B}$ alone (Moffatt, 1969). An approximation of this double integral can be realized by splitting the magnetic field in N flux tubes (Berger and Field, 1984):

$$H^{\mathrm{closed}} = \frac{1}{4\pi} \int_{\mathcal{V}} \int_{\mathcal{V}} \mathbf{B}(\mathbf{x}) \times \mathbf{B}(\mathbf{x}') \cdot \frac{(\mathbf{x}-\mathbf{x}')}{|\mathbf{x}-\mathbf{x}'|^3} \; \mathrm{d}^3 x \; \mathrm{d}^3 x' \, , \tag{3}$$

$$\approx \sum_{i=1}^{N} T_i^{\mathrm{closed}} \Phi_i^2 + \sum_{i=1}^{N} \sum_{j=1, j \neq i}^{N} \mathcal{L}_{i,j}^{\mathrm{closed}} \Phi_i \Phi_j \, . \tag{4}$$

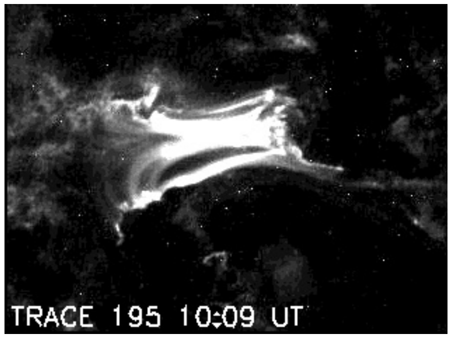

Figure 1. Example of a simple figure with only one panel. Relative units (here `\textwidth`) are preferred so that the figure adapts automatically to the text width (this command is very useful in more complex figures such as Figures 2 and 3). The use of the command `\includegraphics` requires the inclusion of `\usepackage{graphicx}` at the beginning of the LaTeX file.

where Φ_i and $T_i^{\rm closed}$ are the magnetic flux and the self helicity of flux tube i respectively ($T_i^{\rm closed}$ includes both twist and writhe), and $\mathcal{L}_{i,j}^{\rm closed}$ is the mutual helicity between flux tubes i and j.

3.1.3. Long Equations

A long equation is broken into several lines:

$$\begin{aligned}\frac{\mathrm{d}H}{\mathrm{d}t} = \frac{1}{2\pi}\int_\Phi\int_\Phi \Bigg(& \frac{\mathrm{d}\theta(\mathbf{x}_{c_-}-\mathbf{x}_{a_+})}{\mathrm{d}t} + \frac{\mathrm{d}\theta(\mathbf{x}_{c_+}-\mathbf{x}_{a_-})}{\mathrm{d}t} \\ & - \frac{\mathrm{d}\theta(\mathbf{x}_{c_+}-\mathbf{x}_{a_+})}{\mathrm{d}t} - \frac{\mathrm{d}\theta(\mathbf{x}_{c_-}-\mathbf{x}_{a_-})}{\mathrm{d}t}\Bigg)\,\mathrm{d}\Phi_a\,\mathrm{d}\Phi_c\,. \qquad (5)\end{aligned}$$

A fine tuning of the positions can be obtained with the following spacing commands (`\!` is a negative thin space):

`\!` $\|\!\|$	`\,` $\|\,\|$	`\:` $\|\:\|$
`\ ` $\|\ \|$	`\quad` $\|\quad\|$	`\qquad` $\|\qquad\|$

3.2. Examples of Figures

A simple figure is presented as Figure 1. When more than one panel is present, one should add labels for those individual panels. One can add labels to a figure by using LaTeX as done in Figures 2 and 3. The package `\usepackage{color}` can be used to write text (*e.g.* labels) in white or in color. Figures can be rotated and their position fine tuned (Figures 2 and 3).

Cutting a figure can be made by editing the `.eps` file with a text editor, and changing the `BoundingBox`, then saving the file (do not use a text editor designed for LaTeX since it could open the file as a figure, and not as a text file). An `.eps` file has typically the command `%%BoundingBox: 54 360 558 720` at the beginning, where the numbers are the left, bottom, right, and top coordinates

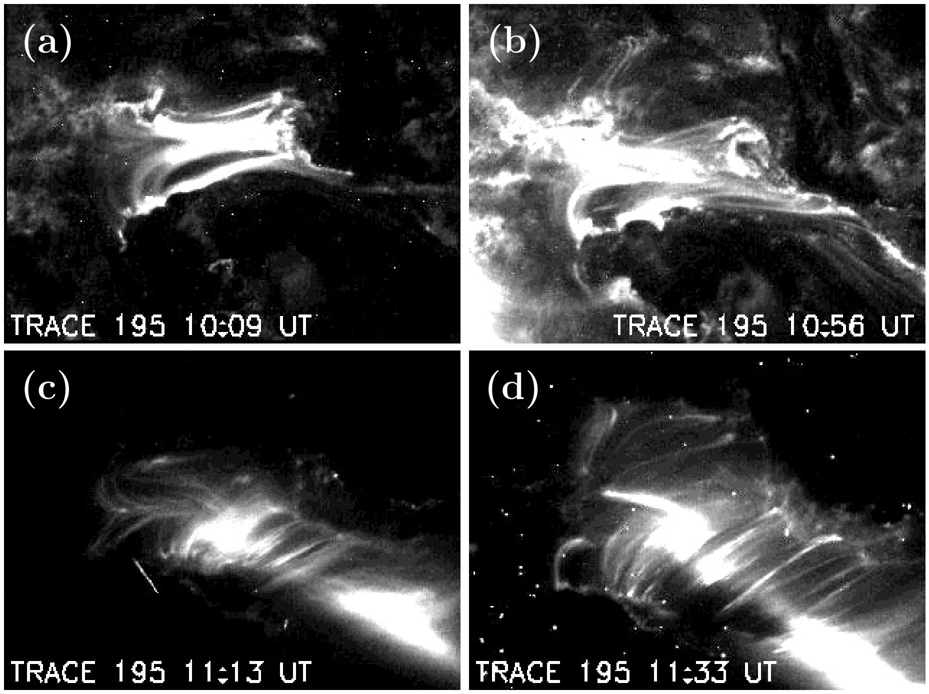

Figure 2. Example of a figure with four panels (constructed with four `.eps` files). The labels of the panels are included with LaTeX commands so that each panel can be referred to unambiguously in the text. The position of the panels is fine-tuned with the `\hspace` and `\vspace` commands.

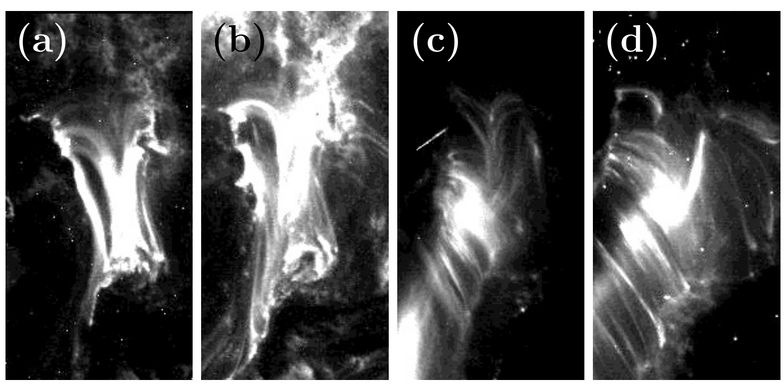

Figure 3. Example of a figure with panels smaller than the original and rotated clockwise by 90° (compare with Figure 2). The `clip=` command is important to include only the selected part of the figure by changing the `BoundingBox`. The labels of the panels are included using LaTeX commands.

Table 1. A simple table. Each column is aligned by one of the letters: l: left, c: center, r: right. Using two $s permits one to insert equation-like features (see last column). The inclusion of ∼ adds a blank to approximately align the numbers of the last two columns (see the LaTeX file).

Rot.	Date	CMEs obs.	CMEs cor.	α $10^{-2}\mathrm{Mm}^{-1}$
1	02–Nov–97	16	24.1	-1.26
2	29–Nov–97	–	2.53	0.94
3	27–Dec–97	06	11.7	0.82
4	23–Jan–98	09	16.82	0.94
5	20–Feb–98	04	9.6	1.00
total		35	64.75	

of the graphic (in units of “pt”). Changing these numbers is a way to reduce the part of the image shown. The `GhostView` application gives the coordinates of the cursor (in units of “pt”), so it permits one to locate the coordinates of the cropping. The result of the changes can be checked using `GhostView`. Note that, depending on the software used to create the `.eps` file, the `BoundingBox` can be repeated at several places in the `.eps` file (*e.g.* with `PageBoundingBox`). Also, with some software, the `BoundingBox` is defined only close to the end of the file (the file has at the beginning: `BoundingBox: (atend)`). The `BoundingBox` can still be changed in place, or defined at the beginning of the `.eps` file. Finally, this method provides a figure with a reduced size, when included in LaTeX (do not forget the `clip=` in the command including the `.eps` file!). The advantage of this method is that the correct `BoundingBox` is easily determined.

An alternative way to crop figures is to include the `BoundingBox` in the `\includegraphics` command, for example:

```
\includegraphics[width=\textwidth,bb=54 440 488 660, clip=]
```

The advantage is that it can be made within LaTeX. The initial value is given by the `BoundingBox` found in the `.eps` file. It may be better to process the figure in a separate `.tex` file, since it will require several iterations to get the right `BoundingBox`.

3.3. Examples of Tables

Tables are easy to write provided one keeps the alignment with the column separator `&` when entering the table in the LaTeX file (even if it is not required by LaTeX). Examples of a simple table, Table 1, and a more complex table, Table 2, are given.

3.4. Including References in the Text

The classical way to input references in the text is with the `\cite{label-ref}` command where `label-ref` is a label unique for each reference. It is defined in

Table 2. A more complex table with multi-columns labels. The command `\multicolumn{4}{c}{Flares (GOES)}` permits writing the title "Flares (GOES)" over four columns. The alignment of the decimal points is made by defining two columns separated with an inter-column replaced by a "." with the command `r@{.}l` (see the LaTeX file).

Rot.	Date	Flares (GOES)				CMEs	CMEs	α
		X	M	C	B	obs.	cor.	10^{-2}Mm^{-1}
1	02–Nov–97	02	04	24	05	16	24.1	-1.26
2	29–Nov–97	–	–	03	04	–	2.53	0.94
3	27–Dec–97	–	01	07	08	06	11.7	0.82
4	23–Jan–98	–	–	03	03	09	16.82	0.94
5	20–Feb–98	–	–	–	–	04	9.6	1.00
total		02	05	37	20	35	64.75	

the environment `\begin{thebibliography}{} ...` , or in the BibTeX file (see Section 3.5). The main citation commands, and their compilation results, are:
`\cite{Kusano04}` : (Kusano *et al.*, 2004)
`\cite{Kusano04,Berger03}` : (Kusano *et al.*, 2004; Berger, 2003)
`\inlinecite{Brown99}` : Brown, Canfield, and Pevtsov (1999)
`\opencite{Brown99}` : Brown, Canfield, and Pevtsov, 1999
`\citeauthor{Brown99}` : Brown, Canfield, and Pevtsov
`\shortcite{Brown99}` : (1999)
`\citeyear{Brown99}` : 1999
`(\opencite{Berger84}, \citeyear{Berger03})` : (Berger, 1984, 2003)

3.5. Using BibTeX

The use of BibTeX simplifies the inclusion of references. Only the references cited and labeled in the text are included at compilation, and an error message appears if some references are missing. Any new reference will automatically be written at the correct location in the reference list after compilation. Moreover the references are stored, in any order, in a separate file (with the `.bib` extension) in the BibTeX format, so independently of the journal format. Such a personal reference file can be re-used with any journal. The formatting of the references and their listing order are made automatically at compilation (using the information given in the `.bst` file).

The references in BibTeX format can be downloaded from the Astrophysics Data System (ADS), then stored in `SOLA_bibliography_example.bib` (file name of the present example). The main extra work is to define a proper and easy label for each citation (a convenient one is simply first-author-name-year). Furthermore, it is better to have the journal names defined by commands (for example `\solphys`), as defined at the beginning of this `.tex` file. This provides an homogeneity in the reference list and permits flexibility when changing for journals. Some caution should be taken for some journals since ADS does not necessarily provide a uniform format for the journal names. This is the case for *J. Geophys.*

Res. Moreover since *J. Geophys. Res.* has a new way to refer to an article (since 2002 it has no page number), then the ADS references need to be corrected. More generally, it is worth verifying each reference from the original publication (independently of BibTeX use).

The full LaTeX and BibTeX compilation is made in four steps:

1) `latex filename` (stores the labels in the `.aux` file)
2) `bibtex filename` (loads the bibliography in the `.bbl` file)
3) `latex filename` (reads the .bbl, stores in the `.aux`)
4) `latex filename` (replaces all labels)

where `filename` is the name of your LaTeX file (for example, the present file) **without** typing its `.tex` extension. If a `(?)` is still present in the output (at the place of a label), it means that this label has not been properly defined. (for example, LaTeX labels are case sensitive). Any undefined label has a warning written in the `console window` (it is better to have this window open by default, since LaTeX warning and error messages are very useful to localize the problem).

When the references are not changed, it is unnecessary to re-run BibTeX. When no new labels are added, running latex once is sufficient to refresh the LaTeX output. So, except for the first, and the final time (safest), running LaTeX once is sufficient in most cases to update the LaTeX output, if the compilation files created are not erased! For example BibTeX keeps the bibliography in the usual environment,
`\begin{thebibliography}{} ... \end{thebibliography}`
in the file with the `.bbl` extension.

3.6. Miscellaneous Other Features

Long URL's can be quite messy when broken across lines `http://gong.nso.edu/data/magmap/` as normal text, however the `url` package does a nice job of this, *e.g.* http://gong.nso.edu/data/magmap/.

4. Conclusion

We hope authors of *Solar Physics* will find this guide useful. Please send us feedback on how to improve it.

LaTeX is very convenient to write a scientific text, in particular with the use of labels for figures, tables, and references. Moreover, the labels and list of references are checked by the software against one another, and, the formatting should be effortless with BibTeX.

Appendix

After the `\appendix` command, the sections are referenced with capital letters. The numbering of equations, figures and labels is is just the same as with classical sections.

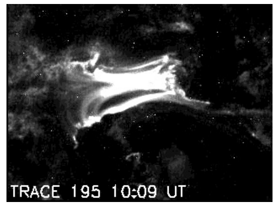

Figure 4. Example of a simple figure in an appendix.

Table 3. A simple table in an appendix.

Rot.	Date	CMEs obs.	CMEs cor.	α $10^{-2}\mathrm{Mm}^{-1}$
1	02–Nov–97	16	24.1	-1.26
2	29–Nov–97	–	2.53	0.94

A. Abbreviations of some Journal Names

Journal names are abbreviated in *Solar Physics* with the IAU convention (IAU Style Book published in Transactions of the IAU XXB, 1988, pp. Si-S3. www.iau.org/Abbreviations.235.0.html). Here are a few journals with their LaTeX commands (see the beginning of this `.tex` file).

`\aap` *Astron. Astrophys.*
`\apj` *Astrophys. J.*
`\jgr` *J. Geophys. Res.*
`\mnras` *Mon. Not. Roy. Astron. Soc.*
`\pasj` *Pub. Astron. Soc. Japan*
`\pasp` *Pub. Astron. Soc. Pac.*
`\solphys` *Solar Phys.*

Acknowledgements The authors thank ... (*note the reduced point size*)

Bibliography Included with BibTeX

With BibTeX the formatting will be done automatically for all the references cited with one of the `\cite` commands (Section 3.4). Besides the usual items, it includes the title of the article and the concluding page number.

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Moffatt, H.K.: 1969, The degree of knottedness of tangled vortex lines. *J. Fluid Mech.* **35**, 117 – 129.

Rust, D.M.: 1994, Spawning and shedding helical magnetic fields in the solar atmosphere. *Geophys. Res. Lett.* **21**, 241 – 244.

Bibliography included manually

The articles can be entered, formatted, and ordered by the author with the command `\bibitem`. ADS provides references in the *Solar Physics* format by selecting the format `SoPh format` under the menu `Select short list format`. Including the article title and the concluding page number are optional; however, we require consistency in the author's choice. That is, all of the references should have the article title, or none, and similarly for ending page numbers.

References

Berger, M.A.: 2003, in Ferriz-Mas, A., Núñez, M. (eds.), *Advances in Nonlinear Dynamics*, Taylor and Francis Group, London, 345.

Berger, M.A., Field, G.B.: 1984, *J. Fluid. Mech.* **147**, 133.

Brown, M., Canfield, R., Pevtsov, A.: 1999, Magnetic Helicity in Space and Laboratory Plasmas, Geophys. Mon. Ser. 111, AGU.

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