

# How to prepare and submit an article for publication in Fluid Dynamics Research (FDR) using $\text{\LaTeX 2}_{\epsilon}$

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**Abstract.** This document describes the preparation of an article using  $\text{\LaTeX 2}_{\epsilon}$  and `iopart.cls` (the IOP Publishing  $\text{\LaTeX 2}_{\epsilon}$  preprint class file). This class file is designed to help authors produce preprints in a form suitable for submission to any of the journals published by Institute of Physics Publishing. Authors submitting to Fluid Dynamics Research (FDR), should follow the guidelines set out here. On acceptance, their TeX code will be converted to the appropriate format for FDR.

*Keywords:* Article preparation, Fluid dynamics, Turbulence

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## 1. Introduction: file preparation and submission

The `iopart` L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> article class file is provided to help authors prepare articles for submission to FDR. Submission is not restricted to those using of this class file and articles prepared using any other class or style files can also be submitted. Use of the `iopart` class file does, however, help to speed the publication process and it is hoped it will make it easy for authors to prepare their articles. This document describes and demonstrates the use of `iopart.cls` to produce a preprint for submission and refereeing. The detailed formatting for print and web use will be undertaken by IOP Publishing as part of the production process after the article has been accepted for publication, but use of `iopart` does make this simpler.

### 1.1. What you will need to supply

Full details on how to submit files to FDR are contained in the document *FDR's Guidelines for authors* which is discussed in section 1.4. Here we mention the key points you need to consider when preparing your files for submission.

**1.1.1. Text** The L<sup>A</sup>T<sub>E</sub>X source code of your paper with all figures included in the source code (see section 9.2). Although we recommend that authors use the `iopart` class file, articles prepared using almost any version of T<sub>E</sub>X or L<sup>A</sup>T<sub>E</sub>X can be handled.

- **Using L<sup>A</sup>T<sub>E</sub>X packages** Most L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> packages can be used if they are available in the normal distribution of L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub>; however, if it is essential to use a non-standard package then any extra files needed to process the article must also be sent in. Authors should be aware that the final version will be printed on a different page size and using different fonts to the preprint version so that any special effects used should not contain material that is not easily scalable. Alterations to the source code will be made during the production process in order to conform to IOP Publishing house style and journal format.

**1.1.2. Figures** Figures must be included in an article as encapsulated PostScript files (see section 9.2) or created using standard L<sup>A</sup>T<sub>E</sub>X drawing commands. Please name all figure files using the guidelines in section 1.2.1. For more detail on preparation of EPS figure files, please refer to the graphics guidelines which can be accessed online at <http://www.iop.org/EJ/journal/fdr>.

- **Including figures** All figures can be included within the body of the text at an appropriate point or grouped together with their captions at the end of the article. A standard graphics inclusion package such as `graphicx` should be used for figure inclusion. Authors should avoid using special effects generated by including verbatim PostScript code. Wherever possible, please try to use standard L<sup>A</sup>T<sub>E</sub>X tools and packages.

**1.1.3. BiBTeX** If you use BiBTeX to prepare your references, we recommend that authors use the `jphysicsB.bst` BiBTeX style file together with the `harvard` L<sup>A</sup>T<sub>E</sub>X package. `jphysicsB.bst` is supplied as part of the `harvard.sty` package which can be downloaded from [www.ctan.org](http://www.ctan.org).

Please make sure that you include your .bib bibliographic database file(s) and any .bst style file(s) you have used (other than `unsrt.bst` or `jphysicsB.bst`).

**1.1.4. Copyrighted material** If you wish to illustrate your article using material for which you do not own the copyright then you must seek permission from the copyright holder, usually both the author and the publisher. It is the author's responsibility to obtain copyright permissions and this should be done prior to submitting your article. If you have obtained permission, please provide full details of the permission granted—for example, copies of the text of any e-mails or a copy of any letters you may have received. Figure captions must include an acknowledgment of the original source of the material even when permission to use has been obtained. Full details on copyright can be found in *FDR's Guidelines for authors* which can be accessed online at <http://www.iop.org/EJ/journal/fdr> .

## 1.2. Naming your files

Please name all your files, both figures and text as follows:

- use only characters from the set a to z, A to Z, 0 to 9 and underscore (-);
- do not use spaces in file names;
- include an extension to indicate the file type (e.g., .tex, .eps, .txt, etc);
- do not use any accented characters in file names; for example, á, ê, ñ, ö, etc because they can cause difficulties when processing your files.

**1.2.1. Naming your figure files** In addition to the above points, please give each figure file a name which indicates the number of the figure it contains; for example, `figure1.eps`, `figure2a.eps` etc. If the figure file contains a figure with multiple parts, for example figure 2(a) to 2(e), give it a name such as `figure2a.2e.eps`, and so forth.

## 1.3. Submitting your article files to FDR

You send your files directly to us by using our online submission system. Please visit <http://fdr.edmgr.com> to register and upload your files.

## 1.4. Where to send your files

Full details of how to submit files to FDR are contained in *FDR's Guidelines for authors* which can be accessed online by going to <http://www.iop.org/EJ/journal/fdr> . From this document's table of contents, select the 'How to submit' link to access full details of the submission address for FDR.

### 1.5. Obtaining the class file and documentation

The  $\text{\LaTeX} 2_{\epsilon}$  class file can be downloaded from the author guidelines at <http://www.iop.org/EJ/journal/fdr>.

## 2. Preparing your article

Please follow these guidelines as closely as possible, particularly with regard to the preparation of the reference list.

At the start of the  $\text{\LaTeX}$  source please include commented material to identify the journal, author and reference number if known. The first non-commented line should be `\documentclass[12pt]{iopart}` to load the preprint class file. Omitting `[12pt]` produces an article with the normal journal page and type sizes. The start of the article text is signalled by `\begin{document}`. Authors of very long articles may find it convenient to separate their article into a series of files each containing a section, each of which is called in turn by the primary file.

Authors may add their own macros at the start of an article provided they do not overwrite existing definitions and that they send copies of their new macros with their text file. Macros for the individual paper not included in a style file should be inserted in the preamble to the paper with comments to describe any complex or non-obvious ones. `iopart` can be used with other package files such as those loading the AMS extension fonts `msam` and `msbm` (these fonts provide the blackboard bold alphabet and various extra maths symbols as well as symbols useful in figure captions); an extra style file `iopams.sty` is provided to load these packages and provide extra definitions for bold Greek letters.

## 3. The title and abstract page

The code for setting the title page information is slightly different from the normal default in  $\text{\LaTeX}$ .

### 3.1. Titles and article types

The title is set using the command `\title{#1}`, where `#1` is the title of the article. The first letter of the title should be capitalized with the rest in lower case. Mathematical expressions within the title may be left in light-face type.

For article types other than papers, `iopart.cls` has a generic heading `\article[] {TYPE} {Full title}` and the specific definitions given in table 1.

Footnotes to titles may be given, though acknowledgment of funding should be included in the acknowledgments section rather than here. A footnote can be included by using `\footnote{Text of footnote.}` immediately after the title.

**Table 1.** Types of article defined in the `iopart.cls` class file.

Command	Type	Heading on first page
<code>\title{#1}</code>	Paper	—
<code>\review{#1}</code>	Review	REVIEW
<code>\comment{#1}</code>	Comment	COMMENT
<code>\paper{#1}</code>	Paper	—
<code>\article{#1}{#2}</code>	Other articles	Whatever is entered as #1

### 3.2. Authors' names and addresses

The next information required is the list of authors' names and their affiliations. For the authors' names type `\author{#1}`, where #1 is the list of all authors' names. The style for the names is initials then family name, with a comma after all but the last two names, which are separated by 'and'. Initials should *not* be followed by full stops. First (given) names may be used if desired and Chinese-style names included in the form they should be printed in. If the authors are at different addresses a superscripted number, e.g. <sup>1</sup>, `$~1$`, should be used after each name to reference the author to his/her address. If an author is a corresponding author or has additional information to appear as a footnote, such as a permanent address, a normal L<sup>A</sup>T<sub>E</sub>X footnote command should be given after the family name and address marker with this extra information.

The addresses of the authors' affiliations follow the list of authors. Each address is set by using `\address{#1}` with the address as the single parameter in braces. If there is more than one address then the appropriate superscripted number, followed by a space, should come at the start of the address.

Please also add the e-mail addresses for at least one of the authors (corresponding author(s)). This is done by inserting the command `\ead{#1}` after the postal address(es) where #1 is the e-mail address. See section 3.6 for sample coding. For more than one e-mail address, please use the command `\eads{\mailto{#1}}, \mailto{#2}}` with `\mailto` surrounding each e-mail address.

### 3.3. The abstract

The abstract follows the addresses and should give readers concise information about the content of the article and indicate the main results obtained and conclusions drawn. It should be self-contained with no reference to figures, tables, equations, bibliographic references etc included and should not normally exceed 200 words. To indicate the start of the abstract type `\begin{abstract}` followed by the text of the abstract (not in braces). The abstract should normally be restricted to a single paragraph and is terminated by the command `\end{abstract}`

### 3.4. Keywords

Three, four or five keywords should be provided for submissions to FDR. Add these as a new paragraph starting `\noindent{\it Keywords\}`: after the end of the abstract.

### 3.5. Making a separate title page

The command `\maketitle` forces a page break after the point where it is inserted and so to keep the header material on a separate page from the body of the text insert `\maketitle` or `\newpage` before the start of the text. If `\maketitle` is not included the text of the article will start immediately after the abstract.

### 3.6. Sample coding for the start of an article

The code for the start of a title page of a typical paper might read:

```
\documentclass[12pt]{iopart}
\begin{document}
\title[] {Studies on Fluid Dynamics}
\author{P J Smith$^1$, T M Collins$^2$,
R J Jones$^3$\footnote{Corresponding author: smith@math.open-u.ac.uk
} and Janet Williams$^3$}

\address{$^1$ Mathematics Faculty, Open University,
Milton Keynes MK7~6AA, UK}
\address{$^2$ Department of Mathematics,
Imperial College, Prince Consort Road, London SW7~2BZ, UK}
\address{$^3$ Department of Computer Science,
University College London, Gower Street, London WC1E~6BT, UK}
\ead{williams@ucl.ac.uk}

\begin{abstract}
...
\end{abstract}
\maketitle
```

## 4. The text

### 4.1. Sections, subsections and subsubsections

The text of articles may be divided into sections, subsections and, where necessary, subsubsections. To start a new section, end the previous paragraph and then include `\section` followed by the section heading within braces. Numbering of sections is done *automatically* in the headings: sections will be numbered 1, 2, 3, etc, subsections will be numbered 2.1, 2.2, 3.1, etc, and subsubsections will be numbered 2.3.1, 2.3.2, etc. Cross references to other sections in the text should, where possible, be made using labels (see section 7) but can also be made manually. See section 5.6 for information on the numbering of displayed equations. Subsections and subsubsections are similar to sections

but the commands are `\subsection` and `\subsubsection` respectively. Sections have a bold heading, subsections an italic heading and subsubsections an italic heading with the text following on directly.

```
\section{This is the section title}
\subsection{This is the subsection title}
```

The first section is normally an introduction, which should state clearly the object of the work, its scope and the main advances reported, with brief references to relevant results by other workers. In long papers it is helpful to indicate the way in which the paper is arranged and the results presented.

Footnotes should be avoided whenever possible and can often be included in the text as phrases or sentences in parentheses. If required, they should be used only for brief notes that do not fit conveniently into the text. The use of displayed mathematics in footnotes should be avoided wherever possible and no equations within a footnote should be numbered. The standard L<sup>A</sup>T<sub>E</sub>X macro `\footnote` should be used.

#### *4.2. Acknowledgments*

Authors wishing to acknowledge assistance or encouragement from colleagues, special work by technical staff or financial support from organizations should do so in an unnumbered ‘Acknowledgments’ section immediately following the last numbered section of the paper. The command `\ack` sets the acknowledgments heading as an unnumbered section. For Letters `\ack` does not set a heading but leaves a line space and does not indent the next paragraph.

#### *4.3. Appendices*

Technical detail that it is necessary to include, but that interrupts the flow of the article, may be consigned to an appendix. Any appendices should be included at the end of the main text of the paper, after the acknowledgments section (if any) but before the reference list. If there are two or more appendices they should be called Appendix A, Appendix B, etc. Numbered equations will be in the form (A.1), (A.2), etc, figures will appear as figure A1, figure B1, etc and tables as table A1, table B1, etc.

The command `\appendix` is used to signify the start of the appendices. Thereafter `\section`, `\subsection`, etc, will give headings appropriate for an appendix. To obtain a simple heading of ‘Appendix’ use the code `\section*{Appendix}`. If it contains numbered equations, figures or tables the command `\appendix` should precede it and `\setcounter{section}{1}` must follow it.

#### *4.4. Some matters of style*

It will help the readers if your article is written in a clear, consistent and concise manner. The Production Department at Institute of Physics Publishing will try to make sure that your work is presented to its readers in the best possible way without sacrificing the

individuality of your writing. Some recommended points to note, however, are the following.

- (i) Authors are often inconsistent in the use of ‘ize’ and ‘ise’ endings. We recommend using ‘-ize’ spellings (diagonalize, renormalization, minimization, etc) but there are some common exceptions to this, for example: devise, promise and advise.
- (ii) The words table and figure should be written in full and **not** abbreviated to tab. and fig. Do not include ‘eq.’ ‘equation’ etc before an equation number or ‘ref.’ ‘reference’ etc before a reference number.

Please check your article carefully for accuracy, consistency and clarity before submission. Remember that your article will probably be read by many people whose native language is not English and who may not therefore be aware of many of the subtle meanings of words or idiomatic phrases present in the English language. It therefore helps if you try to keep sentences as short and simple as possible.

## 5. Mathematics

### 5.1. Two-line constructions

The great advantage of L<sup>A</sup>T<sub>E</sub>X over other text processing systems is its ability to handle mathematics to almost any degree of complexity. However, in order to produce an article suitable for publication both within a print journal and online, authors should exercise some restraint on the constructions used. Some equations using very small characters which are clear in a preprint style article may be difficult read in a smaller format or online at a relatively low resolution. For simple fractions in the text the solidus /, as in  $\lambda/2\pi$ , should be used instead of `\frac` or `\over`, care being taken to use parentheses where necessary to avoid ambiguity, for example to distinguish between  $1/(n-1)$  and  $1/n-1$ . Exceptions to this are the proper fractions  $\frac{1}{2}$ ,  $\frac{1}{3}$ ,  $\frac{3}{4}$ , etc, which are better left in this form. In displayed equations horizontal lines are preferable to solidi provided the equation is kept within a height of two lines. A two-line solidus should be avoided where possible; the construction  $(\dots)^{-1}$  should be used instead; for example use:

$$\frac{1}{M_a} \left( \int_0^\infty d\omega \frac{|S_o|^2}{N} \right)^{-1} \quad \text{instead of} \quad \frac{1}{M_a} / \int_0^\infty d\omega \frac{|S_o|^2}{N}.$$

### 5.2. Roman and italic in mathematics

In mathematics mode L<sup>A</sup>T<sub>E</sub>X automatically sets variables in an italic font. In most cases authors should accept this italicization. However, there are some cases where it is better to use a Roman font; for instance, FDR use a Roman d for a differential d, a Roman e for an exponential e and a Roman i for the square root of  $-1$ . To accommodate this and to simplify the typing of equations we have provided some extra definitions. `\rmd`, `\rme` and `\rmi` now give Roman d, e and i respectively for use in equations, e.g.  $ixe^{2x}dx/dy$  is obtained by typing `\$ \rmi x \rme^{2x} \rmd x / \rmd y \$`.



Certain other common mathematical functions, such as  $\cos$ ,  $\sin$ ,  $\det$  and  $\ker$ , should appear in Roman type. L<sup>A</sup>T<sub>E</sub>X provides macros for most of these functions (in the cases above, `\cos`, `\sin`, `\det` and `\ker` respectively); we have also provided additional definitions for  $\text{Tr}$ ,  $\text{tr}$  and  $\text{O}$  (`\Tr`, `\tr` and `\Or`, respectively).

Subscripts and superscripts should be in Roman type if they are labels rather than variables or characters that take values. For example in the equation

$$\epsilon_m = -g\mu_n Bm$$

$m$ , the  $z$  component of the nuclear spin, is italic because it can have different values whereas  $n$  is Roman because it is a label meaning nuclear ( $\mu_n$  is the nuclear magneton).

### 5.3. Special characters for mathematics

Bold italic characters can be used in FDR to signify vectors (rather than using an upright bold or an over arrow). To obtain this effect use `\bi{#1}` within maths mode, e.g. ***ABCdef***. If upright bold characters are required in maths use `\mathbf{#1}` within maths mode, e.g. **XYZabc**. The calligraphic (script) uppercase alphabet is obtained with `\mathcal{AB}` or `\cal{CD}` (*ABCD*).

The American Mathematical Society provides a series of extra symbol fonts to use with L<sup>A</sup>T<sub>E</sub>X and packages containing the character definitions to use these fonts. Authors wishing to use Fraktur or Blackboard Bold can include the appropriate AMS package (e.g. `amsgen`, `amsfonts`, `amsbsy`, `amssymb`) with a `\usepackage` command or add the command `\usepackage{iopams}` which loads the four AMS packages mentioned above and also provides definitions for extra bold characters (all Greek letters and some additional other symbols).

The package `iopams` uses the definition `\boldsymbol` in `amsbsy` which allows individual non-alphabetical symbols and Greek letters to be made bold within equations. The bold Greek lowercase letters are obtained with the commands `\balpha` ... `\bomega` (but note that bold eta is `\bfeta` rather than `\beta`) and the capitals with commands `\bGamma` ... `\bOmega`. Bold versions of the following symbols are predefined in `iopams`: bold partial `\bpartial`, bold ‘ell’ `\bell`, bold  $\text{imath}$  `\bimath`, bold  $\text{jmath}$  `\bjmath`, bold infinity `\binfty`, bold nabla `\bnabla`, bold centred dot `\bdot`, other characters are made bold using `\boldsymbol{\symbolname}`.

Please do not use the style file `amsmath.sty` (part of the AMSTeX package) in conjunction with `iopart.cls`. This will result in several errors. To make use of the macros defined in `amsmath.sty`, we have provided the file `setstack.sty` which reproduces the following useful macros from `amsmath.sty`:

```
\overset \underset \sideset \substack \boxed \leftroot
\uproot \dddot \ddddot \varrow \harrow
```

Table 2 lists some other macros for use in mathematics with a brief description of their purpose.

**Table 2.** Other macros defined in IOP Publishing macros for use in maths.

Macro	Result	Description
<code>\fl</code>		Start line of equation full left
<code>\case{#1}{#2}</code>	$\frac{\#1}{\#2}$	Text style fraction in display
<code>\Tr</code>	Tr	Roman Tr (Trace)
<code>\tr</code>	tr	Roman tr (trace)
<code>\Or</code>	O	Roman O (of order of)
<code>\tdot{#1}</code>	$\ddot{x}$	Triple dot over character
<code>\lshad</code>	$\llbracket$	Text size left shadow bracket
<code>\rshad</code>	$\rrbracket$	Text size right shadow bracket

#### 5.4. Alignment of displayed equations

The normal style for aligning displayed equations is to align them left rather than centre them. The class file automatically does this and indents each line of a display. To make any line start at the left margin of the page, add `\fl` at its start (to indicate full left).

Using the `eqnarray` environment equations will naturally be aligned left without the use of any ampersands for alignment, see equations (1) and (8)

$$\alpha + \beta = \gamma^2 \quad (1)$$

$$\alpha^2 + 2\gamma + \cos \theta = \delta \quad (2)$$

This is the normal equation style for FDR.

Where some secondary alignment is needed, for instance a second part of an equation on a second line, a single ampersand is added at the point of alignment in each line (see (3) and (4)).

$$\alpha = 2\gamma^2 + \cos \theta + \frac{XY \sin \theta}{X + Y \cos \theta} \quad (3)$$

$$= \delta \theta PQ \cos \gamma. \quad (4)$$

Two points of alignment are possible using two ampersands for alignment (see (5) and (6)). Note in this case extra space `\qqquad` is added before the second ampersand in the longest line (the top one) to separate the condition from the equation.

$$\alpha = 2\gamma^2 + \cos \theta + \frac{XY \sin \theta}{X + Y \cos \theta} \quad \theta > 1 \quad (5)$$

$$= \delta \theta PQ \cos \gamma \quad \theta \leq 1 \quad (6)$$

For a long equation which has to be split over more than one line the first line should start at the left margin, this is achieved by inserting `\fl` (full left) at the start of the line, the use of the alignment parameter `&` is not necessary unless some secondary alignment is needed.

$$\alpha + 2\gamma^2 = \cos \theta + \frac{XY \sin \theta}{X + Y \cos \theta} + \frac{XY \sin \theta}{X - Y \cos \theta} + \left( \frac{XY \sin \theta}{X + Y \cos \theta} \right)^2$$

$$+ \left( \frac{XY \sin \theta}{X - Y \cos \theta} \right)^2 \quad (7)$$

The Plain  $\text{\TeX}$  command `\eqalign` can be used within an `equation` environment to obtain a multiline equation with a single centred number, for example

$$\begin{aligned} \alpha + \beta &= \gamma^2 \\ \alpha^2 + 2\gamma + \cos \theta &= \delta. \end{aligned} \quad (8)$$

### 5.5. Miscellaneous points

Exponential expressions, especially those containing subscripts or superscripts, are clearer if the notation  $\exp(\dots)$  is used except for simple examples. For instance  $\exp[i(kx - \omega t)]$  and  $\exp(z^2)$  are preferred to  $e^{i(kx - \omega t)}$  and  $e^{z^2}$ , but  $e^x$  is acceptable. Similarly the square root sign  $\sqrt{\phantom{x}}$  should only be used with relatively simple expressions, e.g.  $\sqrt{2}$  and  $\sqrt{a^2 + b^2}$ ; in other cases the power  $1/2$  should be used; for example,  $[(x^2 + y^2)/xy(x - y)]^{1/2}$ .

It is important to distinguish between  $\ln = \log_e$  and  $\lg = \log_{10}$ . Braces, brackets and parentheses should be used in the following order:  $\{[(\ )]\}$ . The same ordering of brackets should be used within each size. However, this ordering can be ignored if the brackets have a special meaning (e.g. if they denote an average or a function). Decimal fractions should always be preceded by a zero: for example 0.123 **not** .123. For long numbers commas are not inserted but instead a thin space is added after every third character away from the position of the decimal point unless this leaves a single separated character: e.g. 60 000, 0.123 456 78 but 4321 and 0.7325.

Equations should be followed by a full stop (periods) when at the end of a sentence.

### 5.6. Equation numbering

$\text{\LaTeX}$  provides facilities for automatically numbering equations and these should be used where possible. Sequential numbering (1), (2), etc, is the default numbering system although, if the command `\eqnobysec` is included in the preamble, equation numbering by section is obtained, e.g. (2.1), (2.2), etc. In articles with several appendices equation numbering by section is useful in the appendices even when sequential numbering has been used throughout the main body of the text and is switched on by the `\appendix` command. When referring to an equation in the text it is not normally necessary to include the word equation before the number, which should be in parentheses. Do not use abbreviations such as eqn or eq. When cross-referencing is used, `(\ref{<label>})` will produce ‘(<eqnum>)', `\eref{<label>}` produces ‘(<eqnum>)' and `\Eref{<label>}` produces ‘Equation (<eqnum>)', where <label> is the label to produce equation number <eqnum>.

Sometimes it is useful to number equations as parts of the same basic equation. This can be accomplished by inserting the commands `\numparts` before the equations concerned and `\endnumparts` when reverting to the normal sequential numbering.

The equations below show the previous equations numbered as separate parts using `\numparts ... \endnumparts` and the `eqnarray` environment

$$T_{11} = (1 + P_e)I_{\uparrow\uparrow} - (1 - P_e)I_{\uparrow\downarrow} \quad (9a)$$

$$T_{-1-1} = (1 + P_e)I_{\downarrow\downarrow} - (1 - P_e)I_{\downarrow\uparrow} \quad (9b)$$

$$S_{11} = (3 + P_e)I_{\downarrow\uparrow} - (3 - P_e)I_{\uparrow\uparrow} \quad (9c)$$

$$S_{-1-1} = (3 + P_e)I_{\uparrow\downarrow} - (3 - P_e)I_{\downarrow\downarrow} \quad (9d)$$

### 5.7. Miscellaneous extra commands for displayed equations

The `\cases` command of Plain  $\text{\TeX}$  is available for use with  $\text{\LaTeX}$  but has been amended slightly to increase the space between the equation and the condition. Equation (10) demonstrates simply the output from the `\cases` command

$$X = \begin{cases} 1 & \text{for } x \geq 0 \\ -1 & \text{for } x < 0 \end{cases} \quad (10)$$

To obtain text style fractions within displayed maths the command `\case{#1}{#2}` can be used (see equations (2) and (5)) instead of the usual `\frac{#1}{#2}` command or `{#1 \over #2}`.

When two or more short equations are on the same line they should be separated by a ‘quad space’ (`\qqquad`), rather than `\quad` or any combination of `\,`, `\>`, `\;` and `\ .`

## 6. Referencing

Two different styles of referencing are in common use: the Harvard alphabetical system and the Vancouver numerical system. The use of the Harvard system is required in FDR.

### 6.1. Alphabetical (Harvard) system

In the Harvard system the name of the author appears in the text together with the year of publication. As appropriate, either the date or the name and date are included within parentheses. Where there are only two authors both names should be given in the text; if there are more than two authors only the first name should appear followed by ‘*et al*’ (which can be obtained by typing `\etal`). When two or more references to work by one author or group of authors occur for the same year they should be identified by including a, b, etc after the date (e.g. 1986a). If several references to different pages of the same article occur the appropriate page number may be given in the text, e.g. Kitchen (1982, p 39).

The reference list at the end of an article consists of an unnumbered ‘References’ section containing an alphabetical listing by authors’ names and in date order for each author or group of identical authors. The reference list in the preprint style is started

by including the command `\section*{References}` and then `\begin{harvard}`. Individual references start with `\item[]` and the reference list is completed with `\end{harvard}`. There is also a shortened form of the coding; `\section*{References}` and `\begin{harvard}` can be replaced by the single command `\References` and `\end{harvard}` can be shortened to `\endrefs`.

## 6.2. *BiBTeX*

We recommend that authors use the appropriate `.bst` file to produce references in the correct style—see section 1.1.3 for a list of recommended `.bst` files.

## 6.3. *References, general*

A complete reference should provide the reader with enough information to locate the article concerned. Titles of journal articles are required for FDR. Final page numbers of references are required for FDR.

Up to ten authors may be given in a particular reference; where there are more than ten only the first should be given followed by ‘*et al*’. If an author is unsure of an abbreviation and the journal is not given in appendix B, it is best to leave the title in full.

The terms *loc. cit.* and *ibid.* should not be used. Unpublished conferences and reports should generally not be included in the reference list if a published version of the work exists. Articles in the course of publication should include the article title and the journal of publication, if known. A reference to a thesis submitted for a higher degree may be included if it has not been superseded by a published paper but the institution where the work was done should be included.

A reference in the reference list is preceded by `\item[]` at the start of the reference.

Cross referencing between the text and the reference list is not necessary for alphabetic referencing in the Harvard system as adding or deleting a reference does not normally change any of the other references. Care should, however, be taken to make sure that the text citations match the reference list and vice versa.

Note that footnotes to the text should not be included in reference list, but should appear at the bottom of the relevant page by using the `\footnote` command.

## 6.4. *References to journal articles*

A normal reference to a journal article contains three changes of font: the authors, article titles and date appear in Roman type, the journal title in italic, the volume number in bold and the page numbers or article numbers in Roman again. A typical journal entry would be:

Cisneros A 1971 A study on turbulence *Astrophys. Space Sci.* **10** 87-94

which would be obtained by typing, within the references environment

```
\item[] Cisneros A 1971 A study on turbulence {\it Astrophys. Space Sci.}
{\bf 10} 87-94
```

Features to note are the following.

- (i) The authors should be in the form surname (with only the first letter capitalized) **followed** by the initials with **no** periods after the initials. Authors should be separated by a comma except for the last two which should be separated by ‘and’ with no comma preceding it. For FDR, the title should be in Roman (upright) lower case letters, except for an initial capital, and should follow the date.
- (ii) The year of publication follows the authors and is not in parentheses. An article title (in Roman) follows the year.
- (iii) The journal is in italic and is abbreviated. Appendix B gives a list of macros that will give the correct abbreviation for many of the common journals. If a journal has several parts denoted by different letters the part letter should be inserted after the journal in Roman type, e.g. *Phys. Rev. A*.
- (iv) The volume number is bold; the page number is Roman. Both the initial and final page numbers should be given. The final page number should be in the shortest possible form and separated from the initial page number by an en rule (–), e.g. 1203–14.
- (v) Where there are two or more references with identical authors, the authors’ names should be repeated for the second and subsequent references. Each individual publication should be presented as a separate reference. This facilitates linking in the electronic version of the journal.

### 6.5. *Electronic journal references*

These often do not always follow the conventional *year-journal-volume-page numbers* pattern. Some examples are:

- [1] Carlip S and Vera R 1998 *Phys. Rev. D* **58** 011345
- [2] Davies K and Brown G 1997 *J. High Energy Phys.* JHEP12(1997)002
- [3] Hannestad S 2005 *J. Cosmol. Astropart. Phys.* JCAP02(2005)011
- [4] Hilhorst H J 2005 *J. Stat. Mech.* L02003
- [5] Gundlach C 1999 *Liv. Rev. Rel.* 1994-4

### 6.6. *Preprint references*

Preprint may be referenced but if the article concerned has been published in a peer-reviewed journal, that reference should take precedence. If only a preprint reference can be given, it is helpful to include the article title. Examples are:

- [1] Neilson D and Choptuik M 2000 *Class. Quantum Grav.* **17** 761 (*Preprint* gr-qc/9812053)
- [2] Harrison M 1999 Dipheomorphism-invariant manifolds *Preprint* hep-th/9909196

### 6.7. References to books, conference proceedings and reports

References to books, proceedings and reports are similar, but have only two changes of font. The authors and date of publication are in Roman, the title of the book is in italic, and the editors, publisher, town of publication and page number are in Roman. A typical reference to a book and a conference paper might be

Dorman L I 1975 *Variations of Galactic Cosmic Rays* (Moscow: Moscow State University Press) p 103  
 Caplar R and Kulisic P 1973 *Proc. Int. Conf. on Nuclear Physics (Munich)* vol 1 (Amsterdam: North-Holland/American Elsevier) p 517

which would be obtained by typing

```
\item[] Dorman L I 1975 {\it Variations of Galactic Cosmic Rays}
(Moscow: Moscow State University Press) p~103
\item[] Caplar R and Kulisic P 1973 {\it Proc. Int. Conf. on Nuclear
Physics (Munich)} vol~1 (Amsterdam: North-Holland/American
Elsevier) p~517
```

respectively.

Features to note are the following.

- (i) Book titles are in italic and should be spelt out in full with initial capital letters for all except minor words. Words such as Proceedings, Symposium, International, Conference, Second, etc should be abbreviated to Proc., Symp., Int., Conf., 2nd, respectively, but the rest of the title should be given in full, followed by the date of the conference and the town or city where the conference was held. For Laboratory Reports the Laboratory should be spelt out wherever possible, e.g. *Argonne National Laboratory Report*.
- (ii) The volume number as, for example, vol 2, should be followed by the editors, if any, in a form such as ed A J Smith and P R Jones. Use *et al* if there are more than two editors. Next comes the town of publication and publisher, within brackets and separated by a colon, and finally the page numbers preceded by p if only one number is given or pp if both the initial and final numbers are given.
- (iii) If a book is part of a series (for examples, *Springer Tracts in Modern Physics*), the series title and volume number is given in parentheses after the book title. Whereas for an individual volume in a multivolume set, the set title is given first, then the volume title.

Morse M 1996 Supersonic beam sources *Atomic Molecular and Optical Physics (Experimental Methods in the Physical Sciences* vol 29) ed F B Dunning and R Hulet (San Diego: Academic)

Fulco C E, Liverman C T and Sox H C (eds) 2000 *Gulf War and Health* vol 1 *Depleted Uranium, Pyridostigmine Bromide, Sarin, and Vaccines* (Washington, DC: The National Academies Press)

## 7. Cross referencing

The facility to cross reference items in the text is very useful when composing articles as the precise form of the article may be uncertain at the start and revisions and

**Table 3.** Alternatives to the normal references `\ref` and the text generated by them. Note it is not normally necessary to include the word equation before an equation number except where the number starts a sentence. The versions producing an initial capital should only be used at the start of sentences.

Reference	Text produced
<code>\eref{&lt;label&gt;}</code>	(<num>)
<code>\Eref{&lt;label&gt;}</code>	Equation (<num>)
<code>\fref{&lt;label&gt;}</code>	figure <num>
<code>\Fref{&lt;label&gt;}</code>	Figure <num>
<code>\sref{&lt;label&gt;}</code>	section <num>
<code>\Sref{&lt;label&gt;}</code>	Section <num>
<code>\tref{&lt;label&gt;}</code>	table <num>
<code>\Tref{&lt;label&gt;}</code>	Table <num>

amendments may subsequently be made.  $\text{\LaTeX}$  provides excellent facilities for doing cross-referencing and these can be very useful in preparing articles.

### 7.1. References

Cross referencing is not necessary for referencing in the Harvard system where the final reference list is alphabetical and normally no other changes are necessary when a reference is added or deleted.

### 7.2. Equation numbers, sections, subsections, figures and tables

Labels for equation numbers, sections, subsections, figures and tables are all defined with the `\label{label}` command and cross references to them are made with the `\ref{label}` command.

Any section, subsection, subsubsection, appendix or subappendix command defines a section type label, e.g. 1, 2.2, A2, A1.2 depending on context. A typical article might have in the code of its introduction ‘The results are discussed in section~`\ref{disc}`.’ and the heading for the discussion section would be:

```
\section{Results}\label{disc}
```

Labels to sections, etc, may occur anywhere within that section except within another numbered environment. Within a maths environment labels can be used to tag equations which are referred to within the text.

In addition to the standard `\ref{<label>}` the abbreviated forms given in the table 3 are available for reference to standard parts of the text

## 8. Tables and table captions

Tables are numbered serially and referred to in the text by number (table 1, etc, **not** tab. 1). Each table should have an explanatory caption which should be as concise as



possible. If a table is divided into parts these should be labelled (a), (b), (c), etc but there should be only one caption for the whole table, not separate ones for each part.

In the preprint style the tables may be included in the text or listed separately after the reference list starting on a new page.

### 8.1. The basic table format

The standard form for a table is:

```
\begin{table}
\caption{\label{label}Table caption.}
\begin{indented}
\item[]\begin{tabular}{@{}llll}
\br
Head 1&Head 2&Head 3&Head 4\\
\mr
1.1&1.2&1.3&1.4\\
2.1&2.2&2.3&2.4\\
\br
\end{tabular}
\end{indented}
\end{table}
```

Points to note are:

- (i) The caption comes before the table. It should have a period at the end.
- (ii) Tables are normally set in a smaller type than the text. The normal style is for tables to be indented. This is accomplished by using `\begin{indented}` ... `\end{indented}` and putting `\item[]` before the start of the tabular environment. Omit these commands for any tables which will not fit on the page when indented.
- (iii) The default is for columns to be aligned left and adding `@{}` omits the extra space before the first column.
- (iv) Tables have only horizontal rules and no vertical ones. The rules at the top and bottom are thicker than internal rules and are set with `\br` (bold rule). The rule separating the headings from the entries is set with `\mr` (medium rule).
- (v) Numbers in columns should be aligned on the decimal point; to help do this a control sequence `\lineup` has been defined which sets `\0` equal to a space the size of a digit, `\m` to be a space the width of a minus sign, and `\-` to be a left overlapping minus sign. `\-` is for use in text mode while the other two commands may be used in maths or text. (`\lineup` should only be used within a table environment after the caption so that `\-` has its normal meaning elsewhere.) See table 4 for an example of a table where `\lineup` has been used.

**Table 4.** A simple example produced using the standard table commands and `\lineup` to assist in aligning columns on the decimal point. The width of the table and rules is set automatically by the preamble.

<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>
23.5	60	0.53	−20.2	−0.22	1.7	14.5
39.7	−60	0.74	−51.9	−0.208	47.2	146
123.7	0	0.75	−57.2	—	—	—
3241.56	60	0.60	−48.1	−0.29	41	15

**Table 5.** A table with headings spanning two columns and containing notes. To improve the visual effect a negative skip (`\ns`) has been put in between the lines of the headings. Commands set-up by `\lineup` are used to aid alignment in columns. `\lineup` is defined within the `\Table` definition.

Nucleus	Thickness (mg cm <sup>−2</sup> )	Composition	Separation energies	
			$\gamma$ , n (MeV)	$\gamma$ , 2n (MeV)
<sup>181</sup> Ta	19.3 ± 0.1 <sup>a</sup>	Natural	7.6	14.2
<sup>208</sup> Pb	3.8 ± 0.8 <sup>b</sup>	99% enriched	7.4	14.1
<sup>209</sup> Bi	2.86 ± 0.01 <sup>b</sup>	Natural	7.5	14.4

<sup>a</sup> Self-supporting.

<sup>b</sup> Deposited over Al backing.

## 8.2. Simplified coding and extra features for tables

The basic coding format can be simplified using extra commands provided in the `iopart` class file. The commands up to and including the start of the tabular environment can be replaced by

```
\Table{\label{label}Table caption}
```

this also activates the definitions within `\lineup`. The final three lines can also be reduced to `\endTable` or `\endtab`. Similarly for a table which does not fit in when indented `\fulltable{\label{label}caption} ... \endfulltable` or `\endtab` can be used. L<sup>A</sup>T<sub>E</sub>X optional positional parameters can, if desired, be added after `\Table{\label{label}caption}` and `\fulltable{\label{label}caption}`.

`\centre{#1}{#2}` can be used to centre a heading `#2` over `#1` columns and `\crule{#1}` puts a rule across `#1` columns. A negative space `\ns` is usually useful to reduce the space between a centred heading and a centred rule. `\ns` should occur immediately after the `\\` of the row containing the centred heading (see code for table 5). A small space can be inserted between rows of the table with `\ms` and a half line space with `\bs` (both must follow a `\\` but should not have a `\\` following them).

Units should not normally be given within the body of a table but given in brackets following the column heading; however, they can be included in the caption for long column headings or complicated units. Where possible tables should not be broken over pages. If a table has related notes these should appear directly below

the table rather than at the bottom of the page. Notes can be designated with footnote symbols (preferable when there are only a few notes) or superscripted small roman letters. The notes are set to the same width as the table and in normal tables follow after `\end{tabular}`, each note preceded by `\item[]`. For a full width table `\noindent` should precede the note rather than `\item[]`. To simplify the coding `\tabnotes` can, if desired, replace `\end{tabular}` and `\endtabnotes` replaces `\end{indented}\end{table}`.

If all the tables are grouped at the end of a document the command `\Tables` is used to start a new page and set a heading ‘Tables and table captions’. If the tables follow an appendix then add the command `\noappendix` to revert to normal style numbering.

## 9. Figures and figure captions

Figures (with their captions) can be incorporated into the text at the appropriate position or grouped together at the end of the article. If the figures are at the end of the article and follow an appendix then add the command `\noappendix` to revert to normal style numbering.

### 9.1. *Using copyright material*

If you wish to illustrate your paper using material for which you do not own the copyright then you must seek permission from the copyright holder, usually both the author and the publisher of the previous work. It is the author’s responsibility to obtain copyright permissions and this should be done prior to submitting your paper. If you have obtained permission, please provide full details of the permission granted—for example, copies of the text of any e-mails or a copy of any letters you may have received. Figure captions must include an acknowledgment of the original source of the material even when permission to use has been obtained.

### 9.2. *Inclusion of graphics files*

Using the `graphicx` package graphics files can be included within figure and center environments at an appropriate point within the text using code such as:

```
\includegraphics{file.eps}
```

The `graphicx` package supports various optional arguments to control the appearance of the figure. Other similar packages can also be used (e.g. `graphics`, `epsf`). For more detail about graphics inclusion see the documentation of the `graphicx` package, refer to one of the books on L<sup>A</sup>T<sub>E</sub>X (Goosens *et al* 1997) or download some of the excellent free documentation available via the Comprehensive TeX Archive Network (CTAN) <http://www.ctan.org>—in particular see Reckdahl (1997). The graphics guidelines, provide further information on preparing EPS files—a copy can be downloaded from <http://www.iop.org/EJ/journal/fdr>.

**Table 6.** Control sequences to describe lines and symbols in figure captions.

Control sequence	Output	Control sequence	Output
<code>\dotted</code>	.....	<code>\opencircle</code>	○
<code>\dashed</code>	----	<code>\opentriangle</code>	△
<code>\broken</code>	---	<code>\opentriangledown</code>	▽
<code>\longbroken</code>	— — —	<code>\fullsquare</code>	■
<code>\chain</code>	— . —	<code>\opensquare</code>	□
<code>\dashddot</code>	— .. —	<code>\fullcircle</code>	●
<code>\full</code>	——	<code>\opendiamond</code>	◇

### 9.3. Captions

Each figure should have a brief caption describing it and, if necessary, interpreting the various lines and symbols on the figure. As much lettering as possible should be removed from the figure itself and included in the caption. If a figure has parts, these should be labelled (a), (b), (c), etc and all parts should be described within a single caption. Table 6 gives the definitions for describing symbols and lines often used within figure captions (more symbols are available when using the optional packages loading the AMS extension fonts).

### 9.4. Multimedia

FDR allows authors to submit multimedia attachments to enhance the online versions of published research articles. Multimedia enhancements typically consist of video clips, animations or supplementary data such as data files, tables of extra information or extra figures. They can add to the reader's understanding and present results in attractive ways that go beyond what can be presented in the print version of the journal. The printed journal remains the archival version, and multimedia items are supplements which enhance a reader's understanding of the paper but are not essential to that understanding. Guidelines on multimedia file formats are contained in the document *FDR's Guidelines for authors* which can be accessed online by going to <http://www.iop.org/EJ/journal/fdr>.

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## Appendix A. List of macros for formatting text, figures and tables

**Table A1.** Macros available for use in text. Parameters in square brackets are optional.

Macro name	Purpose
<code>\title[#1]{#2}</code>	Title of article and short title (optional)
<code>\paper[#1]{#2}</code>	Title of paper and short title (optional)
<code>\letter{#1}</code>	Title of Letter to the Editor
<code>\comment[#1]{#2}</code>	Title of Comment and short title (optional)
<code>\topical[#1]{#2}</code>	Title of Topical Review and short title (optional)
<code>\review[#1]{#2}</code>	Title of review article and short title (optional)
<code>\note[#1]{#2}</code>	Title of Note and short title (optional)
<code>\prelim[#1]{#2}</code>	Title of Preliminary Communication & short title
<code>\author{#1}</code>	List of all authors
<code>\article[#1]{#2}{#3}</code>	Type and title of other articles and short title (optional)
<code>\address{#1}</code>	Address of author
<code>\pacs{#1}</code>	PACS classification codes
<code>\pacno{#1}</code>	Single PACS classification code
<code>\ams{#1}</code>	Mathematics Classification Scheme
<code>\submitto{#1}</code>	‘Submitted to’ message
<code>\maketitle</code>	Creates title page
<code>\begin{abstract}</code>	Start of abstract
<code>\end{abstract}</code>	End of abstract
<code>\nosections</code>	Inserts space before text when no sections
<code>\section{#1}</code>	Section heading
<code>\subsection{#1}</code>	Subsection heading
<code>\subsubsection{#1}</code>	Subsubsection heading
<code>\appendix</code>	Start of appendixes
<code>\ack</code>	Acknowledgments heading
<code>\References</code>	Heading for reference list
<code>\begin{harvard}</code>	Start of alphabetic reference list
<code>\end{harvard}</code>	End of alphabetic reference list
<code>\begin{thebibliography}{#1}</code>	Start of numeric reference list
<code>\end{thebibliography}</code>	End of numeric reference list
<code>\etal</code>	<i>et al</i> for text and reference lists
<code>\nonum</code>	Unnumbered entry in numerical reference list

**Table A2.** Macros defined within `iopart.cls` for use with figures and tables.

Macro name	Purpose
<code>\Figures</code>	Heading for list of figure captions
<code>\Figure{#1}</code>	Figure caption
<code>\Tables</code>	Heading for tables and table captions
<code>\Table{#1}</code>	Table caption
<code>\fulltable{#1}</code>	Table caption for full width table
<code>\endTable</code>	End of table created with <code>\Table</code>
<code>\endfulltab</code>	End of table created with <code>\fulltable</code>
<code>\endtab</code>	End of table
<code>\br</code>	Bold rule for tables
<code>\mr</code>	Medium rule for tables
<code>\ns</code>	Small negative space for use in table
<code>\centre{#1}{#2}</code>	Centre heading over columns
<code>\crule{#1}</code>	Centre rule over columns
<code>\lineup</code>	Set macros for alignment in columns
<code>\m</code>	Space equal to width of minus sign
<code>\-</code>	Left overhanging minus sign
<code>\0</code>	Space equal to width of a digit

## Appendix B. Control sequences for journal abbreviations

**Table B1.** Abbreviations for the IOP Publishing journals.

Macro name	Short form of journal title	Years relevant
<i>Current journals</i>		
\CQG	Class. Quantum Grav.	
\EJP	Eur. J. Phys.	
\IP	Inverse Problems	
\JHEP	J. High Energy Phys.	1999 and onwards
\JMM	J. of Michromech. and Microeng.	
\JNE	J. Neural Eng.	
\JOA	J. Opt. A: Pure and Applied Opt.	1998 and onwards
\JOB	J. Opt. B: Quantum and Semiclass. Opt.	1999 and onwards
\JPA	J. Phys. A: Math. Gen.	
\jpb	J. Phys. B: At. Mol. Opt. Phys.	1988 and onwards
\JPCM	J. Phys: Condens. Matter	1989 and onwards
\JPD	J. Phys. D: Appl. Phys.	
\jpg	J. Phys. G: Nucl. Part. Phys.	1989 and onwards
\MSMSE	Modelling Simul. Mater. Sci. Eng.	
\MST	Meas. Sci. Technol.	1990 and onwards
\NJP	New J. Phys.	1999 and onwards
\NL	Nonlinearity	
\NT	Nanotechnology	
\PB	Phys. Biol.	
\PM	Physiol. Meas.	
\PMB	Phys. Med. Biol.	
\PPCF	Plasma Physics and Controlled Fusion	
\PSST	Plasma Sources Sci. Technol.	
\RPP	Rep. Prog. Phys.	
\SST	Semicond. Sci. Technol.	
\SMS	Smart Mater. Struct.	
\SUST	Supercond. Sci. Technol.	
<i>No Longer Published</i>		
\JPB	J. Phys. B: At. Mol. Phys.	1968–1987
\JPC	J. Phys. C: Solid State Phys.	1968–1988
\JPE	J. Phys. E: Sci. Instrum.	1968–1989
\JPF	J. Phys. F: Met. Phys.	1971–1988
\JPG	J. Phys. G: Nucl. Phys.	1975–1988
\PAO	Pure and Applied Opt.	1992–1998
\QO	Quantum Opt.	1989–1994
\QSO	Quantum and Semiclass. Opt.	1995–1998

**Table B2.** Abbreviations for some more common non-IOP Publishing journals.

Macro name	Short form of journal
\AC	Acta Crystallogr.
\AM	Acta Metall.
\AP	Ann. Phys., Lpz
\APNY	Ann. Phys., NY
\APP	Ann. Phys., Paris
\CJP	Can. J. Phys.
\GRG	Gen. Rel. Grav.
\JAP	J. Appl. Phys.
\JCP	J. Chem. Phys.
\JJAP	Japan. J. Appl. Phys.
\JMMM	J. Magn. Magn. Mater.
\JMP	J. Math. Phys.
\JOSA	J. Opt. Soc. Am.
\JP	J. Physique
\JPhCh	J. Phys. Chem.
\JPSJ	J. Phys. Soc. Japan
\JQSRT	J. Quant. Spectrosc. Radiat. Transfer
\NC	Nuovo Cimento
\NIM	Nucl. Instrum. Methods
\NP	Nucl. Phys.
\PF	Phys. Fluids
\PL	Phys. Lett.
\PR	Phys. Rev.
\PRL	Phys. Rev. Lett.
\PRS	Proc. R. Soc.
\PS	Phys. Scr.
\PSS	Phys. Status Solidi
\PTRS	Phil. Trans. R. Soc.
\RMP	Rev. Mod. Phys.
\RSI	Rev. Sci. Instrum.
\SSC	Solid State Commun.
\SPJ	Sov. Phys.–JETP
\ZP	Z. Phys.

## References

- Goosens M, Rahtz S and Mittelbach F 1997 *The L<sup>A</sup>T<sub>E</sub>X Graphics Companion* (Reading, MA: Addison-Wesley)
- Reckdahl K 1997 *Using Imported Graphics in L<sup>A</sup>T<sub>E</sub>X* (search CTAN for the file ‘epslatex.pdf’)