

## INSTRUCTIONS FOR PRODUCING A CAMERA-READY COPY (CRC) USING WORLD SCIENTIFIC PUBLISHING STYLE FILES

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This is where the abstract should be placed. It should consist of one paragraph and give a concise summary of the material in the article below. Replace the title, authors, and addresses within the curly brackets with your own title, authors, and addresses. You may have as many authors and addresses as you. The control sequences of author and addresses can be repeated as often as necessary. Do not use footnotes in the abstract or the title; the acknowledgments for funding bodies etc. are placed in a separate section at the end of the text.

### 1 Guidelines

#### 1.1 *Producing the Hard Copy*

The hard copy may be produced using the instructions given in the file *stlread.1st*, which are repeated in this section. You should have three files in total.<sup>a</sup>

*readme.txt* — the preliminary guide.

*ws-p10x7.cls* — the style file that provides the higher level latex2e commands for the proceedings. Don't change these parameters.

*ws-p10x7.tex* — the main text.

You can delete our sample text and replace it with your own contribution to the volume, however we recommend keeping an initial version of the file for reference. Strip off any mail headers and then latex the tex file. The command for latexing is `latex ws-p10x7`, do this twice to sort out the cross-referencing.

We have provided the running page num-

ber, jobname and submission informations at the bottom of each page with overfull box for identification purpose only. The same will be removed at the final stage and the new folio will be set by us according to the lineup of the volume.

If you wish to use some other form of word-processor, some guidelines are given in Sec. 1.2 below. These files will work with standard Latex2e. If there is an abbreviation defined in the new definitions at the top of the file *ws-p10x7.tex* that conflicts with one of your own macros, then delete the appropriate command and revert to longhand. Failing that, please consult your local texpert to check for other conflicting macros that may be unique to your computer system. Page numbers are included at the bottom of the page for your guidance. Do not worry about the final pagination of the volume which will be done after you submit the paper.

#### 1.2 *Using Other Word-Processing Packages*

If you want to use some other form of word-processor to construct your output, and are using the final hard copy version of these

<sup>a</sup>You can obtain these files from our WWW pages at: [www.wspc.com/others/style\\_files/authorsf\\_new.html](http://www.wspc.com/others/style_files/authorsf_new.html) [www.wspc.com.sg/others/style\\_files/authorsf\\_new.html](http://www.wspc.com.sg/others/style_files/authorsf_new.html) or by ftp from [ftp.wspc.com.sg](ftp://ftp.wspc.com.sg),  
`cd /pub/style_files/proceedings/stwocol/.`

$$U = D(\delta_1, \delta_2, \delta_3, \delta_4)R_{12}(a, \delta_5)R_{13}(b, \delta_6)R_{14}(c, \delta_7)R_{23}(d, \delta_8)R_{24}(e, \delta_9)R_{34}(f, \delta_{10}) \quad (1)$$



Figure 1. Caption for the figure will come here.

files as guidelines; then please follow the style given here for headings, table and figure captions, and the footnote and citation marks. For this size of volume, the final page dimensions will be 10 by 7 inches, however you should submit the copy on standard A4 paper. The text area (which includes the page numbers) should be 8.25 by 5.6 inches and the separation between the columns is 0.20in. The text should be in 10pt roman for the title, section heads and the body of the text, using capitals for the title and authors, bold face for the title and headings, and italics for the subheadings. The abstract, footnotes, figure and table captions should be in 8pt.

It's also important to reproduce the spacing of the text and headings as shown here. Text should be slightly more than single-spaced; use a baselineskip (which is the average distance from the base of one line of text to the base of an adjacent line) of 13 pts and 10 pts for footnotes. All headings should be separated from the text preceding it by a baselineskip of about 26 pts and use a baselineskip of about 18 pts for the following text.

Paragraphs should have a first line indented by about 0.25in (6mm), except where the paragraph is preceded by a heading, and the abstract should be indented on both sides by 0.25in (6mm) from the main body of the

Table 1. This is a Small Table.

Title	$\epsilon'$	$\lambda$	$\gamma$
3.5687	3.4567	3.8746	2.8934
Trans Process for Decay			
6.8977	8.9087	2.8989	4.2928

text.

### 1.3 Headings and Text

Please preserve the style of the headings, text fonts and line spacing to provide a uniform style for the proceedings volume. In a two column format there are more difficulties when finding suitable line and page breaks. We recommend that you leave such problems until preparing the final draft and after you have checked the placing of the two-column wide tables etc. (See Sec. 1.7 below).

### 1.4 Equations

Equations should be confined to one column wherever possible, as in Eq. (2), and the *eqnarray* environment may be used to split equations into several lines, for example in Eq. (3), or to align several equations. An alternative method is given in Eq. (4) for long sets of equations where only one referencing equation number is wanted.

If it's essential to have a two-column wide equation then use the method of Eq. (1) above. The surrounding environment is important here. In the text file *ws-p10x7.tex* make sure that you keep the declarations `\begin{table*}` and `\end{table*}` and only change the equation and its label within the inner equation environment.

For problems of placement of a wide equation, see Sec. 1.7 below. Please note, do not use square brackets in two-column

wide figures, tables and equations. This is a bug due to the declaration `\twocolumn[...]` which is hidden in the definition of `table*` and `figure*`.

### 1.5 Tables

The tables are designed to have a uniform style throughout the proceedings volume. It doesn't matter how you choose to place the inner lines of the table, but we would prefer the border lines to be of the style shown in Tables 1 and 2. For either a single or a double column table, the top and bottom horizontal lines should be single (using `\hline`), and there should be single vertical lines on the perimeter, (using `\begin{tabular}{|...|}`) as in Tables 1 and 2. For the inner lines of the table, it looks better if they are kept to a minimum. We've chosen more complicated examples purely as an illustration of what is possible.

We recommend the use of single column-wide tables wherever possible. For the page wide tables, use the environment given in the example of Table 2. Do not change the latex commands from `\begin{table*}` to `\begin{tabular}`, or from `\end{tabular}` to `\end{table*}`, apart from inserting your own caption heading and table label. The caption heading for a table should be placed at the top of the table.

### 1.6 Figures

The same arguments apply as are given above for tables, i.e. it is preferable to have figures that fit into one column of the text. If this is not possible, then use the example of figure 2 and use the commands `\begin{figure*}` and `\end{figure*}`. The `\figurebox{...}` command is defined with three arguments. First argument is for the figure height, second argument is for figure width, and the third will be for the actual figure/image file name, (i.e. eps/ps file name).

If you wish to 'embed' a *eps/postscript*

figure in the file, then include the figure/image (*eps/ps*) file name in the third argument with an extension, (i.e. *figure.eps* or *figure.ps*), etc. While embedding the figure it is not necessary to fill the first and second arguments and if the third argument is empty, the system will read the first two arguments and generate the box based on the measurements provided.

If you like to reduce or enlarge (scaling) the eps/ps figure, please remove the % mark from the declaration of the `\epsfxsize` and provide the exact width of the figure. LaTeX2e will scale the figure based on the width provided and adjust the height accordingly. You can use any form of the units of measurement described in the L<sup>A</sup>T<sub>E</sub>X Book.

If instead you wish to use some other method, then it's most important to leave the right amount of vertical space in the figure declaration to accommodate your figure (i.e. remove the lines and change the space in the example). Send the original hard copy of the figure on a separate page, clearly identifying where it should be placed on the final hard copy. The original figure you send should be correctly scaled as this ensures that the details will be visible in the final version. The figure caption should be placed below the figure.

### 1.7 Limitations on the Placement of Equations, Tables and Figures

In the final stages of preparing the document, try to declare the two-column wide figures, tables or equations at a point in *ws-p10x7.tex* that is prior to the top of the column of hard-copy text where you would like the item to appear.<sup>b</sup> Very large figures and tables should be placed on a page by themselves. One can use the instruction `\begin{figure*}[p]` or `\begin{table*}[p]` to position these, and they

<sup>b</sup>By 'declaring' we refer to placing the chunk of material describing the table or whatever at a particular point in the text file.

Table 2. Experimental Data bearing on  $\Gamma(K \rightarrow \pi\pi\gamma)$  for the  $K_S^0$ ,  $K_L^0$  and  $K^-$  mesons.

Meson	$\Gamma(\pi^+\pi^-) s^{-1}$	$\Gamma(\pi^+\pi^-\gamma) s^{-1}$	
$K_S^0$	$0.769 \times 10^{10}$	$5.46 \times 10^7$	No DE observed, not even (IB)-E1 interference, despite large statistics, for $E_\gamma^* > 20$ MeV.
$K_L^0$	$3.93 \times 10^4$	$0.90 \times 10^3$ (DE = $0.62 \times 10^3$ )	DE prominent, exceeding IB over the range of measurement $20 < E_\gamma^* < 160$ MeV.
	$\Gamma(\pi^-\pi^0) s^{-1}$	$\Gamma(\pi^-\pi^0\gamma) s^{-1}$	
$K^-$	$1.711 \times 10^7$	$2.22 \times 10^4$ (DE = $1.46 \times 10^3$ )	No (IB)-E1 interference seen but data shows excess events relative to IB over $E_\gamma^* = 80$ to 100 MeV

will appear on a separate page devoted to figures and tables. Again, we would recommend making any necessary adjustments to the layout of the figures and tables only in the final draft. It is also simplest to sort out line and page breaks in the last stages.

### 1.8 Footnotes, the Bibliography, Appendices and Acknowledgments

Acknowledgments to funding bodies etc. may be placed in a separate section at the end of the text, before the Appendices. This should not be numbered so use `\section*{Acknowledgments}`.

It's preferable to have no appendices in a brief article, but if more than one is necessary then simply copy the `\section*{Appendix}` heading and type in Appendix A, Appendix B etc. between the brackets.

Footnotes are denoted by a letter superscript in the text, and references are denoted by a number superscript. We have used `\bibitem` to produce the bibliography. Citations in the text use the labels defined in the bibitem declaration, for example, the first paper by Jarlskog<sup>1</sup> is cited using the command `\cite{ja}`.

If you more commonly use the method of square brackets in the line of text for citation than the superscript method, please note that you need to adjust the punctuation so that the citation command appears after the punctuation mark.

### 1.9 Final Manuscript

The final hard copy that you send must be absolutely clean and unfolded. It will be printed directly without any further editing. Use a printer that has a good resolution (300 dots per inch or higher). There should not be any corrections made on the printed pages, nor should adhesive tape cover any lettering. Photocopies are not acceptable.

The manuscript will not be reduced or enlarged when filmed so please ensure that indices and other small pieces of text are legible.

## 2 Sample Text

The following may be (and has been) described as 'dangerously irrelevant' physics. The Lorentz-invariant phase space integral for a general n-body decay from a particle

with momentum  $P$  and mass  $M$  is given by:

$$I((P-k_i)^2, m_i^2, M) = \frac{1}{(2\pi)^5} \int \frac{d^3 k_i}{2\omega_i} \delta^4(P-k_i). \quad (2)$$

The only experiment on  $K^\pm \rightarrow \pi^\pm \pi^0 \gamma$  since 1976 is that of Bolotov *et al.*<sup>3</sup> The photon spectrum observed certainly exceeds the IB spectrum for  $E_\gamma^* \geq 70$  MeV. These authors report definite evidence for DE, however they “conclude that [IB-DE] interference is not observed” in their experiment but such interference is expected to be seen.

Although PDG has recorded the Serphukov experiment as  $K^+$  decay, it is in fact a  $K^-$  experiment. This is not a trivial difference. Assuming CPT invariance to be satisfied, CP violation is equivalent with T violation. The latter has to do with phases in the DE processes. Part of the calculated phase will arise from the final-state interactions, but there will also be a non-zero phase in the initial Lagrangian which may feed through to the phases in the final amplitudes. These Lagrangian phases will be different for the  $K^+$  and  $K^-$  processes, and can give rise to differences between spectra and rates for  $K^+$  and  $K^-$  mesons.

### 2.1 Parametrizations of the CKM Matrix

It is emphasised that there are two necessary conditions required for any acceptable parametrization of the quark mixing matrix. The first is that the matrix must be unitary, and the second is that it should contain a CP violating phase  $\delta$ . In Sec. 2.2 the connection between invariants (of form similar to  $J$ ) and unitarity relations will be examined further for the more general  $n \times n$  case. For the present, it's sufficient to note that  $J$  is equal to just twice the area of any one of these triangles. This does not mean that a non-zero  $J$  follows from unitarity alone; if  $J$  equalled zero, the unitarity constraint would still hold, but the triangle would collapse to a straight

line and the measurement of  $J$  would be of no use in determining the existence of CP violation if the quark mixing matrix was in fact represented by such a matrix. The reason is that such a matrix is not a faithful representation of the group, i.e. it does not cover all of the parameter space available.

$$\begin{aligned} T = & \text{Im}[V_{11}V_{12}^*V_{21}^*V_{22}] \\ & + \text{Im}[V_{12}V_{13}^*V_{22}^*V_{23}] \\ & - \text{Im}[V_{12}V_{13}^*V_{22}^*V_{23}] \\ & - \text{Im}[V_{33}V_{31}^*V_{13}^*V_{11}]. \end{aligned} \quad (3)$$

There are only 162 quark mixing matrices using these parameters which are to first order in the phase variable  $e^{i\delta}$  as is the case for the Jarlskog parametrizations, and for which  $J$  is not identically zero.<sup>c</sup> It should be emphasised that these are physically identical and form just one true parametrization.

### 2.2 Four and $N$ -Generation Mixing Matrix

Murnaghan<sup>2</sup> provided the most general representation of a  $4 \times 4$  unitary matrix given in Eq. (1). We have calculated the possible combinations and have found that there are eight distinct parametrizations.

The unitary nature of the matrix imposes eight conditions on the connections between adjacent rows and columns, analogous to the six unitarity triangles for the three family case, but for four generations the unitarity condition forms a quadrilateral in the imaginary plane.

We have found only one set of invariants that are independent of their positions in the matrix, i.e. for which one can choose any element to be the ‘starting point’ element  $V_{j,\alpha}$  in the definitions of  $\mathbf{K}$ ,  $\mathbf{L}$  and  $\mathbf{M}$  given below

<sup>c</sup>An example of a matrix which has elements containing the phase variable  $e^{i\delta}$  to second order, i.e. elements with a phase variable  $e^{2i\delta}$  is given at the end of this section.

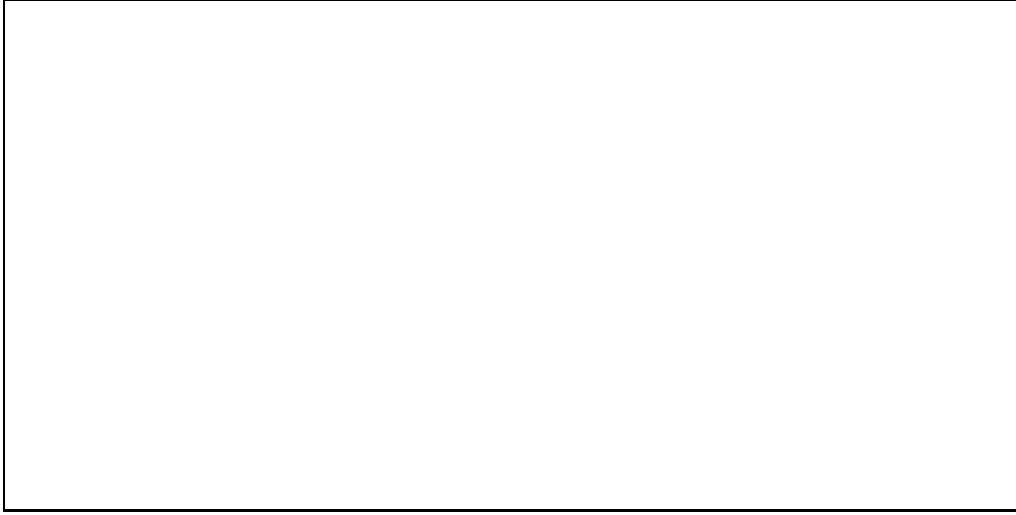


Figure 2. Dynamics of two limit cycle oscillators. The repulsive case ( $K < 0$ ) and attractive case ( $K > 0$ ) are shown. The rate of phase separation,  $f$ , is plotted versus the phase separation between the oscillators.

(where the invariants are the sums or differences of the imaginary parts of four plaquettes). These are not however independent of the choice of parametrization but are invariant for each of the individual choices.

$$\begin{aligned}
\mathbf{K} &= \Im[V_{j,\alpha} V_{j,\alpha+1}^* V_{j+1,\alpha}^* V_{j+1,\alpha+1}] \\
&\quad + \Im[V_{k,\alpha+2} V_{k,\alpha+3}^* V_{k+1,\alpha+2}^* V_{k+1,\alpha+3}] \\
&\quad + \Im[V_{j+2,\beta} V_{j+2,\beta+1}^* V_{j+3,\beta}^* V_{j+3,\beta+1}] \\
&\quad + \Im[V_{k+2,\beta+2} V_{k+2,\beta+3}^* V_{k+3,\beta+2}^*] \\
\mathbf{L} &= \Im[V_{j+1,\alpha} V_{j+1,\alpha+1}^* V_{k,\alpha+2}^* V_{k,\alpha+3}] \\
&\quad - \Im[V_{j,\alpha} V_{j,\alpha+1}^* V_{k+1,\alpha+2}^* V_{k+1,\alpha+3}] \\
&\quad + \Im[V_{j+3,\beta} V_{j+3,\beta+1}^* V_{k+2,\beta+2}^* V_{k+2,\beta+3}] \\
&\quad - \Im[V_{j+2,\beta} V_{j+2,\beta+1}^* V_{k+3,\beta+2}^* V_{k+3,\beta+3}] \\
\mathbf{M} &= \Im[V_{j,\alpha+1} V_{j,\alpha}^* V_{j+1,\alpha+1}^* V_{j+1,\alpha}] \\
&\quad + \Im[V_{k,\alpha+2} V_{k,\alpha+3}^* V_{k+1,\alpha+2}^* V_{k+1,\alpha+3}] \\
&\quad + \Im[V_{j+2,\beta+1} V_{j+2,\beta}^* V_{j+3,\beta+1}^* V_{j+3,\beta}] \\
&\quad + \Im[V_{k+2,\beta+2} V_{k+2,\beta+3}^* V_{k+3,\beta+2}^*], \quad (4)
\end{aligned}$$

where  $k = j$  or  $j + 1$  and  $\beta = \alpha$  or  $\alpha + 1$ , but

if  $k = j + 1$ , then  $\beta \neq \alpha + 1$  and similarly, if  $\beta = \alpha + 1$  then  $k \neq j + 1$ .

### Acknowledgments

This is where one places acknowledgments for funding bodies etc. Note that there are no section numbers for the Acknowledgments and Appendix. The style file will automatically generate the heading for references.

### Appendix

We can insert an appendix here and place equations so that they are given numbers such as Eq. (5).

$$x = y. \quad (5)$$

### References

1. C Jarlskog in *CP Violation*, ed. C Jarlskog (World Scientific, Singapore, 1988).
2. L. Maiani, *Phys. Lett. B* **62**, 183 (1976).
3. J.D. Bjorken and I. Dunietz, *Phys. Rev. D* **36**, 2109 (1987).