Inserts in a Multiple-Column Format

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ABSTRACT

A few years ago, we approached the problem of placing inserts (or “objects”) automatically in a multiple-column format. Among the issues we encountered were enabling users to place an object wherever they desired following a textual reference (the “place-it-here” option); placing objects that spanned columns into a page while maintaining text flow in a one-pass system; and creating a text-flow pattern that followed the style of the physics journal *Physical Review*. We use a stack-like method of storing objects to create solutions to these problems.

1. Introduction

In October 1986 we became intrigued by the problems caused when inserts or objects, such as figures and equations, must be placed within a multiple-column TeX format. Such text/figures/equations formats are common in documents we process at Los Alamos National Laboratory in our composition section. Therefore, we felt we had to find a (hopefully simple) way to solve the figure-placement (or insert-placement) problem within TeX. The goal of our first attempts was to place inserts at the top and bottom of pages in a three-column report format.

We were able to complete the TeX coding required to solve this first problem in about forty hours and produced the desired results. However, reports designed by various groups at Los Alamos required different insert-placement rules — frequently ones that would not permit the simple top or bottom insertion. At this point, therefore, our thoughts turned to the larger problem of placing inserts either after a textual reference or down and to the right of a reference. Because of other work assignments, we produced only design notes and sketches at first. In February 1989, however, we received a request from the editors working on a journal at Los Alamos for TeX macros that would direct the placement of inserts according to the style of the *Physical Review* in a two-column format. This gave us the opportunity to work with insert-placement rules considerably more complex than our original problem.

2. Definition of the Problem

The *Physical Review* format requires that several basic rules be followed. These are:

1. Material must be easily included into multiple-column (in this case two-column) text.
2. The insert must always follow the textual reference to it, which means that, depending on its position within the article, it could conceivably fall at the top of a page, at the bottom, or anywhere...
0 — the page number that is currently being processed
user specified — in which case the program will try to place the insert on the specified page

*Note:* this does not apply to "place-it-here"-type objects; see item 6 below.

4. \endmulcolinsert. Shows where the inserted object ends and places the object on the stack.

5. \balancetothispoint. This macro balances the material that \TeX{} is going to put on the current page between two columns and makes a top insert of the balanced material.

6. \texttt{refinsertadj} = a dimension value. Use this macro to position a "place-it-here" object after its reference. We found that, in some cases, an object is not placed correctly (for example, between the word "Figure" and the number "1" with each on a separate line). This macro is a "fudge factor" to ensure proper placement in such cases, and goes before the \beginmulcolinsert macros.

The above macros required a few additions to format articles according to the *Physical Review* specifications. Notably, *Physical Review* uses reading flow indicators, or "reader bars," to guide the reader's eye in the direction of text when the text flow is interrupted by a figure or equation that spans two columns. We show an example of *Physical Review* page layout using these reader bars in Sec. 4, examples 3 and 4. The additional macros supporting a *Physical Review*-style format are given below.

1. \phyrevtrue. This draws reading flow indicators when a \balancetothispoint macro is encountered. It draws \begin{center} \texttt{J} \end{center} to indicate that the text above the line is a section and draws \begin{center} \texttt{I} \end{center} to indicate that the text below the line is a section.

2. \phyrevfalse. This cancels the effect of \phyrevtrue.

3. \noclubtextlines\{n\}, where \(n\) is the number of lines of text ("club lines") allowed to sit by themselves in a column below an insert. At Los Alamos, we usually require five or more lines to appear in such a position, so the \noclubtextlines argument would be 5.

4. \copy\upreadbarbox. This sequence of commands creates an upward-pointing reader bar at the position specified in the text.

5. \copy\downreadbarbox. Likewise, this sequence of commands creates a downward-pointing reader bar at the position specified in the text.

### 3.4 Design and Implementation Concerns

The coding for the macros listed in Section 3.3 required about 100 hours. Up to ten objects can be stored on the stack at one time. Only versions of \TeX{} that have their registers doubled can process code using these macros; i.e., Sun and VAX systems.

Early in the design we realized that users may mistake features of these macros for bugs and that, to avoid user confusion, we'd better document what the code does not do as well as what it does do. For example, take the case of an object that is referenced in the right column but spans two columns. This situation will process correctly only if there are no multiple-column-spanning objects already in place that had been referenced in the left column. (This is a one-pass system, remember.) With this macro package, the program will place the object referenced in the right column on the next page.

We divided the processing code so that it would be easy to introduce new coding and allow fault (bug) detection. Some of the bugs we suspected were not bugs, but resulted from our inability to foresee results. There were, as usual, a number of typos and "why did I do that?"-type problems. However, there are still several elusive bugs that need to be found. For example, the following conditions occurring together in a document cause some text to be dropped:

1. The first page of the document contains a \balancetothispoint, which creates an object containing text and graphics that is placed on the stack as a top object. The next object is an equation.
2. The second page of the document contains two top and two bottom objects. \noclubtextlines is set to 5 to avoid club text at midpage.
3. The third page, like the first, contains a \balancetothispoint, creating an object containing text and graphics that is placed on the stack as a top object, and an equation follows as the next object. However, text is suddenly missing from the top of this page. We've worked around this situation by placing the two top and two bottom objects from the second page within a full-page object, but this fix seems clumsy.
4. Examples

4.1 Example 1: A Simple Example

This is a simple example of a page with two inserted objects. The first is a top object and is placed automatically at the top of the page. The second is a "place it here" (or referenced) object that is placed about midway on the page after its reference in the text. (Note that the object is placed correctly after its reference.) The reference point is flagged "(*Second Figure*)". The first part of the TeX code for this example is given below.

The first object's coding was placed before the start of the text. By coding this way, a compositor can group all the top and bottom objects in a report together in one place. Compositors like this feature because they tend to think of object placement in terms of "Fig. 1 at the top of page 5," Picture 3a at bottom of page 7," etc. However, because the number of objects that can be placed on a stack at any one time is ten, a report with more than ten inserts will require more than one grouping of top and bottom objects. Only the referenced objects must be embedded within text.

```tex
\begin{mulcol2}{18.5pc}
\begin{mulcolinsert{t}{2}{1}{1}
\begin{figure}[t]
\centerline{(this is an example of a "place it here" referenced object)}
\end{figure}
\end{mulcolinsert}
\end{mulcol2}
```

The Proton Storage Ring (PSR) at Los Alamos functions as a high-current accumulator or pulse compressor to provide intense pulses of 800 MeV protons for the Los Alamos Neutron Scattering Center (LANSCE) spallation Neutron Source. The neutron scattering community has seen several proposals for similar neutron sources based on compressor rings feed from a proton linac e.g., SNQ from J"ulich, one from Moscow, JHP from Japan, and (*Second Figure*)
A portion of the log for example 2

The insert starts in the left column
and only spans the left column
>> Placing bottom insert number 4
   The insert starts in the right column
   and spans only the right column
>> Removing insert 3, from stack
>> Removing insert 4, from stack
>> [Finished page 2]
[3]
>> Processing insert number 9, to be placed on page 3
>> Processing insert number 10, to be placed on page 3
>> Processing insert number 11, to be placed on page 3
>> Processing insert number 12, to be placed on page 4
>> Processing insert number 13, to be placed on page 4
>> Processing insert number 14, to be placed on page 4
>> Insert 9, and reference moving to page 4
>> Insert 10, and reference moving to page 4
>> Insert 11, and reference moving to page 4
>> Insert 8, referenced in left column
   and spans the right column
>> Placing referenced insert number 8

Overfull \vbox (0.38889pt too high) has occurred while \output is active
>> Removing insert 8, from stack
>> [Finished page 3]
[4]
>> Insert 11, will not fit in left column
   Moving it to page 5, as a top insert and
   leaving the reference on the current page
>> Placing top insert number 7
   The insert starts in the right column
   and spans only the right column
>> Placing top insert number 6
   The insert starts in the left column
   and only spans the left column
>> Placing top insert number 5
   The insert starts in the left column
   and spans the right column
>> Placing bottom insert number 12
   The insert starts in the left column
   and only spans the left column
>> Placing bottom insert number 13
   The insert starts in the right column
   and spans only the right column
>> Placing bottom insert number 14
   The insert starts in the left column
>> Insert 9, referenced in left column
   and spans the right column
>> Placing referenced insert number 9

4.3 Example 3: What's Nice About the Fizzrev Shuffle.
This example illustrates the use of the macros to produce Physical Review-style documents and illustrates the advantage of using this style.

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The example is broken up into two sections. The first section represents the output without using the Physical Review style; the second section shows the result of using this style. The example makes up a "before-and-after" sequence.

Before

1.1.4 Determination of Peak Position by a Modified Gaussian Fit

The procedure involves solving the Gaussian equation for the peak to be fitted and then using the Gauss-Legendre quadrature to integrate over the parameters of maximum peak (Eq. 1). The approximation of the integral is given as

\[ I(x) = \frac{a^2 - x^2}{b^2 - x^2} \]  

where

\[ x = \frac{a - b}{2} \]

The fit is made only to the Gaussian equation. The parameter that determines the Gaussian function best approximates only smoothly to shape over the range of parameters peak (Eq. 1). The equation of a second approximation of the form

\[ I(x) = \left( e^{-c^2 x^2} \right) \]  

where \( c = \sqrt{\frac{a - b}{2}} \)

is better than the Gauss-Legendre quadrature. The parameters being inserted are flagged with "(* eq. no. *)" for example, "(* 5-14*)". The points of reference of the objects (equations) being inserted are flagged with "(* eq. no. *)" — for example, "(* 5-14*)".

On the first page of the "before" example, the equations flow correctly up until Eq. 5-14. This equation did not appear after its reference because of its size; thus, it was moved to the top of the next page. Equation 5-17 is referenced in the right column and place two lines below its reference. This could have been corrected by use of the \texttt{\textbackslash refinsertadj} dimension register. Equation 5-19 was too large to fit after its reference and thus was moved to the top of the next page.

The only two-column-spanning equations that were set correctly in the "before" example are Eqs. 5-22 and 5-24, which occur on page 3.

\[ x = \frac{a - b}{2} \]  

\[ x = \frac{a - b}{2} \]
In addition to the objects discussed above, the fizzrev macro package formats a journal's title page, figure captions (including figures inserted with the psfig macro package), three levels of section headings, and textual references and numbers for equations (using a placeholder instead of an equation number). The line lengths of the title and running heads are both user-adjustable. See the listing below for definitions of available macros in the fizzrev package.

Using the two-column macros from inside one's own macros makes writing macros like \refrule easier; neither the macro designer nor the user needs to worry about the details of getting out of two-column mode to center the rule. The following coding was required to implement the reference rule:

\def\refrule{
  \phyrevfalse
  \beginmulcolinsert{r}{2}{1}{pg.no.}
  \begin{tabular}{l}
    \begin{tabular}{rl}
      r &= \text{the rule is an insert},
      2 &= \text{spanning two columns},
      l &= \text{starting in the left column},
      0 &= \text{on current page}
    \end{tabular}
  \end{tabular}
  \vskip2pc
  \centerline{\vrule width16.5pc depth0pt height.5pt}
  \vskip1.5pc
  \end{tabular}
  \end{tabular}
  \phyrevtrue
}

4.5 Fizzrev Macro Definitions

Following each definition, is an example of how to use the macro in a paper. See the Fizzrev Users Guide for complete descriptions.1

\abstract{}

\affil{}

\authors{}

\autoauthorfalse or true:

\autotitlefalse or true:

1 Available from the authors.
\begin{mc}{2}\{20.5pc\}

abbreviation for the multi-column \beginmulcol macro. \beginmulcol{2}\{20.5pc\}

\begin{mcinsert}\{2},\{1\},\{2\}

"Place it right here, span 2 columns, start in 1st column, and put the object on page 2."

\begin{http}

abbreviation for the multi-column \beginmulcolinsert macro. \beginmulcolinsert{r}\{2\},\{1\},\{2\}

\begin{eq}

used to reference an equation in the text and number it. ‘‘See Equation \eq{\qa}. \ A + B = C \ \\eqno(\qa)’’ \ \qa is just a placeholder, the \eq macro will evaluate the placeholder to the current number stored in the equation counter.

\begin{fig}\{20pc\},\{20.5pc\},\{This is a caption.\},\{1\}

used to set the caption and leave space for the figure. Argument 1 is the height of the figure, argument 2 is the width of the figure, argument 3 is the caption excluding a label (i.e., Fig. 1), and argument 4 is a switch for a box outline (set to 1 for on, 0 for off). \fig{20pc}{20.5pc}{This is a caption.}{1}

\begin{figcount}

used to control the figure number. \figcount=3 to get a figure labelled “Fig. 4”.

\begin{getheaderfooterinfo}\{12\},\{35\},\{Title\},\{Author\}

provides the information for the header and the footer. Argument 1 is the volume number, argument 2 is the issue number, argument 3 is the title, and argument 4 is the author’s name. \getheaderfooterinfo{12}{35}{Title}{Author}

\begin{it}

used for standard italics text. \it{emphasis}

\begin{jtp}

used to set a journal titlepage and page parameters. See also \jtp.

\begin{letter}\{\}

used for figures that are lettered, i.e., Fig. 1A. The argument is the needed letter. \letter{A}

\begin{ninepoint}

for text and math at nine point. Shouldn’t be needed but it is available. {\ninepoint This text will be in 9-point.}

\begin{page}\{\}

used instead of \pageno macro. The argument is the first page of the journal or the paper. \page{1}

\begin{phyrevfalse or true}

switch that controls the drawing of reading flow indicators, true for on, false for off. Set to true in the fizzrev package.

\begin{postscriptfig}\{\}

for use with PSFIG macro package. Argument 1 is the height of the figure, argument 2 is the width of the figure, argument 3 is the figure caption, excluding a label (i.e., Fig. 1), and argument 4 is the name of the PostScript file. \postscriptfig{20pc}{20.5pc}{This is a caption.}{figure1.ps}

\begin{ptp}

for a paper’s title page. Will set up the \vsize and the headline size for a paper.

\begin{recvd}\{\}

argument is a date. The word “Received” and the opening and closing parentheses are added by the macros and centered. \recvd{3 March 1989}
centers a rule before the references, leaving white space before and after the rule.

\textit{for times roman font. Ten point default font for text.}

\textbf{the \texttt{rsize} for the running author headline. Defaults to 32 picas.}\texttt{\authorhsize=28pc}

\textbf{the \texttt{rsize} for the running title headline. Defaults to 27 picas.}\texttt{\titlehsize=28pc}

\textbf{section{}: for a level one -heading. Argument is the heading, will be centered in bold and set in all caps automatically. Macro will leave the appropriate vertical spacing.}\texttt{\section{This is a section heading}}

\textbf{subsection{}: for a level-two heading. Argument is the heading and it will be centered in italics. Macro will leave the appropriate vertical spacing. User must type the argument using mixed case.}\texttt{\subsection{This is a subsection heading}}

\textbf{subsubsection{}: for a level-three heading. Argument is the heading and it will be centered in italics. Macro will leave the appropriate vertical spacing. User must type the argument using mixed case.}\texttt{\subsubsection{This is a subsubsection heading}}

\textbf{tenpoint: the default point size used for a paper. Shouldn't be needed but it is available.}\texttt{\tenpoint}

\textbf{titlehsize: the \texttt{rsize} used for the title on the titlepage of the paper. Defaults to 38 picas.}\texttt{\titlehsize=36pc}
TRANSPORT COEFFICIENTS OF HARD-SPHERE SYSTEMS. THEORY 

I. The author refers to the equation for the transport coefficient in a hard-sphere fluid, which is given by:

\[ \chi = \frac{1}{4} \left( 1 - \frac{1}{R} \right) \]

where \( R \) is the radius of the hard sphere.

II. The author then calculates the transport coefficient for a mixture of hard spheres, using the equation:

\[ \chi = \frac{1}{4} \left( 1 - \frac{1}{R} \right) \left( 1 - \frac{1}{R'} \right) \]

where \( R' \) is the radius of the smaller sphere in the mixture.

III. The author discusses the effects of temperature and density on the transport coefficient, showing that both parameters decrease the coefficient.

IV. The author concludes that the transport coefficient is an important parameter in the study of hard-sphere fluids, and that further research is needed to understand its behavior under various conditions.

V. The author suggests that future research should focus on experimental measurements of the transport coefficient, as well as theoretical calculations using more sophisticated models.

VI. The author thanks the anonymous reviewers for their valuable comments and suggestions, and looks forward to future collaborations on this topic.
5. What Next?
1. We need to simplify the TeX code for these macros and make it smaller. It would be nice if PCs and Macintoshes could use it.
2. We want to start processing flowing text as objects.
3. There is a need for one- and two-column footnotes.
4. Document the code.
5. Port the “place it here” code to three columns so it could be used for other formats.

6. A Comment on the Future of TeX
TeX must be enhanced with multiple-column formatting, object-placement options, and other related commands if it is to remain viable in the years ahead. WYSIWYG systems (such as Interleaf and Frame) that combine WYSIWYG with batch formatting in an effort to allow users to use tags for Standard Generalized Markup Language (SGML), will be tough competition for TeX as it now stands. In addition to these features, math formatting will soon be offered by Frame.

With content tagging (SGML) soon to be a way of life for most of us as we enter the age of knowledge information processing, a good batch formatting system in the public domain would be of great value. We would like that system to be TeX. We have a lot of TeX experience to draw upon. However, the program can’t perform the tasks its competitors are beginning to be able to address.

Some of the other enhancements we would like to see include:
1. An input file that could be buffered so that processing could be done on the contents of the buffer. A command such as \inputbuffersize2000 would establish the size of the buffer in bytes.
2. The ability to do string searches on the contents of the buffer and process the buffer up to the point a string match was found. It would also be useful if string searches could be done on the contents of any box and the match point returned. Commands such as \vsplit\mybox to \findstring{string arg} would then be possible.
3. The ability to write the contents of the unprocessed buffer to another file.
4. The ability to write contents of any box or delineated string to an ASCII file.
5. The ability to create multiple dvi output files.
6. The ability to assign a variable as a real, as well as a dimension or count register. Full floating-point arithmetic would be available on these variables.