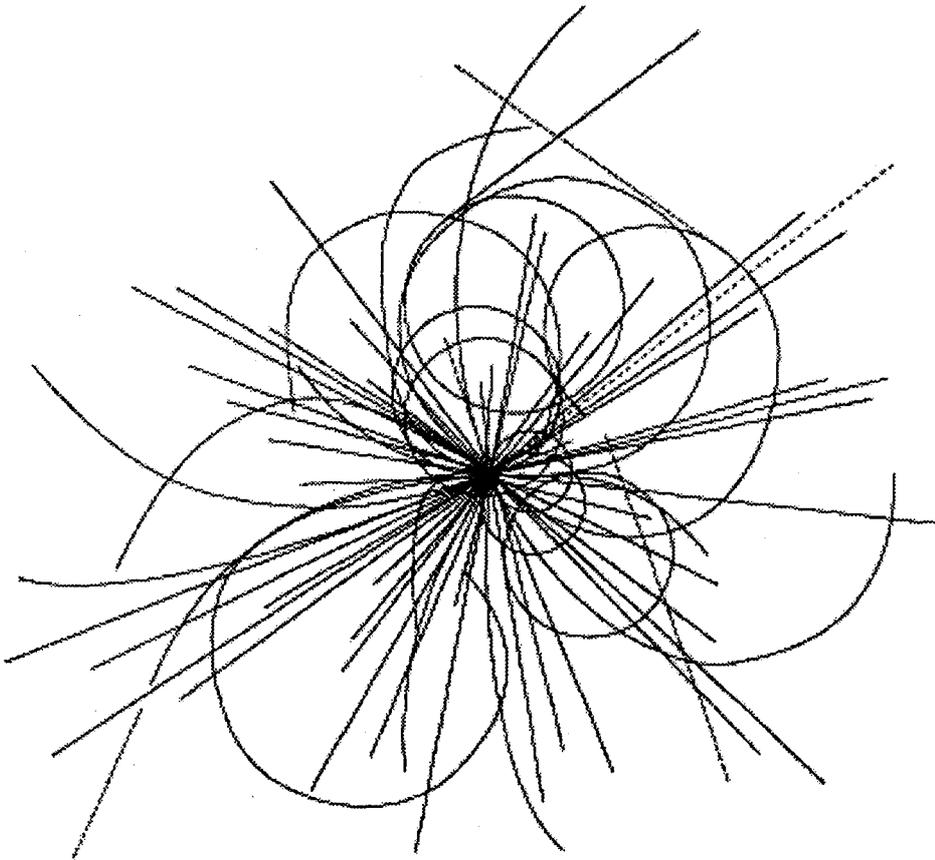


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# Discovering Graphics in LATEX Documents



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## Discovering Graphics in $\LaTeX$ Documents\*

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# Discovering Graphics in L<sup>A</sup>T<sub>E</sub>X Documents

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## Abstract

This paper attempts to share all information obtained in researching the graphics inclusion in L<sup>A</sup>T<sub>E</sub>X, from using the `picture` environment to using EPS graphics, briefly discussing how graphics enter user documents, the graphics packages available to accomplish graphics inclusion, and the various uses of the `\special` command for the SSCL printers.

## Introduction

**What is the SSC?** The Superconducting Super Collider (SSC) will have little environmental impact despite its 54-mile circumference. The main ring will be buried many feet below ground, leaving few visible traces of its existence.

The technical and experimental facilities will be located in two clusters, on opposite sides of the ring. The main laboratory site will consist of assembly areas, experimental halls, technical buildings, and offices. The injector complex will be mostly underground, but also attached to the main laboratory. The second cluster will have additional experimental halls with supporting facilities to accompany these halls. Staff and visiting scientists are expected to number in the 3000+ range.

Through the ring two beams of protons will be accelerated in opposite directions and brought into collision in several experimental areas. There, highly sensitive detectors will capture the resulting shower of subatomic particles for study by scientists.

The SSC will be located in the City of Waxahachie in Ellis County, Texas, 30 miles south of Dallas and 40 miles southeast of Fort Worth (Figure 1). Many one-lane and two-lane highways traverse the SSC ring, including I35E, U.S. 77, and U.S. 287. To the east of the ring is I45, which links Dallas and Houston. Several road improvements are planned as the project nears completion.

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Figure 1: SSC Laboratory ring location

**Learning L<sup>A</sup>T<sub>E</sub>X.** In the summer of 1985, Professor Stanly Steinberg approached me about learning L<sup>A</sup>T<sub>E</sub>X. Up to this point, the Department of Mathematics and Statistics at the University of New Mexico (UNM) used troff and hand-drawn figures. The discovery that equations and tables, as well as graphics, was easier to create lent credence to my further investigation of L<sup>A</sup>T<sub>E</sub>X usage.

L<sup>A</sup>T<sub>E</sub>X was virtually unknown at UNM. Thus, there was no T<sub>E</sub>X guru to turn to nor any T<sub>E</sub>Xpert. With the L<sup>A</sup>T<sub>E</sub>X manual in hand, my investigation began. Equations and tables were easily created.

However, when it came to the use of the `picture` environment, I feared that I might have met my match.

**Flavors of  $\TeX$  at the SSC.** There are many flavors to  $\TeX$  in use throughout the SSC Laboratory. These flavors can be compared to the 31 flavors offered by Baskin-Robbins; however, there are only 5  $\TeX$  flavors.

At the SSCL, there are the three traditional  $\TeX$  packages— $\TeX$ ,  $\LaTeX$ , and  $\AMS\TeX$ ; but there are two others. Since the SSC is a high-energy physics (HEP)-type environment, we also use `PHYZZX` (a  $\TeX$  macro package containing many HEP formatting requirements) and `TeXsis` (another HEP-type  $\TeX$  macro package). `PHYZZX` was developed at the Stanford Linear Accelerator Center by M. Weinstein; `TeXsis` was developed as the result of a `TechRpt` format described by W. Groppe and from `TeXsis` 1.01, the  $\TeX$  thesis format by E. Myers; with modifications made by F. Paige.

The use of  $\TeX$  at the SSCL provides a multitude of learning experiences. Familiarity with each package is required to become the  $\TeX$  support person at the laboratory; but more than that, it keeps one fluid in the use of every form of  $\TeX$ .

**Graphics experience: Past and present.** My first attempt at graphics saw the first 16 hours spent learning the limitations of the `picture` environment. However, this was not the only problem I encountered. Also, I had to master the limitations of the Imagen LBP-10 laser printer. One project that I attempted was drawing a simple piece of graph paper for plotting all my pictures (Figure 2). The ability to produce complex mathematical diagrams in fields such as combinatorics, graph theory, discrete and applied mathematics was soon achieved (Figure 3).

Working at the Superconducting Super Collider Laboratory (SSCL) since 1989, my graphics experience blossomed when I used a Macintosh with its enhanced graphics capabilities. This new experience led to including graphics into  $\LaTeX$  documents. However, graphics inclusion does not stop with a graphics package; it also sees the inclusion of Macintosh or DECstation screen dumps (or captures) into these documents. According to Freedman (page 612), a *screen dump* is “the ability to print the entire contents of the current display screen”.

Still using the Macintosh for most of the graphics placed in documents, a DECstation 2100 is used for screen dumps of workstation windows, applications, and environments. Being able to locate graphics applications that allow PostScript (PS) or En-

capsulated PostScript (EPS) conversion has been interesting.

This experience opened an opportunity to produce completely professional-looking documents.

## Documents With Graphics Included

In preparing several users' guides requiring the graphics inclusion, an investigation was started on the use of the `\special` command. The `\special` macro is used for inserting illustrations or graphics in text. This led to some interesting discoveries about printer drivers, available commercial printer packages, the PostScript world, and seeing completed documents with self-contained graphics. Results from these discoveries have led to the production of three documents—the SSCL Computer User's Guide, the SSCL Computer Operations Manual, and the SSCL Physics Detector Simulation Facility (PDSF) User's Guide and Training Manuals. The self-contained graphics in these documents were created using Deneba Canvas for a Macintosh, Unigraphics CAD software from an Intergraph workstation, and screen captures from the Macintosh and a DECstation 2100.

Details of the procedures used for the graphics inclusion and the DVI-to-PS packages used are discussed later in this paper. A little history is now given on the above documents.

**The SSCL Computer User's Guide and SSCL Computer Operations Manual** were created with graphics inclusion. Only one figure in the first versions of these two documents was non-contained. Graphics packages used for these documents were Deneba Canvas and Unigraphics CAD graphics converted to Canvas-readable format. These graphics were next converted to EPS format and transferred to the VMS mainframe. After transferring the converted graphics to the mainframe, Northlake Software's T2/script product was used for the `\special` command inclusion.

These documents are in the second revision stage and are being done on a DECstation 2100 workstation running the Ultrix operating system. Some of these graphics are carryovers from the first versions, but the one non-contained figure is being replaced by an electronic version (Figure 4). Arbortext's DVILASER/PS software is used for the `\special` command inclusion.

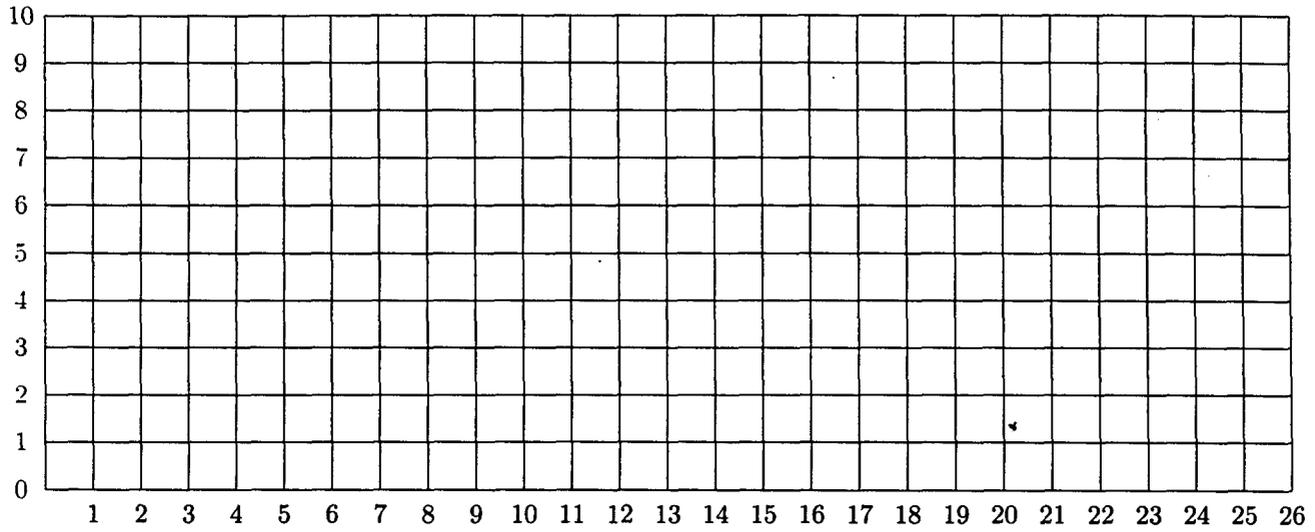


Figure 2: First project — creating graph paper

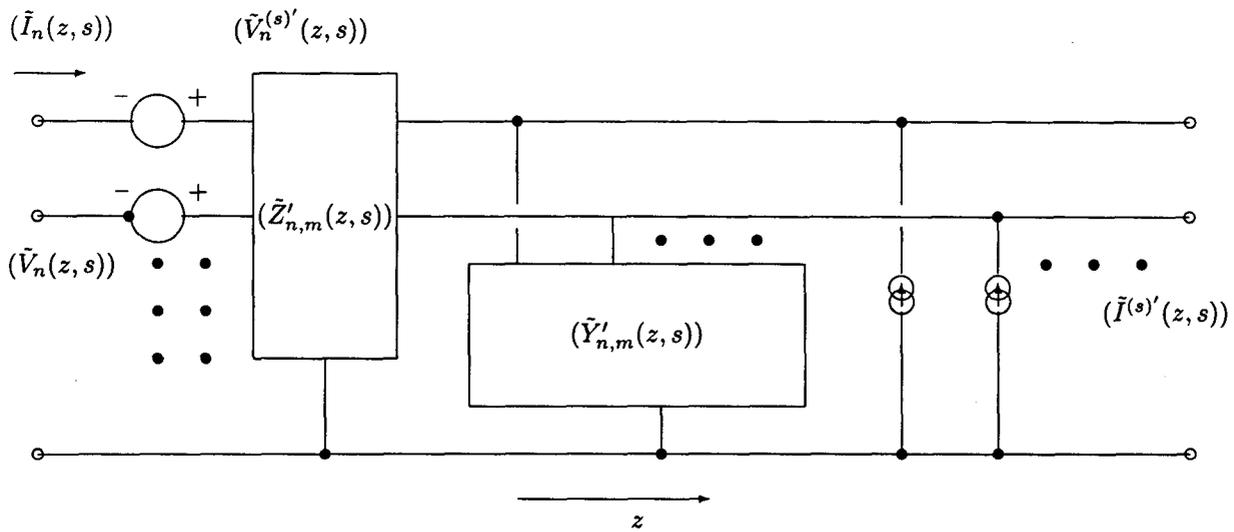


Figure 3: Second project — schematic diagram

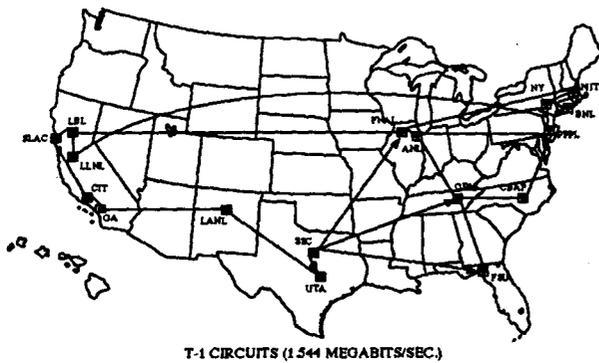


Figure 4: Non-contained figure now included

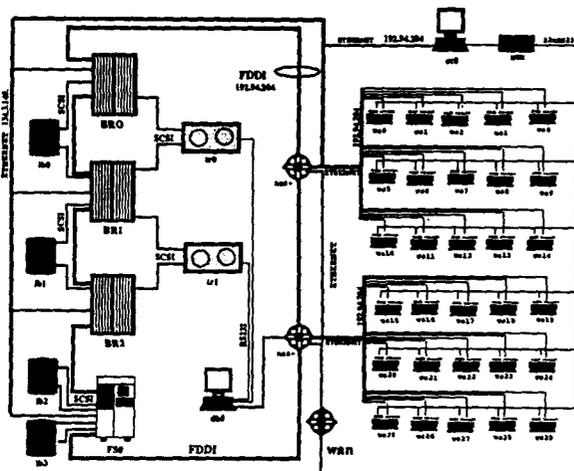


Figure 5: PDSF computer system

The PDSF User's Guide and Training Manuals were written to support users of the Physics Detector Simulation Facility, a complex system that enhances the scientist's ability to do high level simulations of detector experiments. The graphics inclusion and DVI-to-PS packages used were the same as the other documents, except for one difference. One figure was created using a software package called NetCentral Station (Figure 5).

After all this background history, you are probably wondering how do you create graphics. What packages are used? How do I import/export them into PostScript or EPS format and include them in your L<sup>A</sup>T<sub>E</sub>X document.

### Graphics Packages Used

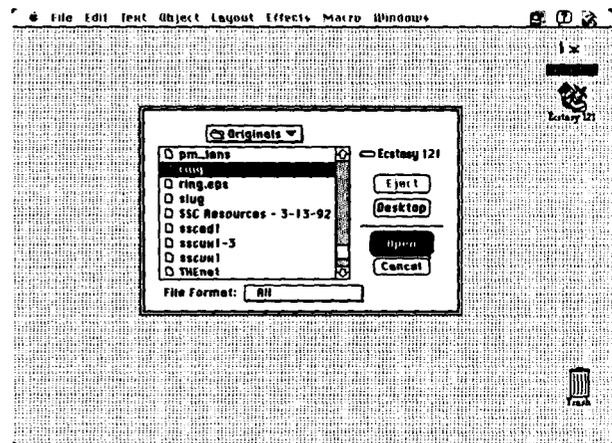
Schwer (page 195) provided the basic steps needed for including Macintosh graphics in L<sup>A</sup>T<sub>E</sub>X documents. These steps are:

- To create graphics with the user's favorite Macintosh application;
- convert graphics into PostScript representation;
- transfer the PostScript file to the L<sup>A</sup>T<sub>E</sub>X host machine; and
- include the PostScript file in the L<sup>A</sup>T<sub>E</sub>X document via the DVI-to-PS driver's `\special` command.

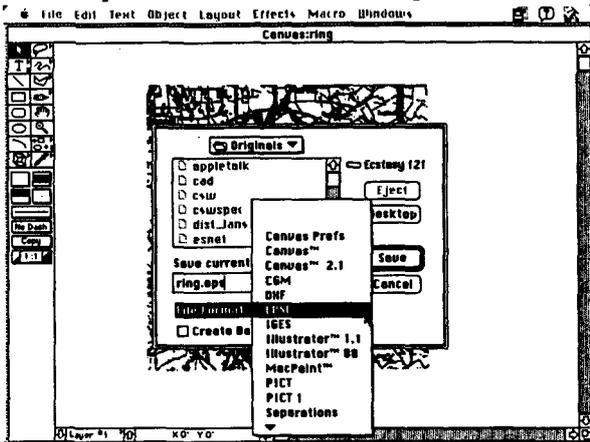
The next four sections describe the methods of creating the PS representation of the graphics into a usable file for the `\special` command.

Deneba Canvas 3.0 is a complete graphics package created by Deneba for the Macintosh. By complete, it is meant that Canvas combines MacDraw II and MacPaint 2.0 to create a great graphics image. Canvas 3.0 allows the conversion of Canvas files into several selections, such as EPSF, Adobe Illustrator 1.1, etc. Once the conversion is done, the new files are in EPS representation, thus having the ability of being opened, modified, and saved into other Macintosh programs, or imported into different Macintosh programs. However, the purpose of this paper is to show how to include graphics into L<sup>A</sup>T<sub>E</sub>X documents. Therefore, the following procedures, shown pictorially below, explain how to convert the file into EPSF format.

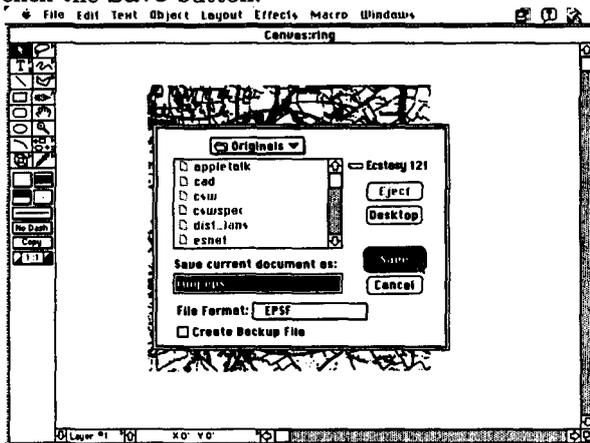
- Open the file to be converted, then
- Click on the **Save As...** button providing a filename, such as *filename.eps*.



Another dialog box appears allowing selection of the proper **File Format** with all available conversion options. Select the **EPSF** option.



After choosing the appropriate conversion format, click the **Save** button.



The next step is transferring the **.eps** files to the host computer. This procedure is not covered in the scope of this paper.

The **Unigraphics CAD** graphics system controls production of engineering drawings, floor plans, etc. For the user documents produced at the SSCL, the CAD Group converts the floor plans into PICT files that are imported into Canvas. Once in Canvas, the floor plans are modified and then converted to an EPSF-formatted file.

**Macintosh/DECstation screen captures.** A screen capture is similar to the screen dump. The major difference is that the DECstation software allows you to capture, or take a *snapshot*, a portion of the screen versus the entire screen. Digital Equipment Corporation refers to this as their Print Screen feature. Print Screen lets you print the snapshot im-

mediately or capture the image and save it in a PS file to be printed later.

A Macintosh screen dump is done by pressing the **3** key with the **Apple** and **Shift** keys held down. This results in a MacPaint file being created containing the current screen regardless what type of application is running.

Canvas is used to open the MacPaint file. Once the file is open, rotation and sizing modifications are made. This file is then converted to the appropriate EPSF-formatted file.

The **NetCentral Station (NCS)** is Cisco Systems' network management product that is designed to monitor complex internetworks and to simplify in-depth network planning and analysis. NCS incorporates a high-level graphics editor that provides users with the tools to create and position their own graphic images of routers, bridges, hosts, and links. The graphics editor is able to convert active, online graphics into suitable raw PS files that are placed directly into L<sup>A</sup>T<sub>E</sub>X documents.

The ability of seeing the printed page becomes an exciting reality. Thus, the next step was to acquire the right DVI-to-PS printer drivers.

### How DVI-to-PS Printer Packages and `\special` Commands Intertwine?

Schwer (page 195) states two key points in his article:

1. There are several DVI-PostScript drivers available and they all treat the `\special` command differently.
2. Not all PostScript devices are the same. Macintosh QuickDraw, a PostScript language shorthand, in combination with various PostScript implementations of DVI drivers produces different results on different PostScript drivers.

These observations are certainly true. Most users are not aware that the way they use the `\special` for figure inclusion is not standard. The reason for this is that a local T<sub>E</sub>X wizard has located specific macros to work with the Laboratory's dvi processing programs. Thus, there is no reason for users to look under the sheets to discover that not all `\special` commands work the same way.

At the SSCL, there are three different computing platforms available—VMS, UNIX, and Macintosh (with PCs soon to be added)—it became necessary to learn how the `\special` command worked on these platforms. Referring back to Schwer's two key points, I discovered that the `\special` command

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did work differently depending on which computing platform and DVI-to-PS packages were used.

Discussion is presented about three commercial packages currently in use at the Laboratory:

- VMS: Northlake Software's T2/script
- UNIX: Arbortext's DVILASER/PS
- Macintosh: Blue Sky Research's *Textures*

Each of these packages support capabilities other than figure inclusion (e.g., selecting color for text; raw PS code insertion; landscape mode; and TIFF, PCX or PICT file insertion).

**VMS.** Northlake's T2/script (1989) software translates "TeX DVI files and fonts into PostScript, for printing on many different PostScript printers... PostScript commands and Encapsulated PostScript files may be inserted in the job using TeX `\special` commands."

The use of this package was easy. Steps for using this package are presented below.

1. Place the `\special` command where you want the graphics to appear using the syntax:

```
\special{insert filename.eps [qualifier]}
```

2. Four additional qualifiers are available for use. They are:

<code>orientation=±1</code>	Rotates picture 90 degrees
<code>magnification=n</code>	Enlarges or reduces graphics (default = 1000)
<code>left=[±len]</code>	Controls left side of graphics
<code>top=[±len]</code>	Controls top side of graphics

Three examples on the use of this `\special` command are:

```
\special{insert filename.eps, left=-xxbp}
\special{insert filename.eps, orientation=-1,
left=-180bp, top=-72bp}
\special{insert filename.eps,
magnification=750}
```

where *bp* stands for big points (or 72 bp = 1 inch).

**UNIX.** Arbortext's (page 3) DVILASER/PS product translates "TeX dvi files into PostScript; these PostScript files can be printed on any printer or typesetter that supports the PS language". The `\special` command provides graphics inclusion into L<sup>A</sup>T<sub>E</sub>X documents and provide the capability to send PS commands directly to the printer.

Arbortext's `\special` command provides the ability of embedding graphics files in the `.ps` file with one of three commands — `ps: epsfile`, `ps: plotfile`, and `ps: overlay`. For purposes of this paper, the `ps: epsfile` command is discussed. The other two are left for discovery on your own.

The `epsfile` command takes the form:

```
\special{ps: epsfile filename.eps magnification}
```

showing that the file `filename.eps` is to be inserted with the lower left-hand corner of the figure's bounding box placed at TeX's current point, scaled by `magnification/1000`. Magnification is optional; however, it must be an integer. Other uses of DVILASER/PS involves inclusion of extensive verbatim PS code.

**Macintosh.** Blue Sky Research's *Textures* is simply TeX for the Macintosh computer. The best way of describing *Textures*' concept of graphics inclusion is to use Blue Sky Research's (back cover, 1990 TUGboat) own words.

"... Adobe Illustrator *does* do pictures, with a line quality finer than any technical pen. Or use MacDraw from Claris for technical drawings; learn it in less than one hour. Image Studio from Letraset does halftones, hand-painted or scanned. All world-class programs, all only on the Macintosh. With these tools (and many others), *Textures* does pictures—on screen, on paper, beautifully."

To begin using the *Textures* `\special` command, the following definition should be placed in your preamble.

```
\def\picture #1 by #1 (#3){
\ vbox to #2{
\ brule width #1 height Opt depth Opt
\ vfill
\special{picture #3}}}
```

After having entered this definition, the proper syntax of including an EPS or PS file is `\special{picture name}`. If the picture needs to be centered within the page dimensions, type:

```
\centerline{\hbox to h_dimen
{\special{picture name}}}
```

All these packages detail the use of their version of the `\special` command and how each includes graphics into L<sup>A</sup>T<sub>E</sub>X documents.

**Printing the document.** Once the PS file has been created, the final step is to process the file through the right printer driver. There are two types of printers available for printing PS documents. For small documents (1–20 pages in length), the nearest Apple LaserWriter is used; for large documents (20+ pages in length), one of three Imagen laser printers is used. The Imagens are located in strategic places throughout the Laboratory—normally, far from where you are located.

## Conclusions and Recommendations

Recently, graphics created by the high energy physics community, such as PAW and TOPDRAWER, have been placed into L<sup>A</sup>T<sub>E</sub>X documents. Experimenting through the years and learning new methods of graphics inclusion, several procedural quick references for Laboratory personnel were developed to show how to include graphics in documents.

A recommendation from one Usenet user on standardization:

“Unfortunately there is no standard yet for use of `\special`—every DVI processor uses its own scheme. DVI processors should be able to deal with both plain vanilla encapsulated PostScript files (EPS), as well as the ‘augmented’ encapsulated PostScriptfiles (EPSF) used by some applications, where a low-resolution preview bitmap image in MetaFile or TIFF format is packaged with a PostScriptfile. Most are not able to do this.”

By no means am I an expert, but I look forward to continuing to learn more on the subject of graphics inclusion. In this paper I have attempted to share the information I have obtained in researching graphics inclusion in L<sup>A</sup>T<sub>E</sub>X from using the `picture` environment to using EPS graphics, briefly discussing how graphics enter user documents, the graphics packages available to accomplish graphics inclusion, and the various uses of the `\special` command for the SSCL printers.

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