STAR Note #164

STARGL Manual

Herbert Ward, Amal Banerjee, Kesheng Chan
C. Fred Moore, Shaul Mordechai and Jawluen Tang

Department of Physics
University of Texas at Austin
Austin, TX 78712

Internet: ward@moore.ph.utexas.edu

STARGL Manual

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1. Introduction

STARGL is an event visualization program for STAR, which provides an efficient way for viewing large numbers of hits and the associated fits as a result of collision events. It allows one to "fly an airplane" through the hits and fits, and thus allows rapid, intuitive and complete examination of their three dimensional relationships.

STARGL uses the special graphics capabilities of Silicon Graphics Inc.'s (SGI) Graphics Library (GL) for event visualization. It has an X/Xt/Motif user interface with a menu bar across the top of the window and incorporates various functionalities for piloting the airplanes, controlling the view and drawing, selecting subsets of the data, and identifying various components of the pictures.

We assume here that the program is already "installed" on your computer. If not, please see *Appendix A* for information on how to install STARGL on your machine.

2. Input

The input data file used in STARGL is an editable, human-readable "ASCII" file of simple format which allows use of a selection of seven primary colors (red, pink, yellow, green, blue, purple, and white) for particle tracks. For details about the data file format, please see the sample input data file in *Appendix B*. Work is in progress to interface more closely to TAS.

3. Invoking the STARGL program

You need an executable "stargl" and a sample data file "dataSample" to run STARGL. If you have not installed STARGL on your system, please see *Appendix A* for details.

To begin runnung STARGL, type the following command at the UNIX prompt and press Enter.

```
% stargl dataSample
```

The stargl window will appear on your screen and you can use the mouse to click the menu bar to start working with it.

If you have two data files that you want to compare, type

```
% stargl datafilename1 datafilename2
```

4. Quick start for STARGL

After you type the command "stargl dataSample", you should see the detector with many tracks and an airplane to the right. Use he mouse to drag the airplane around. The notation *View/From control tower X* means to select the " From control tower X" item from the "View" menu. Try *View/From control tower Y*. Now you are looking down on the same scene.

Do *Piloting/Pivot on Exterior Point.* The flashing diamond is the exterior pivot point. If you have trouble seeing it, use *Drawing/Hide Detector.* Use the mouse to drag the pivot point in a circle around the airplane. Leave it moderately close to the airplane. Try the left arrow key. Try the other arrow keys. You should see the airplane pivoting about the flashing diamond. Do *Piloting/Pivot on Nose*. Use the arrow keys again. Do *View/From airplane* and use the arrow keys in the two pivot modes.

Do *File/Quit* and start the program again. Do *View/From airplane* and then *Piloting/Fast Forward*. If you lose the airplane, go back to the beginning of this paragraph. While the the airplane is moving, try *Drawing/Fast Draw*. Try the arrow keys while the airplane is moving. Note that the animation speed increases at sacrifice of quality. Stop the airplane and note that the quality automatically goes back to *Drawing/Slow Draw* when the display is static.

Start the airplane again and stop it with ⟨alt-S⟩. Some of the other menu items besides *Piloting/Stop* also have accelerators. Try *Drawing/Randomize Colors*. Then try other menu items. If you do something bad that you can't reverse any other way, stop the program and start over. The next section "The STARGL menus" provides detailed functional description of each STARGL menu item.

A characteristic of X program is that they are insensitive to keyboard input unless the mouse pointer (on the screen) is within the program's window. Therefore, whenever the program seems "jammed", check that your mouse pointer (the little arrow) is within the approriate window on the screen.

The following is a convenient procedure for examining a point of particular interest. Begin by viewing from the X control tower. Do *Piloting/Pivot on Exterior Point*. Drag the airplane to an appropriate position. Since dragging does not affect the position component perpendicular to the screen, one must repeat a second drag from either the Y or Z control tower to adjust the x-coordinate. Do *View/From airplane*, and then use the arrow keys to pivot the airplane and inspect the point of interest from any direction.

5. The STARGL menus

Across the top of the STARGL window is a menu bar. There are six menus under which several different menu items can be selected by clicking the mouse.

5.1 File menu

5.1.1 Re-read Data File

This causes the program to re-read the input data file and re-draw the tracks.

5.1.2 Quit

This causes the program to quit.

5.2 Piloting menu

The items listed in this menu enable the user to pilot the "airplane" around. These items are listed here in the same descending order as they appear in the actual program menu.

5.2.1 Stop

Clicking on this menu item immediately stops the motion of the airplane. The notation "Alt-S" indicates the accelerator key pair which will initiate the same action as clicking on the menu button.

5.2.2 Slow Forward

Clicking on this button makes the airplane move forward slowly. The accelerator key pair "Alt-F" achieves the same action as that by clicking on the menu button.

5.2.3 Slow Backward

Clicking on this button causes the airplane to move backwards slowly. At present, there are no accelerator key pairs for this action.

5.2.4 Fast Forward

Clicking on this menu item causes the airplane to move forwards faster than in the case of "Slow Forward". At present, there are no accelerator key pairs for this action.

5.2.5 Fast Backward

Clicking on this menu item causes the airplane to move backwards at a rate faster than in the case of "Slow Backward". There are no accelerator key pairs for this action at present.

5.2.6 Nose Up

For the cases of "Nose Up", "Nose Down", "Nose Left", and "Nose Right", the actual action is achieved through the four arrow keys on the keyboard. When one clicks on any of these menu items, a dialog box appears on the screen to remind the user that he/she needs to use one of the arrow keys.

5.2.7 Nose Down

Please see 5.2.6 above.

5.2.8 Nose Left

Please see 5.2.6 above.

5.2.9 Nose Right

Please see 5.2.6 above.

5.2.10 Pivot on Nose

Clicking on this menu item enables one to use the arrow keys to cause the airplane to revolve about its nose (the pivot point), more or less like a real airplane. The accelerator "Alt-N" key pair achieves the same action from the keyboard.

5.2.11 Pivot on Exterior Point

Clicking on this menu item enables one to use the arrow keys to cause the airplane to revolve about an exterior point (the pivot point) which appears on the screen as a flashing diamond. When viewed from any of the three control towers, the airplane and the pivot point can be dragged with the mouse. The idea here is to position the pivot point at an interesting point and then examine it carefully from the airplane. The corresponding accelerator key pair is "Alt-E".

5.2.12 Examine Clicked Point

If there is some track that one wants to examine in detail, one can click on it with the mouse (which causes it to start blinking) and then select this menu item. The airplane and its pivot point will automatically jump to the correct position. This saves one from the bother of piloting the airplane to get there.

5.2.13 Go to Track Number

If one is interested in a particular track and knows its track number, one can select this menu item and type the track number into the edit box. The airplane will be in the "Pivot on Exterior Point" mode and automatically jump to the track that one chooses. See also 5.2.12 above.

To get the track number, one can click on the interested track when in the "View/From Airplane" mode. A dialog box containing information about the track number will soon come up on the screen and the selected track will start blinking.

5.2.14 Set Velocity

Clicking on this menu item opens a dialog box which allows the user to adjust the velocity of the airplane. This is useful when one feels the airplane "flying" too fast or too slowly.

5.3 View menu

These Menu items enable the user to view the detector and the tracks inside from some important points. The menu items are listed here in the same descending order as they appear in the actual program menu.

5.3.1 From Control Tower - Neg X

Clicking on this button causes the program to draw the current view from the point x=-6 meters, $y = 0$, $z = 0$.

5.3.2 From Control Tower - Pos Y

Clicking on this menu item causes the program to draw the current view from the point $x = 0$, $y = 6$ meters and $z = 0$.

5.3.3 From Control Tower - Pos Z

Clicking on this menu item causes the program to draw the current view from the point $x = 0$, $y = 0$ and $z = 6$ meters.

5.3.4 From Airplane

Clicking on this button causes the program to draw the current view from the current position of the airplane.

5.4 Help menu

5.4.1 Help

Clicking on this menu item makes a medium-size dialogue box appear on the screen which explains the format of the input data file. These include assignment of colors for each track, the number of available colors, and the correct spacing between the coordinates of each individual track point. Clicking on the "OK" button closes the dialog box.

5.4.2 Send Help to File

Clicking on this menu item opens a small message window which instructs the user to look at the file "star.help" for more information. Clicking on the "OK" button closes the help window.

5.5 Drawing menu

These menu items enable the user to manipulate the drawing of the tracks on the screen. The menu items are listed here in the same descending order as they appear in the actual program menu.

5.5.1 Randomize Colors

At present, the program uses seven colors to color the tracks. In case one has dense data, it might be that close tracks will have the same colors. Clicking on this menu item enables one to randomly assign colors to tracks. This may improve distinguishability of the tracks.

5.5.2 Show Track/pts

In some cases, if one wishes to examine the track points very carefully, one can use the "Hide Detector" menu item to remove the detector temporarily. Conversely, in presence of a very large number of tracks, the time response of the program becomes very slow, and one can remove the tracks temporarily to fasten the navigation of the airplane; this is achieved with the menu item "Hide Track/pts". The menu item "Show Track/pts" then enables one to restore the tracks after the airplane has been successfully navigated to the correct position. It is also the default setting when the program first gets started.

5.5.3 Hide Track/pts

See item 5.5.2 above.

5.5.4 Show Axes

This is like a compass and artificial horizon. It helps one find one's direction during the "flight".

5.5.5 Hide Axes

This un-does 5.5.4 above. It is the default setting when the program starts.

5.5.6 Show Detectors

This un-does 5.5.7 below. It is the default setting of the program.

5.5.7 Hide Detector

This menu item temporarily removes the outline of the detector to improve distinguishability. This is convenient for examining tracks close to the detector boundary, and tracks having the same color as the detector.

5.5.8 Thin Tracks/pts

Clicking on this menu item has no effect when viewing from any of the control towers. When viewing from the airplane, however, it disables the perspective narrowing of the tracks with distance and always draws tracks one pixel wide. This feature facilitates the viewing of tracks that are far away or obscured by intermediate tracks. One can also use the accelerator keys "Alt-I" to invoke this function.

5.5.9 Thick Track/pts

This un-does 5.5.8 above. It is the default setting of the program.

5.5.10 Data File A

Clicking on this menu item causes the first input data file to be displayed.

5.5.11 Data File B

Clicking on this menu item causes the second input data file to be displayed.

5.5.12 Fast Draw

In case of a large number of tracks, when one is in the viewing mode "From Airplane", the quality of the tracks is not very good as each frame has to be calculated by the computer and then displayed on the screen. In such cases, this drawing mode ("Fast Draw") deliberately makes the tracks look "bad" so that the navigation of the airplane is not slowed down. As soon as the airplane reaches the region of interest and stops, the computer automatically reverts to the "Slow Draw" mode and the picture quality improves back to normal.

5.5.13 Slow Draw

This un-does 5.5.12 above. It is the default setting.

5.5.14 Theta Phi Toggle

Each of the tracks has a zenith angle and an azimuth angle. This menu item enables one to toggle between the two, by interchanging the theta and phi values of each track.

5.5.15 Toggle Background

Clicking on this menu item causes the background to become white instead of black. This is very useful when making hard copy screen dumps. Note that yellow color does not show well on transparencies.

5.6 Subsets menu

The items in this menu enable the user to manipulate the tracks shown on the screen. The items listed here are in the same descending order as in the actual program menu.

5.6.1 Show Unselected Tracks

It has been explained previously that it is possible to select a particular track. In some cases, the user might feel like examining that particular track in detail, without being distracted by those in the vicinity. Clicking on "Hide Unselected Tracks" automatically removes the unselected tracks. After that, one can always go back by clicking on the menu item "Show Unselected Tracks"; the screen will display all the tracks again as before.

5.6.2 Hide Unselected Tracks
Please see 5.6.1 above.

5.6.3 Find Intersecting Tracks
Self-explanatory. This feature is slow for large data sets. It is recommended that one spends some time with small data sets to get a feel for the time intervals involved. The tolerance for the intersection is hard coded into the program with a C #define.

5.6.4 Suppress Background
Clicking on this button causes only the hits and fits close to the pivot point (See "Pivot on Exterior Point") to be drawn. The word "close" is defined from the point of view of the distance between airplane and the pivot point.

5.6.5 Tube
It is recommended that track numbers be put for each track in STARGL's data input file. Clicking on this button allows one to eliminate all hits and fits (i.e. all points and curves) except those within a certain distance from a given track (i.e. within a tube). This is invoked by selecting the menu item "Tube" and then typing the track number and the radius into the edit box.

5.6.6 Reset to Normal
This resets the program to the default mode.

6. Quitting the program

To quit the program, click on the menu item "Quit" from the "*File*" menu. See also section 5.1.3 above.

7. Acknowledgement

This work is supported by the U.S. Department of Energy and the Robert A. Welch Foundation. To report difficulties or obtain further information send email to ward@moore.ph.utexas.edu.

Appendix A: Installing STARGL

Before installing STARGL on your system, make sure that your computer meets the system hardware and software requirements*. For safety, make sure also that you have backed up the source files before installing STARGL.

To install STARGL on your machine,

1. Copy the files stargl1.c, stargl2.c, stargl.h, dataSample and Makefile at /u2/ward/Star directory on rsgi02.rhic.bnl.gov to your machine.
2. Build the binary exectuable "stargl" by typing the following command at the UNIX prompt and press Enter.

```
% make stargl
```

After successfully compling and linking the source code, your will have an executable "stargl" in your directory. You can also ftp the binary executable "stargl" directly to your computer if you are not interested in modification of the source code.

* The stargl program now can only compile/run on Silicon Graphics machines.

Appendix B: Sample input data files for STARGL

Here is a sample file which shows the data format of input file used in STARGL.

```
# comment lines begin with a pound sign
green 1
1.235    0.115     0.9409
1.24     0.1200    −0.9306
1.25     0.1300    −0.9204
1.26     0.1400    −0.9102
1.27     0.1500    −0.9001
red 2
1.11111  0.9       0.9998
red 3
1.211    0.006     0.9997
red 3
1.311    0.003     0.9996
red 3
1.411    0.001     0.9995
```

The first line is a comment line which begins with a pound sign. The second line specifies the color index (green) and track number (1) for the particle trajectory. The third line and the following 4 lines are a set of number triplets which are cartetsian coordinates (x,y and z) in meters for STAR. Each color line may be followed by n such triples, where $n > 1$ and $n <$ limits imposed by static memory allocation and degradation of animation performance.