USER'S MANUAL FOR THE TWINS SCIENCE DATA SYSTEM (TSDS)

JULY 2007

SwRI® Project 04475

Document No. 1609-TSDS_UM-01
Revision 1

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REVISION NOTICE

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1. INTRODUCTION

1.1 Project Overview

The Two Wide-angle Imaging Neutral-atom Spectrometers (TWINS) mission provides a new capability for stereoscopically imaging the magnetosphere. In contrast to traditional space experiments, which make measurements at only one point in space, imaging experiments provide simultaneous viewing of different regions of the magnetosphere. Stereo imaging, as done by TWINS, takes the next step of producing 3-D images, and will provide a leap ahead in our understanding of the global aspects of the terrestrial magnetosphere.

This document details the tools and functions available to the user at the TWINS Science Data System (TSDS) website. It also encompasses details of how to maintain the TSDS as a system administrator. The site is located at: http://twins.space.swri.edu.

1.2 Document Overview

This document describes the utility of the TSDS. The outline of the document is as follows:

- Introduction – this section provides background for the TWINS instrument, the website and a list of applicable documents
- Overview – this section provides a basic description as to the functionality of the website as viewed by users.
- Functions and Their Operation – this section covers the content of the website and the functions therein

In the appendix section, there are five appendices as follows:

- Webpage Screenshots – this section gives screenshots of the webpages
- Large Plot Data Screenshots – shows the user the expanded Data plotting options
- Plot Type Examples – this section shows the user each type of plot that can be made
- Data Discussion – this section discusses the types of data available through TSDS
- Acronyms – this section explains the meaning of the acronyms

1.3 Applicable Documents

The following documents, of the exact issue shown, were referenced as indicated during the development of this User Manual. The applicability statement associated with each document reference will indicate *Superseding* if the referenced document will supersede this document in the event of a conflict.

Document ID:	TWINS-PROJ-D008-A
Originator:	TBD
Issue:	Issue A June 2004
Title:	*TWINS* Project Data Management Plan (PMDP)
Applicability:	Provides the data management plan for the TWINS instrument *Superseding*.

Document ID: TBD
Originator: TBD
Issue: TBD
Title: *TWINS* Explorer Program Plan
Applicability: Provides TBD for the TWINS instrument.

Superseding.

Document ID: TBD
Originator: TBD
Issue: Version 3
Title: *TWINS* Data System V1 Requirements
Applicability: Provides TWINS requirements for Version 1 of the software.

Superseding.

Document ID: TWINS-PROJ-D005-C
Originator: Aerospace Corporation
Issue: Revision C
Title: TWINS Instrument Specification Document
Applicability: Defines the baseline technical objectives and interfaces for TWINS.

Superseding.

Document ID: 1609-TSDS_SDD-01
Originator: Southwest Research Institute
Issue: Revision 0
Title: TWINS SDS Software Design Document
Applicability: Defines the overall system design, module design and interface design of the TWINS Science Data System (TSDS)

Superseding.

Document ID: 1609-TSDS_SRD-01
Originator: Southwest Research Institute
Issue: Revision 0
Title: TWINS SDS Software Requirements Document
Applicability: Defines the requirements for the TWINS Science Data System (TSDS)

Superseding.

2. OVERVIEW

This section provides an overview of the TWINS Science Data System (TSDS) from the perspective of a user. The actual detailed functions are listed in the Functions section. The TWINS Science Data System provides general mission information, data plotting capabilities, a list of publications, meeting information, and TWINS team member information. A set of webpage screenshots can be seen in Appendix A.

2.1 Data System Components

The TSDS utilizes a menu tab interface to divide the tools and sections of the site. This tab interface will be present on every page of the site. There are six possible tabs as seen in Figure 1.

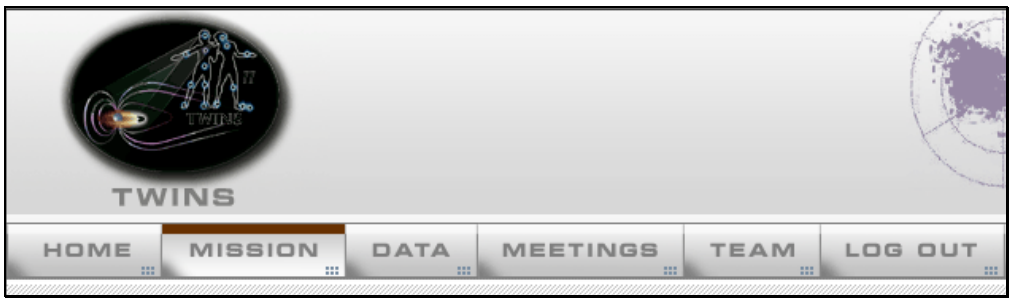

Figure 1: TSDS Tab Interface

The Home tab is the initial webpage users go to when utilizing http://twins.space.swri.edu. The Home tab also gives the user access to a list of relevant publications. The Mission tab provides a more detailed description of the instrument and its capabilities. The Data tab displays plotted data, allows users to export data and save any plot made during the current session. The Meetings tab has information about future and past meetings. The Team tab contains team member names and their organizations. The Logout tab logs users off the team website. Each tab will be discussed in more detail in the Section 3.

3. FUNCTIONS AND THEIR OPERATION

The overall design of the TSDS website has three sections. The first is the graphical banner at the top, composed of the two graphics seen in Figure 2. The second section contains the user-available tabs that the user can click on to go to various webpages. These tabs can be seen in Figure 1. The rest of the page contains the various functions related to the particular webpage the user is currently on. These functions will be shown on a page-by-page basis. Screenshots of individual webpages can be seen in Appendix A.

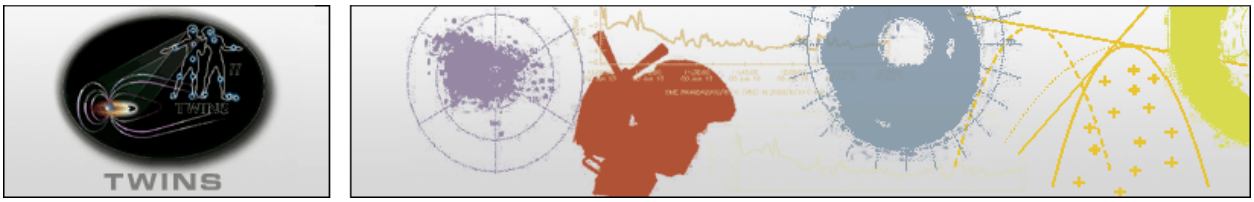

Figure 2: TWINS Webpage Display Banner Graphics

The TSDS website uses a tab interface to divide the sections of the site. There are six possible tabs as shown in Figure 1. The tab interface is present on every page of the site. Each tab is discussed in detail in the following sections.

3.1 Home

The Home tab is the central webpage of the TSDS. It is the first page to appear after accessing the TSDS through http://twins.space.swri.edu. A glance of the homepage can be seen in Figure 3; the entire page is shown in Appendix A, Figure 47. Below the tabs are two partition links: Main and Publications.

3.1.1 Main

When the user first accesses the TSDS the main webpage will appear. Part of the webpage can be seen below in Figure 3; the entire page can be seen in Appendix A, Figure 47. On the left hand side are two sections entitled Preferences and Help. The user can alter his preferences by clicking on the *My Preferences* link. The *Page Help* link connects the user to parts of this document. On the right hand side, there is one section entitled TWINS that gives the user useful news and alerts.

Figure 3: Available Website Tabs

If the user would like to change or see their preferences, he can click on the *My Preferences* link. The preferences page appears giving the user information about his current user settings. An example of this information is given in Figure 4. The information displayed includes the username, full name, phone number, and email address for the user. The type of email the user would like to receive and the banner preference are also given along with a log of the last login. The *Display Banner* preference is set to '*Yes'* in the example; this causes the banner at the top of the page to appear. The banner contains the two graphics as seen in Figure 2. The user can update his information by clicking on the *Update* button.

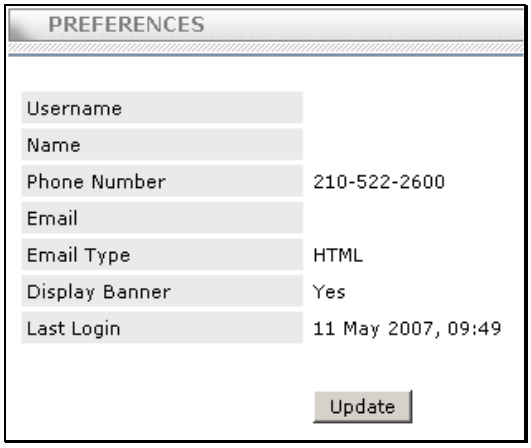

Figure 4: Current User Settings

When the *Update* button is pressed it brings up the update preferences webpage where changes can be made. This page is shown in Figure 5. The user can change his password, phone number, and email address. The user can also select the type of email he would like to receive, either HTML or Text, and whether or not the user would like the display banner to appear on the webpages. If the user doesn't want

the banner to be displayed on the webpages, he should uncheck the *Display Banner* check box. If the user has made a mistake while editing his preferences, he can click the *Reset* button to reset the preferences to their stored values. If the user makes changes and would like them to be stored, he should click the *Update* button. The user can also cancel making changes by clicking on the *Cancel* button. The user returns to the preferences webpage when the *Update* or *Cancel* button is pressed; if the user presses the *Reset* button the user stays on the update preferences webpage.

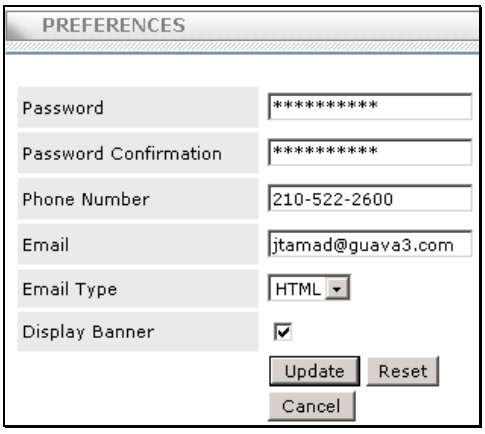

Figure 5: Update User Preferences

3.1.2 Publications

The *Publications* partition lists the publications that have been published by team members about TWINS. There is also a *Current Documents* link that links to a large list of files at LANL. The publications are listed as a bibliographical reference along with a link to the actual paper. The link to the document is given by the Size information. An example of the publications is shown below in Figure 6; the link to the paper says 919 KB and is in blue. A screenshot of the whole Publications webpage can be seen in Figure 48.

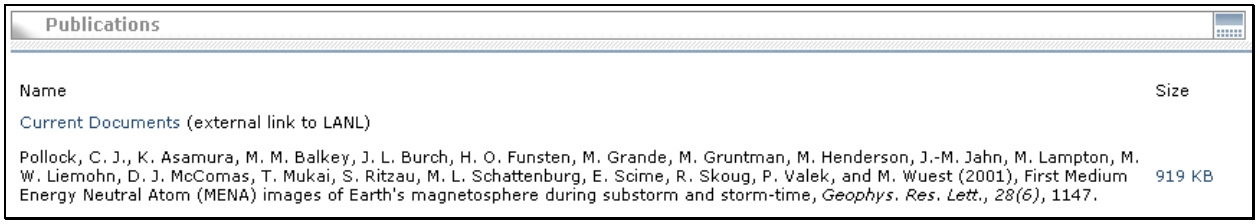

Figure 6: Publications

3.2 Mission

The Mission webpage is shown in Figure 49 of Appendix A. On the left hand side is the General Info header which contains three links to various sections of the Mission webpage. Below these links is a Science header that also contains three links that lead to the Imaging webpage. Both sets of links can be seen in Figure 7. On the right hand side is the Mission area that describes the TWINS Mission as a whole, the TWINS Instrument, and TWINS Orbits.

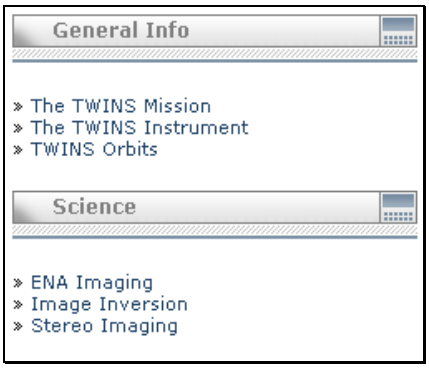

Figure 7: Links on the Mission webpage

The Imaging webpage is only accessible through the links on the Mission webpage. A snippet of the Imaging webpage can be seen in Figure 8; the entire webpage can be seen in Figure 50 of Appendix A. On the left hand side are links back to the Mission webpage as well as links to other areas of the Imaging webpage. The right side will display the descriptions of ENA Imaging, Image Inversion, and Stereo Imaging. This webpage describes how TWINS can give the scientific community a global view of the ring current ions.

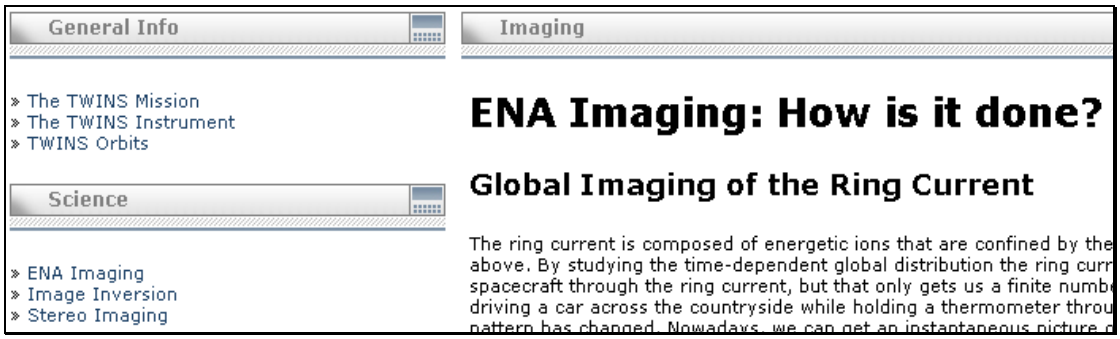

Figure 8: Imaging Webpage

3.3 Data

The user as access to three partitions: *Browse Plots*, *Data*, and *Session Plots*. The *Data* partition gives the user more plotting options and access to additional data such as Flight, Housekeeping and Calibration. This partition also permits the user to export the plotted data. From the *Session Plots* partition the user can save their previous plots as well as their previous data exports. These additional partitions will be discussed in detail in the upcoming sections. See Figure 9 for a snapshot of the partitions.

3.3.1 Browse Plot

For additional information regarding the Browse Plots please see the Browse Plot User Manual located on the Browse Plots tab.

3.3.2 Data

The *Data* consoles are available to the user for plotting additional data beyond Browse Plots. The user can also export the data in addition to plotting it. On the left hand side are the plotting options and the resulting plots will display on the right hand side. The user can select multiple data elements to plot resulting in multiple plots displayed in a vertical manner on the right hand side. On the Data webpage there are five categories, *Data Export, Flight Data Console, Image Plot Console, Calibration Data Console, Help,* each of which will be discussed below. The Data Export category allows the user to export the raw data as well as different image types. There are three different data categories that can be plotted: TWINS Flight Data, Image Plots, and TWINS Calibration Data. TWINS Flight Data includes Ancillary Data along with Science, Housekeeping, Attitude, and Ephemeris data recorded during TWINS mission. Image Plots are composed of Direct Events images and Onboard images. The Calibration Data includes Calibration Chamber data along with Science and Housekeeping data that was taken during instrument calibration. The Help Link links the user to this document or sections thereof. Due to the length of the webpage, several helpful tools have been placed throughout the webpage. The categories can be expanded and collapsed to for easier viewing. Also several of the sections have *Top* links in their headers which will cause the webpage to scroll back up to the top, see Figure 19 for an example. By pressing the *(expand)* links on the category's header as indicated below in Figure 9, the categories can be expanded. For an expanded view please see Figure 55, Figure 56, Figure 57, and Figure 58 in Appendix B.

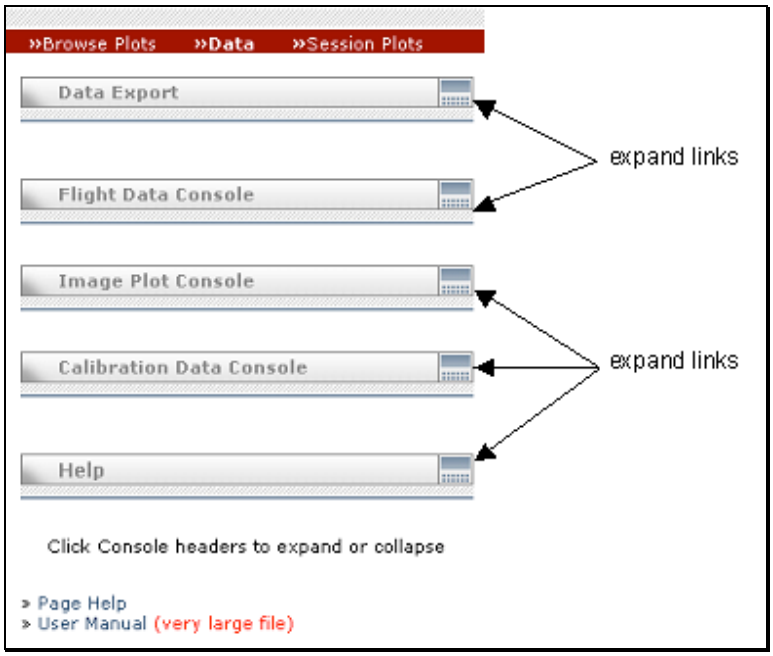

Figure 9: Unexpanded Data Section

3.3.2.1 Data Export

After the data variables have been selected and the plot setup, the data can be exported using the *Data Export* tool. Instructions on how to select Flight data elements is given in 3.3.2.2.5; Calibration and Image data can also be exported using this utility. The data can be saved as an ASCII, EPS, IDL, or PNG. The ASCII option will save the data as a text file. The ASCII export also contains a description of each selected data element so an export of a sample of the data can be a good reference of what is available. The EPS option saves the plot as an Encapsulated PostScript file. The IDL option saves the data as an IDL saveset file. The PNG option saves the plot as a .png image. An example of the *Data Export* tool is seen below in Figure 10. Clicking on the *Export* button will start the export process.

The red warning labels occur before data has been selected, they will disappear once data has been chosen. Also the *Summary* link will be discussed later in Section 3.3.2.5.

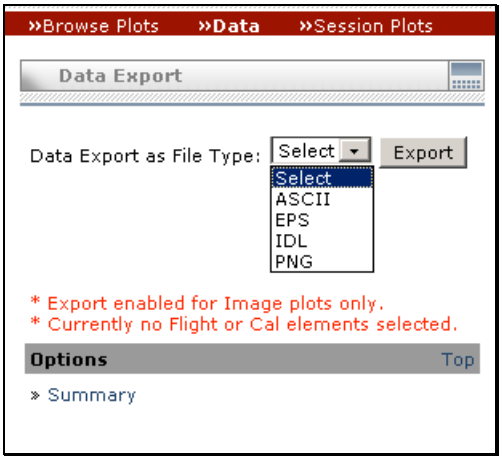

Figure 10: Data Export Area

The data/plot is saved within a ZIP file, which will be exported to the user's desktop or to a specific directory. An example of the popup window that appears when data is to be saved can be seen in Figure 11. The user can then save the zip file to his desktop.

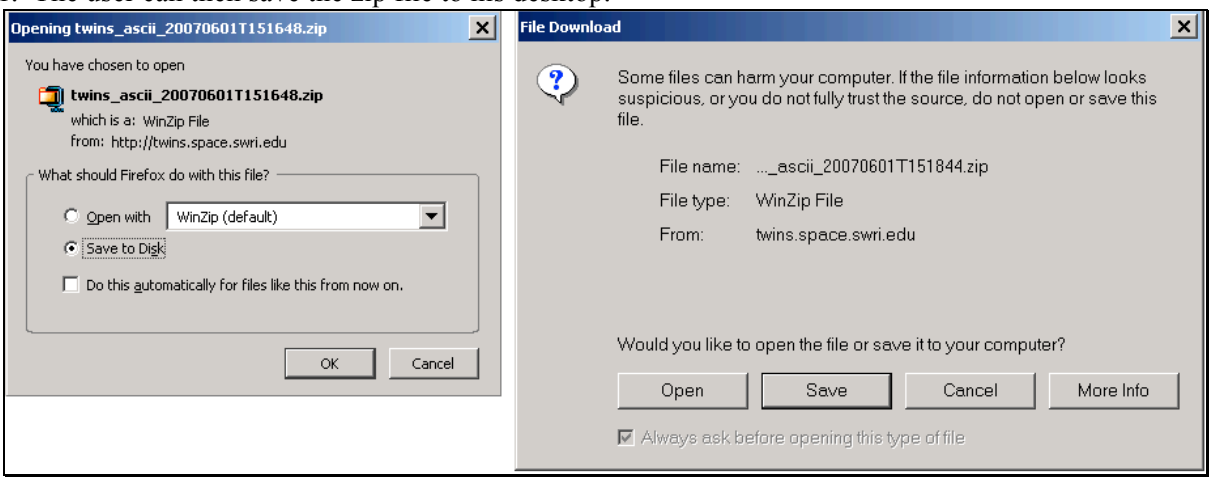

Figure 11: Data Export Popup Window

3.3.2.2 Flight Data Console

The Flight Data console allows the user to plot Flight Data and Ancillary Data over a specified time range. The entire expanded console is shown in Appendix B, Figure 56. Individual parts of the TWINS Flight Data section will be shown as they are discussed. The first part is shown in Figure 12; it contains the *Predefined Plot Criteria* and *Spacecraft* choice areas.

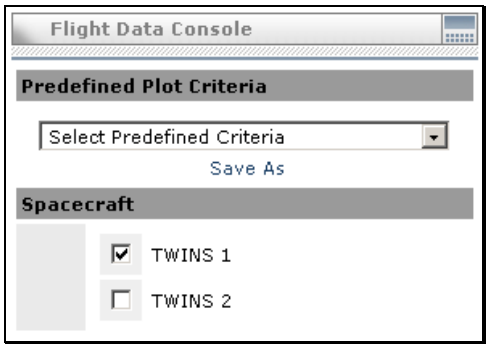

Figure 12: Predefined Plot Criteria and Spacecraft Sections

3.3.2.2.1 Predefined Plot Criteria

The user has the option to select a single predefined plot type that will automatically select the appropriate variables and plotting options for the user or the user can select data elements independently for both the X and Y-axes, this will be described later. If the user chooses a predefined plot type, he can modify the selected data elements if desired. A list of predefined plot types is given below in Figure 13. The first set of predefined plot types creates histograms from the Direct Events data both Toward and Away. The second set produces line plots of the data variables vs. time. The last predefined plotting type, *Starts, Stops, Valids vs. Actuation Angle*, creates a 2-D histogram plot of the data. Once the user selects a predefined plot type, the webpage refreshes to show the selected data elements. If the user chooses another predefined plot type after the data selection has been made, the selection will be reset. This applies to user selected data elements and predefined data elements.

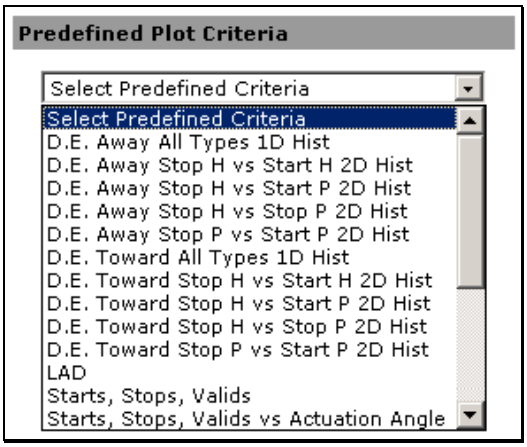

Figure 13: Predefined Plot Criteria Option Listing

The user can also save important plot criteria that he wants to use at a later date. To do so he should select the elements he wants, select which satellite or both to plot, and set up the plot options and then choose *Save As* under the *Predefined Plot Criteria* section. Its important to note that the start and stop time is not saved in the plot criteria and neither are the Direct Event conditions or other data conditions. When the user returns to the TSDS at a later time, the saved plot criteria will appear in the list of available Predefined Plot Criteria under a dashed line. The universal plot criteria will be listed above any personal plot criteria. See Figure 14 and Figure 15 for an example of a saved plot entitled *Scatter DE Toward All*.

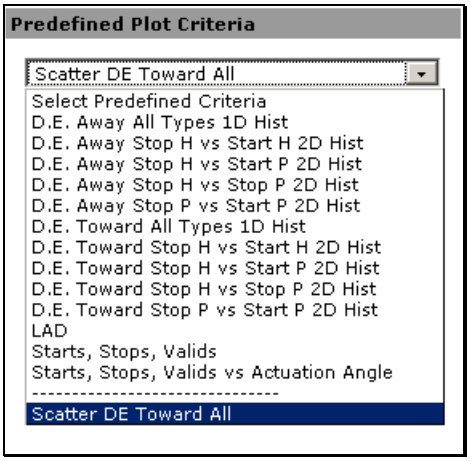

Figure 14: User Defined Plot Criteria

After the user selects one of his personal predefined plot criteria, he can modify the plot elements and options and resave the plot under its original name using the *Save* link. The user can also use *Save As* and save the plot criteria under a new name. If the user no longer needs a saved plot, he can delete it. He can also review the history of any plot criteria, both personal and universal.

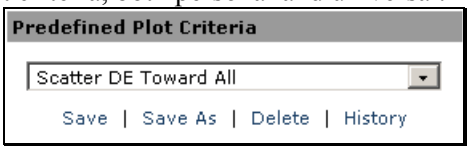

Figure 15: Predefined Plot Options

3.3.2.2.2 Spacecraft

Next the user needs to specify from which spacecraft he needs data. The user can choose either one or both spacecrafts as seen in Figure 12. Should the user neglect to select a spacecraft, the *Plot* button will remain inactive. The *Plot* button can be seen in Figure 21.

3.3.2.2.3 Time

The user must specify a time range from which to extract data. The *Time* section is shown below in Figure 16. As the user fills in the start and stop time, it automatically moves the cursor to the next field assuming the number has been zero-padded if not the nominal length. The nominal lengths are from left to right 4, 2, 2, 2, and 2. Depending upon the web browser being used, the cursor may move to the stop time year field when the user finishes the start time minute field. The valid values for the time parameters are as follows: Year values are 1 to 9999, Month values are 1 to 99, Day values are –9 to 99, Hour values are –9 to 99, and Minute values are –9 to 99. Even though the inputs can have these ranges, data is only

available for times when TWINS is in orbit. If the month value is greater than 12 or less than 0, the year value will change once the request is submitted. For example a request of '2000 19 01 01 01' will result in the date '2001 07 01 01 01'. The same is true for day, hour and minute values. If the user forgets a time field or enters in a non-numeric character, then the system returns a message like this one 'Please enter the Start Month in numeric format' which occurs when the start month is left blank.

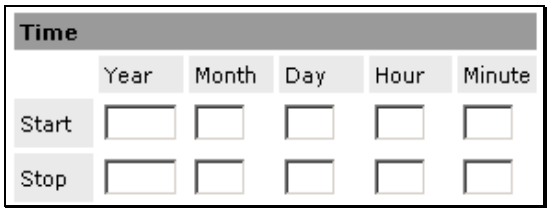

Figure 16: Time Selection Area

3.3.2.2.4 X-Axis

The user can choose to have either time, or another variable be the X-axis. If the user has previously chosen a predefined plot, the appropriate data element will already be selected. The X-axis section of the TWINS Flight Data is shown in Figure 17. If the user would like to specify a variable for the X-axis, they should click the radio button next to *Select Data Source* and then choose a *Data Source* and then choose a variable from the *Select Data Element* drop box that fills in once the Data Source has been selected.

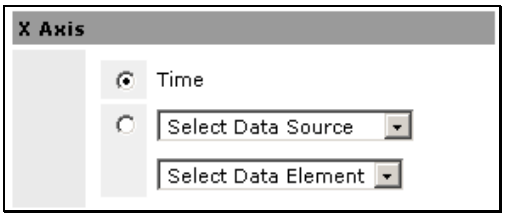

Figure 17: X-Axis Selection

The choices for Data Source are seen below in Figure 18. The Data Element choices for each Data Source type can be seen in Appendix D. The data is organized into five groups in Appendix D: Flight Science, Flight Housekeeping, Attitude, Ephemeris, and Ancillary Data. The Flight Science group contains Flight Science, Direct Events Away, and Direct Events Toward data. The Flight Housekeeping group contains only the Flight Housekeeping data. The Attitude Data group contains TWINS Spacecraft Attitude data. The Ephemeris data group contains TWINS Derived Ephemeris data. The Ancillary Data group contains ACE MAG, ACE SWEPAM, DST, and KP.

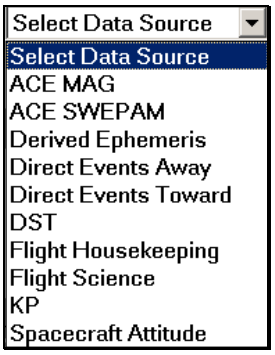

Figure 18: Data Source Choices

3.3.2.2.5 Y-Axis

Once the X-axis has been selected, the Y-axis data elements need to be selected. If the user has previously chosen a predefined plot, those data elements will already be selected. The Y-axis data elements can be chosen from Flight Science, Flight Housekeeping, Attitude, Ephemeris, or Ancillary data. The data elements that belong to each group are shown in Appendix D. If the user would like to plot Flight Science data, he would click on the *Flight Science* link shown in blue in Figure 19. This will bring up the Flight Science Data elements that may be selected by clicking in the check box on the left of the data element.

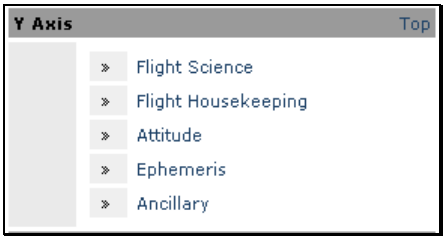

Figure 19: Y-axis Selection Area

All of the *Flight Science* data elements can be seen in Appendix D in Figure 64, Figure 65, and Figure 66. Figure 66 shows that all the data elements have been chosen for an example plot. If the user no longer wants to plot a particular data element, he can deselect the element by unchecking the check box on the left of the unwanted data element. The user can also use the *Select All* and *Clear All* buttons to quickly select/deselect all of the elements under the heading. An example of the data element listing can be seen in Figure 20, where the DE data element 'Stop Height' has been selected.

Figure 20: Direct Events Selection Example

If the user would like to change the plot options from their default values, he can click on the data element itself, which will bring up the *Plot Options* page as seen in Figure 39, this will be further

discussed in Section 3.3.2.6. Up to 16 data elements can be selected at a time and each plot appears separately in a vertical line on the right hand side of the webpage. If the user attempts to select more than 16 data elements, the *Plot* button will be disabled. The user can export ASCII files of more than 16 elements if he should choose to do so under the *Data Export* tool.

3.3.2.2.6 Options and Actions

The Options section allows the user to specify additional limitations on the data to be plotted, learn more about what data is available, and access this help document through the links shown below. *Summary* allows the user to see what data elements they have selected to plot as well as gives the user the opportunity to limit the data further. For instance a user can limit their plotting to times when TWINS is actuating at 3 deg/sec. *Summary* will be further discussed in 3.3.2.5.

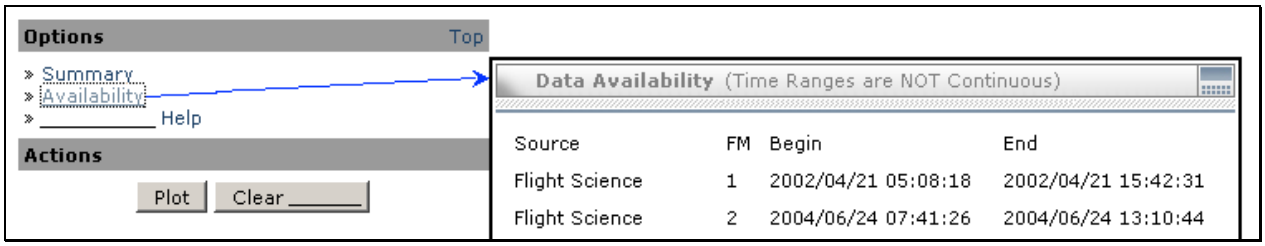

Figure 21: Plot Options and Actions

The Action section allows the user to plot the selected data or to reset all fields within the Flight section. The *Plot* button will display the user-defined plots in the right-hand side of the webpage in PNG format. The *Clear* button will reset all the settings made by the user in a particular data console.

The *Availability* link gives the user a guideline of what data is available for plotting as well as exporting. Clicking on the *Availability* link pops up a window with information regarding Flight, Calibration, and Ancillary data. An example can be seen in Figure 22, it should be noted that the image in this document is just an example and in no way means to imply availability at these times. The FM in the table indicates flight model, so 1 refers to TWINS1 and 2 refers to TWINS2.

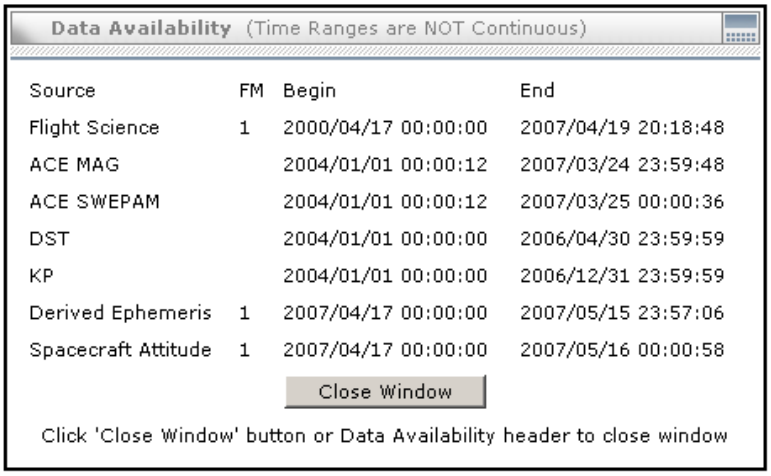

Figure 22: Data Availability example

3.3.2.2.7 Conditions

Another option for the user is to set additional conditions upon the data selection. This section of the TWINS Flight Data is shown below in Figure 23 and is now located on the right-hand side of the webpage. The *Condition* and *Direct Event Condition* areas are shown with their respective pop-up windows in Figure 24. Picking a condition will limit the data that is plotted to data that fits the particular condition.

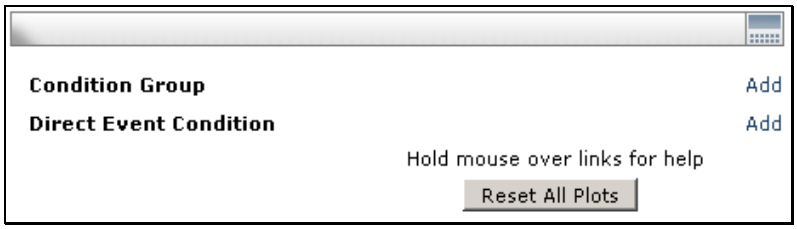

Figure 23: Conditions

The *Condition* area lets the user pick a single condition to limit the plotted data. The condition can be any data element from Flight Science (except Direct Events), Flight Housekeeping, and Ancillary Data. The lists of possible data elements are shown in Appendix D sections 1.1, 1.2, and 1.3. The condition on the selected data element has four options: *'Greater than*', *'Equal to'*, *'Less than*', and *'Between*'. For the first three options, only the leftmost value can be used; it's currently set to 0.0 in the following figure. If the second value is filled in, the system returns with the message 'The second condition value is only used for the 'Between' condition.' If the user is using the 'Between' condition, he needs to specify both numbers. If the needed condition values are blank or non-numeric, then the system returns with the message *'Please enter the condition value in numeric format'*.

The *Direct Events Condition* area allows the user to pick a single condition from the Direct Events, both Toward and Away, data elements. The data elements are listed in Figure 24. There is not a way to limit just one head, both Toward and Away are limited when the condition is used. There are four possible options just like the *Condition* options.

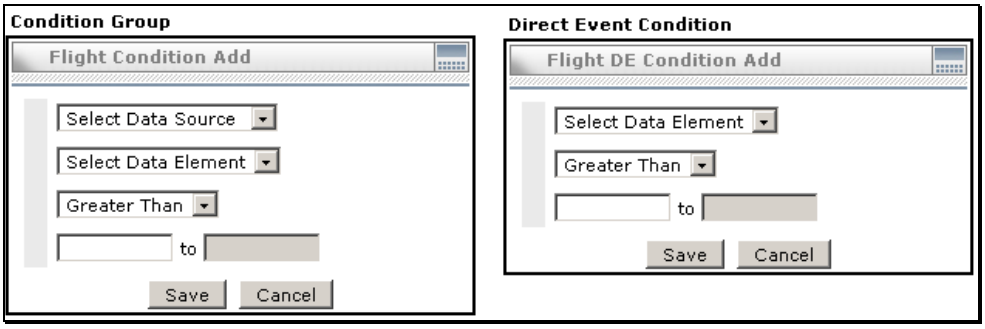

Figure 24: Condition Group and Direct Event Condition Pop-ups

Last section of the TWINS Flight Data is the *Options* and *Actions* headers explained at the beginning of the *Data* section. Pressing the *Plot* button will cause the data selections made on the webpage to be plotted on the right hand side of the webpage. Pressing the *Clear Flight* button will reset the selections made within the TWINS Flight Data section.

3.3.2.3 Image Plot Console

The Image Plot console allows the user to plot either Direct Events images or Onboard images. The Direct Events images and Onboard images are both Energetic Neutral Atom (ENA) images projected into a geocentric frame. The Onboard Images are created from data processed onboard the spacecraft and the Direct Events Images are created from the raw data. For additional information about the spectrograms, please contact Jerry Goldstein.

The first portion of the Image Plot console is shown below in Figure 25. Please refer to Figure 57 for the whole unexpanded console. The user must specify a start time just as was previously mentioned in Section 3.3.2.2.3. The user also specifies how many sweeps he would like included in the spectrogram, instead of specifying a stop time. The user must also specify the spacecraft they would like to see data from. Creating images from both spacecrafts has yet to be developed.

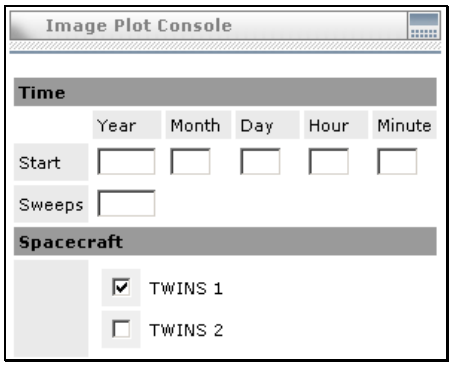

Figure 25: Image Time, Sweeps, and Spacecraft options

The user can then choose the type of Image Plot to be created by choosing from a dropdown menu under the Plot Options of the console. There are only two types: Direct Events Images and Onboard Images. These options are shown below in Figure 26 and will be discussed in the next sections as well as their specific features.

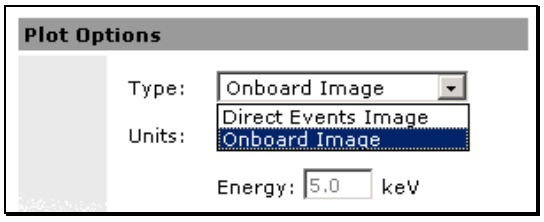

Figure 26: Image Plot Type selection

3.3.2.3.1 Direct Event Images

When making Direct Event images, the user has several options available to tailor the plot. These options can be seen in Figure 27. The user can specify all energies in a plot that returns an integral flux image or another plot that returns a differential energy flux image. If the user wants a differential energy flux image, a unique energy must be selected in keV. The user also can choose either Linear or Logarithmic scales for the plot. Furthermore, the user can change the polar angle pixelsize, but not the azimuthal pixelsize. The default selection is 4 degrees. The user can choose to autoscale the image based on a minimum and maximum flux or to have them manually set. It should be noted that if a user selects

logarithmic scaling, these values need to be linear. If the user would like to plot the data, he should press the Plot button. To reset only the Image Plot console, he can press the Clear Image button.

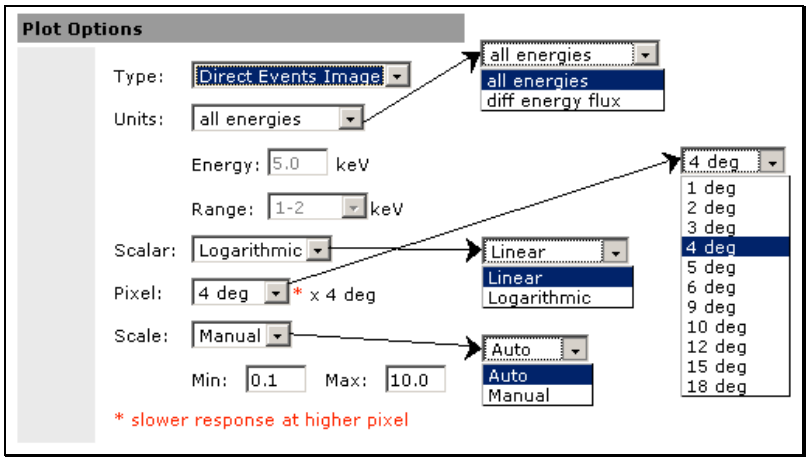

Figure 27: Direct Events Image Plot Options

3.3.2.3.2 Onboard Images

When making Onboard images, the user also has several options available to tailor the plot for one's own purpose. These options can be seen in Figure 28. The user can still specify whether he wants an all energies plot that returns an integral flux or diff energy flux image. If the user wants a differential energy flux image he must specify a preset energy range given in keV. The user also can choose either Linear or Logarithmic scales. For Onboard images, the user cannot change the pixelsize of the image. The user can choose to autoscale the image based on minimum and maximum flux or manually set a minimum and maximum. It should be noted that if a user selects logarithmic scaling, the min and max values need to be linear. If the user would like to plot the data, he should press the Plot button. To reset only the Image Plot console, he can press the Clear Image button.

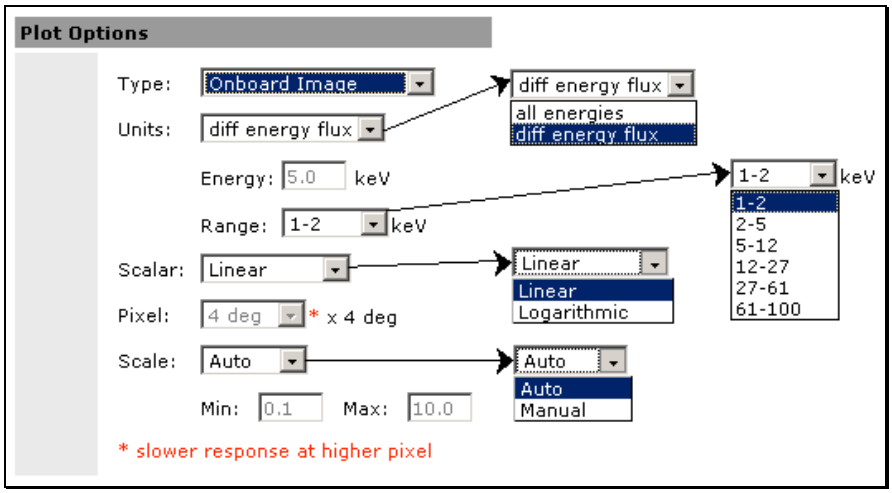

Figure 28: Onboard Image Plot Options

Several options either become available or unavailable depending on the user selection. When a user selects 'diff energy flux' under Direct Event images, the textbox under the 'Units' dropdown menu becomes available while the Range is grayed out. But when a user has selected 'diff energy flux' under the Onboard Image type, only the Range dropdown menu becomes available. Also, under Onboard images the Pixel selection menu is disables since the pixelsize is already preset. Lastly, when choosing the scale for the Image plot the min and max textboxes become disabled when 'Auto' is selected. Otherwise under 'Manual' the user can specify the Min and Max values in the corresponding fields.

3.3.2.4 Calibration Data Console

The Calibration Data section allows the user to plot Calibration Instrument and Chamber data for a set of calibration measurements. The entire TWINS Calibration Data section is shown in Appendix B, Figure 58. Individual parts of the TWINS Calibration Data section will be shown as they are discussed. The first part is shown in Figure 29; it contains the *Predefined Plot Criteria* choice area. The user has the option to select a single predefined plot type that will automatically select the appropriate variables for the user or the user can select data elements for both the X and Y-axes. If the user chooses a predefined plot type, he can modify the selected Y-axis data elements if desired. A list of predefined plot types is given in Figure 13; the predefined plot criteria are the same for TWINS Flight Data and TWINS Calibration Data. Once the user selects a predefined plot type, the webpage refreshes to show the selected data elements along with other data of the same general type. Upon refresh, the *Predefined Plot Criteria* reverts back to 'Select Predefined Plot Criteria'; it does not indicate the predefined plot selection the user made. If the user chooses another predefined plot type after the data selection has been made, the selection will be reset. This applies to user selected data elements and predefined data elements.

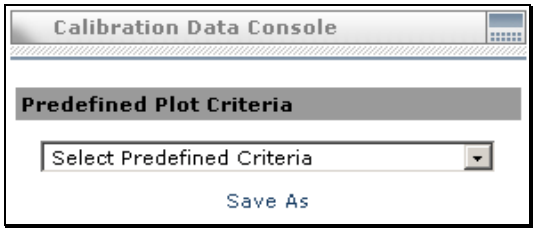

Figure 29: Predefined Plot Criteria

The user needs to select the Calibration Measurements he would like to plot. The measurement names are listed in the TWINS 1 and TWINS 2 select box. These boxes are shown below in Figure 30. The user can select multiple measurements by holding the Ctrl key while selecting the choices. The measurement names are described on another webpage that is accessed by clicking on the *Measurements Table* link.

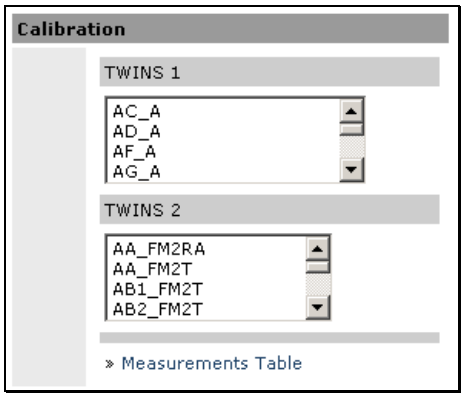

Figure 30: Measurement Selection

By clicking on the *Measurements Table* link, the *Calibration Measurements* table appears on the right hand side. This table lists the measurements for each instrument in alphabetical order. It provides the measurement name, a brief description, a start and stop time, and whether the measurement is one solid block of time. If the measurement is in one piece, then the **'Std'** column is marked with a **'Y'**. The beginning of the *Calibration Measurements* table is shown below in Figure 31.

Calibration Measurements

TWINS 1 TWINS 2

Name	Description	Start Time	End Time	Std
AC_A	Fine MCP, Course Imaging, Course LLD, 31 keV O	2002 04 08, 17:09:02	2002 04 08, 17:40:48	Y
AD_A	Mdium MCP, Medium Imaging, Course LLD, @ 31kev O	2002 04 08, 17:40:50	2002 04 08, 18:31:17	Y

Figure 31: Example Listing of Calibration Measurement Names with Descriptions

The user can choose to have either time, or another variable be the X-axis. The X-axis section of the TWINS Calibration Data is shown in Figure 17. If the user would like to specify a variable for the X-axis, they should click the radio button next to *Select Data Source* and then choose a *Data Source* and then choose a variable from the *Select Data Element* drop box that fills in once the Data Source has been selected.

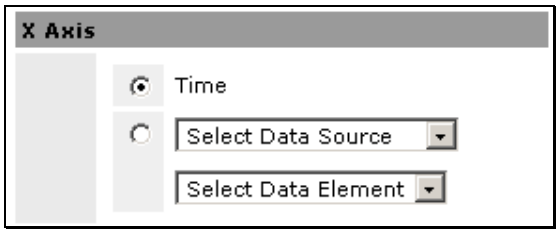

Figure 32: X-Axis Selection

The choices for Data Source are seen below in Figure 33. The Data Element choices for each Data Source type can be seen in Appendix D. The data is organized into three groups in Appendix D: Calibration Science, Calibration Housekeeping, and Chamber data. The Calibration Science group contains Cal Science, Cal Direct Events Away, and Cal Direct Events Toward data. The Calibration Housekeeping group contains only the Cal Housekeeping data. The Chamber group contains only Chamber data.

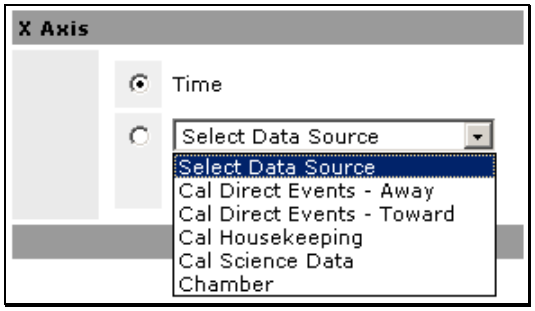

Figure 33: Possible Data Sources

Once the X-axis has been selected, the Y-axis data elements need to be selected. If the user has previously chosen a predefined plot, those data elements will be already selected. The Y-axis data elements can be chosen from Cal Science, Cal Housekeeping, or Chamber data. The data elements that belong to each group are shown in Appendix D If the user would like to plot Cal Science data, he would click on the *Cal Science* link shown in Figure 34. This will bring up the Cal Science Data elements that may be selected by clicking in the check box on the left of the data element. The data elements can be seen in Appendix D in Figure 77, Figure 78, and Figure 79. If the user no longer wants to plot a particular data element, he can deselect the element by unchecking the check box on the left of the unwanted data element. If the user would like to change the plot options from their default values, he can click on the data element itself, which will bring up the pop-up as shown in Figure 35.

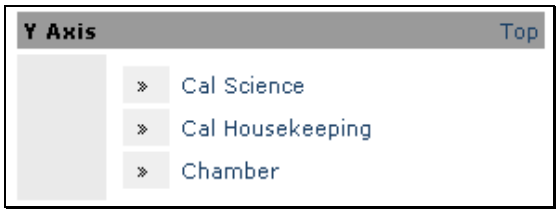

Figure 34: Y-Axis Data Choices

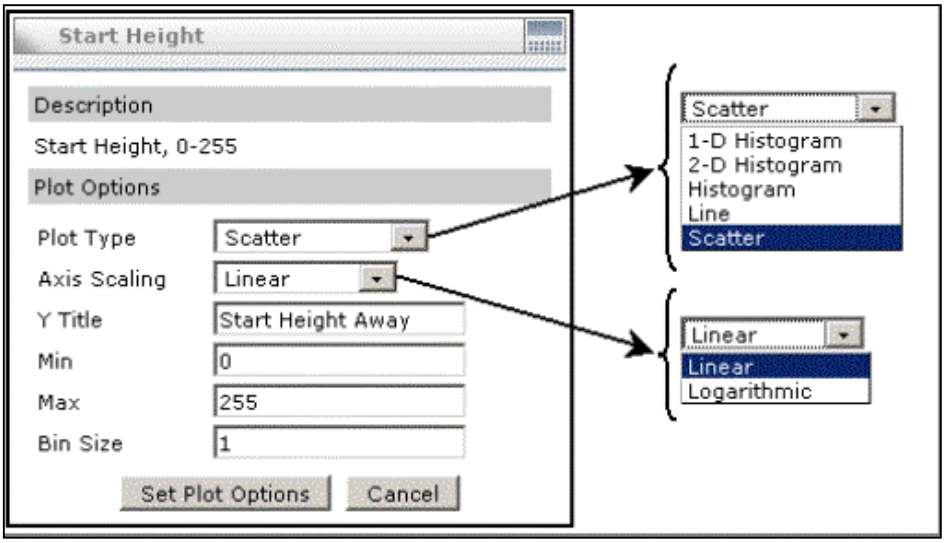

Figure 35: Calibration Data Plot Options

Once the user has made his choices, he needs to press the *Plot* button at the bottom of the console. If the user does not press this button and tries to go to another data set or tries to plot, the previously selected data elements will not be plotted because the data elements selection was not set.

Another option for the user is to set additional conditions upon the data selection. This section of the TWINS Calibration Data is shown below in Figure 36 with unexpanded *Condition* and *Direct Event Condition* areas. The *Condition* and *Direct Event Condition* areas are shown expanded with all of the drop boxes in Figure 37. Picking a condition will limit the data that is plotted to data that fits the particular condition.

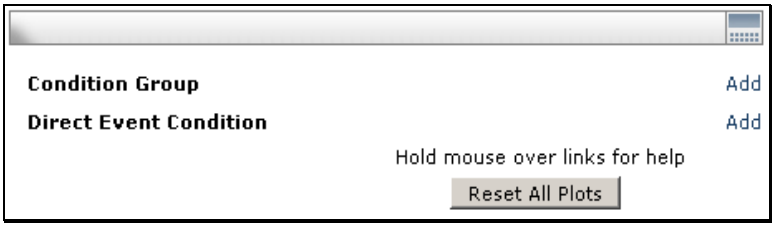

Figure 36: Unexpanded Conditions

The *Condition* area lets the user pick a single condition to limit the plotted data. The condition can be any data element from Calibration Science (except Direct Events), Calibration Housekeeping, and Chamber Data. The lists of possible data elements are shown in Appendix D sections 6, 7, and 8. The conditions work the same way as the *TWINS Flight Data* conditions.

The *Direct Events Condition* area allows the user to pick a single condition from the Direct Events, both Toward and Away, data elements. The data elements are listed in Figure 65 and Figure 66. There is not a way to limit just one head, both Toward and Away are limited. There are four possible options just like the *Condition* options. The error messages also work the same way.

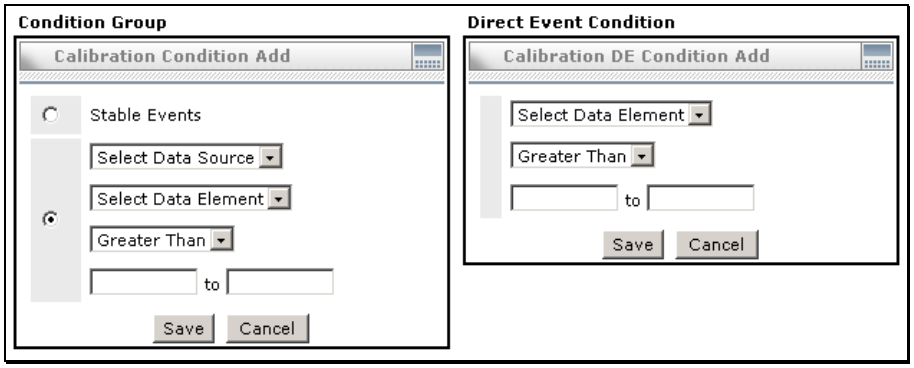

Figure 37: Expanded Condition and Direct Event Condition Areas

The bottom sections of the TWINS Calibration Data console are the Options and Actions sections, explained at the beginning of the *Data* section. In the *Actions* section, pressing the *Plot* button will cause the data selections made on the webpage to be plotted on the right hand side of the webpage. Pressing the *Clear Calibration* button will reset the selections made within the TWINS Calibration Data console.

3.3.2.5 Summary

Under each of the categories is a link to either *Summary* section under the Options header. A *Summary* section on the right-hand side of the webpage will display all of the selected data variables with their specific parameters and options for both the Flight and Calibration Data. The user can also choose to add certain conditions to the data variables using the *Summary* area. See Figure 38 for snapshot of the *Summary* sections of the website. At the top and bottom of the Summary section are *Reset All Plots* buttons that can clear all selections made by the user on the *Data* webpage.

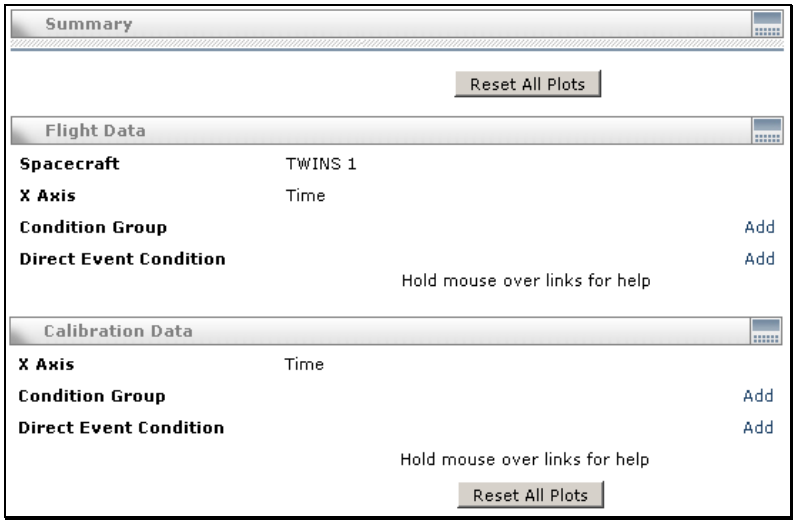

Figure 38: Summary Area of the Data Webpage

The Flight and Calibration Data consoles include a link to the *Condition Builder*, which is also found in the *Summary* section.

3.3.2.6 Plot Options

For Flight and Calibration Data, there are plotting options available to the user so that one can suit the plot to his needs. Each data element has a default setting for the plotting options. The plotting options can be accessed by expanding the Flight Data or Calibration Data consoles. These options are unique for each of the three consoles, so each will be discussed.

The most simplistic plot for the Flight and Calibration Data consoles entails the user selecting a start and stop time or measurement for the X-axis, a Y-axis variable, and pressing the *Plot* button. One of the major differences between the Flight and Calibration Data sections is that the Flight console needs to have a specified time range from the user while in the Calibration console the user chooses an available Calibration measurement from a drop-down list. All of the Y-axis data variables are given in Appendix D; all the listed variables are links to the plotting options. As shown previously in Figure 35, the user can left click on the variable to get to the plot options popup window. Also, hovering the mouse cursor over the variable will display the plot options as shown in Figure 39.

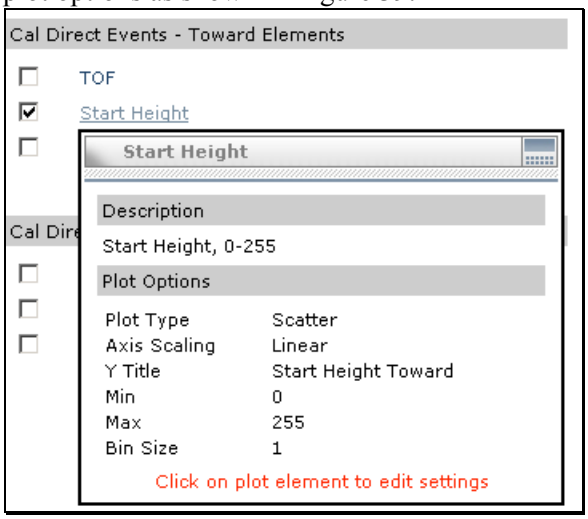

Figure 39: Plot Settings For Data Elements

For each chosen data variable, the user can decide to make five different types of plots. The 1-D Histogram plot is a bar graph drawn with data resulting from a histogram algorithm. The 2-D Histogram plot is a spectrogram. The Histogram plot is a bar graph drawn with the data unprocessed. The line plot connects the data points with a line. The scatter plot does not connect the data points with a line. The axis scale can also be changed to Linear or Logarithmic. Each variable has a default setting for the plot. The Y-axis title can also be changed in the Plot Options window. The user can choose different Min and Max values for the y-axis. Data outside this range will not be plotted, essentially zooming in on the desired data. When the user selects a 1-D or 2-D histogram the Bin Size value is used to set the size of the y-axis bin. The user can confirm their choices by clicking on *Set Plot Options* button. The changes can also be canceled by clicking on the *Cancel* button. Examples of each plot type can be seen in Appendix C.

3.3.3 Session Plots

The Session Plots partition lists the previous exports and plots created from the Data partition. The partition only lists those plots and exports that are created during the current login session in the Data

partition. There are sections for *Previous Plots generated from Cal Console*, *Previous Exports*, *Previous Plots generated from Flight Console*, and *Previous Plots generated from Image Console*. An example of the partition is shown below in Figure 40.

Figure 40: An Example of a Session Plots Listing

3.4 Meetings

The *Meetings* webpage lists and describes upcoming and past team meetings. When the user initially accesses the page, on the left is a *Meetings* area containing links to *Upcoming* and *Past Meetings* and on the right is the *Upcoming Meetings* section. The links can be seen in Figure 41. The *Upcoming Meetings* section can be seen in Figure 42. The user can click on the *Past Meetings* link to see a list of past meetings. The *Past Meetings* can be seen in Figure 43. The *Past Meetings* section contains the same information as the *Upcoming Meetings* section.

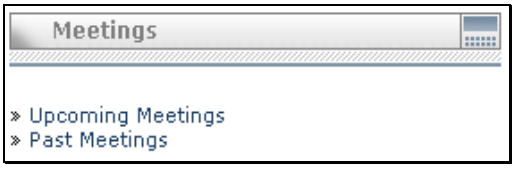

Figure 41: Meetings header

The *Upcoming Meetings* section contains a list of future meetings with the dates, a description, a location, and who to contact about the meeting. If the meeting has a webpage, then the webpage is listed in the description.

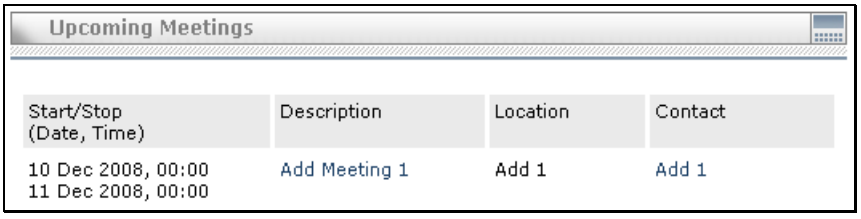

Figure 42: Upcoming Meeting Description

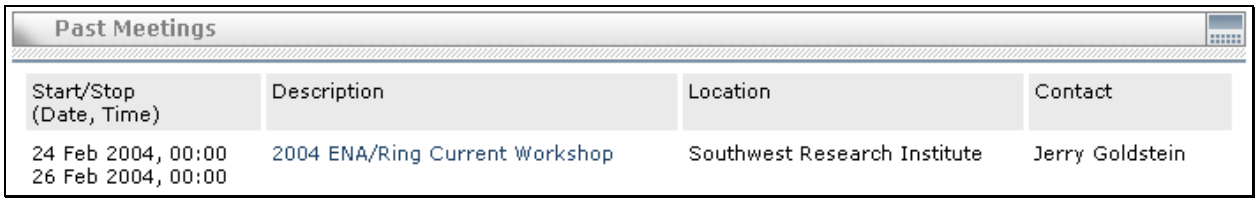

Figure 43: Past Meeting Description

3.5 Team

The initial *Team* webpage lists the team member names along with their organizations on the right hand side as seen in Figure 44.

Figure 44: Partial List of Team Members

The left hand side contains a list of links to the *List Team Members* and the *Email Team Members* webpage. This can be seen in Figure 45.

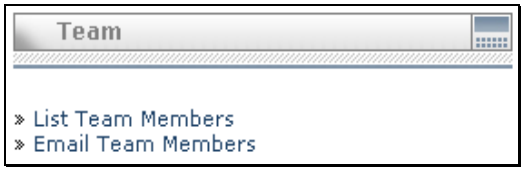

Figure 45: Team Member Links

Figure 46 shows the *Email Team Member* webpage. The user can enter in his email address and select multiple email recipients by pressing the Ctrl key while clicking on the team member's name. The user then specifies a Subject line and types his message in the *Email Body* text box. To send the email the user should press the *Send Email* button at the bottom.

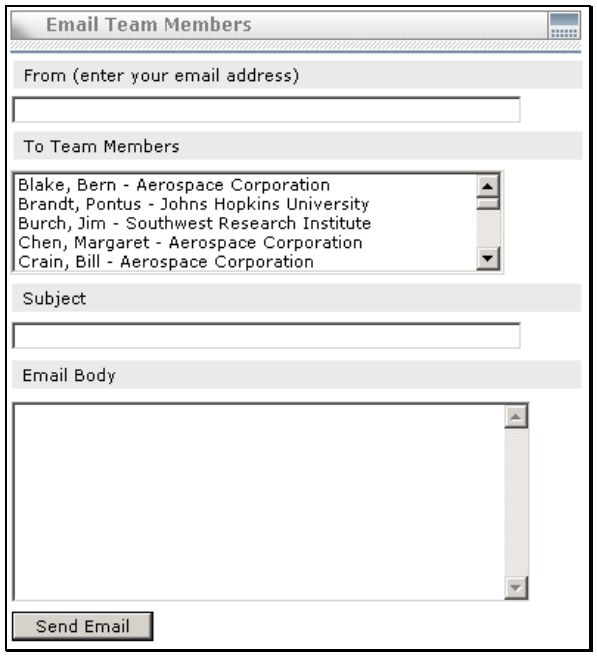

Figure 46: Webpage to Email Team Members

3.6 Logout

The *Logout* tab merely logs the user out of the TSDS and returns the user to the TWINS *Home* webpage. The team user can logout by clicking on the *Logout* tab or merely closing the browser. The user will also be logged out of the system after an extended period of inactivity.

APPENDIX A WEBPAGE SCREENSHOTS

This appendix contains screenshots of the various webpages available.

Figure 47 is the main webpage. It gives the user information in the form of news and alerts and allows the user to change his preferences.

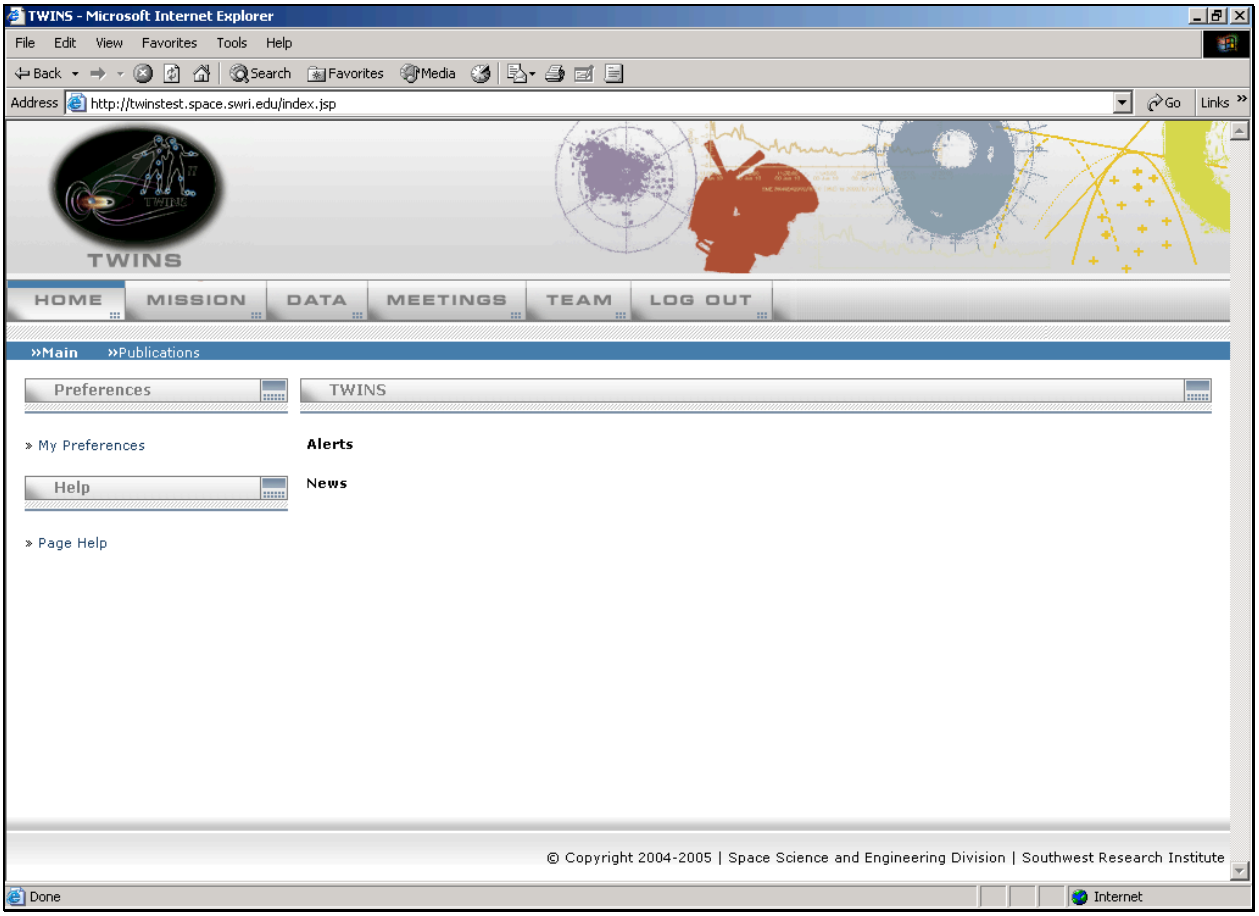

Figure 47: User Homepage

The Publications page lists and provides links to various publications about TWINS. For additional information see Section 3.1.2.

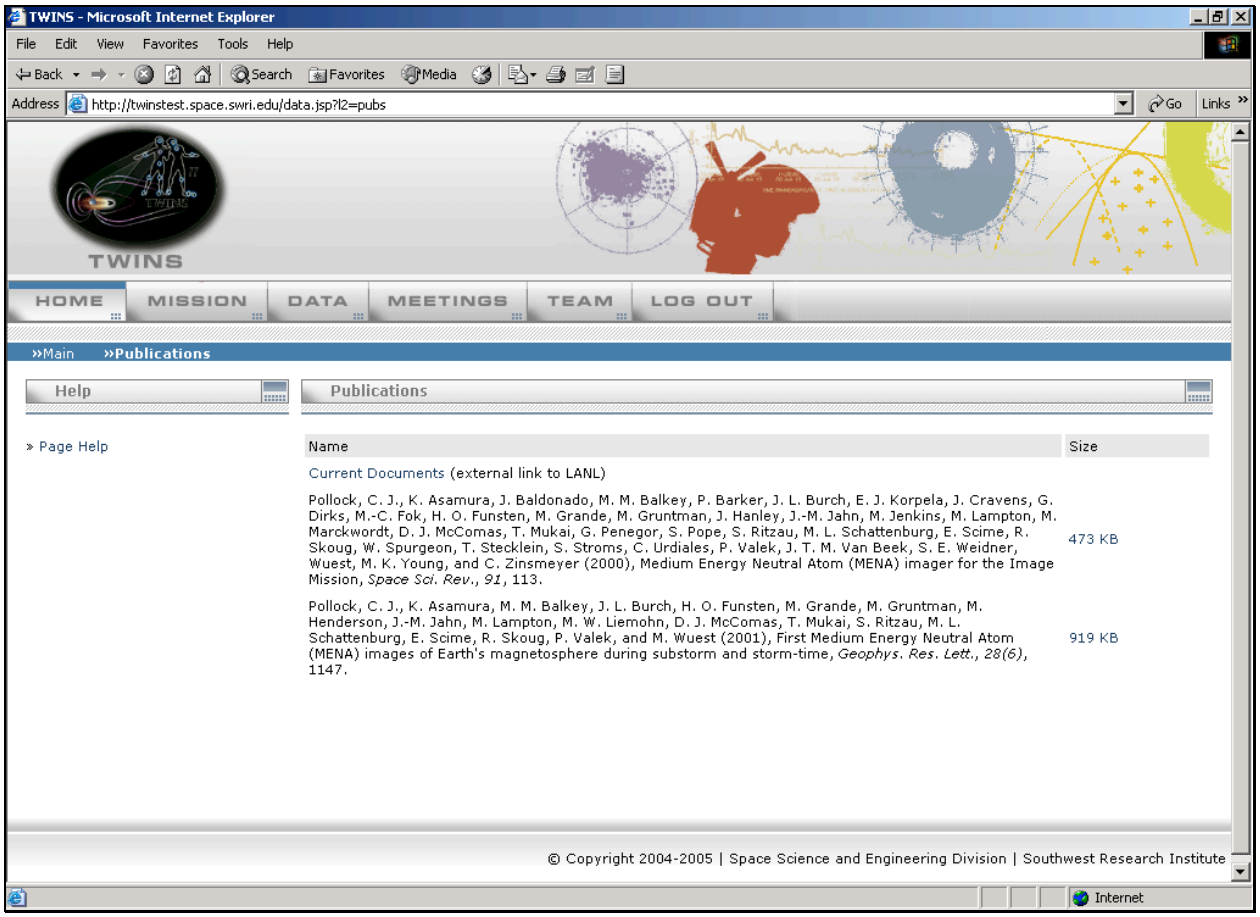

Figure 48: Publications webpage

The Mission webpage gives a detailed description of the TWINS mission and links to additional information. The Mission webpage is shown below in Figure 49. For additional information see Section 3.2.

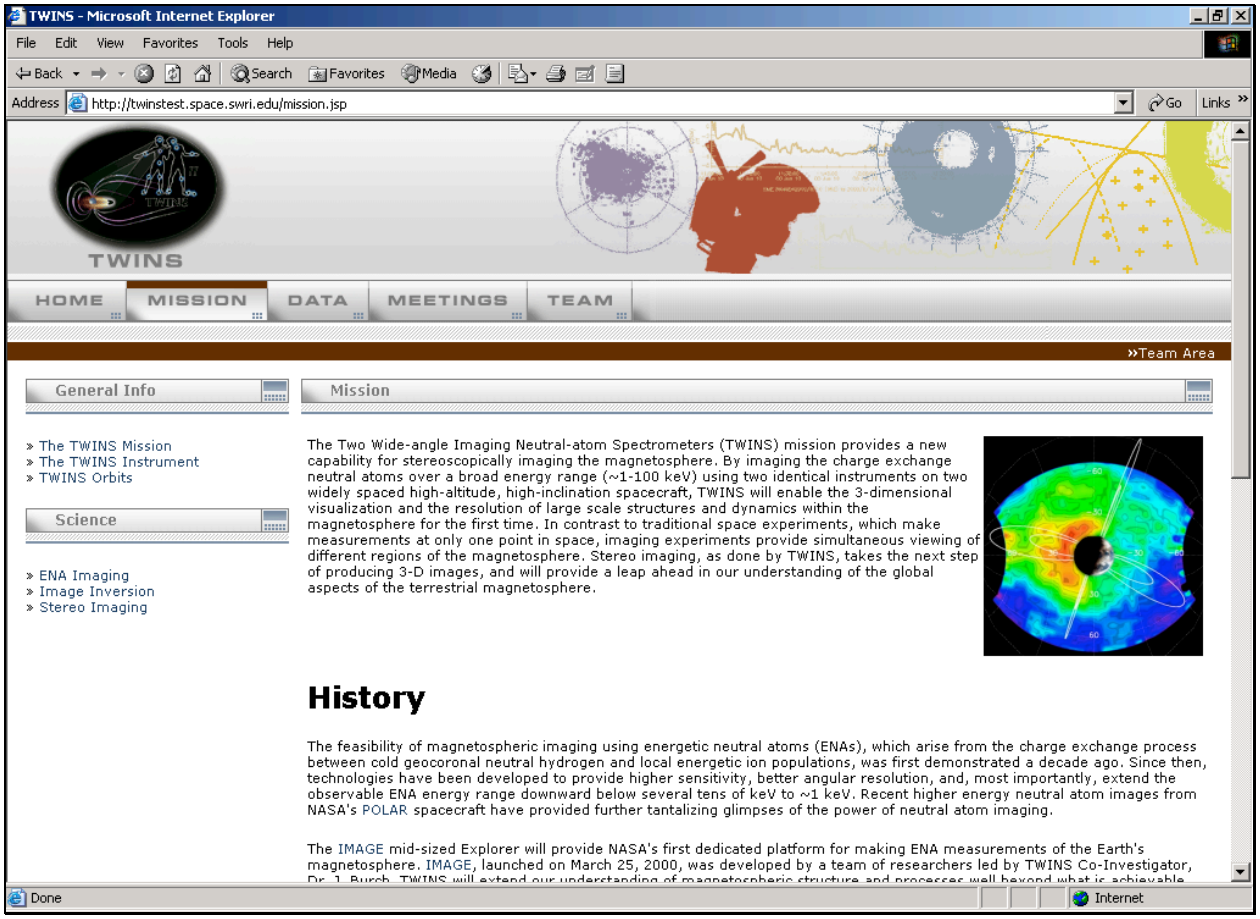

Figure 49: Mission Webpage

The Imaging webpage is accessible only through the Mission webpage by clicking on the additional links on the left of the page. The Imaging webpage contains additional information on the scientific background of TWINS operations. The webpage is seen below in Figure 50. For additional information see Section 3.2.

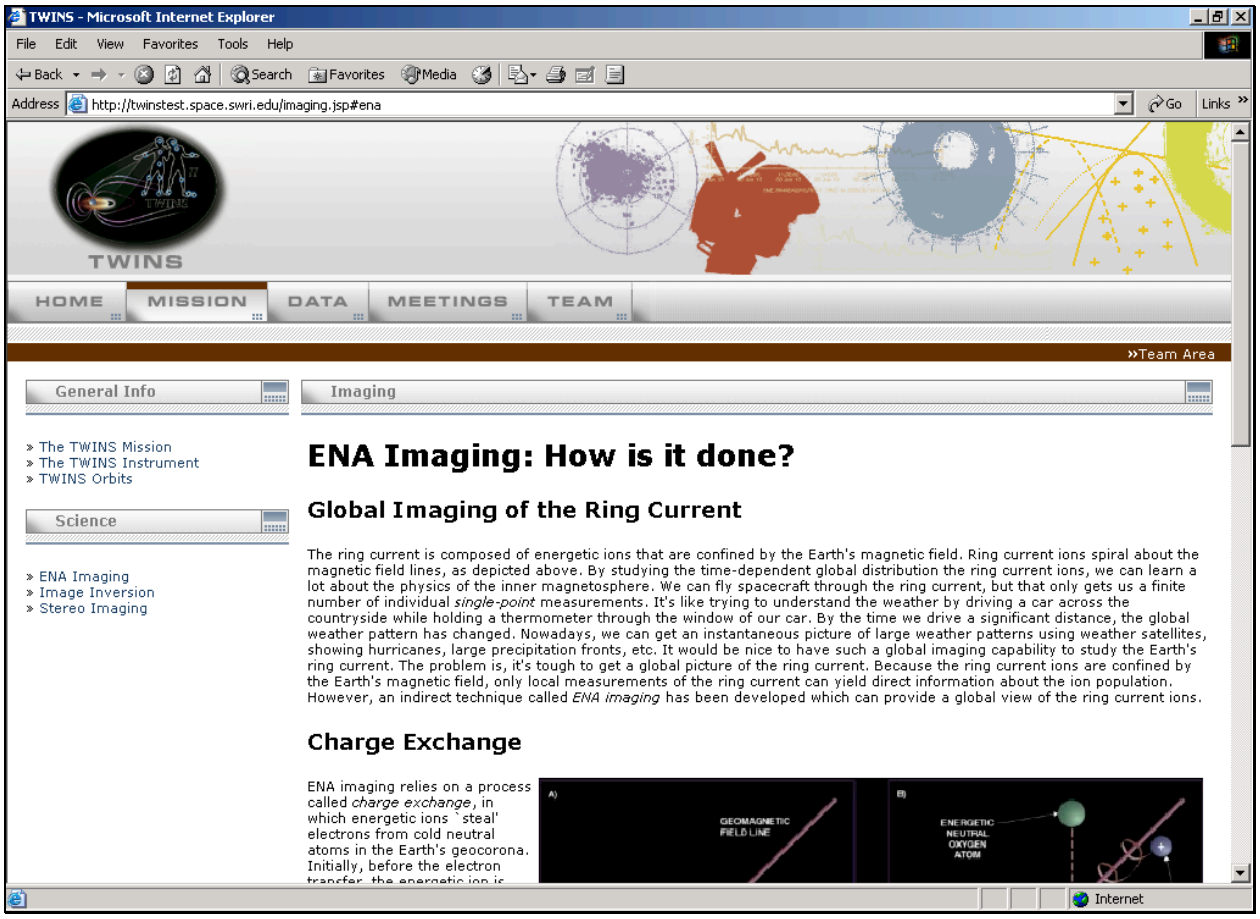

Figure 50: Imaging Webpage

The Team Data page is shown in Figure 51. The user can plot data from TWINS Flight, TWINS Calibration, and TIM images. The user can also export the data or plots to a file. For additional information see Section 3.3.2.

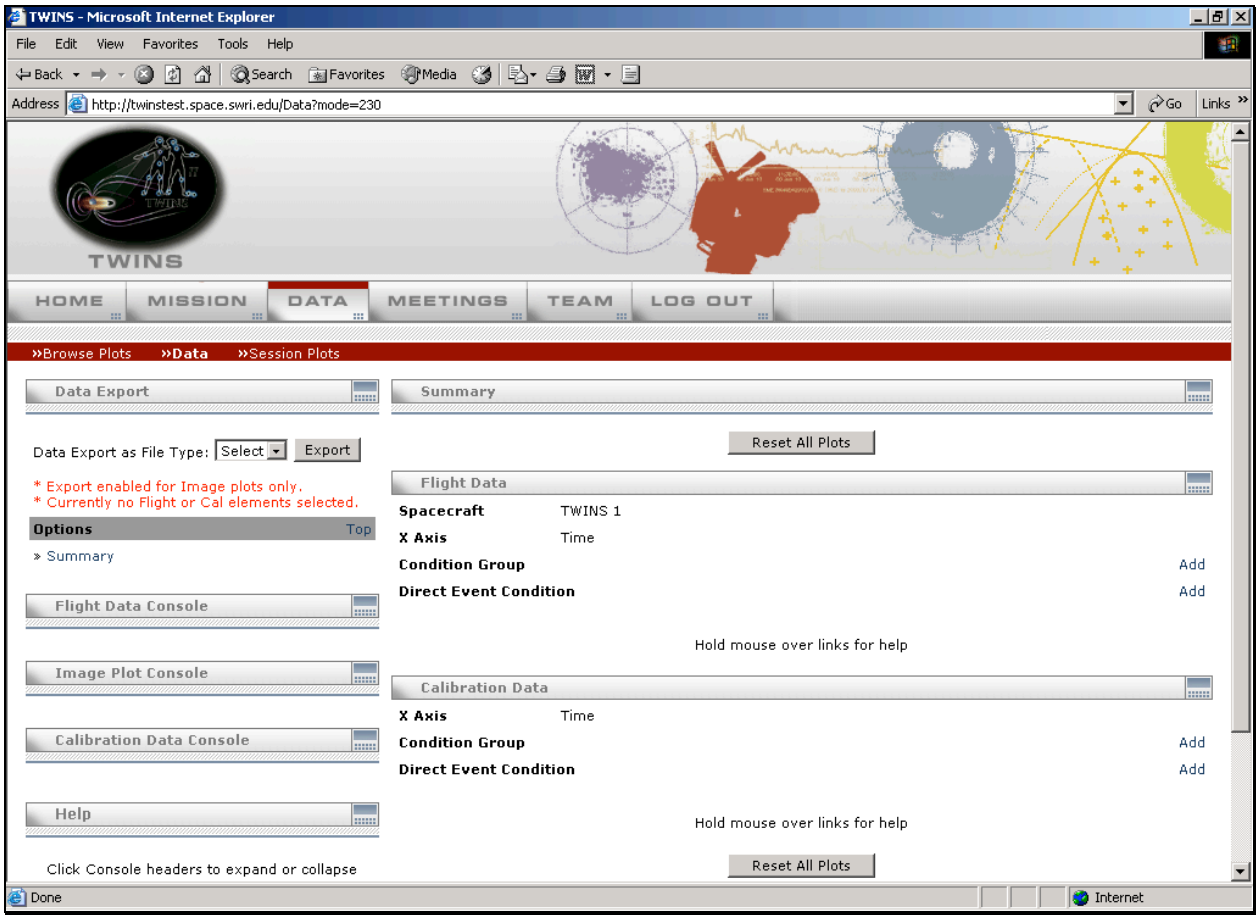

Figure 51: Data webpage

The Session Plots page allows the user to save any data plot or export made during his current session. For additional information see Section 3.3.3.

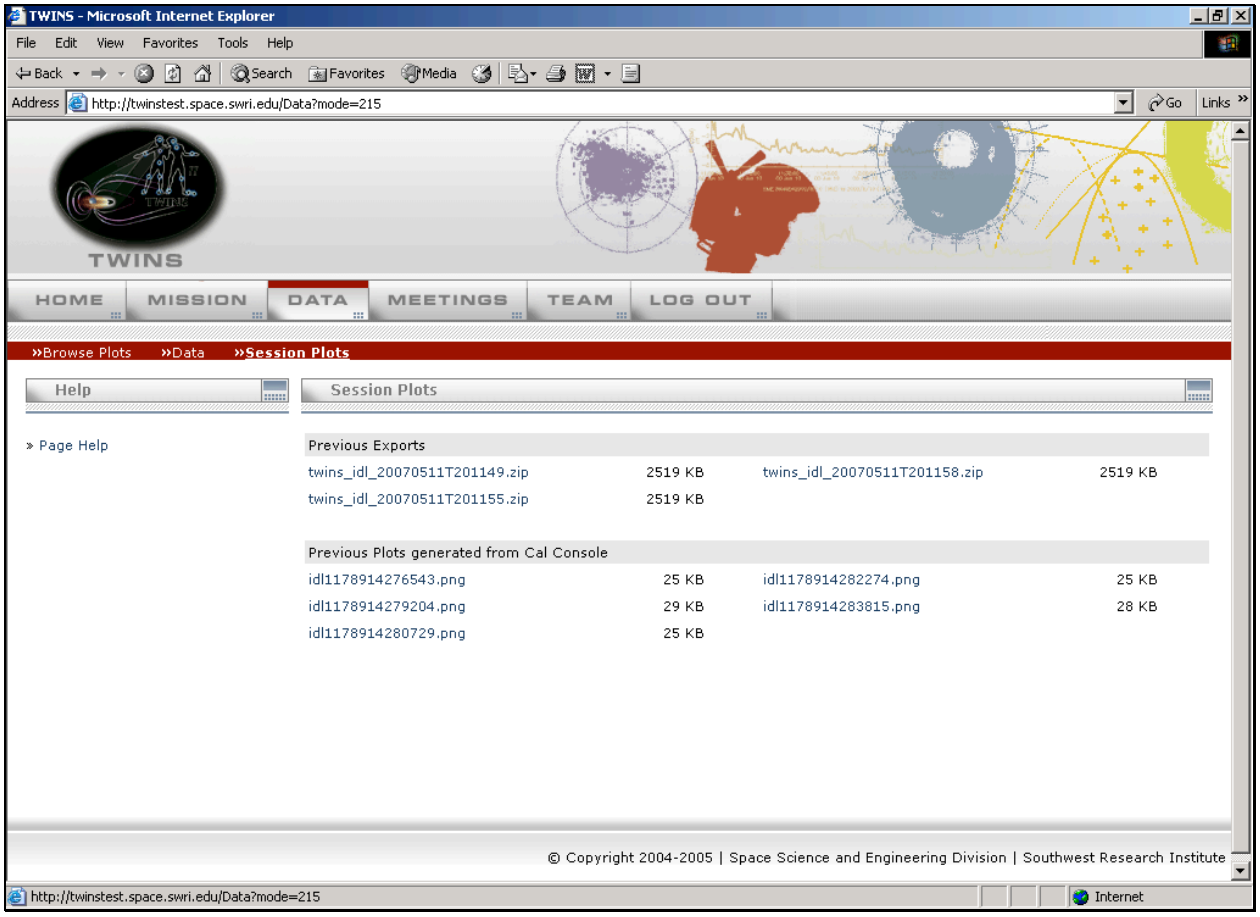

Figure 52: Sessions webpage

The Meetings page provides a listing of past and upcoming meetings. For additional information see Section 3.4.

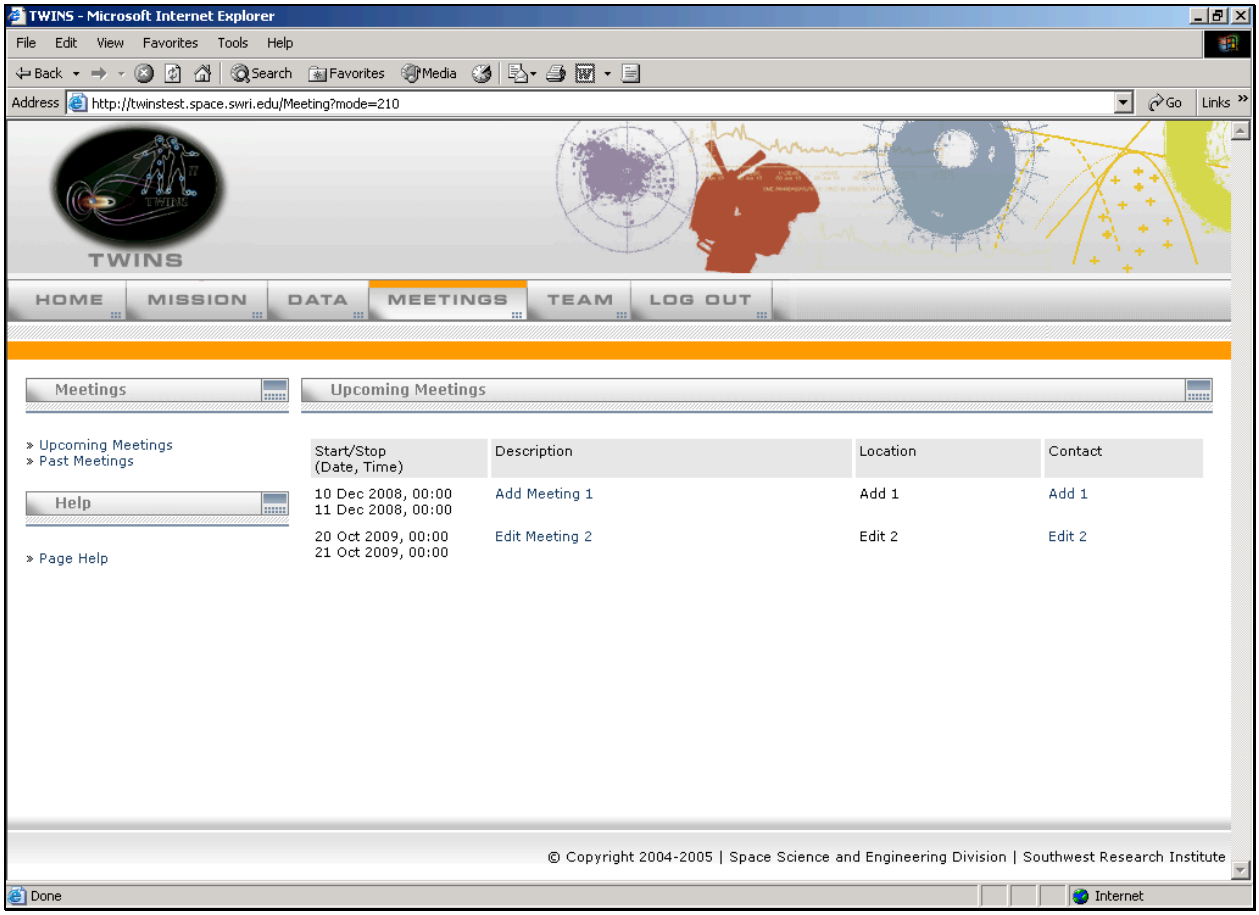

Figure 53: Meetings page

The Team page allows the user to email team members as well as see a list of the team members. For additional information see Section 3.5.

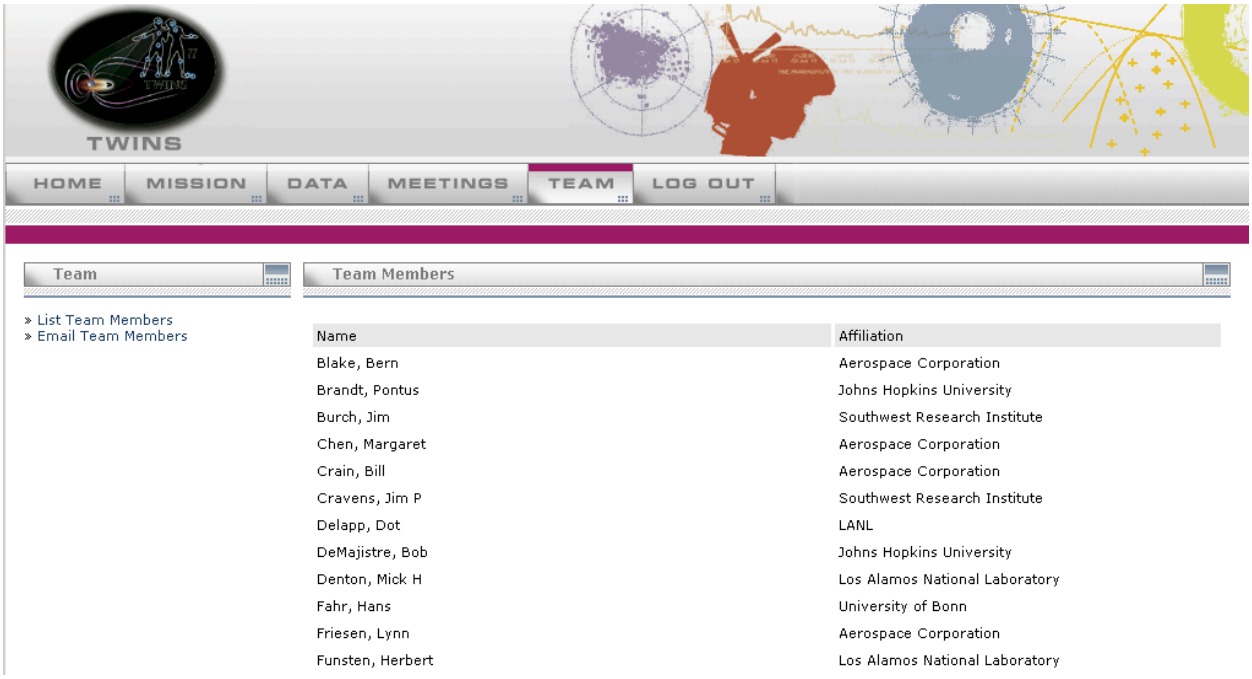

Figure 54: Team Member Listing Webpage

APPENDIX B LARGE PLOT DATA SCREENSHOTS

This appendix contains images of the large sections contained in the Team Plot webpage. These large structures have been discussed in smaller pieces in Sections 3.3.2.2, 3.3.2.3, and 3.3.2.4. Figure 55, Figure 56, Figure 57, and Figure 58 are presented for clarity purposes.

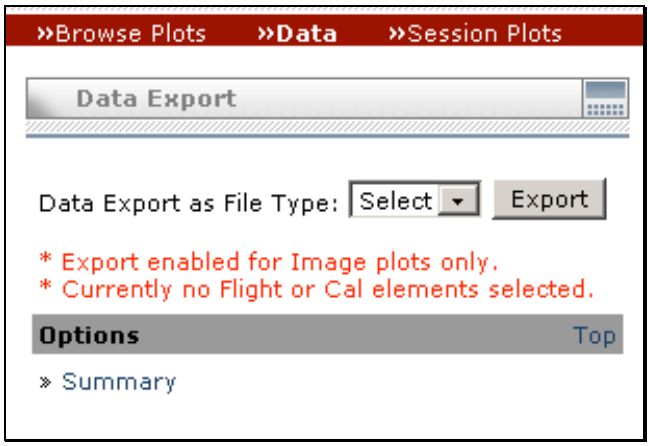

Figure 55: Data Export Console

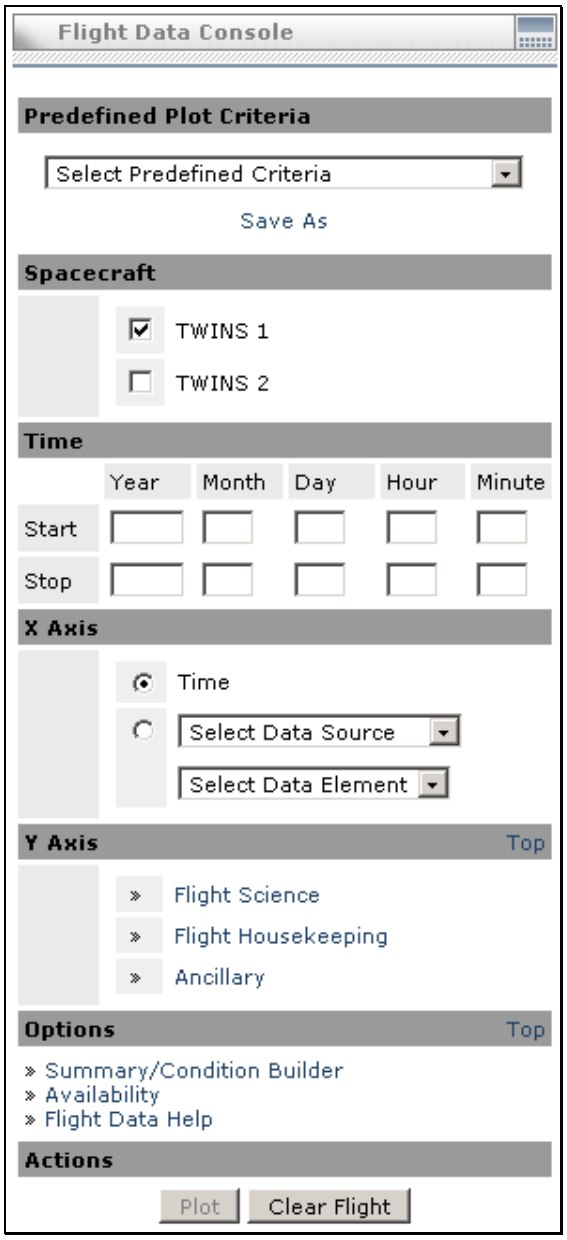

Figure 56: Flight Data Console

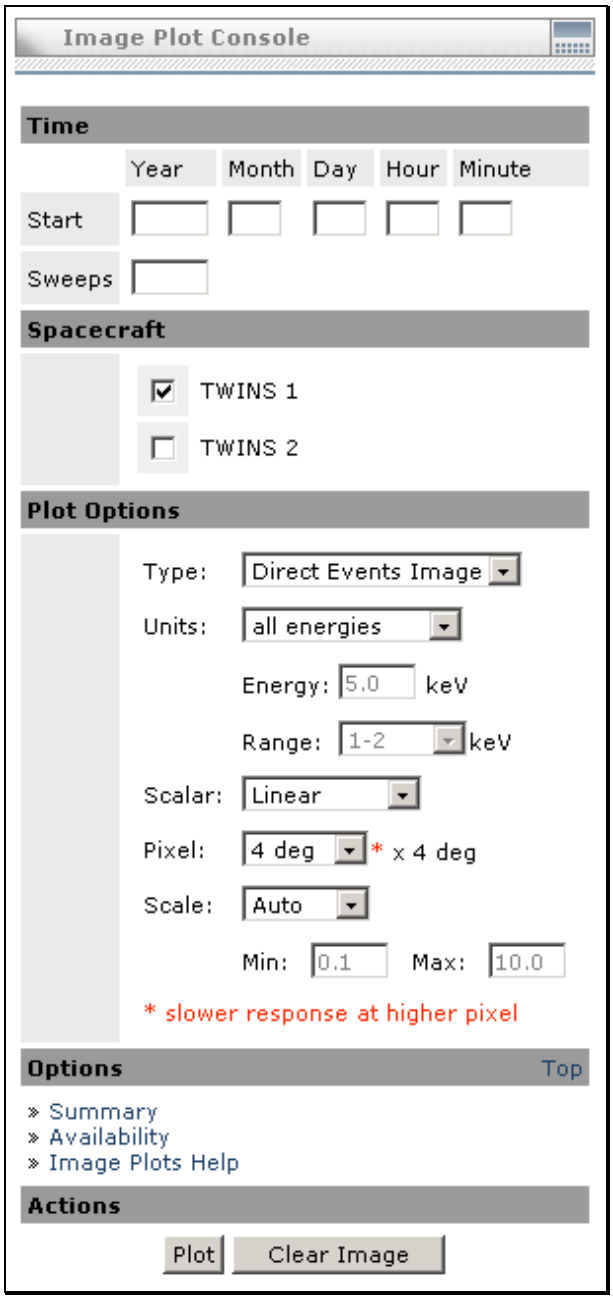

Figure 57: Image Plots Console

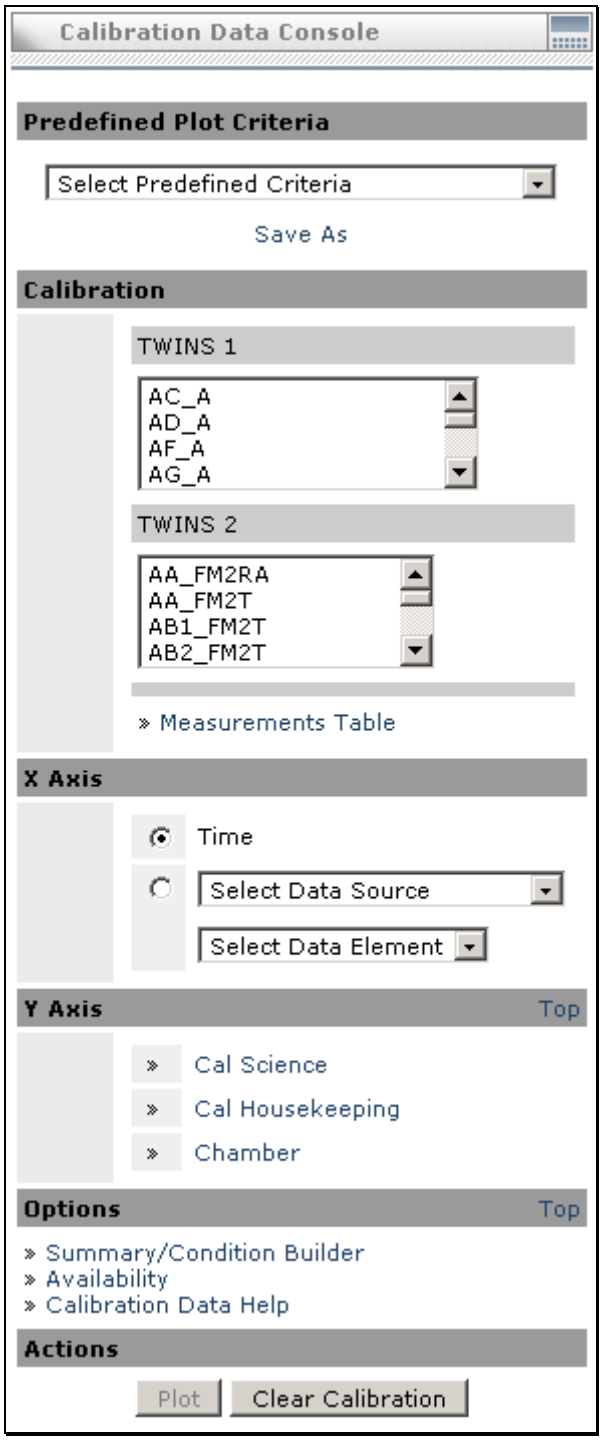

Figure 58: Calibration Data Console

APPENDIX C PLOT TYPE EXAMPLES

This appendix contains examples of each type of plot that can be produced from the Data webpage. There are five types of plots that can be created in the Data area: 1-D histogram, 2-D histogram, histogram, line, and scatter. All of the following plots besides for the 2-D histogram plot are of the same Time of Flight (TOF) data over the same time period.

The 1-D histogram plot option takes the data and processes it through a histogram algorithm. The resulting plot is of Counts vs. variable, in this case Time of Flight. The Counts are determined in the histogram algorithm. The variable is chosen as the y-axis on the Team Data page, but shows up as the x-axis when the 1-D histogram algorithm is applied. The y-axis is then the Counts.

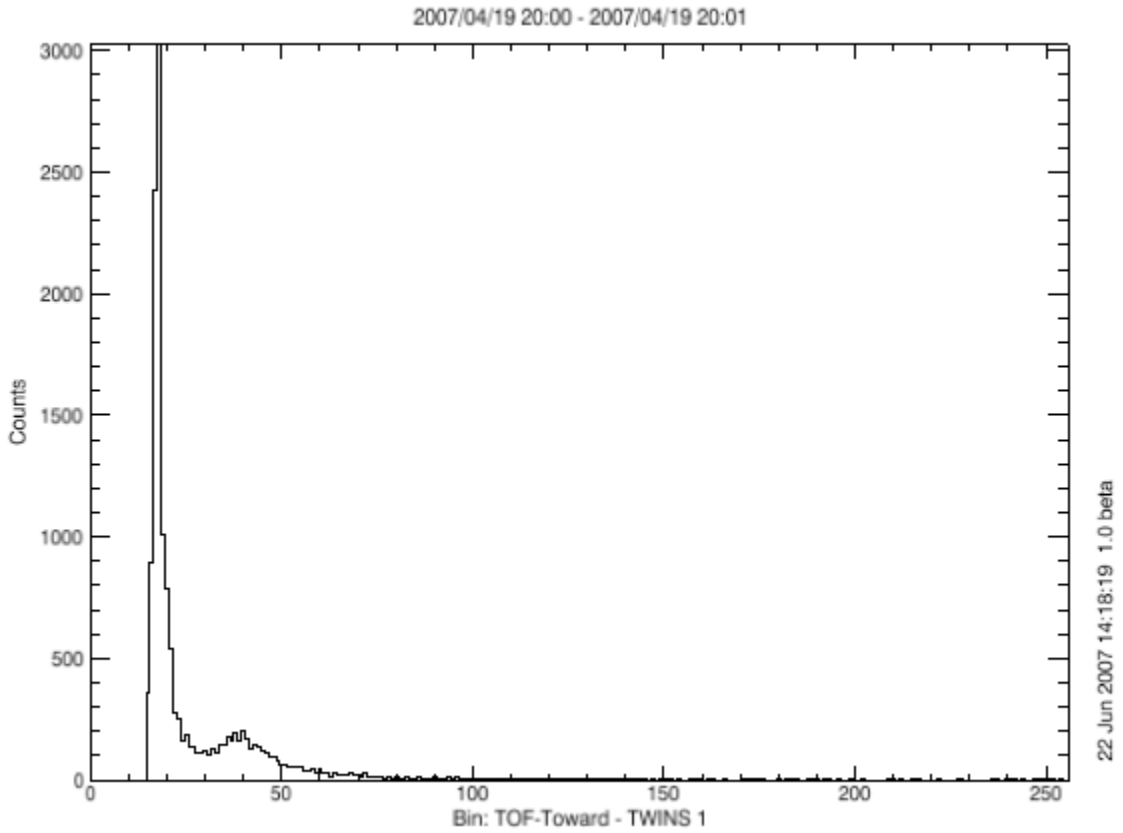

Figure 59: 1-D Histogram Option

The 2-D histogram plotting option takes two variables (one specified as the x-axis, the other as the y-axis) and processes the data through a histogram algorithm. The resulting plot is a color spectrogram where the color indicates the number of counts from the histogram algorithm.

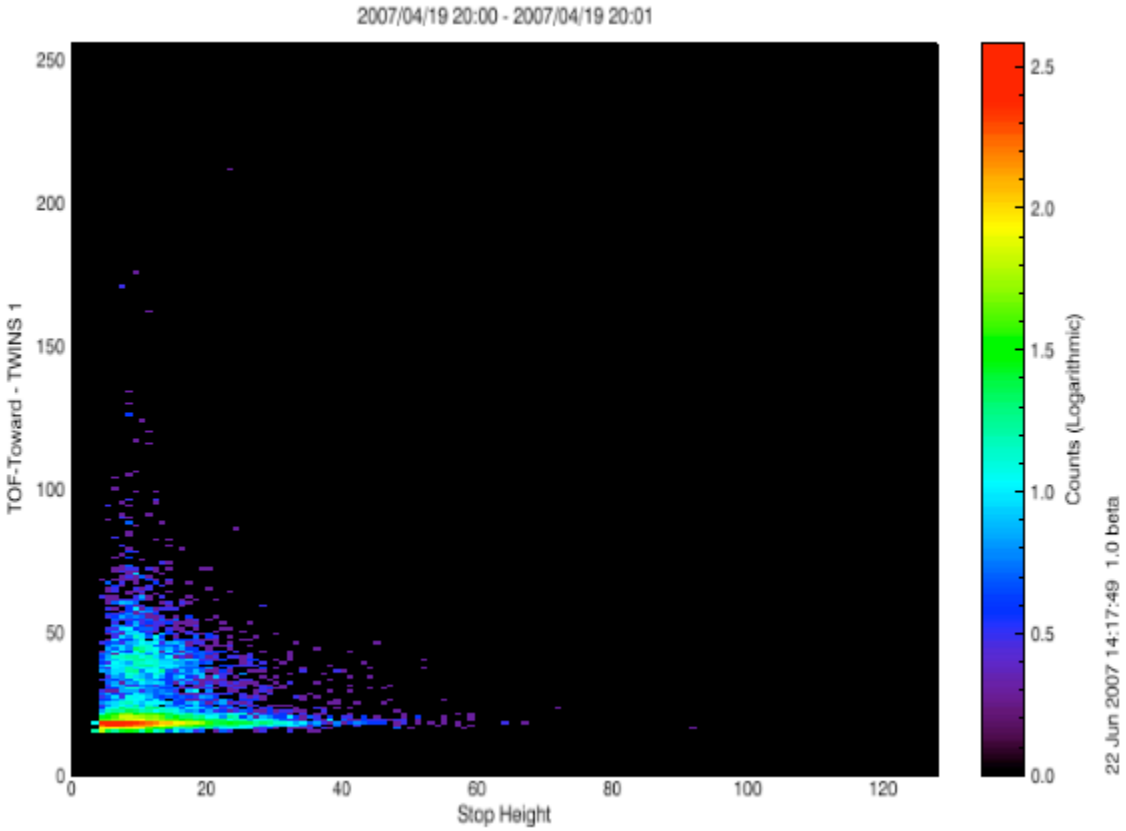

Figure 60: 2-D Histogram Option

The histogram option is different than the 1-D histogram and 2-D histogram because the data does not run through a histogram algorithm. Instead, the data is plotted like a bar graph. In this case, the specified x-axis and y-axis remain the same on the plot unlike the 1-D histogram option.

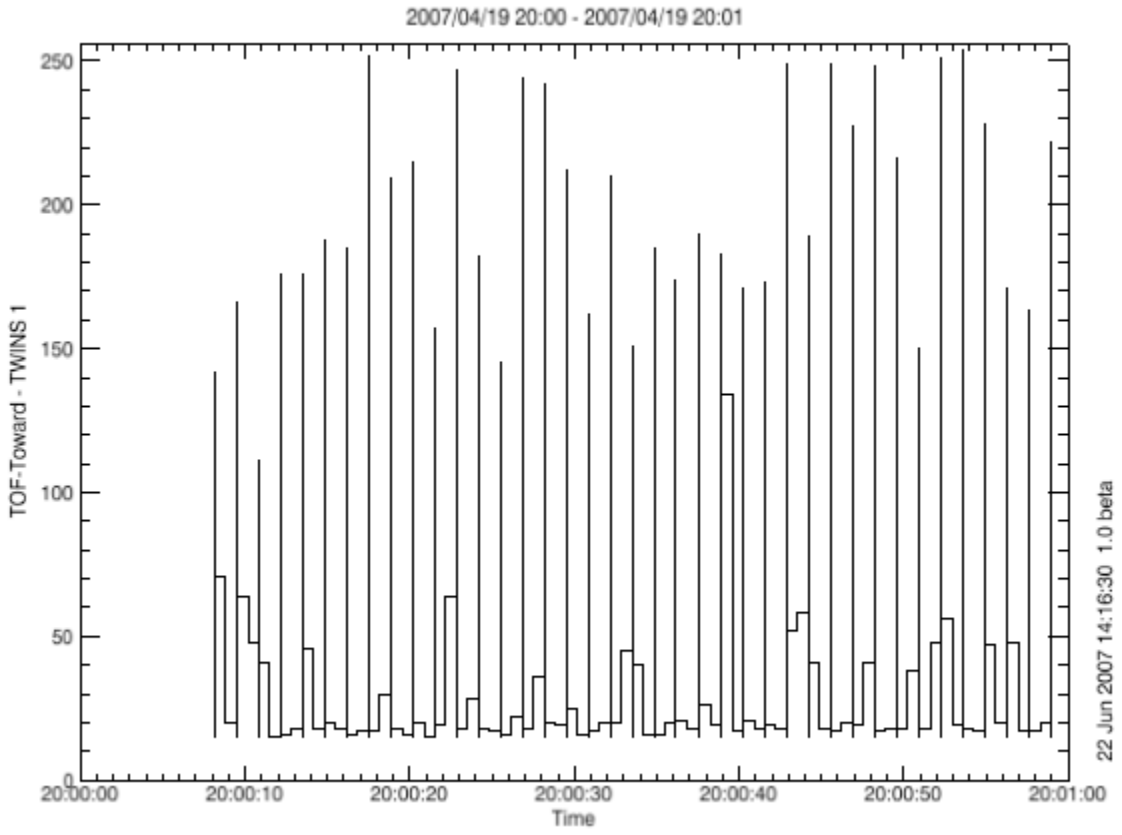

Figure 61: Histogram Option

The line option simply plots the chosen x and y-axis variables and connects the datapoints with a line.

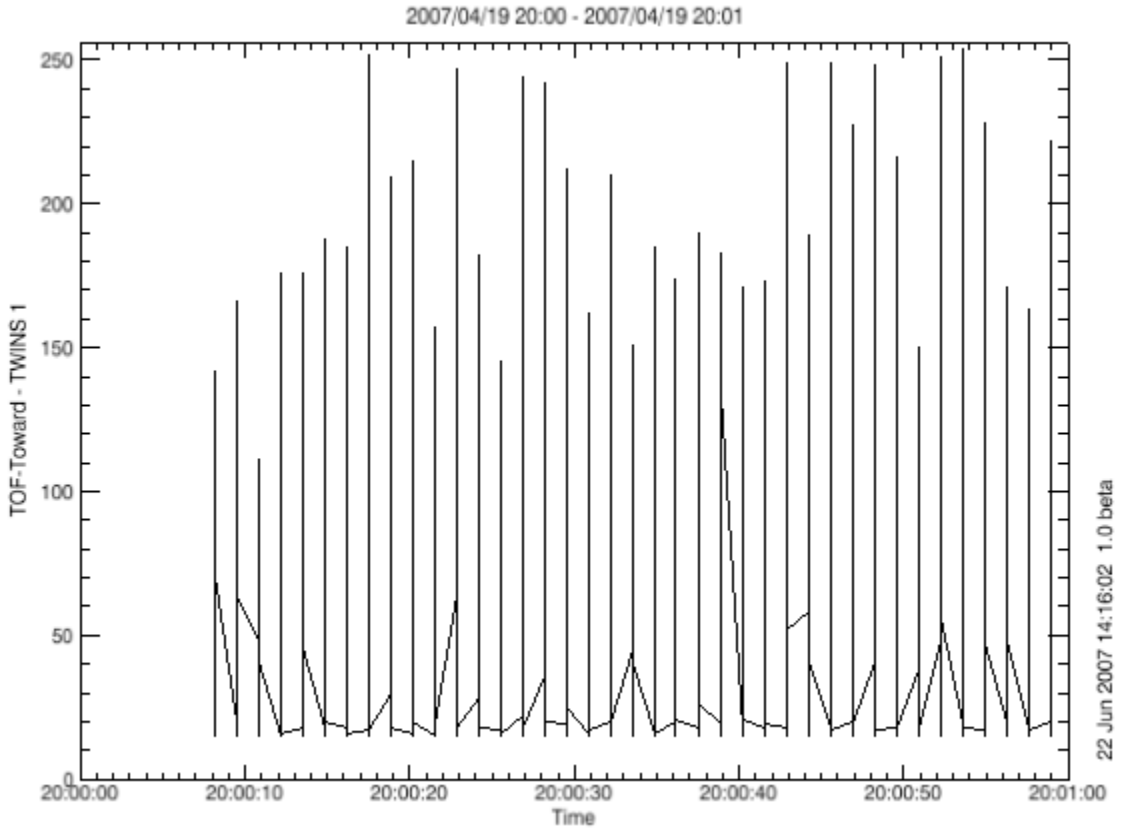

Figure 62: Line Plot Option

The scatter option gives the user the opportunity to plot the data without connecting the datapoints.

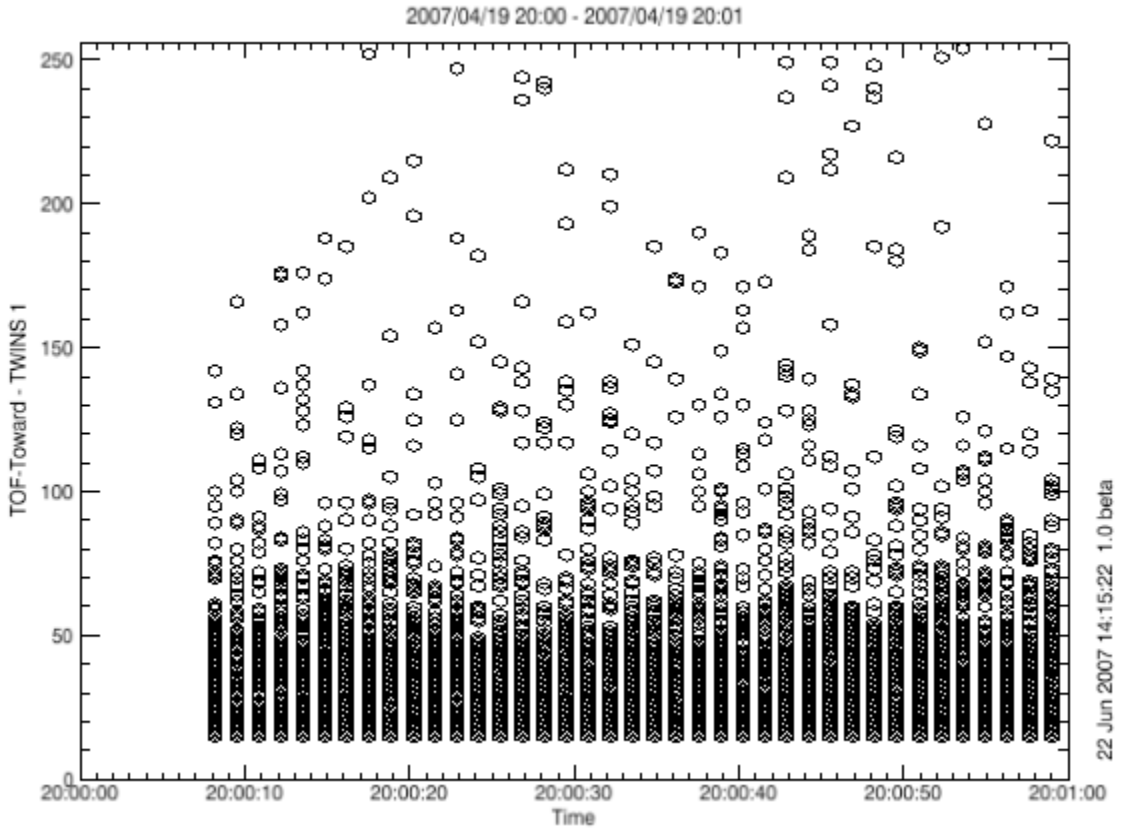

Figure 63: Scatter Plot Option

APPENDIX D DATA DISCUSSION

The various data elements from the Team Data webpage are discussed in this appendix.

1. Flight Science

Flight Science data is composed of three datasets: Flight Science Elements, Direct Events Toward Elements, and Direct Events Away Elements. These datasets are described below.

1.1 Flight Science Elements

Telemetry Mode indicates the instrument's current mode. The telemetry mode can be: Maintenance, Engineering, Static Imaging, Dynamic Imaging, Static Test, and Dynamic Test. During the Static modes the instrument can scan at a variable rate. During the Dynamic modes, the instrument scans at 3 degrees per second. Dynamic Imaging mode is the default mode for nominal flight operations. The sector and scan variables refer to how and where the actuator (TWA) is within its scan. The LAD data elements refer to the Lyman Alpha Detector. Start Count, Stop Count, and Valid Count are the number of events that hit the start anode, stop anode, and make a valid event, respectively. If there is a start and stop event under the right conditions, then a valid event will be made. There will be many more start and stop events than valid events because of the need for proper conditions. If a valid event is not made from a start and stop event, these events are recorded in the No Stop, Overload, Overflow, and Underflow variables.

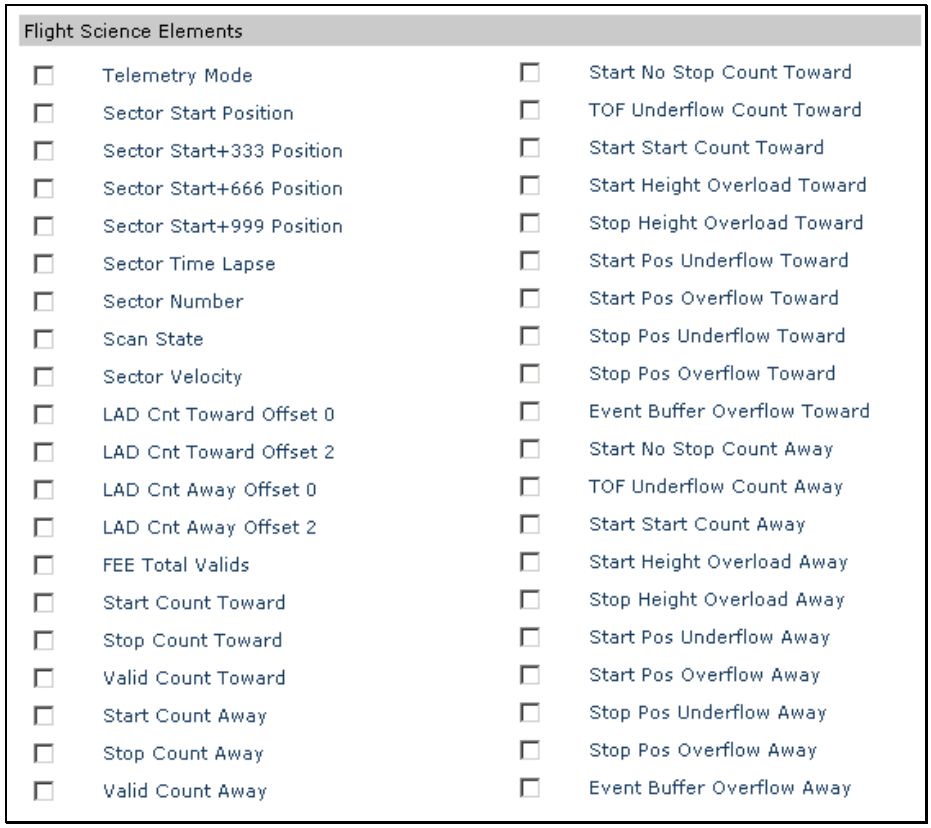

Figure 64: Flight Science Elements

1.2 Direct Events Toward Elements

A Direct Event is made from a valid event. A Direct Event is composed of TOF, Start and Stop Height, and Start and Stop Position elements. TOF is the time, in binary format, between the start and stop pulse. The TOF ranges from 0 to 255; there is a conversion from TOF to time. Start Height and Stop Height are the size of the voltage pulse generated by the start event and stop event, respectively. From the height information the mass of the ENA can be determined. The Start and Stop Position are where the pulse hit the start and stop anode, respectively. From the position information the incident angle can be calculated. For this data group the sensor is the 'Toward' head.

Figure 65: Direct Events Data for the Toward Head

1.3 Direct Events Away Elements

The Direct Events Away Elements are identical in nature to the Direct Events Toward elements. For this data group the sensor is the 'Away' head.

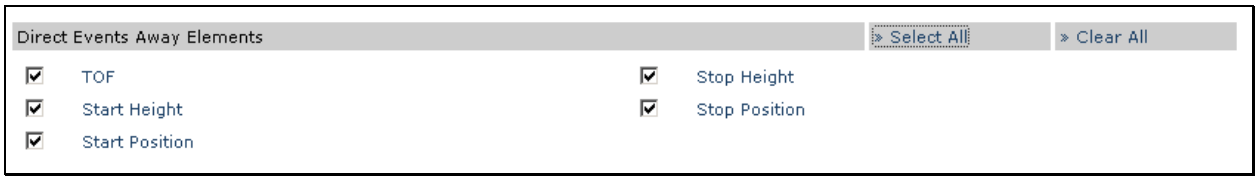

Figure 66: Direct Events Data for the Away Head

2. Flight Housekeeping

2.1 Flight Housekeeping Elements

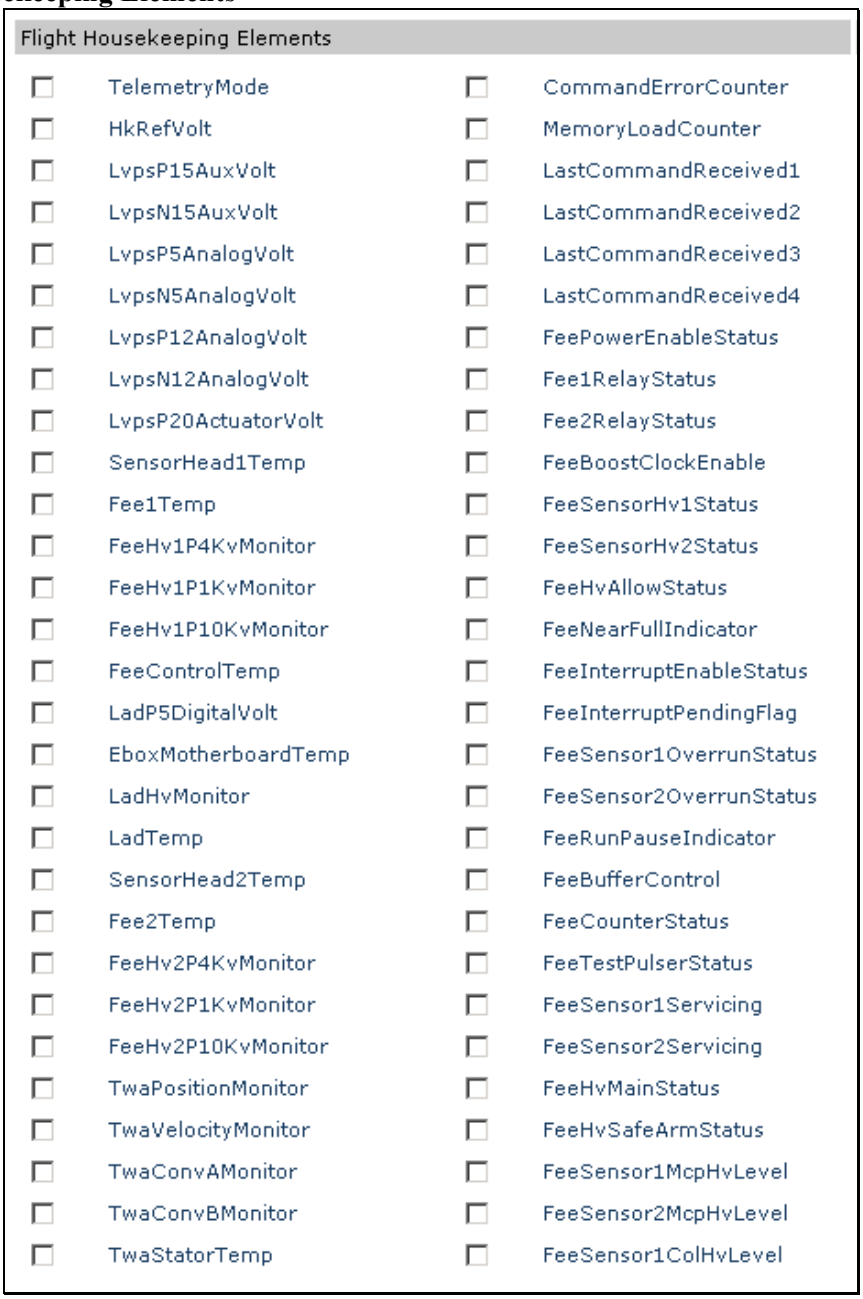

Figure 67: First Set of Housekeeping Data for Flight (1 of 2)

Figure 68: Second Set of Housekeeping Data for Flight (2 of 2)

3. Attitude Data

3.1 Spacecraft Attitude Elements

The Spacecraft Attitude Elements are calculated from S/C attitude file and instrument alignment. The data is represented as a unit vector in ECI coordinates.

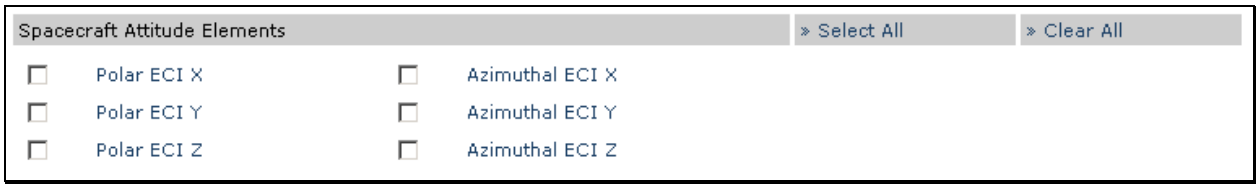

Figure 69: Spacecraft Attitude Elements

The seven elements represent time, three components of the polar pointing vector, and three components of the azimuthal pointing vector. Figure 70 specifies both semantic and formatting details for the series and also indicates the ordering of elements.

Item	Name	Label	Type	Format	Valid Range	Units	Description
1	PointingTime	ModJulianDate_day	float	E23.15	> 0	day	Modified Julian Date
2	PolarUnitVectorECI	PolarVecECI*	float[3]	E20.12	[-1, 1]	none	Polar unit vector ECI components
3	AzimuthalUnitVectorECI	AzimuthalVecECI*	float[3]	E20.12	[-1, 1]	none	Azimuthal unit vector ECI components

Figure 70: Attitude Data Explanation Table

4. Ephemeris Data

4.1 Derived Ephemeris Elements

The Derived Ephemeris Data is calculated based upon S/C positional ephemeris, geomagnetic models, and representative space environment indices. The altitude computations are based on an oblate spheroid Earth model. Each data element is further described in tabular format in Figure 72. Each element is given a brief description as well as a range, units, and size of data element. For instance the EphSCeci element has three variables that are listed in Figure 71 as S/C ECI X, S/C ECI Y, and S/C ECI Z. These three variables give the user a position of the spacecraft with respect to ECI coordinates.

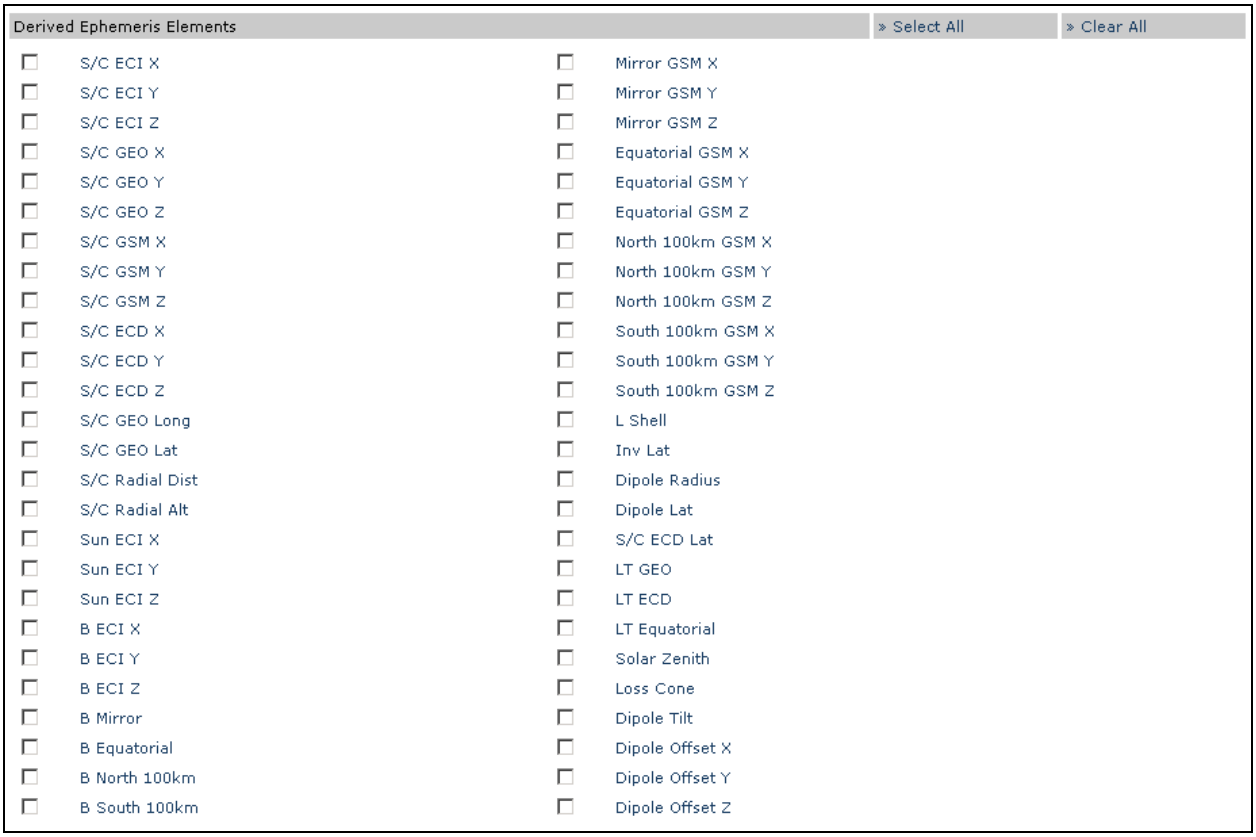

Figure 71: Derived Ephemeris Elements

Item	Name	Type	Format	Valid Range	Units	Description
1	EphTime	float	E23.15	> 0	day	Modified Julian Date
2	EphSCECI	float[3]	E20.12	Format-based	km	S/C ECI Cartesian coordinates
3	EphSCGEO	float[3]	E20.12	Format-based	km	S/C Geographic Cartesian coordinates
4	EphSCGSM	float[3]	E20.12	Format-based	km	S/C GSM Cartesian coordinates
5	EphSCECD	float[3]	E20.12	Format-based	km	S/C ECD Cartesian coordinates
6	EphSClonGEO	float	E20.12	[0, 360)	deg	S/C Geographic East longitude
7	EphSClatGEO	float	E20.12	[-90, 90]	deg	S/C Geographic (geocentric) latitude
8	EphSCradial	float[2]	E20.12	> 0	km	S/C geocentric radial distance & altitude (geocentric)
9	EphSunECI	float[3]	E20.12	Format-based	km	Sun ECI Cartesian coordinates
10	EphBECI	float[3]	E20.12	Format-based	nT	Magnetic field vector w.r.t. ECI basis
11	EphBmirror	float	E20.12	> 0	nT	Field magnitude at mirror point
12	EphBequatorial	float	E20.12	> 0	nT	Field magnitude at field-line minimum
13	EphBnorth100km	float	E20.12	> 0	nT	Field magnitude at north 100 km point
14	EphBsouth100km	float	E20.12	> 0	nT	Field magnitude at south 100 km point
15	EphMirrorGSM	float[3]	E20.12	Format-based	km	Mirror point GSM Cartesian coordinates
16	EphEquatorialGSM	float[3]	E20.12	Format-based	km	Equatorial point GSM Cartesian coordinates
17	EphNorth100kmGSM	float[3]	E20.12	Format-based	km	North 100 km point GSM Cartesian
18	EphSouth100kmGSM	float[3]	E20.12	Format-based	km	South 100 km point GSM Cartesian
19	EphLshell	float	E20.12	> 0	none	Dimensionless McIlwain shell parameter
20	EphInvLat	float	E20.12	[0, 90]	deg	Invariant magnetic latitude
21	EphDipoleRadius	float	E20.12	> 0	km	Dipole magnetic radial distance
22	EphDipoleLat	float	E20.12	[-90, 90]	deg	Dipole magnetic latitude
23	EphSClatECD	float	E20.12	[-90, 90]	deg	S/C latitude in ECD frame
24	EphLTGEO	float	E20.12	[0, 24)	hr	Local time in geographic frame
25	EphLTECD	float	E20.12	[0, 24)	hr	Magnetic local time (MLT) in ECD frame
26	EphLTequatorialECD	float	E20.12	[0, 24)	hr	Equatorial-mapped MLT in ECD frame
27	EphSolarZenithCos	float	E20.12	[-1, 1]	none	Solar-zenith angle cosine
28	EphLossCone	float	E20.12	[0, 90]	deg	Particle loss cone angle
29	EphDipoleTilt	float	E20.12	[0, 90]	deg	Magnetic dipole tilt angle
30	EphDipoleOffset	float[3]	E20.12	Format-based	km	Magnetic dipole displacement

Figure 72: Derived Ephemeris Explanation Table

5. Ancillary Data

5.1 ACE MAG Elements

The Magnetic Field Experiment (MAG) consists of two vector fluxgate magnetometers controlled by a common processor. The data stored by TWINS are the 16-second averages of magnetic field data. The variables Br, Bt, and Bn are the components of the magnetic field vector given in the RTN coordinate system in nT. Bmag is the magnitude of the magnetic field vector given in nT. Delta and Lambda are the RTN latitude and longitude, respectively. BGseX, BGseY, and BGseZ are the components of the magnetic field vector given in the GSE coordinate system in nT. BGsmX, BGsmY, and BGsmZ are the components of the magnetic field vector given in the GSM coordinate system in nT. Fraction_Good is the fraction of the time period where data was available. BPosGseX, BPosGseY, BPosGseZ are the components of the spacecraft position in km in GSE coordinates. BPosGsmX, BPosGsmY, BPosGsmZ are the components of the spacecraft position in km in GSM coordinates. For more information see http://www.srl.caltech.edu/ACE/ASC/level2/mag_l2desc.html.

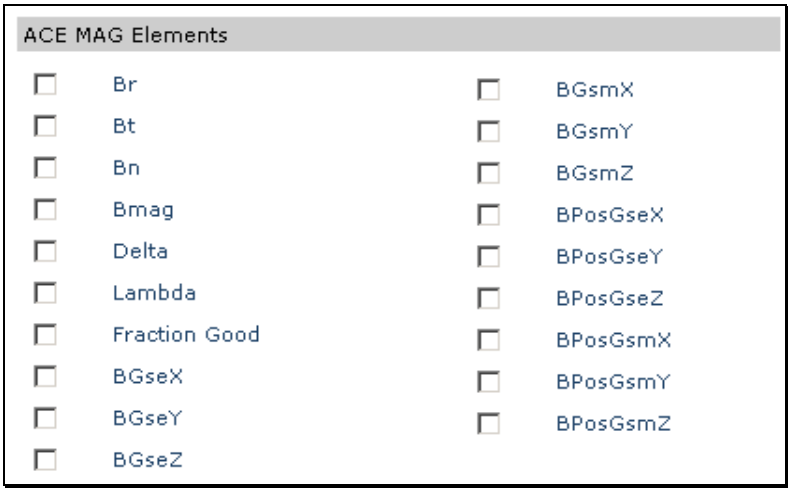

Figure 73: Magnetic Field Experiment (MAG) Data

5.2 ACE SWEPAM Elements

The Solar Wind Electron, Proton, and Alpha Monitor (SWEPAM) measures the solar wind plasma electron and ion fluxes (rates of particle flow) as functions of direction and energy. TWINS stores the 64-second averaged data. Proton Density is the density of protons in n_p/cm^{-3}. Proton Temp is the radial component of the proton temperature in degrees Kelvin. Proton Speed is the magnitude of the proton velocity vector in km/s. He4 To Protons is the ratio of alpha density to proton density. XDotGse, YDotGse, and ZDotGse are proton velocity vector components in GSE coordinates in km/s. XDotGsm, YDotGsm, and ZDotGsm are proton velocity vector components in GSM coordinates in km/s. PosGseX, PosGseY, PosGseZ are the components of the spacecraft position in km in GSE coordinates. PosGsmX, PosGsmY, PosGsmZ are the components of the spacecraft position in km in GSM coordinates. For more information see http://www.srl.caltech.edu/ACE/ASC/level2/swepam_l2desc.html.

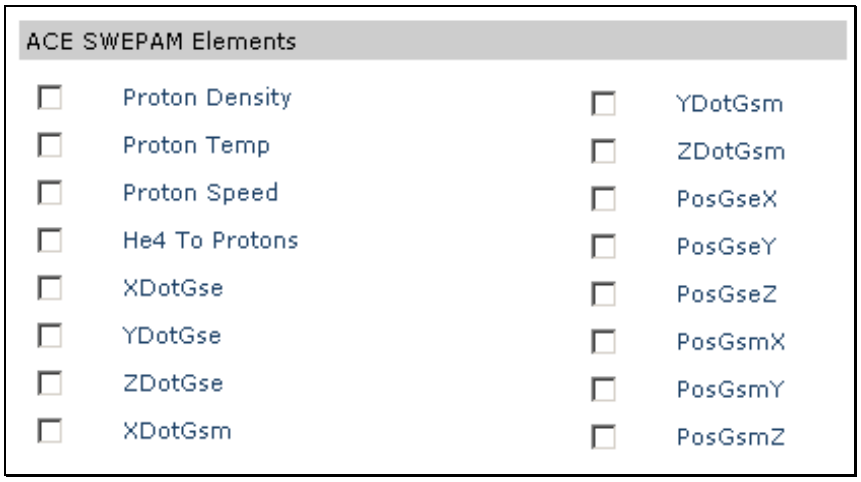

Figure 74: Solar Wind Electron, Proton, and Alpha Monitor (SWEPAM) Data

5.3 DST Elements

The DST or Disturbance Storm Time index is a measure of geomagnetic activity used to calculate the severity of magnetic storms. It is determined from the average value of the horizontal component of the Earth's magnetic field measured hourly at four near-equatorial geomagnetic observatories. DST is maintained at NGDC and is available via FTP from 1957 to the present. For more information regarding DST, please see NGDC's DST website at http://www.ngdc.noaa.gov/stp/GEOMAG/dst.html.

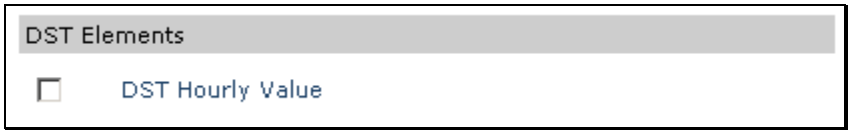

Figure 75: Disturbance Storm Time (DST) Data

5.4 KP Elements

The Kp Index is defined as the mean value of the disturbance levels in the two horizontal field components, observed at 13 selected, subauroral stations. Its values range from 0 to 9 on a logarithmic scale. Values below 4 indicate little activity. Values above 4 indicate a geomagnetic storm. Ap Index is a linearly scaled version of the Kp Index. For more information regarding Kp and Ap, see http://www.ngdc.noaa.gov/stp/GEOMAG/kp_ap.html.

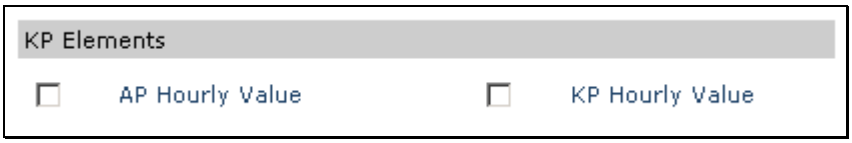

Figure 76: AP and KP Data

6. Cal Science

Calibration Science data is composed of three datasets: Calibration Science Elements, Calibration Direct Events Toward Elements, and Calibration Direct Events Away Elements. These datasets are described below. The Calibration data was collected during TWINS chamber calibrations, not during the actual mission.

6.1 Cal Science Data Elements

Telemetry Mode indicates the instrument's current mode. The telemetry mode can be: Maintenance, Engineering, Static Imaging, Dynamic Imaging, Static Test, and Dynamic Test. During the Static modes the instrument does not scan. During the Dynamic modes, the instrument scans at 3 degrees per second. Dynamic Imaging mode is the default mode for nominal flight operations. The sector variables refer to how and where the actuator (TWA) is within its scan. Start Count, Stop Count, and Valid Count are the number of events that hit the start anode, stop anode, and make a valid event, respectively. If there is a start and stop event under the right conditions, then a valid event will be made. There will be many more start and stop events than valid events because of the need for proper conditions. If a valid event is not made from a start and stop event, these events are recorded in the No Stop, Overload, Overflow, and Underflow variables.

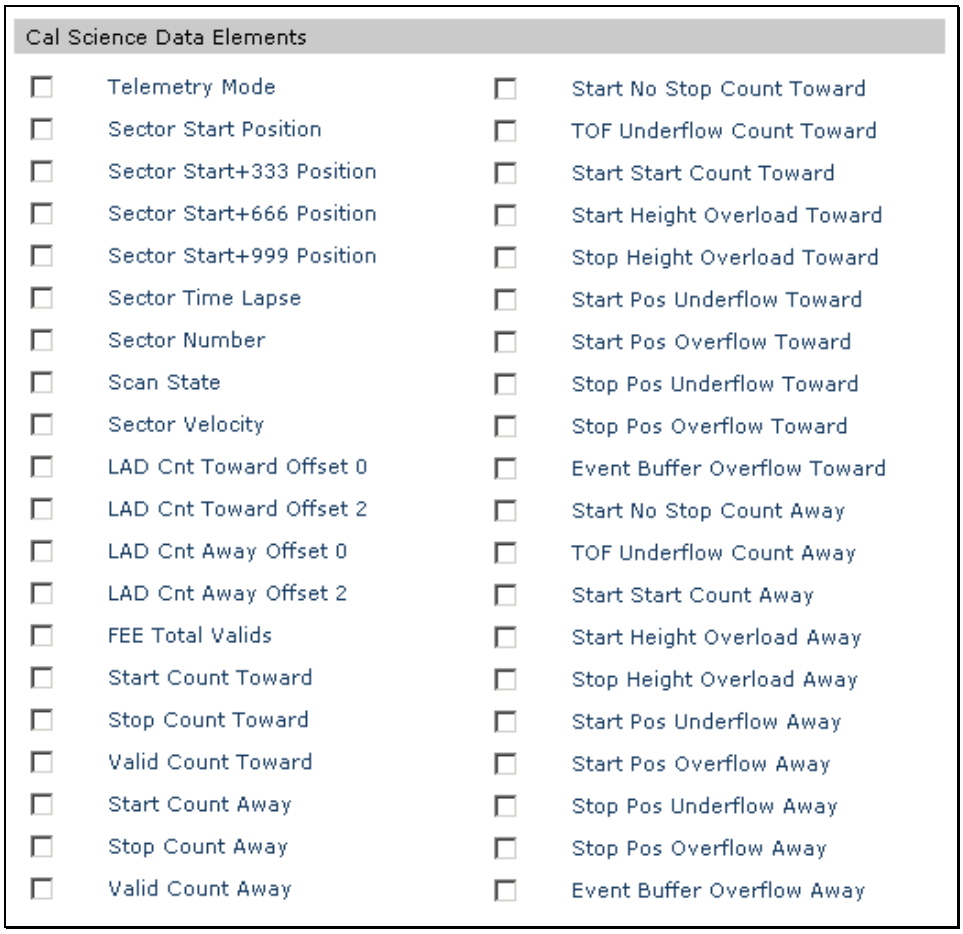

Figure 77: Calibration Science Elements

6.2 Cal Direct Events Toward Elements

A Direct Event is made from a valid event. A Direct Event is composed of TOF, Start and Stop Height, and Start and Stop Position elements. TOF is the time, in binary format, between the start and stop pulse. The TOF ranges from 0 to 255; there is a conversion from TOF to time, contact Jerry Goldstein for additional details. Start Height and Stop Height are the size of the voltage pulse generated by the start event and stop event, respectively. From the height information the mass of the ENA can be determined. The Start and Stop Position are where the pulse hit the start and stop anode, respectively. From the position information the incident angle can be calculated, contact Jerry Goldstein for more details. For this data group the sensor is the 'Toward' head.

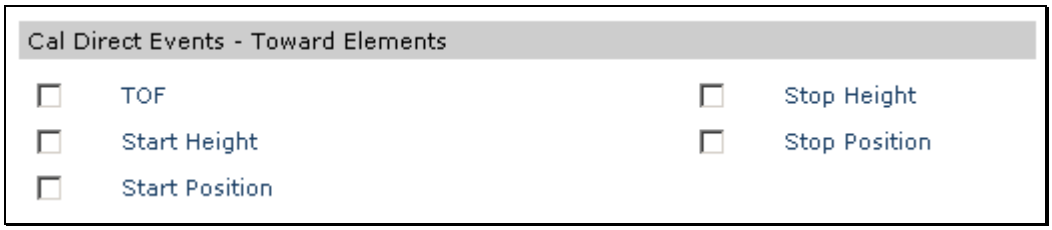

Figure 78: Calibration Direct Events Data for Toward Head

6.3 Cal Direct Events Away Elements

The Direct Events Away Elements are identical in nature to the Direct Events Toward elements. For this data group the sensor is the 'Away' head.

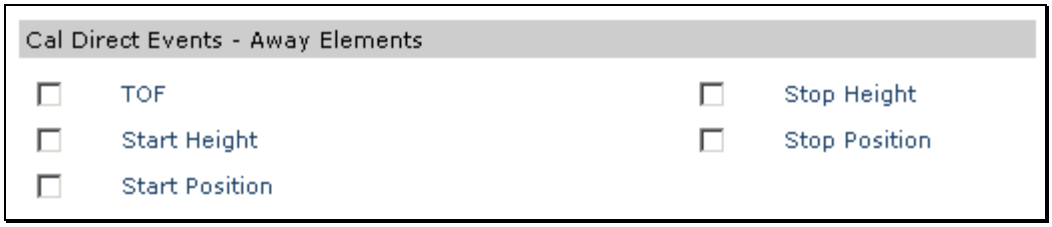

Figure 79: Calibration Direct Events Data for Away Head

7. Cal Housekeeping

7.1 Cal Housekeeping Elements

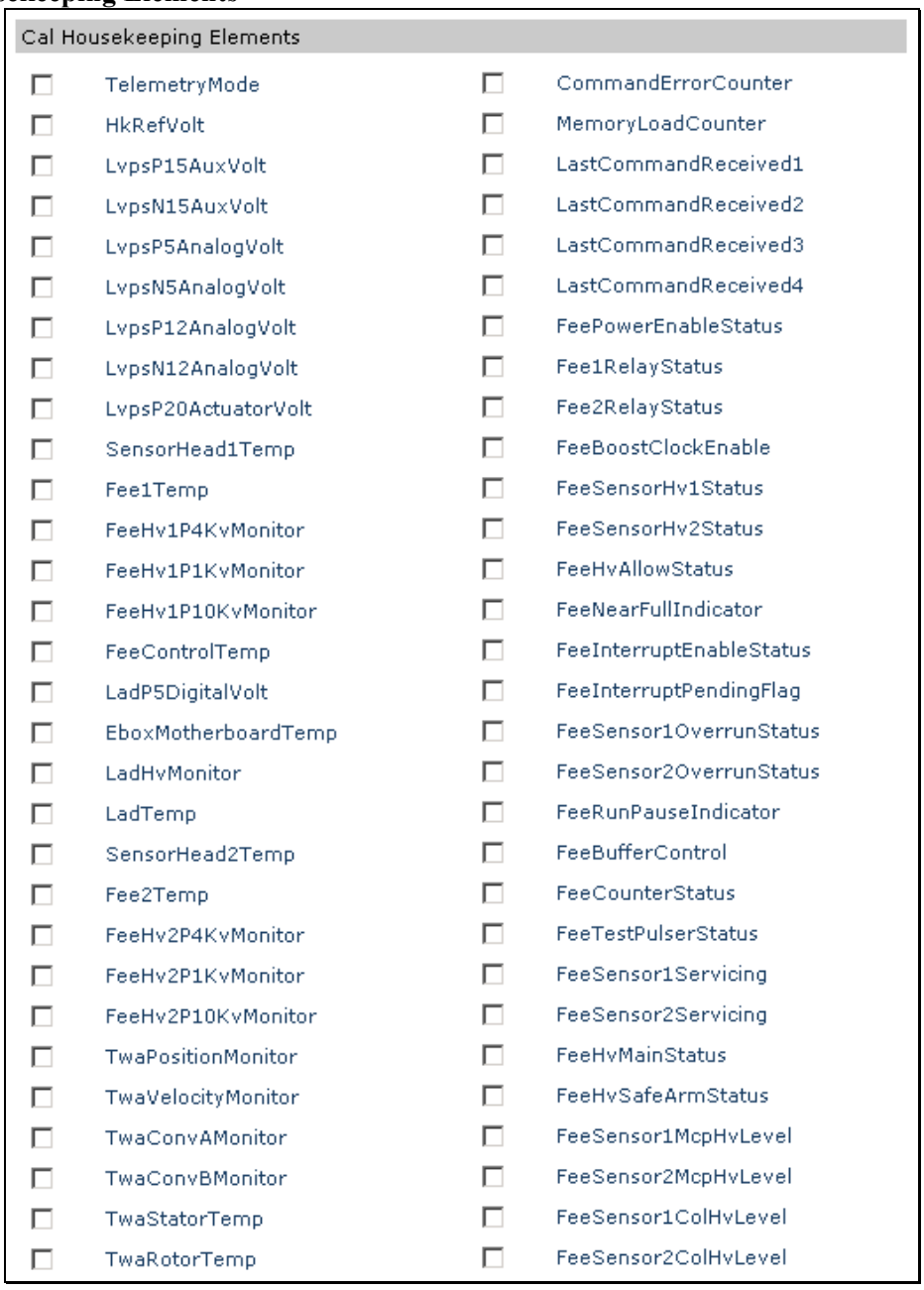

Figure 80: First Set of Calibration Housekeeping Elements (1 of 2)

Figure 81: Second Set of Calibration Housekeeping Elements (2 of 2)

8. Chamber

8.1 Chamber Elements

Horizontal, Vertical, Inner and Outer stage are the names of the positioning system stages. Horizontal and vertical do linear translations in the horizontal and vertical directions. The Inner and Outer stages are rotation stages with the outer stage having a rotation axis that is vertical and the inner stage has a vertical rotation axis. We choose not to use non-standard names for the positioning system axis to prevent confusion with instrument or spacecraft coordinates. IonGauge1 and IonGauge2 measure the pressure in the vacuum chamber. SourceIonGauge and FlightTubeIonGauge measure the pressure in the flight tube. Cryo(n)Temp is the temperature in cryogenic pump (n). Tc(n) is a Resistive Thermal Device temperature measurement in the chamber, These can be put on an instrument, but weren't on TWINS. FloatPotential is the float potential applied to the ion source cage. This is about 1000eV less than the beam energy. See the calibration log for actual beam energy. Exb is the mass filter setting, used to select mass of ion beam. The rule of thumb for Exb is greater than 500 for H+ and less than 500 for N+. The rest of the parameters are not used in TWINS.

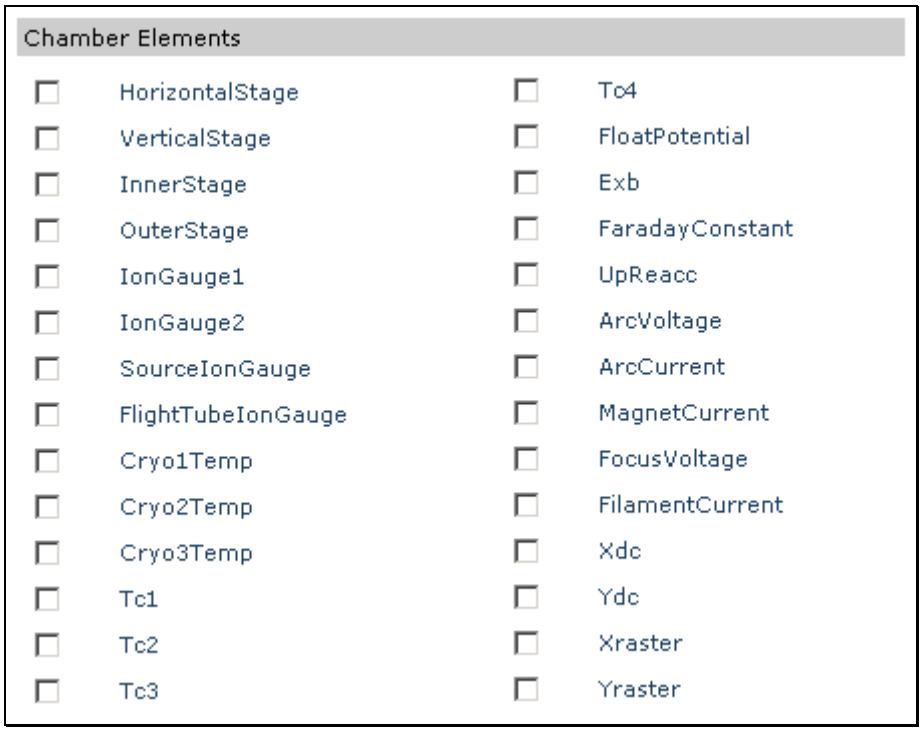

Figure 82: Calibration Chamber Elements

APPENDIX E ACRONYMS

ACE	Advanced Composition Explorer
AP	Mean, 3-hourly "equivalent amplitude" of Magnetic Activity
CDF	Common Data Format
DPU	Data Processing Unit
DST	Disturbance Storm-Time
ENA	Energetic Neutral Atom
FEE	Front-End Equipment
FOV	Field of View
FTP	File Transfer Protocol
GMT	Greenwich Mean Time
GSE	Geocentric Solar Ecliptic Coordinate System
GSM	Geocentric Solar Magnetospheric Coordinate System
HK	Housekeeping
HV	High Voltage
IDL	Interactive Data Language
IMAGE	Imager for Magnetopause-to-Aurora Global Exploration
K-Index	Quasi-Logarithmic Local Index of the 3-hourly Range in Magnetic Activity
KP	Planetary 3-Hour Range K-Index
LAD	Lyman-alpha Detector
LANL	Los Alamos National Laboratory
LVPS	Low Voltage Power Supply
MAG	Magnetometer Instrument
MCP	MicroChannel Plate
MENA	Medium Energy Neutral Atom Imager
NASA	National Aeronautics and Space Administration
NGDC	National Geophysical Data Center
NSSDC	National Space Science Data Center
RTN	Radial Tangential Normal
S/C	Spacecraft
SWEPAM	Solar Wind Electron, Proton and Alpha Monitor
SwRI	Southwest Research Institute
TBC	To Be Calculated

TBD	To Be Determined
TBR	To Be Reviewed
TLM	Telemetry
TOF	Time of Flight
TSDS	TWINS Science Data System
TWA	TWINS Actuator
TWINS	Two Wide-angle Imaging Neutral-atom Spectrometers
UTC	Coordinated Universal Time
UV	Ultraviolet