PLASTIC
Level 1 Data Document

Lynn Kistler & Lorna Ellis
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Modification History

Version	Date	Modifications
A	Dec. 18, 2006	Original Version
B	Dec. 19, 2006	Removed esa_main, esa_s, esa_main_avg, esa_s_avg
C	Jan. 25, 2007	Fixed algorithms for alpha/proton distributions and moments distributions. Explained how deflection reversed on odd esa steps. Fixed typo in Appendix D.
D	March 8, 2007	Added explanation of using epoch5 even for 10-minute cadence. Added discussion of overflow for monitor rates and heavy ion data.
E	Oct. 22, 2007	Changed accumulation time for each defl step.
F	Nov. 8, 2007	Further clarified positions in alpha/proton reduced distribution.
G	Nov. 19, 2007	Explain deflection reversal in PHA.

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1. Overview of PLASTIC Instrument Operation

PLASTIC covers the full azimuthal range (ie. in the ecliptic plane) at all times, but needs to step through energies-per-charge and polar angles. The polar angle steps from +20 to – 20 degrees in 1.33 degree steps (32 steps). In normal mode, the ESA voltage is stepped in logarithmic increments in 128 steps. For each E/Q step, the ESA will sit at one voltage, while the deflector voltages sweep through their full set of values. Then the ESA voltage will continue to the next E/Q step in the cycle. Each deflection step takes 12.8 msec. The instrument sweeps across deflection steps first in one direction, and then in the opposite direction. Therefore, data is sent from the instrument to the DPU with deflection steps reversed on every odd ESA step. However, the DPU compensates for this reversal so that all science products including monitor rates (with the exception of the Memory Data – see section 3.5) arrive on the ground with the correct deflection steps. A full set of angles (32 steps, plus some overhead) takes 435.6 ms, and a full cycle will take 1 minute (128 ESA steps plus some overhead).

Because all solar wind ions flow with approximately the same speed, the E/q selection of the entrance system acts to separate solar wind ions by mass/q. Because the heavy ions are normally not fully ionized, their mass/q is normally larger than 2. Thus the heavy ions are observed at the higher E/q steps than H+, and to some extent, He++. Because there is a large difference in fluxes of H+, He++ and heavy ions, there are two entrance systems for the solar wind ions. One entrance has a large geometric factor, for the low abundance heavy ions, and one entrance has a small geometric factor for the H+ and possibly He++ ions. At the high E/q steps, when we are mainly measuring the heavy ions, we use the main, large geometric factor, aperture. At lower E/q steps, we need to switch to the "S-channel" ("small-aperture") low geometric factor aperture to measure the protons. The E/Q step at which to switch between the two entrance systems is determined by the DPU.

The PLASTIC instrument is functionally divided into two halves, one which has Solid State Detectors (SSD's) as well as MCP's, and one which just has MCP's. The length of the flight path is different for the two sides. There are two sets of time-of-flight electronics, one for each half.

2. Overview of CDF Files

All Level 1 data are stored in CDF (Common Data Format) files. See http://cdf.gsfc.nasa.gov/ for a description of CDF files, in general. Each day, for each spacecraft, we create four CDF files with the following filenames:

STx_L1_PLA_yyyymmdd_doy_Vzz.cdf
STx_L1_PLA_HK_yyyymmdd_doy_Vzz.cdf
STx_L1_PLA_SC_yyyymmdd_doy_Vzz.cdf
STx_L1_PLA_CL_yyyymmdd_doy_Vzz.cdf

In each filename, 'x' stands for 'A' or 'B' depending on the spacecraft; 'yyyymmdd' stands for the date; 'doy' stands for the three-digit day-of-year, and 'zz' gives the version number of the processing software. If you want easily to check if you have the most up-to-date files, you can look in the files 'processing_dates_' and 'sphk_processing_dates_' for each spacecraft. These files list the most recent processing date for the data from each day of year.

The first file, which begins 'STx_L1_PLA_', contains all our science data, including monitor rates, proton moments, proton/alpha distributions, heavy ion data, and pha events. The second file, which includes the 'HK' (housekeeping) abbreviation, contains the housekeeping data that comes from the instrument, including analog and digital housekeeping. The third file, which includes the 'SC' (spacecraft) abbreviation, contains the spacecraft housekeeping values that are pertinent for PLASTIC. The last file, which includes the 'CL' (classifier) abbreviation, contains memory dump information from the instrument. This includes reads of our classifier memory, as well as a continuous 'trickle-down' stream of data that reads all our memory and puts it in telemetry as space allows.

In each file, data records are linked to an 'epoch' variable that gives the time for each record in UTC. CDF epoch variables denote milliseconds since 01-Jan-0000 00:00:00.000. Specifics of the different epoch variables are listed below. Also, in each file, there are a 'level0_file' variable and a 'processing_date' variable which give the name of the level 0 file used to create this CDF, and the date on which this CDF was processed.

In the science CDF, there are also three variables used to indicate potentially bad data. This CDF contains three epoch variables: epoch1 for one-minute resolution data, epoch5_heavy for the heavy-ion data, and epoch5_mon for the science mode normal monitor rates (see below). For each of these variables, there is a corresponding error variable: error1, error5_heavy, error5_mon. If, for any record, the error variable has a value of 1, then the data in that record is suspect. Further analysis of the Level 0 data would be required to determine more details about why it is suspect.

3. Data Products

3.1 Housekeeping Data

3.1.1 Analog Housekeeping

Analog housekeeping in contained in apid 200 packets in our level 0 telemetry. It is stored in CDFs with the prefix STx_L1_PLA_HK_, where 'x' is either 'A' or 'B', depending on the spacecraft. The PLASTIC housekeeping data is collected and sent from the instrument to the DPU once per minute, at the end of a data cycle. Because apid 200 includes data from the IMPACT instrument as well as from PLASTIC, apid 200 packets may be sent more often than once per minute. However, the PLASTIC portion of the data comes on a one-minute cadence.

The level 1 data includes both the raw value, and a converted value, where applicable. All analog housekeeping products are tied to the epoch_analog product, which contains the time for each record. Data products are:

device_code
block_id

lrnm_spare_raw	lrnm_spare_eng
lvc_-12v_raw	lvc_-12v_eng
lvc_-5v_raw	lvc_-5v_eng
esa_vm_pos_raw	esa_vm_pos_eng
dfl_1_vm_raw	dfl_1_vm_eng
dfl_1_tap_raw	dfl_1_tap_eng
dfl_2_vm_raw	dfl_2_vm_eng
dfl_2_tap_raw	dfl_2_tap_eng
lvc_+2.5v_b_raw	lvc_+2.5v_b_eng
pac_cm_dc_raw	pac_cm_dc_eng
lvc_+12v_raw	lvc_+12v_eng
lrpm_spare_raw	lrpm_spare_eng
lvc_+2.5v_a_raw	lvc_+2.5v_a_eng
lvc_+5v_raw	lvc_+5v_eng
adc_avdd_raw	adc_avdd_eng
adc_dvdd_raw	adc_dvdd_eng
pac_vm_raw	pac_vm_eng
cal_vref_raw	cal_vref_eng
pac_cm_ac_raw	
mcp_vm_raw	mcp_vm_eng
mcp_cm_dc_raw	mcp_cm_dc_eng
mcp_cm_ac_raw	
ssd_cm_dc_raw	ssd_cm_dc_eng
s_ch_vm_raw	s_ch_vm_eng
s_ch_vm_tap_raw	s_ch_vm_tap_eng
s_ch_cm_dc_raw	s_ch_cm_dc_eng
esa_vm_neg_raw	esa_vm_neg_eng
esa_cm_dc_raw	esa_cm_dc_eng
dfl_1_cm_dc_raw	dfl_1_cm_dc_eng
dfl_2_cm_dc_raw	dfl_2_cm_dc_eng
lvc_+2.5v_b_imon_raw	lvc_+2.5v_b_imon_eng
lvc_+12v_imon_raw	lvc_+12v_imon_eng
lvc_-12v_imon_raw	lvc_-12v_imon_eng
lvc_+5v_imon_raw	lvc_+5v_imon_eng
lvc_-5v_imon_raw	lvc_-5v_imon_eng
lvc_+2.5v_a_imon_raw	lvc_+2.5v_a_imon_eng
ssd_vm_raw	ssd_vm_eng
plug_id_raw	
adc_lu_flag_raw	
dac_status_raw	

adc_lu_ctr_raw	
adc0_agnd_raw	adc0_agnd_eng
adc1_agnd_raw	adc1_agnd_eng
ra_e0_raw	ra_e0_eng
ra_e1_raw	ra_e1_eng
tac0_tsp_raw	tac0_tsp_eng
tac2_tsp_raw	tac2_tsp_eng
sb0_tsp_raw	sb0_tsp_eng
sb1_tsp_raw	sb1_tsp_eng
tof_hv0_tsp_raw	tof_hv0_tsp_eng
tof_hv1_tsp_raw	tof_hv1_tsp_eng
s_c_0_tsp_raw	s_c_0_tsp_eng
s_c_1_tsp_raw	s_c_1_tsp_eng
lvc0_tsp_raw	lvc0_tsp_eng
lvc1_tsp_raw	lvc1_tsp_eng
adc0_vref_raw	adc0_vref_eng
adc1_vref_raw	adc1_vref_eng
ssd_status_raw	
ssd_v_pos_analog_raw	ssd_v_pos_analog_eng
ssd_v_neg_analog_raw	ssd_v_neg_analog_eng
ssd_hv_bias_raw	ssd_hv_bias_eng
ssd_tc0_raw	ssd_tc0_eng
ssd_tc1_raw	ssd_tc1_eng
ssd_tc2_raw	ssd_tc2_eng
ssd_v_pos_dig_raw	ssd_v_pos_dig_eng

3.1.2 Digital Housekeeping

Digital housekeeping is contained in apid 313 packets in our level 0 telemetry. It is stored in CDFs with the prefix STx_L1_PLA_HK_, where ‘x’ is either ‘A’ or ‘B’, depending on the spacecraft. The PLASTIC housekeeping data is collected and sent down in telemetry once per minute, at the end of a data cycle. The level 1 data includes raw values only. All digital housekeeping products are tied to the epoch_digital product, which contains the time for each record. Data products are:

dpu_sw_version	lbc_reg_seq
cmd_rcvd_cnt	lbc_event_ctl
cmd_exec_cnt	lbc_rlim_ch
cmd_total_err_cnt	lbc_rlim_hi
cmd_parity_err_cnt	lbc_rlim_lo
cmd_frame_err_cnt	lbe_pos_ctrl
cmd_illegal_err_cnt	lbe_pos_disable0
ic_status_reg	lbe_pos_disable2
ic_ctl_reg	lbe_tac0_ctrl
lbc_reset_ctl	lbe_tac0_dac
lbc_mode_ctl	lbe_tac2_ctrl
lbc_logic_ctl_a	lbe_tac2_dac
lbc_logic_ctl_b	lbe_tac0_under_hi
lbc_tac_pwr_ctl	lbe_tac0_under_lo

lbe_tac0_over_hi
lbe_tac0_over_lo
lbe_tac2_under_hi
lbe_tac2_under_lo
lbe_tac2_over_hi
lbe_tac2_over_lo
lbe_ssd_ctrl
lbe_ssd_cmd_h
lbe_ssd_cmd_l
lbe_ssd_dis
lbe_ssd_under_hi
lbe_ssd_under_lo
lbe_ssd_over_hi
lbe_ssd_over_lo
lbe_sel_ctrl
lbe_trig_mode
lbe_esa_step
lbe_defl_step
lbe_ssd_offset0
lbe_ssd_offset1
lbe_ssd_offset2
lbe_ssd_offset3
lbe_ssd_offset4
lbe_ssd_offset5
lbe_ssd_offset6
lbe_ssd_offset7
lbe_stim_enable
lbe_stim_freq_hi
lbe_stim_freq_lo
lbe_sel0_window
lbe_sel2_window
lbe_ssd_offset8
lbe_ssd_offset9
lbe_ssd_offset10
lbe_ssd_offset11
lbe_ssd_offset12
lbe_ssd_offset13
lbe_ssd_offset14
lbe_ssd_offset15
lbe_pos_ra
dacm_pac_mcp_ssd_ctl_mcp_limit
dacm_pac_limit
dacm_esa_ctl
dacm_s_ch_ctl
dacm_dfl_1_ctl
dacm_dfl_2_ctl
dacm_control
dacm_status
dacm_adc_lu_ctr
dacm_dfl_1_offset
dacm_dfl_2_offset
dacm_pac_coarse
dacm_pac_fine
dacm_pac_cm_fs_coarse
dacm_pac_cm_fs_fine
dacm_mcp_coarse
dacm_mcp_fine
dacm_mcp_cm_fs_coarse
dacm_mcp_cm_fs_fine
dacm_ssd_coarse
dacm_ssd_fine
dacm_esa_coarse
dacm_esa_fine
dacm_s_ch_coarse
dacm_s_ch_fine
dacm_s_ch_tap_coarse
dacm_s_ch_tap_fine
dacm_dfl_1_coarse
dacm_dfl_1_fine
dacm_dfl_1_dfine
dacm_dfl_2_coarse
dacm_dfl_2_fine
dacm_dfl_2_dfine
dacr_pac_mcp_ssd_ctl_mcp_limit
dacr_pac_limit
dacr_esa_ctl
dacr_s_ch_ctl
dacr_dfl_1_ctl
dacr_dfl_2_ctl
dacr_control
dacr_status
dacr_adc_lu_ctr
dacr_dfl_1_offset
dacr_dfl_2_offset
dacr_c_pac_coarse
dacr_c_pac_fine
dacr_c_pac_cm_fs_coarse
dacr_c_pac_cm_fs_fine
dacr_c_mcp_coarse
dacr_c_mcp_fine
dacr_c_mcp_cm_fs_coarse
dacr_c_mcp_cm_fs_fine
dacr_c_ssd_coarse
dacr_c_ssd_fine
dacr_c_esa_coarse
dacr_c_esa_fine
dacr_c_s_ch_coarse
dacr_c_s_ch_fine

dacr_c_s_ch_tap_coarse
dacr_c_s_ch_tap_fine
dacr_dfl_1_coarse
dacr_dfl_1_fine
sw_status1
sw_hv_ramp_status
sw_hv_enable_status
sw_hv_limit_status
sw_eepromchksum
hkp_sampletime
pac_discharge_status
pac_discharge_cnt
pac_discharge_conseccntr
pac_discharge_safe_att
analog_limit_status
analog_lim_pt1_status
analog_lim_pt1_id
analog_lim_pt1_red
analog_lim_pt2_status
analog_lim_pt2_id
analog_lim_pt2_red
analog_lim_pt3_status
analog_lim_pt3_id
analog_lim_pt3_red
analog_lim_pt4_status
analog_lim_pt4_id
analog_lim_pt4_red
analog_lim_pt5_status
analog_lim_pt5_id
analog_lim_pt5_red
analog_lim_pt6_status
analog_lim_pt6_id
opmode
sw_mode
proton_mode
active_supplyid
supply_coarse_rb
dacr_dfl_1_dfine
dacr_dfl_2_coarse
dacr_dfl_2_fine
dacr_dfl_2_dfine
analog_lim_pt6_red
analog_lim_pt7_status
analog_lim_pt7_id
analog_lim_pt7_red
analog_lim_pt8_status
analog_lim_pt8_id
analog_lim_pt8_red
analog_lim_pt9_status
analog_lim_pt9_id
analog_lim_pt9_red
analog_lim_pt10_status
analog_lim_pt10_id
analog_lim_pt10_red
analog_lim_pt11_status
analog_lim_pt11_id
analog_lim_pt11_red
analog_lim_pt12_status
analog_lim_pt12_id
analog_lim_pt12_red
analog_lim_pt13_status
analog_lim_pt13_id
analog_lim_pt13_red
analog_lim_pt14_status
analog_lim_pt14_id
analog_lim_pt14_red
analog_lim_pt15_status
analog_lim_pt15_id
analog_lim_pt15_re
supply_fine_rb
swmaint_supplystat
swmaint_pac_coarse
swmaint_pac_fine

3.1.3 Spacecraft Housekeeping

Spacecraft housekeeping is contained in .csh (converted spacecraft housekeeping) files created by APL. It is stored in CDFs with the prefix STx_L1_PLA_SC_, where 'x' is either 'A' or 'B', depending on the spacecraft. The level 1 data includes converted values only; APL does the conversions. All spacecraft housekeeping products are tied to the epoch product, which contains the time for each record. Data products are:

pl_ebox_tmp
pl_inst_msg_pwr_dwn_req
pl_pwr_cur
pl_pwr_tt
pl_surv_pwr_cur
pl_surv_pwr_tt
pl_tof_tmp

3.2 Monitor Rate Data

The monitor rates data consists of the raw rates from individual 16-bit counters and from checks for logical coincidences in the instrument. There are 32 rates. The data from the instrument to the DPU contains the rate data, the E/Q step, and the deflection step information.

These are sent in a message to the DPU every deflection step (every 12.8 ms). From this, two types of data products are formed: "full resolution" rates and "normal" rates. In science mode, for one rate (selectable, but default is start rate, sf0) we keep full angle and time resolution for half the 128 energy steps (full resolution). The first step to use is commandable, and the product then uses the subsequent 63 steps (total of 64 steps). For the full set of rates (normal resolution) we create a data product which sums the rates in energy, angle and time to get a smaller set. This summed product is sent out once every 5 cycles. Each set of 4 adjacent energies, and 4 adjacent deflector angles is summed, and the product is accumulated for 5 cycles (5 minutes). In Engineering mode, the "normal" rates come out every minute, and five additional rates are put into the telemetry at full resolution.

In both modes, the data is compressed from 16 bits to 8 bits. The data in the CDF is uncompressed back to 16 bits. If the 16 bit counters overflow, the DPU sends down a compressed value of 'FF'x which decompresses to 507904. So, a value of 507904 in the CDF implies data overflow.

The 32 rates are:

SSD side	Non-SSD side
s_valid	w_no_pos
s_e_not_req	w_mult_pos
s_e_req	w_valid
s_no_pos	sf2
s_mult_pos	sfr2
s_no_e	stp2
s_mult_e	pos2_0
ra_sat_a	pos2_1
ra_sat_b	pos2_2
ra_sat_both	pos2_3
ssd_sw	pos3_0
ssd_st	pos3_1
sf0	pos3_2
sfr0	pos3_3
stp0	
ra_trig	
pos1_0	
pos1_1	

All monitor rates products are contained in our level 0 telemetry and are stored in CDFs with the prefix STx_L1_PLA_ where 'x' is either 'A' or 'B', depending on the spacecraft. Full resolution monitor rates are contained in apid 317 while normal resolution monitor rates (both science and engineering mode) are contained in apid 316.

3.2.1 Full Resolution Monitor Rates

The full resolution monitor rates are listed in the CDF by their name and the '_full' suffix. For example, there is a 's_valid_full' product. All the full-resolution monitor rates are tied to the 'epoch1' variable because they come out every minute. The time given is the start of cycle time. There will be a record for each minute in the day for which we received any science data. All records that do not contain valid data for any particular product will have the 'fill value' of -1. It does not matter whether we are in science or engineering mode; valid data is simply entered into the CDF of whichever products we receive at any given time.

Each record has the dimensions 128 x 32 which represent the 128 esa steps and the 32 deflection steps. The voltage values for the esa steps and the converted values for the deflection steps will be put in a calibration file (format and location TBD).

The full resolution monitor rates are tied to the following variables (i.e. the same record number will give you the appropriate data for any given value):

'epoch1'	gives time for record
'cycle1'	gives cycle number for record (for synchronization)
's_chan1'	gives the step on which the s-channel switched for this record (0 = didn't switch)
'error1'	if 1, there was a possible error with this cycle's data

3.2.2 Normal Resolution Mon. Rates: Science Mode

The normal resolution monitor rates that are taken in science mode are listed in the CDF by their names and the '_norm_science' suffix. For example, there is a 's_valid_norm_science' product. All the normal resolution monitor rates taken in science mode are tied to the 'epoch5_mon' variable, because they come out every five minutes. The time given is the start time of the first cycle. There are two epoch5 variables (epoch5_mon and epoch5_heavy) because the monitor rates and the heavy ions are not necessarily synchronized.

Each record has the dimensions 32 x 8 which represent the 32 groups of 4 summed esa steps and the 8 groups of 4 summed deflection steps. The summed esa steps and the converted values for the deflection steps will be put in a calibration file (format and location TBD).

The normal resolution monitor rates taken in science mode are tied to the following variables (i.e. the same record number will give you the appropriate data for any given value):

'epoch5_mon'	gives time for record – start of first cycle
'cycle5_mon'	gives cycle number for record (for synchronization)
's_chan5_mon'	gives the step on which the s-channel switched for this record (0 = didn't switch)
'error5_mon'	if 1, there was a possible error with this data

3.2.3 Normal Res. Mon. Rates: Engineering Mode

The normal resolution monitor rates that are taken in engineering mode are listed in the CDF by their names and the '_norm_eng' suffix. For example, there is a 's_valid_norm_eng' product. All the normal resolution monitor rates taken in engineering mode are tied to the 'epoch1' variable, because they come out every minute. The time given is the start of the cycle.

Each record has the dimensions 32 x 8 which represent the 32 groups of 4 summed esa steps and the 8 groups of 4 summed deflection steps. The summed esa steps and the converted values for the deflection steps will be put in a calibration file (format and location TBD).

The normal resolution monitor rates taken in engineering mode are tied to the following variables (i.e. the same record number will give you the appropriate data for any given value):

'epoch1'	gives time for record – start of cycle
'cycle1'	gives cycle number for record (for synchronization)
's_chan1'	gives the step on which the s-channel switched for this record (0 = didn't switch)
'error1'	if 1, there was a possible error with this cycle's data

3.3 Matrix Rate Data

The 16-bit accumulators from the classification board are sent to the DPU after every deflection cycle (435.6 ms). The contents of the accumulators are listed in table 3.

Table 3. Accumulated products on Classification board.

Name	Bin_dat type	Class bins	Pos. bins	Def. bins	Energy steps	# of sections	SECTION*	Total bins	bits/ item	Total Bytes
SW-all	Sw-all	1	32	32	1	1	0 or 1	1024	16	2048
SW-H (Doubles)	sw H alpha	1	32	32	1	1	0 or 1	1024	16	2048
SW- alpha (Doubles)	sw H alpha	1	32	32	1	1	0 or 1	1024	16	2048
SW_alpha (Triples)	sw H alpha	1	32	32	1	1	0 or 1	1024	16	2048
SW Z>2	sw Z>2	15	16	8	1	1	0 or 1	1920	16	3840
Wide-angle, Triples	Supra wide	15	8	1	1	1	2	120	16	240
Wide-angle, Double	Supra no E	7	8	1	1	2	2,3	112	16	224
SW_PHA_Priority_rates	SW Pha pri rates	4	1	32	1	1	0 or 1	128	16	256
WAP_PHA_Priority_rates	WAP Pha pri rates	2	1	1	1	2	2,3	4	16	8
PHA Data								512	48	3072
Total										15832
							*0-SW-main channel, 1-SW-S channel, 2-WAPwSSD 3-WAP_no_SSD			

3.3.1 Solar Wind Proton and Alpha Data

From the instrument, there are three arrays which contain the solar wind proton and alpha data. The first array (SW-all) contains the proton/alpha data together, with only angular binning. The second (SW-H/alpha-Doubles) contains data classified using the time-of flight: there is a 32-azimuthal bin x 32-polar bin array for each of the two species. The third (SW_alpha_Triples) contains the alpha data classified using the both time-of-flight and energy measurement. So that the DPU does not have to store a whole array of data, the telemetered reduced distribution functions and part of the moments are based on the peak from the previous cycle. The data is compressed from 16 bits to 8 bits. The data in the CDF is uncompressed back to 16 bits.

3.3.1.1 Proton Moments

By command, we can choose which array, SW_all or SW_H, is used for calculating proton moments. Default is SW_H. The moments are calculated using a commandable energy range. Default is steps 39-127 (step 39 is 15 keV). The moments calculation uses all odd position bins. For deflection, it uses deflection bins DP-3 to DP+4 where DP is the deflection peak from the previous cycle (i.e. the deflection bin in which the most counts were received).

Proton moments are contained in apid 325 packets in our level 0 telemetry. They are stored in CDFs with the prefix STx_L1_PLA_, where 'x' is either 'A' or 'B', depending on the spacecraft. The moments collected and sent down in telemetry once per minute, when we are in science or proton mode. The level 1 data includes raw values only. All moments products are tied to the epoch1 product, which contains the time for each record. The data is compressed to 16 bits. The data in the CDF is uncompressed.

The moments variables are:

'density_main'	density for main channel
'density_s'	density for s channel
'velocity_main'	3 element array: x,y,z
'velocity_s'	3 element array: x,y,z
'heat_flux_main'	3 element array: x,y,z
'heat_flux_s'	3 element array: x,y,z
'temperature_main'	6 element array: xx,xy,xz,yy,yz,zz
'temperature_s'	6 element array: xx,xy,xz,yy,yz,zz

The moments are tied to the following variables (i.e. the same record number will give you the appropriate data for any given value):

'epoch1'	gives time for record – start of cycle
'cycle1'	gives cycle number for record (for synchronization)
's_chan1'	gives the step on which the s-channel switched for this record (0 = didn't switch)
'moment_meta'	4 elements:[Emin, Emax, Schan conversion factor, Array (0:SW-All, 1:SW-H)]
'error1'	if 1, there was a possible error with this cycle's data

3.3.1.2 Proton/Alpha Reduced Distributions

There are four distribution functions total, from the 4 SW proton/alpha arrays. If the proton peaks are EP (peak energy step) and DP (peak deflection bin) and the alpha peaks are EA (peak energy step) and DA (peak deflection peak), then the min and max energies and deflection angles to use are given in the following table 4. In order to sample all position bins (except position 0 which holds error cases), the position distribution sums across 3 or 4 position steps. Thus, the position bin 0 holds position steps 1-3 (ignoring position step 0); position bin 1 holds position steps 4-7; position bin 2 holds position steps 8-11, etc. Note in the following, we are using the energy stepping sequence number, and the energies step from high energies to low energies. So the highest energy step would be EP=0, and the lowest energy step would be EP=128. Similarly EP+4 corresponds to a lower energy than EP, and EP-5 corresponds to a higher energy than EP.

Table 4. Bins to use to form the reduced proton and alpha distributions.

Source Array	Reduced Array	Class bin	E min	E max	E steps	POS min	POS max	POS summed	Pos bins	DEF min	DEF max	Def bins
SW-all	H_alpha	0	EP+4	EP-15	20	1	31	3,4	8	DP-3	DP+4	8
SW-H(Doubles)	H+ Peak	0	EP+4	EP-5	10	1	31	3,4	8	DP-3	DP+4	8
SW-alpha-(Doubles)	He++ Peak	1	EA+4	EA-5	10	1	31	3,4	8	DA-3	DA+4	8
SW_alpha (Triples)	He++ TCR	0	EA+4	EA-5	10	1	31	3,4	8	DA-3	DA+4	8

These products are contained in apid 324-7 packets in our level 0 telemetry. They are stored in CDFs with the prefix STx_L1_PLA_, where 'x' is either 'A' or 'B', depending on the spacecraft. They collected and sent down in telemetry once per minute, when we are in science. In proton mode, we receive two of the four (SW-H Doubles and SW_alpha Triples). The level 1 data includes raw values only. All these products are tied to the epoch1 product, which contains the time for each record. The data is compressed from 16 bits to 8 bits. The data in the CDF is uncompressed back to 16 bits.

The alpha/proton variables are:

'h_alpha' apid 324, SW-all array
4 dim array, 20 x 8 x 8
[EP+4:EP-15, SummedPos, DP-3:DP+4]

'h+peak' apid 325, SW-H Doubles
4 dim array, 10 x 8 x 8
[EP+4:EP-5, SummedPos, DP-3:DP+4]

'he++peak' apid 326, SW-alpha Doubles
4 dim array, 10 x 8 x 8
[EA+4:EA-5, SummedPos, DA-3:DA+4]

'he++tcr' apid 327, SW-alpha Triples
4 dim array, 10 x 8 x 8
[EA+4:EA-5, SummedPos, DA-3:DA+4]

The alpha/proton reduced distribution products are tied to the following variables (i.e. the same record number will give you the appropriate data for any given value):

'epoch1' gives time for record – start of cycle
'cycle1' gives cycle number for record (for synchronization)
's_chan1' gives the step on which the s-channel switched for this record (0 = didn't switch)
'proton_peak' 4 elements:[ESA, position, deflection, array (0=sw_all, 1=doubles)]
'alpha_peak' 4 elements:[ESA, position, deflection, array (0=doubles, 1=triples)]
'error1' if 1, there was a possible error with this cycle's data

3.3.2 Heavy Ion Data

The heavy ion data products are summed over several cycles as well as over some position and deflection bins. Table 5 gives the source arrays, and the summing that is done to create the final arrays. It is important to note that because the S-channel is switched based on real time count rate, the ESA step at which the S-channel switch occurs can be different between cycles which are summed together. In order to keep data clean, bins are only summed if the channel matches. That is, if the instrument was using the s-channel at esa step 82 on the first cycle, we only include step 82 of the following four cycles in the sum in they are also in the s-channel. In order to keep track of this, there are variables set up to indicate how many of the possible 5 (or 10, for Supra No E) cycles were summed at each esa step.

Table 5. Bins to be summed to form the heavy ion distributions.

Source Array	Classifier board array	Reduced Array	Sec.	Total Class bins	Summed Energy bins	Total Energy bins	Summed Pos. Bins	Total Pos. bins	Summed Def. Bins	Total Def. Bins	Summed Cycles	total bins
SW Z>2	SW Z>2	SW_Z>2 - H	0 and 1	2	1	128	2	8	1	8	5	16384
SW Z>2	SW Z>2	SW_Z>2 - L	0 and 1	13	1	128	2	8	8	1	5	13312
Wide-angle, Triples	Supra Wide	WAP-SSD_TCR	2	15	1	128	2	4	1	1	5	7680
Wide-angle, Double	Supra No E	WAP-SSD_DCR	2	7	1	128	2	4	1	1	5	3584
Wide-angle, Double	Supra No E	WAP-noSSD-DCR	3	7	1	128	1	8	1	1	10	7168
SW_PHA_ Priority_ rates	SW PHA Rates	SW_Priority_ rates	0 and 1	4	1	128	1	1	2	16	5	8192
WAP_PHA_ Priority_ rates	WAP PHA Rate	WAP_Priority-SSD	2	2	1	128	1	1	1	1	5	256
WAP_PHA_ Priority_ rates	WAP PHA Rate	WAP_Priority-no-SSD	3	2	1	128	1	1	1	1	5	256

The heavy ion products are contained in apid 319-323 packets in our level 0 telemetry. They are stored in CDFs with the prefix STx_L1_PLA_, where ‘x’ is either ‘A’ or ‘B’, depending on the spacecraft. They collected and sent down in telemetry once per five minutes, when we are in science mode. In proton mode, we receive three products (SW_Priority_rates, WAP_Priority_SSD, WAP_Priority_no_SSD). The level 1 data includes raw values only. All these products are tied to the epoch5_heavy product, which contains the time for each record. The data is compressed from 16 bits to 8 bits. The data in the CDF is uncompressed back to 16 bits. If there is data overflow from the 16 bit counters, the counters simply roll over, and the data is not tagged as overflow in any way.

The heavy ion variables are:

‘sw_z>2_h’	apids 31A and 31B 4 dim array, 128 x 8 x 8 x 2 [ESA, summed position, summed deflection, class]
‘sw_z>2_l’	apids 31C and 31D 3 dim array, 128 8 13 [ESA, summed position, class]

‘wap_ssd_tcr’	apid 31E, Wide-angle, Triples, Supra Wide 3 dim array, 128 x 4 x 5 [ESA, summed position, class]
‘wap_ssd_dcr’	apid 31F, Wide-angle, Doubles, Supra No E 3 dim array, 128 x 4 x 7 [ESA, summed position, class]
‘wap_no_ssd_dcr’	apid 320, Wide-angle, Doubles, Supra No E 3 dim array, 128 x 8 x 7 [ESA, summed position, class]
‘sw_priority’	apid 321, SW PHS rates 3 dim array, 128 x 16 x 4 [ESA, summed deflection, class]
‘wap_priority_ssd’	apid 322, WAP PHA rates 2 dim array, 128 x 2 [ESA, class]
‘wap_priority_no_ssd’	apid 323, WAP PHA rates 2 dim array 128 x 2 [ESA, class]

The heavy ion products are tied to the following variables (i.e. the same record number will give you the appropriate data for any given value):

‘epoch5_heavy’	gives time for record – start of first cycle. See note below about wap_no_ssd_dcr
‘cycle5_heavy’	gives cycle number for record (for synchronization)
‘s_chan5_heavy’	gives the step on which the s-channel switched for this record (0 = didn’t switch)
‘heavy_ion_num_summed5’	128 elem array for 5 min resolution products num packets summed for each esa step
‘heavy_ion_num_summed10’	128 elem array for wap_no_ssd_dcr num packets summed for each esa step
‘error5_heavy’	if 1, there was a possible error with this cycle’s data

Note: The wap_no_ssd_dcr product has a 10 minute cadence. It is tied to the epoch5_heavy variable because the epoch for the 10 minute cadence matches every-other value for the 5 minute cadence. The data within the CDFs for wap_no_ssd_dcr will generally have only fill-values in every other record.

3.4 Raw Event Data (PHA)

We collect a sample of raw events, which are used for high resolution science analysis, as well as instrument diagnostics. We want to maximize the number of minor ions collected, and also collect a selection of ions from the different sections of the instrument. Thus we have a prioritizing scheme for selecting the ions. The ions are tagged with their priority classification. This comes from the classification board. Then, a selection of these events is put into the telemetry.

On the classifier board, the data have already been sorted by priority. There are 6 priorities, 2 for the WAP section (WAP P0 and WAP P1) and 4 for the Solar Wind Section (SW P0, SW P1, SW P2, SW P3). The DPU is sent up to 512 PHA words for one energy step. These will be already divided as up to 32 WAP P0, 32 WAP P1, 64 SW P0, 64 SW P1 and 160 SW P2 and 160 SW P3. The DPU is responsible for down-selecting the data, but making sure we still emphasize the heavy ions in a full packet.
On average the DPU can send down 6 events per step. We handle the PHA data in sets of 2 E/Q steps. The DPU can send down 12 events every 2 steps. This data is divided into 6 priorities: 2 WAP priorities and 4 SW priorities. We specify, on average, how many of each priority we should collect every 2 steps, with the total adding up to 12. For example, the default is:

1 WAP P0 (H+ and He++)
1 WAP P1 (Heavies)
1 SW P0 (H+)
1 SW P1 (He++)
4 SW P2 (heavies)
4 SW P3 (heavies)

The DPU has a buffers of size 768*48 bits = 36864 bits. It is filled from the front with "primary" events – ie those specified above. The extra space is used to store extra "high priority" events on a first-come basis. In order to get events from all esa steps, the DPU alternates between starting a cycle on esa step 0 and starting on esa step 1.

PHA data are contained in apid 315 packets in our level 0 telemetry. They are stored in CDFs with the prefix STx_L1_PLA_, where 'x' is either 'A' or 'B', depending on the spacecraft. PHA data are collected throughout a cycle and sent down in telemetry once per minute, when we are in science or proton mode. The PHA data are tied to the epoch1 product, which contains the time for each record.

It is important to note that the PHA data are kept in the form they are in when they come out of the classifier board. This means that the deflection value given is based on the time when it arrives at the classifier board. Therefore, to get the physical deflection step during odd esa steps (when the deflectors are retracing), one must subtract the deflection given in the PHA data from 31. So, deflection step 0 on even ESA steps is the same as deflection step 31 on odd ESA steps. For all other products, the level 1 data corrects for this reversal, but the PHA is kept in its rawest form.

The PHA variables are:

'pha'	2 dim array, 768 x 9 1st dim is which event out of possible 768 then – [ESA, Defl, Quadrant, WhichSSD, SSD energy, TOF, Pos in Q, Instr Portion, Priority]
'pha_start_esa'	for each cycle, where pha collection started
'pha_missing'	error field, each bit represents a missing packet (out of 18 packets)

PHA data are tied to the following variables (i.e. the same record number will give you the appropriate data for any given value):

'epoch1'	gives time for record – start of cycle
'cycle1'	gives cycle number for record (for synchronization)
's_chan1'	gives the step on which the s-channel switched for this record (0 = didn't switch)
'error1'	if 1, there was a possible error with this cycle's data

3.5 Memory Data

All memory data products are simple readings of the instrument memory without processing by the DPU (beyond adding headers). Because the instrument sweeps deflection first in one direction and then in the opposite direction any sequence of deflection steps in the memory data is reversed on odd esa steps.

3.5.1 Classifier Data

When 'Proton Mode' is specified, by default, the DPU collects the following data from the classifier memory:

ESA step 0-63 BlockIds 0-7 every 5 cycles.

This data is sent down in compressed form in apid 328. In addition, we can change these parameters. We can specify:

a. The first ESA step to collect
b. The number of ESA steps to collect within the period
c. For each ESA step, the first BlockId to collect
d. For each ESA step, the number of successive blocks to collect
e. The number of cycles to skip between collection periods
f. Whether the data is sent compressed (apid 328) or uncompressed (apid 329)

Classifier data are contained in apids 328 and 329 packets in our level 0 telemetry. They are stored in CDFs with the prefix STx_L1_PLA_CL_, where 'x' is either 'A' or 'B', depending on the spacecraft. Classifier data are tied to the epoch_classifier product, which contains the time for each record.

The classifier memory variables are:

'epoch_classifier'	gives time for record
'block_id_classifier'	gives block number for data
'esa_step'	gives esa step; if 8^{th} bit set, in S-channel
'classifier_data'	128 element array of data

3.5.2 'Trickle-Down' Memory Data

As space in telemetry allows, we receive a continual 'trickle-down' of the contents of memory. These data are contained in apid 318 in our level 0 telemetry. They are stored in CDFs with the prefix STx_L1_PLA_CL_, where 'x' is either 'A' or 'B', depending on the spacecraft. Classifier data are tied to the epoch_memory product, which contains the time for each record.

The trickle-down memory variables are:

'epoch_memory'	gives time for record
'device'	device code – see Logic Referecnce document for details
'block_id_memory'	block id
'memory_data'	256 element array of data

Appendix A: Apids with PLASTIC Data

200	Analog Housekeeping (also includes IMPACT data)
313	Digital Housekeeping
315	PHA Data
316	Normal Monitor Rates
317	Full Resolution Monitor Rates
318	'Trickle-Down' Memory Dump
319	Meta-data for Heavy Ions (number of packets summed)
31A	SW Z>2 – High: Class 0
31B	SW Z>2 – High: Class 1
31C	SW Z>2 – Low: Classes 2-9
31D	SW Z>2 – Low: Classes 10-14
31E	WAP-SSD-TCR
31F	WAP-SSD-DCR
320	WAP-noSSD-DCR
321	SW Priority Rates
322	WAP Priority SSD
323	WAP Priority no-SSD
324	SW-All H-Alpha Reduced Distribution
325	SW-H(Doubles) H+Peak Reduced Distribution & Proton Moments
326	SW-Alpha(Doubles) He++ Peak Reduced Distribution
327	SW-Alpha(Triples) He++ TCR Reduced Distribution
328	Compressed Classifier Data (Proton Mode)
329	Uncompressed Classifier Data (Proton Mode)
370	Beacon Data (not in Level 0 or Level 1)

Appendix B: Compression Algorithms

Compression from 16 bits to 8 bits:

Input Count Range, N, decimal	Input Count Range, N, Hex	Output Code
0 - 31	0 - 1Fh	N
32 - 63	20h - 3Fh	20h+(N-20h)/2
63 - 127	40h - 7Fh	30h+(N-40h)/4
128 - 255	80h - FFh	40h+(N-80h)/8
256 - 511	100h - 1FFh	50h+(N-100h)/10h
512 - 1,023	200h - 3FFh	60h+(N-200h)/20h
1,024 - 2,047	400h - 7FFh	70h+(N-400h)/40h
2,048 - 4,095	800h - FFFh	80h+(N-800h)/80h
4,096 - 8,191	1000h - 1FFFh	90h+(N-1000h)/100h
8,192 - 16,383	2000h - 3FFFh	A0h+(N-2000h)/200h
16,384 - 32,767	4000h - 7FFFh	B0h+(N-4000h)/400h
32,768 - 65,535	8000H - FFFFh	C0h+(N-8000h)/800h
65,536 - 131,071	10000h - 1FFFFh	D0h+(N-10000h)/1000h
131,072 - 262,143	20000h - 3FFFFh	E0h+(N-20000h)/2000h
262,144 - 524,287	40000h - 7FFFFh	F0h+(N-40000h)/4000h
> 524,287	> 7FFFFh	FFh

STEREO Moment Compression

Data has 1 sign bit, 6 exponent bits, and 9 mintissa bits:

MSB LSB

S E E E E E E M M M M M M M M M

A compressed value of zero represents a zero data value.

Otherwise Value = (-1)^S * (512+M) * 2^(E-10)

Appendix C: Analog Housekeeping Products

Abbreviation	Name/Description	Sample Value	Units
'lrnm_spare',	spare monitor channel (negative)		
'lvc_-12v',	low voltage converter -12 V	-12.27	Volts
'lvc_-5v',	low voltage converter -5 V	-4.88	Volts
'esa_vm_pos',	Electrostatic Analyzer Positive Voltage Monitor	35.65	Volts
'dfl_1_vm',	Deflection 1 Voltage Monitor	15.45	Volts
'dfl_1_tap',	Deflection 1 Tap	17.39	Volts
'dfl_2_vm',	Deflection 2 Voltage Monitor	17.21	Volts
'dfl_2_tap',	Deflection 2 Tap	17.74	Volts
'lvc_+2.5v_b',	low voltage converter +2.5 V b	2.43	Volts
'pac_cm_dc',	Post-Acceleration Voltage DC Current Monitor	19.79	mA
'lvc_+12v',	low voltage converter +12 V	12.18	Volts
'lrpm_spare',	spare monitor channel (positive)	0	Volts
'lvc_+2.5v_a',	low voltage converter +2.5 V a	2.43	Volts
'lvc_+5v',	low voltage converter +5 V	4.97	Volts
'adc_avdd',	Analog to Digital Converter Voltage (Analog)	5.07	Volts
'adc_dvdd',	Analog to Digital Converter Voltage (Digital)	5.07	Volts
'pac_vm',	Post-Acceleration Voltage Monitor	-144404.26	Volts
'cal_vref',	Calibration Refernce Voltage	5	Volts
'pac_cm_ac',	Post-Acceleration AC Current Monitor -- not in use		
'mcp_vm',	Micro-channel Plate Voltage Monitor	2333.72	Volts
'mcp_cm_dc',	Micro-channel Plate DC Current Monitor	36.71	mA
'mcp_cm_ac',	Micro-channel Plate AC Current Monitor -- not in use		
'ssd_cm_dc',	Solid State Detector DC Current Monitor	143.8	mA
's_ch_vm',	S-Channel Voltage Monitor	-4.49	Volts
's_ch_vm_tap',	S-Channel Voltage Monitor Tap	1.7	Volts
's_ch_cm_dc',	S-Channel DC Current Monitor	3.64	mA
'esa_vm_neg',	Electrostatic Analyzer Negative Voltage Monitor	-14.94	Volts
'esa_cm_dc',	Electrostatic Analyzer DC Current Monitor	3.96	mA
'dfl_1_cm_dc',	Deflection 1 DC Current Monitor	3.18	mA
'dfl_2_cm_dc',	Deflection 2 DC Current Monitor	3.34	mA
'lvc_+2.5v_b_imon	low voltage converter +2.5 V b Current Monitor	300.63	mA
'lvc_+12v_imon',	low voltage converter +12 V Current Monitor	377.51	mA
'lvc_-12v_imon',	low voltage converter -12 V Current Monitor	64.63	mA
'lvc_+5v_imon',	low voltage converter +5 V Current Monitor	219.98	mA
'lvc_-5v_imon',	low voltage converter -5 V Current Monitor	88.67	mA
'lvc_+2.5v_a_imon	low voltage converter +2.5 V a Current Monitor	287.59	mA
'ssd_vm',	Solid State Detector Voltage Monitor -- conversion factor is incorrect	66.8	V
'adc_lu_flag',	DAC Boards Analog to Digital Converter latchup flag	0	
'plug_id',	high voltage limit plug (none-- fully enabled)	FullEnable	

'adc_lu_ctr',	DAC Boards Analog to Digital Converter latchup counter		0	
'dac_status',	DAC Boards Status		0	
'adc0_agnd',	Analog to Digital Converter 0 Analog Ground			
'adc1_agnd',	Analog to Digital Converter 1 Analog Ground			
'ra_e0',	Resistive Anode Charge Amplifier Output 0			
'ra_e1',	Resistive Anode Charge Amplifier Output 1			
'tac0_tsp',	Time Amplitude Converter 0 temperature		11.75	deg C
'tac2_tsp',	Time Amplitude Converter 2 temperature		15.11	deg C
'sb0_tsp',	Signal Board 0 temperature -- not in use	none		
'sb1_tsp',	Signal Board 1 temperature -- not in use	none		
'tof_hv0_tsp',	Time-of-Flight High Voltage 0 temperature		8.4	deg C
'tof_hv1_tsp',	Time-of-Flight High Voltage 1 temperature		10.08	deg C
's_c_0_tsp',	Space-Craft/Instrument Case temperature 0		-3.35	deg C
's_c_1_tsp',	Space-Craft/Instrument Case temperature 1		5.04	deg C
'lvc0_tsp',	low voltage converter 0 temperature		3.36	deg C
'lvc1_tsp',	low voltage converter 1 temperature		6.72	deg C
'adc0_vref',	Analog to Digital Converter 0 reference voltage		1.33	Volts
'adc1_vref',	Analog to Digital Converter 1 reference voltage		1.33	Volts
'ssd_status',	Solid State Detector Status			
'ssd_v_pos_analog	Solid State Detector Positive Voltage (Analog)		6.7	Volts
'ssd_v_neg_analog	Solid State Detector Negative Voltage (Analog)		-6.76	Volts
'ssd_hv_bias',	Solid State Detector High Voltage Bias		98.91	Volts
'ssd_tc0',	Solid State Detector 0 Temperature		6.26	deg C
'ssd_tc1',	Solid State Detector 1 Temperature		6.26	deg C
'ssd_tc2',	Solid State Detector 2 Temperature		5.49	deg C
'ssd_v_pos_dig'	Solid State Detector Positive Voltage (Digital)		5.68	Volts

Appendix D: Classification Bins

Note: In each category, row 0 overwrites row1 overwrites row2, etc
Note: -1 value means bin all; -2 means bin 0

Rate Name	Class	M/Q_low	M/Q_high	Mass_low	Mass_high	Species
Pha_pri_rates						
SSD	0	0.5	1.3	-2	3	H+
	1	1.3	3	-2	8	He++
	2	1.5	10	8	95	Heavies
	3	-1	-1	-1	-1	The rest
Pha_pri_rates						
Non-SSD	0	0.5	3	-2	-2	H+, He++
	3	-1	-1	-1	-1	Heavies & The Rest
Supra_no_E						
SSD	0	0.5	0.8	-2	-2	<H+
	1	0.8	1.5	-2	-2	H+
	2	1.5	2.2	-2	-2	He++
	3	2.2	3	-2	-2	O+6/O+7
	4	3	10	-2	-2	He+, Fe
	5	10	25	-2	-2	O+
	6	25	30	-2	-2	Overflow
	7	-1	-1	-1	-1	The Rest - Thrown away
Supra_no_E						
Non-SSD	0	0.5	0.8	-2	-2	<H+
	1	0.8	1.5	-2	-2	H+
	2	1.5	2.2	-2	-2	He++
	3	2.2	3	-2	-2	O+6/O+7
	4	3	10	-2	-2	He+, Fe
	5	10	25	-2	-2	O+
	6	25	60	-2	-2	Molecules
	7	-1	-1	-1	-1	The Rest - Thrown away
Supra_wide (triples)						
SSD	0	0.8	1.3	0.5	2	H+
	1	1.7	2.5	1.5	8	He++
	2	1.7	2.2	8	20	C+6,O+8
	3	2.2	3	10	20	O+6,O+7
	4	3	4.5	10	20	O+4,O+5
	5	2.2	2.7	20	40	Mg,Si
	6	2.7	3.7	20	40	Mg,Si
	7	3.7	5	20	40	Mg,Si
	8	3	4.2	40	95	Fe+17,Fe+14
	9	4.2	5.8	40	95	Fe+13,Fe+10
	10	5.8	9	40	95	Fe+9,Fe+7
	11	9	15	40	95	Fe<7
	12	3.5	5	2	8	He+
	13	1.3	1.7	2	5	3He
	14	0.5	30	0.5	95	The rest
	15	-1	-1	-1	-1	The Rest - Thrown away
Supra_wide						

Non-SSD	15	-1	-1	-1	-1	All is not binned
SW Z>2						
SSD	0	2.2	3	-2	-2	O+6/O+7 Doubles
	1	3	5	-2	-2	He+, O+4 Doubles
	2	1.7	2.2	8	20	C+6,O+8
	3	2.2	3	10	20	O+6,O+7
	4	3	4.5	10	20	O+4,O+5
	5	2.2	2.7	20	40	Mg,Si
	6	2.7	3.7	20	40	Mg,Si
	7	3.7	5	20	40	Mg,Si
	8	3	4.2	40	95	Fe+17,Fe+14
	9	4.2	5.8	40	95	Fe+13,Fe+10
	10	5.8	9	40	95	Fe+9,Fe+7
	11	9	15	40	95	Fe<7
	12	3.5	5	2	8	He+
	13	5	14	-2	-2	Fe Doubles
	14	14	30	-2	-2	O+ Doubles
	15	-1	-1	-1	-1	The Rest - Thrown away
SW Z>2						
Non-SSD	15	-1	-1	-1	-1	All is not binned
Sw all						
SSD	0	-1	-1	-1	-1	(bins even invalid TOF)
Sw all						
Non-SSD	1	-1	-1	-1	-1	(do not bin)
SW_H_alpha						
SSD	0	0.5	1.3	-2	3	H+ doubles & triples
	1	1.3	3	-2	-2	He++ doubles
	2	1.3	3	1.5	8	He++ triples
	3	-1	-1	-1	-1	The Rest - Thrown away
SW_H_alpha						
Non-SSD	3	-1	-1	-1	-1	All is not binned