User's Guide for PLASTIC Proton/Alpha Reduced Distributions and Heavy Ion Data

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1. Description (modified from Level1Data.doc)

1.1 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 1. 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. These products are contained in apid 324-7 packets in our level 0 telemetry.

The events in the SW-all array have to be valid events, but there is no other classification. They use the peak to determine where the protons are, and then include 20 energy steps, so that it includes both the proton peak and the alpha peak. The other arrays are subsets of this array.

Table 1. 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

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\

1.2 Heavy Ion Data

The heavy ion data products are summed over several cycles as well as over some position and deflection bins. Table 2 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. The heavy ion products are contained in apid 319-323 packets in our level 0 telemetry.

Table 2. 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 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 15 [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, 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)
‘num_summed….’	128 elem array, 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. Similarly, during times of reduced telemetry, the number of cycles for many products were increased. The first entry in the num_summed…. variable will give the number of minutes that were successfully summed.

2 Accessing Raw Data

2.1 Ascii Files

Daily ascii files can be found internally in daily zip files on oahu in /data2/Ascii/Level1/X/YYYY, where X is ‘A’ or ‘B’ and YYYY is the year, or at https://stereo-ssc.nascom.nasa.gov/data/ins_data/plastic/level1/ASCII/. After unzipping the file for a day you want, for proton/alpha reduced distribution data, you would look for the files that begin Apid324_, Apid325_, Apid326_ and Apid327. For heavy ion data, you would look for the files that begin Apid31A_B_, Apid31C_D_, Apid31E, Apid31F_, Apid320_, Apid321_, Apid322_ and Apid323.

Two Notes about opening these files with Excel. 1) The most recent version of Excel will not open files that don't have a suffix. Therefore, I've had to change the names of ascii files that I want to open so that they end in .txt. This has not been a problem with older versions of Excel. 2) Excel does not deal well with times that include microseconds. To see the proper time of day, highlight the time column, choose "Format -> Cells -> Custom" and type in hh:mm:ss.000.

2.2 CDF Files

Daily CDF files can be found internally on bali in /data1/Spacecraft_A/Level1/CDFs/YYYY (or /data2/Spacecraft_B…), or at https://stereo-ssc.nascom.nasa.gov/data/ins_data/plastic/level1/.

2.3 SPLAT

2.3.1 Proton/Alpha Reduced Distributions

To get the data into IDL arrays, use the following functions.

a. First set your time interval. Eg: IDL> timespan,'2012-01-01',4, /days

b. Next call one of the following fuctions:

```
h_alpha_data = get_pla_h1_alpha('A',/set_to_beg,/from_full)
h1_peak_data = get_pla_h1_peak('A',/set_to_beg,/from_full)
he2_peak_data = get_pla_he2_peak('A',/set_to_beg,/from_full)
he2_tcr_data = get_pla_he2_tcr('A',/set_to_beg,/from_full)
```

Each of these function returns an IDL data structure. To see the elements of the structure, you can type, eg, IDL>print, tag_names(h_alpha_data).

The /set_to_beg flag makes it so that the time given is the beginning of the one-minute interval in question. The /from_full keyword sets the data into the full defl, pos, esa space (eg [time, 32, 8, 129] in addition to the [time,8,8,10] space.

The elements of the structure that I think are most likely to be helpful are .data and .full_array. These contain the same data, but in differently sized arrays. The .data array is in the form it comes from the instrument. That is, in the reduced arrays, such as [time, DP-3:DP+4, summed POS, EP+5:EP-5]. The .full_array array puts this same data into a larger array, taking into account the deflection peak and energy peak that were used. The size for the .full_array is [time, 32 deflection bins, 8 summed pos bins, 128 energy bins].

2.3.2 Heavy Ions

To get the data into IDL arrays, use the following functions.

a. First set your time interval. Eg: IDL> timespan,'2012-01-01',4, /days

b. Next call one of the following functions:

```
sw_z2_h_data = get_pla_sw_z2_h('A',class,/set_to_beg)
sw_z2_l_data = get_pla_sw_z2_l('A',class,/set_to_beg)
wap_ssd_tcr_data = get_pla_wap_ssd_tcr('A',class,/set_to_beg)
wap_ssd_dcr_data = get_pla_wap_ssd_dcr('A',class,/set_to_beg)
wap_nossd_dcr_data = get_pla_wap_no_ssd_dcr('A',class,/set_to_beg)
sw_pri_data = get_pla_sw_priority('A',class,/set_to_beg)
wap_pri_ssd_data = get_pla_wap_priority_ssd('A',class,/set_to_beg)
wap_pri_nossd_data = get_pla_wap_priority_no_ssd('A',class,/set_to_beg)
```

Each of these function returns an IDL data structure. To see the elements of the structure, you can type, eg, IDL>print, tag_names(h_alpha_data).

The /set_to_beg flag makes it so that the time given is the beginning of the one-minute interval in question. The /from_full keyword sets the data into the full defl, pos, esa space (eg [time, 32, 8, 129] in addition to the [time,8,8,10] space.

To see the data for each product, look at the .data element (eg, sw_pri_data.data). Their dimensions are as follows. Note, however, that that these functions require you to specify one class. If you want more than one class, you would need to call the function more than once.:

sw_z2_h	[time, 8, 8, 128]	[time, summed defl, summed pos, ESA]
sw_z2_l	[time, 8, 128]	[time, summed pos, ESA]
wap_ssd_tcr	[time, 4, 128]	[time, summed pos, ESA]
wap_ssd_dcr	[time, 4, 128]	[time, summed pos, ESA]
wap_nossd_dcr	[time, 8, 128]	[time, pos, ESA]
sw_priority	[time, 128]	[time, ESA]
wap_priority_ssd	[time, 128]	[time, ESA]
wap_priority_nossd	[time, 128]	[time, ESA]

3 Displaying Data

For any of these cribs, first edit the crib file, then run in splat using the '@' sign. Eg. IDL>@pla_def_spec_crib. Note, your splat.sh file should have the SPLAT_USER path set to wherever you are editing the cribs.

3.1 Deflection Spectrograms

Use pla_def_spec_crib. Can be used with proton/alpha reduced distributions, and with sw_z2_h, sw_z2_l, and sw_priority products in the heavy ions. Cannot be used with wap products as they do not include deflection information.

3.2 Position Spectrograms

Use pla_pos_spec_crib. Can be used with proton/alpha reduced distributions, and with sw_z2_h, sw_z2_l, wap_ssd_tcr, wap_ssd_dcr, and wap_nossd_dcr products in the heavy ions. Cannot be used with priority products as they do not include position information.

3.3 Energy Spectrograms

Use pla_en_spec_crib. Can be used with all proton/alpha reduced distribution and heavy ion product.

3.4 Energy Line Plots

Use pla_en_spec_line_crib. Can be used with all proton/alpha reduced distribution and heavy ion product.