Solar Wind Around Pluto
SWAP

PRINCIPAL INVESTIGATOR
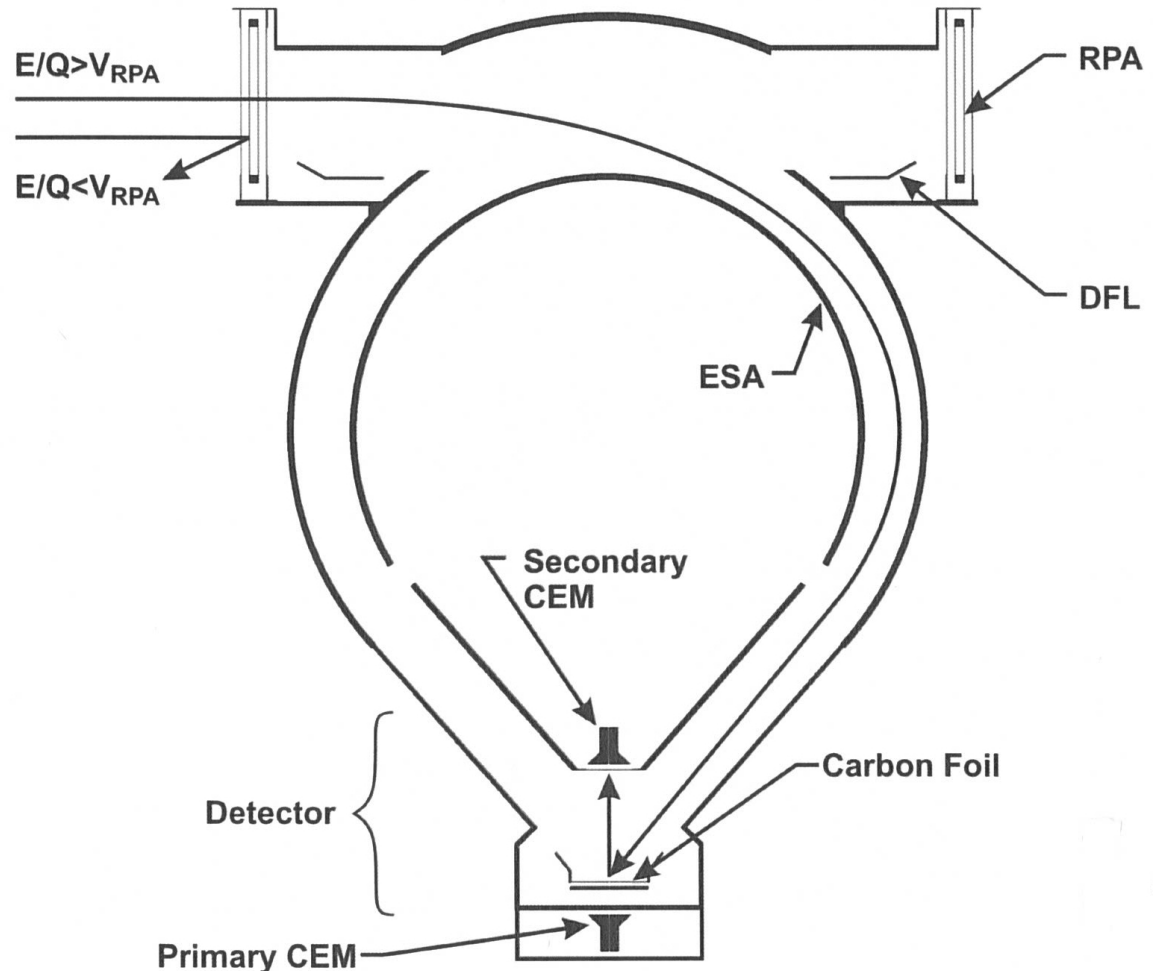Dave McComas, Princeton University

DESCRIPTION
Low Energy Plasma Instrument

ENERGY RANGE
30 eV - 7.7 keV

FIELD OF VIEW
270 deg x 10 deg
(deflection angles up to +15 deg)

ENERGY RESOLUTION
1 eV (< 2 keV); 9% (> 2 keV)

SPECIES
All Ions

New Horizons SWAP Data Sets Delta Review

RAW Data Sets:
nh-j-swap-2-jupiter-v4.0
nh-x-swap-2-plutocruise-v3.0
nh-p-swap-2-pluto-v2.0

CALIBRATED Data Sets:
nh-j-swap-3-jupiter-v4.0
nh-x-swap-3-plutocruise-v3.0
nh-p-swap-3-pluto-v2.0

New Horizons SWAP
Data Set Evaluation Tools

Staging and Evaluation -
    Machine: Dell Precision T3400
    Operating System: Fedora 18 linux

Data Processing -
    Machine: Sun Ultra-350
    Operating System: Sun Solaris OS 5.9

Minor Diagnostics -
    Machine: IBM lenovo T60p ThinkPad
    Operating System: Fedora 25 linux

Explanation of Review Categories

Accepted – The PI Response to the SWAP Lean was accepted by the reviewer as an adequate resolution of the lean.

Accepted and Verified – The reviewer accepts the PI Response as an adequate resolution of the lean and has verified the PI Response was implemented.

Recommendation – Resolution of the lean generated additional issues or did not complete solve the issue cited in the delta review. The statement is the suggestion of the reviewer which will resolve the lean and allow closure of the item.

Not Verified – The reviewer did not evaluate and/or confirm that the PI Resolved this issue due to a reviewer issue. The reviewer considers that this lean remains open for additional response by other reviewers.

Order of Slides

The slide order is configured to match the order of liens shown if the PDS liens_team_response.txt Data file. Some of the liens in this file are general and do not seem to apply to the SWAP data set. This review identified and addressed those leans which were specific to the SWAP data. The following slides are findings of the reviewer.

Accepted
L2 data set contains L3 sample data plots

Unresolved lien from May 2016 review: L2 data set contains L3 sample data plots. Please remove and add sample plots of the L2 data. Plots look the same (same panels, units) but I have found examples where the L2 summary plot contains more data then the L3 plot for the same day (swap_001day_201501132359.png).

PI Response: No-change. The P1 lien requested that the sampleswapplots directory be removed, not data_summary_plots. This change has been implemented in all new datasets.

Not Verified
document directory png file list

Emily notes there is a problem in the document directory in that a label that lists PNG files does not list the same number of files as actually found in the directory. (Already in "notes" [?] with other comments.)\
PI Response: See 73. Fixed.

Recommendation
directory: 'document/data_summary_plots'

--> Multiple summary plots are generated in the data set. But some are black. Is this No Data or Plot Failure?
PI Response: Fixed. Made a note in the label file and swap.cat that this is expected behavior.

Words are fine and explain empty science data summary plots, but not the following two data plots which show no data:
SWAPdelta/nh-p-swap-2-pluto v2.0/document/
data_summary_plots/swap_001day_201507042359.png
SWAPdelta/nh-p-swap-2-pluto-v2.0/document/
data_summary_plots/swap_001day_201507052359.png

Recommendation – Remove these two data files.

Accepted and Verified
file: 'calib/background_009_dac.lbl'

--> typo near #4: 'backgroun' => 'background'\
PI Response: Fixed

Accepted and Verified
file: 'calib/background_009_dac_jup.lbl'

--> typo near #4: 'backgroun' => 'background'\
PI Response: Fixed

Accepted and Verified
file: 'calib/calinfo.txt'

--> typo: remove the '19' from ''spacecraft throughout the
     mission.19''
PI Response: Fixed

Accepted and Verified
file: 'nh-p-swap-*-pluto-v2.0/catalog/dataset.cat'

--> Delete the text "to the" from the line that starts "to the data will be delivered"
PI Response: Fixed

Accepted
files: 'data/*/*0x584_sci'

--> For extension 14 (SPICE Orbit Attitude Calc), the PDS label column
names/descriptions and fits headers describe calculations for Jupiter
instead of Pluto. Is this correct?
PI Response: This is correct for now. We will be updating the column
names and values in the extension for Pluto as part of P3.

--> There may be a discrepancy between the FITS header size
PI Response: This issue overlaps the prior one, for P3?

--> In the EXTENSION_SUMMARY_TABLE column descriptions, the
text "RALPH" or "RALPH_HK" is mentioned several times instead of
"SWAP". Verify that this is correct for this instrument.
PI Response: Noted that this is correct - RALPH and SWAP share a
housekeeping packet. However, the label files have also been
updated to refer to SWAP instead of RALPH.

0x586 Data Recommendation files: 'data/*/*0x586_sci.fit'

--> The histogram data consists of two linear arrays. In the Primary HDU is stored the number of number of times a sample was accumulated at each index of the histogram. Stored in the Histogram HDU is the sum of the counts for each index. Thus, there should be 0 counts stored in the histogram at each location where there is no samples made. The fits file ('swa_0283651232_0x586_sci.fit'), shows an example where there are accumulated counts in the histogram, but no samples made.
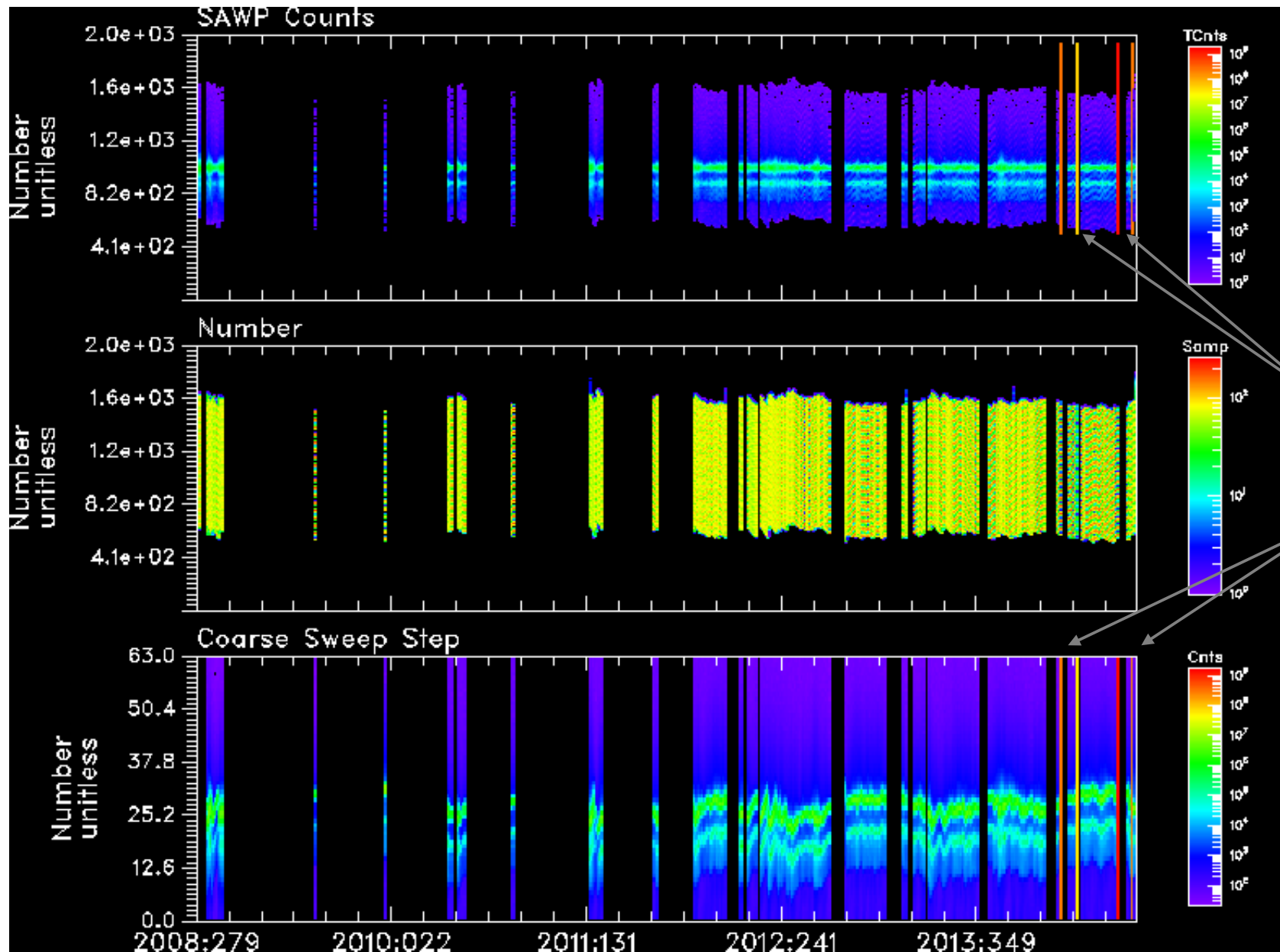PI Response: Updated swap.cat

See next 6 slides

0x586 Histogram Data

The new information in the swap.cat file describing the Histogram data format is adequate to understand the Histogram data. However, the processed 0x586 data shows an issue. This is described in the next 5 slides.

In **future** releases, I would recommend that the discussion on the contents of the Histogram be migrated into the SWAP portion of the ICD since this is the document describes the 0x586 file format. However, this format is adequate for this delta review.
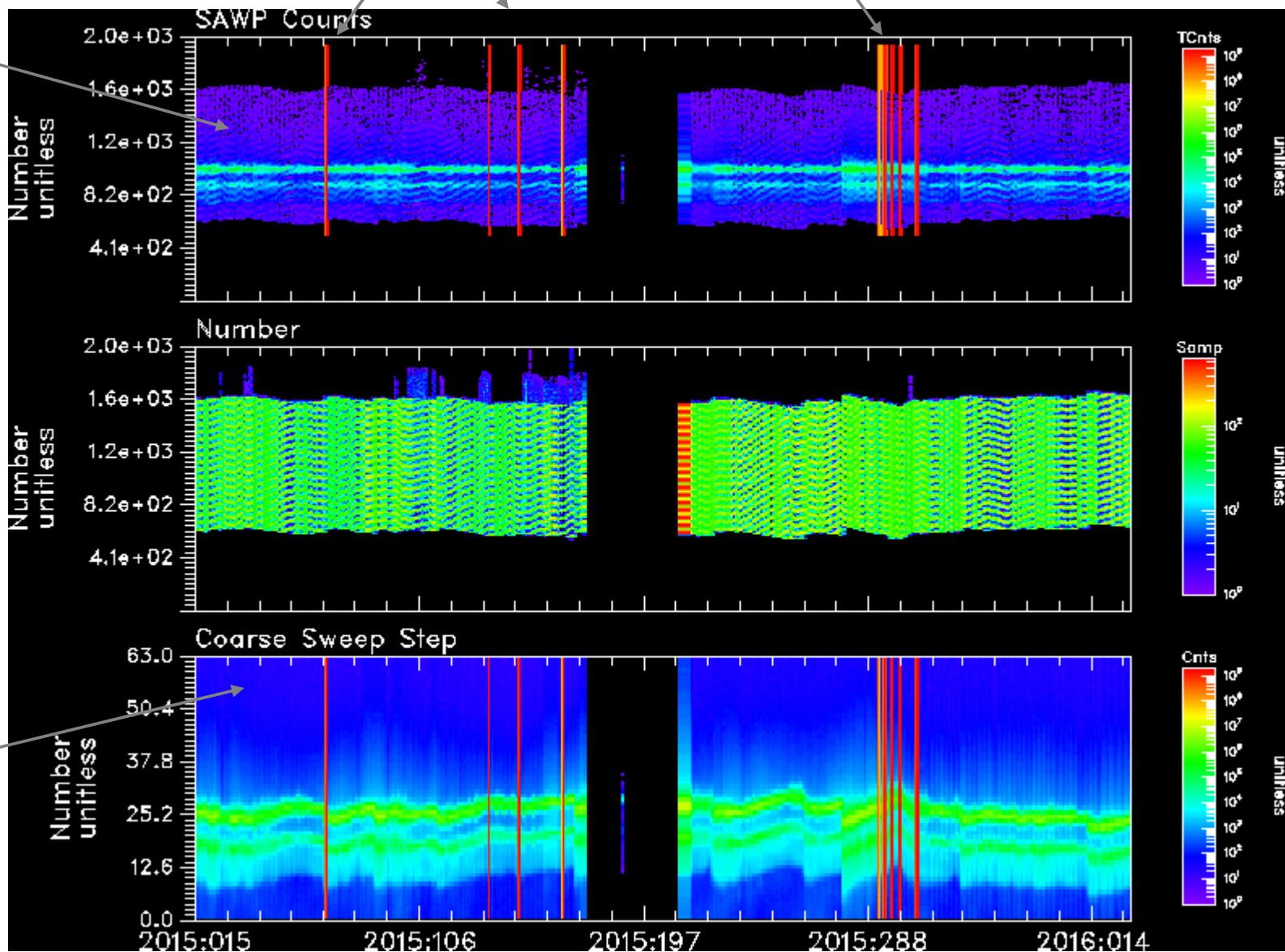
Examination of Entire
nh-x-swap-3-plutocruise-v3.0

High-Value
Does Not
Seem Correct

Examination of Entire
nh-p-swap-3-pluto-v2.0

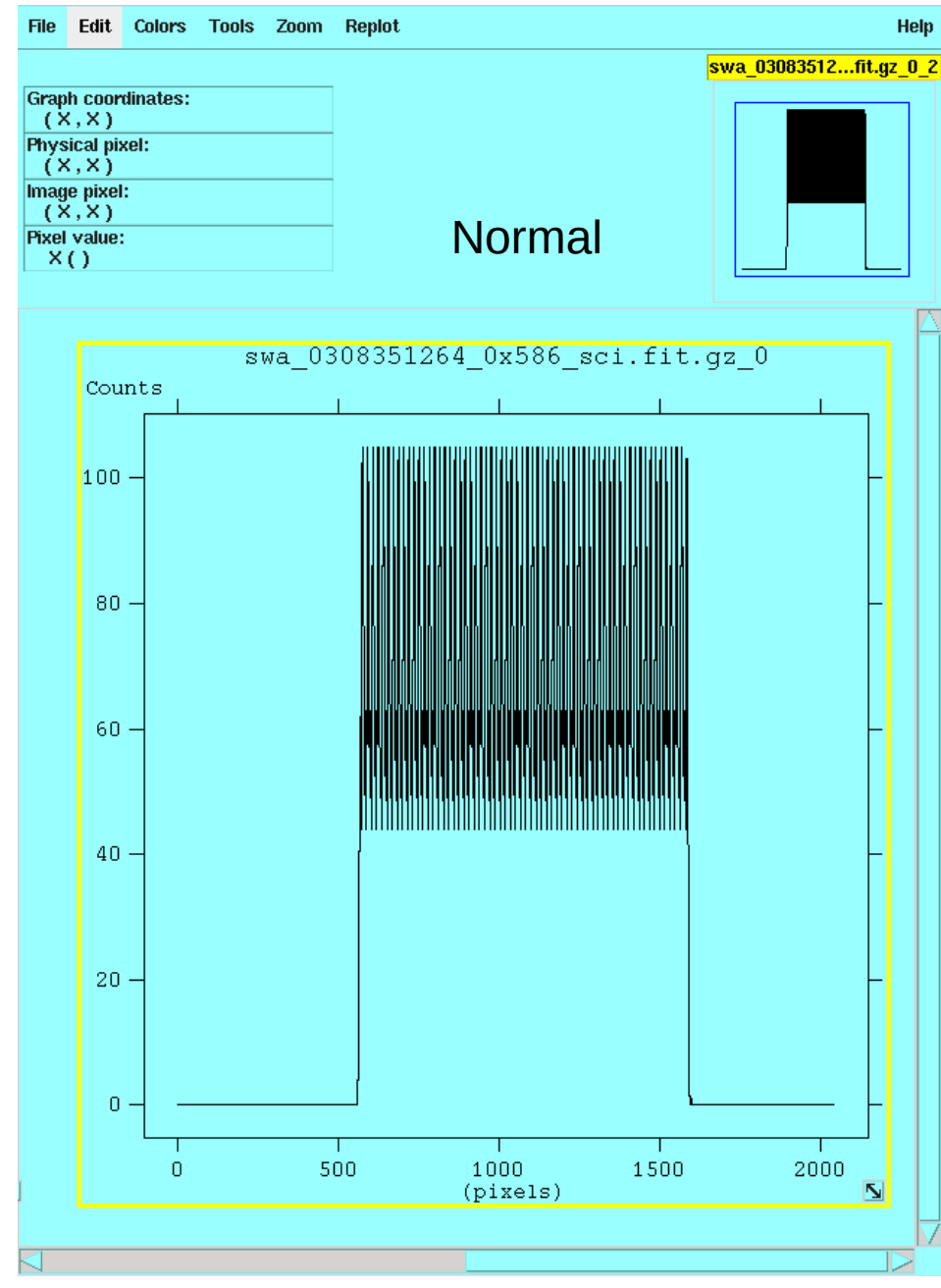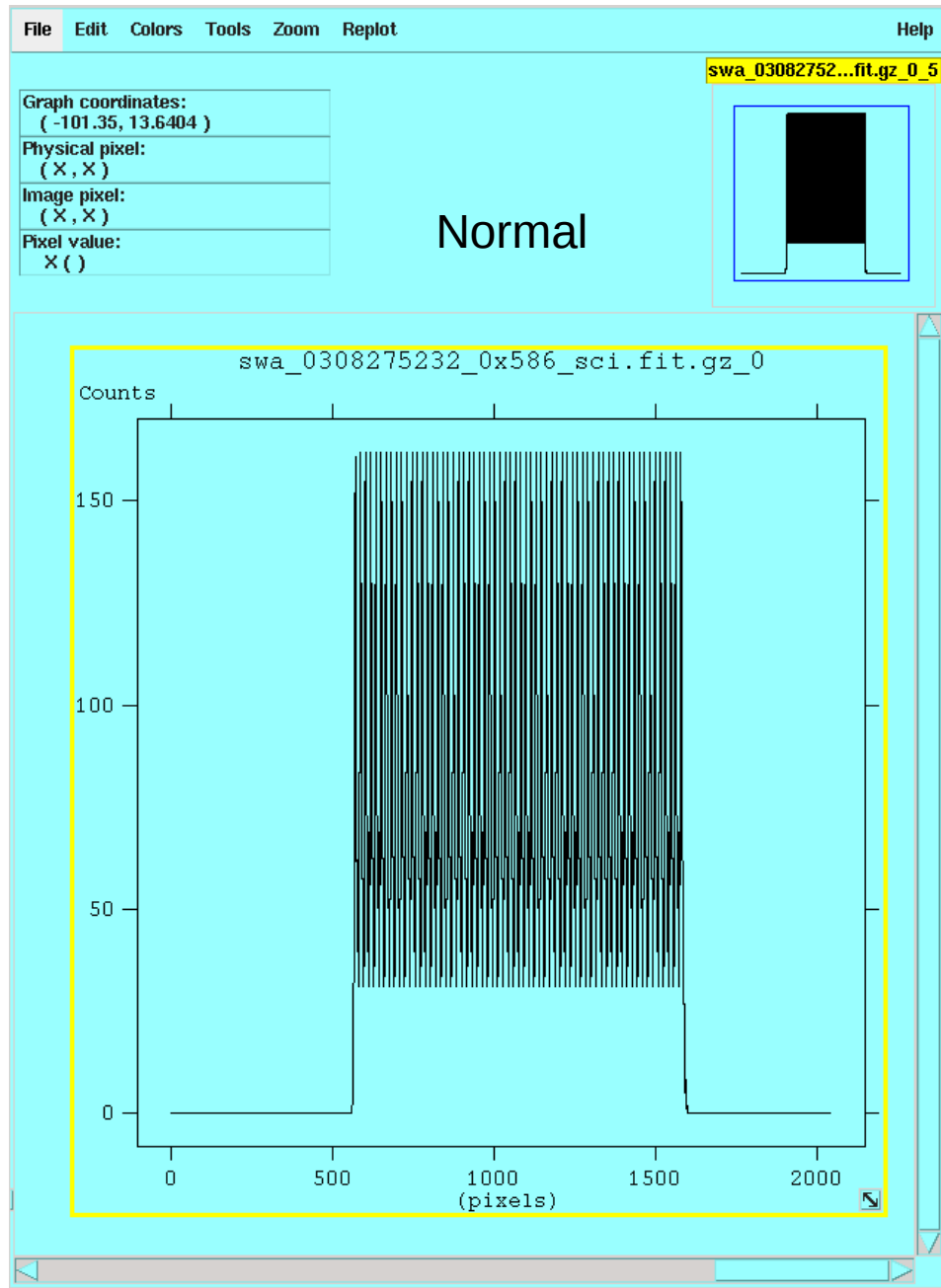More High-values Observed

Normal Data

Number Histogram
Seems Unaffected
(Primary HDU)

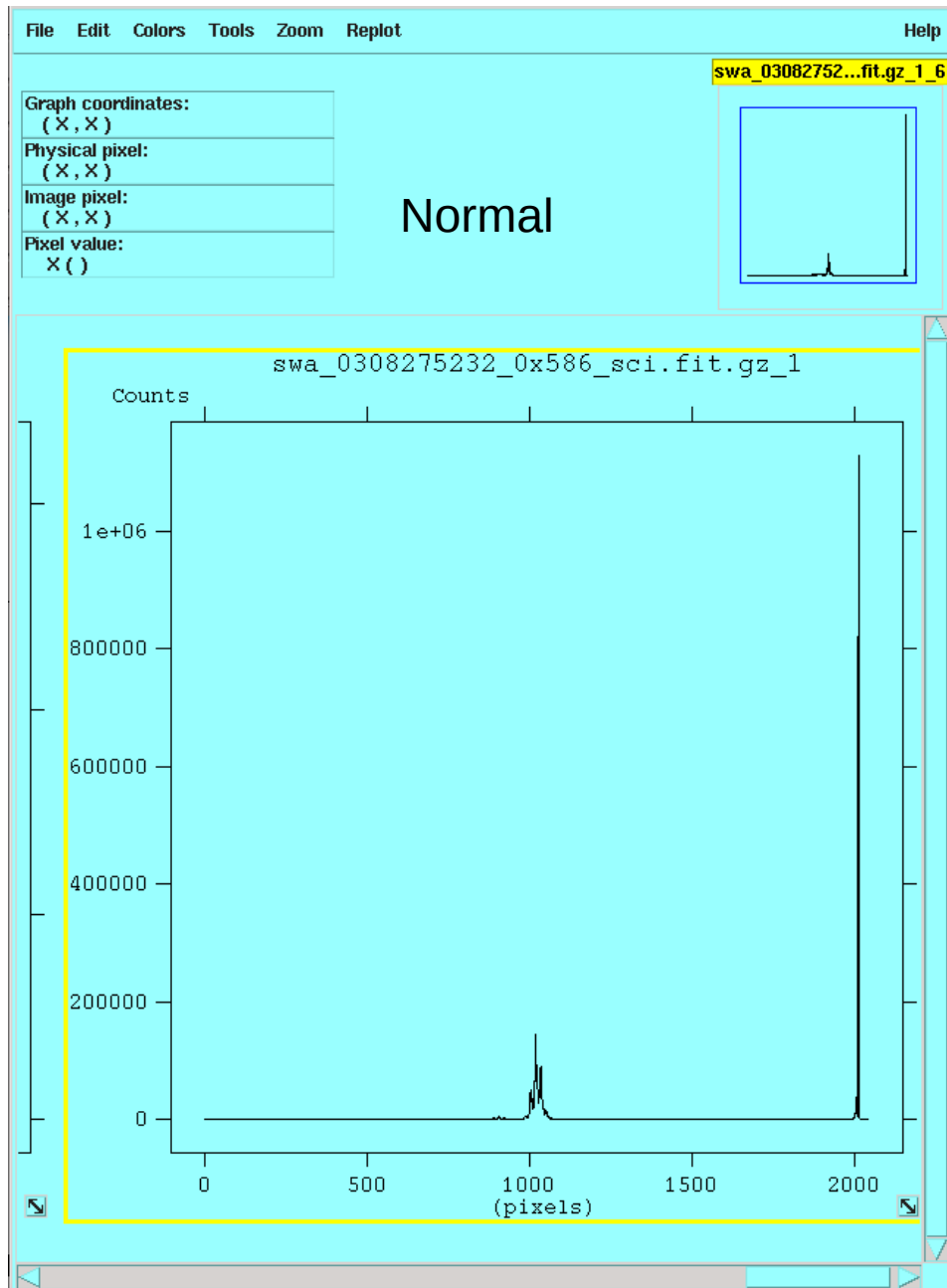Normal Data

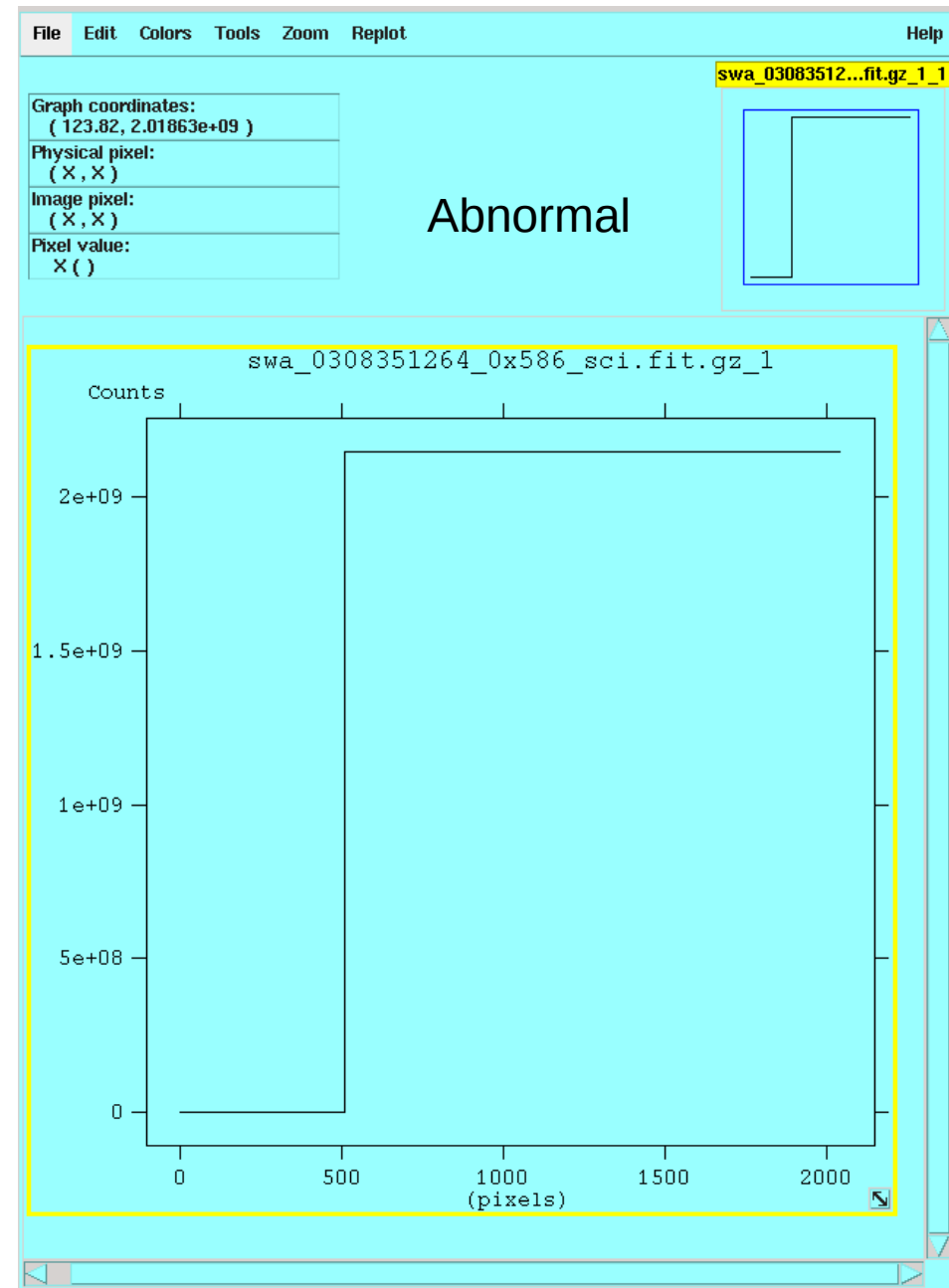# Examination of Primary Fit Extension

Before

During

Examination of Histogram Fit Extension

Before

During

0x586 Data Recommendation

There are limited bad FITs data files in the 0x586 data set; however, the amount is not exorbitant. There could be many reasons why these files show unreasonable values for the Histogram and the investigators should review the 0x586 data to determine the source and fix the issue if at all possible. The issue does not influence the rest of the data which is a scientifically valid product. Thus, I would recommend removing these bad data files from the archive and then releasing these data to the public.

Accepted
file: 'document/swap_cal.pdf'

--> pg 1, par 1: add comma: "geometric factor, the energy"
--> pg 9, #6 par 1: typo: "the the"
PI Response: This file will be updated with the updated
    Calibrations for the P3 delivery

Accepted
0x586 Improved Description

73.nh-x-swap-2-plutocruise-v3.0/data/20081005_008555/swa_0085550432_0x586_eng.lbl & others
74.nh-x-swap-3-plutocruise-v3.0/data/20081005_008555/swa_0085550432_0x586_sci.lbl & others
75.nh-p-swap-2-pluto-v2.0/data/20150115_028359/swa_0283599968_0x586_eng.lbl & others
76.nh-p-swap-3-pluto-v2.0/data/20150115_028359/swa_0283599968_0x586_sci.lbl & others
71.nh-j-swap-2-jupiter-v4.0/document/samples/*.lbl
72.nh-j-swap-3-jupiter-v4.0/document/samples/*.lbl
-> Can you make this value more descriptive: AXIS_NAME = AXIS_1
PI Response: Deferred to P3. Note that AXIS_NAME is an optional field. We will
   ask the SWAP team for a more meaningful value, and the ICD does describe
   these fields too.

Accepted
Reduced Descriptions

71.nh-j-swap-2-jupiter-v4.0/document/data_summary_plots/swap_*_datasumm.lbl
72.nh-j-swap-3-jupiter-v4.0/document/data_summary_plots/swap_*_datasumm.lbl
73.nh-x-swap-2-plutocruise-v3.0/document/data_summary_plots/swap_*_datasumm.lbl
74.nh-x-swap-3-plutocruise-v3.0/document/data_summary_plots/swap_*_datasumm.lbl
75.nh-p-swap-2-pluto-v2.0/document/data_summary_plots/swap_*_datasumm.lbl
76.nh-p-swap-3-pluto-v2.0/document/data_summary_plots/swap_*_datasumm.lbl

-> Suggestion: each pair has one of
 DOCUMENT_TOPIC_TYPE = "SWAP JUPITER ENCOUNTER SOLAR WIND SUMMARY DATA PLOTS"
 DOCUMENT_TOPIC_TYPE = "SWAP PLUTO CRUISE SOLAR WIND SUMMARY DATA PLOTS"
 DOCUMENT_TOPIC_TYPE = "SWAP PLUTO ENCOUNTER SOLAR WIND SUMMARY DATA PLOTS"

Perhaps replace them all with
 DOCUMENT_TOPIC_TYPE = "SWAP SOLAR WIND SUMMARY DATA PLOTS"

Leaving it is fine as well.

PI Response: Leaving these alone for now.

Not Verified
Pointer Issues

71.nh-j-swap-2-jupiter-v4.0/document/data_summary_plots/swap_jupiter_datasumm.lbl
- Same problem with ^PNG_DOCUMENT as 73.nh-x-swap-2-plutocruise-v3.0
PI Response: Fixed

72.nh-j-swap-3-jupiter-v4.0/document/.../
- Same problem with ^PNG_DOCUMENT as 73.nh-x-swap-2-plutocruise-v3.0
PI Response: Fixed

- Same problem with ^ASCII_DOCUMENT as 76.nh-p-swap-3-pluto-v2.0
PI Response: Fixed

Accepted
Reduced Descriptions

73.nh-x-swap-2-plutocruise-v3.0/data/.../*.lbl
-> Does this matter? START_TIME's day of year sometimes does not match the
     directory's day of year. This is a grep -r of START_TIME
  20081005_008555/swa_0085552032_0x586_eng.lbl: START_TIME = 2008-10-05T22:35:14.620
  20081005_008555/swa_0085552160_0x586_eng.lbl: START_TIME = 2008-10-05T22:37:22.620
  20081006_008553/swa_0085536000_0x584_eng.lbl: START_TIME = 2008-10-05T22:02:42.620
  20081006_008553/swa_0085536000_0x585_eng.lbl: START_TIME = 2008-10-05T18:08:02.620
PI Response: No-change. These directory names are OK. They correspond to the
     STOP_TIME values in products which span more than one day.

Accepted
No Equivalent Calibrated Files

- Does this matter? Many raw files have no equivalent calibrated files:

  20081005_008555/swa_0085552032_0x586_sci.lbl:START_TIME = 2008-10-05T22:35:14.620
  20081005_008555/swa_0085552160_0x586_sci.lbl:START_TIME = 2008-10-05T22:37:22.620
  20081006_008553/swa_0085536000_0x584_sci.lbl:START_TIME = 2008-10-05T22:02:42.620

The SWAP Pluto data is similar.

PI Response: No-change? Checked all 1932 raw products and could not find any without a corresponding calibrated product.

Not Verified
More Pointer Issues

73.nh-x-swap-2-plutocruise-v3.0/document/data_summary_plots/swap_plutocruise_datasumm.lbl
-> ^PNG_DOCUMENT points to 1028 files, but that directory has 1134 .png files. The
    extra files have slightly different names (no minutes in the filename). The listed files:
  swap_001day_200805272359.png ... swap_001day_201408172359.png
  swap_010day_200805192359.png ... swap_010day_201408162359.png
The unlisted files:
  swap_001day_2008052723.png ... swap_001day_2010111523.png
  swap_010day_2008051923.png ... swap_010day_2010111523.png
PI Response: Fixed

74.nh-x-swap-3-plutocruise-v3.0/document/...
- Same problem with ^PNG_DOCUMENT as 73.nh-x-swap-2-plutocruise-v3.0
PI Response: Fixed

- Same problem with ^ASCII_DOCUMENT as 76.nh-p-swap-3-pluto-v2.0
PI Response: Fixed

76.nh-p-swap-3-pluto-v2.0/document/sampleswapplots/swapplots.lbl
- ^ASCII_DOCUMENT = ("00README.ASC", ...)
should be
  ^ASCII_DOCUMENT = \{ "00README.ASC", ... \}
PI Response: Fixed

Accepted and Verified
file: 'aareadme.txt'

--> Boiler Plate commands to pipeline not deleted:
   "skel_DELETE_BETWEEN_IF_INSTRUMENT_IS_rex"
SDC Response: Corrected

Review Note: also contains updated contact information

Accepted and Verified
file: 'catalog/dataset.cat'

--> Remember to update the 'Review" section in DATA_SET_DESC from
    TBD.
PI Response: Updated for all except REX and PEPSSI since they
    haven't been reviewed yet.
--> Several ABSTRACT_DESC are lacking or may be incomplete as
    compared to the rest of the data sets. Ex: ALICE/PEPSSI/SDC PC
    and LORRI launch/jupiter/PC
PI response: Some have been updated.

(note - additional spelling also corrected.)

Accepted and Verified
file: 'catalog/nh.cat'

--> It is stated twice that the "spacecraft closest approaches were 13,678 kilometers ..." (also in mission phase section), but SPICE as currently available at NAIF gives 13,674 km. Note the 13,678 vs 13,674.
PI Response: Fixed

--> "Mission phases and sub-phases in data products" uses sub-phases that are not defined "ACO#" "AP#" "DP#"
PI Response: Fixed

--> Under the Summary section, the 'Trajectory' description second line is not aligned with the first line.
PI Response: Fixed

Accepted and Verified
file: 'catalog/nhsc.cat'

--> I prefer for wavelength ranges of instruments to be provided
   rather than just the general "visible" and "infrared" description.
PI Response: Fixed

--> Incomplete sentence: "Operational requirements for catalyst
   bed heater ..." stops with "bed heater".
PI Response: Fixed

Accepted and Verified
file: 'catalog/ref.cat'

--> Remove ITAR documents.
PI Response: Fixed

--> Note that not all data sets have the most current copy of this
    file.
SDC Response: Fixed, current copy.

Accepted and Verified
file: 'document/aareadme_bu.txt'

--> Boiler Plate commands to pipeline not deleted:
    "skel_DELETE_BETWEEN_IF_INSTRUMENT_IS_rex"
PI Response: Fixed

Review Note: also updated contact information

Accepted and Verified
file: 'document/docinfo.txt' - 1 of 2

--> The quote/ditto (use of ") is a minor issue, but seems to have confused at least a few reviewers.
PI Response: Fixed

--> line 51:   3) SOC Instrument Interface Control Document (aka the 'ICD') => 1) and 2) provide the file name, it would be best to use the file name when possible. In this case: soc_inst_icd.pdf. Same applies for reference 4) on line 76. This lien was for LEISA, but apply almost across the board.
SDC Response: Fixed - removed numbers

--> typo: "backgound" => "background" near entry for "LUNINEETAL1995.PDF"
PI response: SDC: Fixed

Recommendation
file: 'document/docinfo.txt' – 2 of 2

Descriptions are more complete; however an extra line was found. The SWAPdelta/nh-j-swap-2-jupiter-v4.0/document/docinfo.txt and the SWAPdelta/nh-j-swap-3-jupiter-v4.0/document/docinfo.txt has:

```
    +->NH_MISSION_TRAJECTORY.LBL   Label for mission trajectory;
    |                         please read the label for more detail
```

but an extra line is found in SWAPdelta/nh-x-swap-2-plutocruise-v3.0/document/docinfo.txt, SWAPdelta/nh-x-swap-3-plutocruise-v3.0/document/docinfo.txt, SWAPdelta/nh-p-swap-2-pluto-v2.0/document/docinfo.txt, and SWAPdelta/nh-p-swap-3-pluto-v2.0/document/docinfo.txt
so that the text reads:

```
    +->NH_MISSION_TRAJECTORY.LBL   Label for mission trajectory;
    |                         please read the label for more detail
    |                         please read the label for more detail
```

Recommendation – Remove Extra Line Before Release.

Accepted and Verified
file: 'document/nh_mission_trajectory.lbl'

--> typo: "quantitities" => "quantities"
--> typo: "intrument" => "instrument"
PI Response: Both Fixed

Accepted and Verified
file: 'document/nh_trajectory.tab'

--> nh_mission_trajectory.tab contains the trajectory of the whole mission, nh_trajectory.tab covers the first half of 2007 (Jupiter phase). Suggest to remove the latter. Mentioned as MVIC lien, but may apply for most other data sets.

PI Response: Removed nh_trajectory.tab (removed in Pluto and Pluto Cruise data sets)

Accepted and Verified

--> pg 134, 14.1, par 2: Sentence starts with "shows a cross section".

--> pg 135, 14-2: Caption correction (**changes**): "Diagram of New Horizons spacecraft **highlighting the location of the** SWAP instrument on the left. On the right **is a ** diagram of the SWAP ..."

--> pg 136, 14.3: The summary data (0x585) from SWAP needs to be describe what product levels will exist and where. Currently there is level 2 and expected to be level 4, but no level 3 data.

--> pg 136, 14.3 par 1: Suggest rewriting this section (**change**): "Housekeeping, messages, **summary,** and memory dump provide engineering data and the other *two* modes contain science data. ... For **[delete science]** summary and science histogram modes, ...". The last change happens twice in this paragraph.

--> pg 137, 14.3 par 3, last sentence: change "are not" -> "is" and add more details (**changes**): "The summary data 0x585 packet **is** included in the PDS SWAP data sets**; however, they are delivered as a level 2 product only. It was found that the solar wind speed, density, and temperature provided in the summary packet were not adequate for science studies of the solar wind. These values will be included in the PDS data set for SWAP as a Level 4 data product**."

--> --> May want to make this change present tense since the products are expected to be reviewed shortly.

--> pg 140, 14.4.2 (**suggested changes**): "Summary packets are **[delete 'no longer']** included in the SWAP PDS delivered data sets**; however, they are delivered as a level 2 product only**."

--> pg 144, 14.5.4 par 1: combine second and third sentences: 'for the rates. The errors and include an error' => 'for the rates, and an error'

--> pg 145, 14.5.7 par 1: Add **text** to sentence as shown: "In the tail **of the Jupiter encounter,** the spacecraft is spinning so we ..."

--> pg 148, 14-10: In the caption, remove second 'of' from the sentence: "Two minutes of data set **of** measurements ..."

--> pg 153, 14-12: In the caption, remove the words 'in the' from the second sentence: "The y-axis **is in** the energy per charge."

--> pg 155, 14.9: Change underscore to whitespace: '(CEM)_detector' => '(CEM) detector'

Accepted and Verified
file: 'document/soc_inst_icd.pdf' – 3 of 4

PI Response: Fixed all of the issues with the ICD document. For the SWAP section of the ICD (Section 14), specific responses include:

Section 14.1: added missing reference to SWAP Figure 14-1.

Figure 14-2 caption: enhanced SWAP instrument description per reviewer liens.

Section 14.3: rearranged SWAP summary data description in 1st paragraph.

Section 14.3: rearranged SWAP summary data description in 3rd paragraph.

Section 14.4.2: rearranged SWAP summary data description.

Section 14.5.4: combined 2nd and 3rd sentences.

Section 14.5.4: replaced SWAP equation images with Libre Math formulas.

Section 14.5.7: added "of the Jupiter encounter".

Accepted and Verified
file: 'document/soc_inst_icd.pdf' – 4 of 4

Figure 14-10 caption: of data set of measurements => of data set measurements.

Figures 14-11 and 14-12 captions: y-axis is in the => y-axis is the.

Section 14.9: (CEM)_detector => (CEM) detector.

Additional Comment on 0x585 Data

The Summary data (0x585) giving bulk solar wind parameters was removed from being a scientifically valid product almost a year ago. These data files described the bulk solar wind and were to be replaced by a scientifically valid product which was generated by a more appropriate analysis technique. This technique fit the solar wind data to extract the solar wind parameters and ignored other ions in the heliosphere (like pick-up ions). This procedure is better for determining the bulk solar wind parameters than a moments technique because the moments technique is distorted by the inclusion of all ions, and thus, does not describe the bulk solar wind parameters.

One of the scientific goals of the SWAP instrument is to determine the bulk solar wind parameters. Although these can be ascertained from the real-time data, the process would be difficult and a duplication of the experimenters' work. I would recommend that this Summary data replacement be released to the public ASAP to complement these SWAP data.

(Note – Before completion of this delta review, the replacement 0x585 data product was submitted for review)