Solar Wind Around Pluto
SWAP

PRINCIPAL INVESTIGATOR
Dave McComas, Princeton University

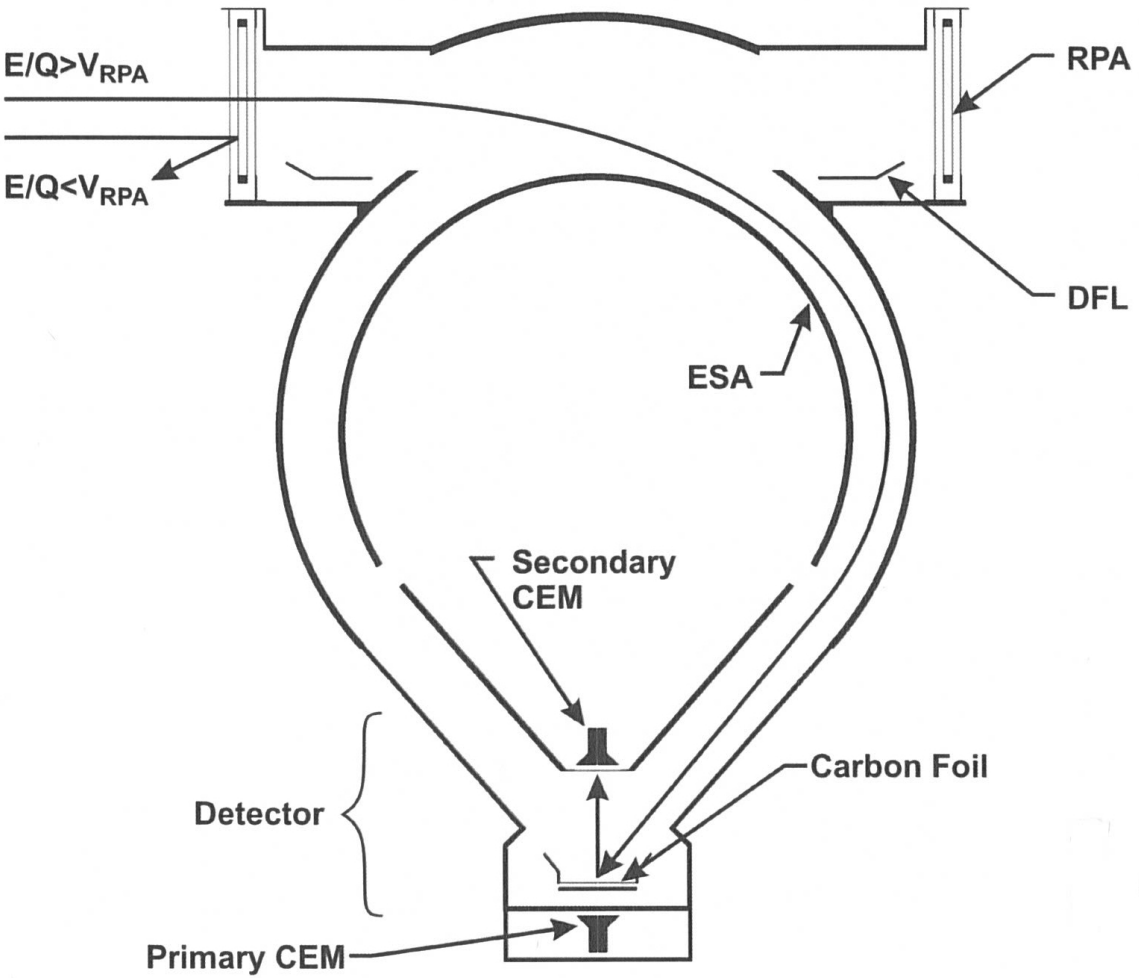
DESCRIPTION
Low Energy Plasma Instrument

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

RAW Data Sets:
nh-a-swap-2-kem1-v3.0

CALIBRATED Data Sets:
nh-a-swap-3-kem1-v3.0

New Horizons SWAP Data Set Evaluation Tools

Staging and Evaluation -

- Machine: Dell Precision Power 5810
- Operating System: Fedora 31 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

SWAP Documentation Evaluation

nh-a-swap-2-kem1-v3.0
nh-a-swap-3-kem1-v3.0
voldesc.cat

Level 2

```
The nominal start and stop times for the
  KEM1 VERSION 3.0
mission phase are
  2018-08-14T20:08:02.011
and
  2019-07-31T18:08:02.355
```

Level 3

```
The nominal start and stop times for the
  KEM1 VERSION 3.0
mission phase are
  2018-08-14T20:08:02.011
and
  2019-07-29T19:08:02.353
```

Why are these normal stop times different between the level 2 and level 3 files?

nh-a-swap-2-kem1-v3.0/catalog
nh-a-swap-3-kem1-v3.0/catalog
dataset.cat


```
SWAP data product completeness at the end of a mission phase
------------------------------------------------------------

Downlink data several days beyond the end of the nominal end of
mission phase* were included in this data set in an attempt to fill
the products at the nominal end of mission phase*.  This was done in
an attempt to ensure complete coverage of data up through the nominal
end of the mission phase*.  This also means that for the SWAP
last-in-time products in this data set, which include observations
beyond the nominal end of the mission phase*, may be incomplete.
The following paragraphs provide details about this issue.

SWAP data product completeness - details
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SWAP data are taken more or less continuously, but telemetry downlinks
are done in batches, so the SWAP data are stored on-board the
spacecraft at least until they are downlinked, sometimes hours or days
after they are taken.  Furthermore, SWAP PDS data are grouped into
products, each covering approximately one day's worth of data,
starting and ending at a time of day near 18:08 UTC.

This data set comprises data downlinked through a fixed cutoff date*.
```

What does the asterisk mean at the end of these sentences? I can not find any notes in this document.

Could this mark where automatic substitutions in the text were supposed to occur, but did not?

nh-a-swap-2-kem1-v3.0/catalog
nh-a-swap-3-kem1-v3.0/catalog
nh_kem.cat


```
KEM 1 Encounter
---------------
    Short phase name (in DSID):  KEM1
    Formal mission phase name:  KEM1 ENCOUNTER
    Mission Phase Start Time - 2018-08-14
    Mission Phase Stop Time  - TBD

    Activities during this encounter are TBD, but will be similar to
    the Pluto Encounter phases. They will also include post-MU69
    encounter calibrations in mid-2019, along with continuing download
    of data from the MU69 encounter.

    The name and times chosen for this mission phase are still in flux
    and may change in the future.

    [STERNETAL2019] discusses the initial results from the Arrokoth
    flyby.
```

The KEM 1 encounter has already occurred and initial results have even been published, so it is unclear why the activities during this encounter are still TBD.

nh-a-swap-2-kem1-v2.0/catalog
nh-a-swap-3-kem1-v2.0/catalog
nhsc.cat - 1 of 2

Previous Review Slide

This document needs to be updated. There are references to measurements at Pluto in numerous places. New Horizons is no longer measuring Pluto and is essentially a new mission to the Kuiper Belt. The instrument description gives no confidence that the New Horizons instruments can measure properties of a KBO. The focus of this document is on Pluto and does not discuss the capabilities of the instruments beyond Pluto. I suspect that this is a hold-over document which was never updated for the current extended mission.

nh-a-swap-2-kem1-v3.0/catalog
nh-a-swap-3-kem1-v3.0/catalog
nhsc.cat - 2 of 2

Since this document has not been updated, I would suggest that the project at least change the following line (underlined):

```
Payload
=======
  The New Horizons team selected instruments that not only directly
  measure NASA-specified items of interest (NASA AO 01-OSS-01, 2001,
  [NASAAO2001]), but also provide backup to other instruments on the
  spacecraft should one fail during the mission.

  The payload comprises seven instruments:
```

To read as follows:

The instrumentation chosen for the payload is adequate to observe and return new information on a multitude of additional objects in the solar system for which the New Horizons spacecraft will encounter, but were mainly chosen to highlight measurements at Pluto. The seven instruments which comprises the scientific payload, highlighting measurement capabilities at Pluto, are:

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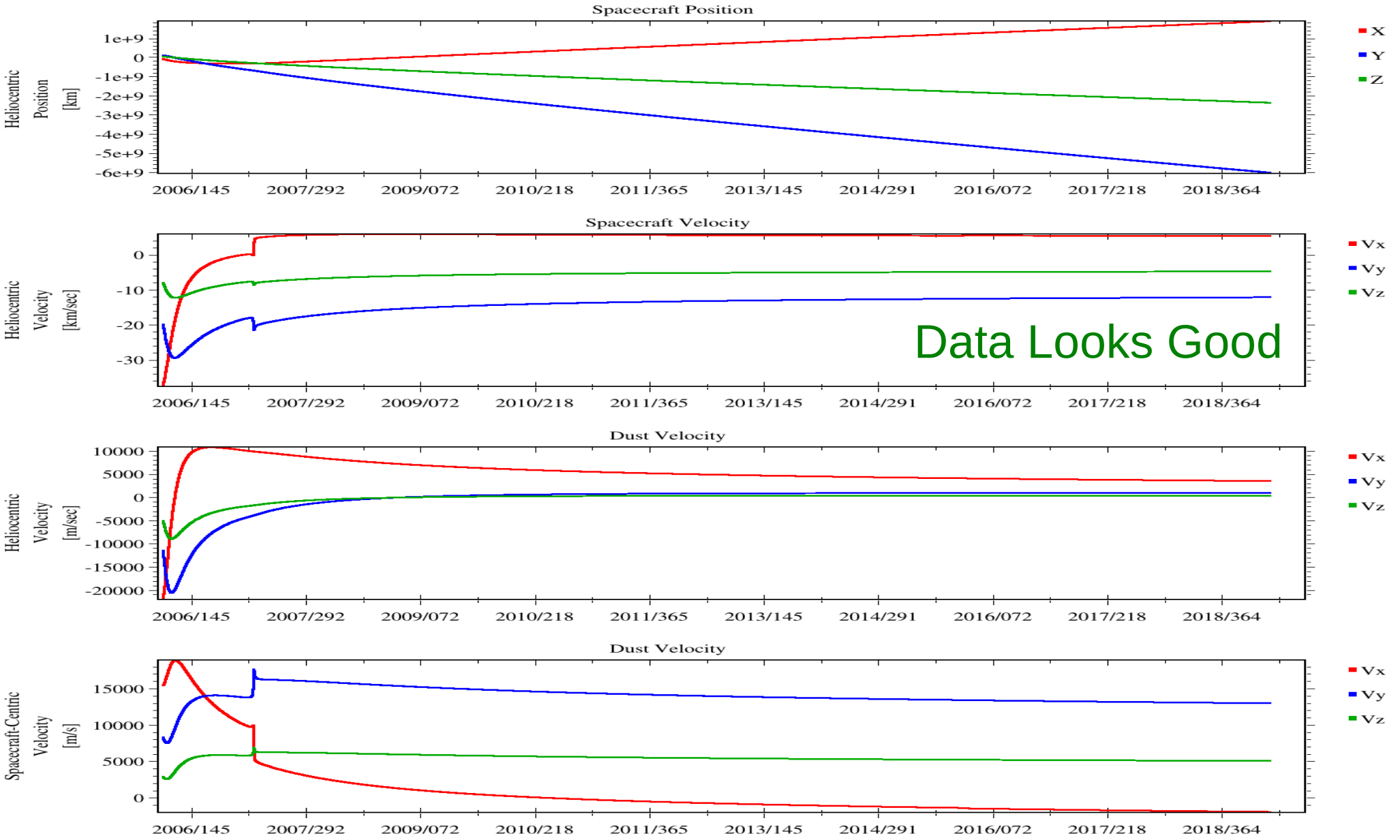
nh-a-swap-3-kem1-v3.0/document
nh_mission_trajectory.tab



Plot created by SDDAS/gPlot - J. Mukherjee, et al. Generated on Mon May 11 15:50:52 2020.

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
swap_cal.lbl – 1 of 6

2) Deflector System (DFL)

The nominal FOV of the SWAP instrument is 276° about the spacecraft roll axis by 10° in the plane normal to the roll axis. SWAP uses an electrostatic deflection (DFL) plate to increase the FOV out of plane by up to 15° in azimuth (α) (range is 0 to 15°). The required DFL voltage, normalized to the beam energy goes as

Missing Equation (1)

where ↣ is the angle from the plane.

Missing Symbol

For non-normal incident particles, the RPA response needs a calibration correction. For an ideal RPA, non-normal incident particles with $E/q > (V_{RPA} / \cos^2 \alpha$ would be passed. The

Missing “)”

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
swap_cal.lbl – 2 of 6

1000, 1010, and 1900 eV are shown in red, green and blue, respectively. We set the DFL voltage according to Equation 1, leading to an empirically derived calibration function for SWAP:

Missing Equation (2)

For the SWAP RPA, non-normal incident particles with $E/q > (V_{RPA} / f(\Omega))$ would be passed.

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
swap_cal.lbl – 3 of 6

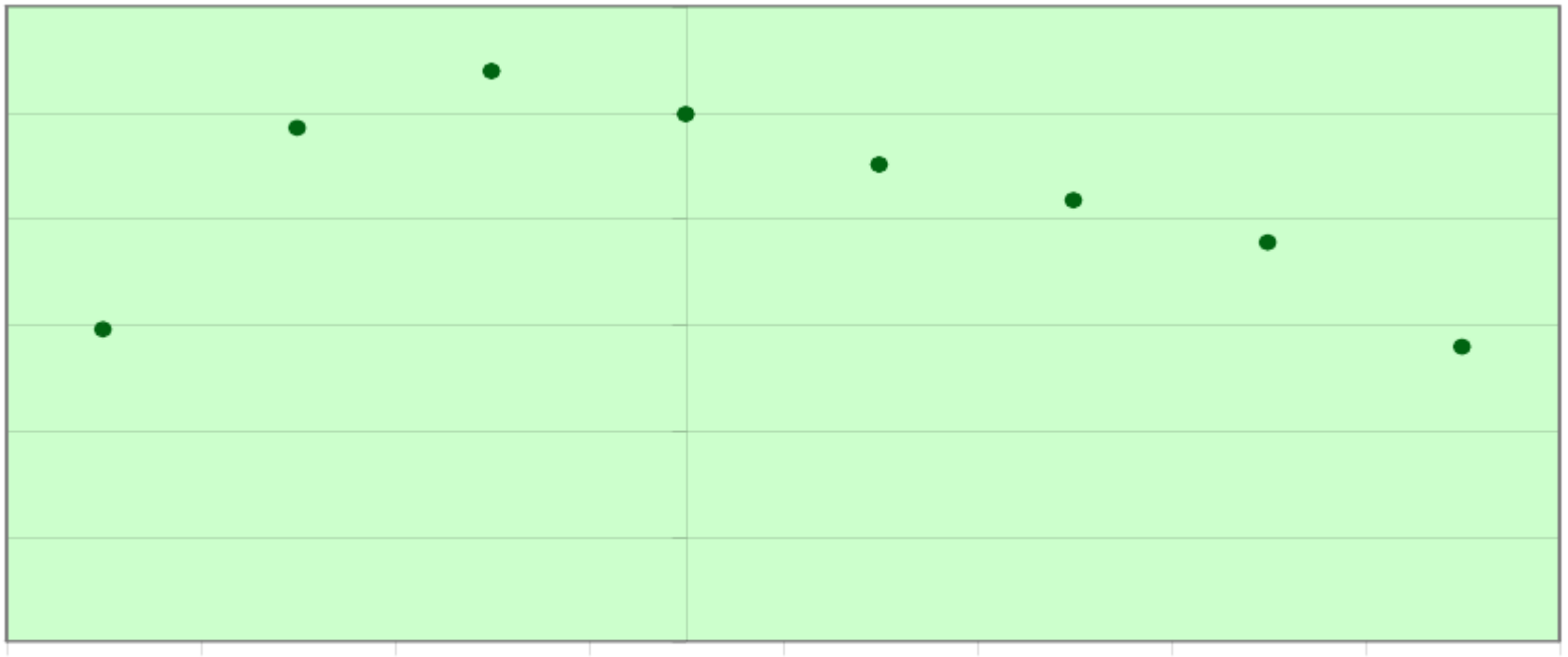


Figure 5: Ratio of the ESA response width normalized by the center of the ESA response as a function of azimuth angle.

No Labels on Either Axis

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
swap_cal.lbl – 4 of 6

Table 1: Normalized ESA width versus azimuth angle.

@6 E/E	Azimuth
0.0588	-6
0.0970	-4
0.1077	-2
0.0995	0
0.0900	2
0.0833	4
0.0754	6
0.0556	8

What is @6?

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
swap_cal.lbl – 5 of 6

Table 2: Table of Slope and intercept for Varying Roll Angles

Roll Angle	m (@6 <0)	b(@6 <0)	m (@6 >0)	b(@6 >0)
-90	-0.0010849	0.538471	-0.00477399	0.537755
0	0.00036525	0.530168	-0.00489876	0.527318
90	-0.000227406	0.529935	-0.00491875	0.528725

What is @6?

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
swap_cal.lbl – 6 of 6

times the square of the distance from the Sun in AU ($R_{Sun,AU}$) versus the energy. Most of the vertical spikes are the solar wind peaks. In the middle panel the solar wind peak and 3 points below and above the energy of the peak have been removed from each scan individually. The bottom panel of Figure 9 is an average of the top bin where the average has been performed on each bin individually since there are a different number of data points in each bin after removing the solar wind peaks.

Why does the Font and Point Size Change?

To use the background information in the pipeline the data was converted from Hz back to counts/sample since the background subtraction is done prior to the rest of the data processing. The background rates (counts / sample) are scaled by the square of the distance to the Sun ($R_{Sun,AU}$) and those scaled rates (counts * $(R_{Sun,AU})^2$ / sample) are stored in the background files in the

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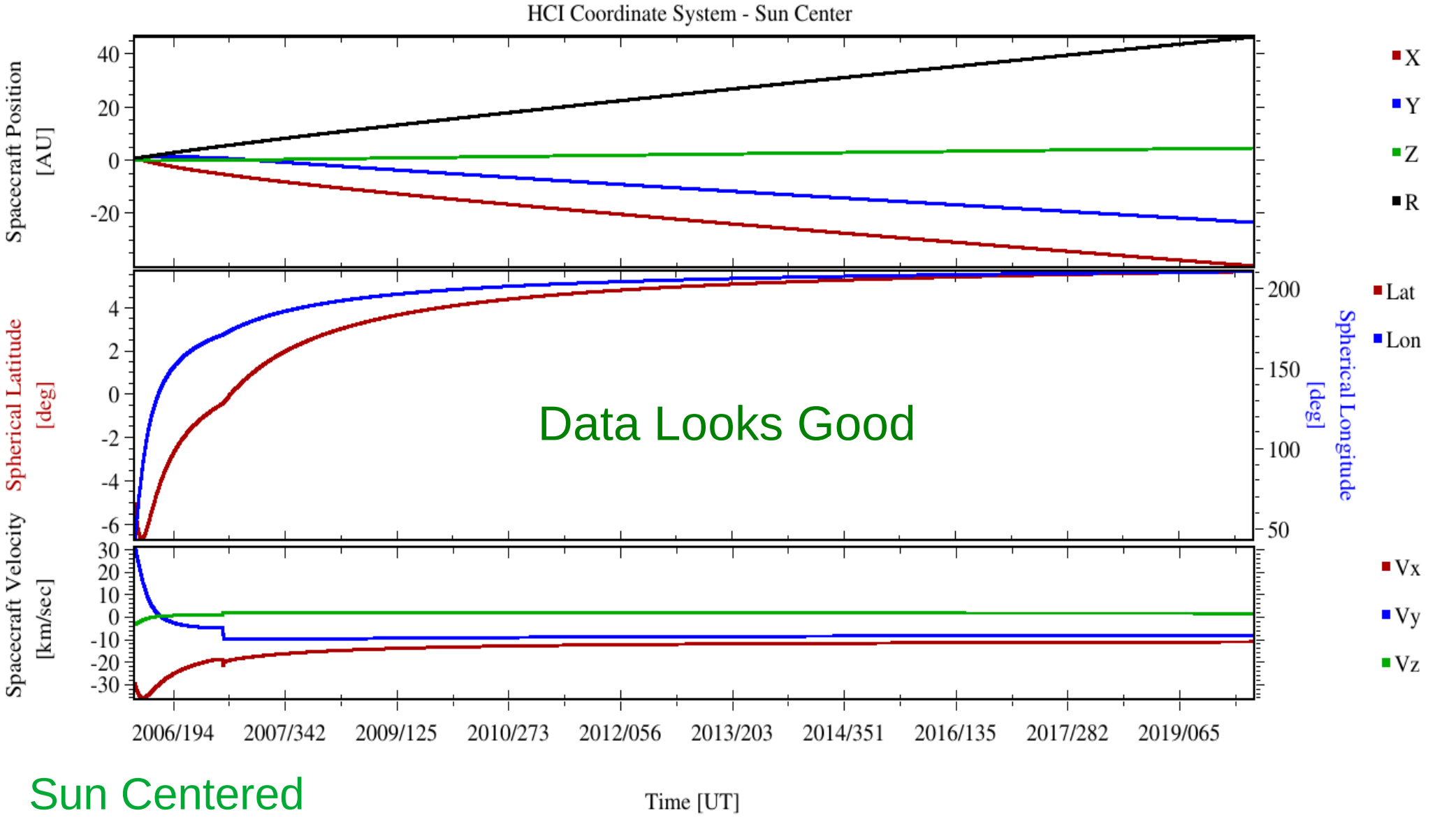
nh-a-swap-3-kem1-v3.0/document
traj/traj_2006_2021_1d.tab - HCI



Sun Centered

Plot created by SDDAS/gPlot - J. Mukherjee, et al. Generated on Mon May 11 16:29:50 2020.

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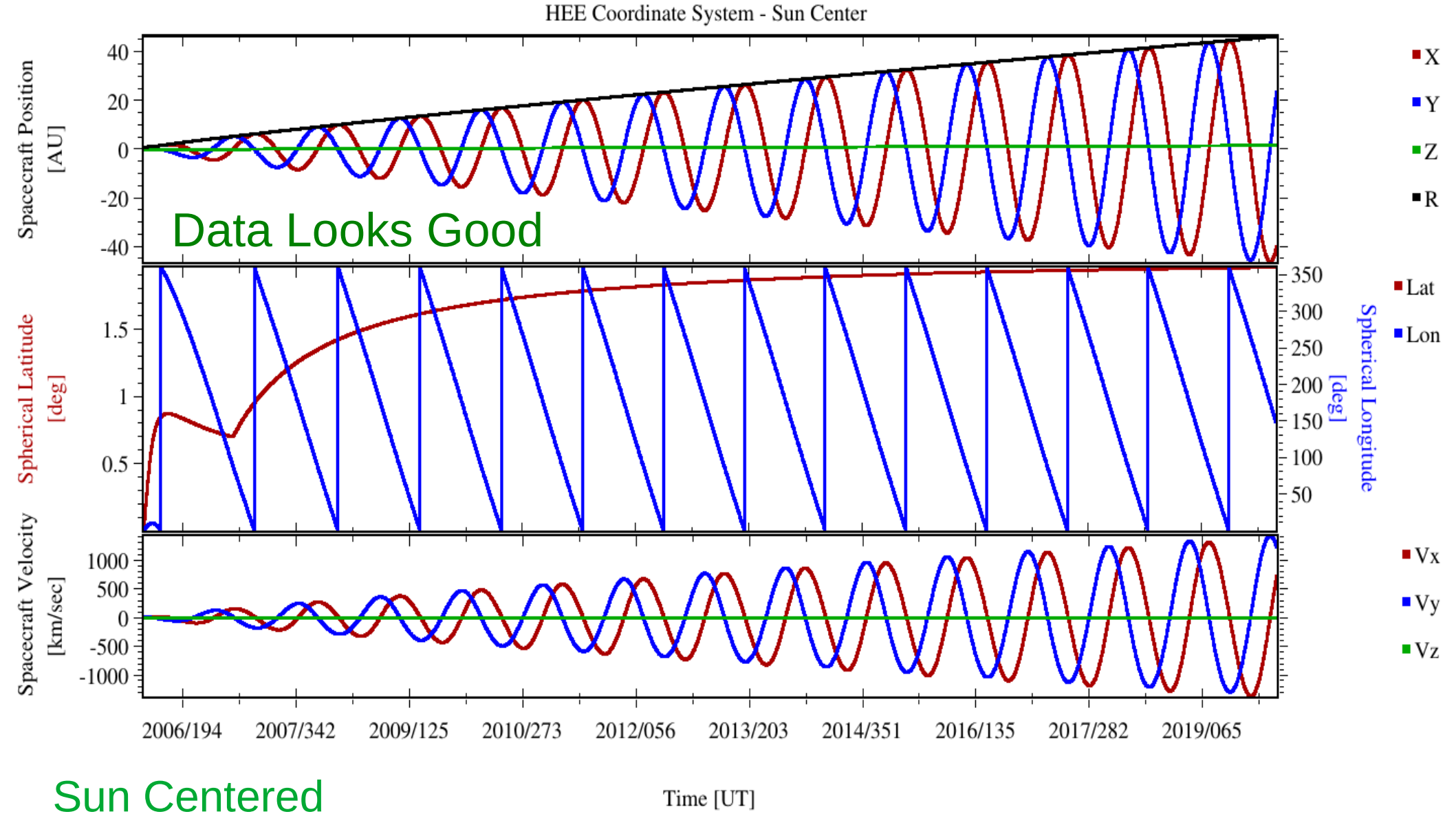

Sun Centered

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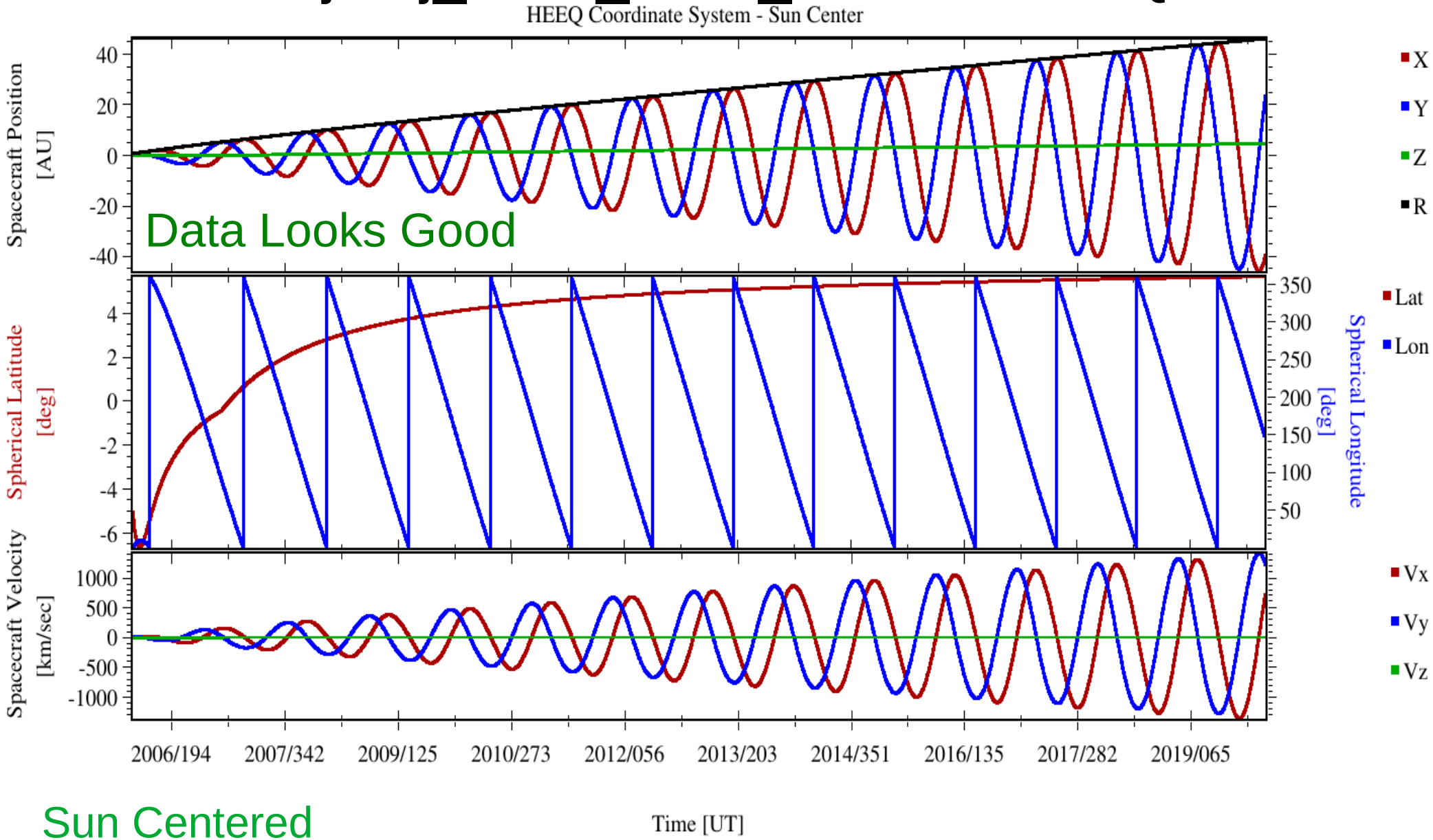

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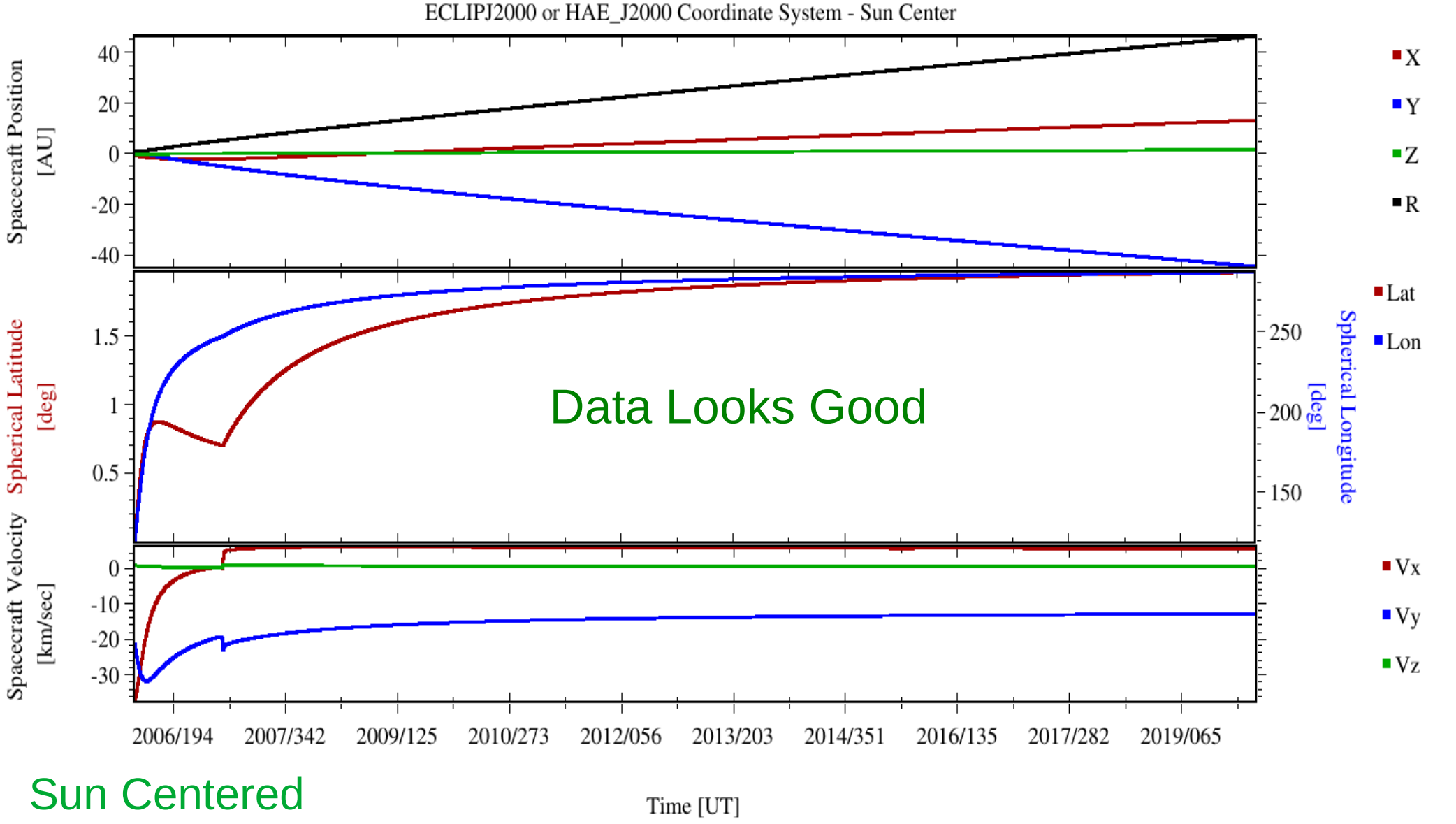

Sun Centered

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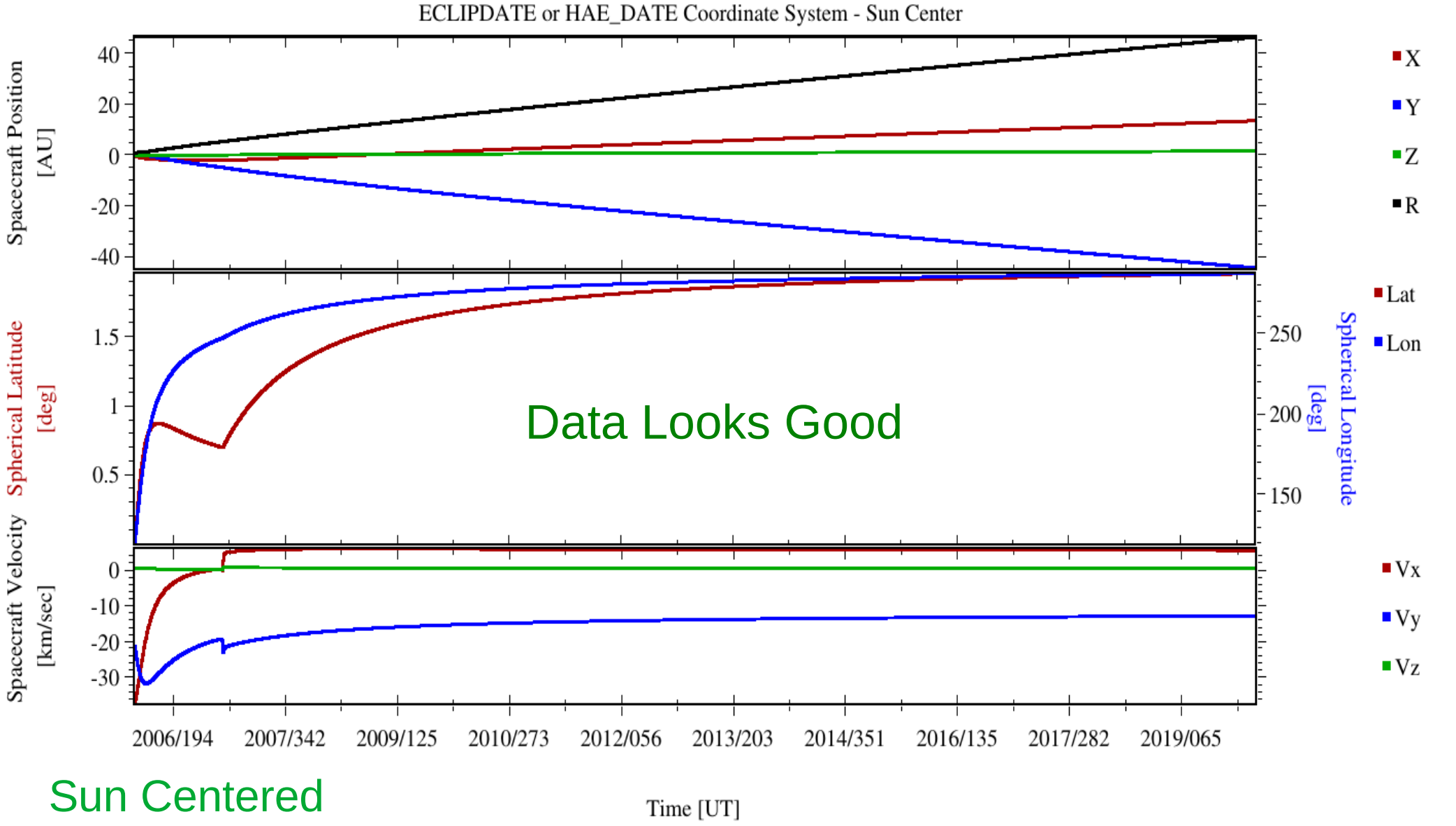

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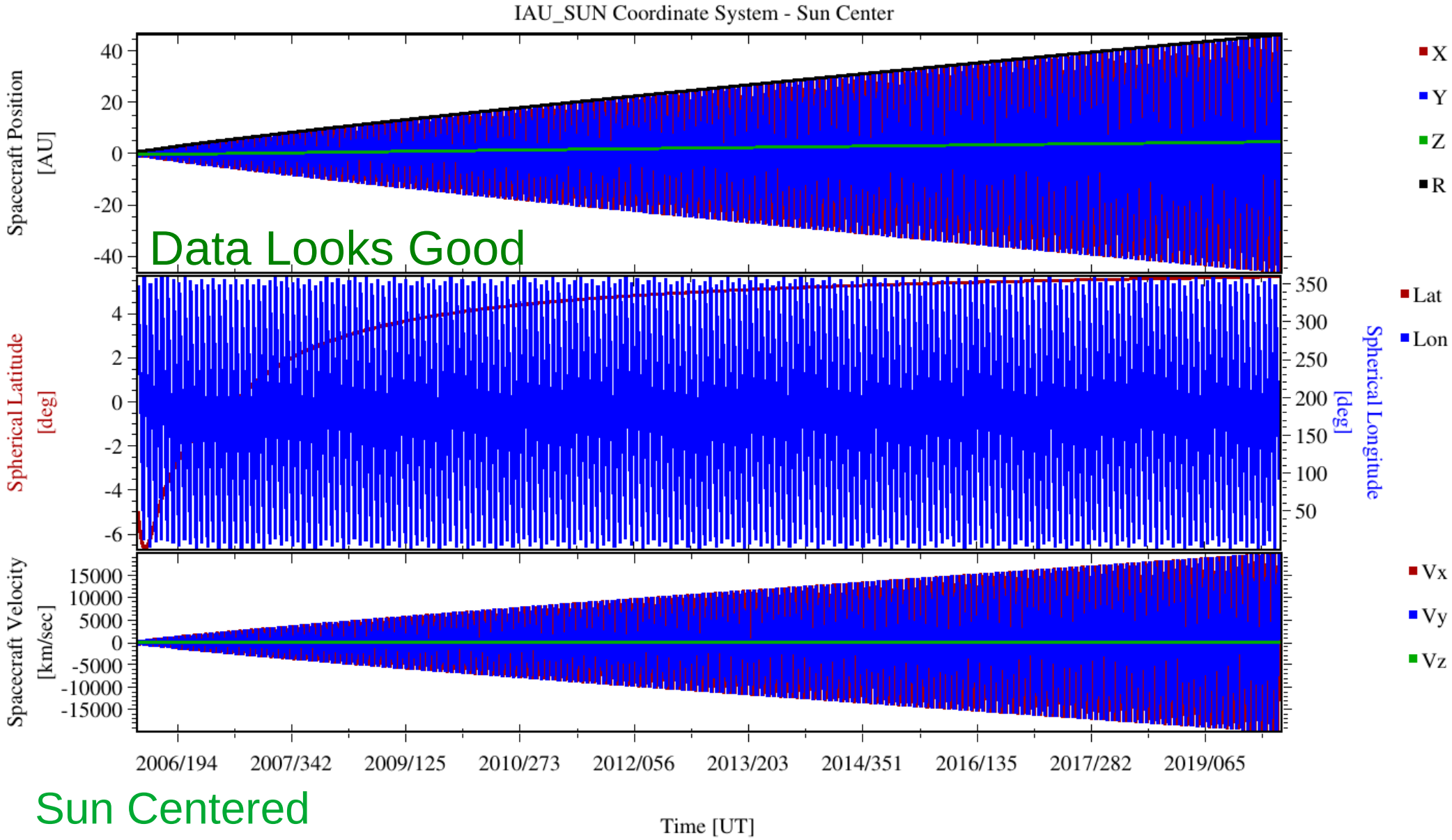

Sun Centered

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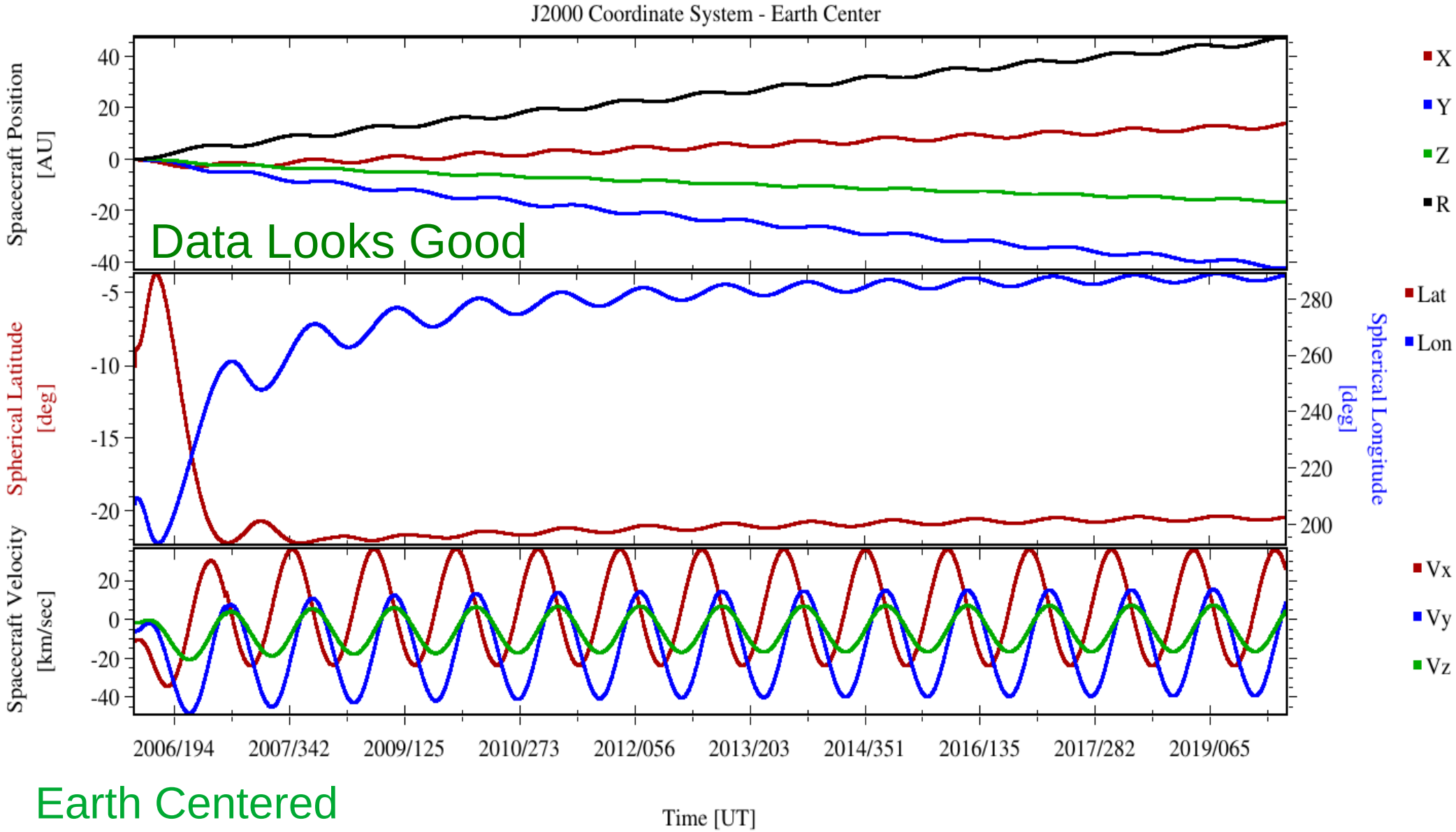

Earth Centered

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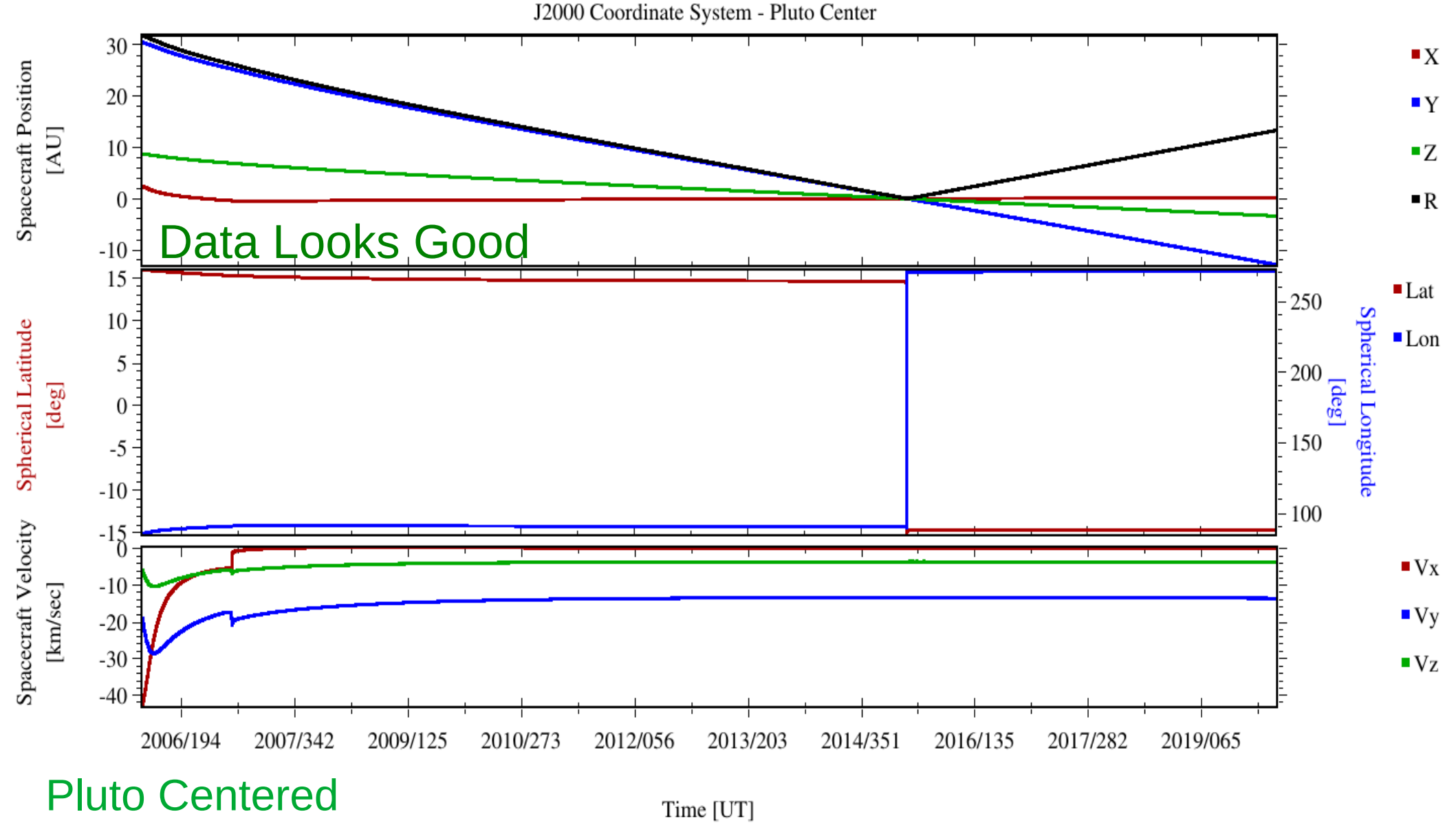

Pluto Centered

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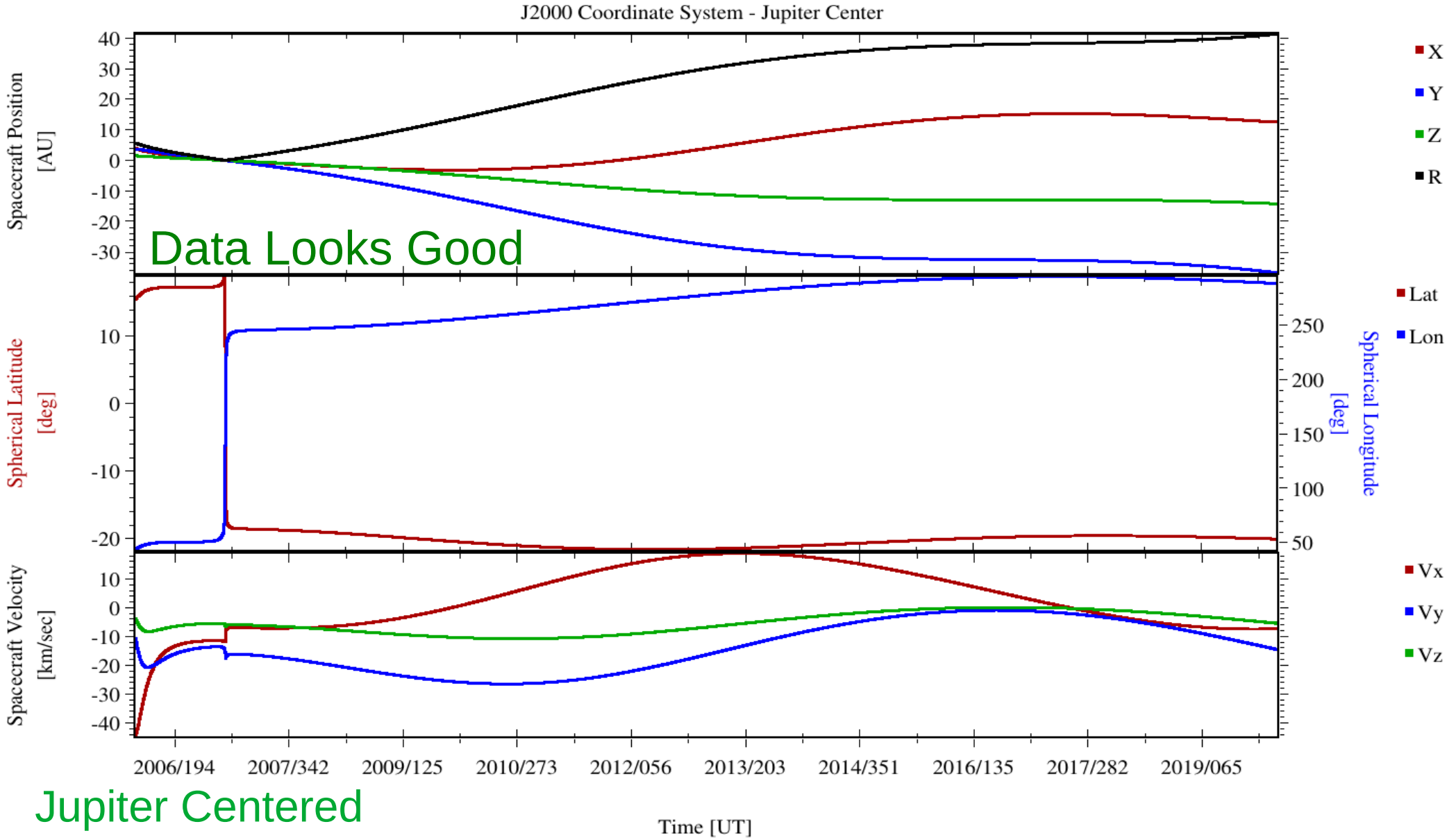

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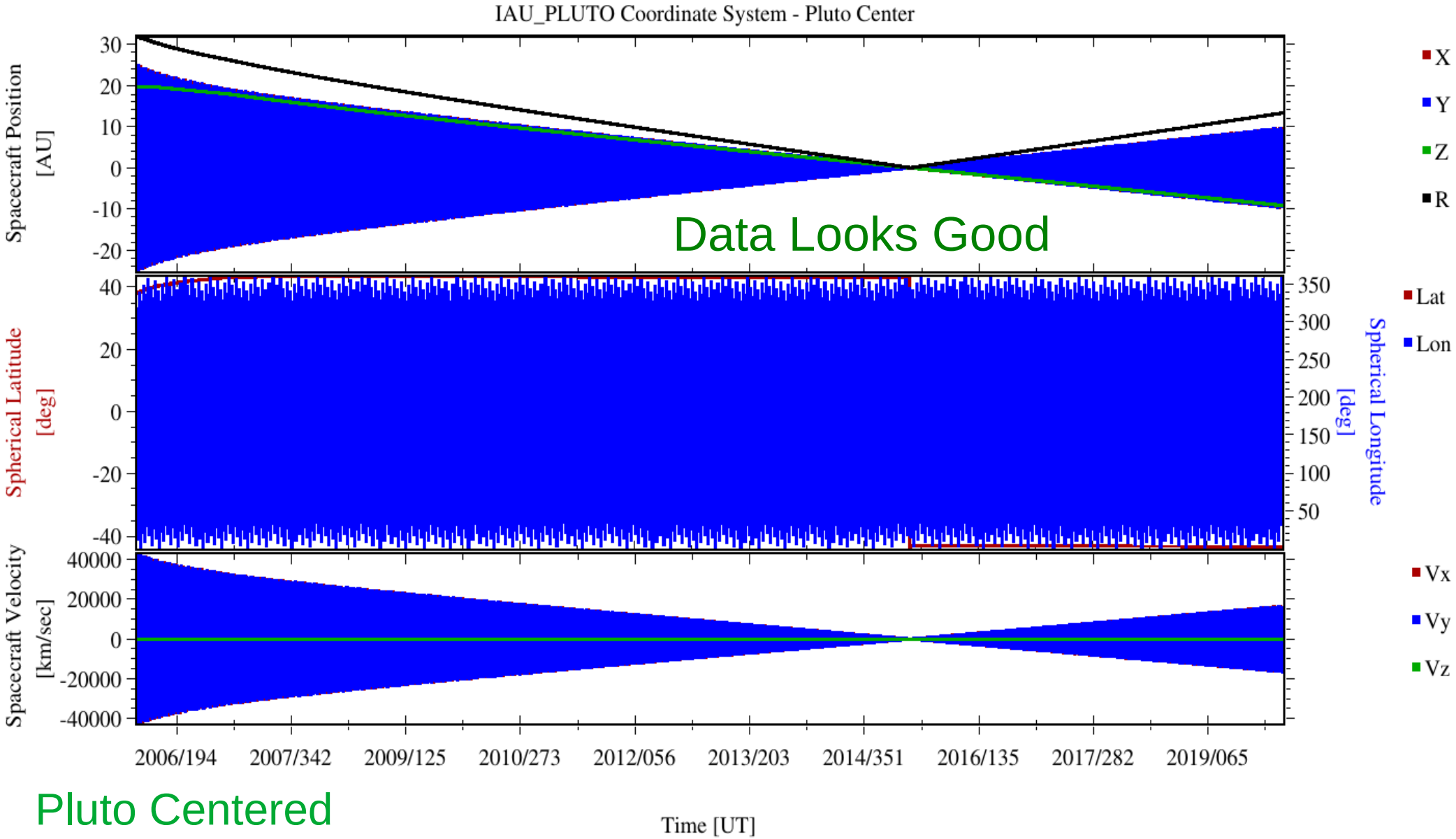

Pluto Centered

Plot created by SDDAS/gPlot - J. Mukherjee, et al. Generated on Mon May 11 16:44:15 2020.

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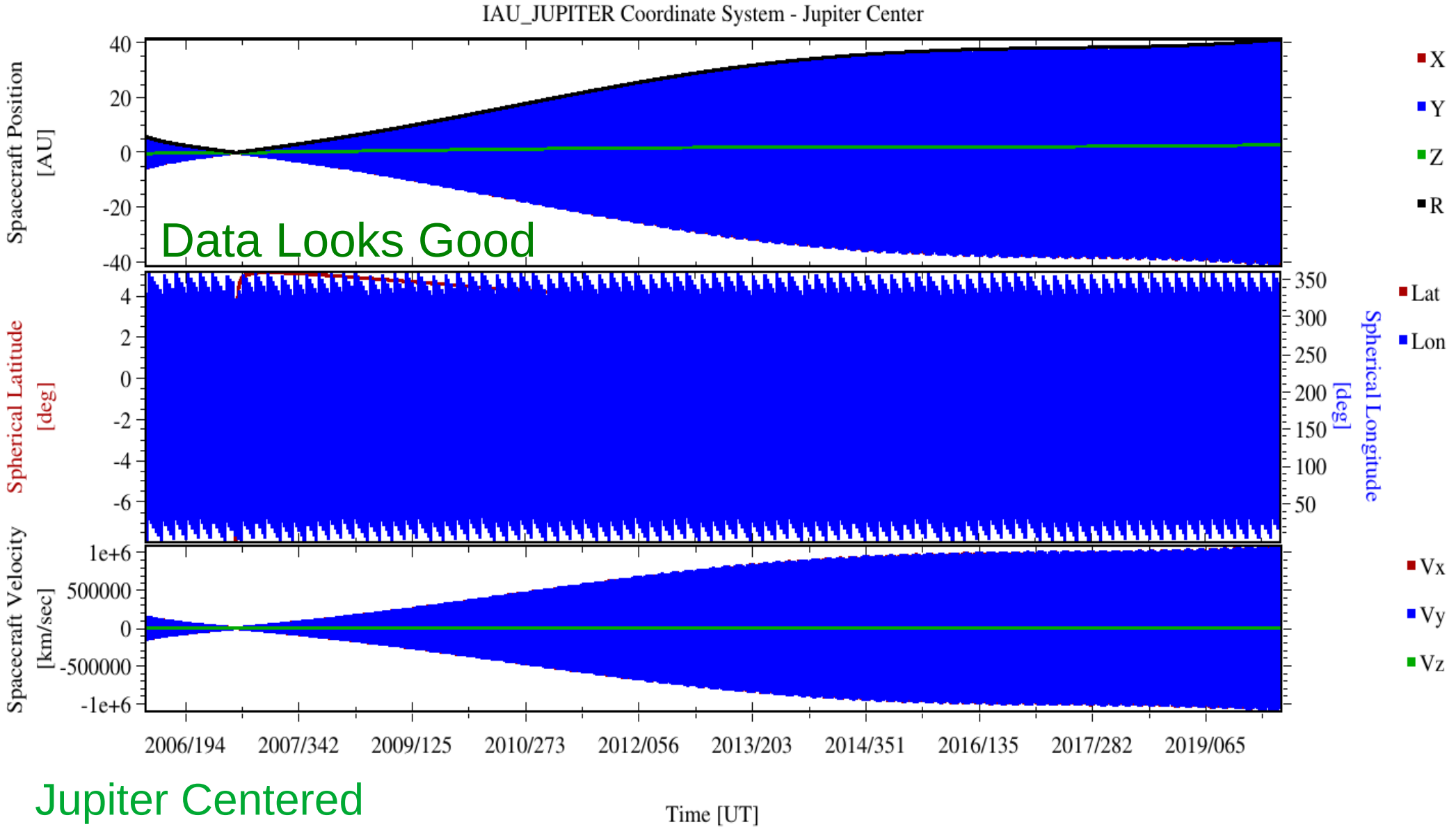

Jupiter Centered

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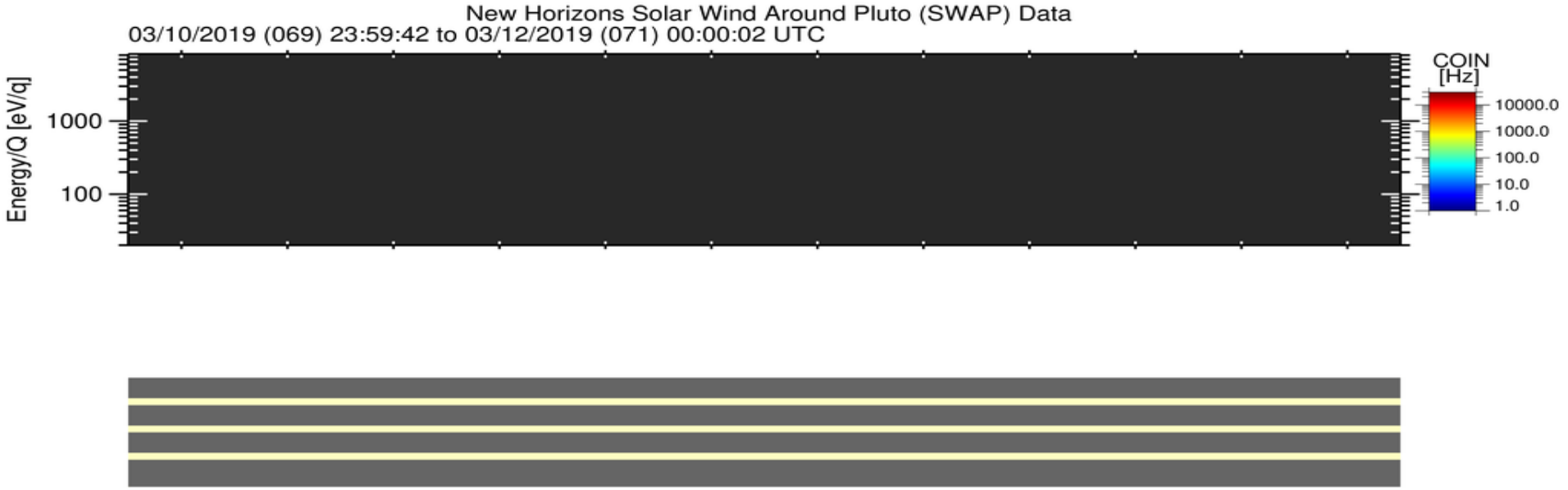

I still do not like having plots like this in the archive. This looks like the plotting package software failed where you really want to convey that there is no data for the time frame covered by the plot. Empty plot frames with the words “no data” are much better because you see right away that the reason for the empty frame is that there was no data to plot and it was not due to a failure in the plotting software.

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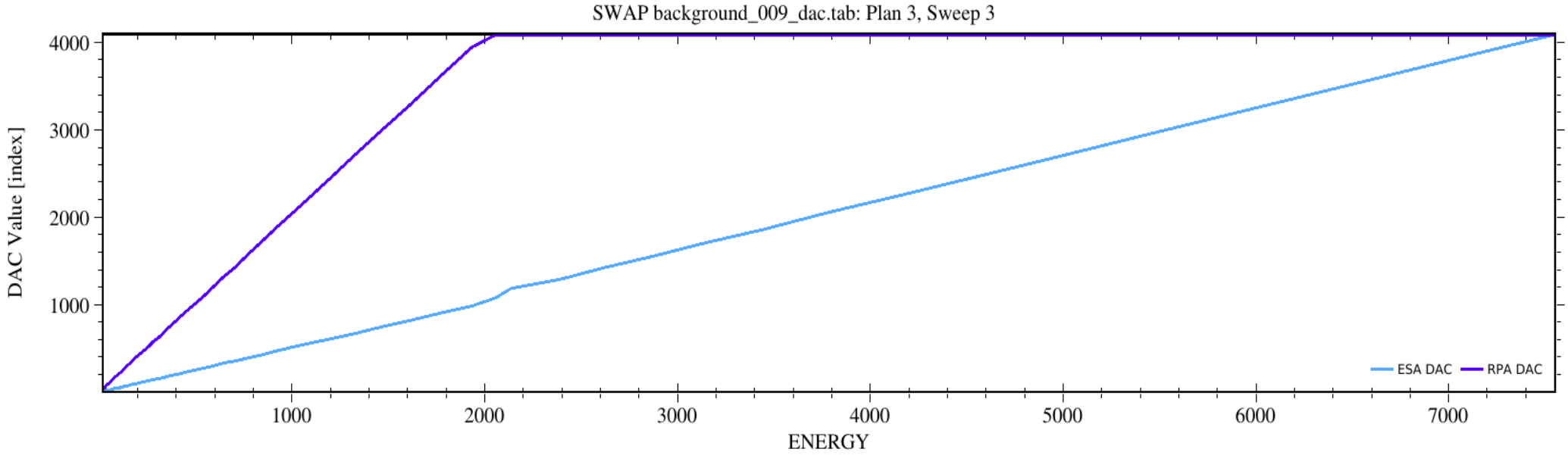
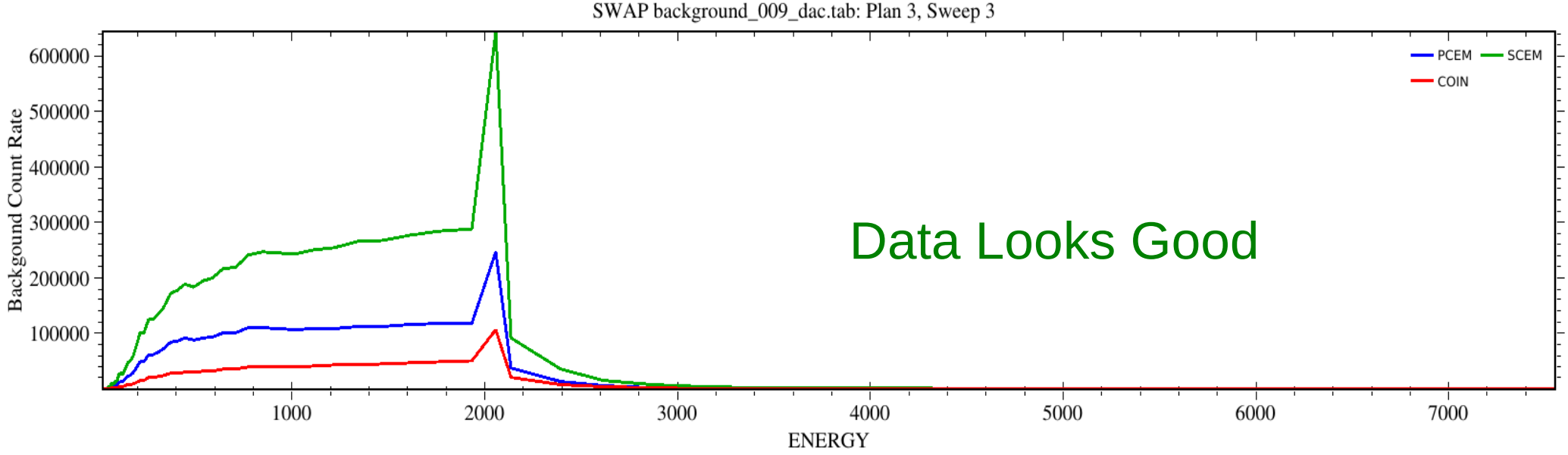
background_009_dac.tab





Data Looks Good

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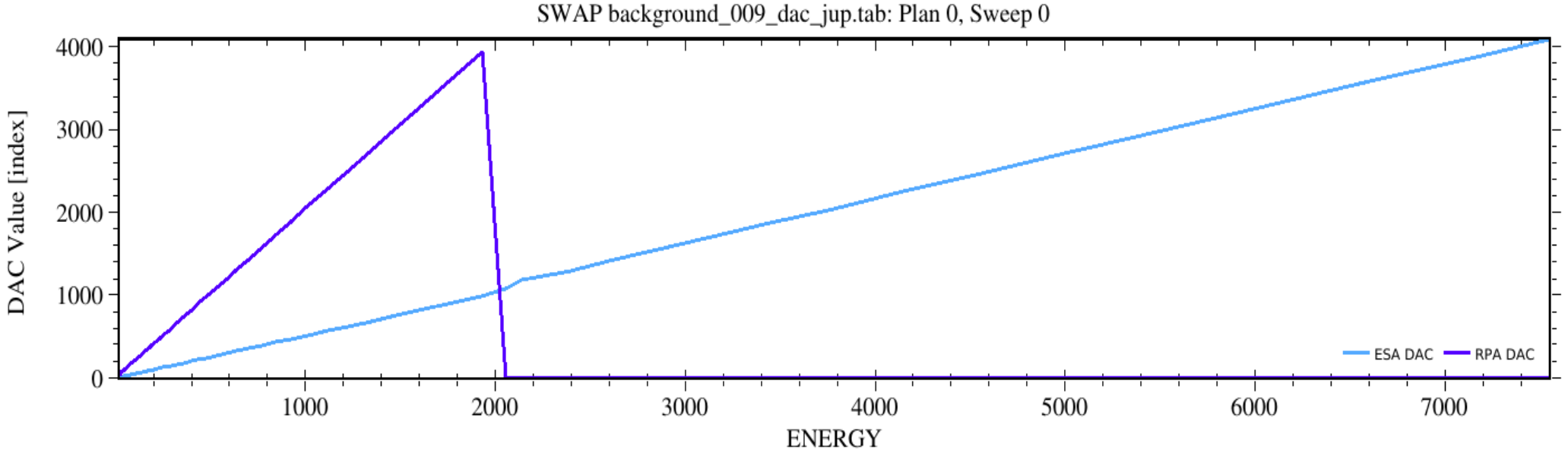
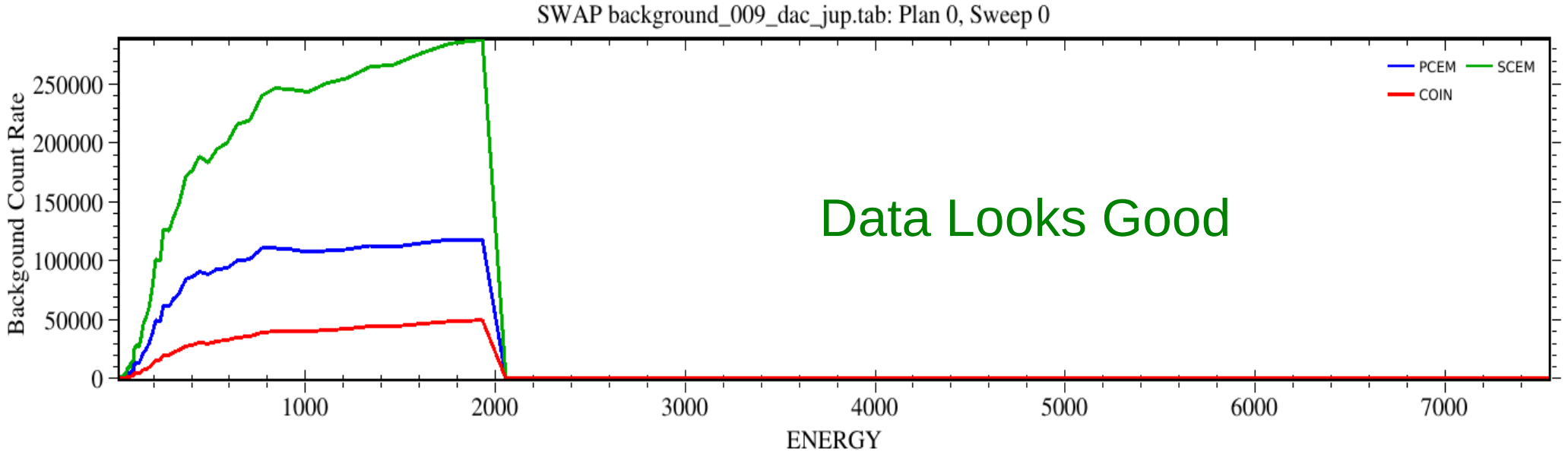
background_009_dac_jup.tab





Data Looks Good

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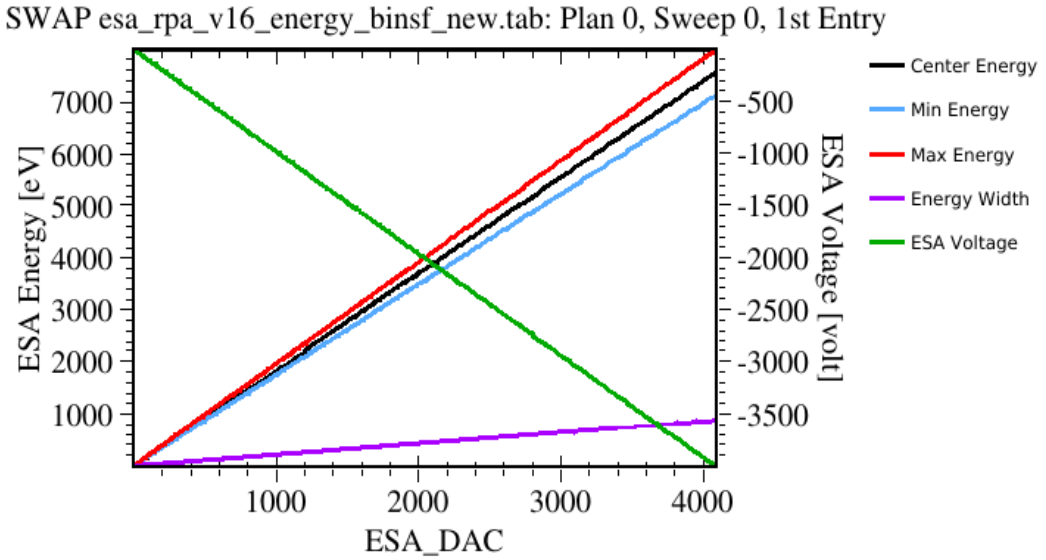

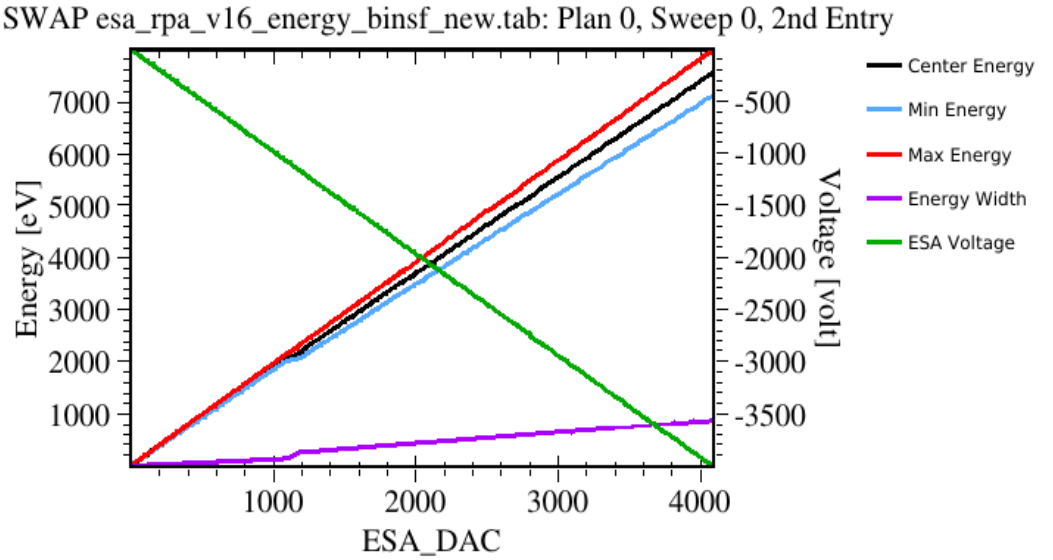

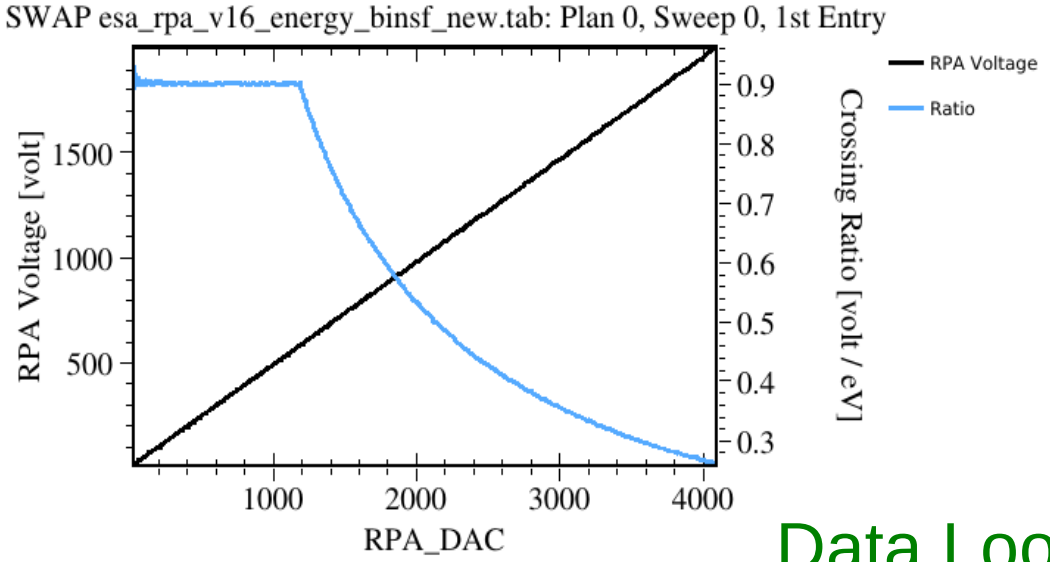

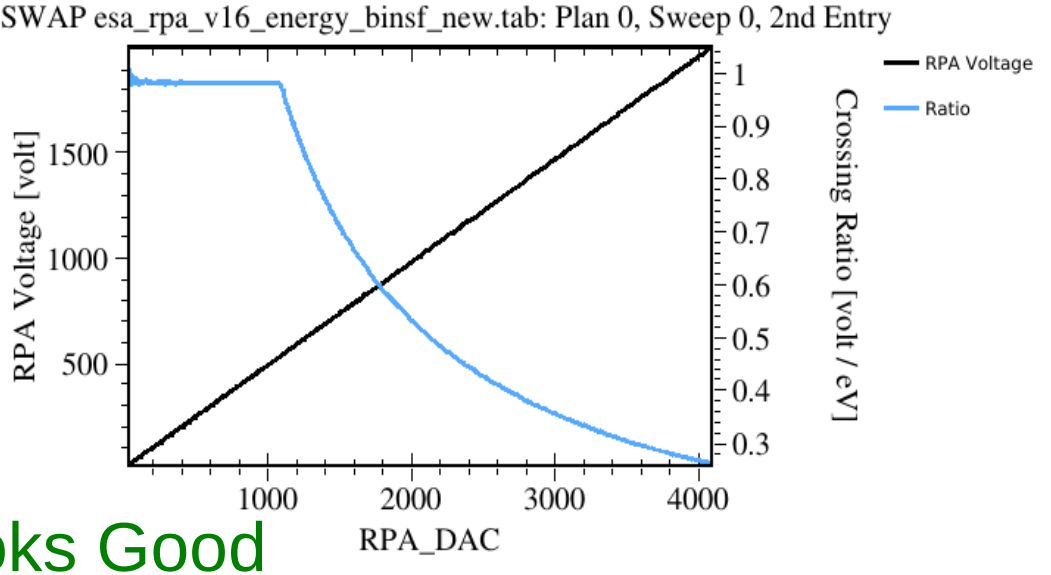

Data Looks Good

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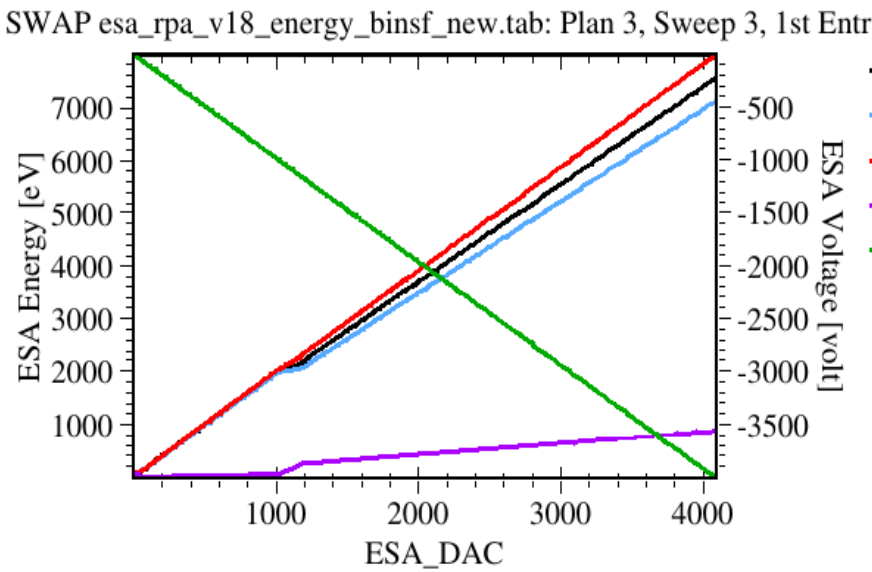

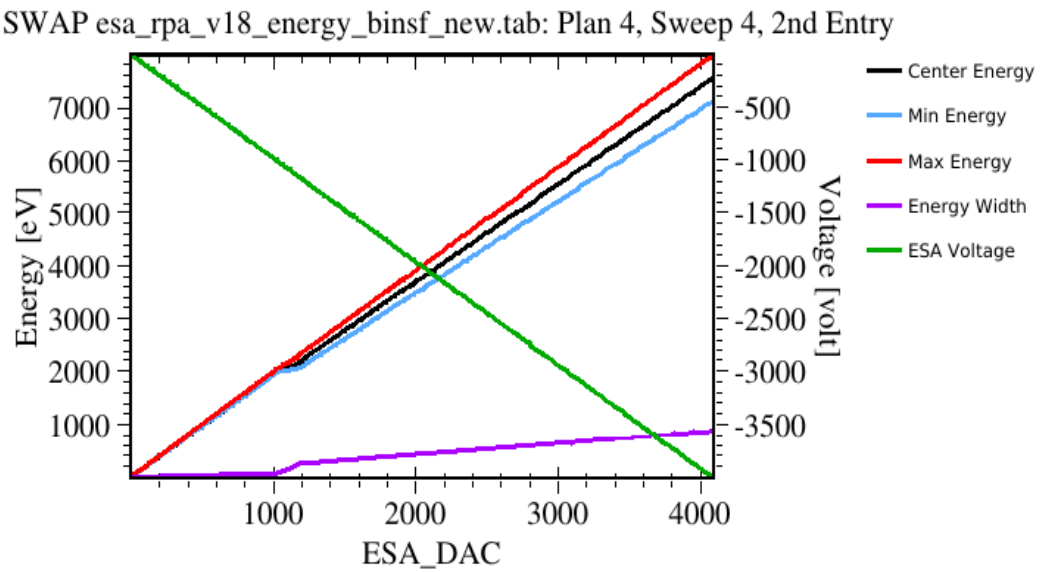

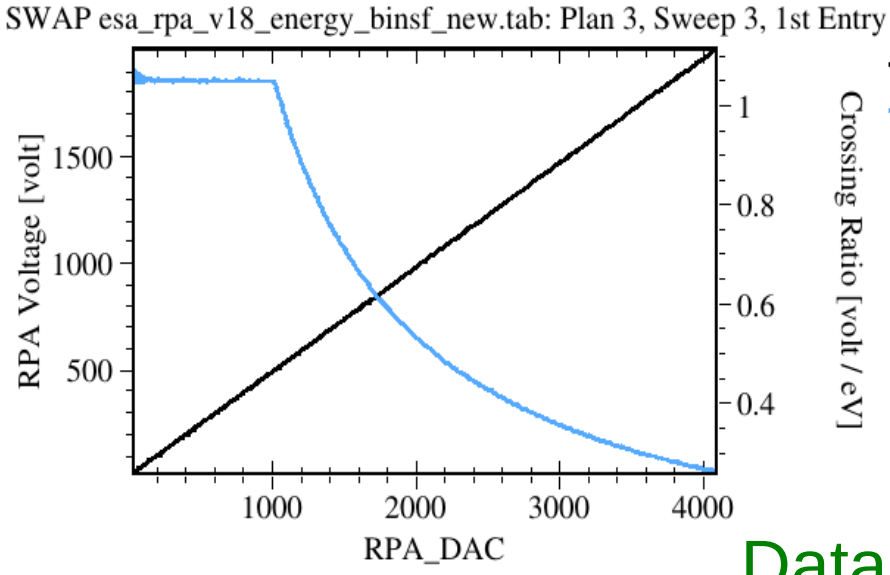

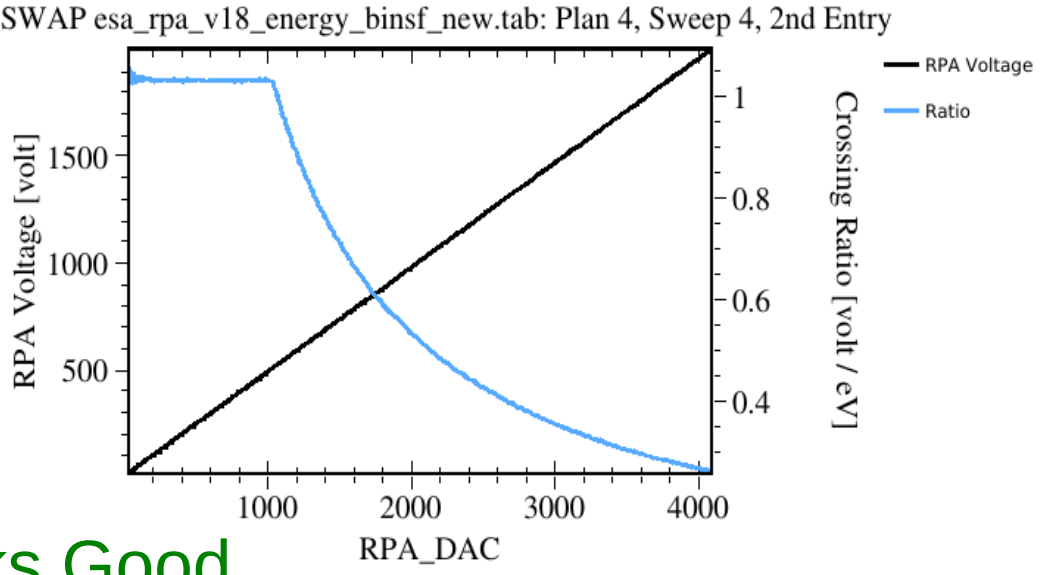

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Data Looks Good

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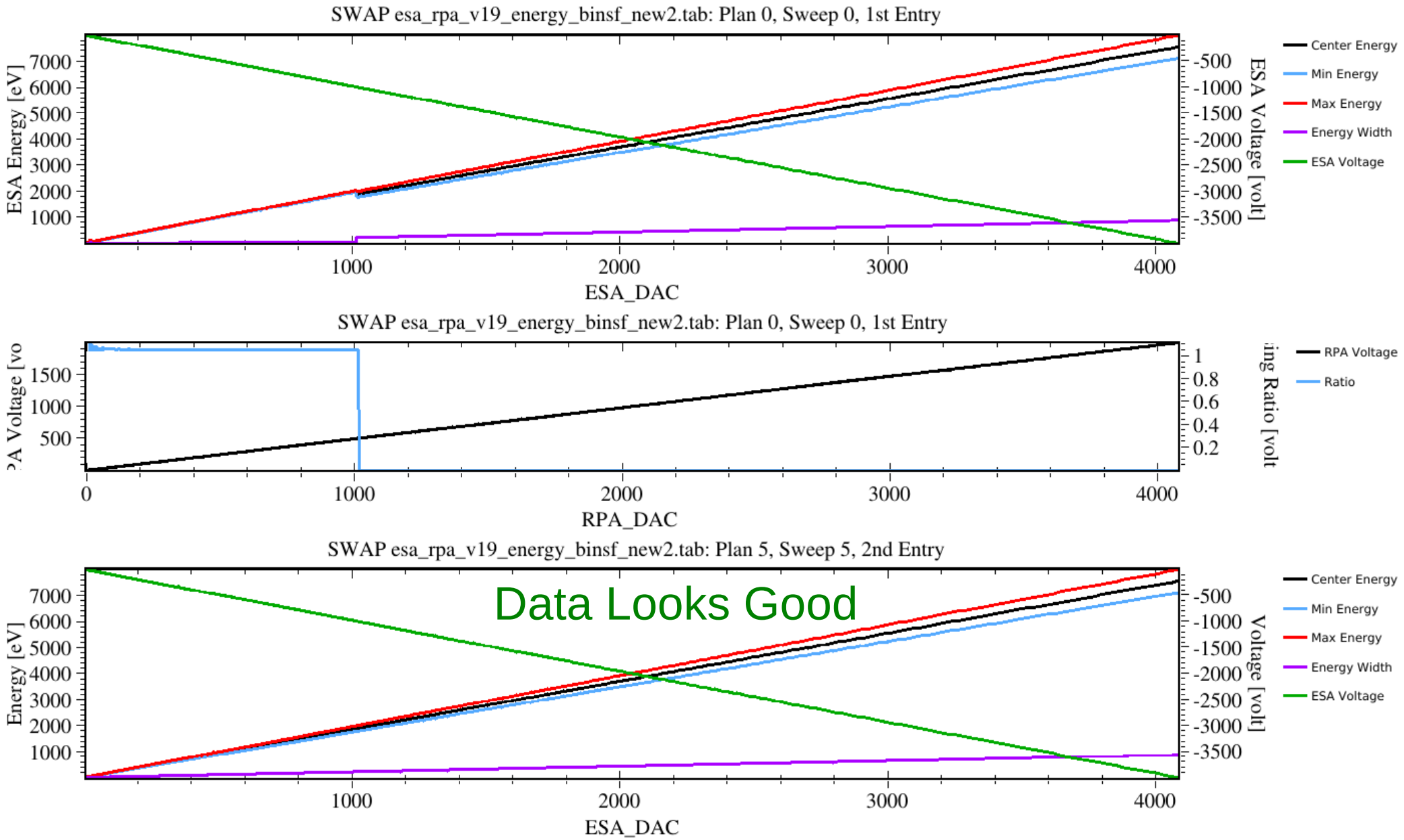

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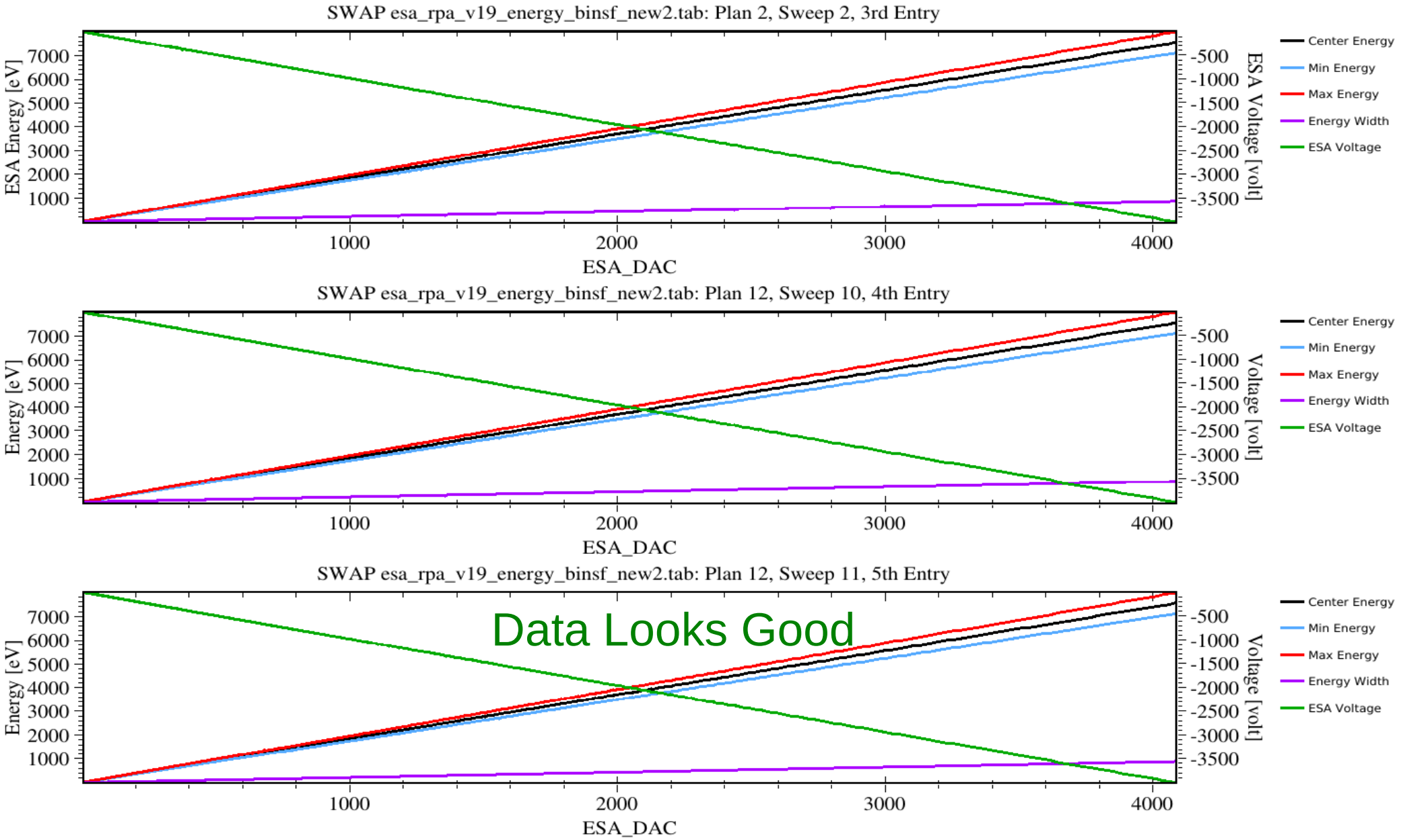
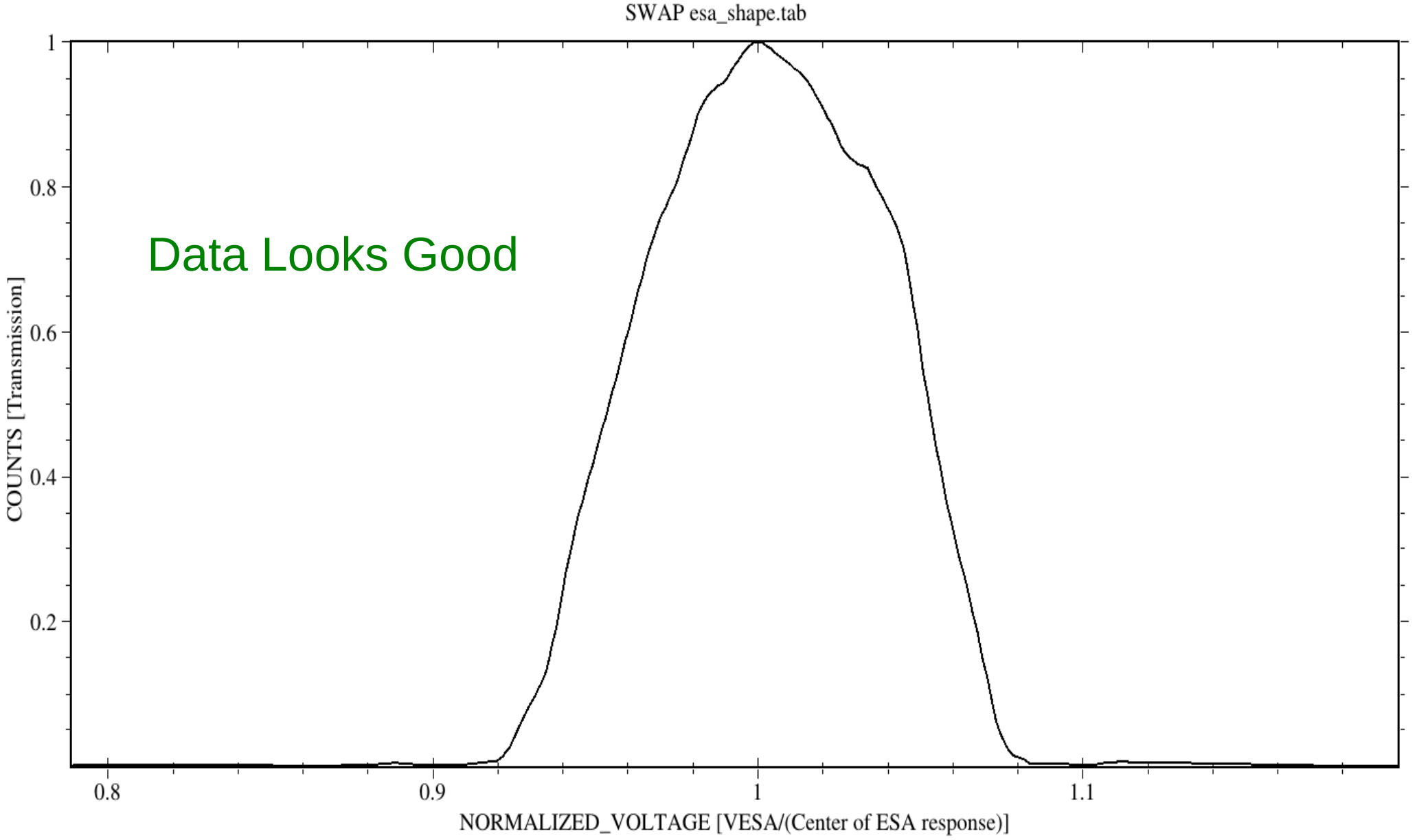
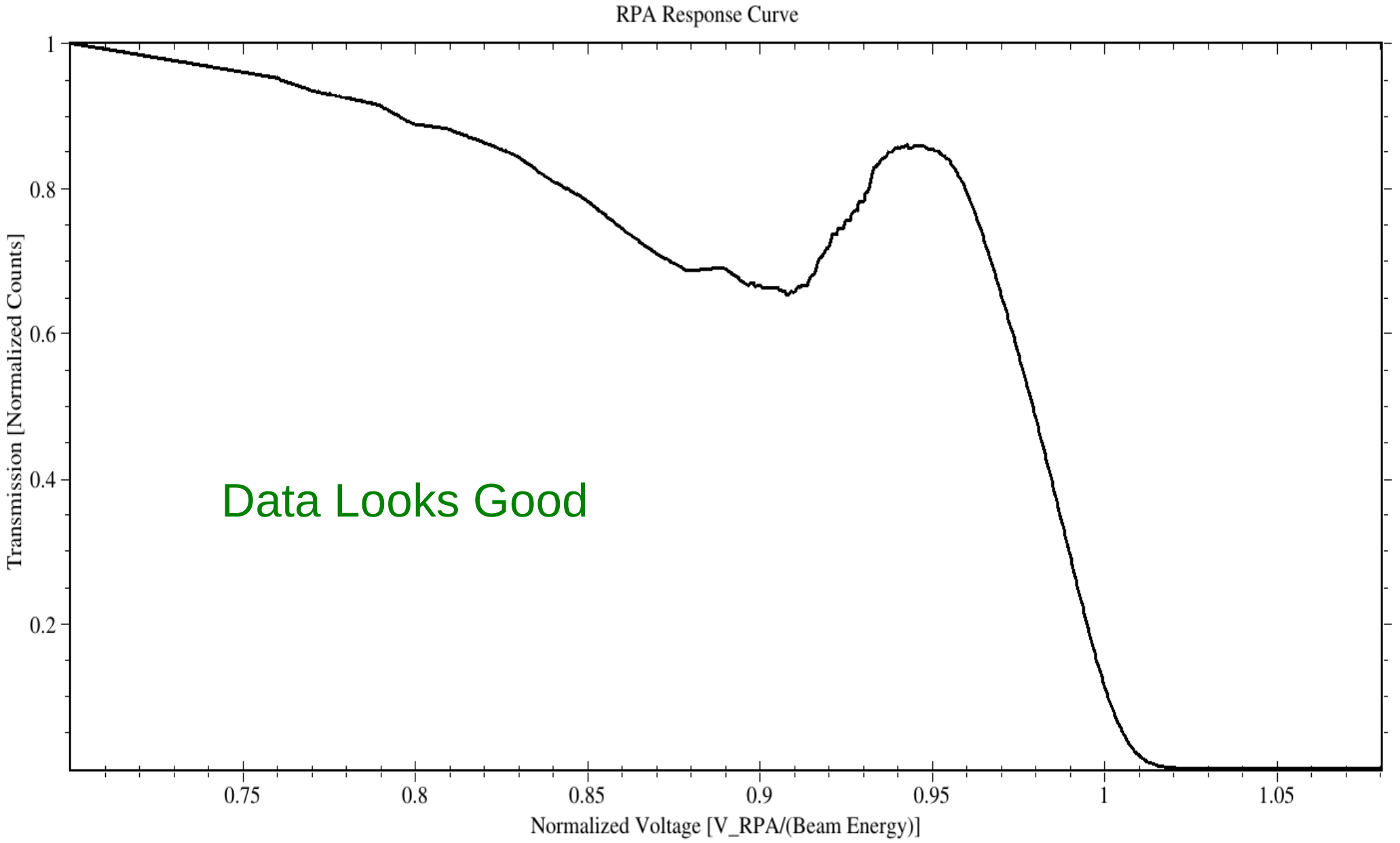


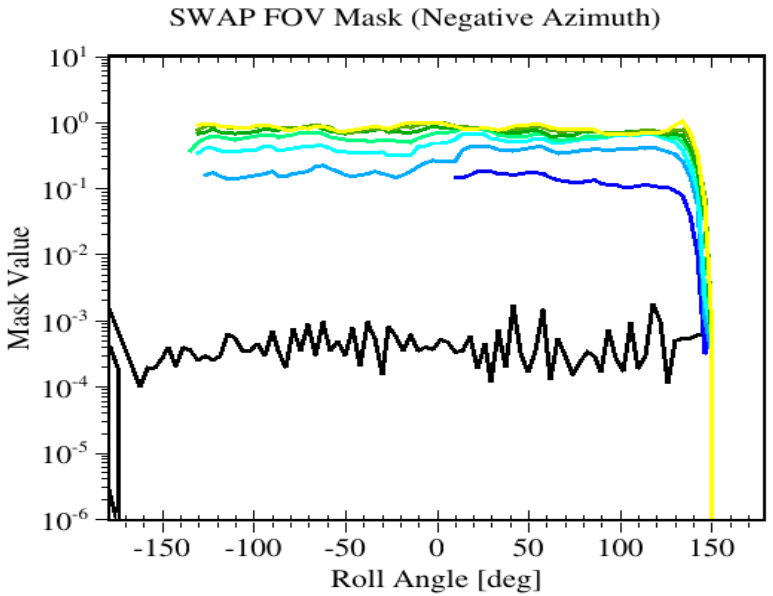
nh-a-swap-2-kem1-v3.0/calib
nh-a-swap-3-kem1-v3.0/calib
esa_shape.tab

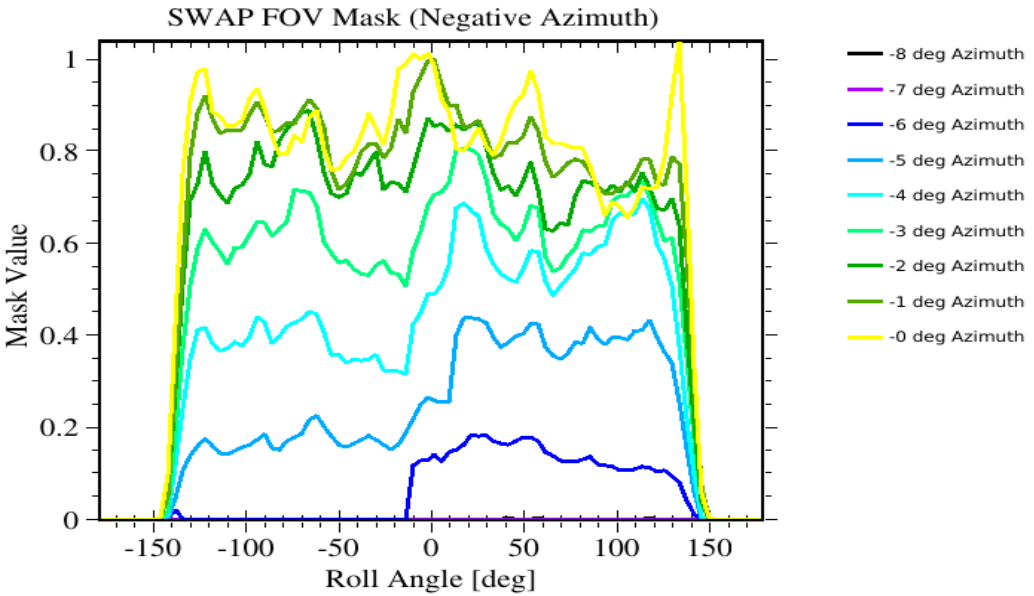


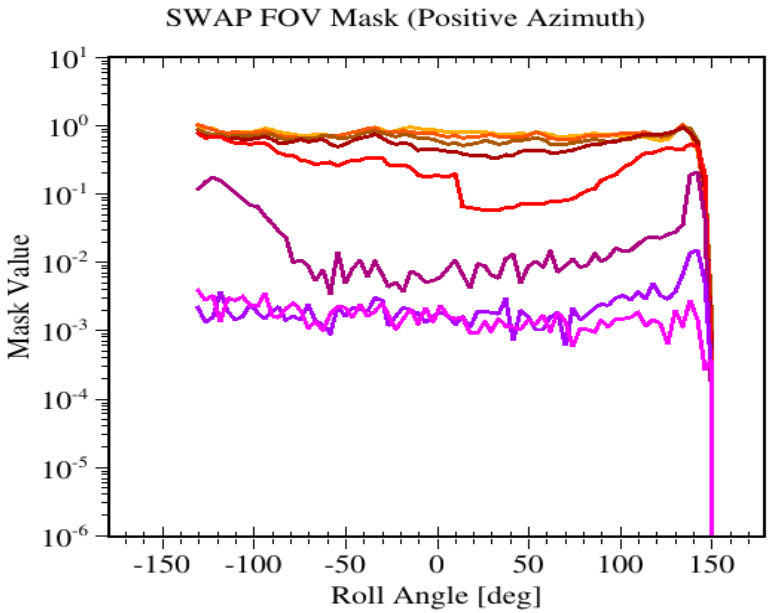
nh-a-swap-2-kem1-v3.0/calib
nh-a-swap-3-kem1-v3.0/calib
rpa_shape.tab

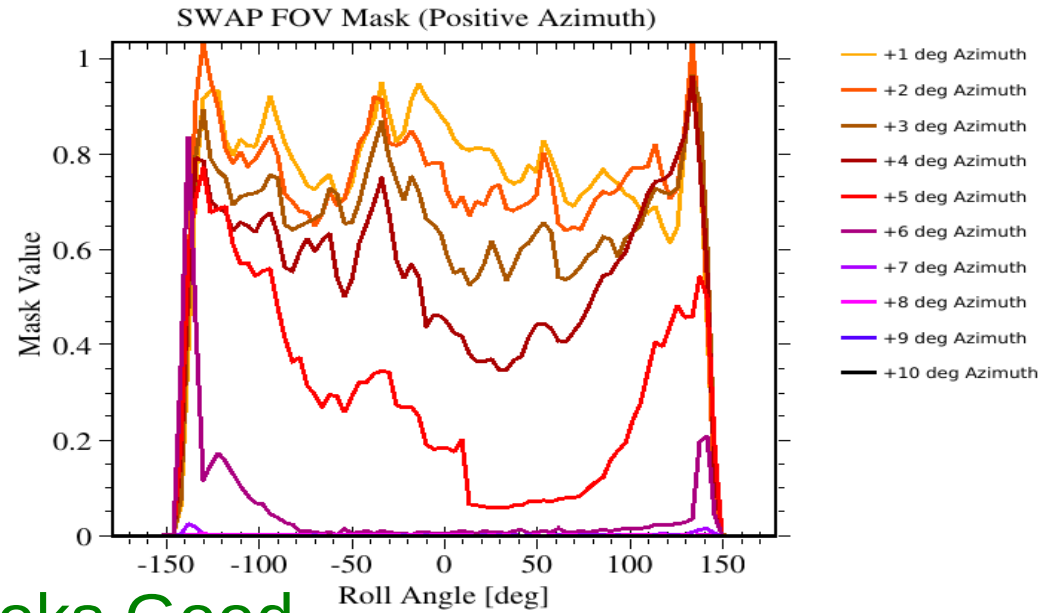


nh-a-swap-2-kem1-v3.0/calib
nh-a-swap-3-kem1-v3.0/calib
fov_mask_2d.tab







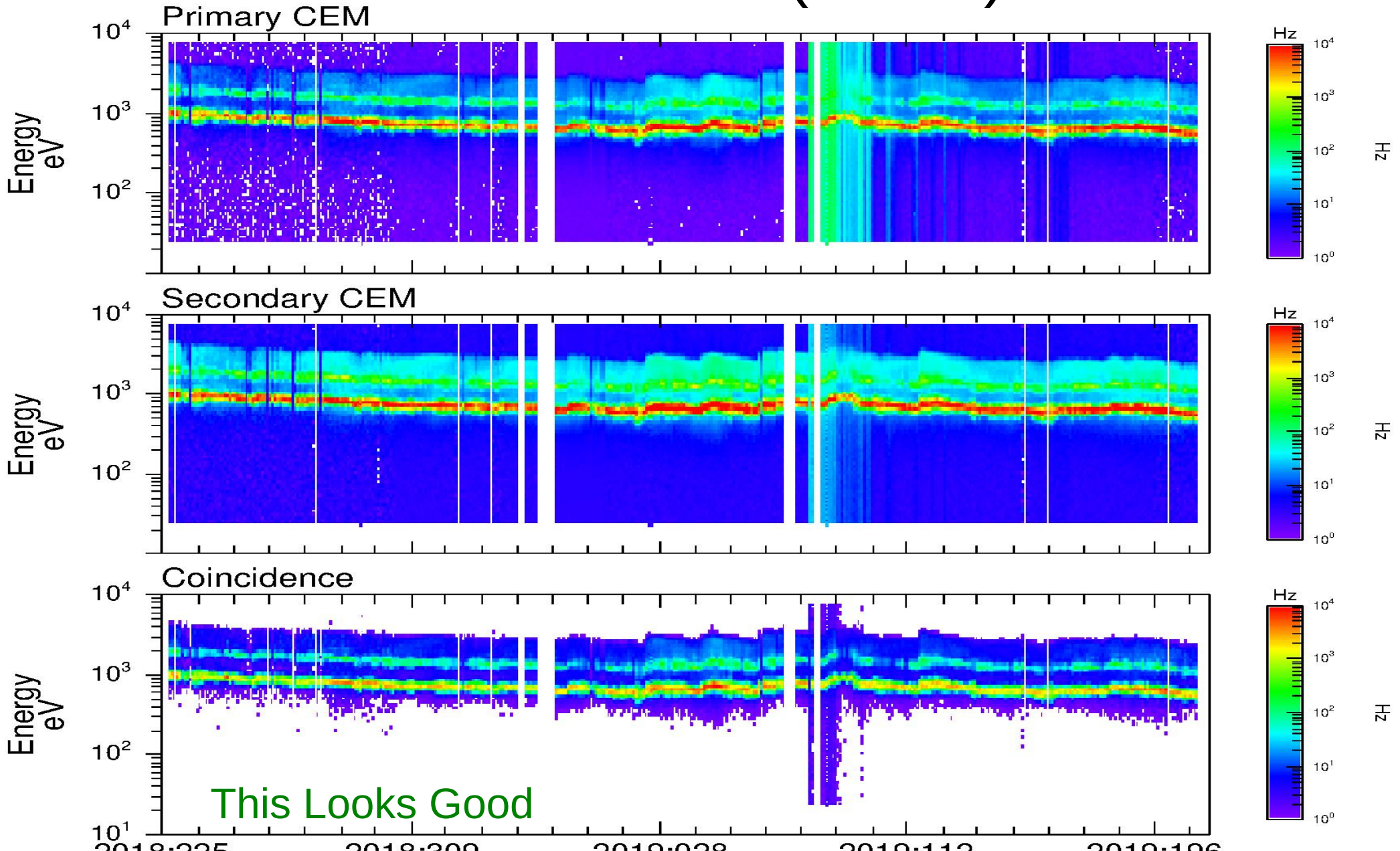


Plot created by SDDAS/gPlot - J. Mukherjee, et al. Generated on Mon May 11 14:44:57 2020.

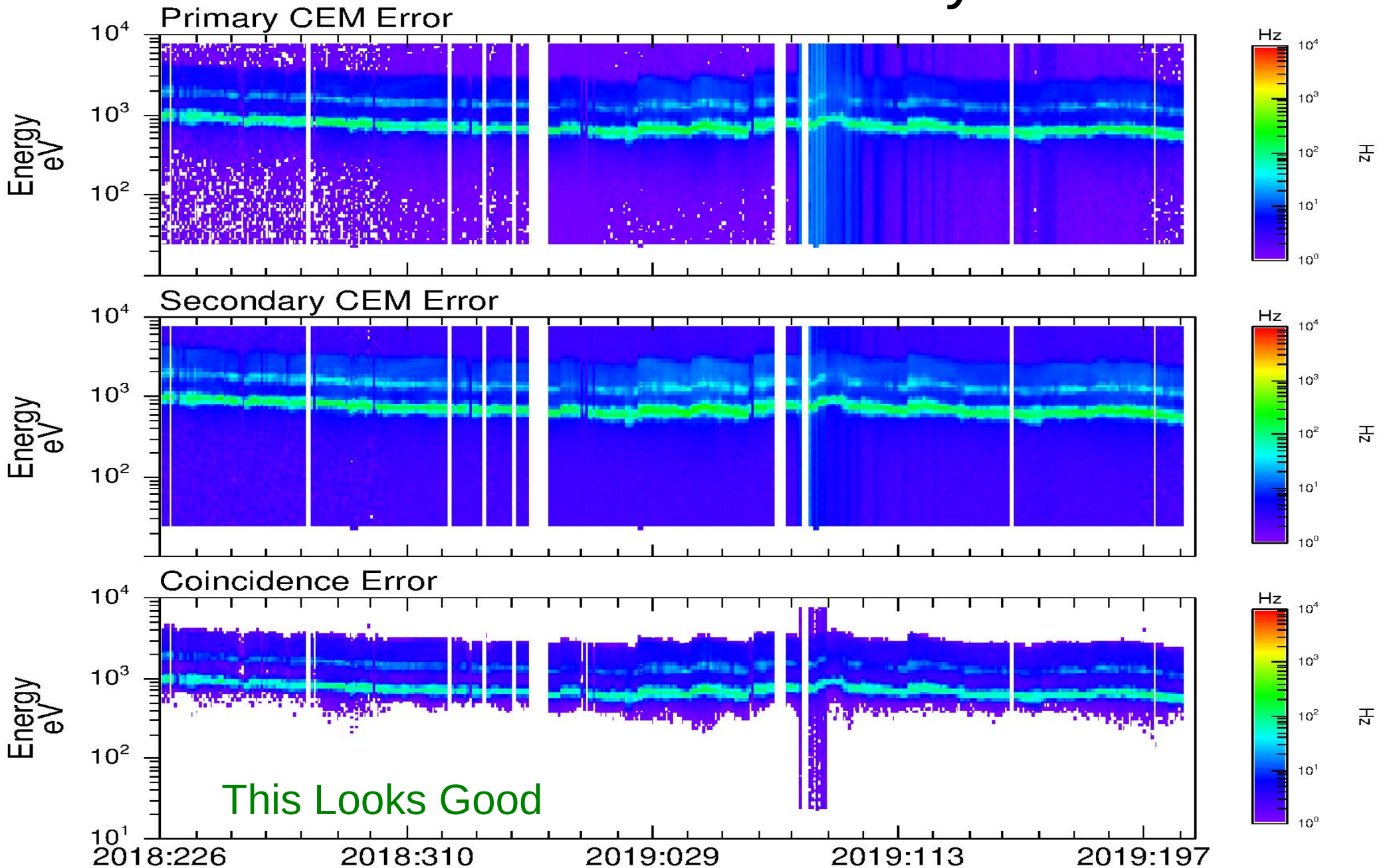
Data Looks Good

SWAP Data Evaluation

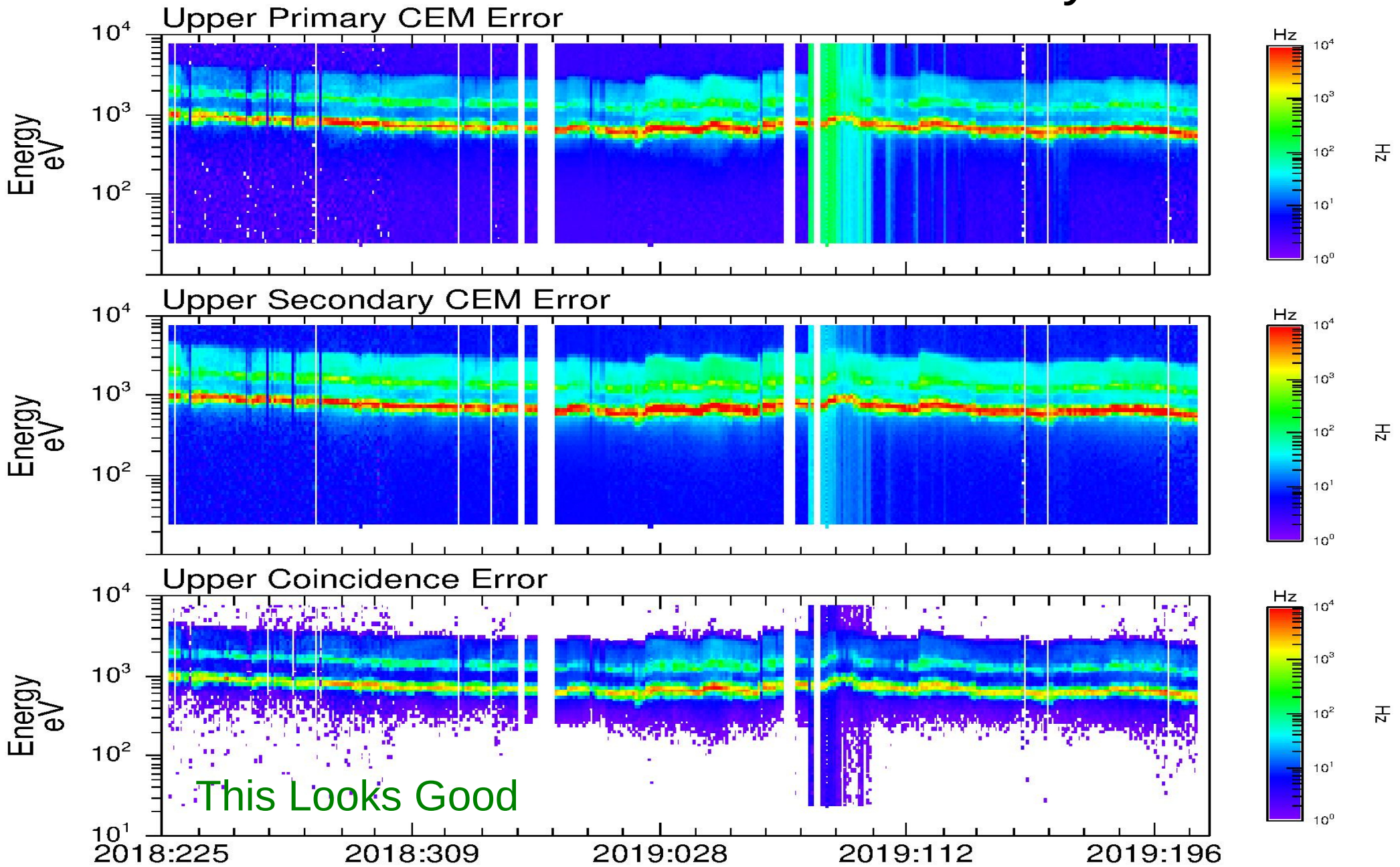
nh-a-swap-3-kem1-v3.0/data
Science Data (0x584)



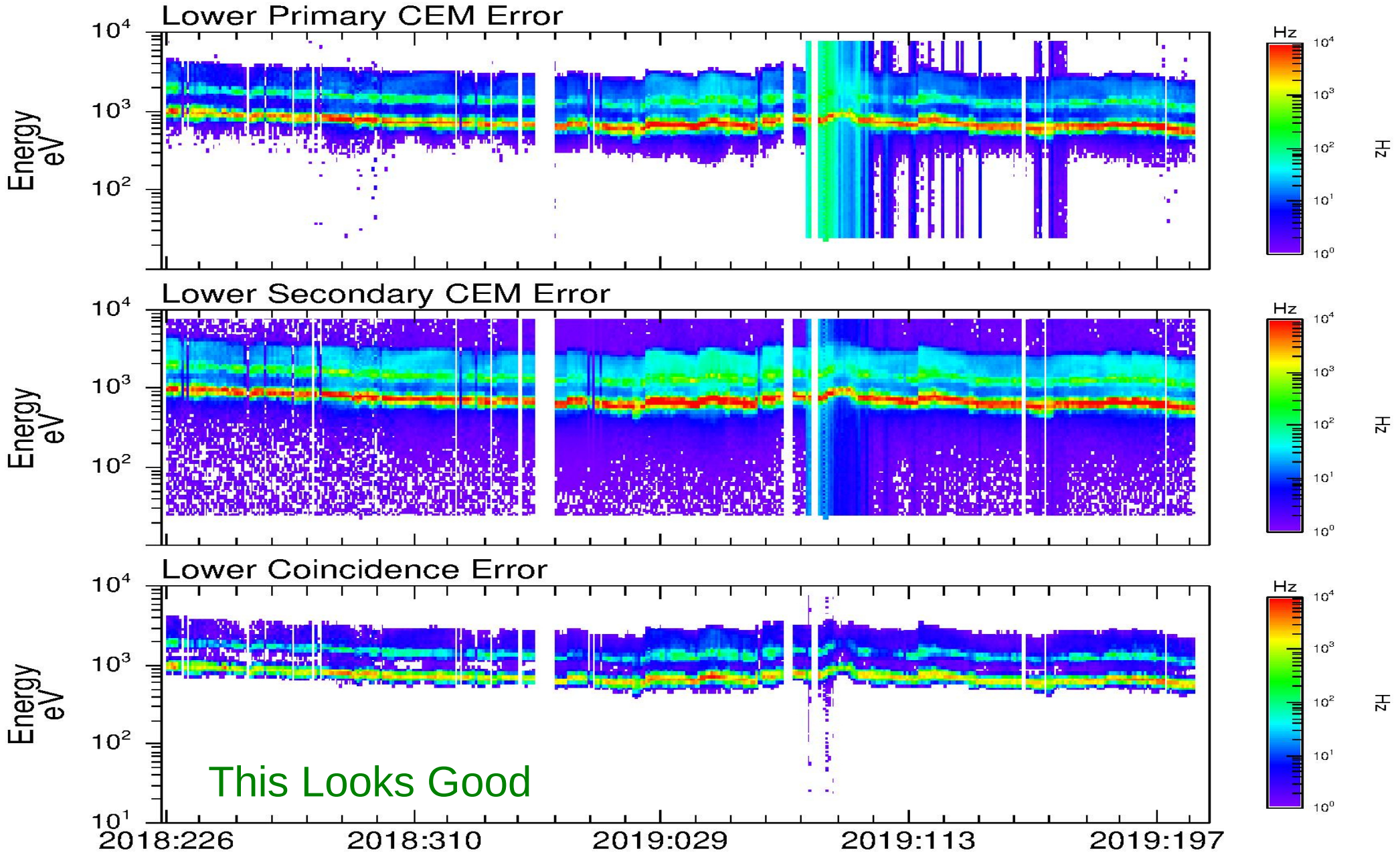
nh-a-swap-3-pluto-v3.0/data
Relative Uncertainty



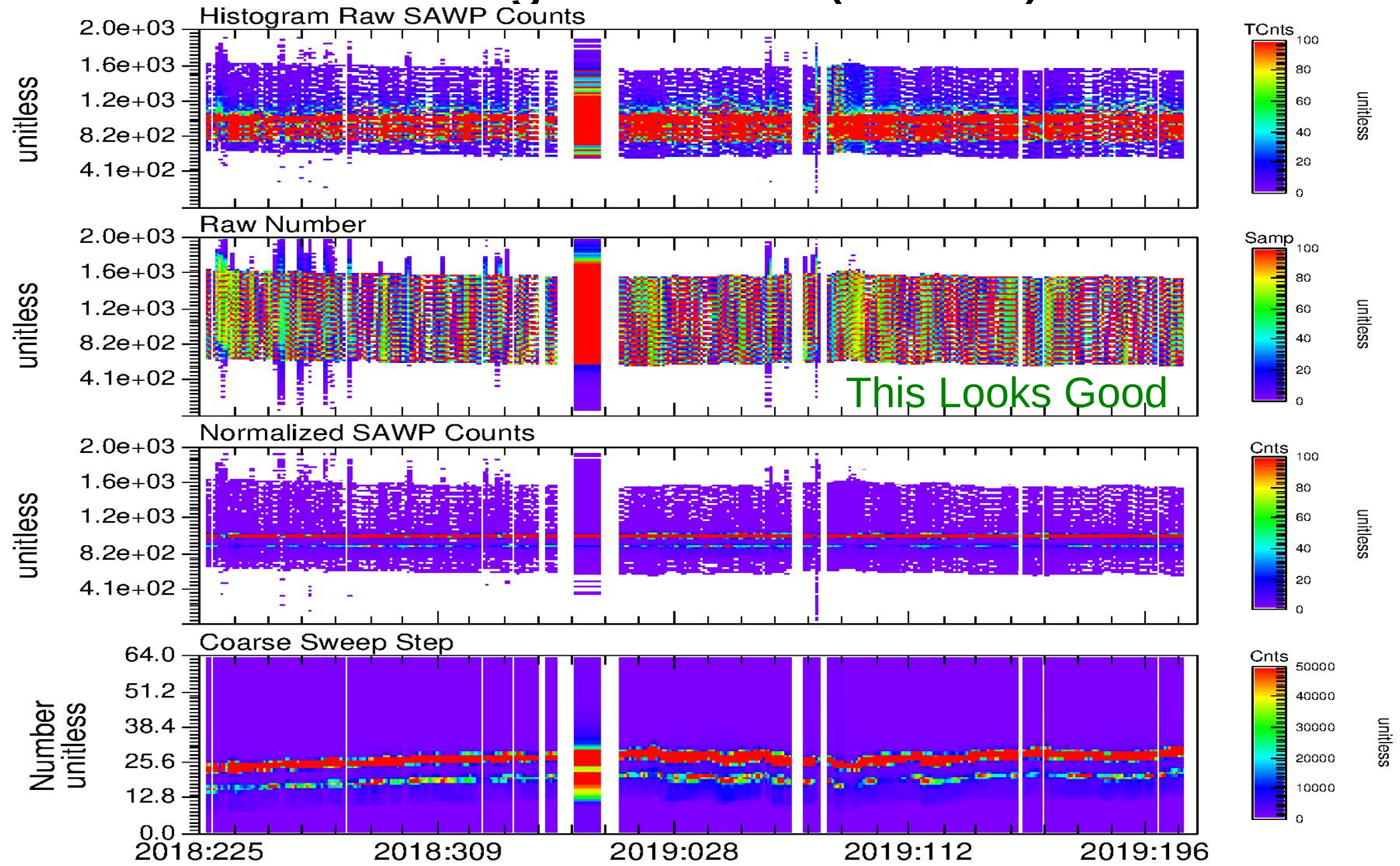
nh-a-swap-3-kem1-v3.0/data
Absolute Maximum Uncertainty



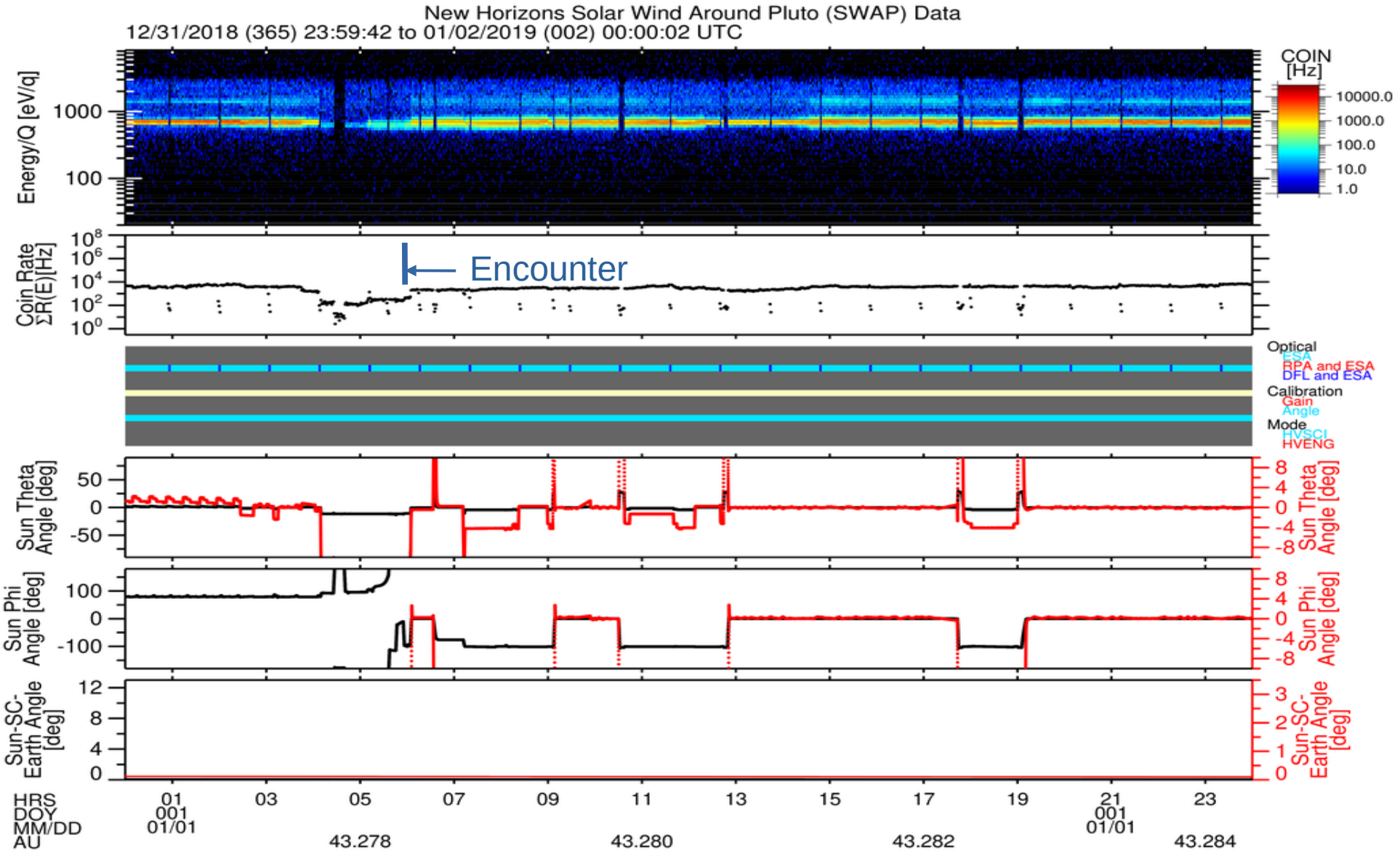
nh-a-swap-3-kem1-v3.0/data
Absolute Minimum Uncertainty



nh-a-swap-3-kem1-v3.0/data
Histogram Data (0x586)



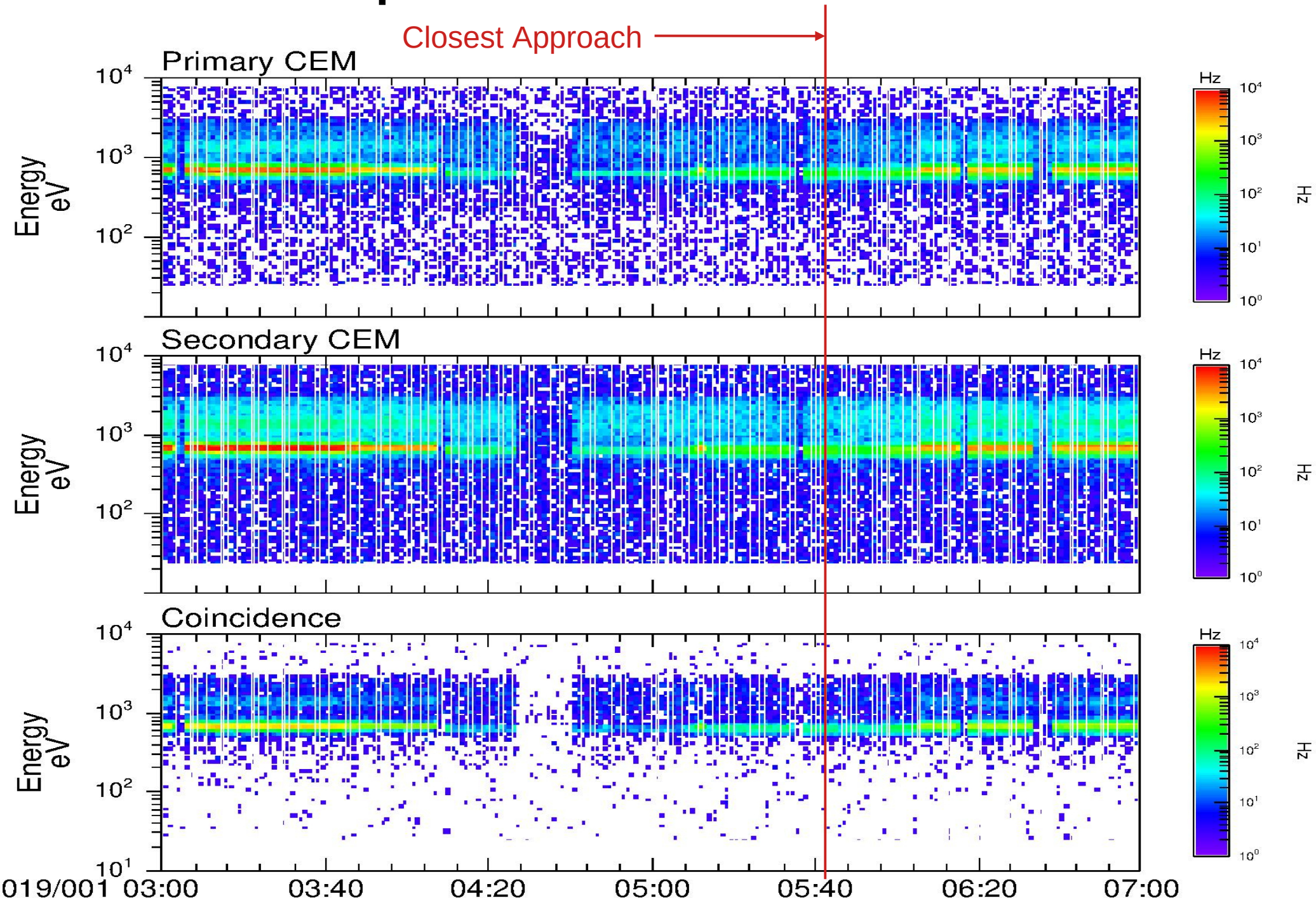
swap_001day_201812312359.png
Arrokoth Encounter



Software Version: ' 3.00000' Processed: 2020-01-25T21:21:35
Plot Created: Wed Mar 4 17:30:29 2020
Files: 0408585600_0x584_sci.fit to 0408758400_0x584_sci.fit

Spectrogram Timing Accurate to Within: 20.00 [sec]
Plot Width:: 0.754545 [norm]
Plot Width: 8.3000 [in]

Close-up of Arrokoth Encounter



swa_0407116800_0x584_sci.lbl


```
5550      "
5551    END_OBJECT    = COLUMN
5552    OBJECT        = COLUMN
5553      NAME          = "EEP1_RDY"
5554      BYTES         = 4
5555      COLUMN_NUMBER = 83
5556      DATA_TYPE     = "CHARACTER"
5557      START_BYTE    = 472
5558      DESCRIPTION   = "
5559                  Full Mnemonic:
5560                    SWAP_HK.EEP1_RDY
5561
5562                  General Description:
5563                    EEPROM 1 is ready to be written
5564
5565                  Extended Description:
5566                    EEPROM 2 is ready to be written
5567
5568                  Conversion:  STATES
5569                  - [lo:hi]=state description:
5570                    [0:0]=BUSY
5571                    [1:1]=READY
```

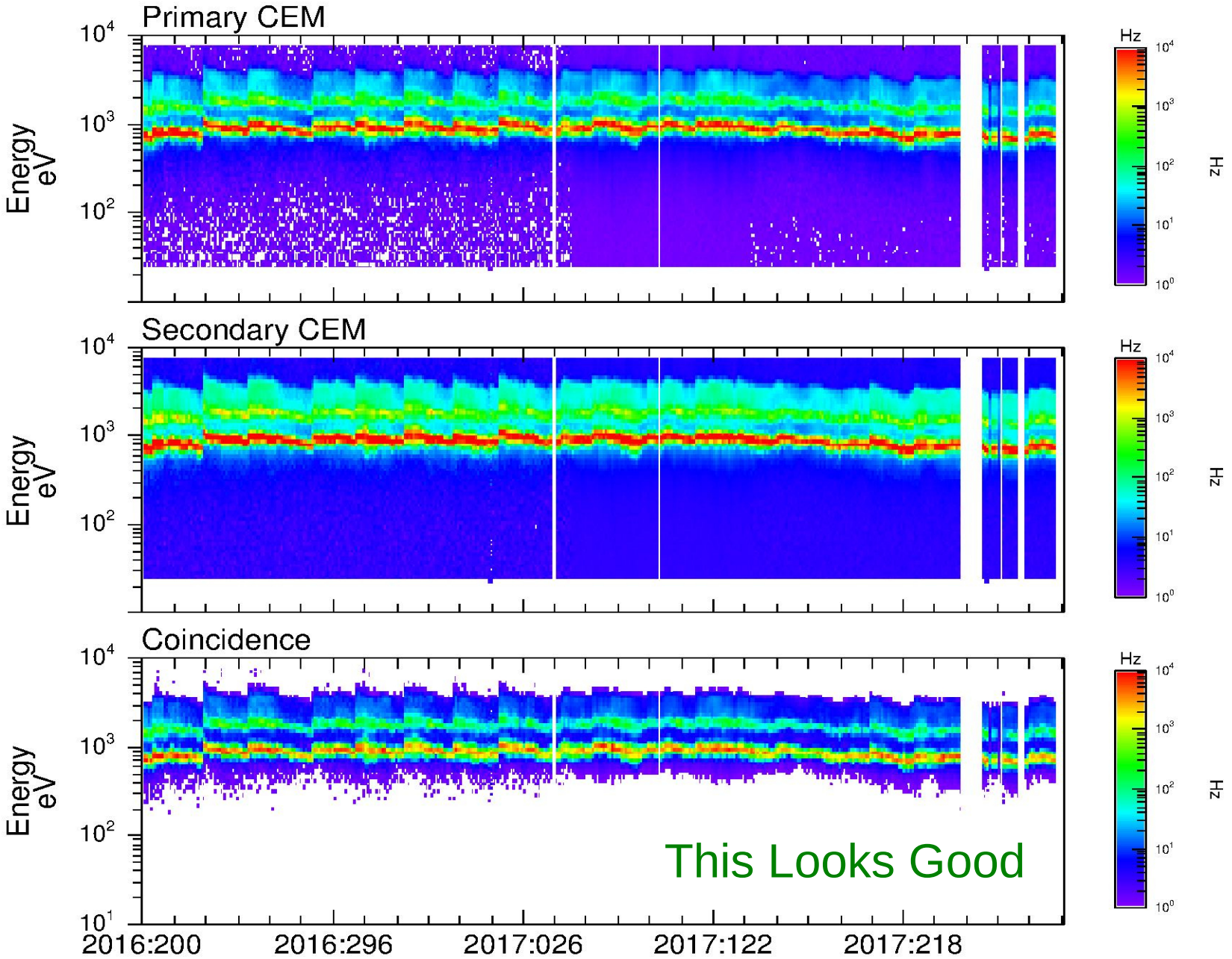
This should be EEPROM 1

Certification

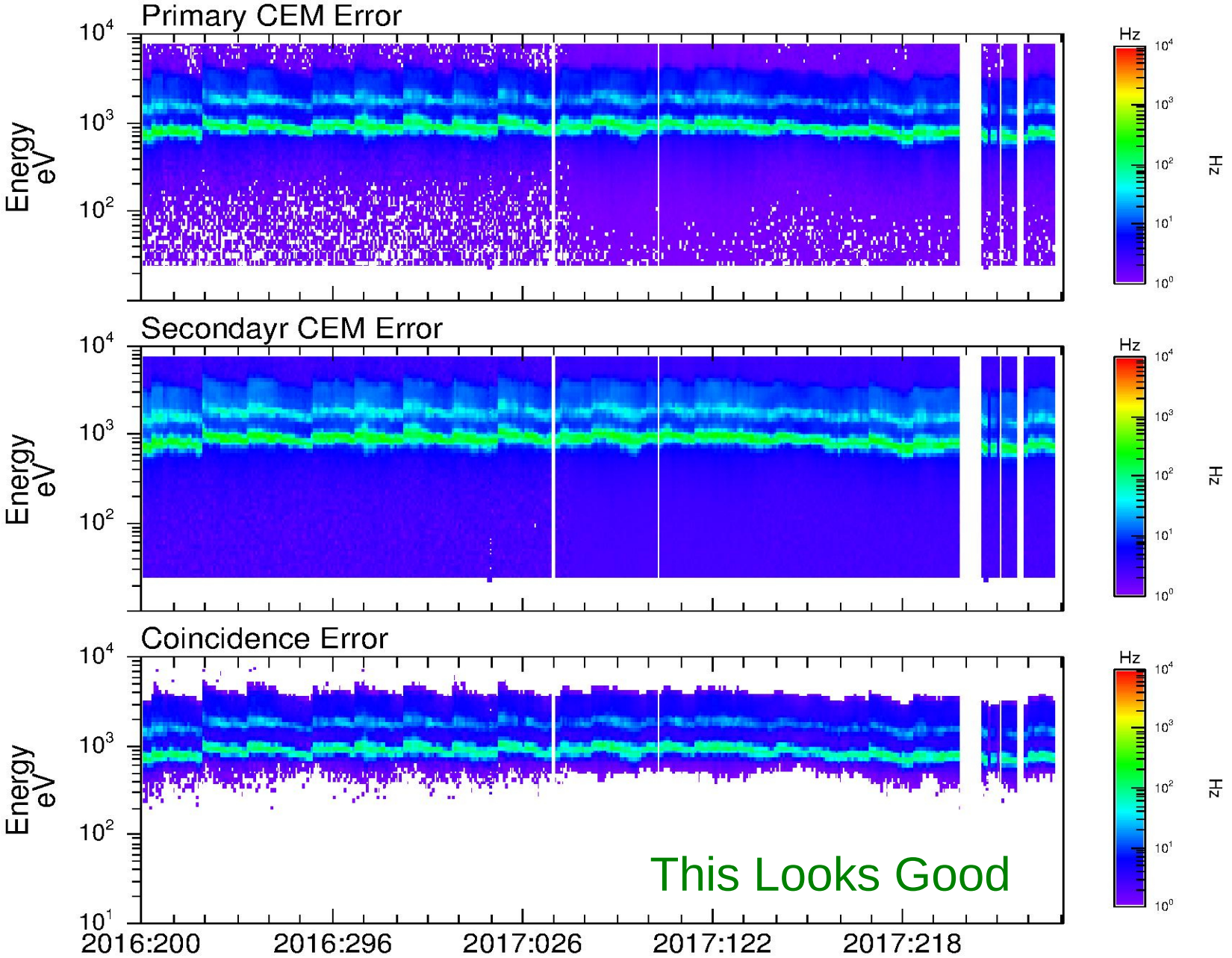
These SWAP data are certifiable once the issues have been fixed with the SWAP documentation. In particular, the SWAP calibration document, the New Horizons spacecraft catalog file, and the new Horizons KEM catalog file. There is also a minor error which effects the label files of the data. I recommend that this be treated as a spelling error. Other ApID files should be checked for the same “spelling” error.

BACK-UP SLIDES

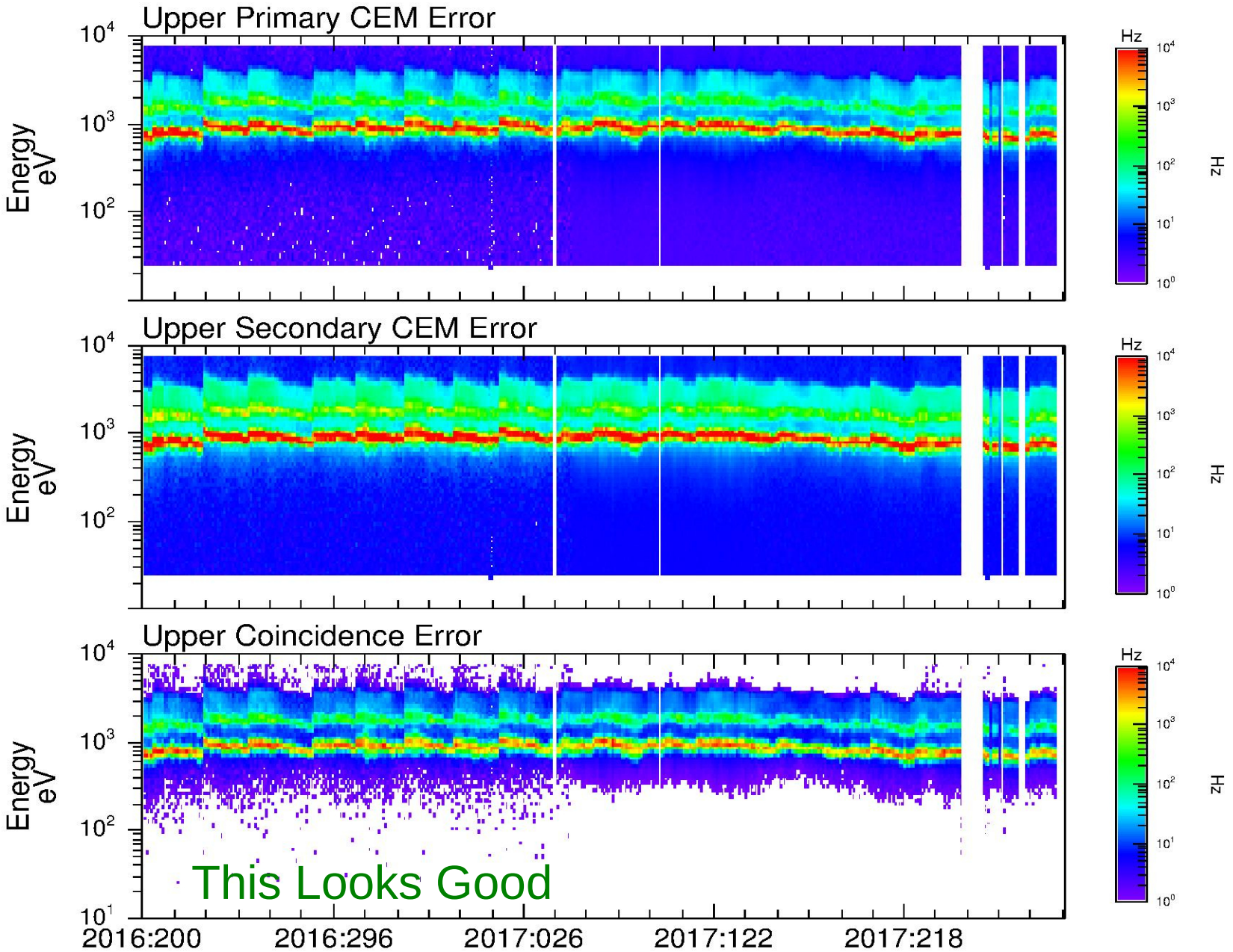
nh-p-swap-3-pluto-v3.0/data
Science Data (0x584)



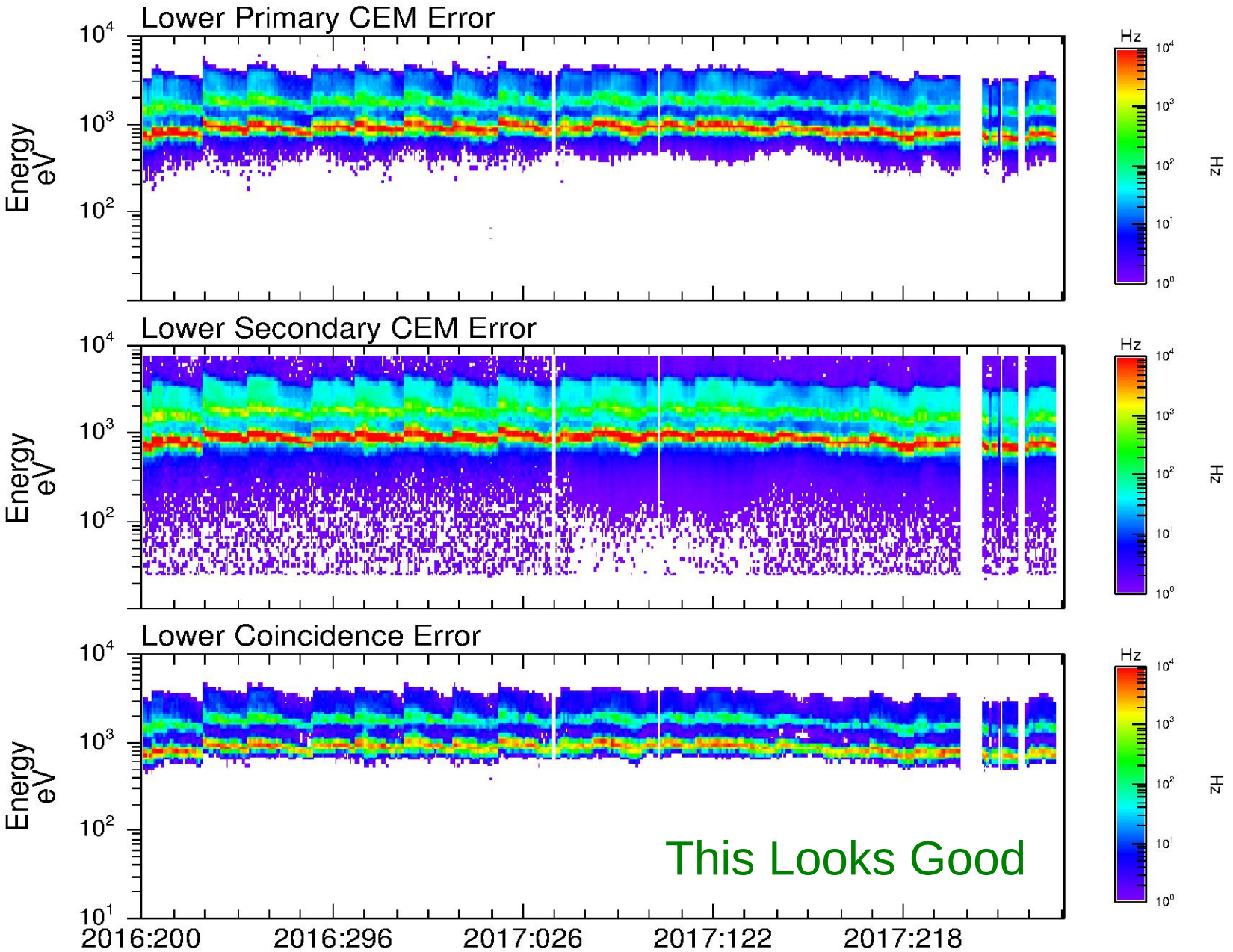
nh-p-swap-3-pluto-v3.0/data
Relative Uncertainty



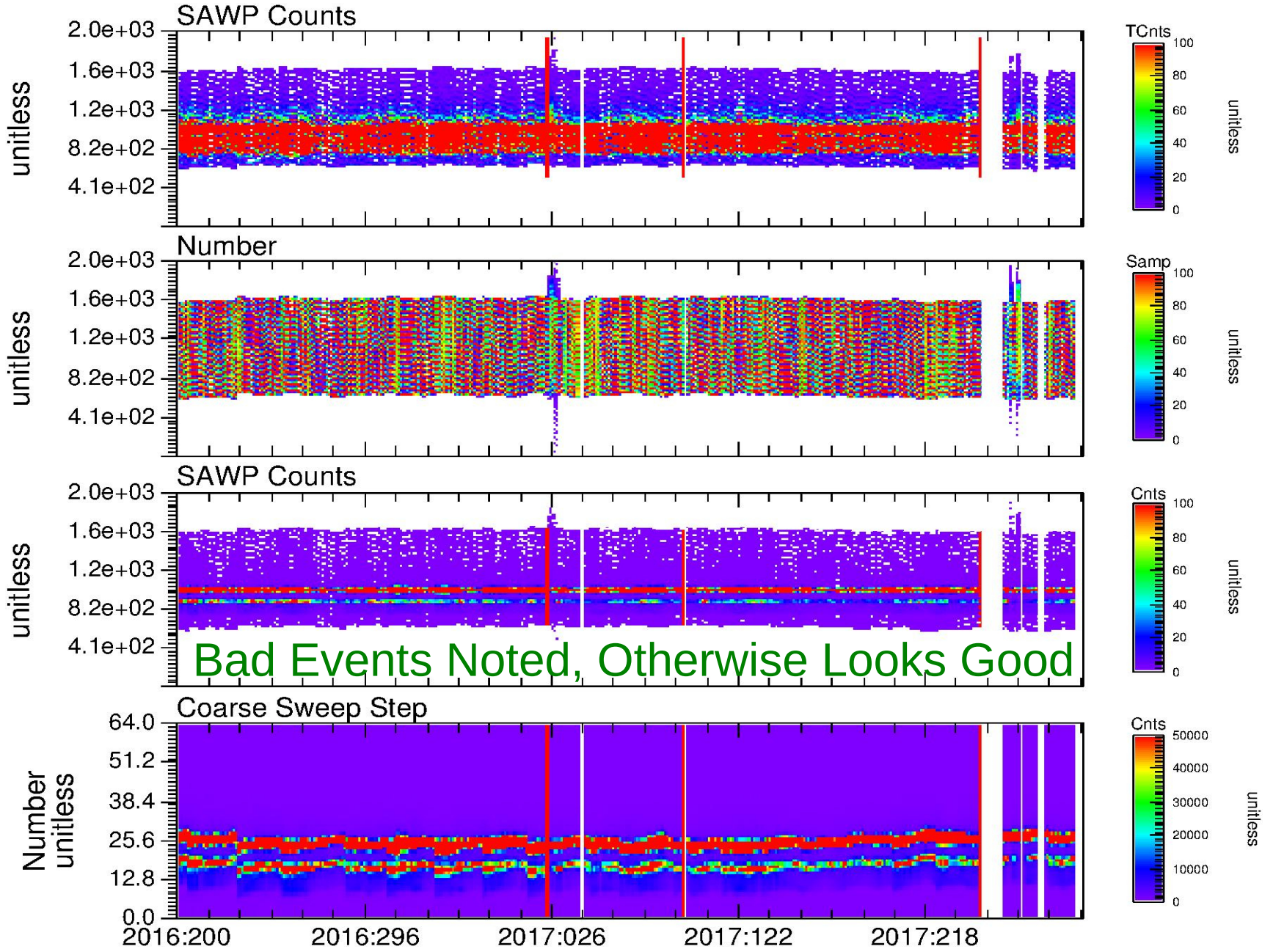
nh-p-swap-3-pluto-v3.0/data
Absolute Maximum Uncertainty



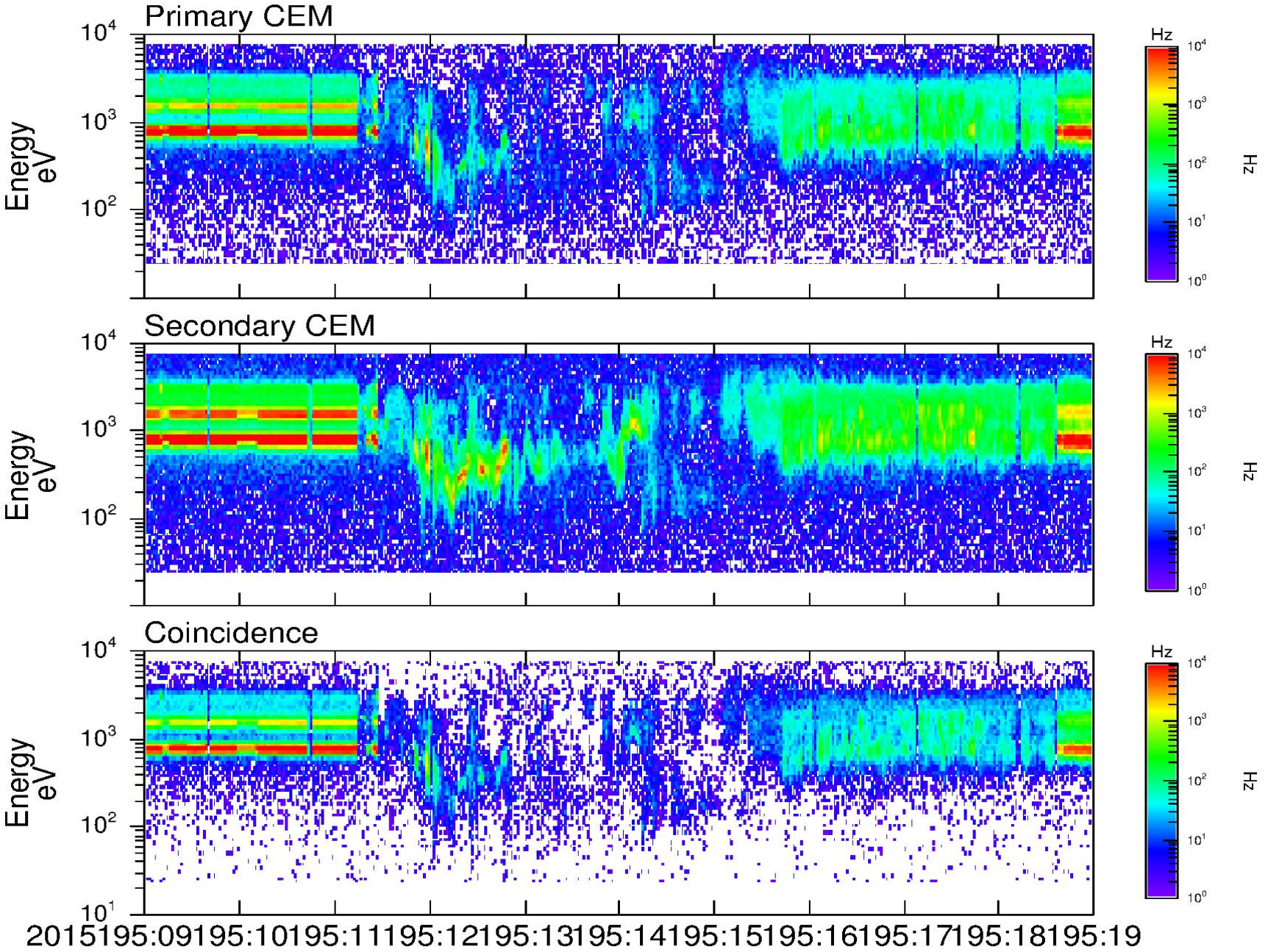
nh-p-swap-3-pluto-v3.0/data
Absolute Minimum Uncertainty



nh-p-swap-3-pluto-v3.0/data
Histogram Data (0x586)



nh-p-swap-3-pluto-v3.0/data
Pluto Encounter



nh-a-swap-2-kem1-v3.0
nh-a-swap-3-kem1-v3.0
aareadme.txt

GOOD

nh-a-swap-2-kem1-v3.0/calib
nh-a-swap-3-kem1-v3.0/calib
ref.cat

GOOD

nh-a-swap-2-kem1-v3.0/calib
nh-a-swap-3-kem1-v3.0/calib
swap.cat

GOOD

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
docinfo.txt

GOOD

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
codmac_level_definitions.lbl
codmac_level_definitions.pdf

GOOD

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
lunineetal1995.lbl & lunineetal1995.pdf

GOOD

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
nh_fov.lbl & nh_fov.png

GOOD

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
nh_met2utc.lbl & nh_met2utc.tab

GOOD

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
nh_mission_trajectory.lbl

GOOD

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
nh_swap_v200_ti.txt

GOOD

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
payload_ssr.lbl & payload_ssr.pdf

GOOD

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
quat_axyz_instr_to_j2k.lbl
quat_axyz_instr_to_j2k.asc

GOOD

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
seq_swap_kem1.lbl & seq_swap_kem1.tab

GOOD

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
soc_inst_icd.lbl

GOOD

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
swap_ssr.lbl & swap_ssr.pdf

GOOD

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
traj/trajinfo.txt

GOOD

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
traj/traj.fmt

GOOD

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
traj/traj_2006_2021_1d.lbl

GOOD

nh-a-swap-2-kem1-v3.0/document
nh-a-swap-3-kem1-v3.0/document
data_summary_plots/data_summary.lbl

GOOD

nh-a-swap-2-kem1-v3.0/calib
nh-a-swap-3-kem1-v3.0/calib
calinfo.txt

GOOD

nh-a-swap-2-kem1-v3.0/calib
nh-a-swap-3-kem1-v3.0/calib
background_009_dac.lbl

GOOD

nh-a-swap-2-kem1-v3.0/calib
nh-a-swap-3-kem1-v3.0/calib
background_009_dac_jup.lbl

GOOD

nh-a-swap-2-kem1-v3.0/calib
nh-a-swap-3-kem1-v3.0/calib
list_energy_files.lbl & list_energy_files.tab

GOOD

nh-a-swap-2-kem1-v3.0/calib
nh-a-swap-3-kem1-v3.0/calib
esa_rpa_v16_energy_binsf_new.lbl

GOOD

nh-a-swap-2-kem1-v3.0/calib
nh-a-swap-3-kem1-v3.0/calib
esa_rpa_v18_energy_binsf_new.lbl

GOOD

nh-a-swap-2-kem1-v3.0/calib
nh-a-swap-3-kem1-v3.0/calib
esa_rpa_v18_energy_binsf_new2.lbl

GOOD

nh-a-swap-2-kem1-v3.0/calib
nh-a-swap-3-kem1-v3.0/calib
esa_shape.lbl

GOOD

nh-a-swap-2-kem1-v3.0/calib
nh-a-swap-3-kem1-v3.0/calib
rpa_shape.lbl

GOOD

nh-a-swap-2-kem1-v3.0/calib
nh-a-swap-3-kem1-v3.0/calib
fov_mask_2d.lbl

GOOD

nh-a-swap-2-kem1-v3.0/index
nh-a-swap-3-kem1-v3.0/index
indxinfo.txt

GOOD

nh-a-swap-2-kem1-v3.0/index
nh-a-swap-3-kem1-v3.0/index
index.lbl & index.tab

GOOD

nh-a-swap-2-kem1-v3.0/index
nh-a-swap-3-kem1-v3.0/index
slimindx.lbl & slimindx.tab

GOOD

nh-a-swap-2-kem1-v3.0/index
nh-a-swap-3-kem1-v3.0/index
checksum.lbl & checksum.tab

GOOD