Solar Wind Around Pluto SWAP

PRINCIPAL INVESTIGATOR
Dave McComas, Princeton University

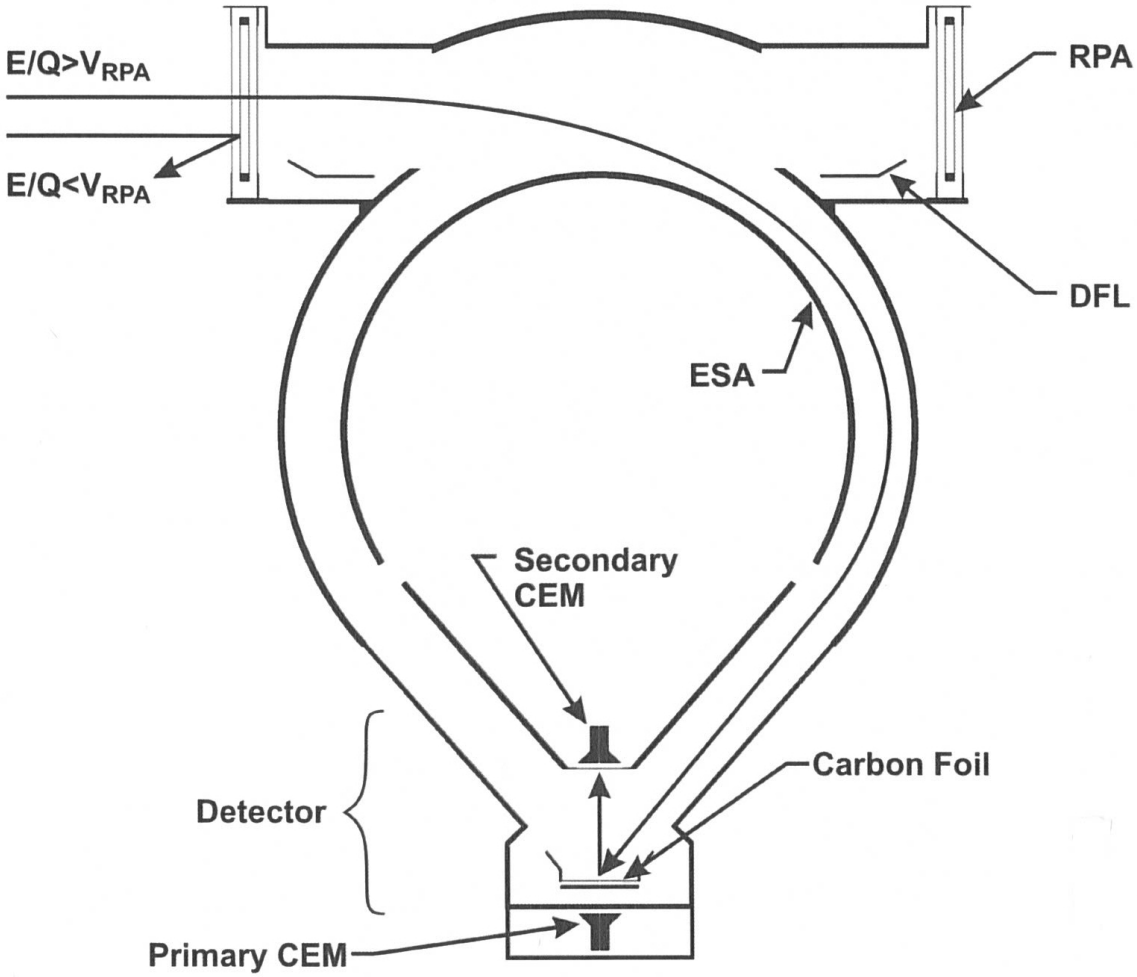
DESCRIPTION
Low Energy Plasma Instrument

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-v6.0

CALIBRATED Data Sets:
nh-a-swap-3-kem1-v6.0

New Horizons SWAP Data Set Evaluation Tools

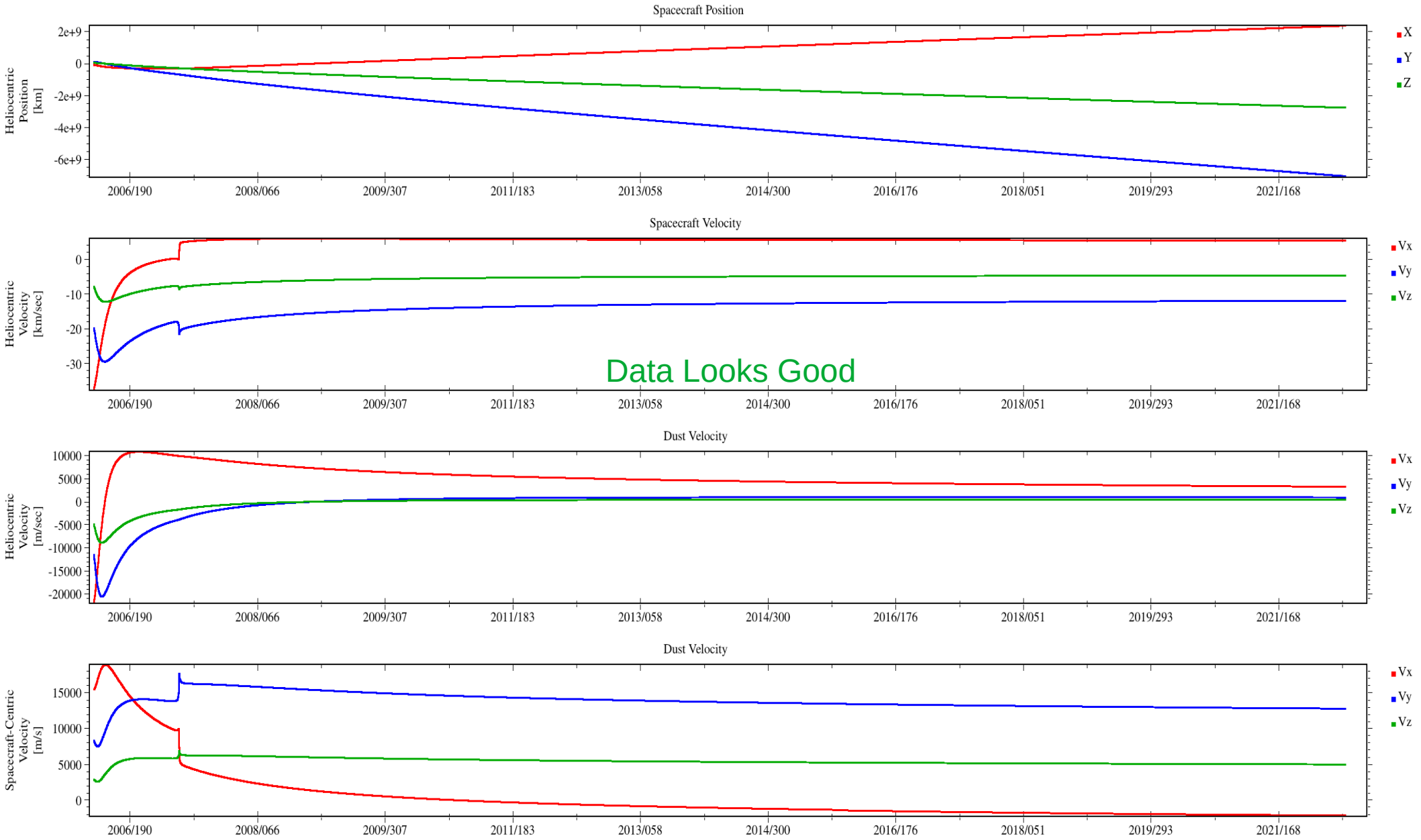
Staging and Evaluation -
- Machine: Dell Precision Tower 5810
- Operating System: Rocky-8 linux

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

Minor Diagnostics -
- Machine: Dell 7520
- Operating System: Fedora 33 linux

SWAP RAW and CALIBRATED Documentation Evaluation

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
nh_mission_trajectory.tab



nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
soc_inst_icd.pdf – 1 of 3

boundaries and shocks. In Figure 14-8 we show examples of what coincidence and an error coincidence spectrogram arrays look like when opened in FV.

14.5.4 Errors

In the level 3 (calibrated) data files an error value for every measurement is given in the extension labeled ERROR_BARS. We also provide spectrogram arrays for each signal type for the errors in the extensions labeled X_ERROR_BARS_SPECT_HZ where X is PCEM, SCEM, or COIN. The errors provided are errors for the rates, and an error for the sample time, and data compression when compression occurs. The raw rates (count counts per sample (C)) are converted to Hz using the 0.390 sec sample/accumulation time (t) (Equation 1). The error squared is given in Equations 2 and 3, and the fractional error squared is shown Equation 4. Taking the square root the resulting fractional error is given by Equation 5. The final error given in the data files is shown in Equation 6. If the count rates are not compressed (C_{un}) then $C = C_{un}$ and $\Delta C = \sqrt{C_{un}}$. However, if the counts are compressed (C_{comp}) then $C = 16C_{comp} + 7.5$ and $\Delta C = \sqrt{(16C_{comp} + 7.5)}$. In the ERROR table there is a column indicating if a background has been removed. The background is described in Section **Error! Bookmark not defined.** and described in detail in the calibration document.

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
soc_inst_icd.pdf – 2 of 3

$$R_c = \frac{C}{t} \qquad \text{(Equation 1)}$$

$$(\Delta R_c)^2 = \left(\frac{\partial R_c}{\partial t}\right)^2 (\Delta t)^2 + \left(\frac{\partial R_c}{\partial C}\right)^2 (\Delta C)^2 \qquad \text{(Equation 2)}$$

$$(\Delta R_c)^2 = \left(\frac{C^2}{t^4}\right)^2 (\Delta t)^2 + \left(\frac{1}{t}\right)^2 (\Delta C)^2 \qquad \text{(Equation 3)}$$

Incorrect, $\partial R_c = (-C/t^2) * \partial t$

$$\frac{(\Delta R_c)^2}{R_c^{\,2}} = \frac{(\Delta t)^2}{t^2} + \frac{(\Delta C)^2}{C^2} \qquad \text{(Equation 4)}$$

← Correct

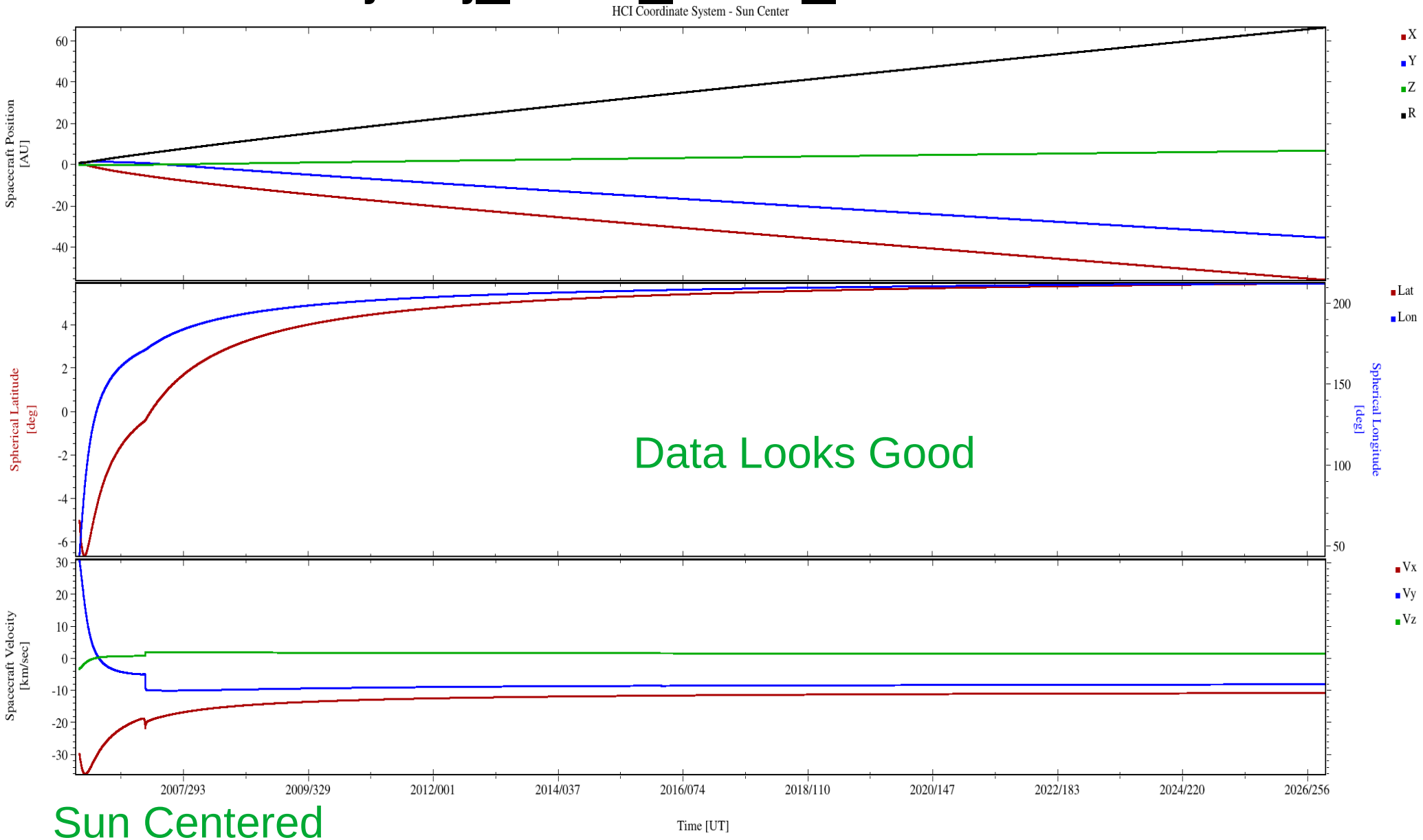
Note that this was not corrected from version 5

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
soc_inst_icd.pdf – 3 of 3

in calibration (see calibration document). We also calculate the position and velocity of the spacecraft in IAU Jupiter Cartesian coordinates. The

Sentence stops abruptly and then continues on the next page!

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
traj/traj_2006_2028_1d.tab - HCI



Sun Centered

Plot created by SDDAS/gPlot - J. Mukherjee, et al. Generated on Fri Oct 7 12:06:38 2022.

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nh-a-swap-3-kem1-v6.0/document
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nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
traj/traj_2006_2028_1d.tab - ECLIPJ2000

Sun Centered

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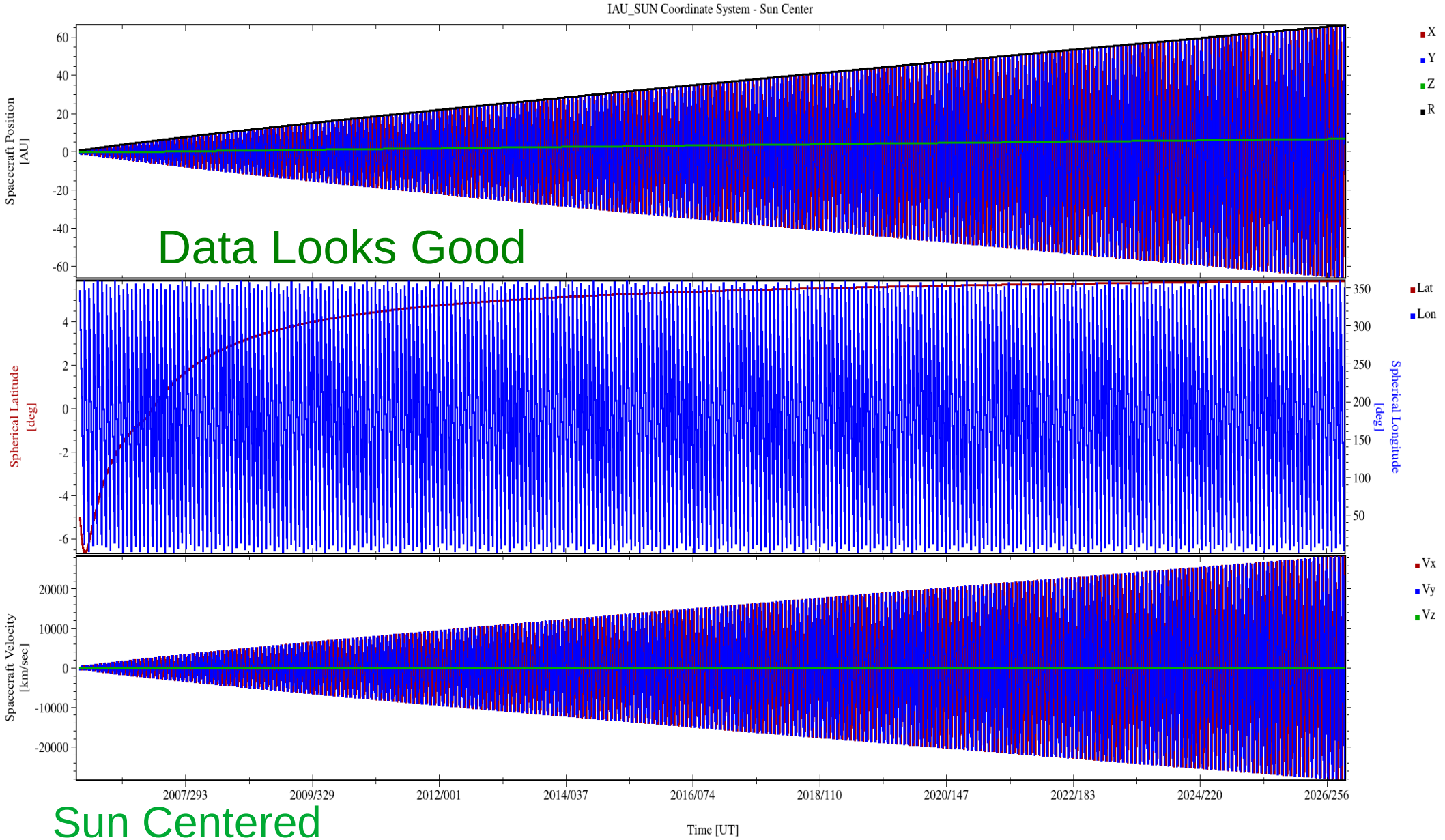

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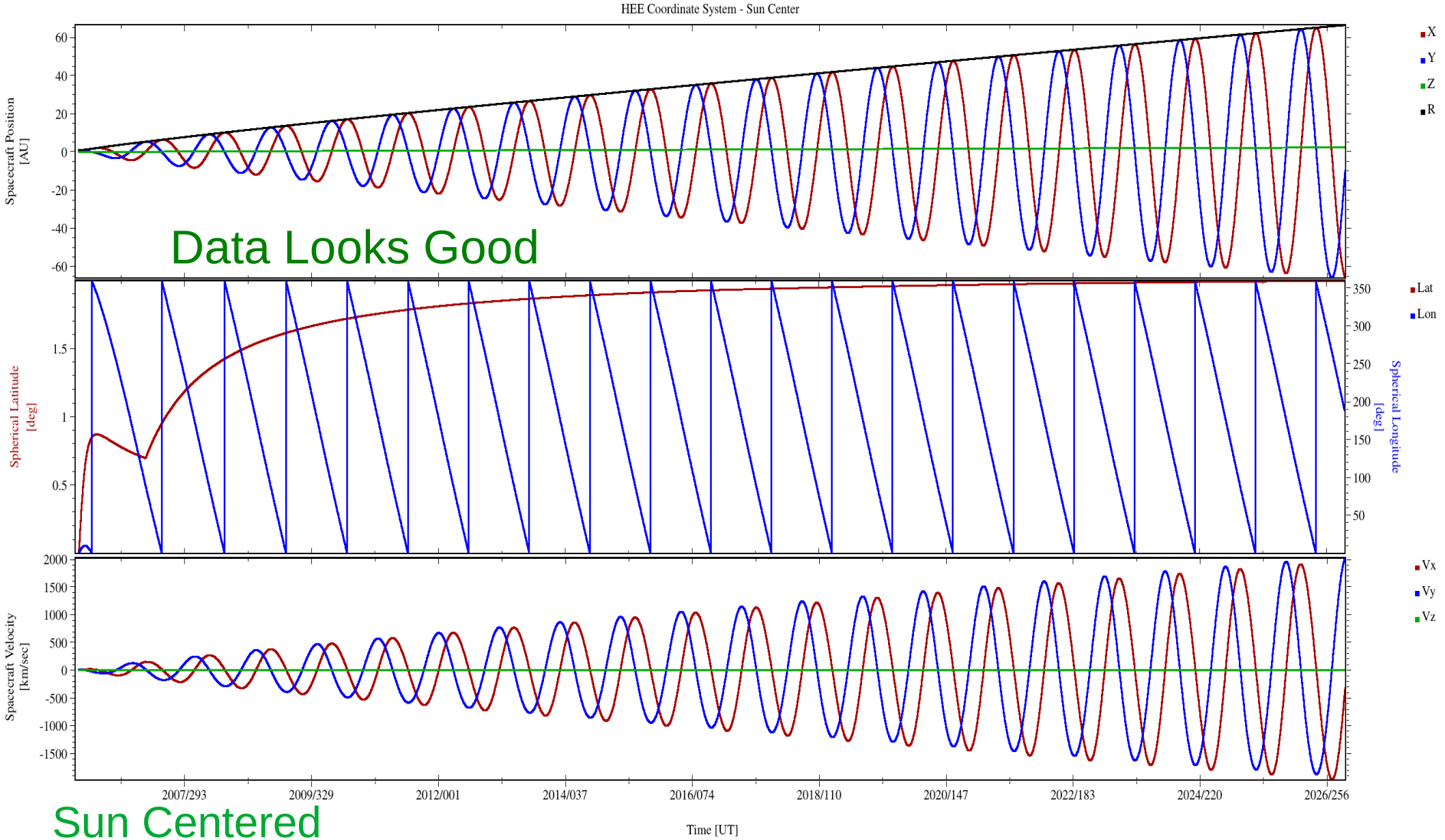

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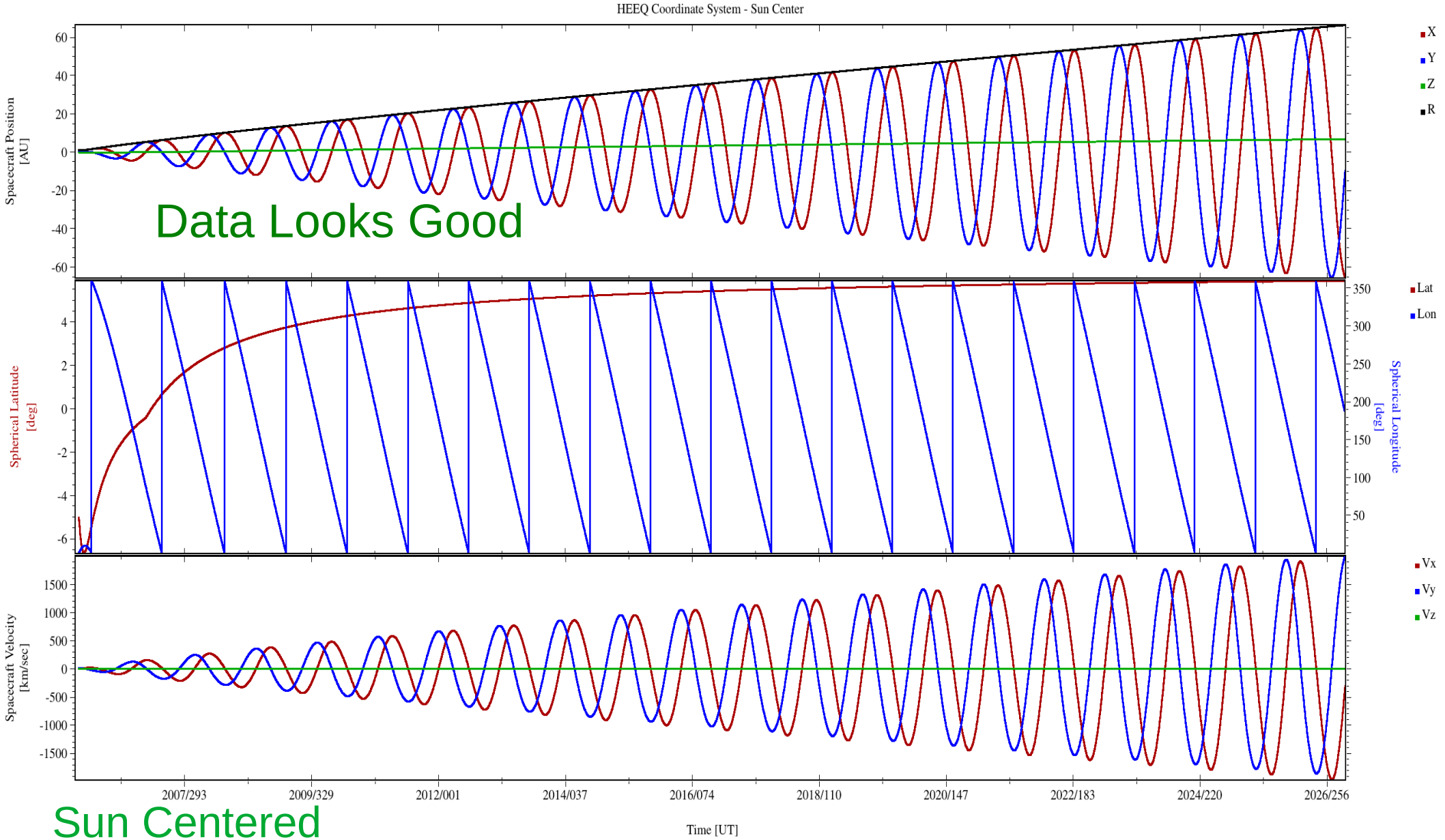

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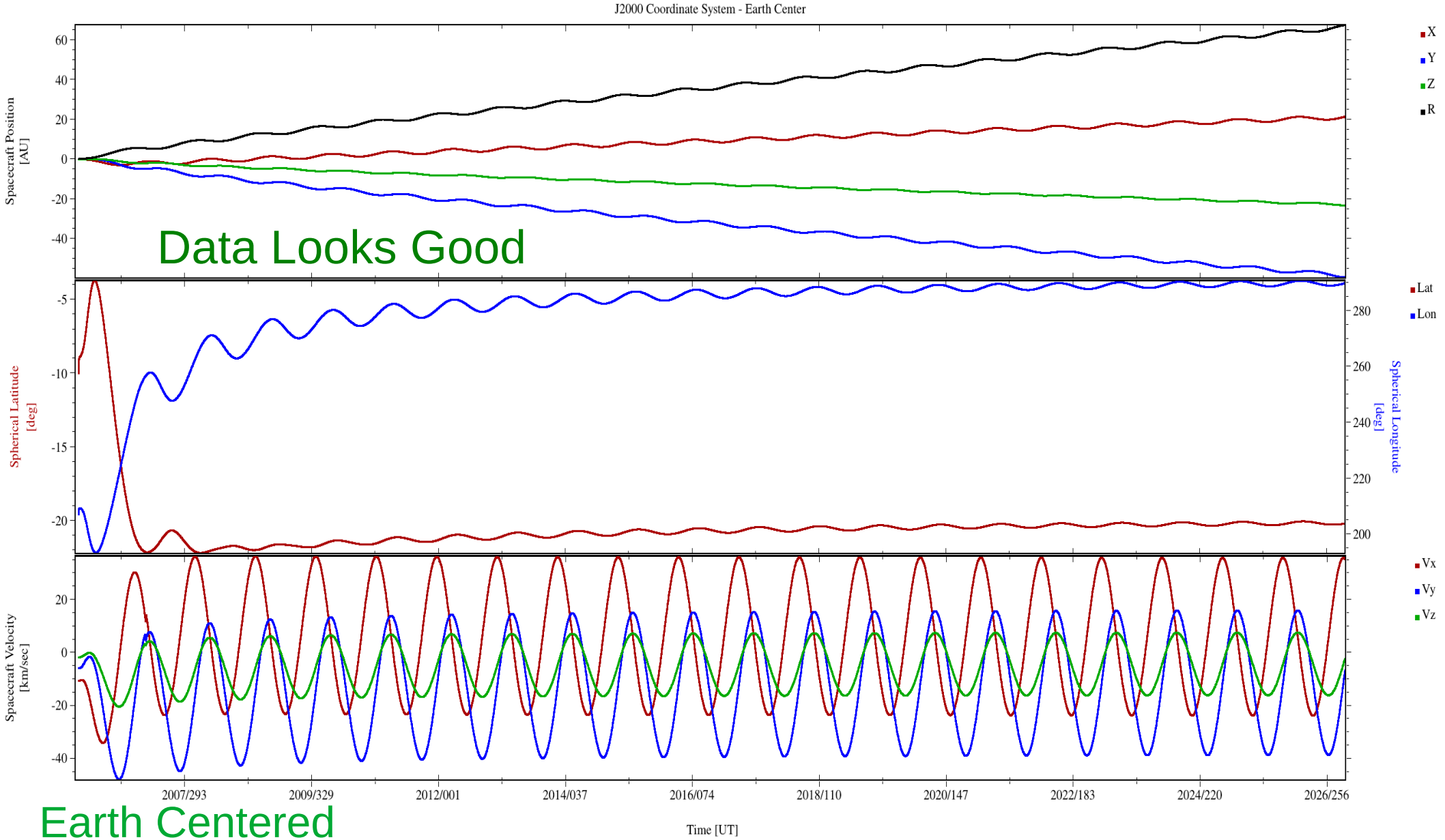
traj/traj_2006_2028_1d.tab - J2000



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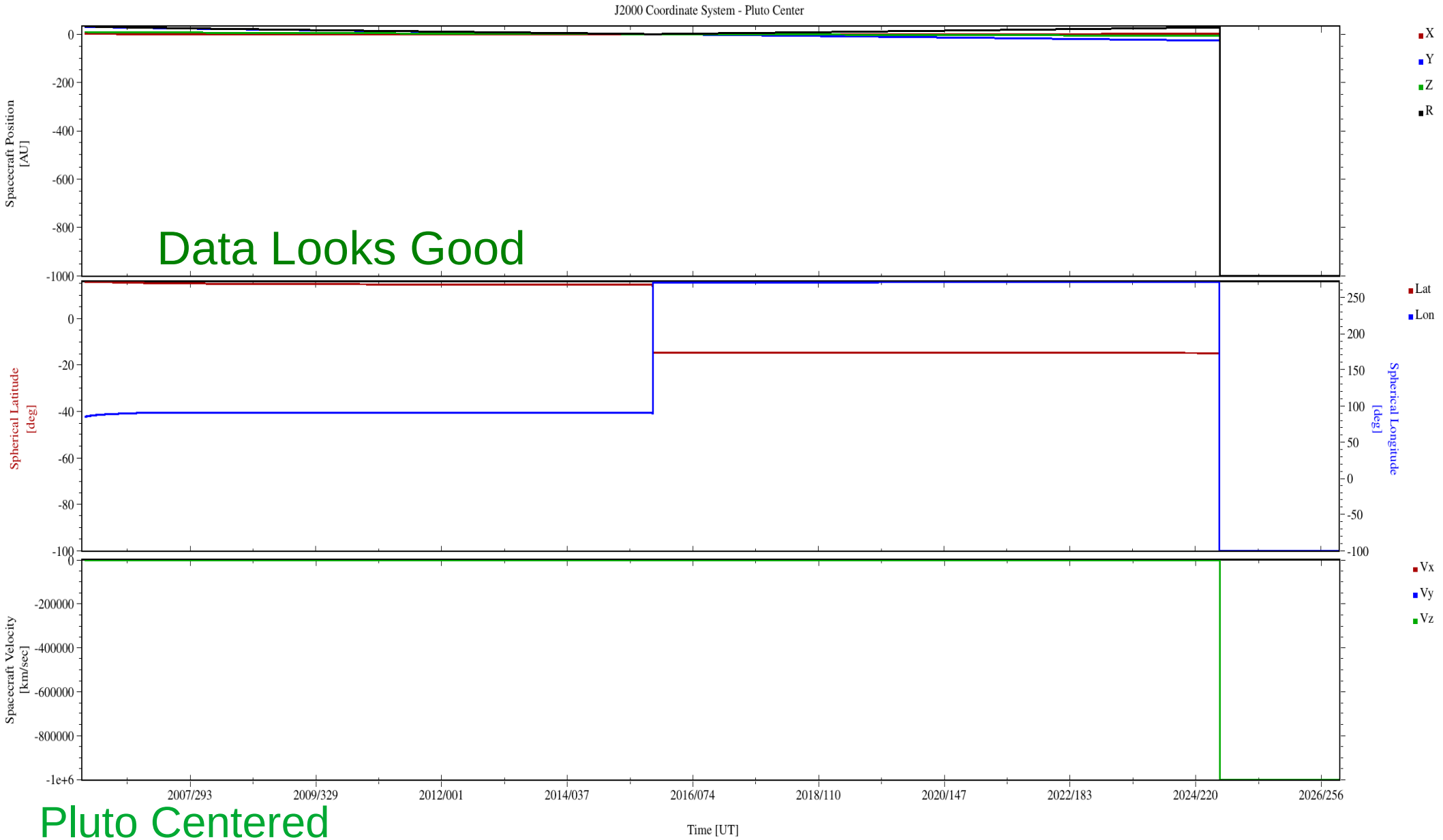

Data Looks Good

Pluto Centered

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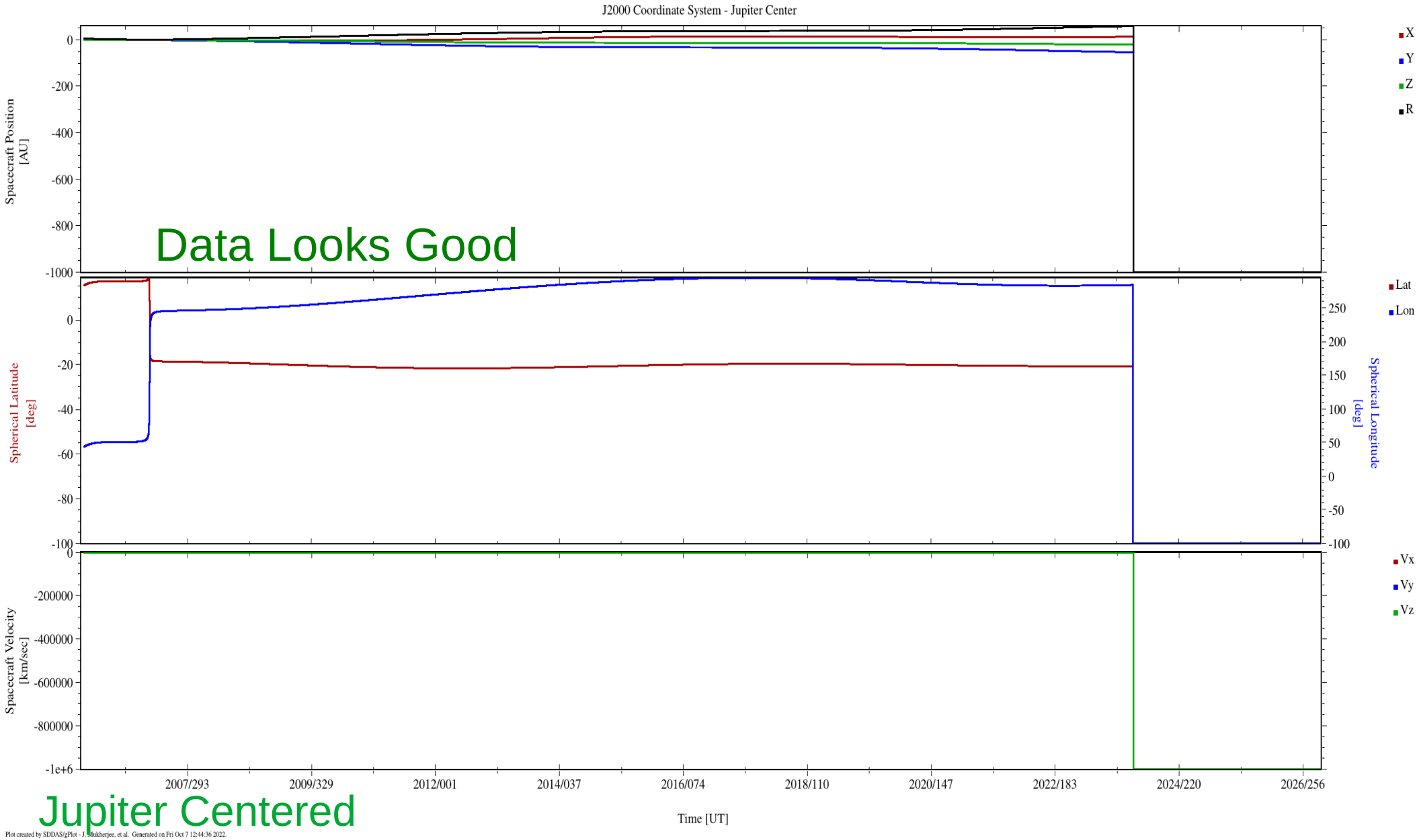
nh-a-swap-3-kem1-v6.0/document
traj/traj_2006_2028_1d.tab - J2000



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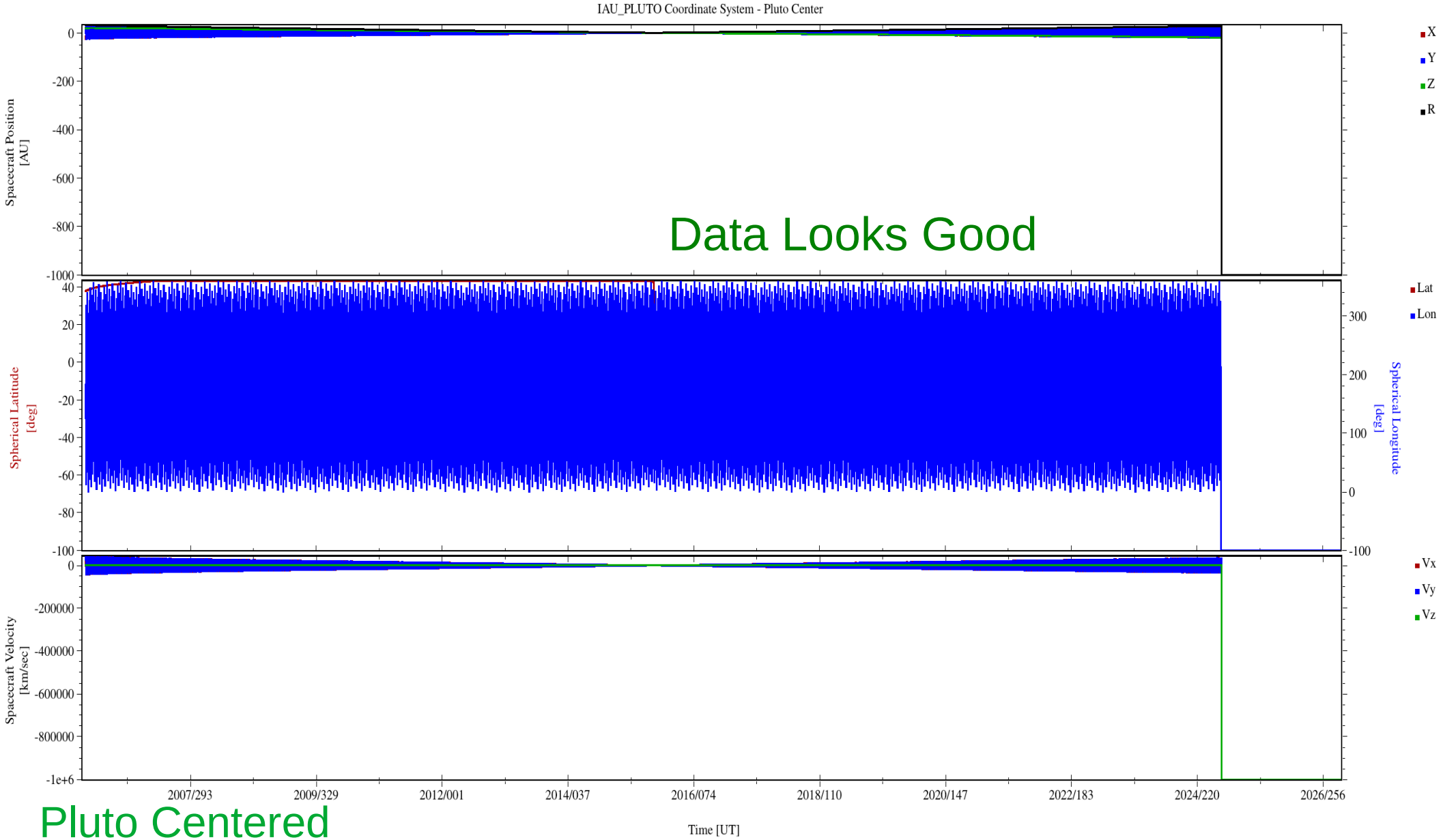

Data Looks Good

Pluto Centered

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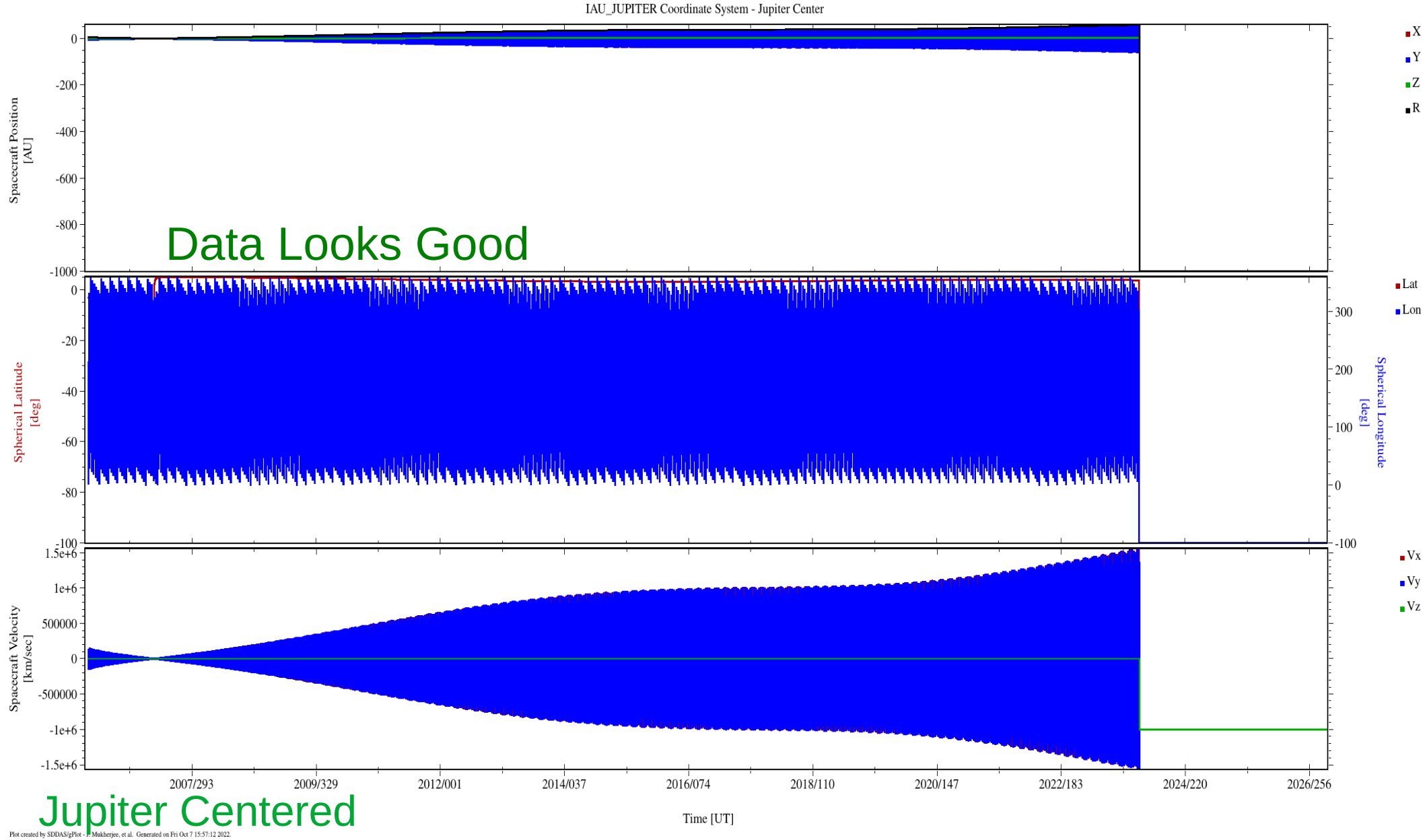
nh-a-swap-3-kem1-v6.0/document
traj/traj_2006_2028_1d.tab - IAU_JUPITER



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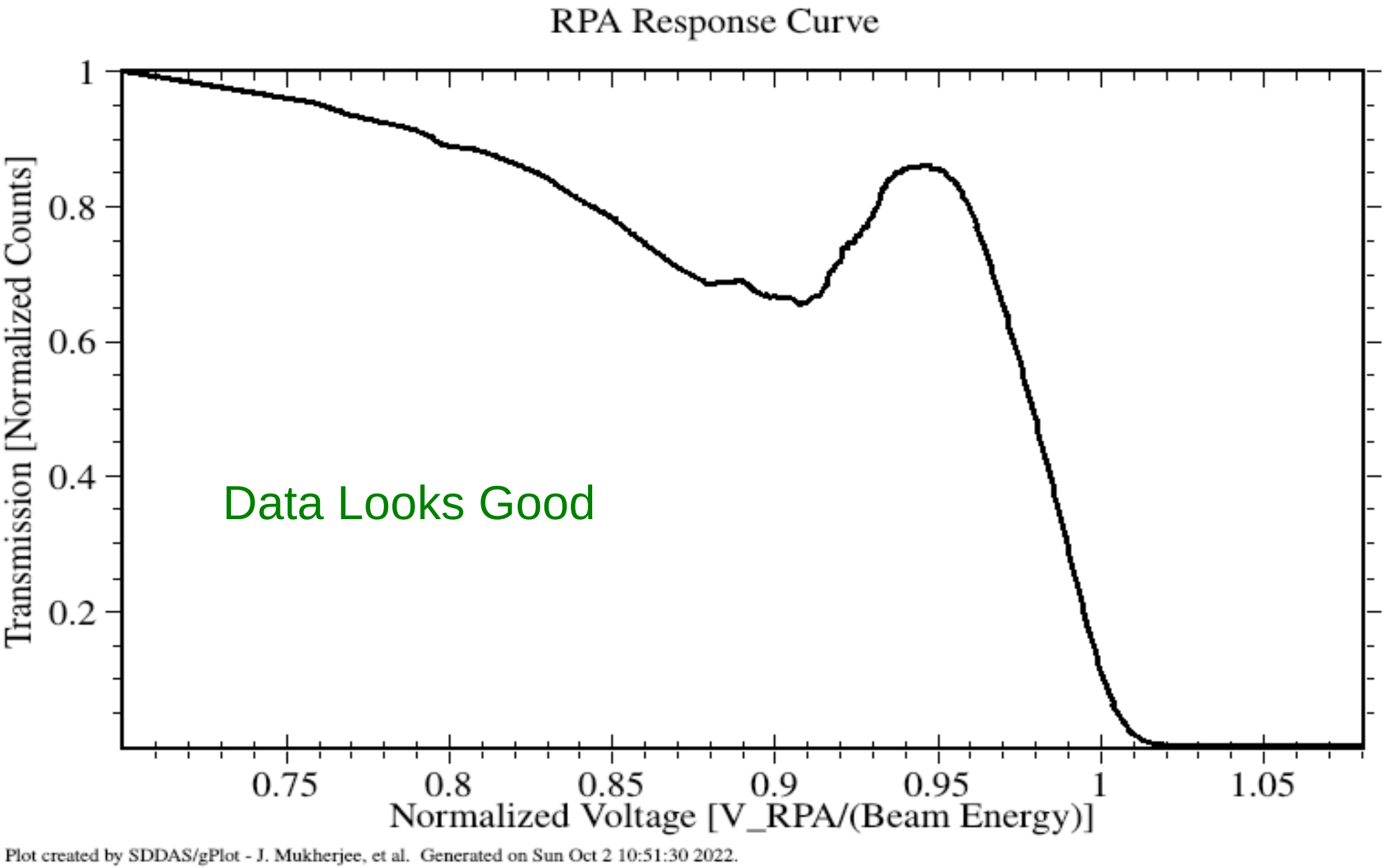

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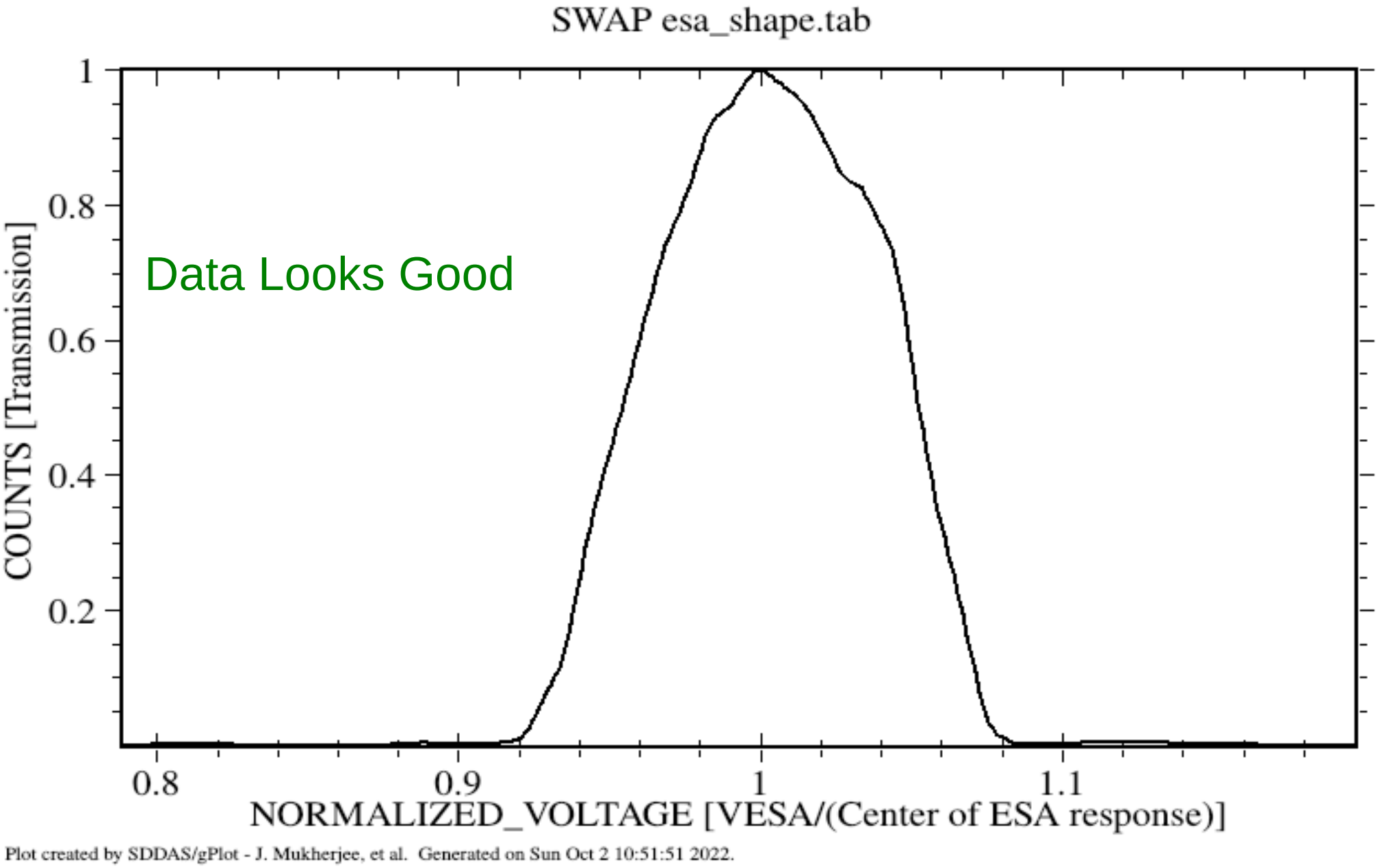

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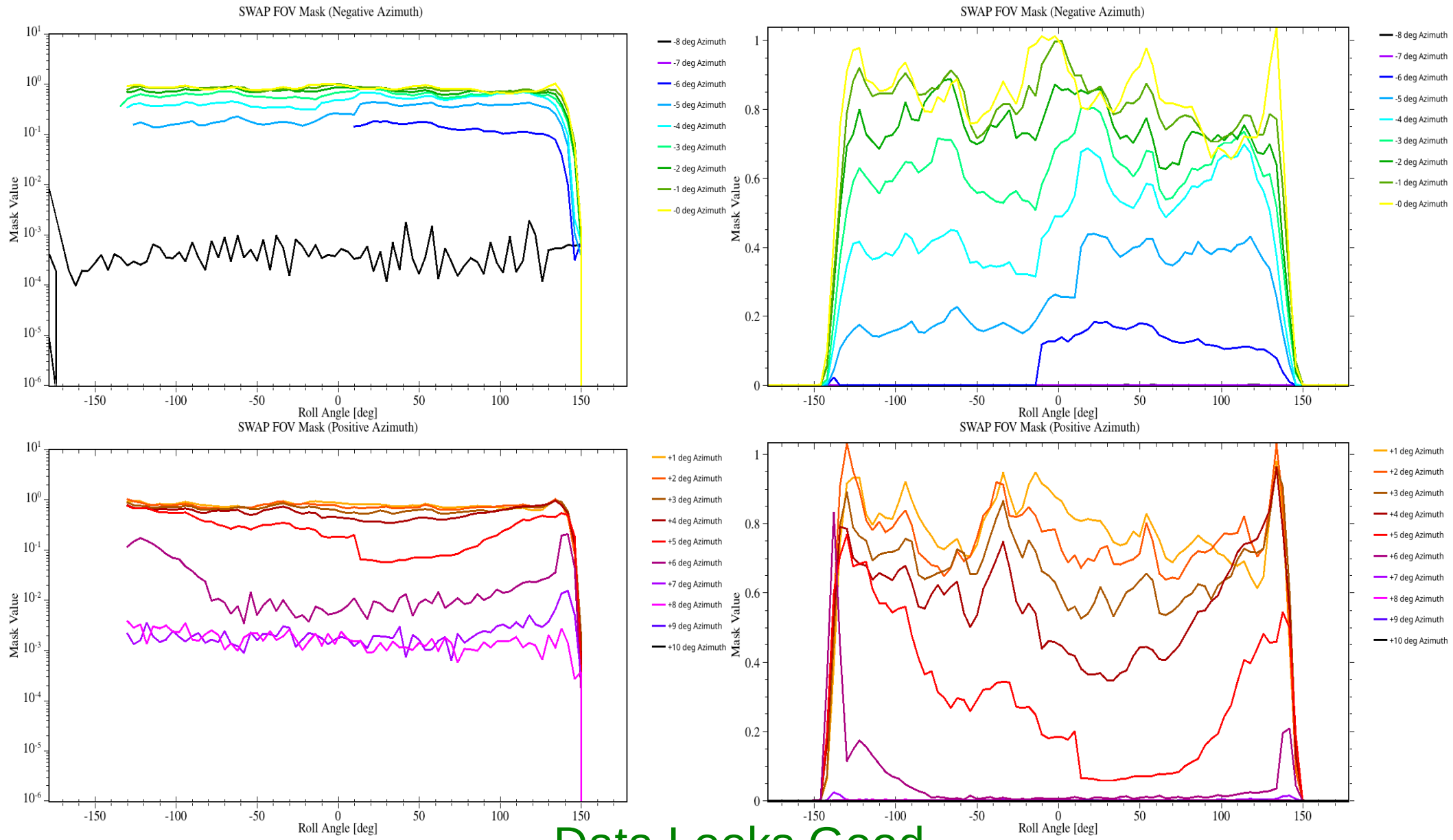

Data Looks Good

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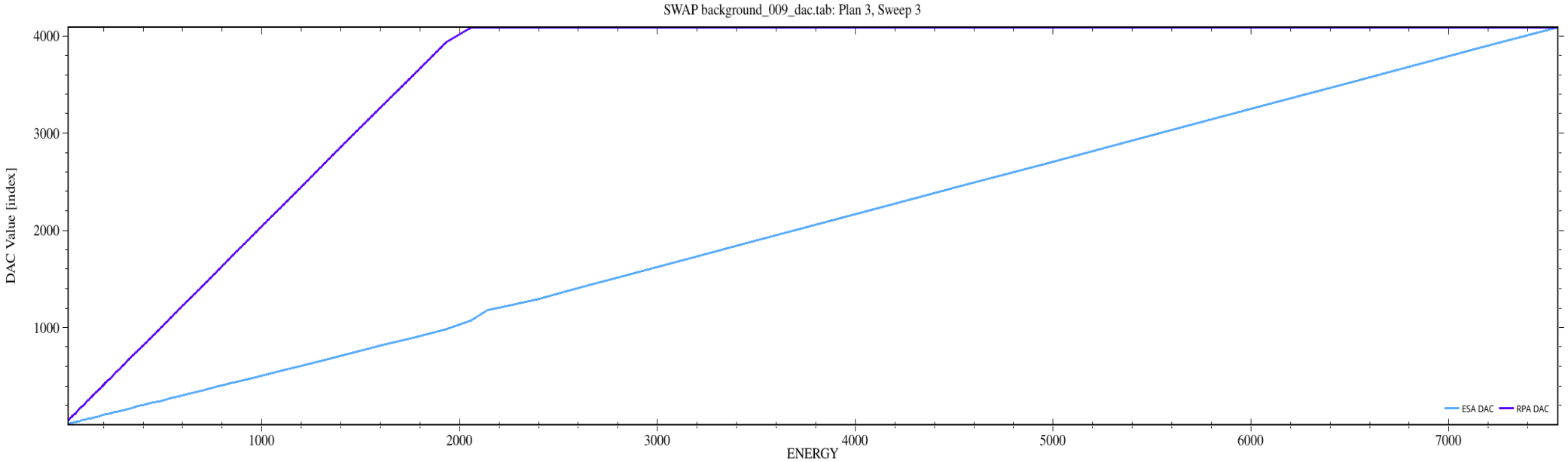

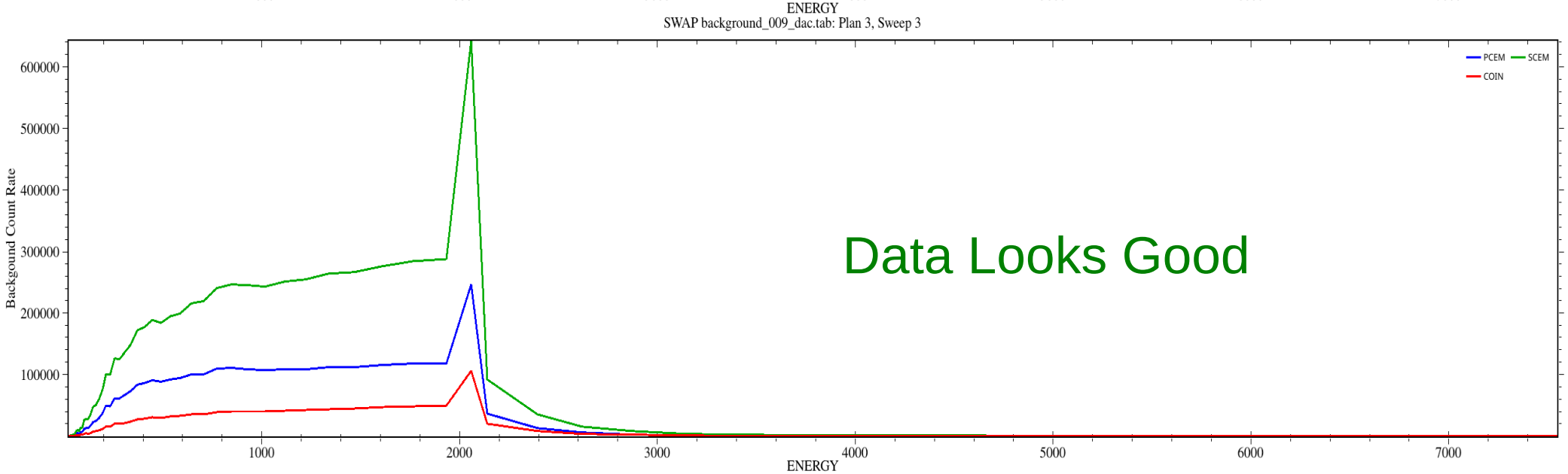

Data Looks Good

Plot created by SDDAS/gPlot - J. Mukherjee, et al. Generated on Sun Oct 2 11:02:13 2022.

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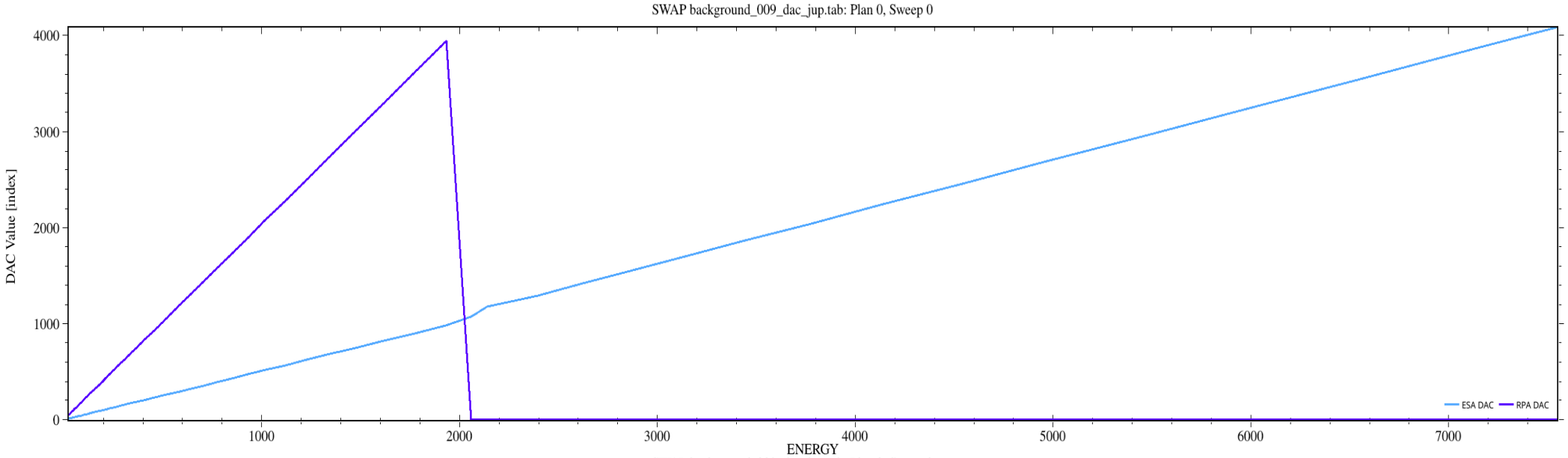

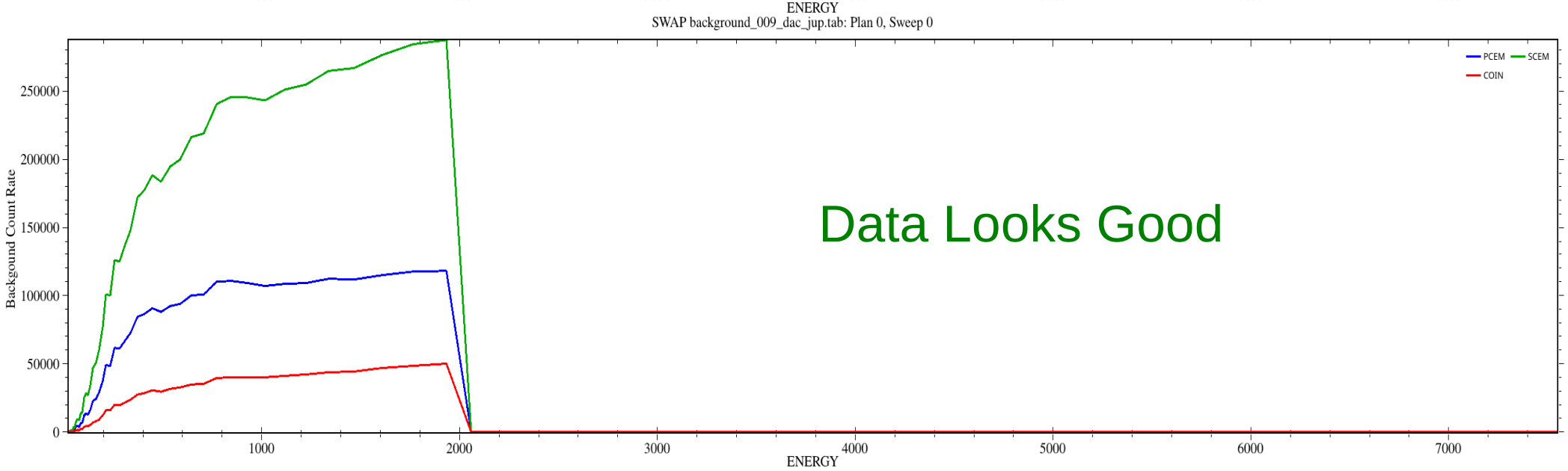

Data Looks Good

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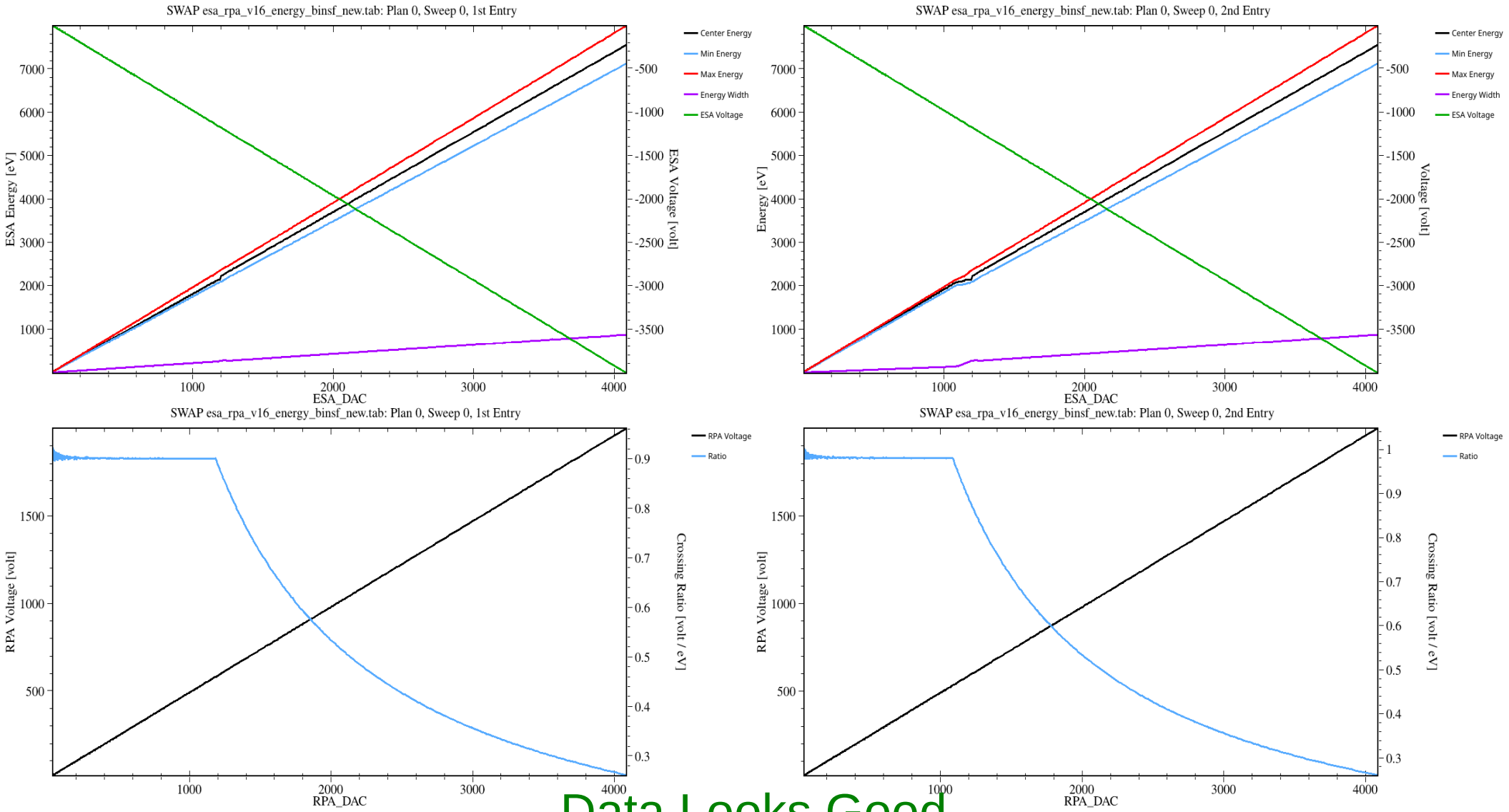

Data Looks Good

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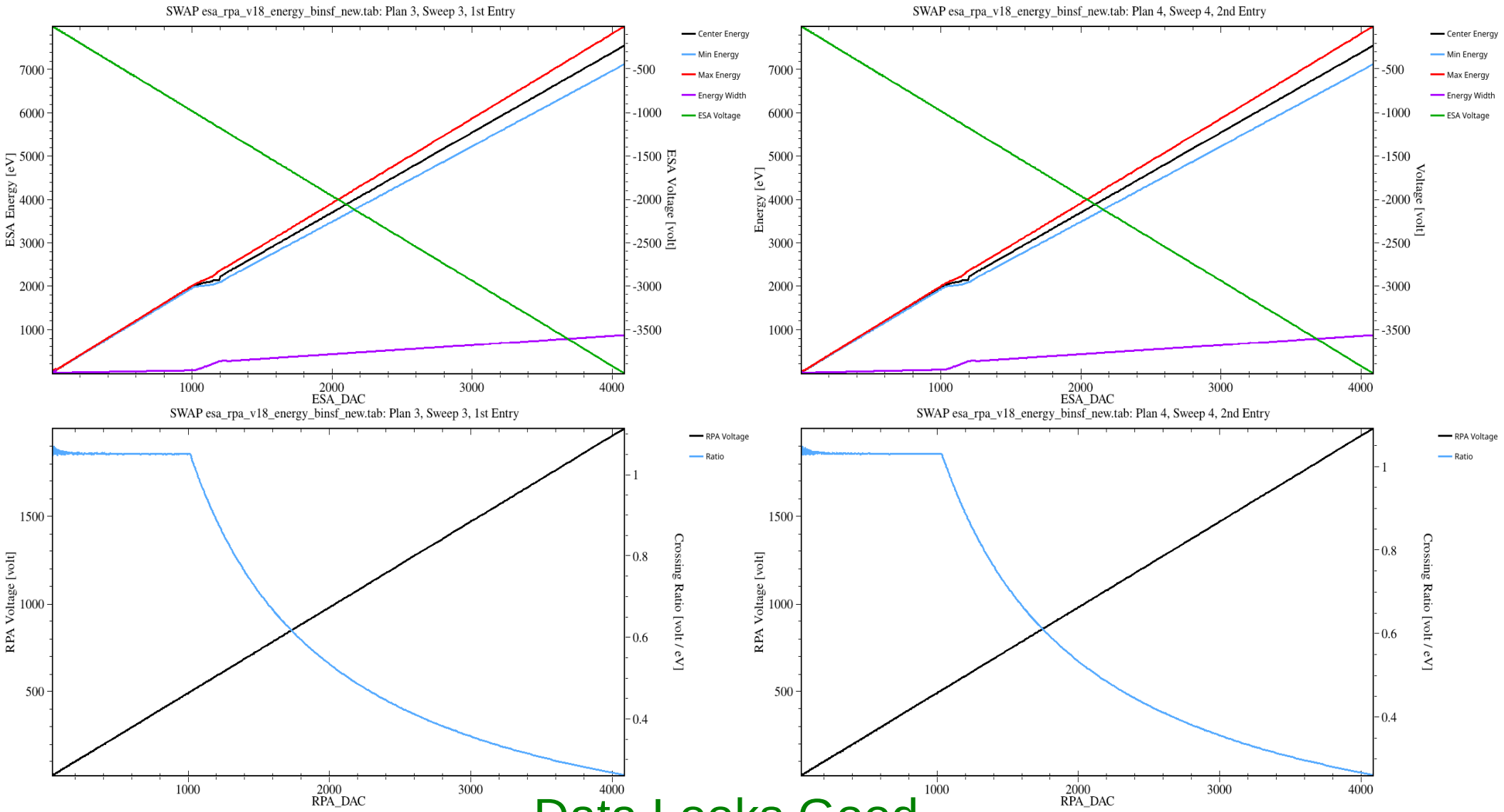

Data Looks Good

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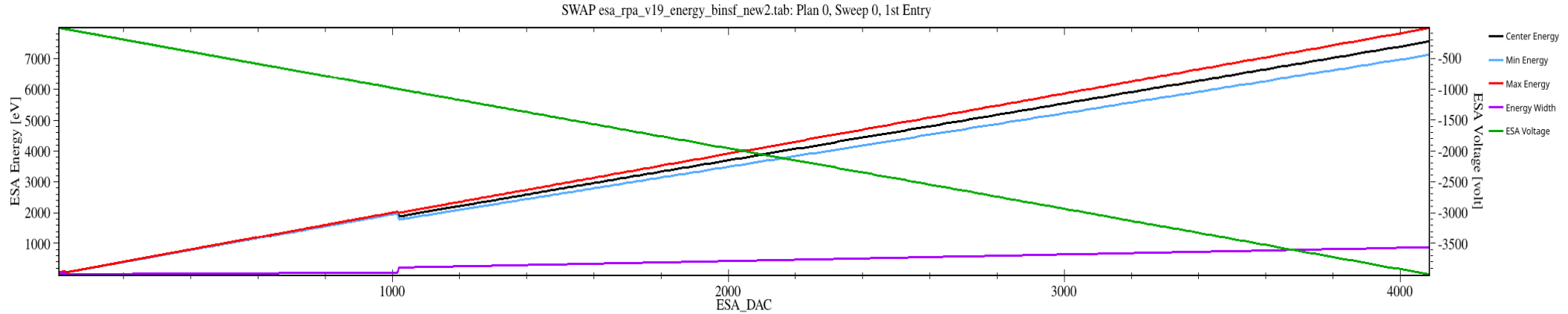
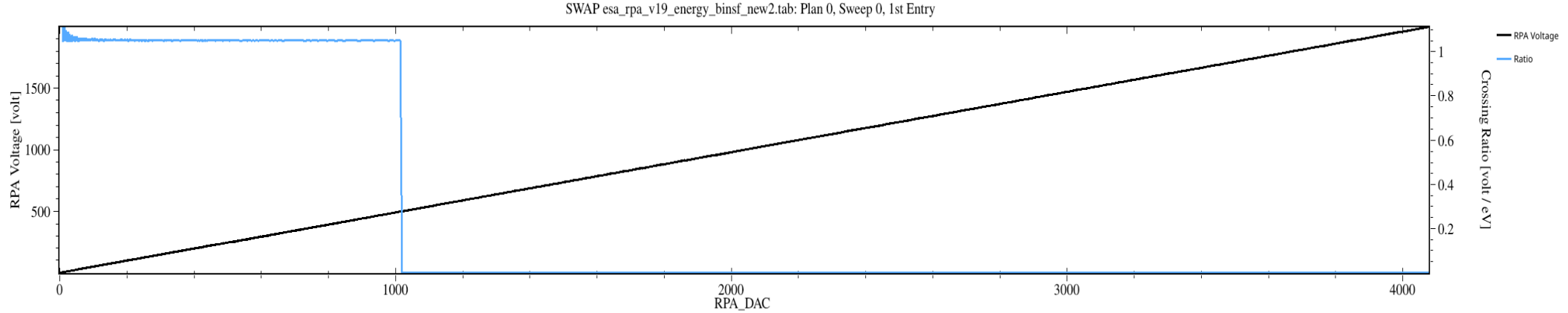
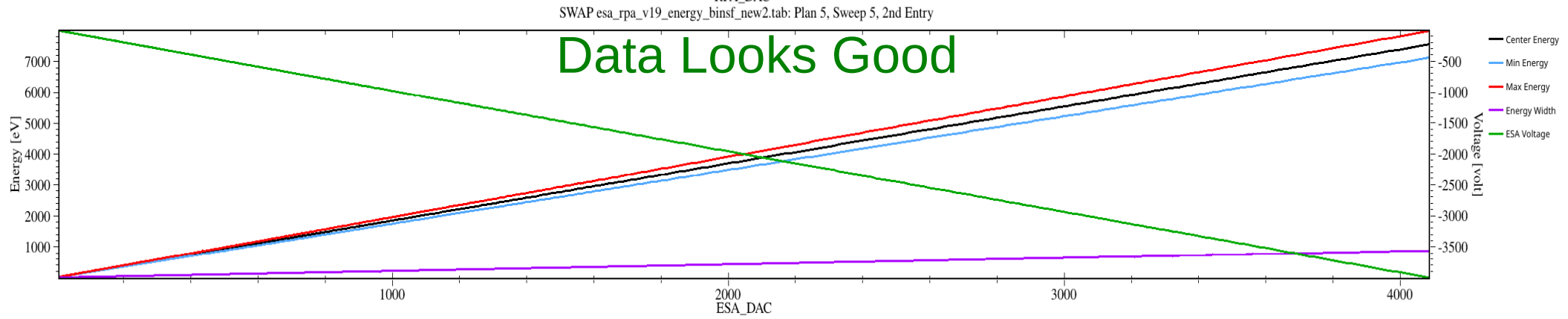
esa_rpa_v19_energy_binsf_new2.tab







Data Looks Good

Plot created by SDDAS/gPlot - J. Mukherjee, et al. Generated on Sun Oct 2 11:17:17 2022.

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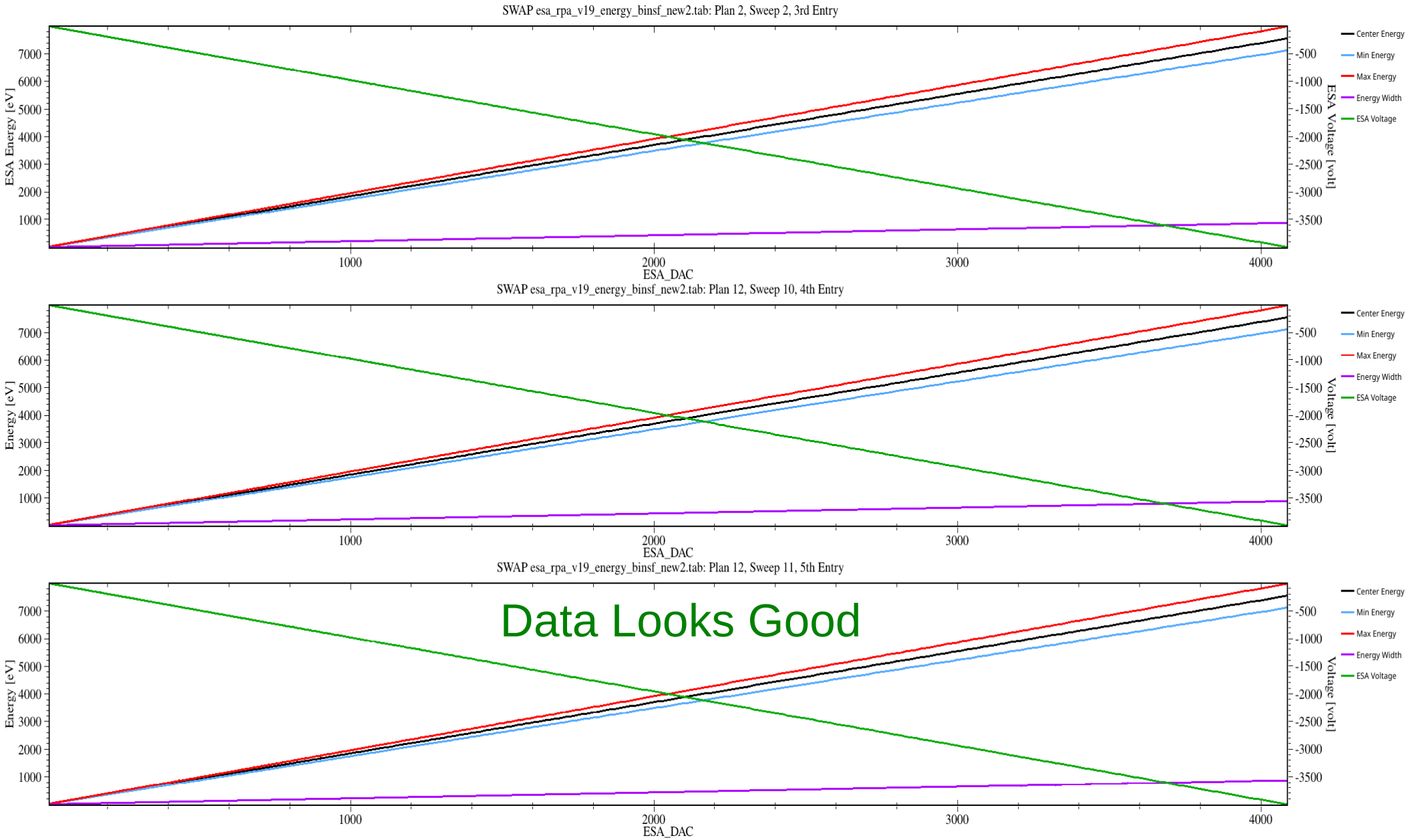

SWAP RAW and CALIBRATED Data Evaluation

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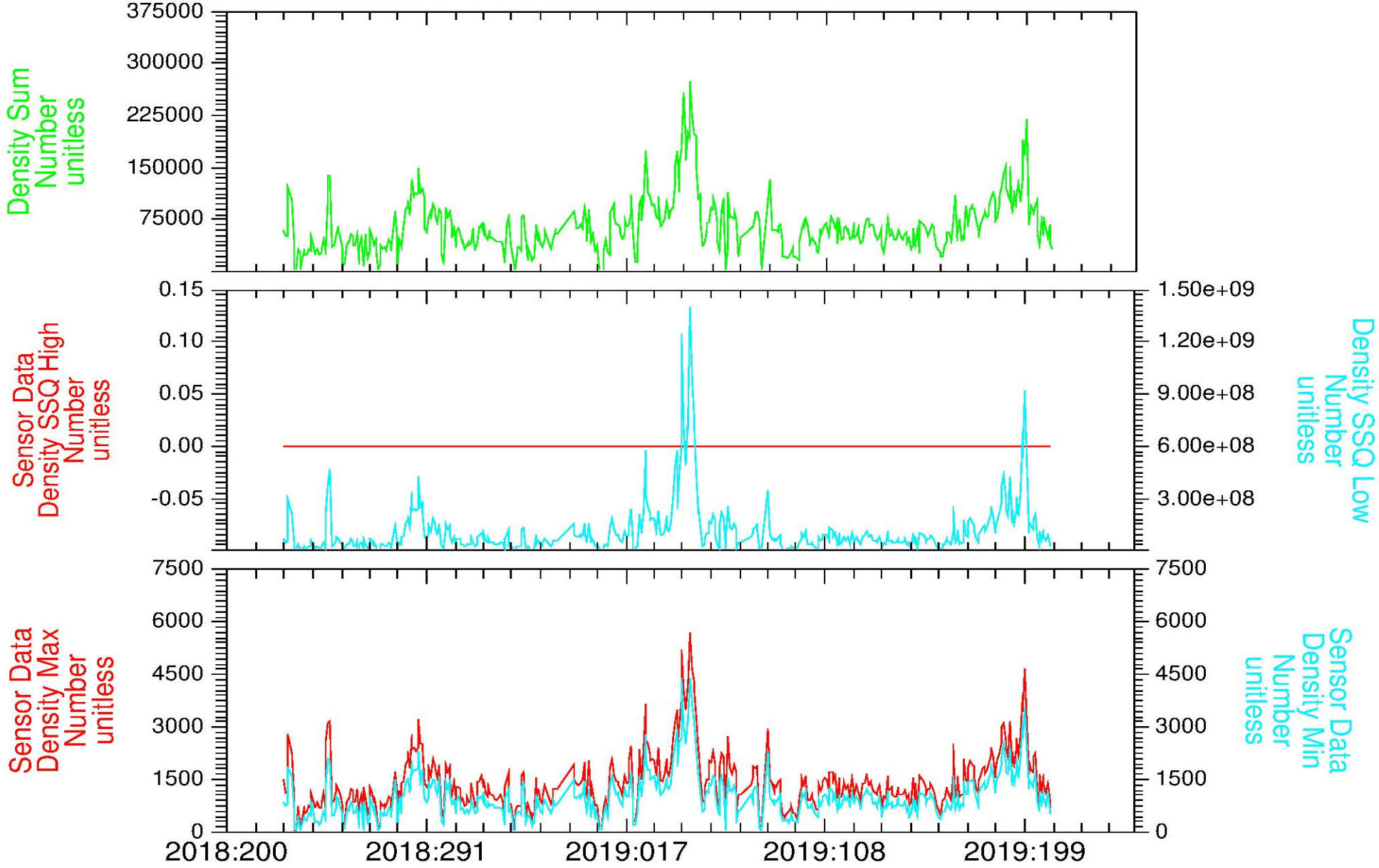
Summary Data (0x585) - Density

Total Data Time Range Found in Data Set. Is there missing data?



nh-a-swap-2-kem1-v6.0/data Summary Data (0x585) - Velocity

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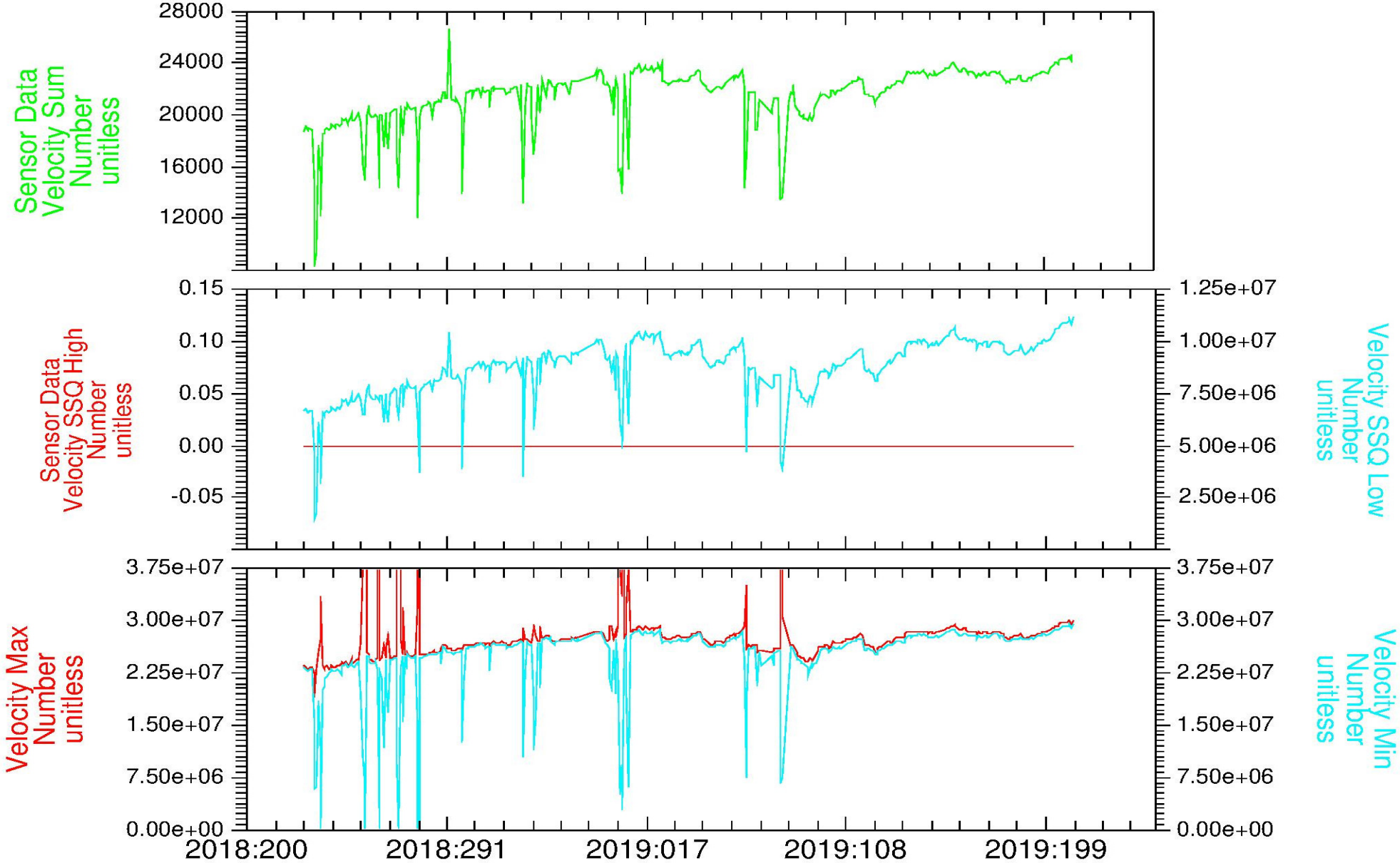

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Summary Data (0x585) - Temperature

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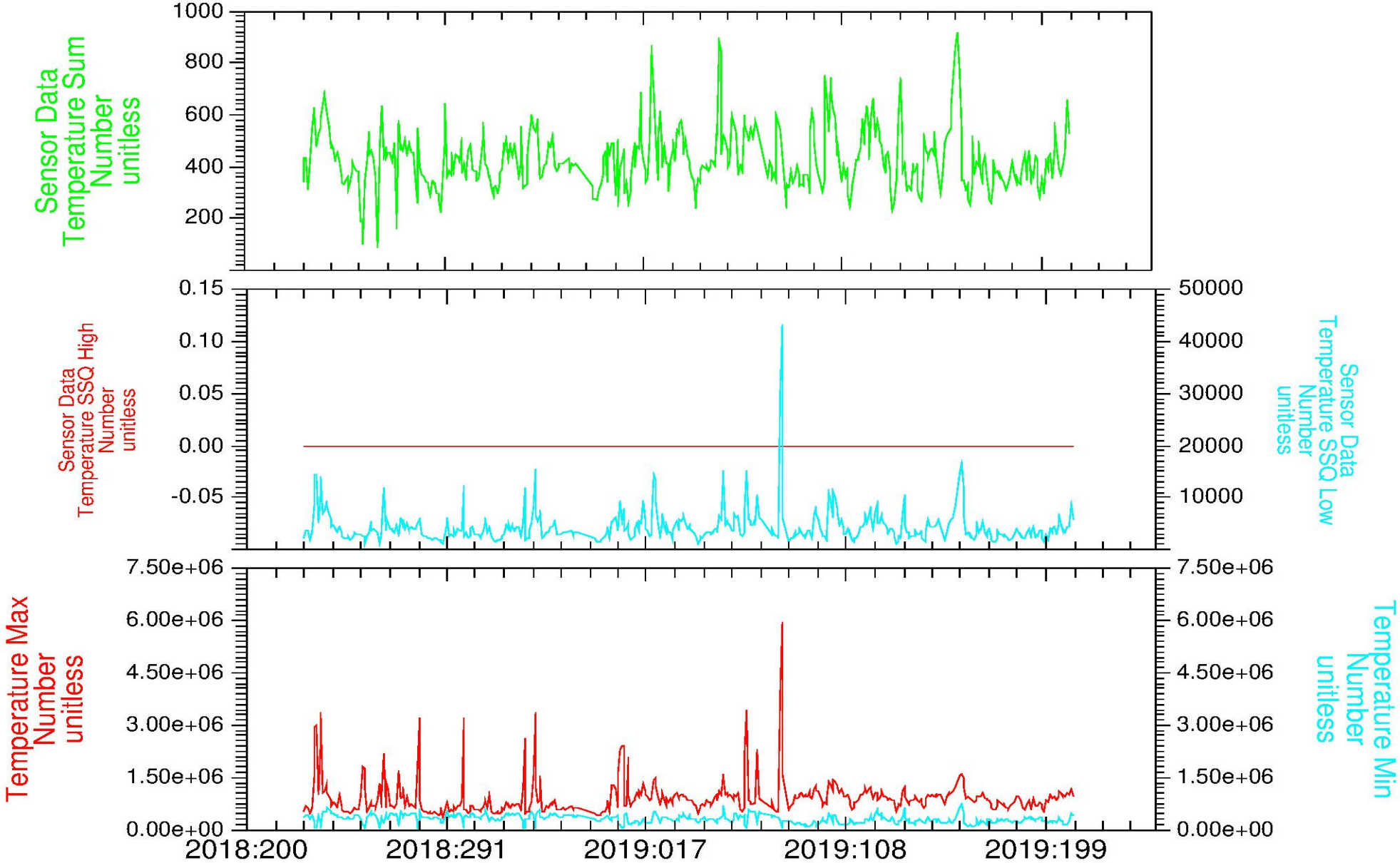

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Summary Data (0x585) – Other

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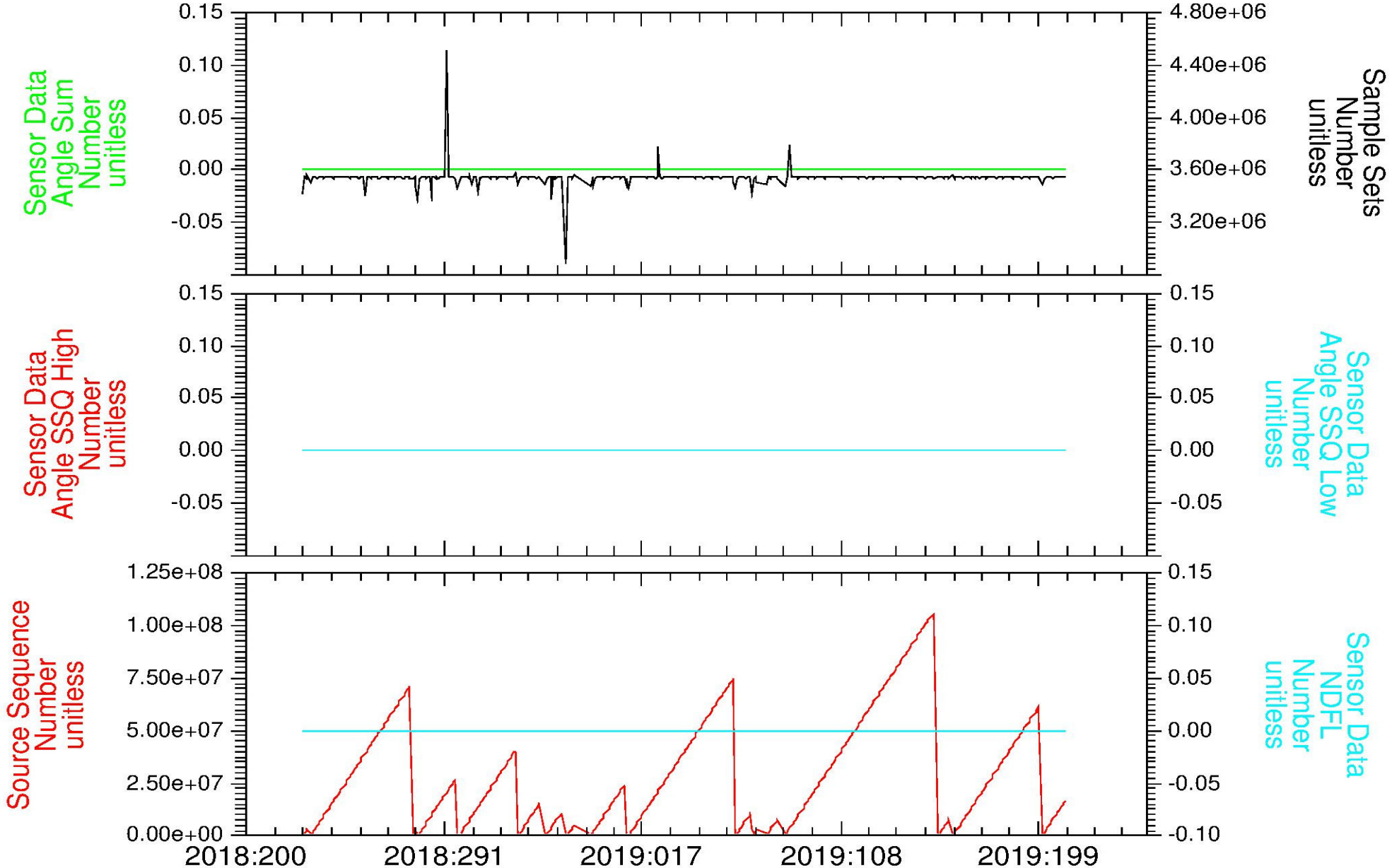

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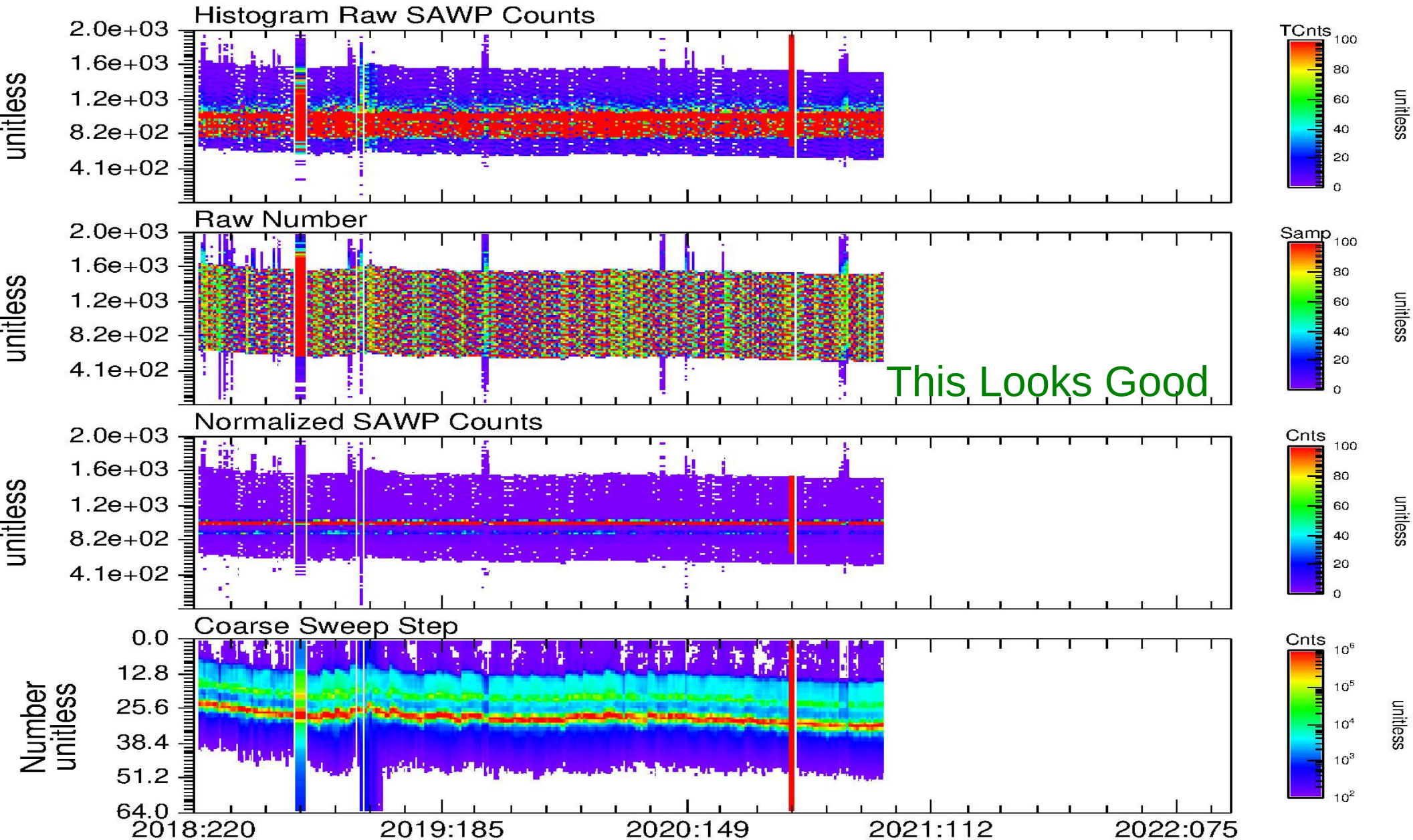

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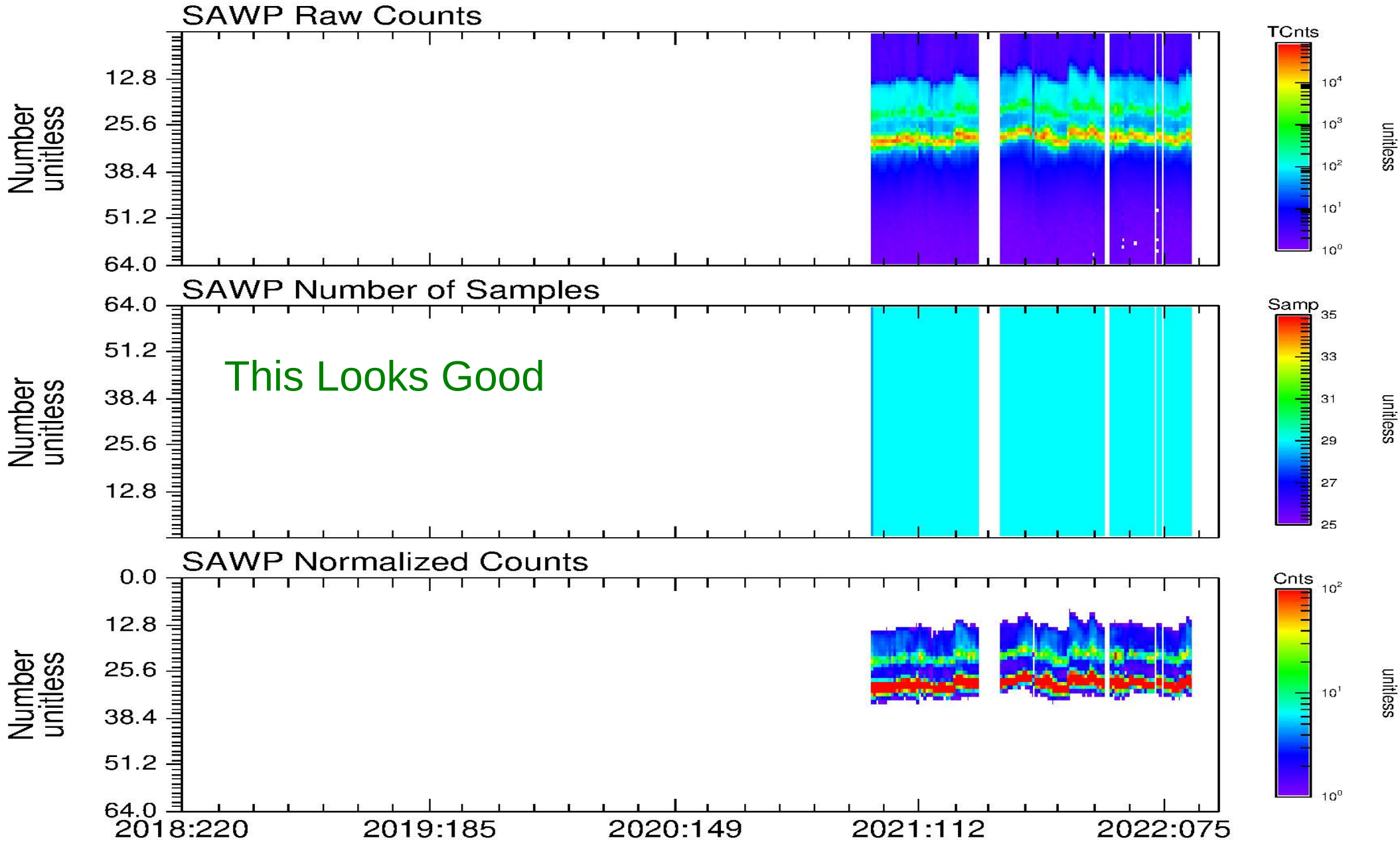

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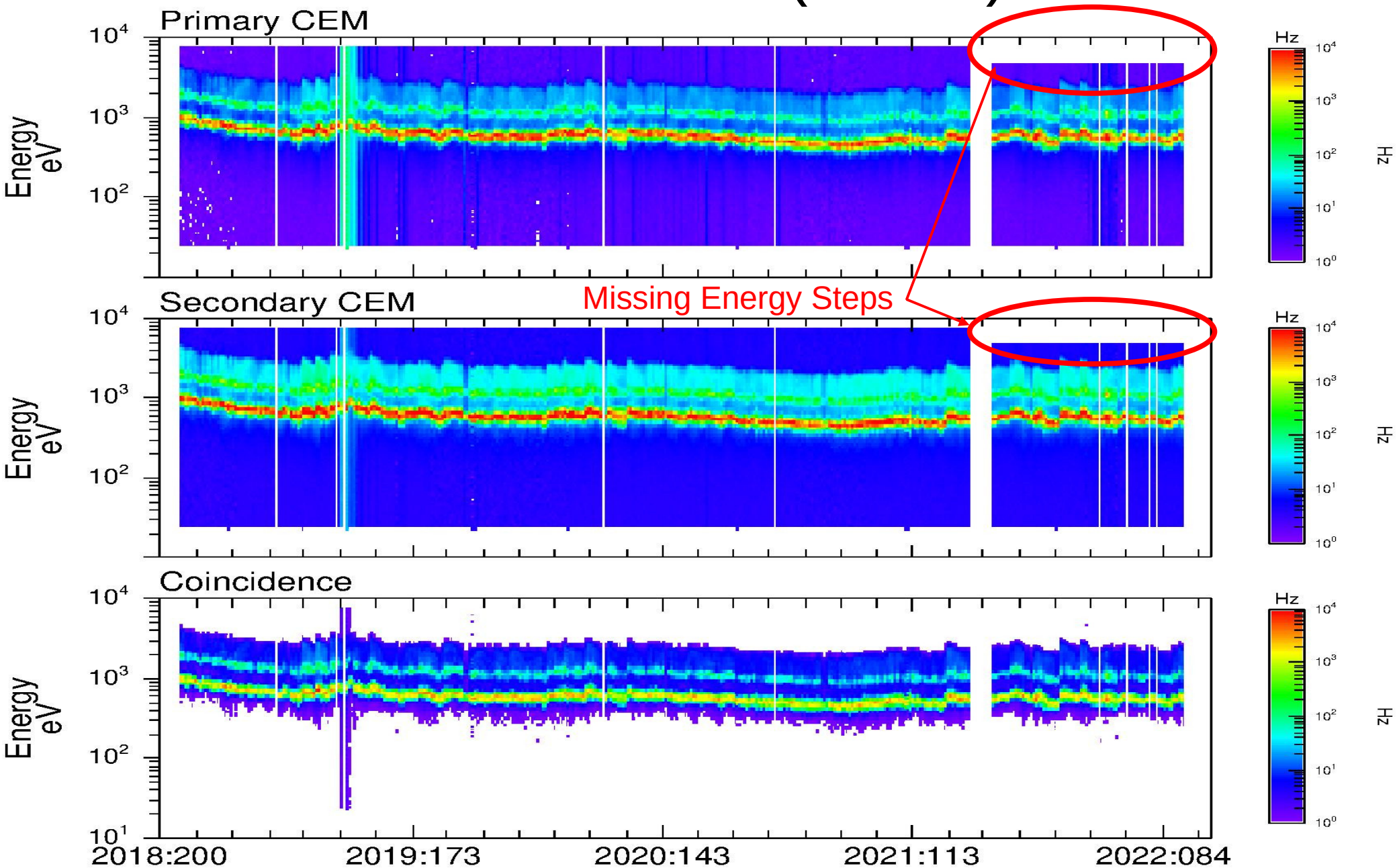
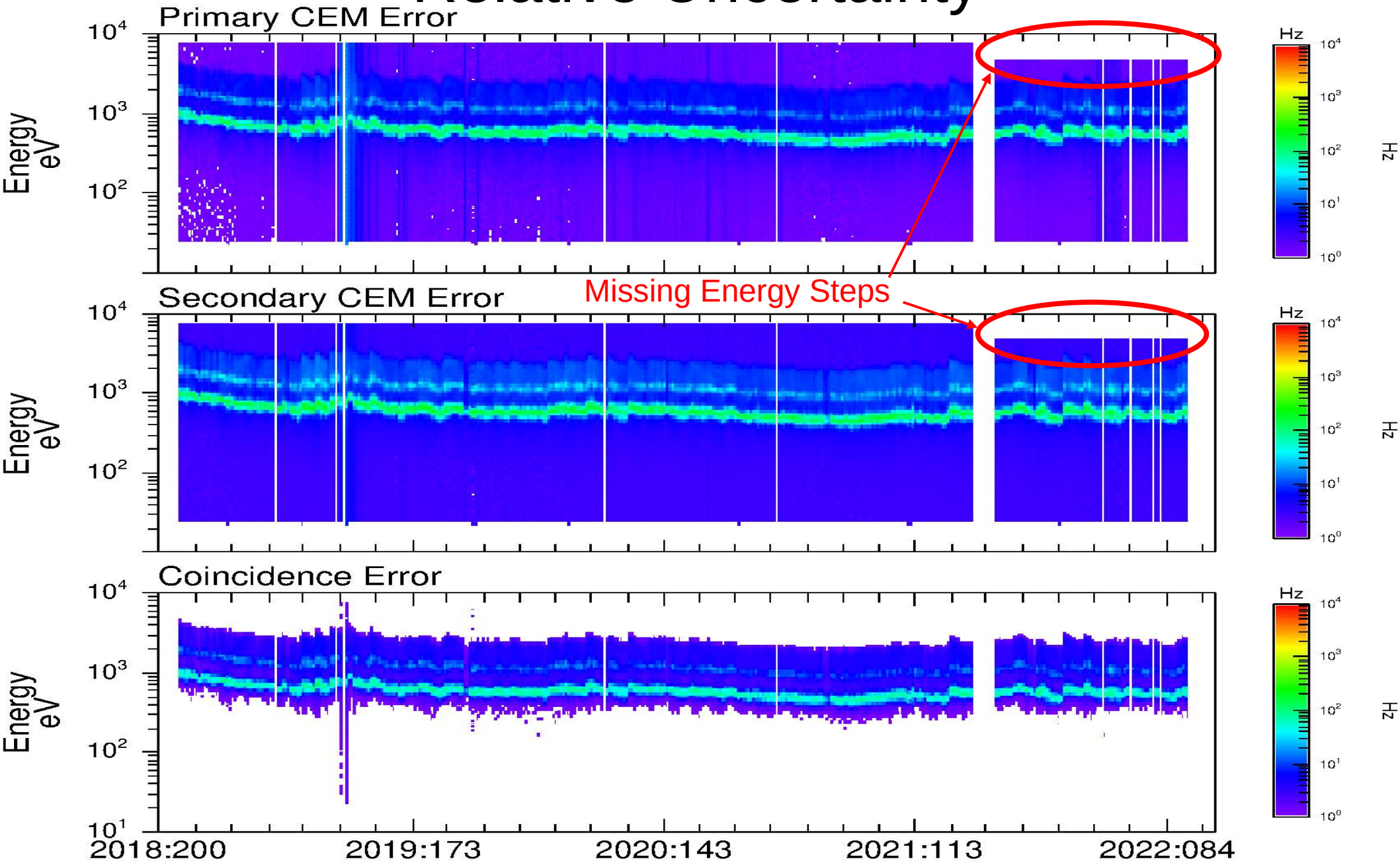
Science Data (0x584)

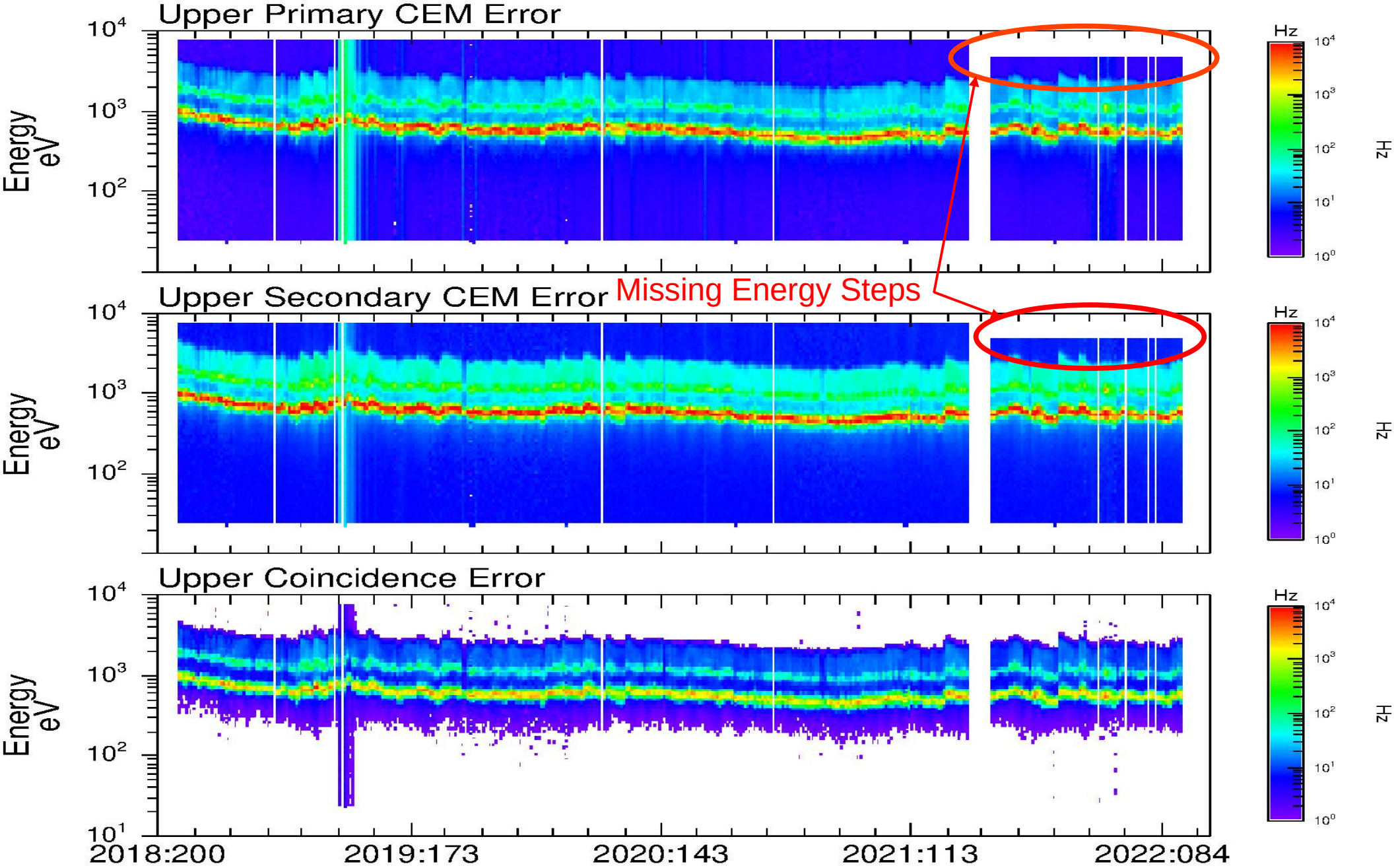


nh-a-swap-3-pluto-v6.0/data Relative Uncertainty



nh-a-swap-3-kem1-v6.0/data

Absolute Maximum Uncertainty



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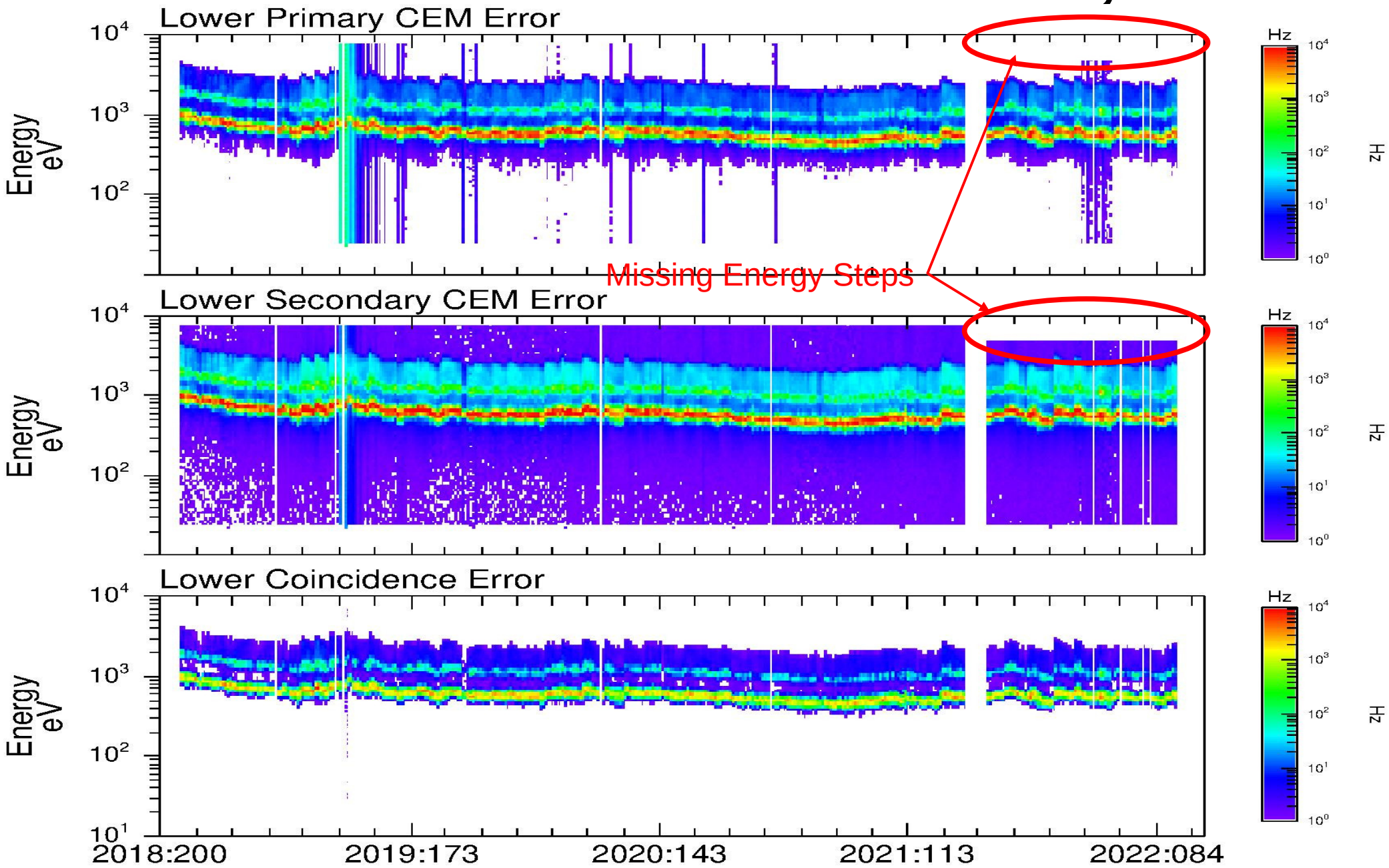

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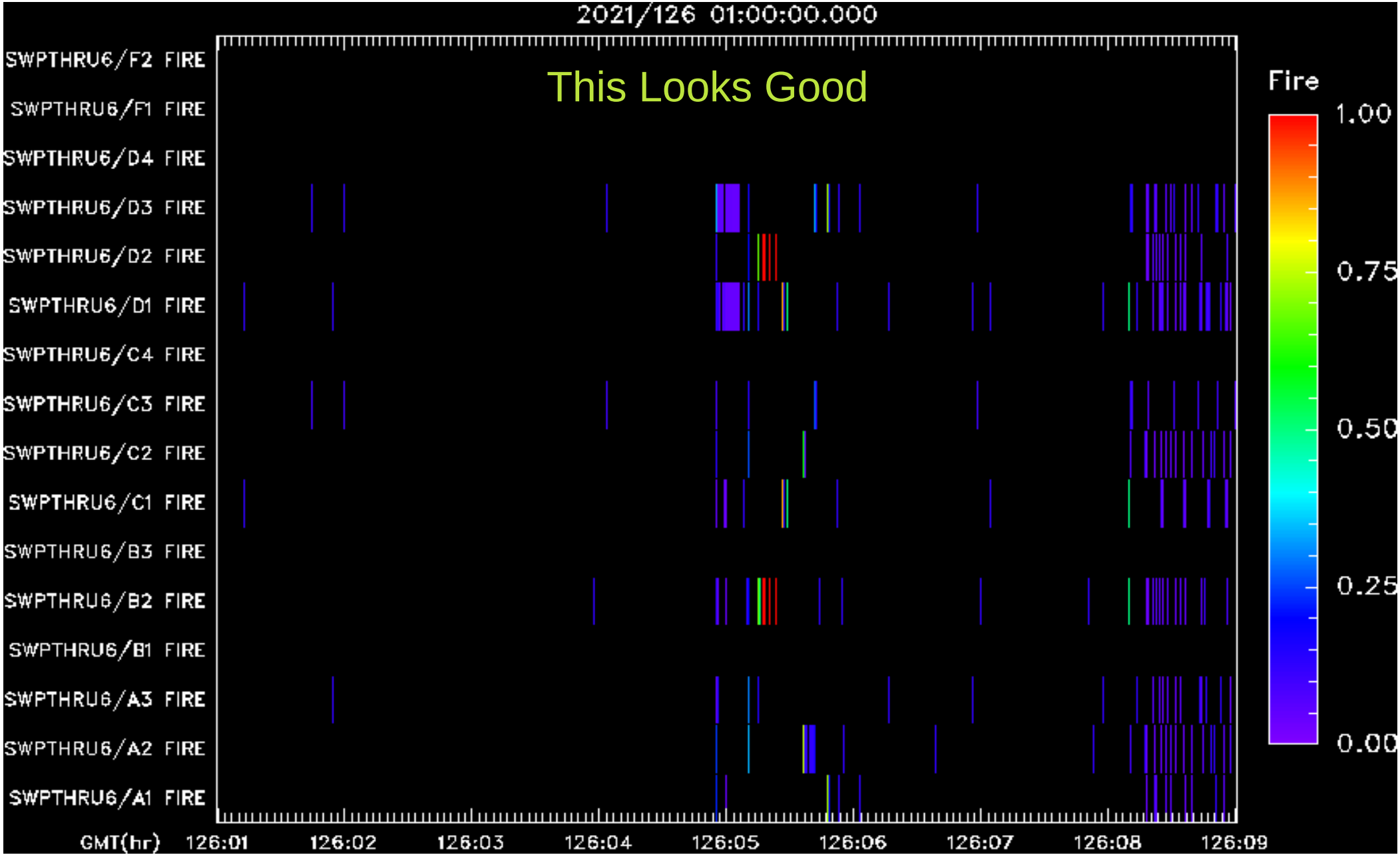
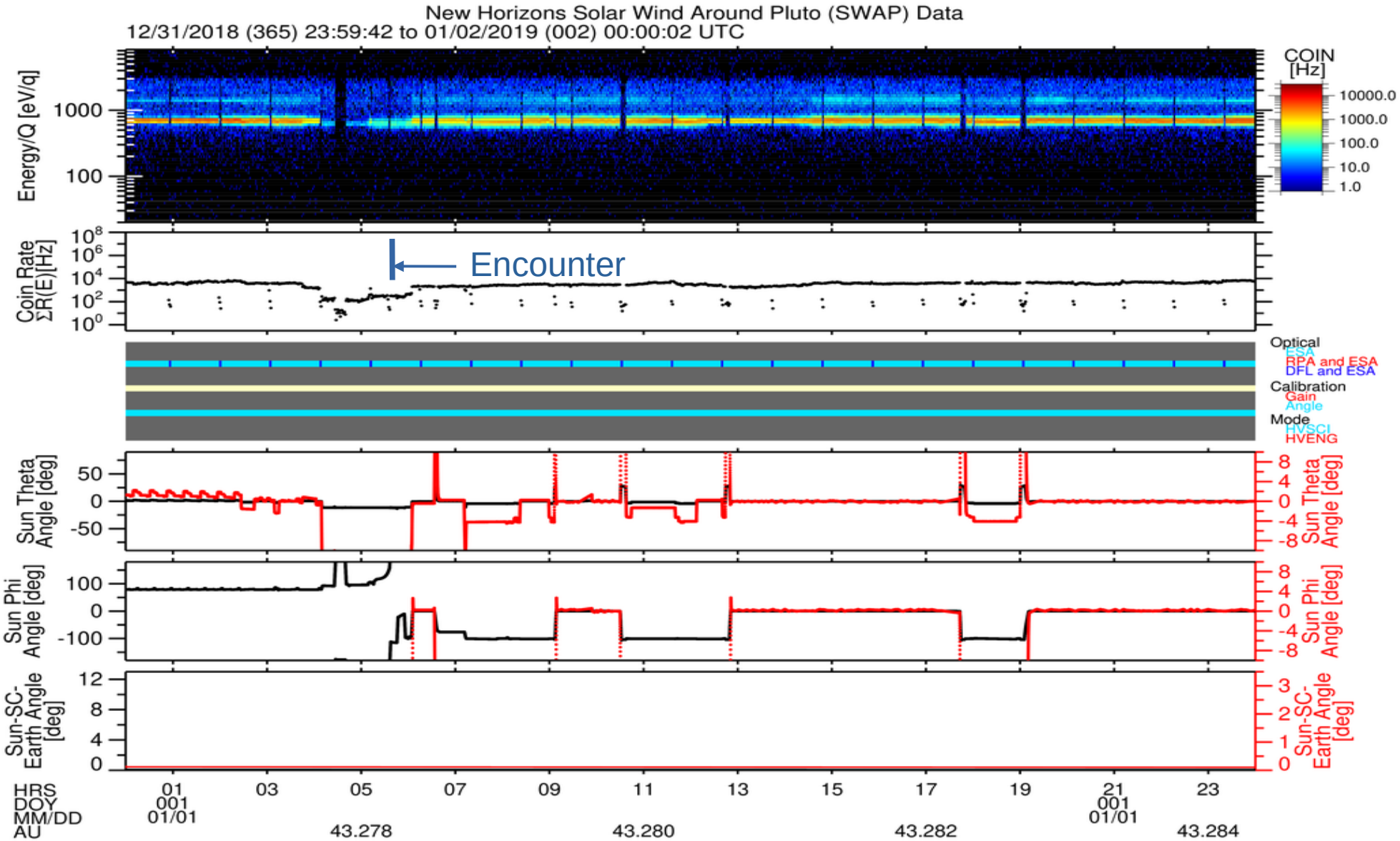
Thruster Firings



swap_001day_201812312359.png
Arrokoth Encounter



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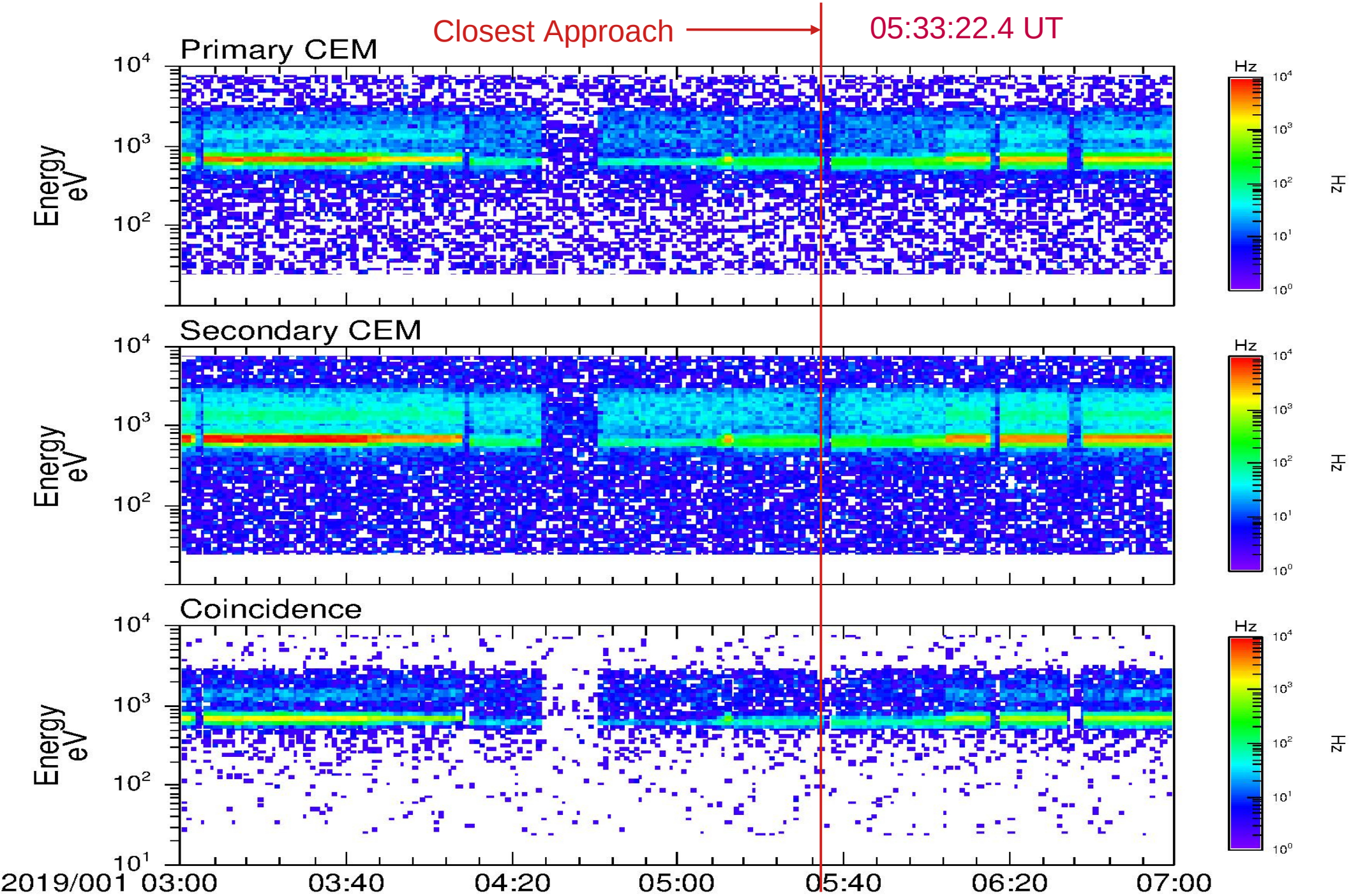
Plot Created: Sun Jun 12 08:11:16 2022
Files: 0408585600_0x584_sci.fit to 0408758400_0x584_sci.fit

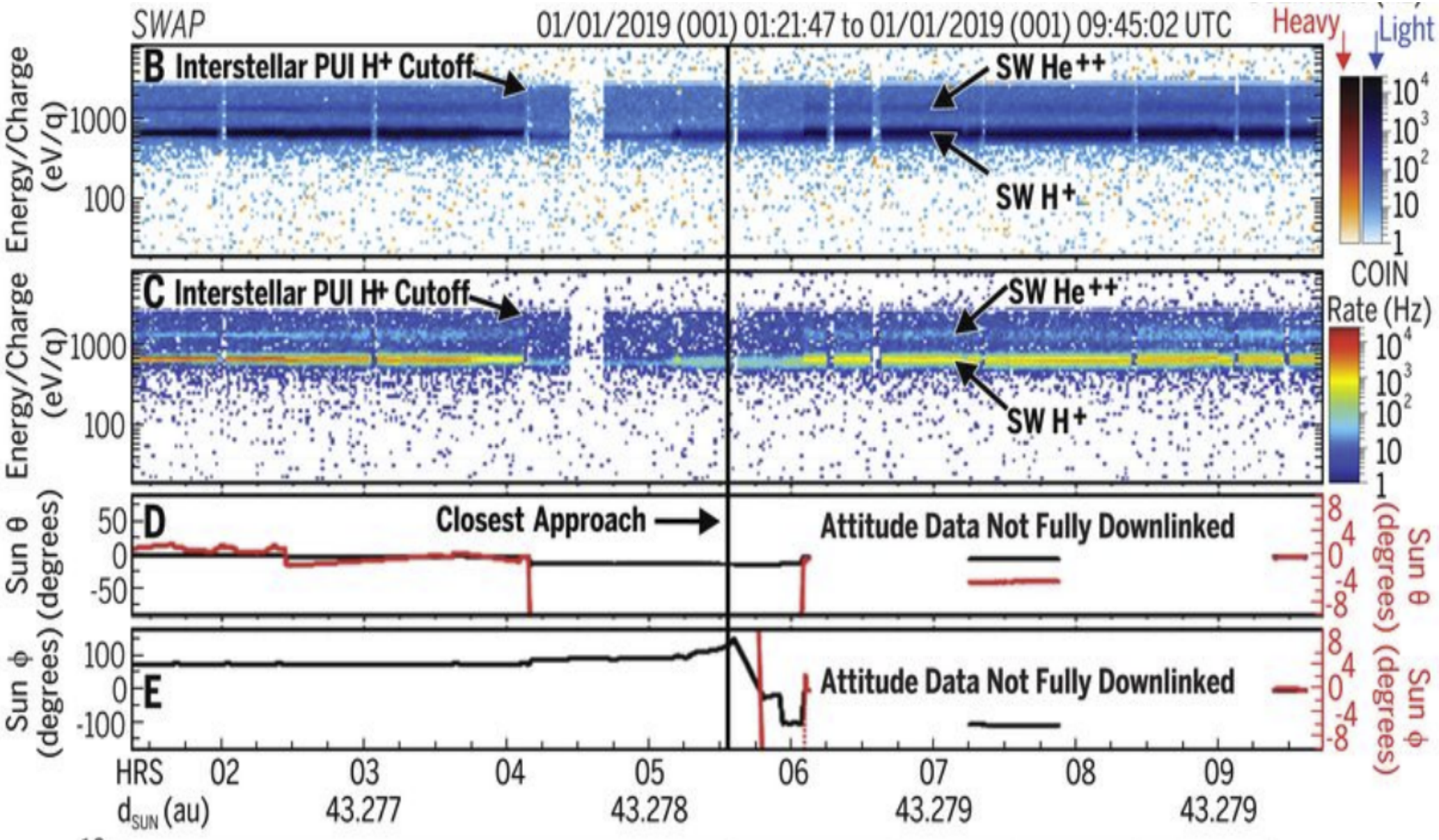
Spectrogram Timing Accurate to Within: 20.00 [sec]
Plot Width:: 0.754545 [norm]
Plot Width: 8.3000 [in]

Close-up of Arrokoth Encounter



Stern, S. A., et al., Initial results from the New Horizons exploration of 2014 MU69, a small Kuiper Belt object, Science 364, 2019. DOI: 10.1126/science.aaw9771

Closest Approach



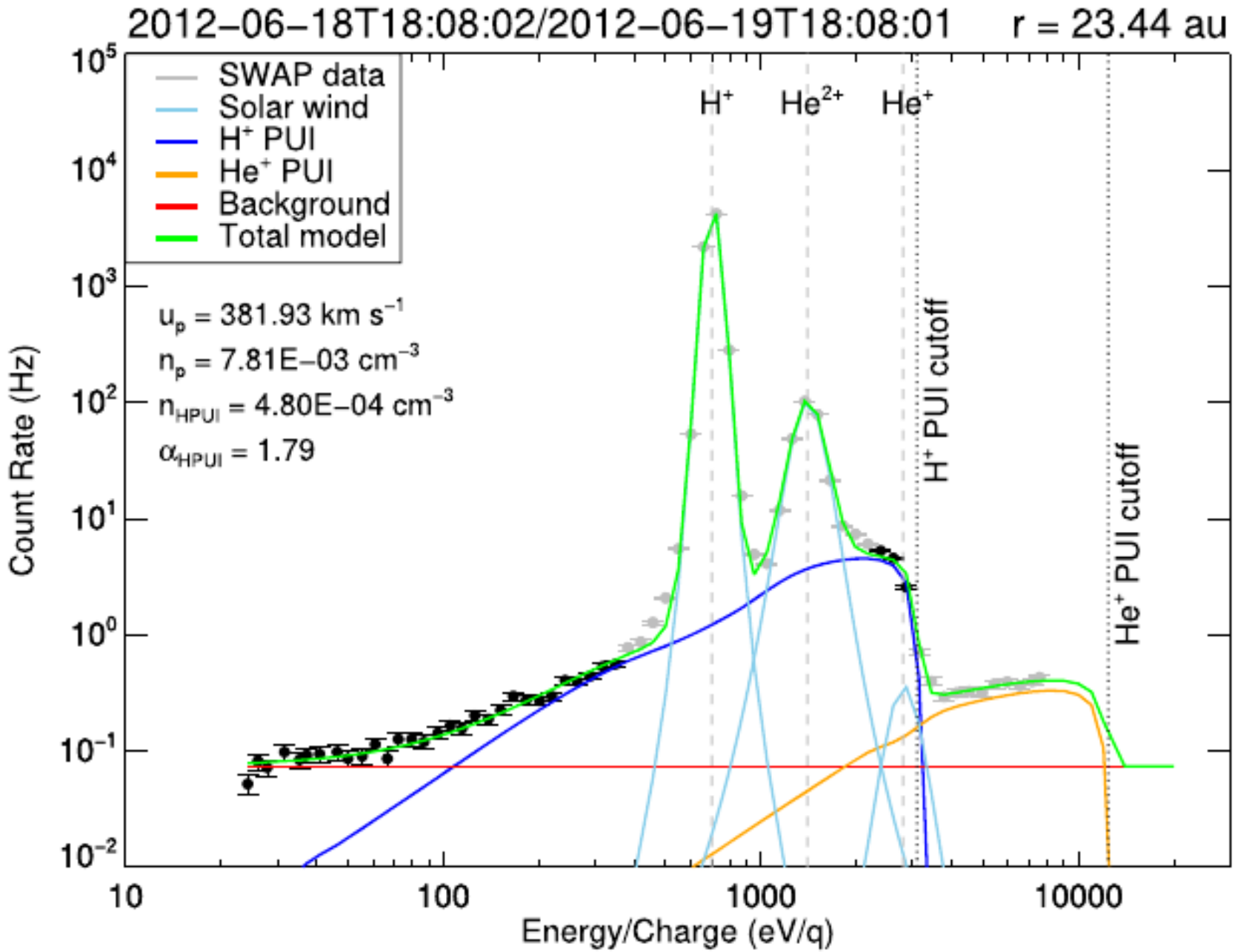
Certification

1) Correct ICD

2) Correct missing energy scan information.

BACK-UP SLIDES

Example Spectrum
Swaczyna et al., Astrophysical Journal, 2020.



nh-a-swap-2-kem1-v6.0
nh-a-swap-3-kem1-v6.0
aareadme.txt

GOOD

nh-a-swap-2-kem1-v6.0
nh-a-swap-3-kem1-v6.0
voldesc.cat

GOOD

nh-a-swap-2-kem1-v6.0/catalog
nh-a-swap-3-kem1-v6.0/catalog
catinfo.txt

GOOD

nh-a-swap-2-kem1-v6.0/catalog
nh-a-swap-3-kem1-v6.0/catalog
dataset.cat

GOOD

nh-a-swap-2-kem1-v6.0/catalog
nh-a-swap-3-kem1-v6.0/catalog
nh_kem.cat

GOOD

nh-a-swap-2-kem1-v6.0/catalog
nh-a-swap-3-kem1-v6.0/catalog
nhsc.cat

GOOD

nh-a-swap-2-kem1-v6.0/catalog
nh-a-swap-3-kem1-v6.0/catalog
ref.cat

GOOD

nh-a-swap-2-kem1-v6.0/catalog
nh-a-swap-3-kem1-v6.0/catalog
swap.cat

GOOD

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
docinfo.txt

GOOD

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
codmac_level_definitions.lbl
codmac_level_definitions.pdf

GOOD

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
lunineetal1995.lbl & lunineetal1995.pdf

GOOD

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
nh_fov.lbl & nh_fov.png

GOOD

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
nh_met2utc.lbl & nh_met2utc.tab

GOOD, table updated

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
nh_mission_trajectory.lbl

GOOD

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
nh_swap_v200_ti.txt

GOOD

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
payload_ssr.lbl & payload_ssr.pdf

GOOD

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
quat_axyz_instr_to_j2k.lbl
quat_axyz_instr_to_j2k.asc

GOOD

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
seq_swap_kem1.lbl & seq_swap_kem1.tab

GOOD, sequences added

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
swap_ssr.lbl & swap_ssr.pdf

GOOD

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
swap_cal.lbl

GOOD

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
soc_inst_icd.lbl

GOOD

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
traj/trajinfo.txt

GOOD

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
traj/traj.fmt

GOOD

nh-a-swap-2-kem1-v6.0/document
nh-a-swap-3-kem1-v6.0/document
traj/traj_2006_2028_1d.lbl

GOOD

nh-a-swap-2-kem1-v6.0/calib
nh-a-swap-3-kem1-v6.0/calib
calinfo.txt

GOOD

nh-a-swap-2-kem1-v6.0/calib
nh-a-swap-3-kem1-v6.0/calib
rpa_shape.lbl

GOOD

nh-a-swap-2-kem1-v6.0/calib
nh-a-swap-3-kem1-v6.0/calib
esa_shape.lbl

GOOD

nh-a-swap-2-kem1-v6.0/calib
nh-a-swap-3-kem1-v6.0/calib
fov_mask_2d.lbl

GOOD

nh-a-swap-2-kem1-v6.0/calib
nh-a-swap-3-kem1-v6.0/calib
background_009_dac.lbl

GOOD

nh-a-swap-2-kem1-v6.0/calib
nh-a-swap-3-kem1-v6.0/calib
background_009_dac_jup.lbl

GOOD

nh-a-swap-2-kem1-v6.0/calib
nh-a-swap-3-kem1-v6.0/calib
list_energy_files.lbl & list_energy_files.tab

GOOD

nh-a-swap-2-kem1-v6.0/calib
nh-a-swap-3-kem1-v6.0/calib
esa_rpa_v16_energy_binsf_new.lbl

GOOD

nh-a-swap-2-kem1-v6.0/calib
nh-a-swap-3-kem1-v6.0/calib
esa_rpa_v18_energy_binsf_new.lbl

GOOD

nh-a-swap-2-kem1-v6.0/calib
nh-a-swap-3-kem1-v6.0/calib
esa_rpa_v19_energy_binsf_new2.lbl

GOOD

nh-a-swap-2-kem1-v6.0/index
nh-a-swap-3-kem1-v6.0/index
indxinfo.txt

GOOD

nh-a-swap-2-kem1-v6.0/index
nh-a-swap-3-kem1-v6.0/index
index.lbl & index.tab

GOOD

nh-a-swap-2-kem1-v6.0/index
nh-a-swap-3-kem1-v6.0/index
slimindx.lbl & slimindx.tab

GOOD

nh-a-swap-2-kem1-v6.0/index
nh-a-swap-3-kem1-v6.0/index
checksum.lbl & checksum.tab

GOOD