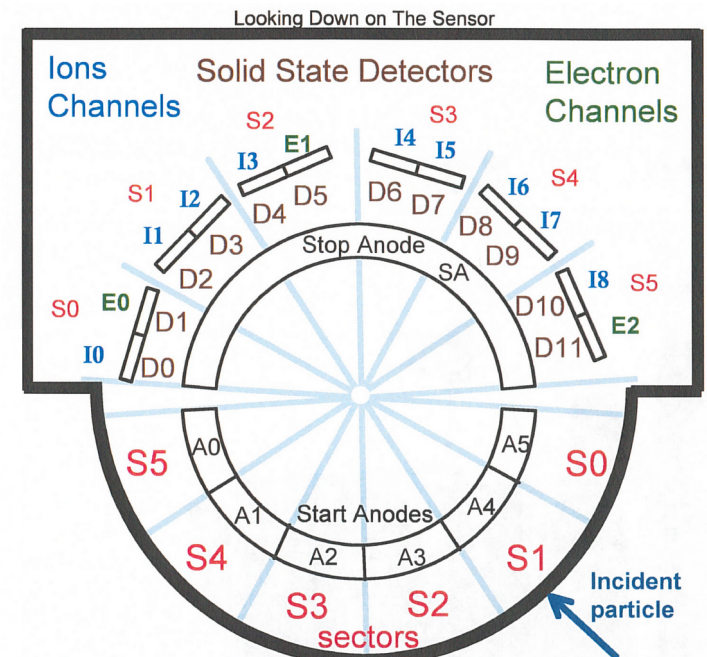
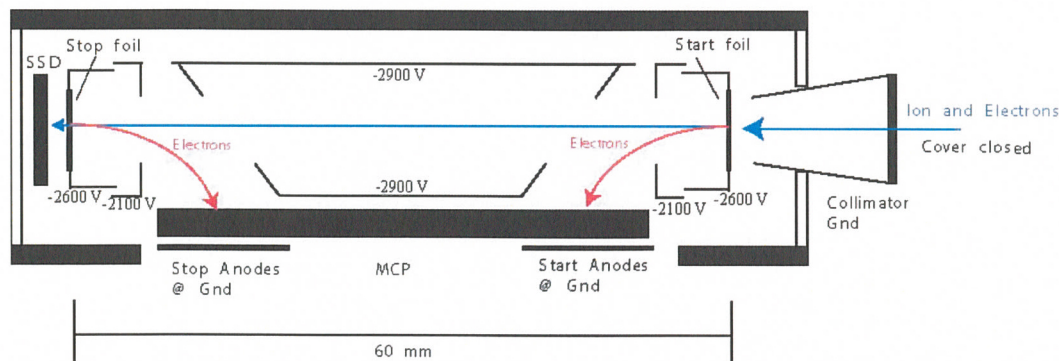


New Horizons Pluto Energetic Particle Spectrometer Science Investigation (PEPSSI)

PRINCIPAL INVESTIGATOR: Ralph McNutt, APL
 DESCRIPTION: Medium Energy Particle Spectrometer
 ENERGY RANGE: 25-1000 keV (protons)
 60-1000 keV (atomic ions)
 25-500 keV (electrons)
 FIELD OF VIEW: 160 deg x 12 deg
 ANGULAR RESOLUTION: 25 deg x 12 deg
 ENERGY RESOLUTION: 0.25 keV
 SENSOR SIZE: 7.6 cm dia. x 2.5 cm thick
 POWER: 1.4 watt
 MASS: 1.5 kg



New Horizons PEPSSI Data Sets

RAW Data Sets:

nh-a-pepssi-2-kem1-v5.0

CALIBRATED Data Sets:

nh-a-pepssi-3-kem1-v5.0

RESAMPLED Data Sets:

nh-x-pepssi-4-plasma-v1.0

RAW and CALIBRATED Data Sets Handled
Separately from RESAMPLED Data Sets

New Horizons PEPSSI Data Set Evaluation Tools

Staging and Evaluation -

Machine: Dell Precision Tower 5810

Operating System: Fedora 33 linux

Data Processing -

Machine: Sun Ultra-350

Operating System: Sun Solaris OS 5.9

Minor Diagnostics -

Machine: Dell 7520

Operating System: Fedora 33 linux

PEPSSI RAW and CALIBRATED Documentation Evaluation

nh-a-pepssi-2-kem1-v5.0
nh-a-pepssi-3-kem1-v5.0
aareadme.txt

GOOD

nh-a-pepssi-2-kem1-v5.0
nh-a-pepssi-3-kem1-v5.0
voldesc.txt

GOOD

nh-a-pepssi-2-kem1-v5.0/catalog
nh-a-pepssi-3-kem1-v5.0/catalog
catinfo.txt

GOOD

nh-a-pepssi-2-kem1-v5.0/catalog
nh-a-pepssi-3-kem1-v5.0/catalog
dataset.cat

GOOD

nh-a-pepssi-2-kem1-v5.0/catalog
nh-a-pepssi-3-kem1-v5.0/catalog
nhsc.cat

GOOD

nh-a-pepssi-2-kem1-v5.0/catalog
nh-a-pepssi-3-kem1-v5.0/catalog
nh_kem.cat

GOOD

nh-a-pepssi-2-kem1-v5.0/catalog
nh-a-pepssi-3-kem1-v5.0/catalog
pepssi.cat

GOOD

nh-a-pepssi-2-kem1-v5.0/catalog
nh-a-pepssi-3-kem1-v5.0/catalog
ref.cat

GOOD

nh-a-pepssi-3-kem1-v5.0/document
docinfo.txt

GOOD

nh-a-pepssi-3-kem1-v5.0/document
codmac_level_definitions.lbl
codmac_level_definitions.pdf

GOOD

nh-a-pepssi-3-kem1-v5.0/document
lunineetal1995.lbl & lunineetal1995.pdf

GOOD

nh-a-pepssi-3-kem1-v5.0/document
nh_met2utc.tbl & nh_met2utc.tab

GOOD

nh-a-pepssi-3-kem1-v5.0/document
nh_fov.lbl & nh_fov.pdf

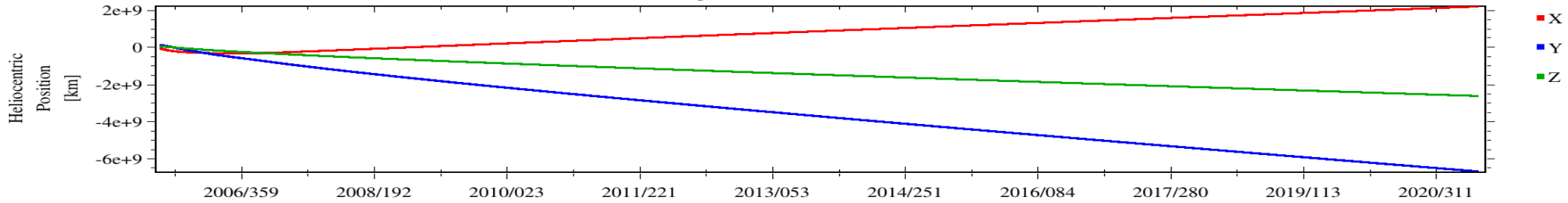
GOOD

nh-a-pepssi-3-kem1-v5.0/document
nh_mission_trajectory.lbl

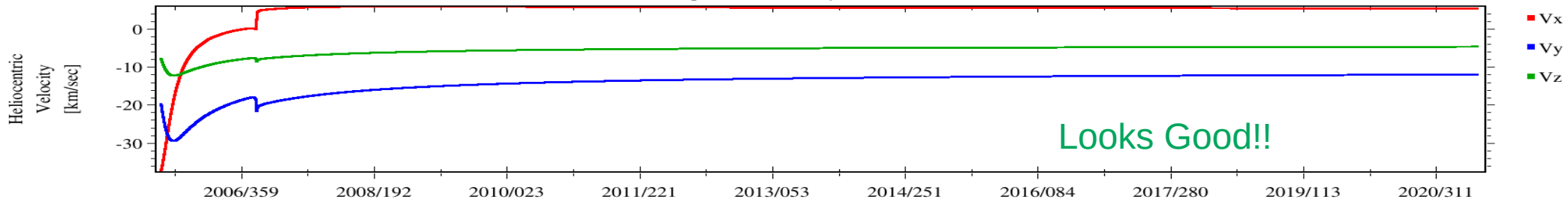
GOOD

nh-a-pepssi-3-kem1-v5.0/document nh_mission_trajectory.tab

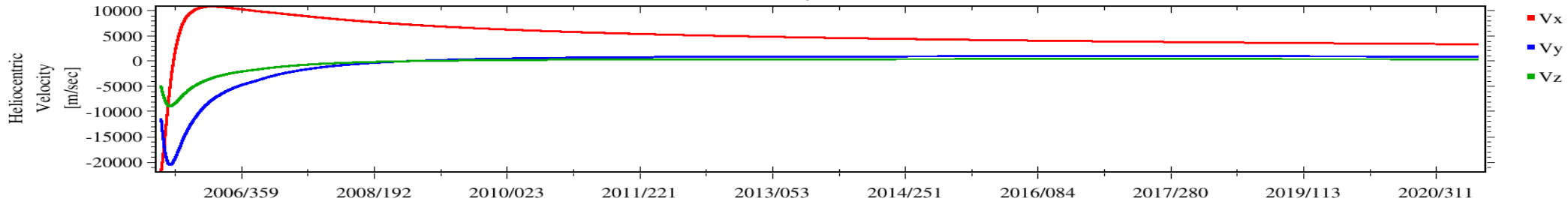
Spacecraft Position



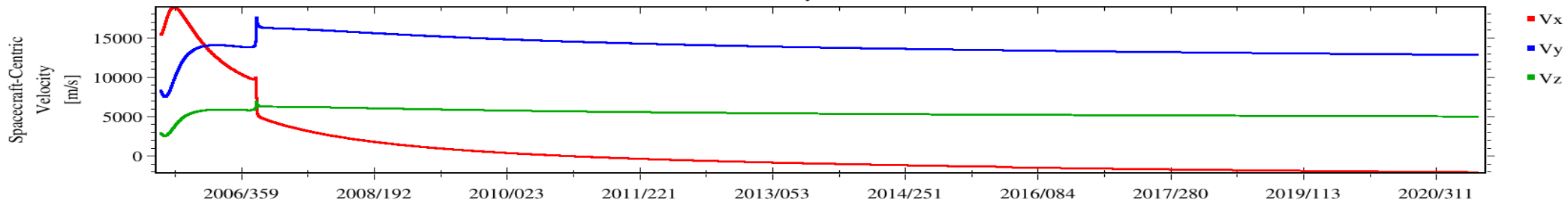
Spacecraft Velocity



Dust Velocity



Dust Velocity



nh-a-pepssi-3-kem1-v5.0/document
nh_pepssi_v110_ti.txt

GOOD

nh-a-pepssi-3-kem1-v5.0/document
payload_ssr.lbl & payload_ssr.pdf

GOOD

nh-a-pepssi-3-kem1-v5.0/document
pep_bti.lbl & pep_bti.pdf

GOOD

nh-a-pepssi-3-kem1-v5.0/document
pepssi_ssr.lbl & pepssi_ssr.pdf

GOOD

nh-a-pepssi-3-kem1-v5.0/document
quat_xyz_instr_to_j2k.lbl
quat_xyz_instr_to_j2k.asc

GOOD

nh-a-pepssi-3-kem1-v5.0/document
seq_pepssi_kem1.tbl
seq_pepssi_kem1.tab

GOOD

nh-a-pepssi-3-kem1-v5.0/document
soc_inst_icd.tbl & soc_inst_icd.pdf

GOOD

nh-a-pepssi-3-kem1-v5.0/calib
calinfo.txt

GOOD

nh-a-pepssi-3-kem1-v5.0/calib
hk_n1_input_20050228.lbl
hk_n1_input_20050228.tab

GOOD

nh-a-pepssi-3-kem1-v5.0/calib
hk_stat_input_20041016.tbl
hk_stat_input_20041016.tab

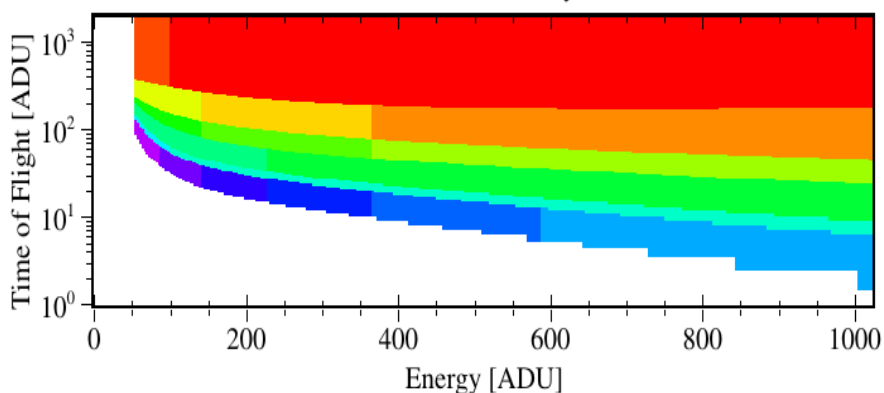
GOOD

nh-a-pepssi-3-kem1-v5.0/calib
rateboxdefinitionplanes.tbl

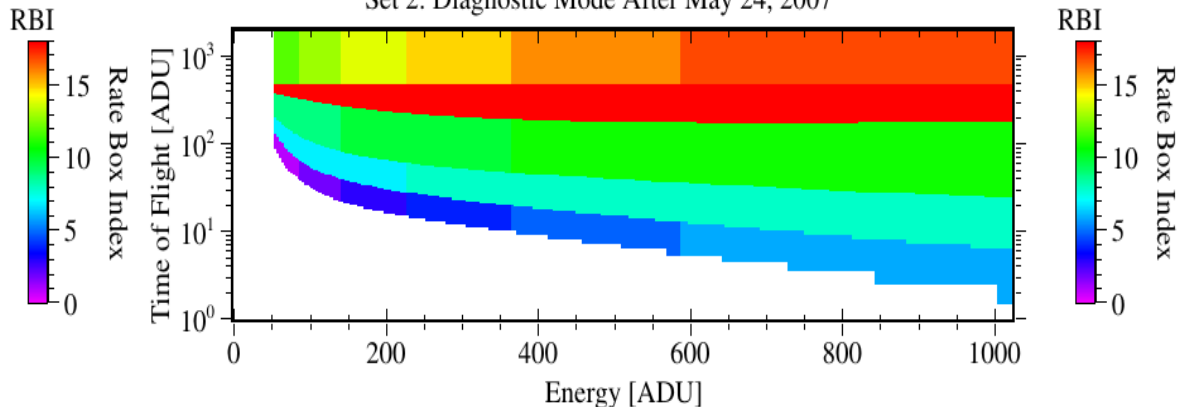
GOOD

nh-a-pepssi-3-kem1-v5.0/calib rateboxdefinitionplanes.fit

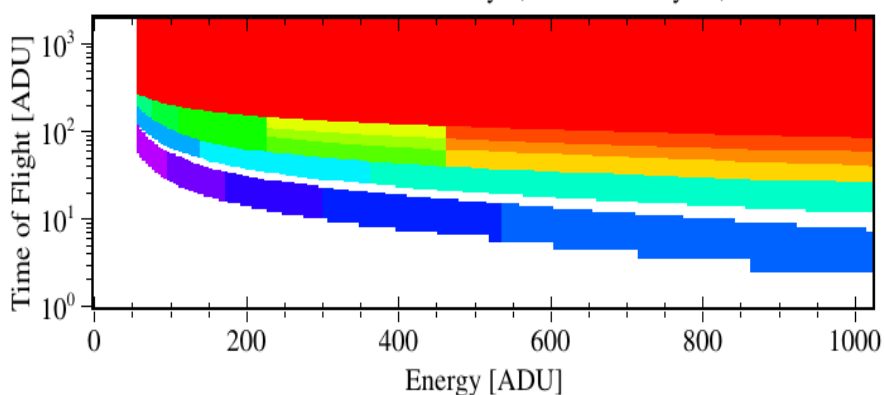
Set 2: Normal Mode After May 24, 2007



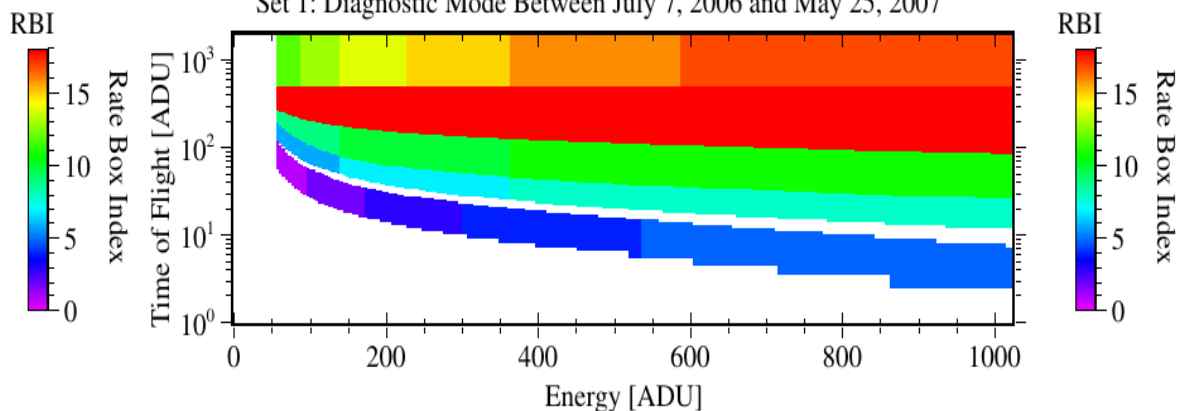
Set 2: Diagnostic Mode After May 24, 2007



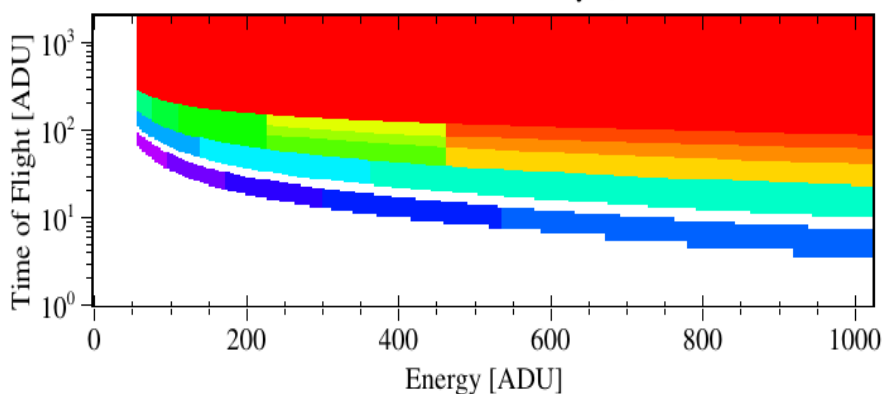
Set 1: Normal Mode Between July 7, 2006 and May 25, 2007



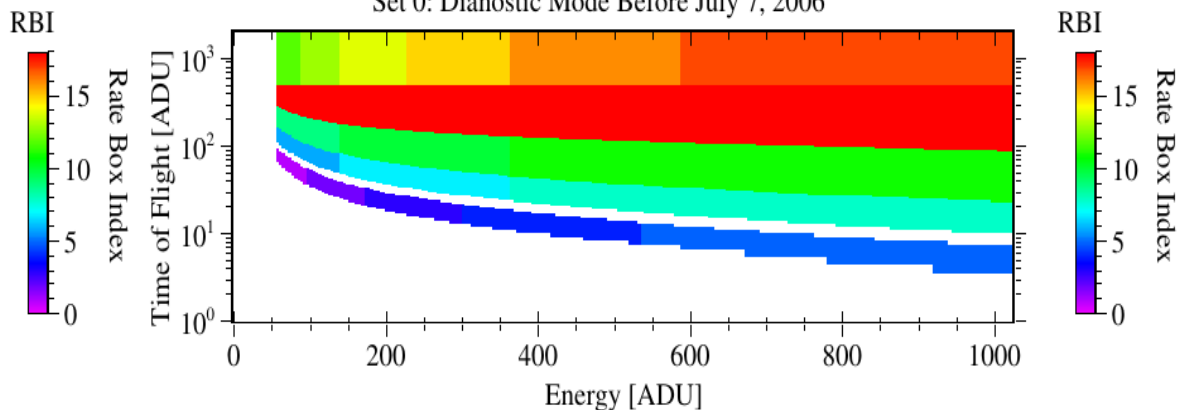
Set 1: Diagnostic Mode Between July 7, 2006 and May 25, 2007



Set 0: Normal Mode Before July 7, 2006



Set 0: Diagnostic Mode Before July 7, 2006



nh-a-pepssi-3-kem1-v5.0/calib/calpars
calpinfo.txt

GOOD

nh-a-pepssi-3-kem1-v5.0/calib/calpars
calpar_columns.fmt

GOOD

nh-a-pepssi-3-kem1-v5.0/calib/calpars
pep_0476085117_0x691_calpar.tab

GOOD

nh-a-pepssi-2-kem1-v5.0/index
nh-a-pepssi-3-kem1-v5.0/index
indxinfo.txt

GOOD

nh-a-pepssi-2-kem1-v5.0/index
nh-a-pepssi-3-kem1-v5.0/index
checksum.tbl & checksum.tab

GOOD

nh-a-pepssi-2-kem1-v5.0/index
nh-a-pepssi-3-kem1-v5.0/index
slimindx.lbl & slimindx.tab

GOOD

nh-a-pepssi-2-kem1-v5.0/index
nh-a-pepssi-3-kem1-v5.0/index
index.lbl & index.tab

GOOD

PEPSSI RAW and CALIBRATED Data Evaluation

nh-a-pepssi-3-kem1-v5.0/data

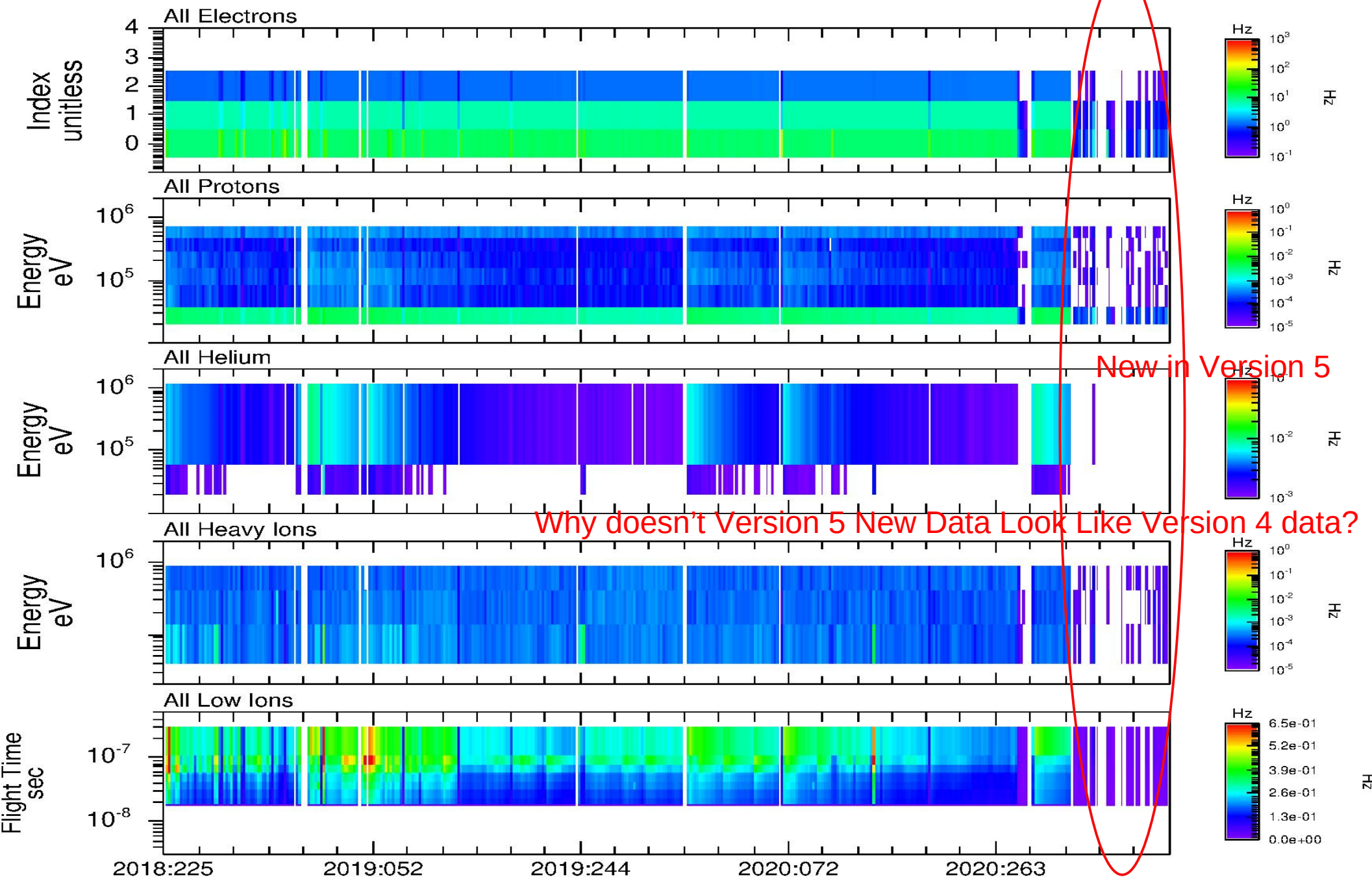
PEPSSI FIT File Structure

fv: Summary of pep_0450337917_0x691_sci.fit in /mnt/..._2020c/nh-a-pepssi-3-kem1-v4.0/data/20200429_045033/

File Edit Tools Help

Index	Extension	Type	Dimension	View				
0	Primary	Image	1017 X 614	Header	Image	Table		
1	SPEC_Protons	Image	1440 X 6	Header	Image	Table		
2	SPEC_Helium	Image	1440 X 2	Header	Image	Table		
3	SPEC_Heavies	Image	1440 X 3	Header	Image	Table		
4	SPEC_Electrons	Image	1440 X 3	Header	Image	Table		
5	SPEC_LowIon	Image	1440 X 8	Header	Image	Table		
6	FLUX	Binary	796 cols X 37 rows	Header	Hist	Plot	All	Select
7	FLUXN1A	Binary	466 cols X 4 rows	Header	Hist	Plot	All	Select
8	FLUXN1B	Binary	344 cols X 4 rows	Header	Hist	Plot	All	Select
9	PHA_ELECTRON	Binary	8 cols X 654 rows	Header	Hist	Plot	All	Select
10	PHA_LOW_ION	Binary	23 cols X 47 rows	Header	Hist	Plot	All	Select
11	PHA_HIGH_ION	Binary	19 cols X 79 rows	Header	Hist	Plot	All	Select

nh-a-pepssi-3-kem1-v5.0/data Quick Look Spectrograms



nh-a-pepssi-3-kem1-v4.0/data

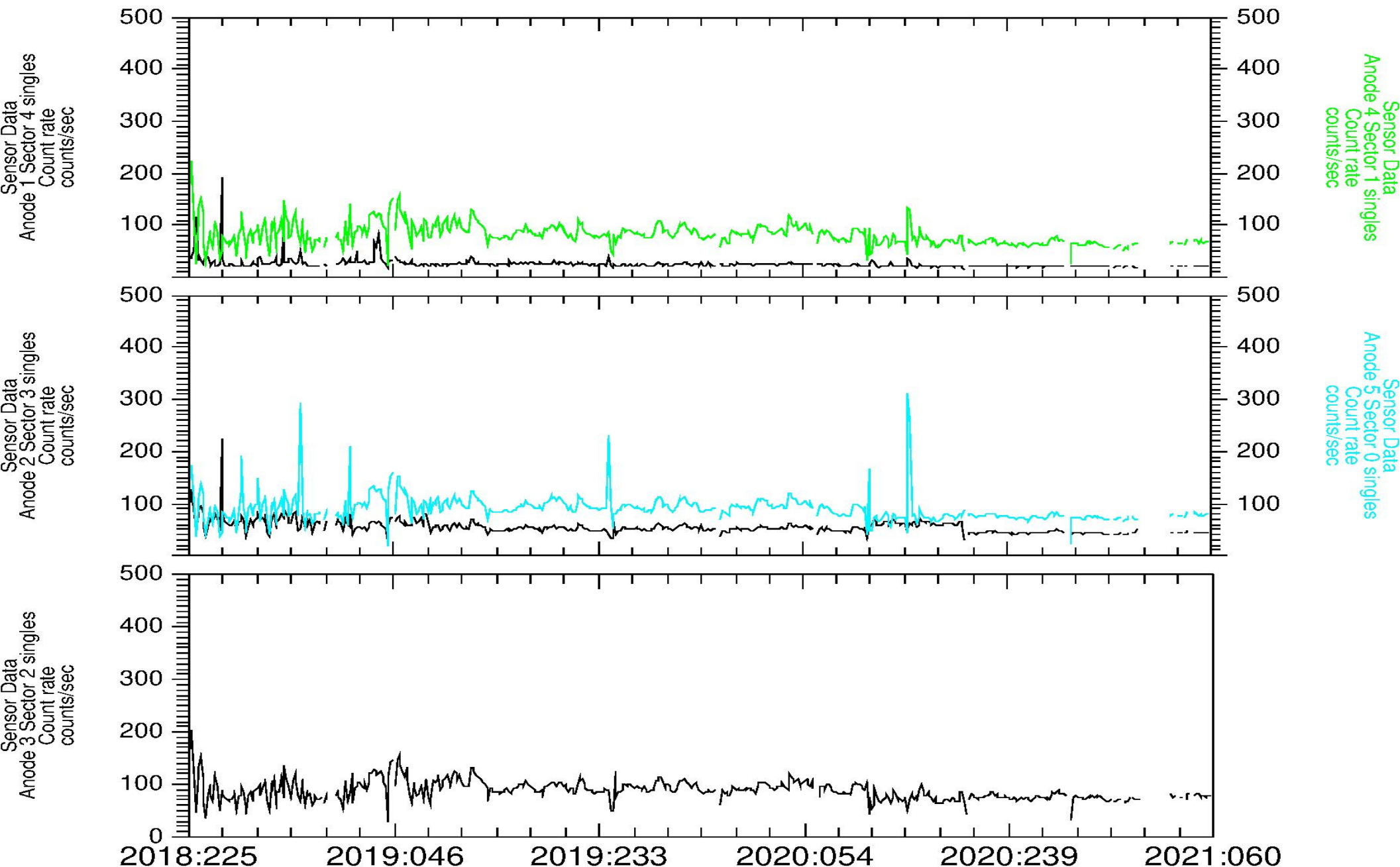
PEPSSI FIT File Structure

fv: Summary of pep_0414395517_0x691_sci.fit in /mnt/..._2020b/nh-a-pepssi-3-kem1-v3.0/data/20190309_041439/

Index	Extension	Type	Dimension	View				
0	Primary	Image	1017 X 614	Header	Image	Table		
1	SPEC_Protons	Image	1440 X 6	Header	Image	Table		
2	SPEC_Helium	Image	1440 X 2	Header	Image	Table		
3	SPEC_Heavies	Image	1440 X 3	Header	Image	Table		
4	SPEC_Electrons	Image	1440 X 3	Header	Image	Table		
5	SPEC_LowIon	Image	1440 X 8	Header	Image	Table		
6	FLUX	Binary	796 cols X 1066 rows	Header	Hist	Plot	All	Select
7	FLUXN1A	Binary	466 cols X 184 rows	Header	Hist	Plot	All	Select
8	FLUXN1B	Binary	344 cols X 184 rows	Header	Hist	Plot	All	Select
9	PHA_ELECTRON	Binary	8 cols X 31804 rows	Header	Hist	Plot	All	Select
10	PHA_LOW_ION	Binary	23 cols X 2585 rows	Header	Hist	Plot	All	Select
11	PHA_HIGH_ION	Binary	19 cols X 2874 rows	Header	Hist	Plot	All	Select

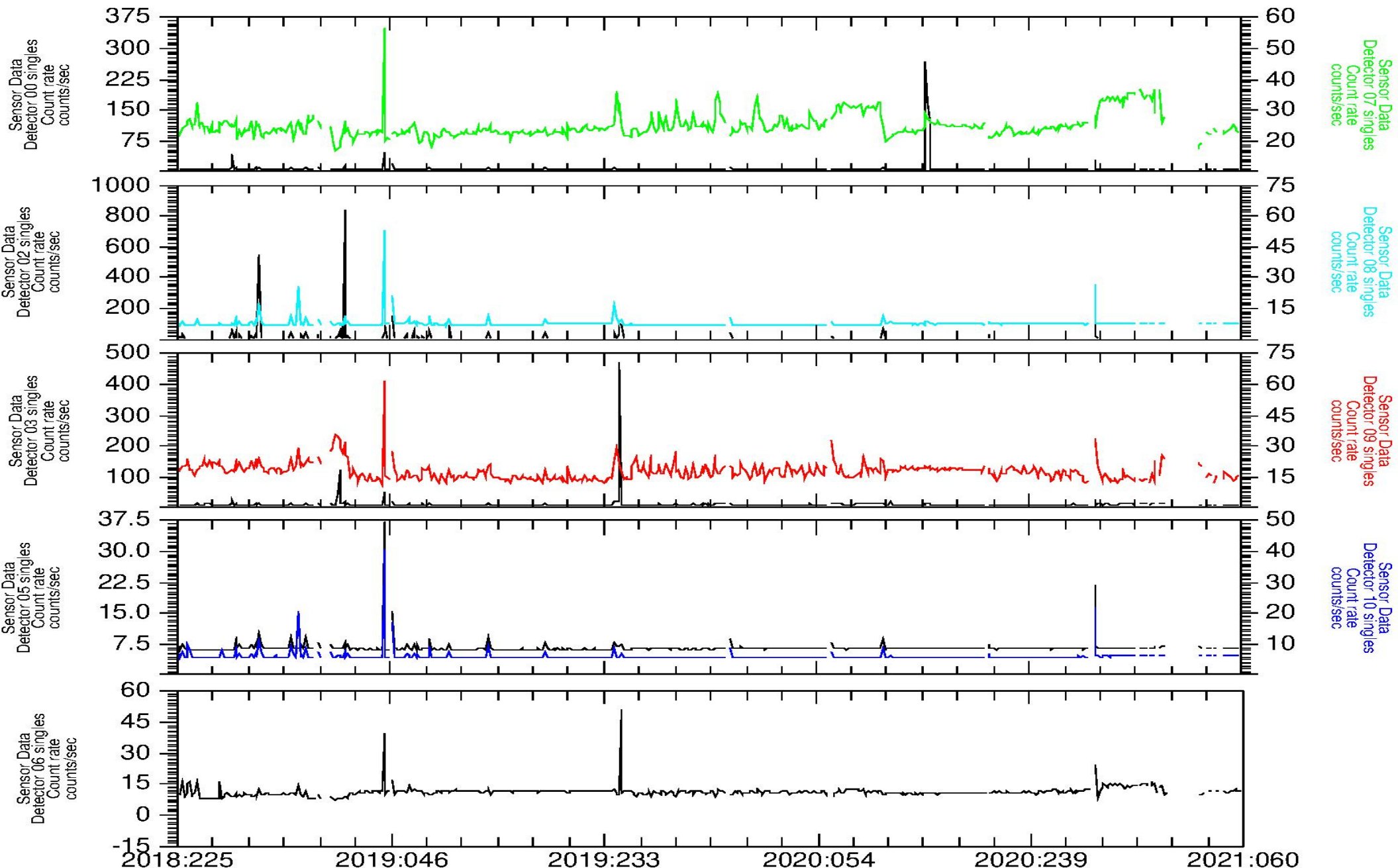
nh-a-pepssi-3-kem1-v5.0/data

FLUX Anode Singles



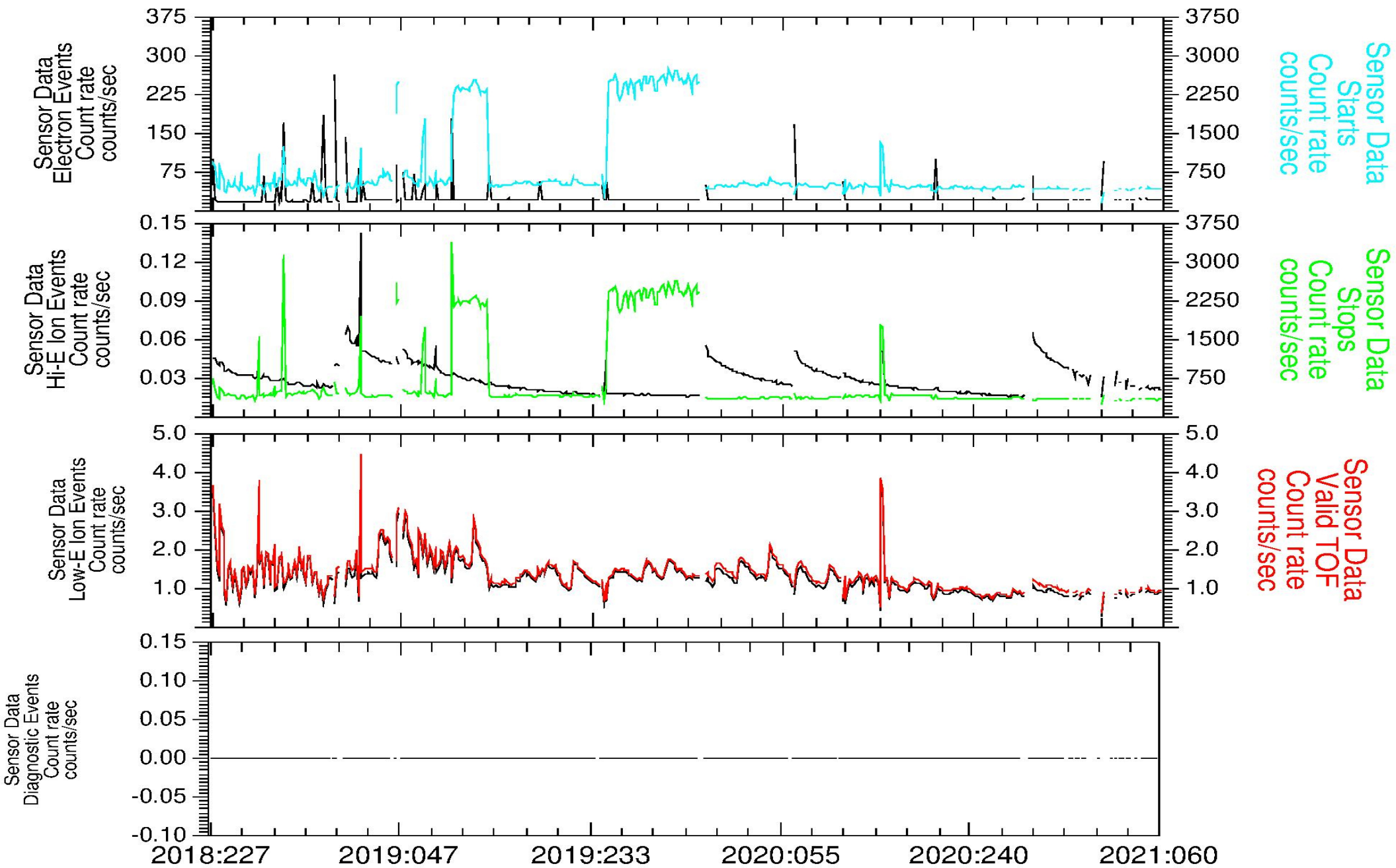
nh-a-pepssi-3-kem1-v5.0/data

FLUX Detector Singles



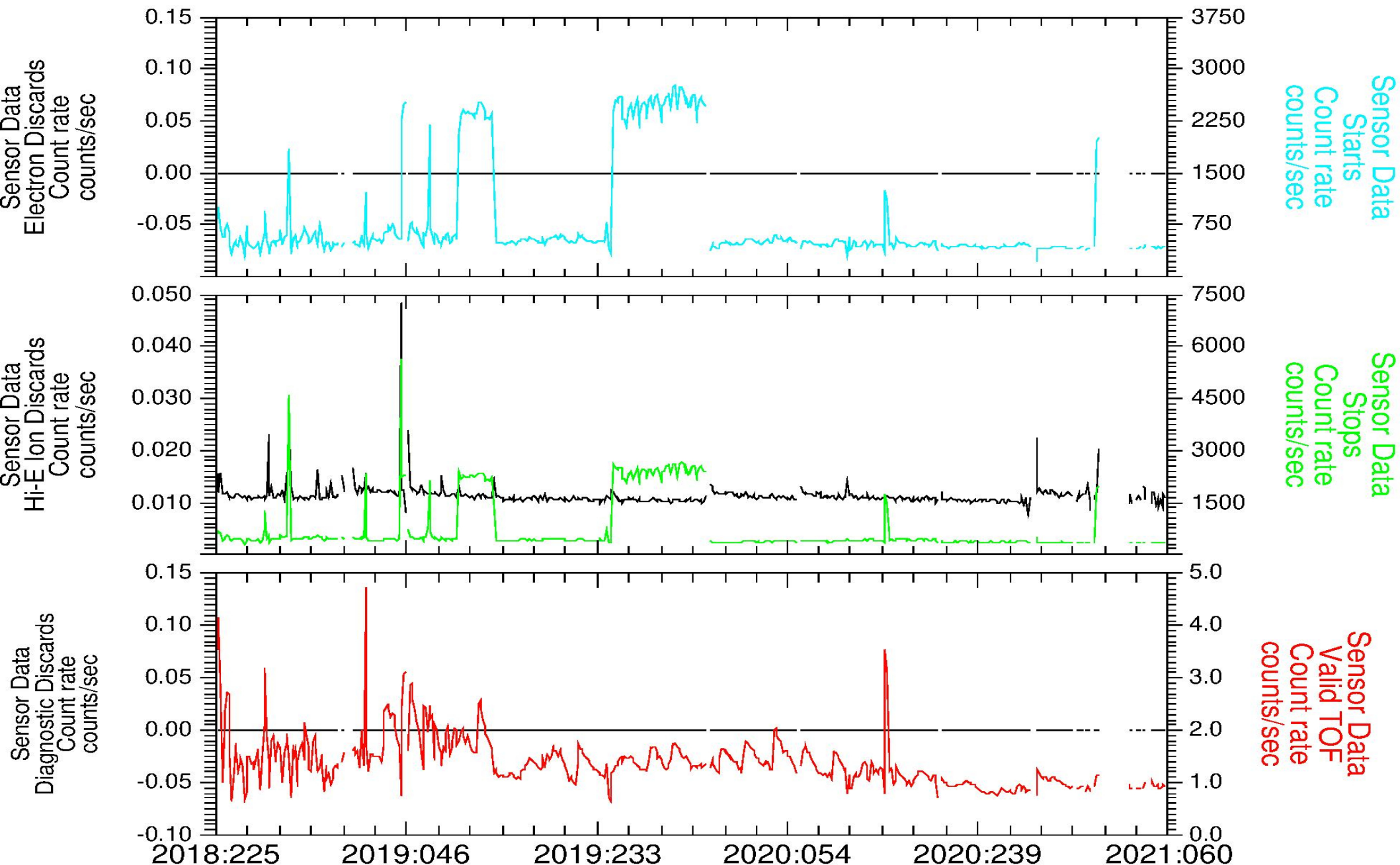
nh-a-pepssi-3-kem1-v5.0/data

FLUX Events "C" Rates

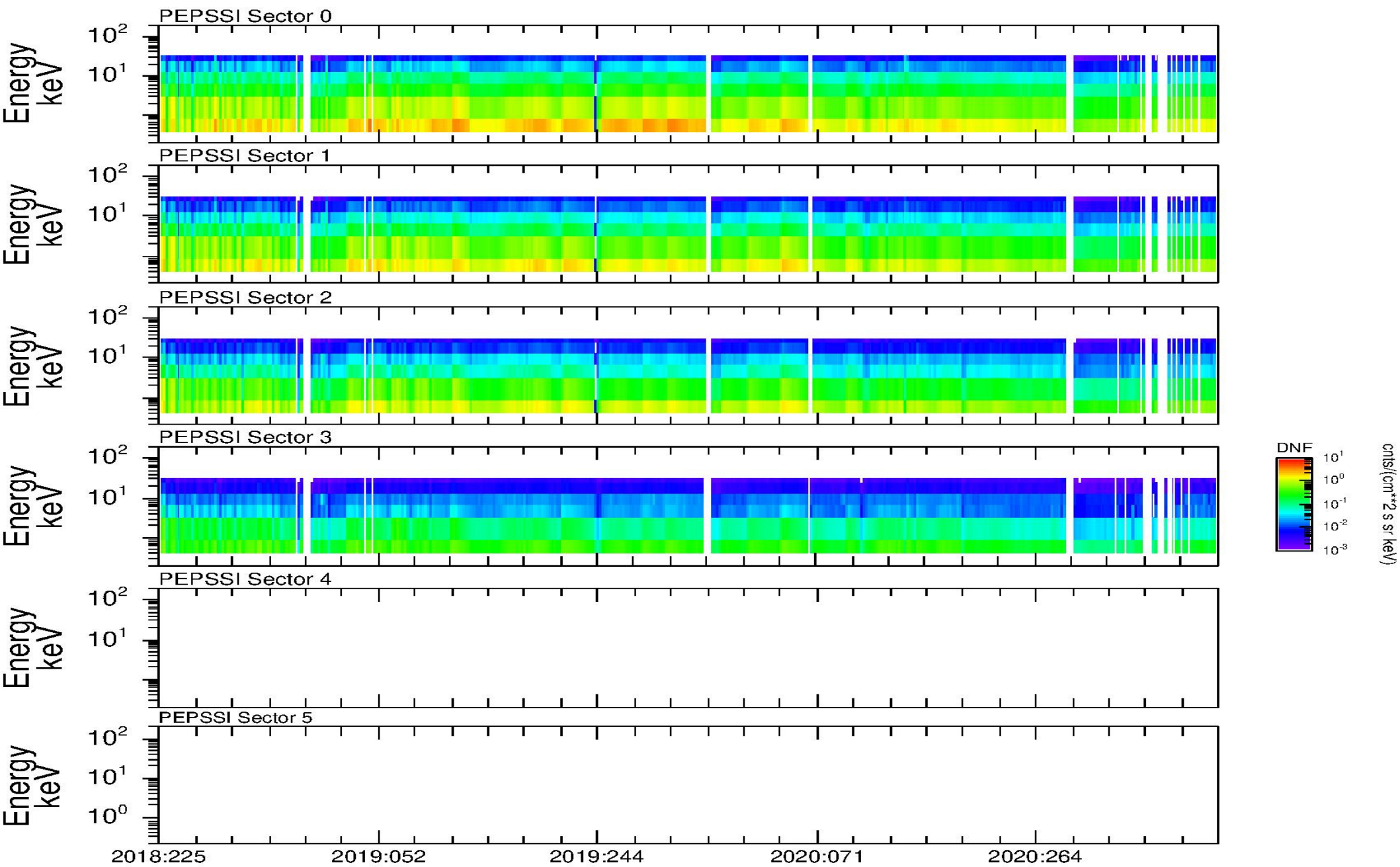


nh-a-pepssi-3-kem1-v5.0/data

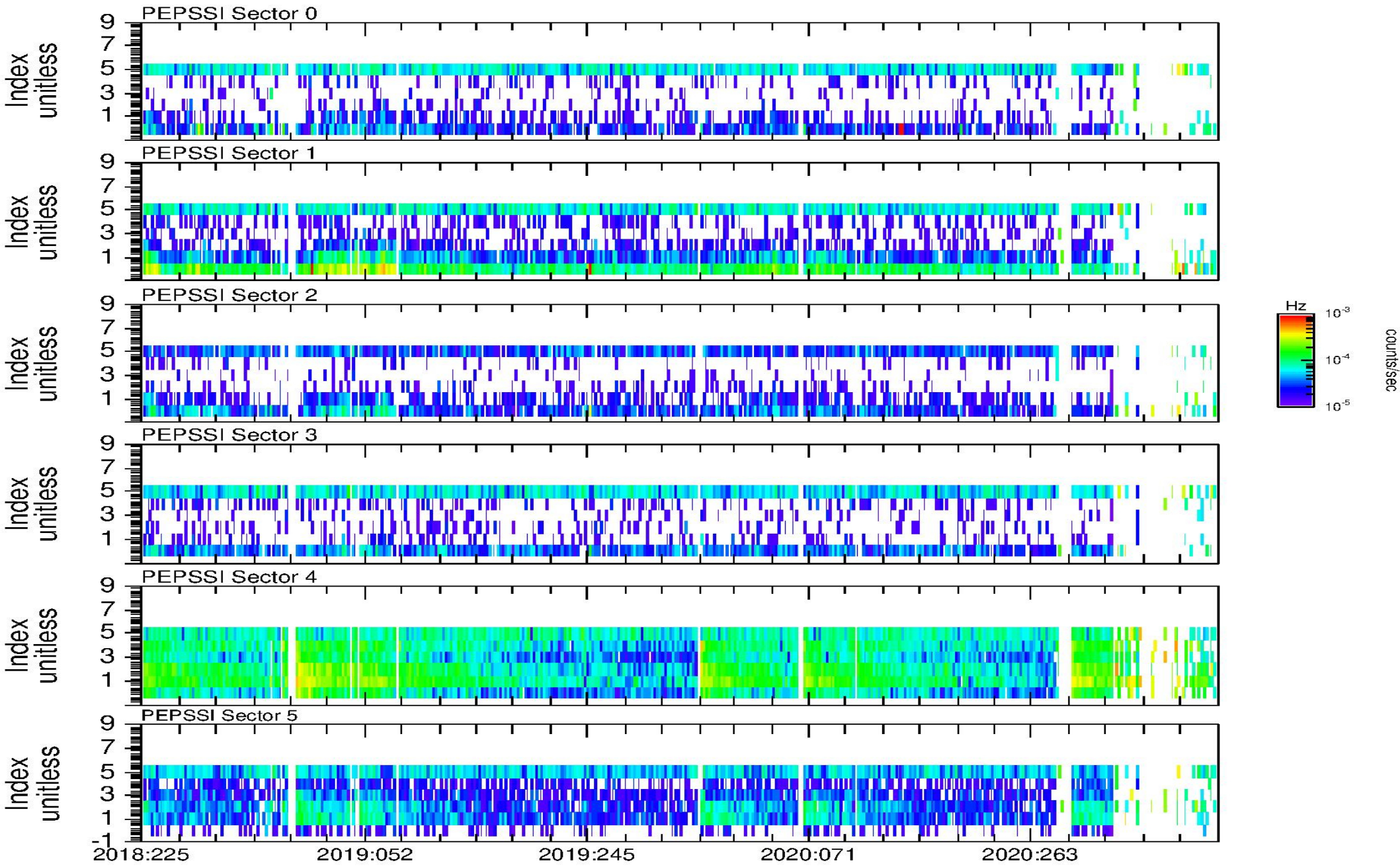
FLUX Discards "J" Rates



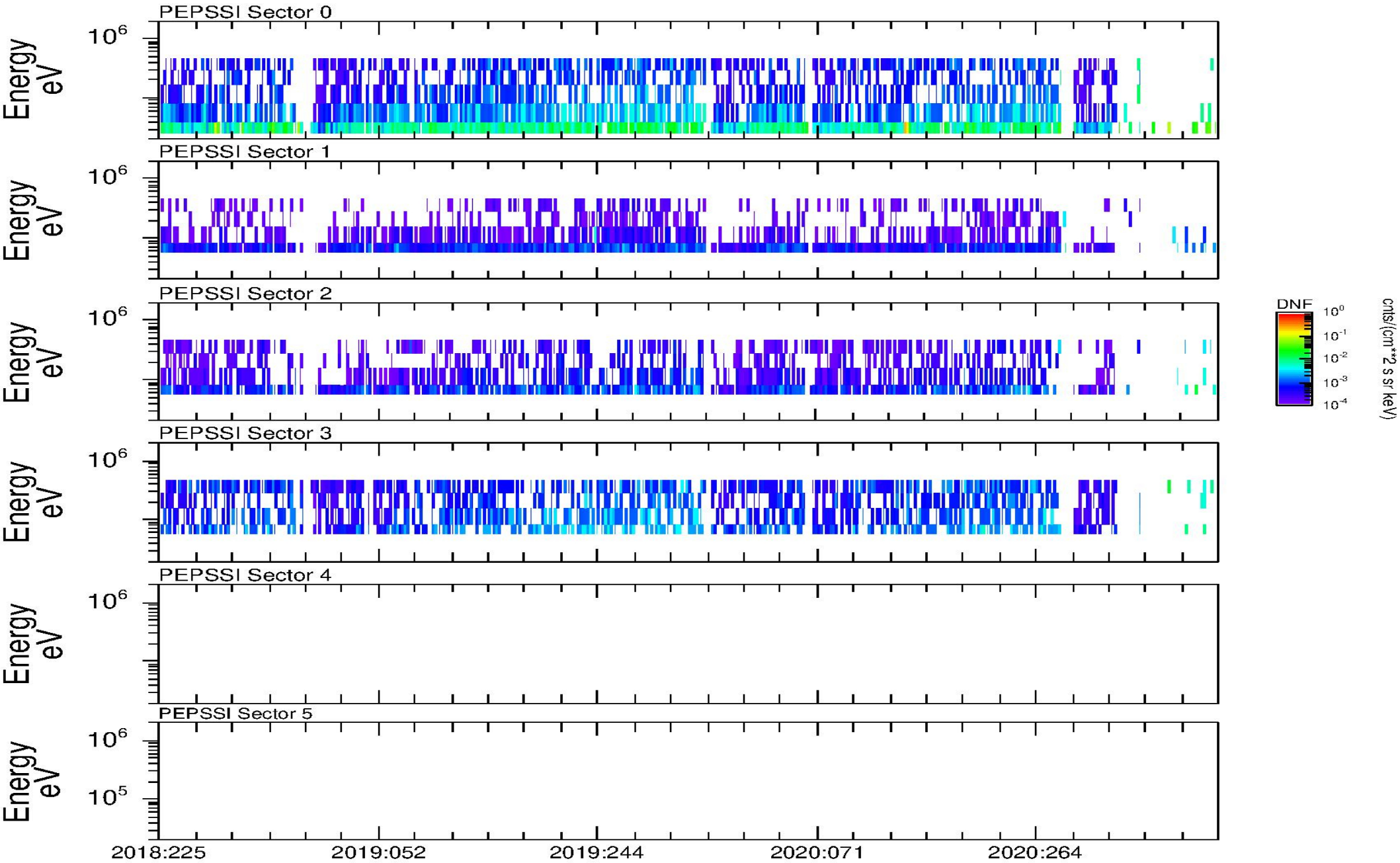
nh-a-pepssi-3-kem1-v5.0/data FLUX Doubles ("L") DNF



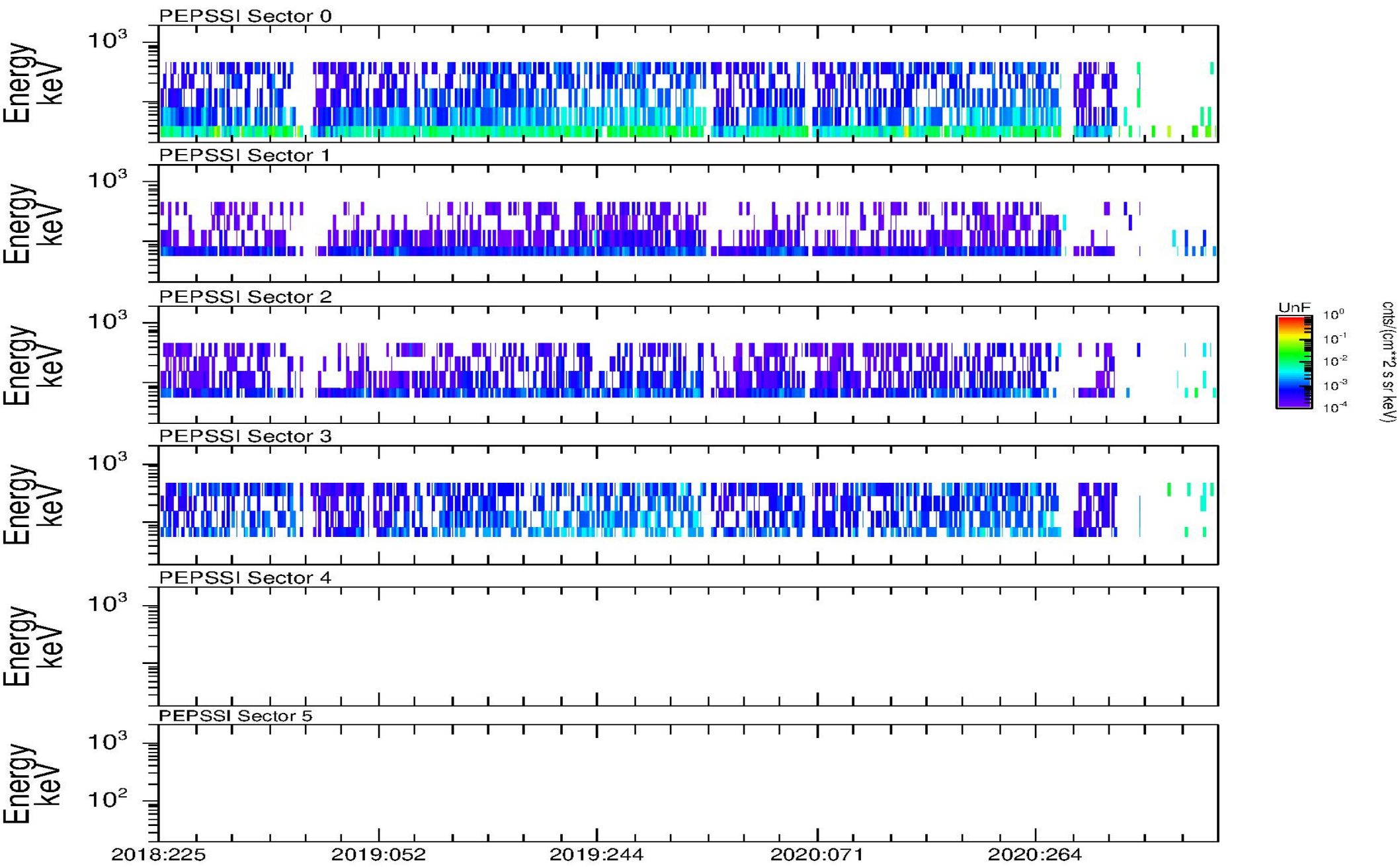
nh-a-pepssi-3-kem1-v5.0/data FLUX Triples ("D") CPS Protons



nh-a-pepssi-3-kem1-v4.0/data FLUX Triples ("D") DNF Protons



nh-a-pepssi-3-kem1-v4.0/data FLUX Triples ("D") UNC Protons



nh-a-pepssi-3-kem1-v5.0/data

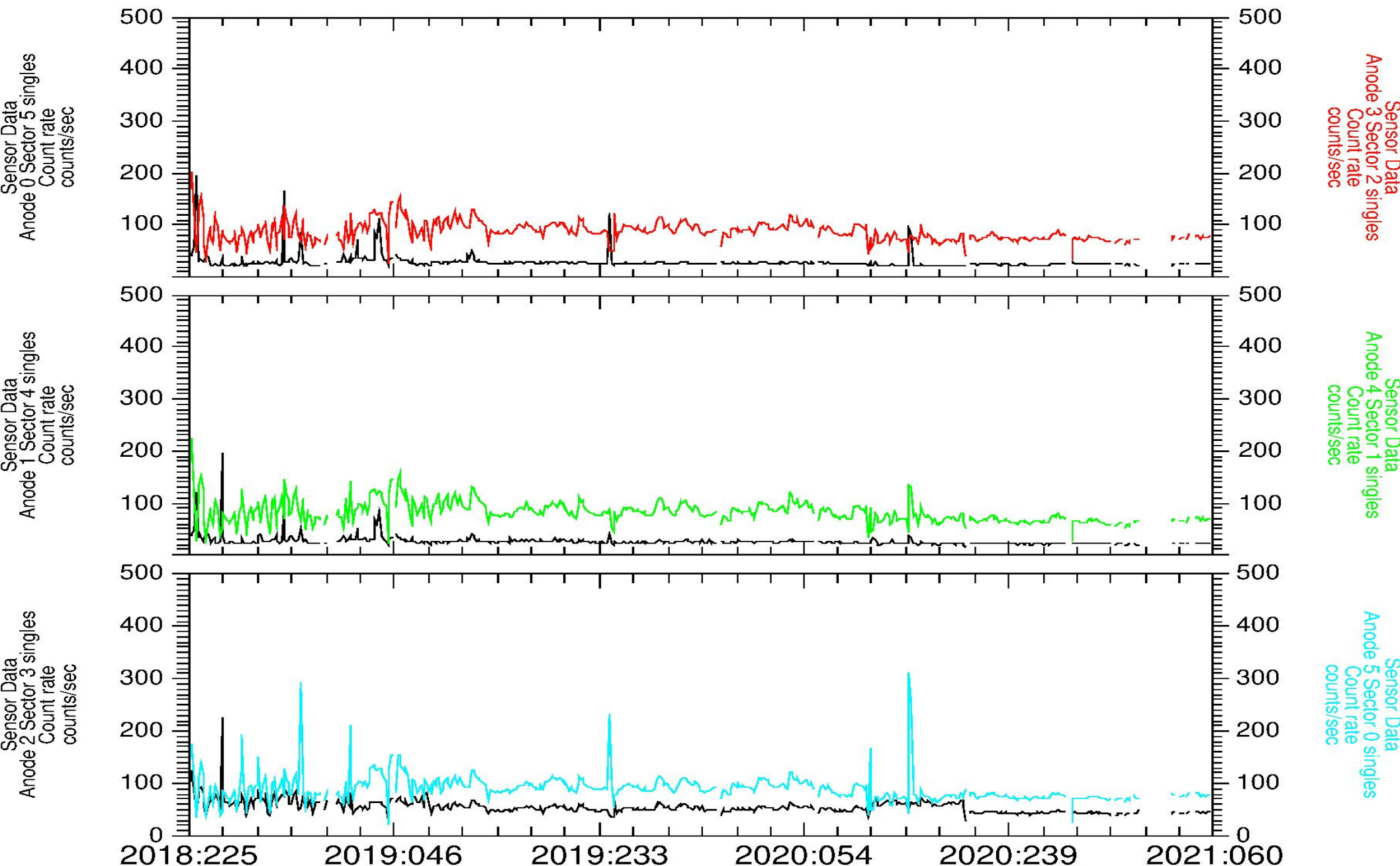
PEPSSI FIT File Structure

fv: Summary of pep_0450337917_0x691_sci.fit in /mnt/..._2020c/nh-a-pepssi-3-kem1-v4.0/data/20200429_045033/

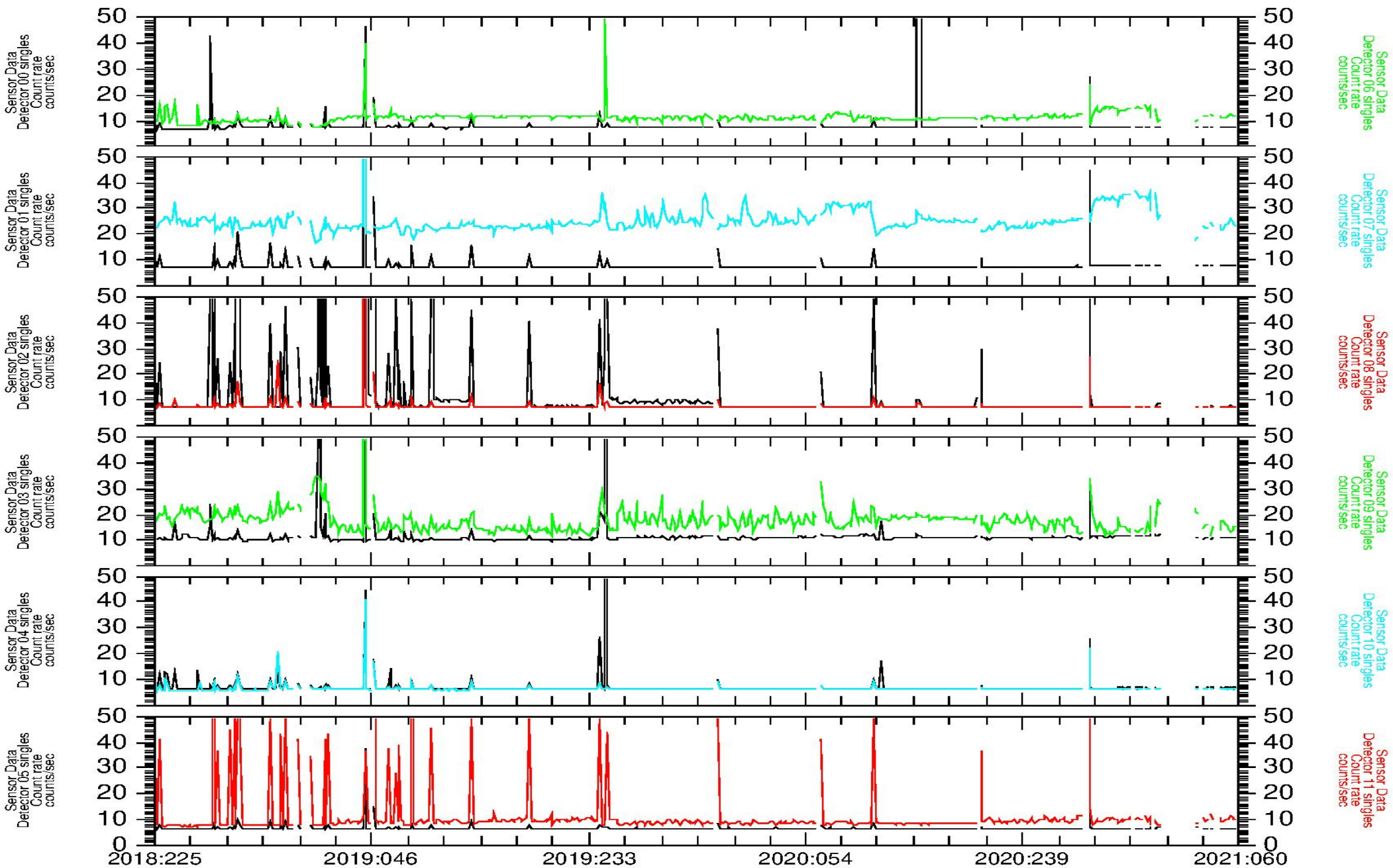
Index	Extension	Type	Dimension	View				
0	Primary	Image	1017 X 614	Header	Image	Table		
1	SPEC_Protons	Image	1440 X 6	Header	Image	Table		
2	SPEC_Helium	Image	1440 X 2	Header	Image	Table		
3	SPEC_Heavies	Image	1440 X 3	Header	Image	Table		
4	SPEC_Electrons	Image	1440 X 3	Header	Image	Table		
5	SPEC_LowIon	Image	1440 X 8	Header	Image	Table		
6	FLUX	Binary	796 cols X 37 rows	Header	Hist	Plot	All	Select
7	FLUXN1A	Binary	466 cols X 4 rows	Header	Hist	Plot	All	Select
8	FLUXN1B	Binary	344 cols X 4 rows	Header	Hist	Plot	All	Select
9	PHA_ELECTRON	Binary	8 cols X 654 rows	Header	Hist	Plot	All	Select
10	PHA_LOW_ION	Binary	23 cols X 47 rows	Header	Hist	Plot	All	Select
11	PHA_HIGH_ION	Binary	19 cols X 79 rows	Header	Hist	Plot	All	Select

nh-a-pepssi-3-kem1-v5.0/data

FLUXN1B Anode Singles

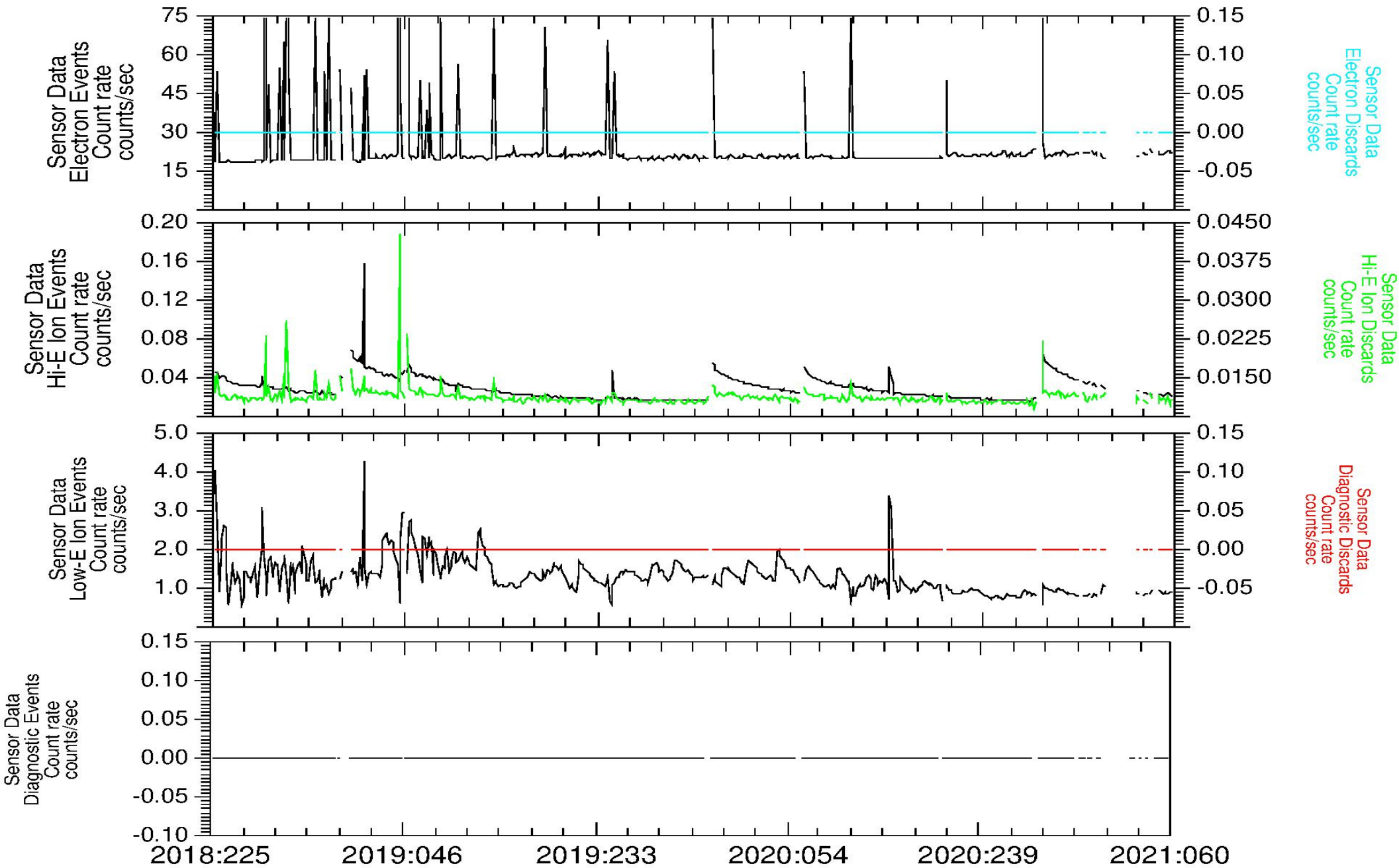


nh-a-pepssi-3-kem1-v5.0/data FLUXN1B Detector Singles

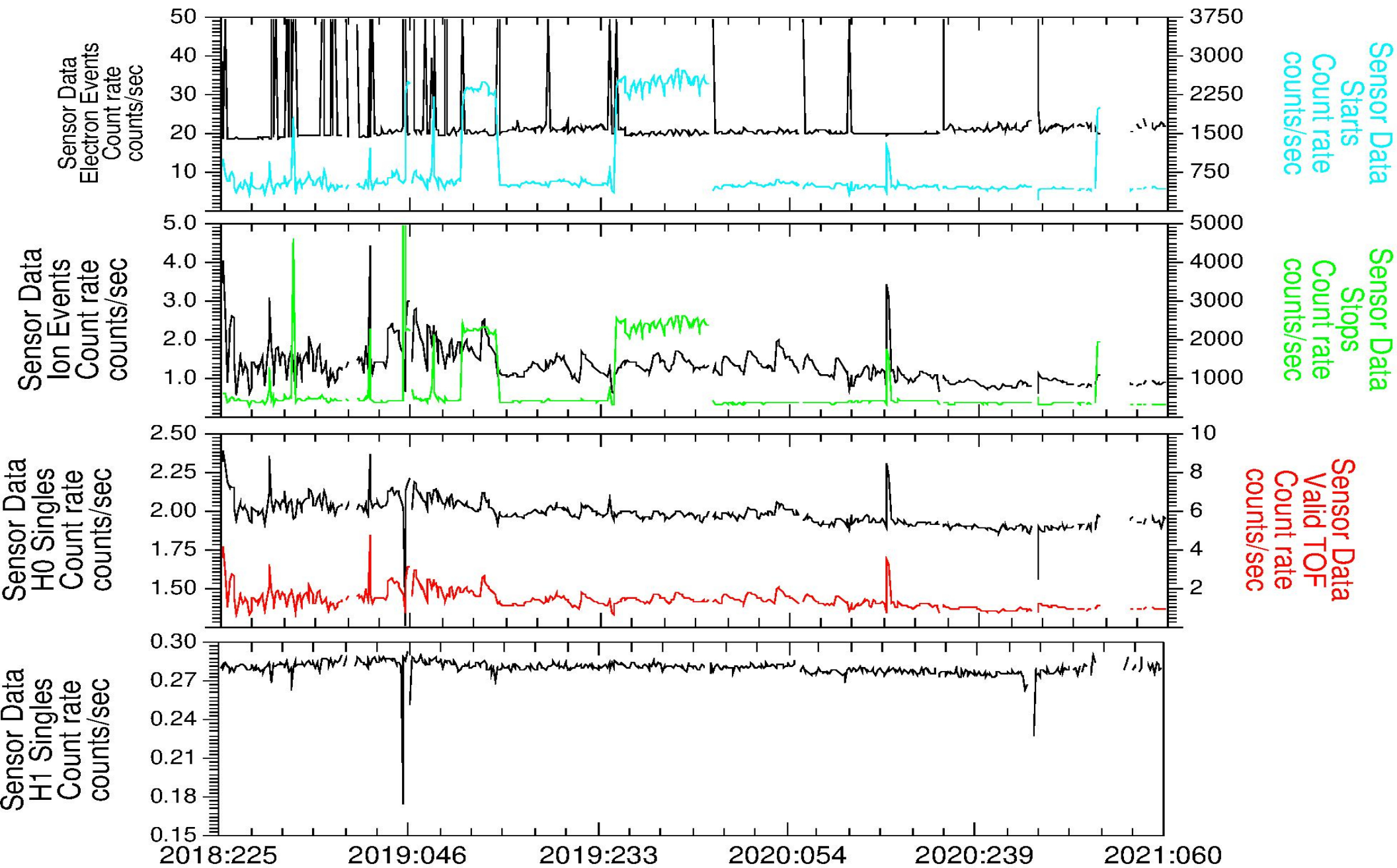


nh-a-pepssi-3-kem1-v5.0/data

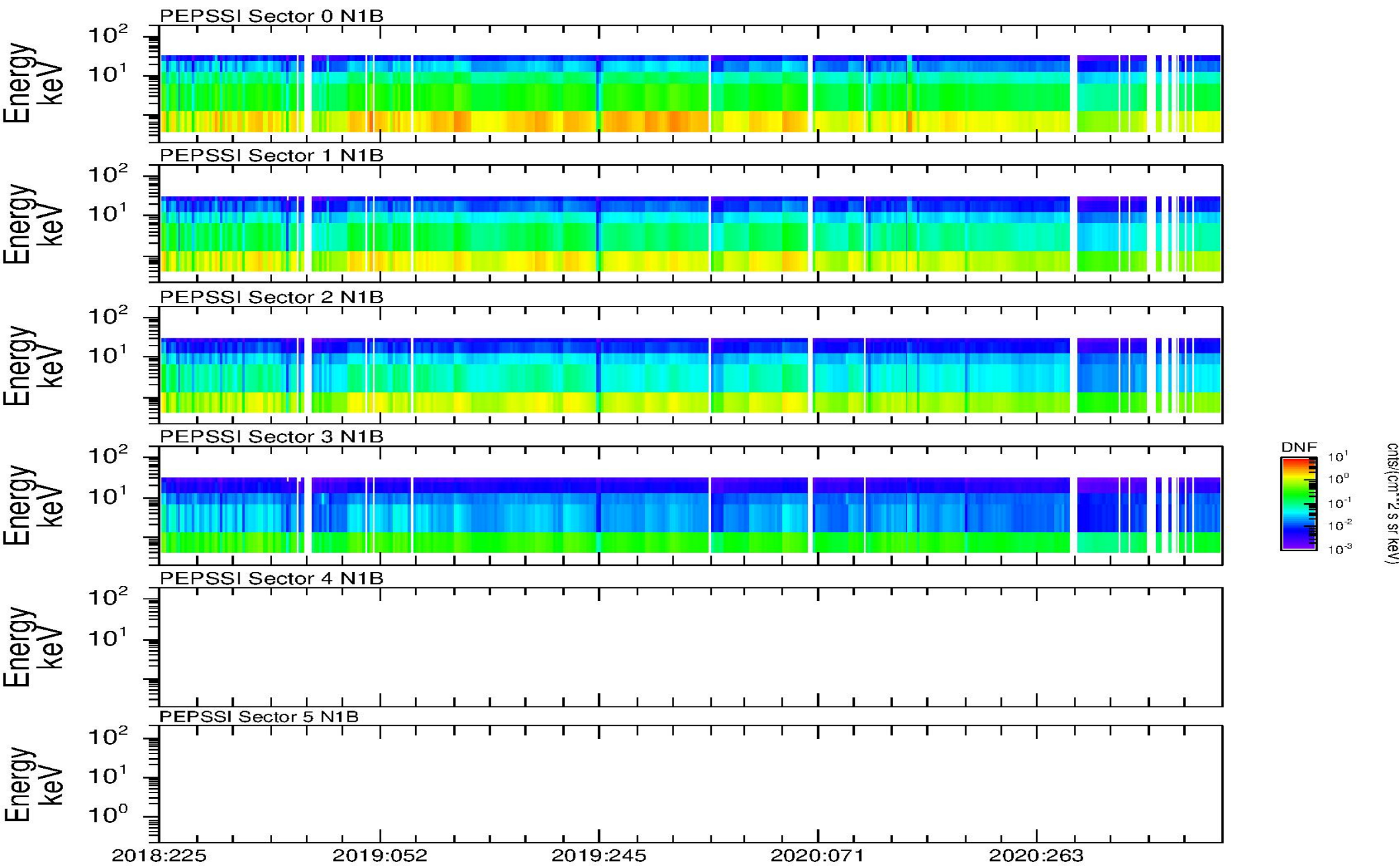
FLUXN1B Events & Discards - "J" Rates



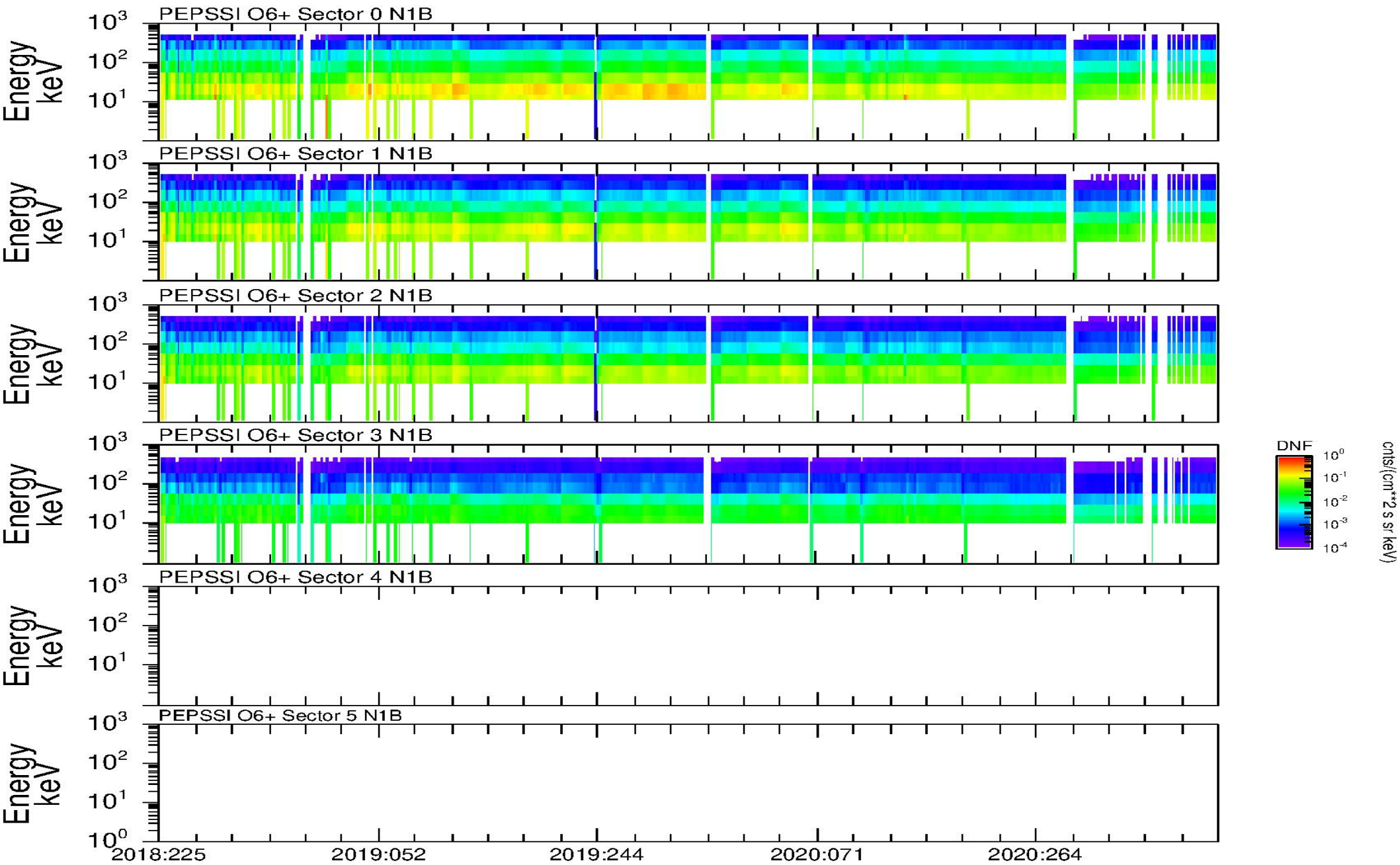
nh-a-pepssi-3-kem1-v5.0/data FLUXN1B Events - "C" Rates



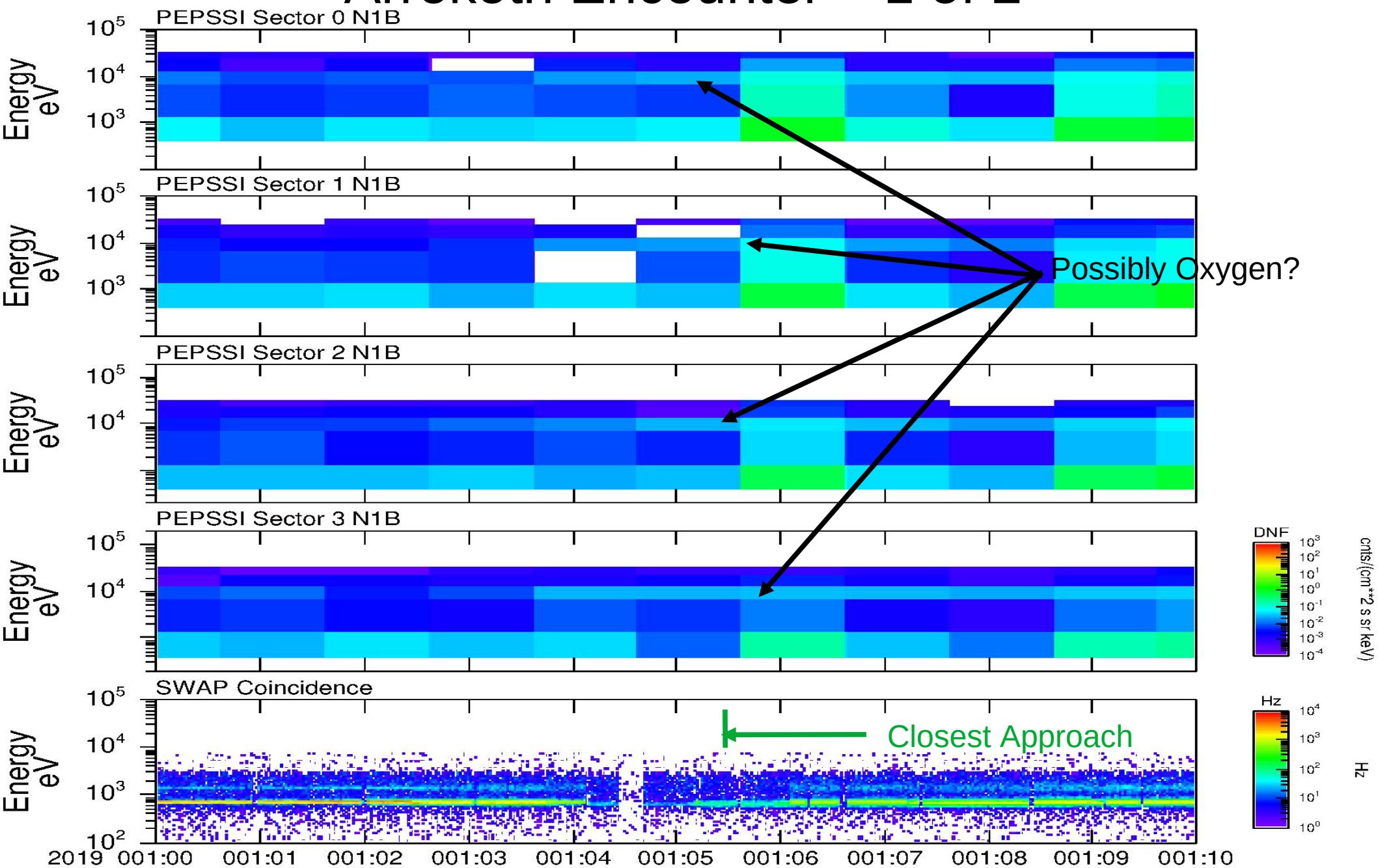
nh-a-pepssi-3-kem1-v5.0/data FLUXN1B Proton Flux



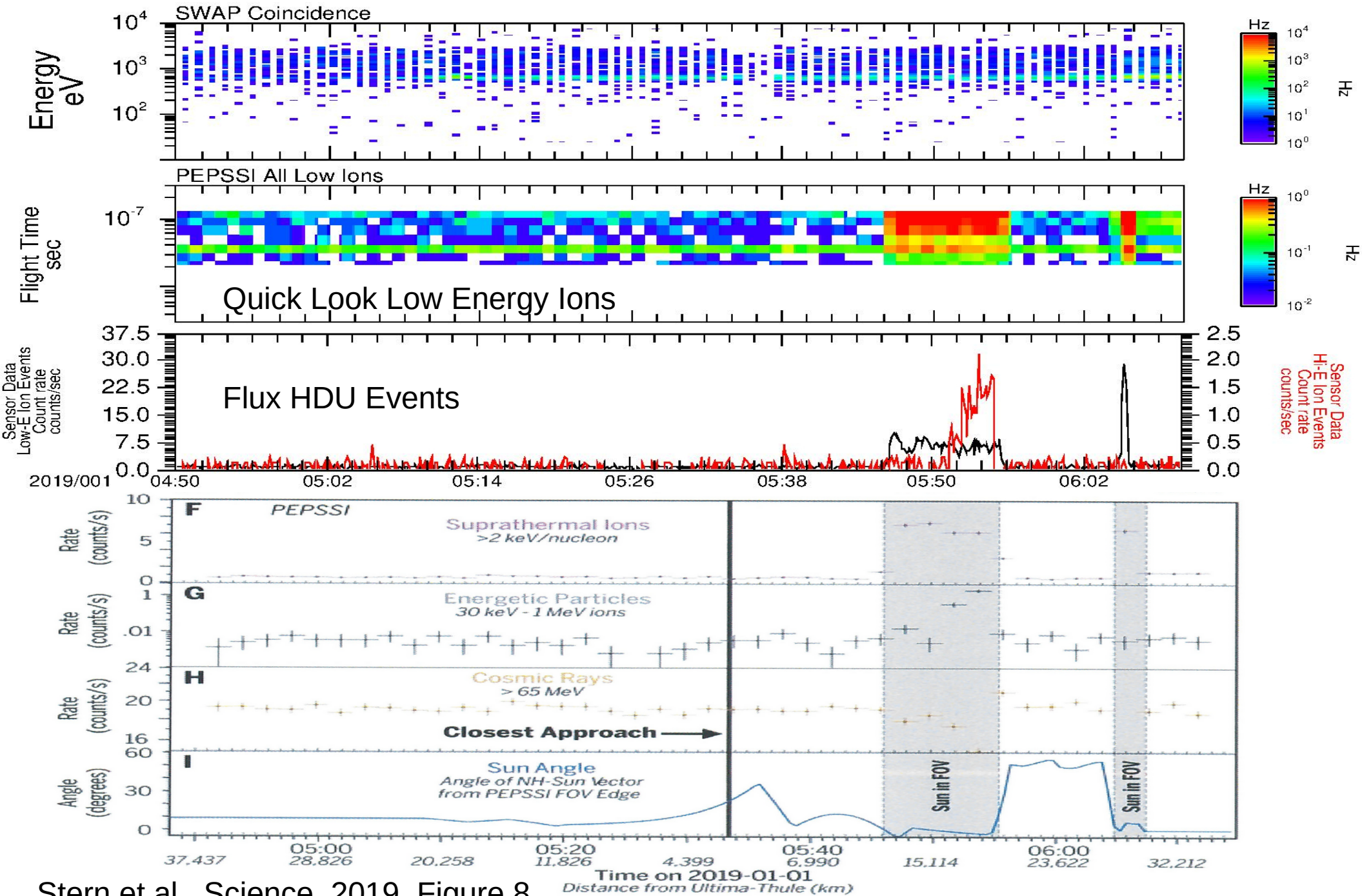
nh-a-pepssi-3-kem1-v5.0/data FLUXN1B Oxygen Flux



PEPSSI-SWAP Arrokoth Encounter – 1 of 2



PEPSSI-SWAP Arrokoth Encounter – 2 of 2



Stern et al., Science, 2019, Figure 8

Certification Raw and Calibrated

This data can be certified.

PEPSSI RESAMPLED Documentation Evaluation

nh-x-pepssi-4-plasma-v1.0
aareadme.txt

GOOD

nh-x-pepssi-4-plasma-v1.0
voldesc.txt

GOOD

nh-x-pepssi-4-plasma-v1.0/catalog
catinfo.txt

GOOD

nh-x-pepssi-4-plasma-v1.0/catalog
catinfo.txt

GOOD

nh-x-pepssi-4-plasma-v1.0/catalog nh_kem.cat

Can this be Updated?

```
OBJECT = MISSION_INFORMATION
MISSION_START_DATE = 2016-10-26
MISSION_STOP_DATE = 2021-09-30
MISSION_ALIAS_NAME = "NH_KEM"
MISSION_DESC = "
```

This material has been adapted from the New Horizons web site. The mission stop date is the current stop date of the Kuiper Belt (KB) Extended Mission (KEM).
The MISSION_STOP_DATE is the current contracted mission stop date. If approved KEM1's phase may exceed this date and therefore the end is TBD.

Has this not Completed?
The Encounter has
Already Occurred.

KEM Cruise1

```
-----
Short phase name (in DSID):  KEMCRUISE1
Formal mission phase name:  CRUISE TO FIRST KBO ENCOUNTER
Mission Phase Start Time - 2016-10-26
Mission Phase Stop Time - 2018-08-14
```

Activities during the KEMCRUISE1 mission phase to the first KBO encounter are similar to those for Pluto Cruise phase. They also include post-Pluto encounter calibrations in mid-2016, along with continuing download of data from the Pluto encounter.

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

nh-x-pepssi-4-plasma-v1.0/catalog
nhsc.cat

GOOD

nh-x-pepssi-4-plasma-v1.0/catalog pepssi.cat

Please refer to dataset.cat for additional details on the applicability and use of the Primary HDU and extensions of data products in this dataset.

Data files in this data set are in CSV format, not FIT format. The Level 4 dataset.cat file contains no information about the Primary HDU or extensions in FIT files.

nh-x-pepssi-4-plasma-v1.0/catalog dataset.cat

It seems that this file is the only document which describes the resampled data. Thus, extra comments were included as missing in this file.

```
START_TIME           = 2012-028T00:30:00.000
STOP_TIME            = 2020-366T23:30:00.000

DATA_SET_DESC        = "

Data Set Overview
=====

This dataset contains one-hour averaged energetic particle flux rate
values and counts-per-second generated by the New Horizons Particles
and Plasma science team from data taken by the Pluto Energetic Particle
Spectrometer Science Investigation (PEPSSI) instrument. The data covers
a time range from early 2012 through January 1, 2020. Flux rates and
sums are presented for each of the six instrument look directions.
```

Does not agree, stop time does agree with the data files, so
this document is incorrect.

nh-x-pepssi-4-plasma-v1.0/catalog dataset.cat

```
The headers and contents for these higher level derived data products  
are described below.
```

```
Data File Headers  
=====
```

Missing Information: these data are organized into separate subdirectories under the data directory:

```
data: total_counts: pepssi_reduced_j_YYYY (csv and lbl)  
      double:       pepssi_reduced_lZZZ_YYYY_X (csv and lbl)  
      triple:       pepssi_reduced_bZZZ_YYYY_X (csv and lbl)
```

Where: YYYY is the year the measurements were taken
X is the segment number (a or b)
ZZZ is the units of the data (csv or flux)

nh-x-pepssi-4-plasma-v1.0/catalog dataset.cat

Data File Contents

=====

Three of four detection types are provided in this dataset.

Triples: B-rates where both the total energy detected and the time of flight of the charged particle are known. Thus, the mass and energy of the particle can be determined.

Doubles: L-rates where only the time of flight of the charged particle is known. Since the distance of the measurement is also known a velocity can be determined. The energy per unit mass, more commonly called the 'energy per nucleon', E/m , can also be determined through the following formulas:

$$E = (m v^2) / 2$$
$$E/m = (v^2) / 2$$

Totals: Total counts in each of the three detection modes. This is useful for determining overall charged particle activity at a given time.

Analysis of the fourth detection type, cosmic ray energy-only events, is not yet ready for public release.

For each measurement, calculated statistical uncertainties are provided.

The L and B fluxes include a complex correction for instrument efficiency variations related to turning the instrument off and on. See [KOLLMANNETAL2019] Appendix A.

Data has been removed if it was captured during times (aka 'Bad Time Intervals') when spacecraft operations make interpretation difficult (power on, power off, unusual telescope pointings, etc).

This section is a description of the dataset and the section title is mislabeled (should be Dataset Contents). This section should be placed above the section labeled "Data File Headers".

The "Data File Contents" section should describe what is in the data files. It should describe the contents of each type of data file and what is inside of each. The section "Data File Types" makes a stab at this.

nh-x-pepssi-4-plasma-v1.0/catalog dataset.cat

Under “Data File Types”:

BFLUX: 'Triples', counts-per-second.

LFLUX: 'Doubles', counts-per-second.

The data files say the units are:

$c/s/ster/cm^2/keV$

nh-x-pepssi-4-plasma-v1.0/catalog dataset.cat

The labels are cryptic and not explained. These should be included and below is an example (although it could be written in many ways):

LTTSDDI_X where L means Doubles and TT is the channel (0-15), S means the Sensor and DD is the sensor number (0-6), I is the species combined with “Unc” to indicate an Uncertainty, and X is the segment (a or b).

LlonsAllAllS00_B or LlonsAllAllS00Unc_B ...
LlonsAllAllSAll_B or LlonsAllAllSAllUnc_B ...
LlonsAllAllS012_B or LlonsAllAllS012Unc_B ...
L01toL13OddAllS00_B or L01toL13OddAllS00Unc_B ...
L01toL13OddAllSAll_B or L01toL13OddAllSAllUnc_B ...
L01toL13OddAllS012_B or L01toL13OddAllS012Unc_B ...
L01toL13OddAllS00_B or L01toL13OddAllS00Unc_B ...
L01toL13OddAllSAll_B or L01toL13OddAllSAllUnc_B ...
L01toL13OddAllS012_B or L01toL13OddAllS012Unc_B ...

The explanation of the J's in the “Data File Types” section is good, the Doubles and Triples files should be the same. Right now, the general user does not know how to interpret the labels.

nh-x-pepssi-4-plasma-v1.0/catalog dataset.cat

```
ABSTRACT_DESC          = "  
This dataset contains one-hour averaged energetic particle flux rate  
values and counts-per-second generated by the New Horizons Particles  
and Plasma science team from data taken by the Pluto Energetic Particle  
Spectrometer Science Investigation (PEPSSI) instrument. The data covers  
a time range from early 2012 through January 1, 2020. Flux rates and  
sums are presented for each of the six instrument look directions.  
"
```

Data goes a year beyond this date...

Missing Information: Time tag marks the (beginning, center, End?) of an event, which is a one-hour average window.

nh-x-pepssi-4-plasma-v1.0/catalog
ref.cat

GOOD

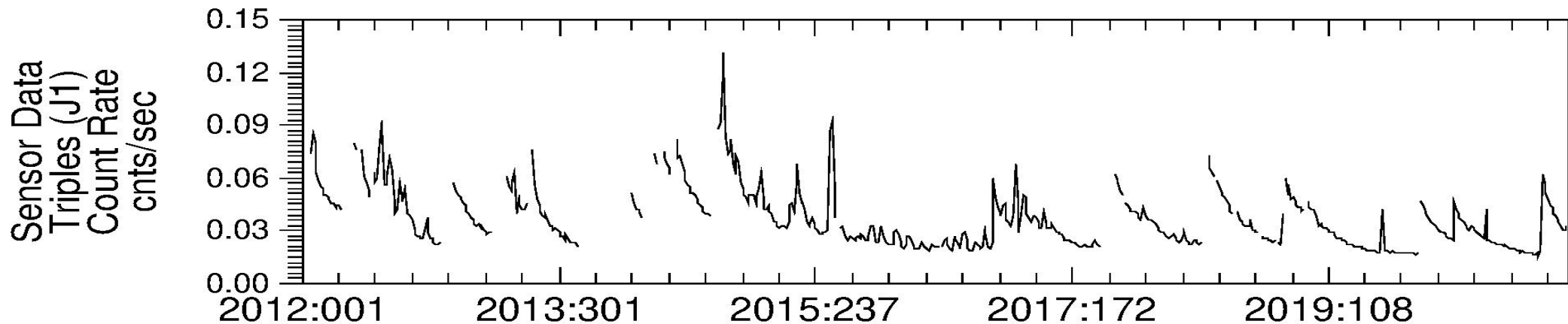
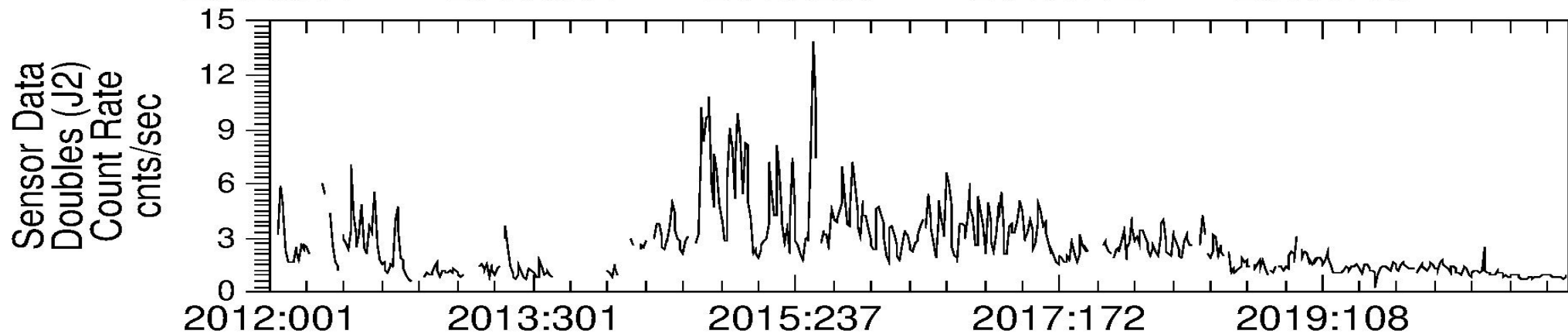
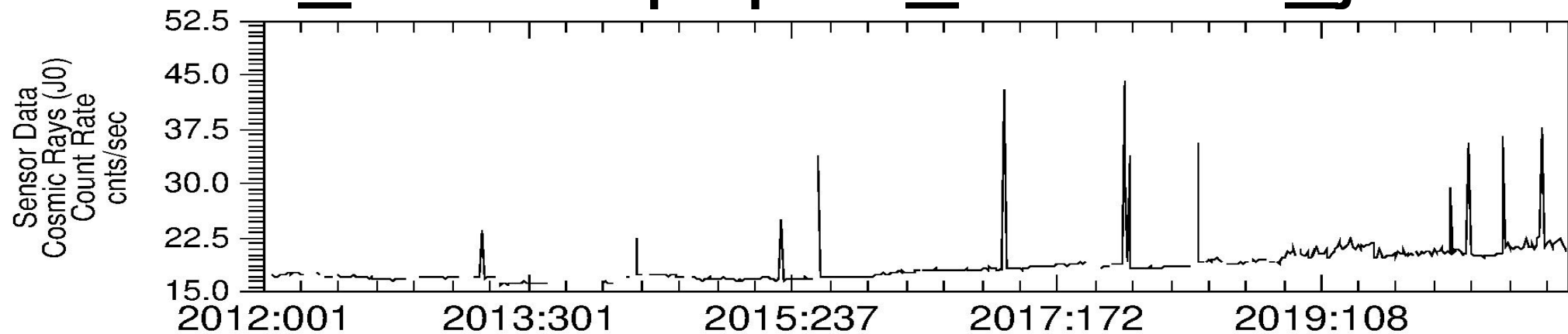
PEPSSI RESAMPLED Data Evaluation

Assumptions

Not enough information in the documentation is given to register the data within the 1 hour accumulation period. The following assumption was made in order to analyze the data:

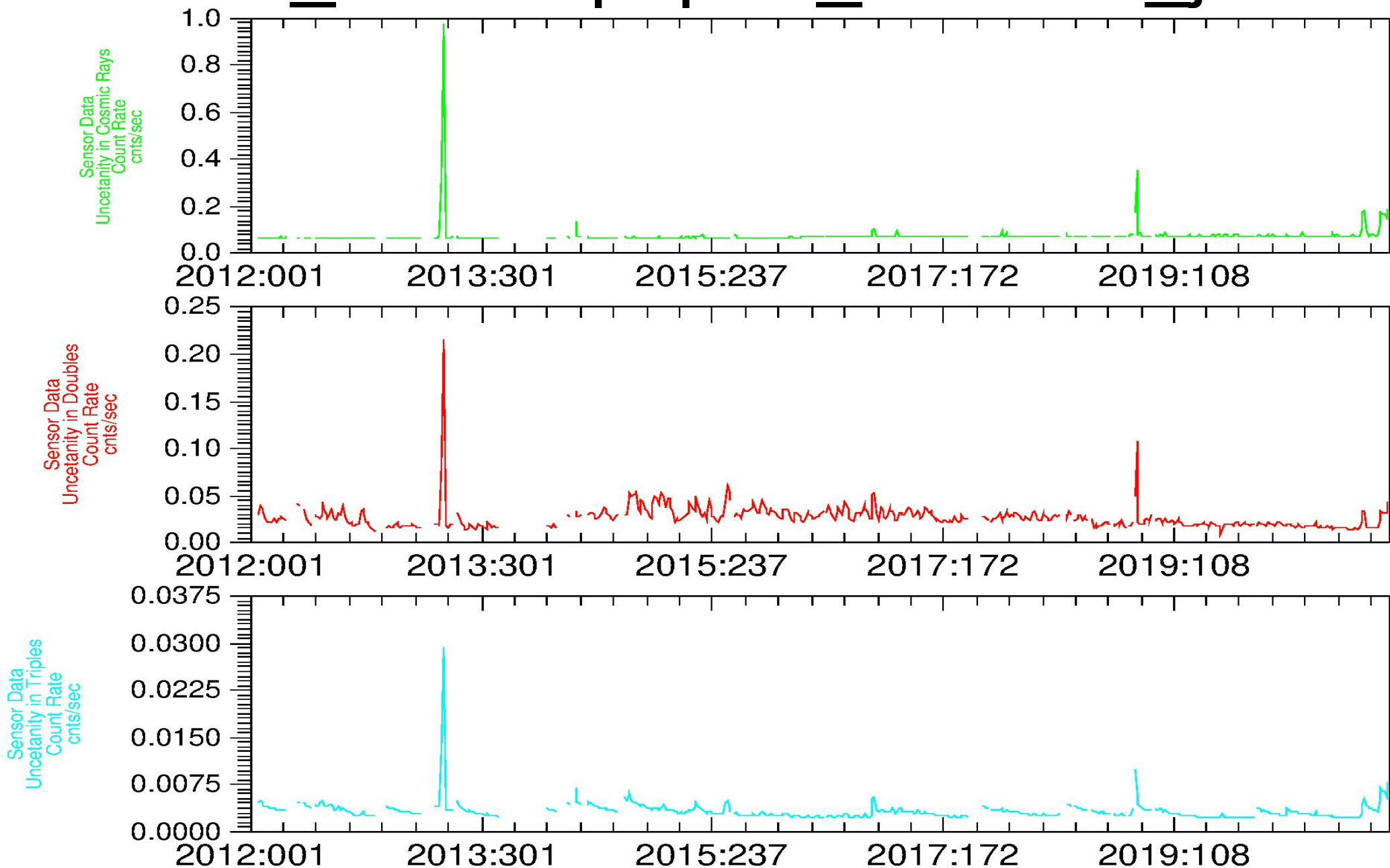
Time stamp in the data files are at the beginning of the accumulation period.

nh-x-pepssi-4-plasma-v1.0/data total_counts/pepssi_reduced_j*

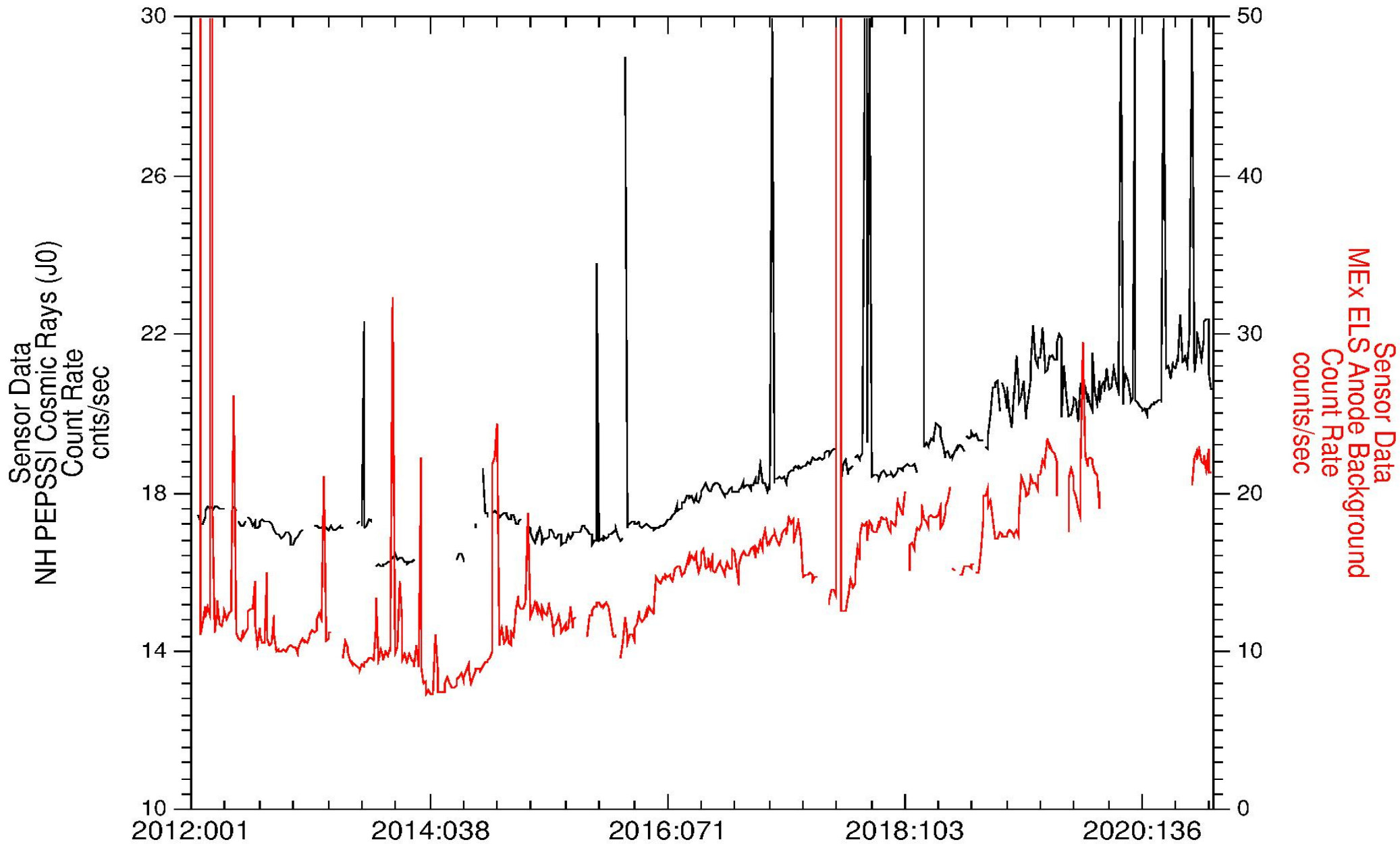


nh-x-pepssi-4-plasma-v1.0/data

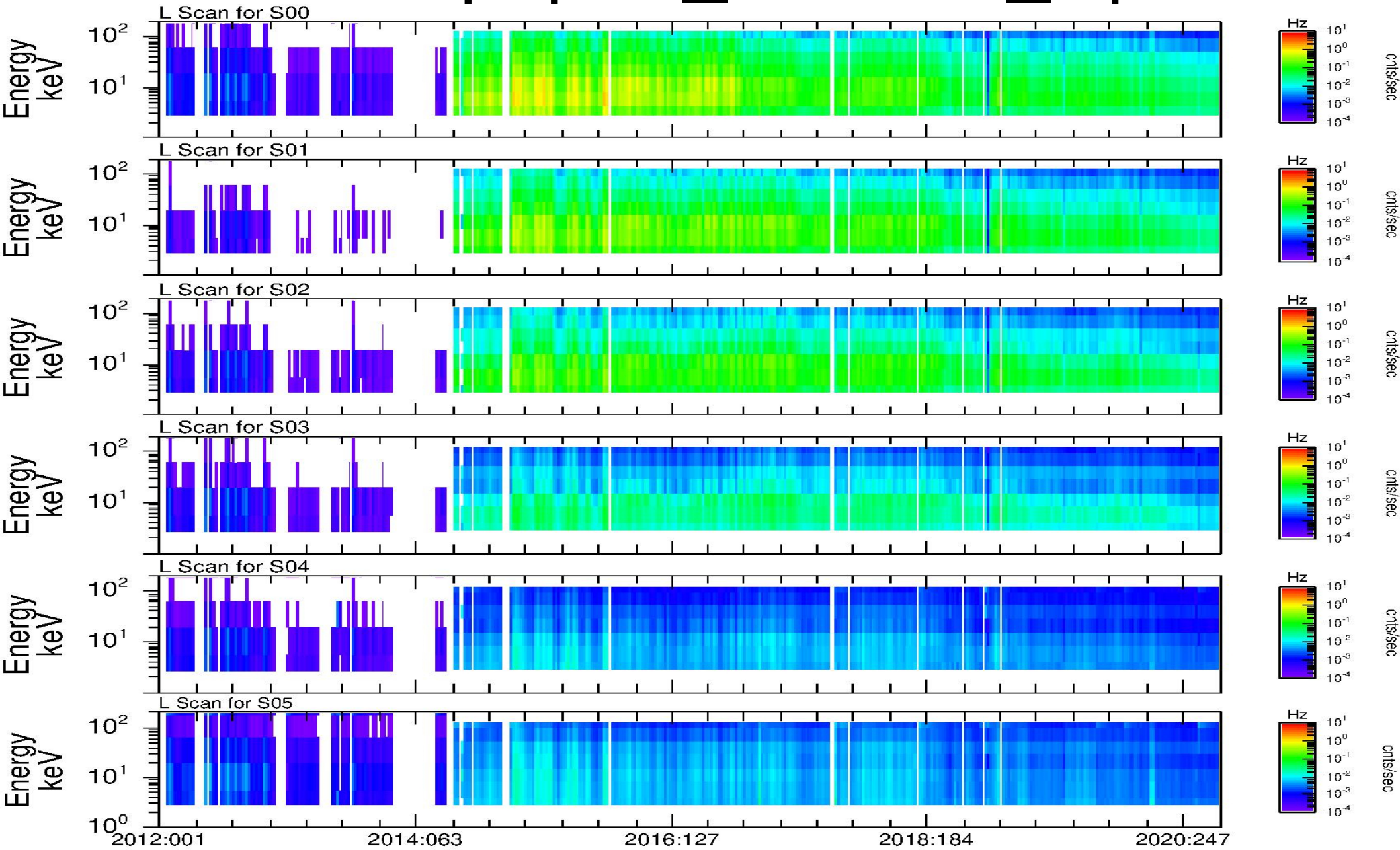
total_counts/pepssi_reduced_j*



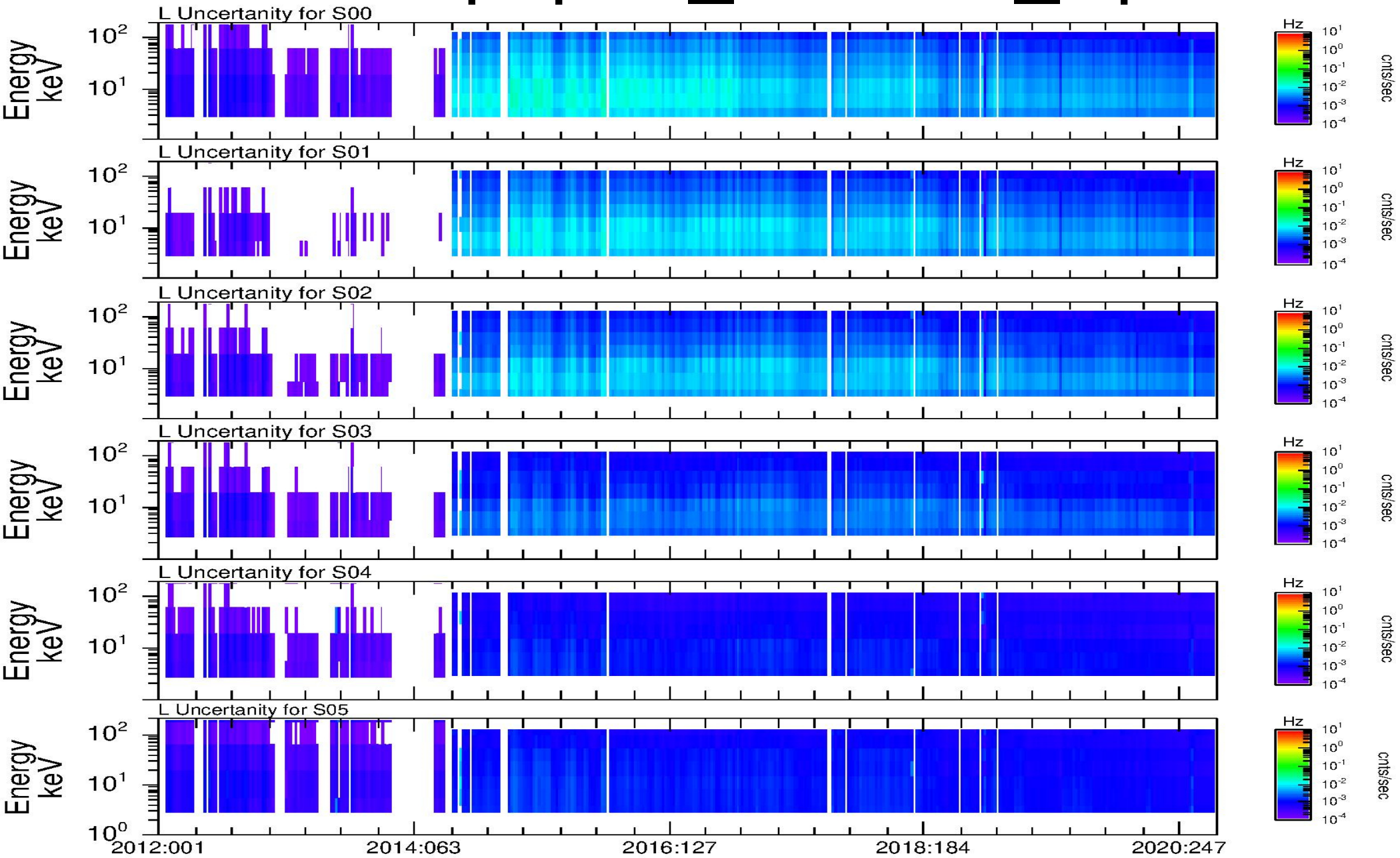
nh-x-pepssi-4-plasma-v1.0/data total_counts/pepssi_reduced_j*



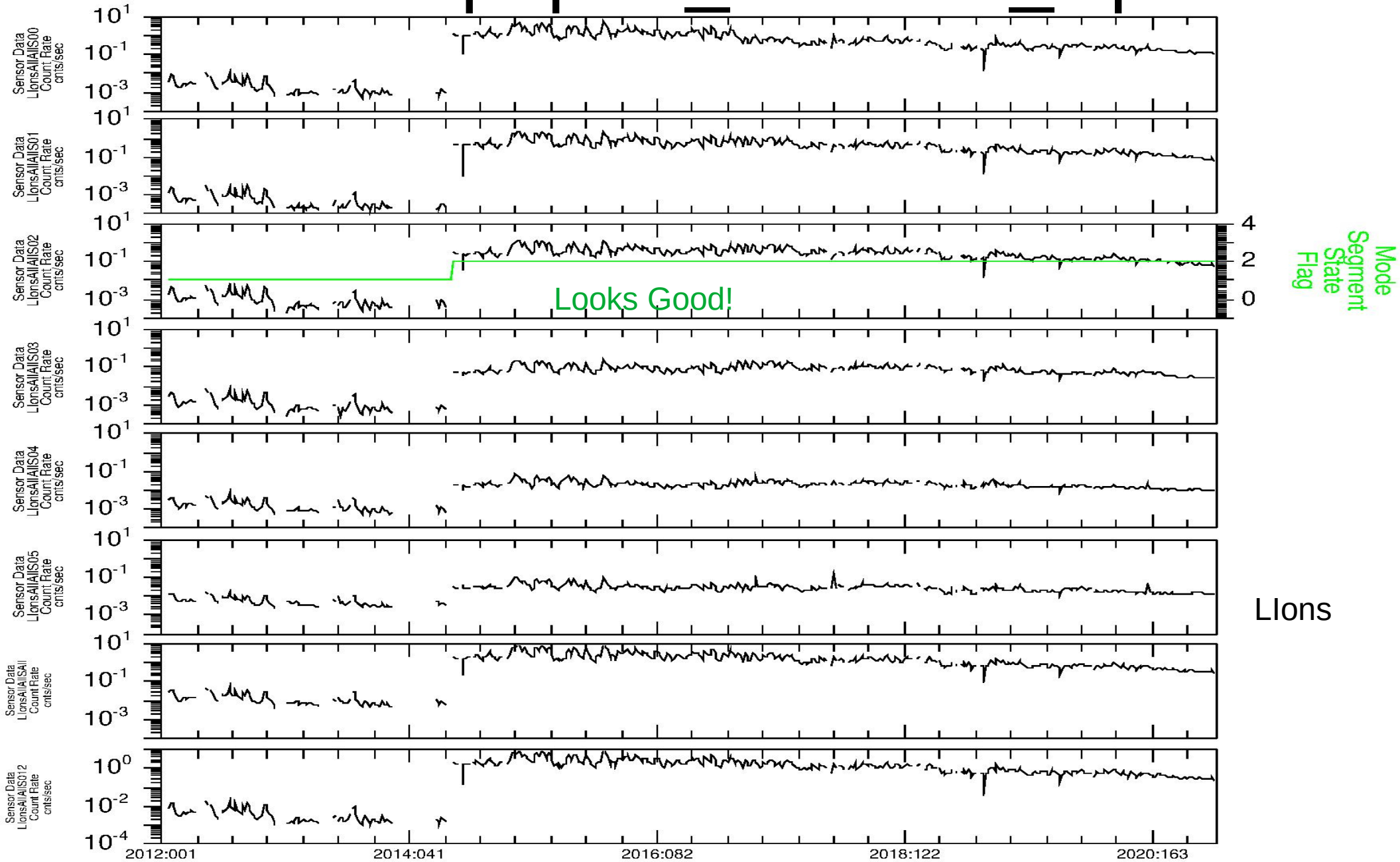
nh-x-pepssi-4-plasma-v1.0/data doubles/pepssi_reduced_lcps*



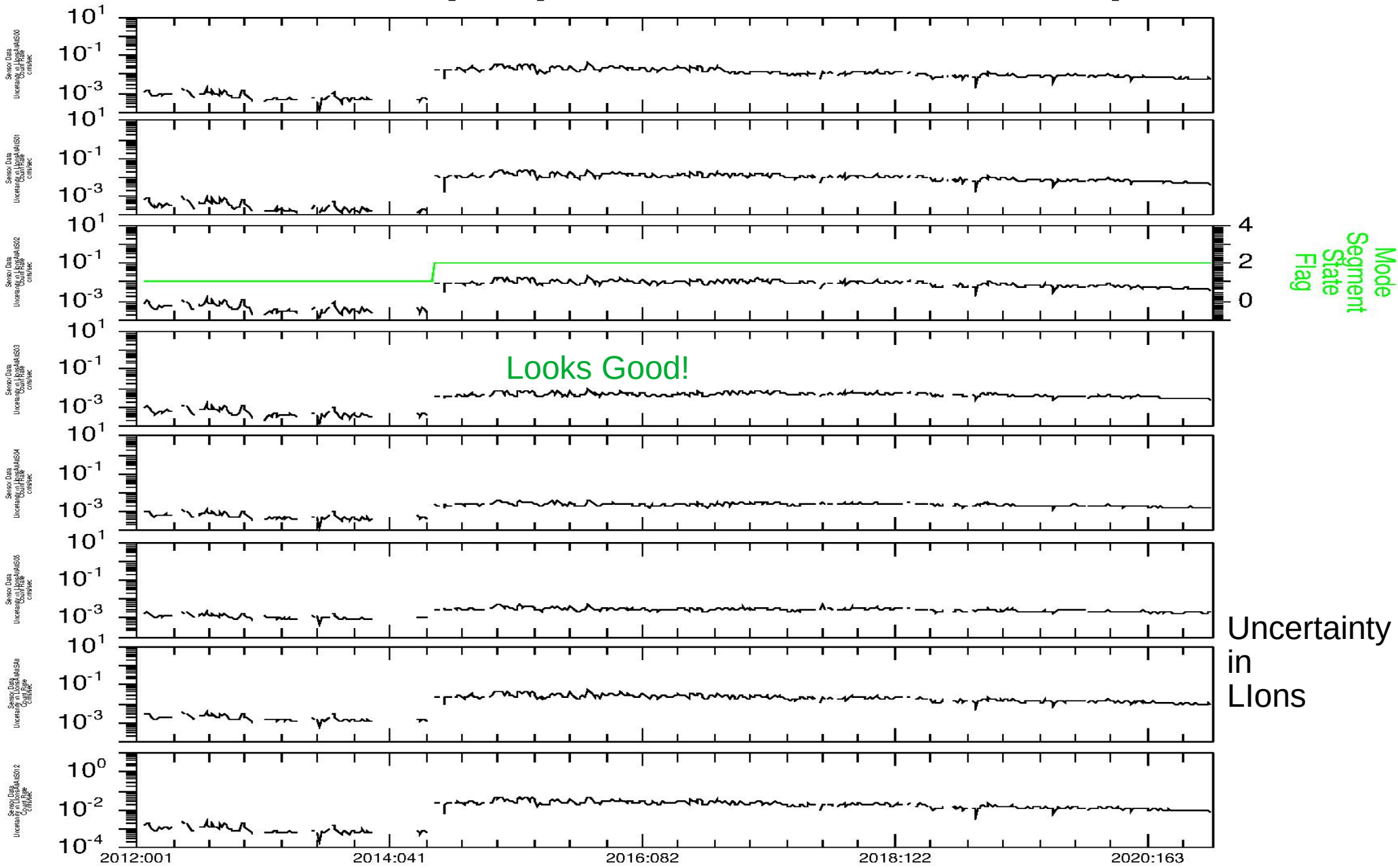
nh-x-pepssi-4-plasma-v1.0/data doubles/pepssi_reduced_lcps*



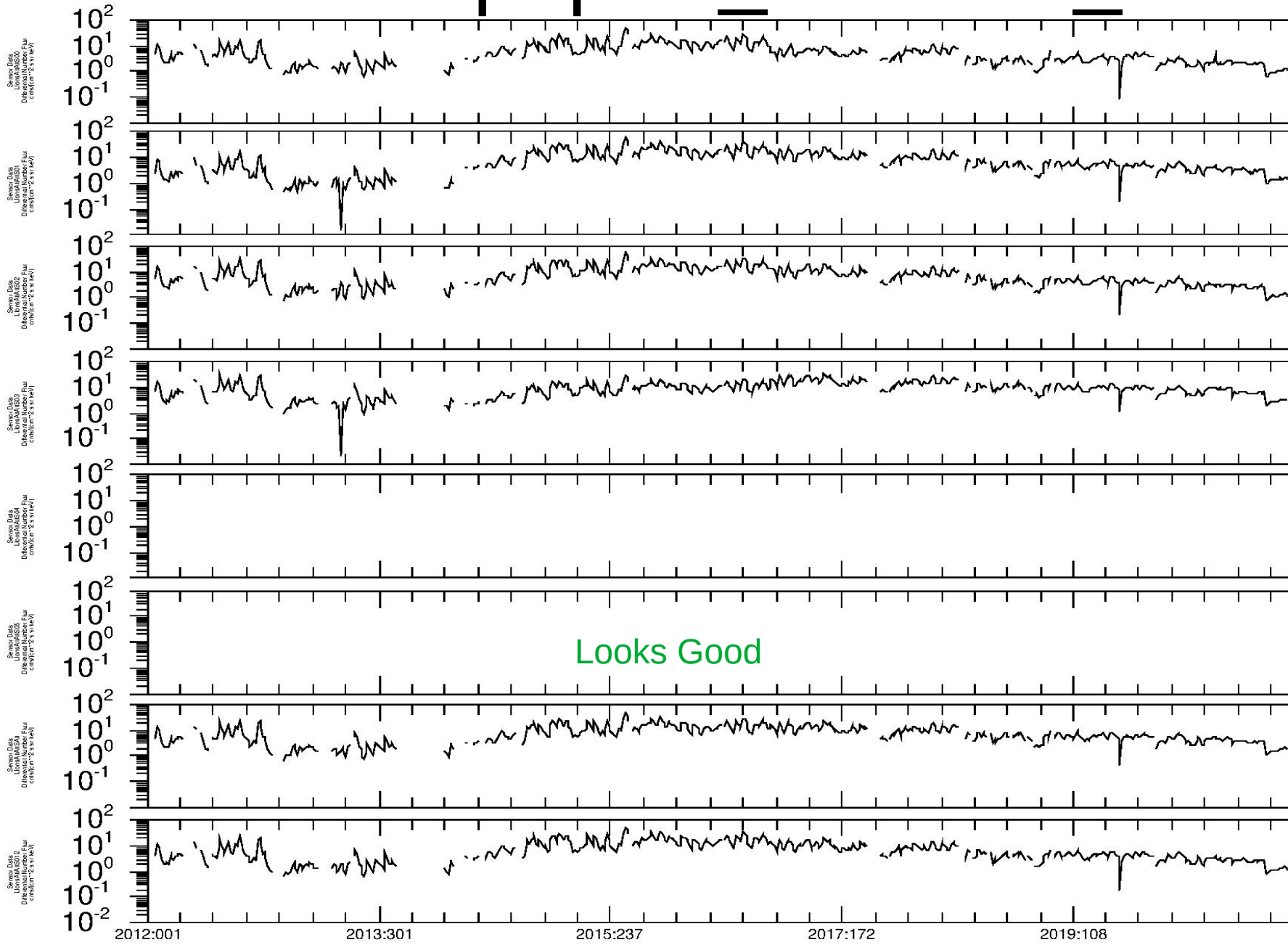
nh-x-pepssi-4-plasma-v1.0/data doubles/pepssi_reduced_lcps*



nh-x-pepssi-4-plasma-v1.0/data doubles/pepssi_reduced_lcps*

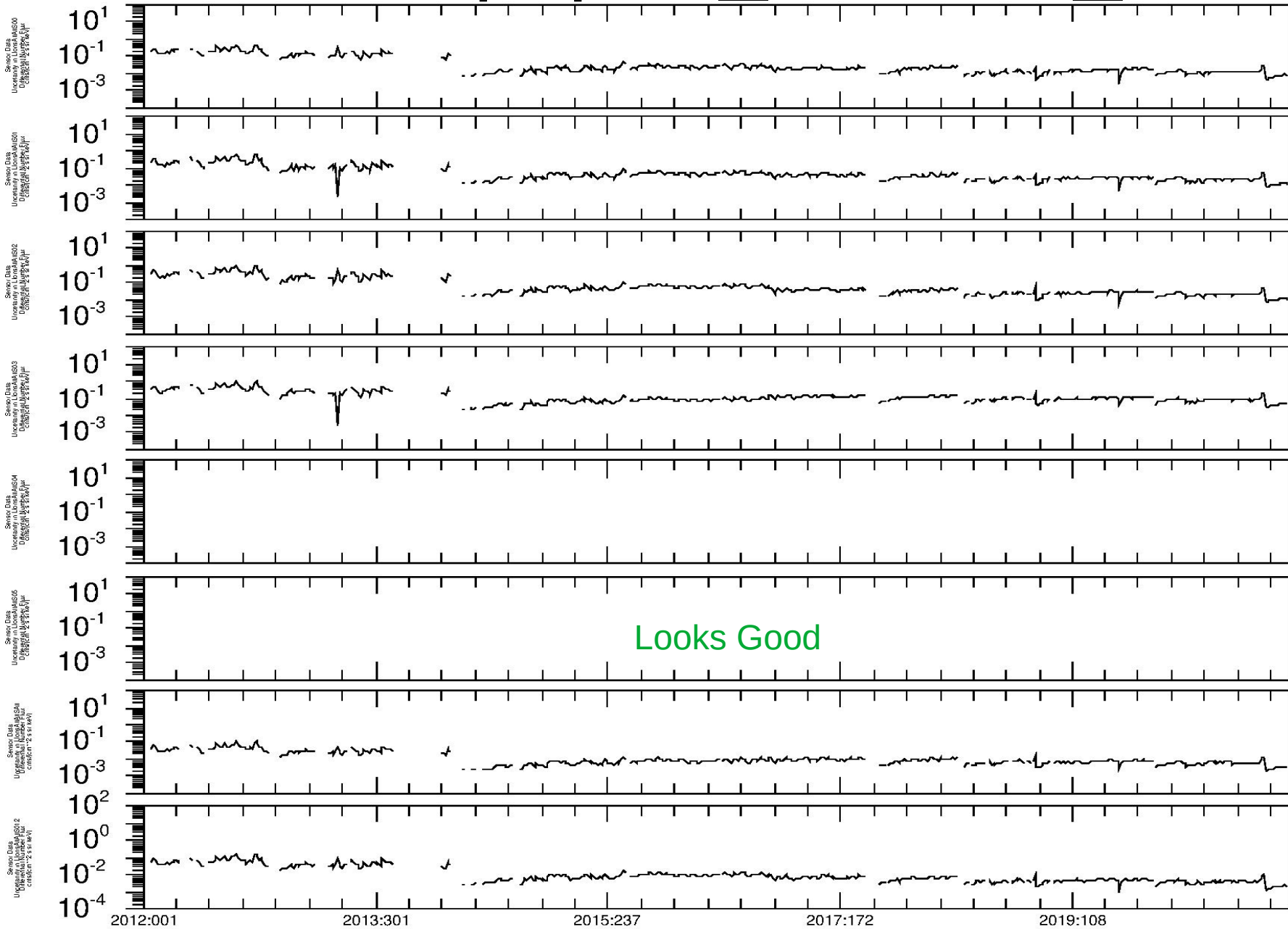


nh-x-pepssi-4-plasma-v1.0/data doubles/pepssi_reduced_lflux*



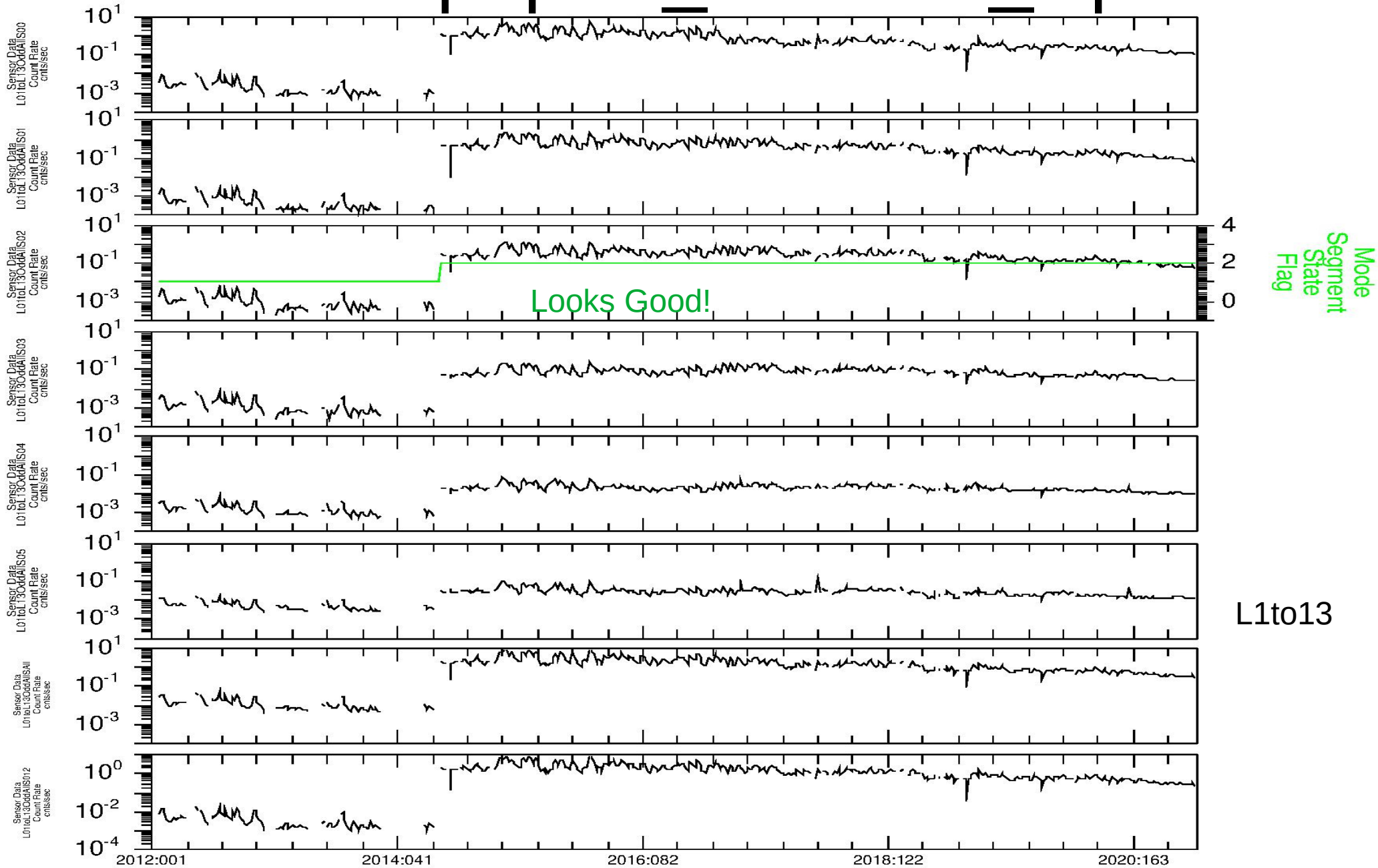
Lions

nh-x-pepssi-4-plasma-v1.0/data doubles/pepssi_reduced_lflux*

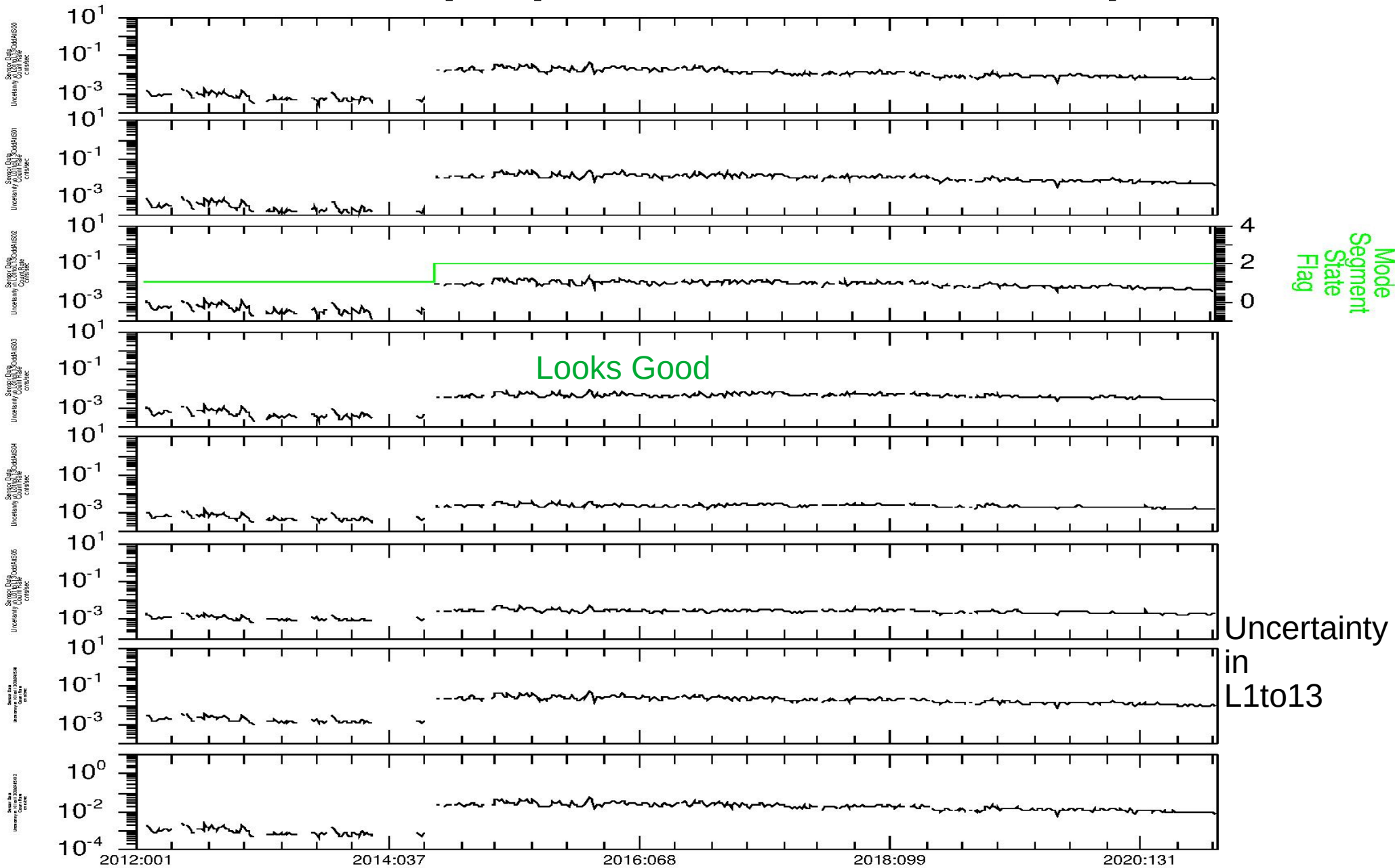


Uncertainty
in
Lions

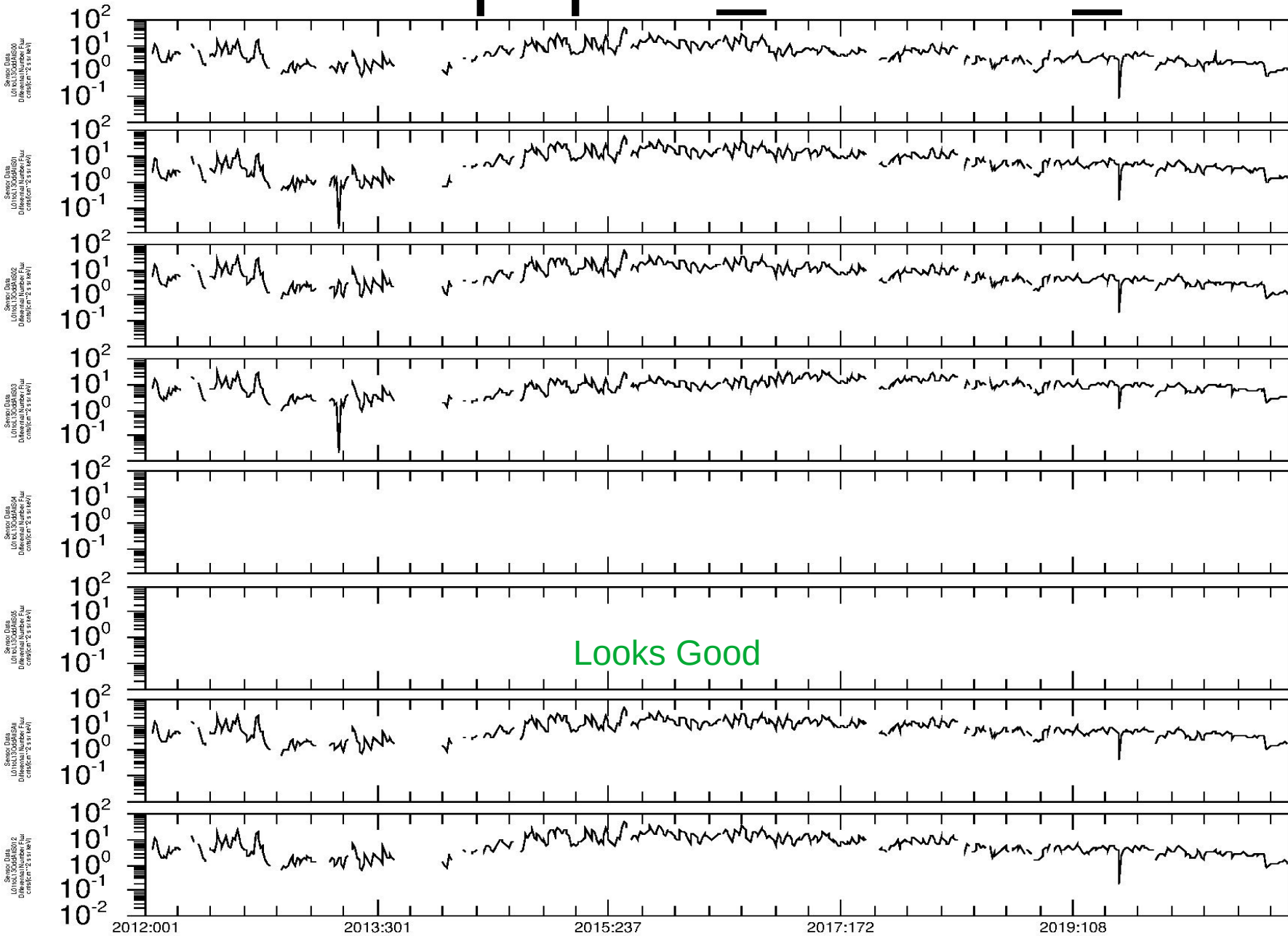
nh-x-pepssi-4-plasma-v1.0/data doubles/pepssi_reduced_lcps*



nh-x-pepssi-4-plasma-v1.0/data doubles/pepssi_reduced_lcps*

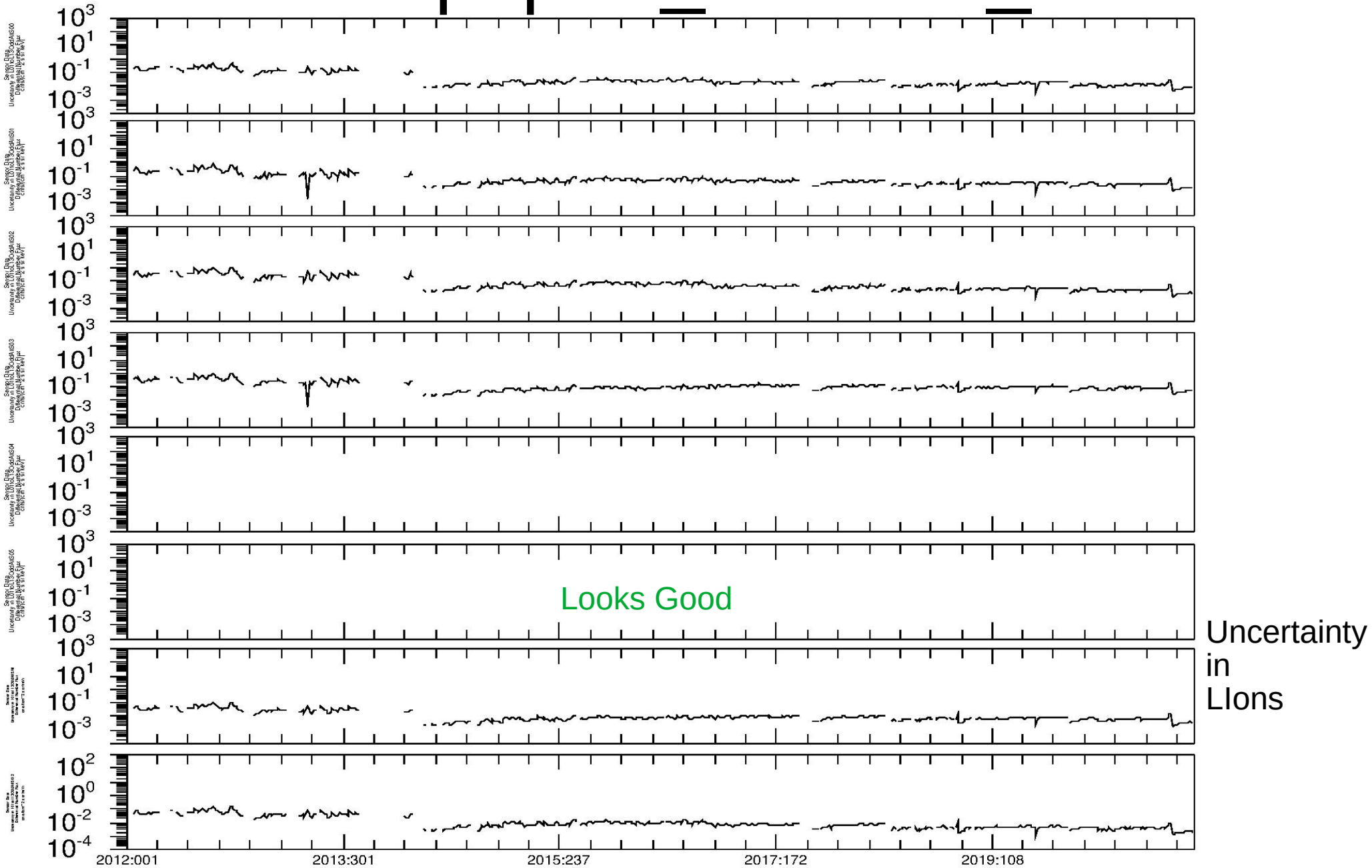


nh-x-pepssi-4-plasma-v1.0/data doubles/pepssi_reduced_lflux*

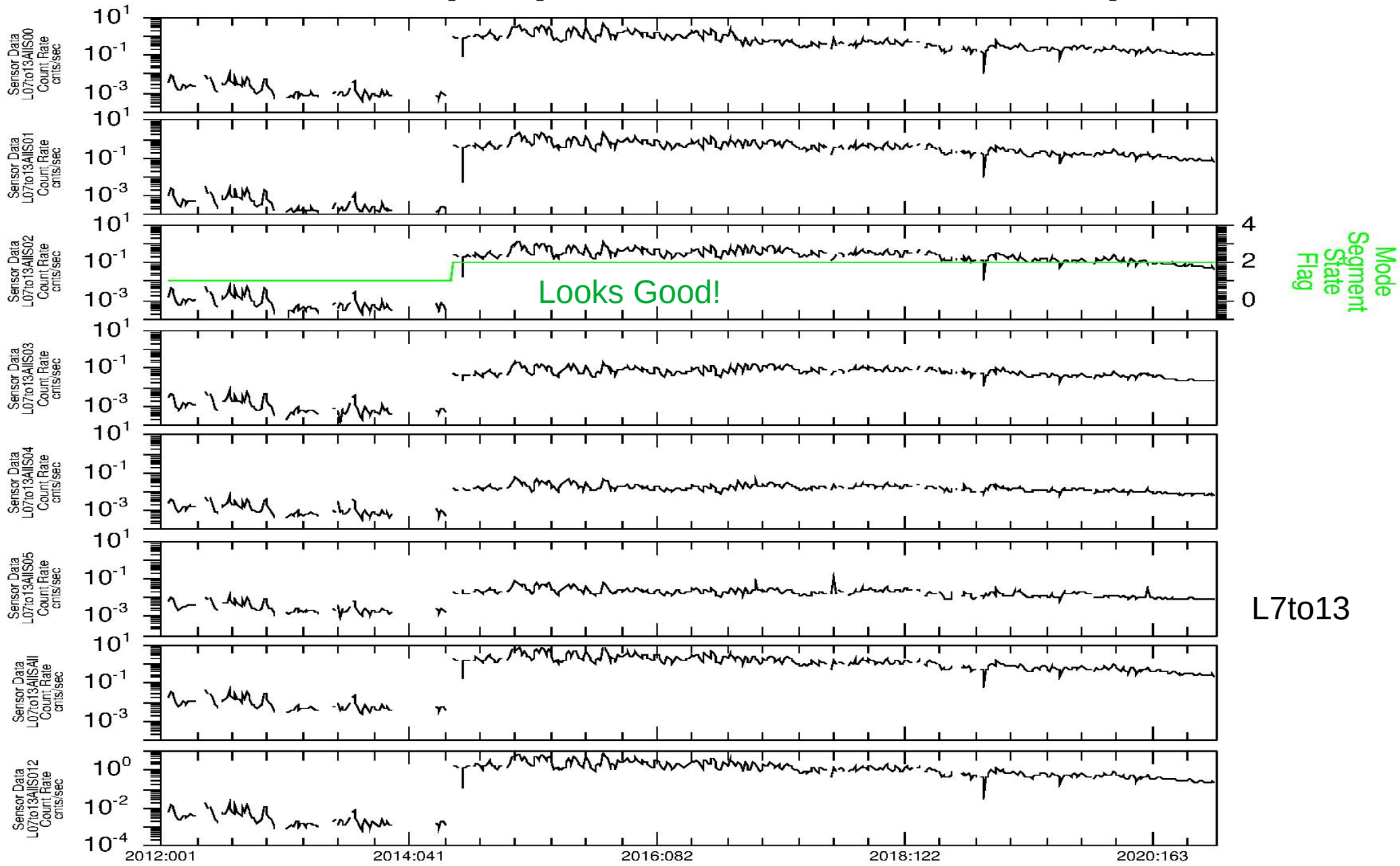


L1to13

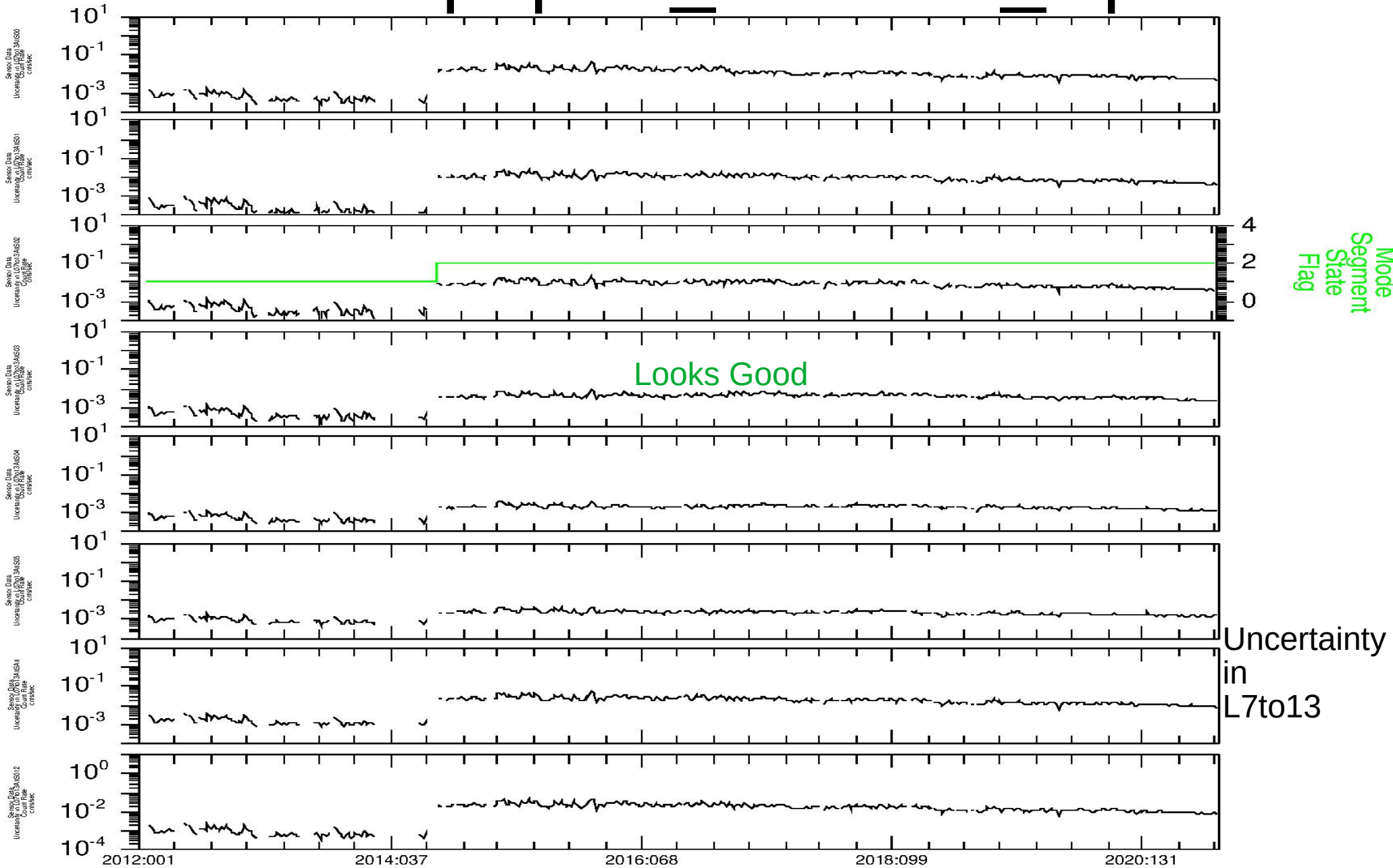
nh-x-pepssi-4-plasma-v1.0/data doubles/pepssi_reduced_lflux*



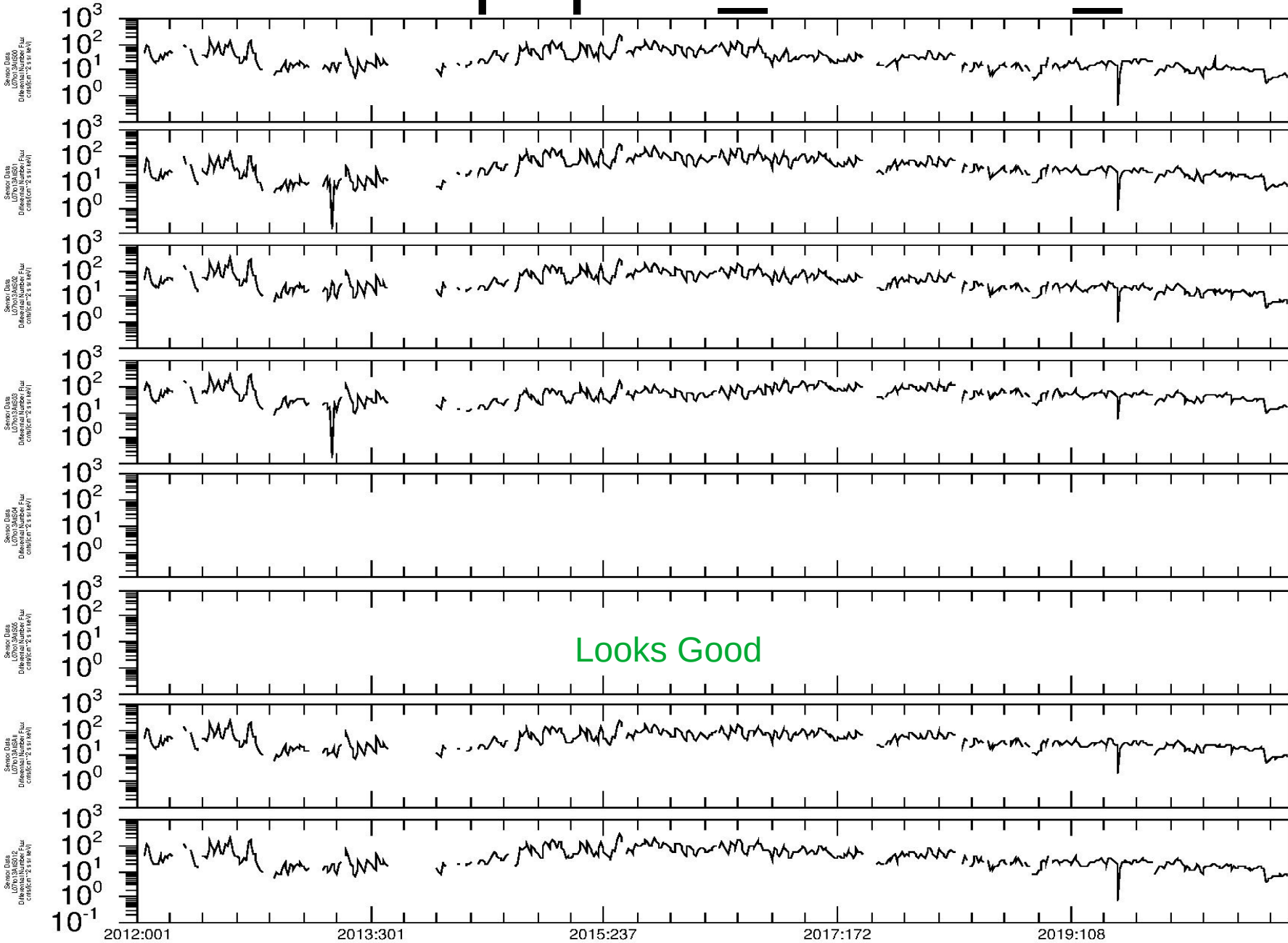
nh-x-pepssi-4-plasma-v1.0/data doubles/pepssi_reduced_lcps*



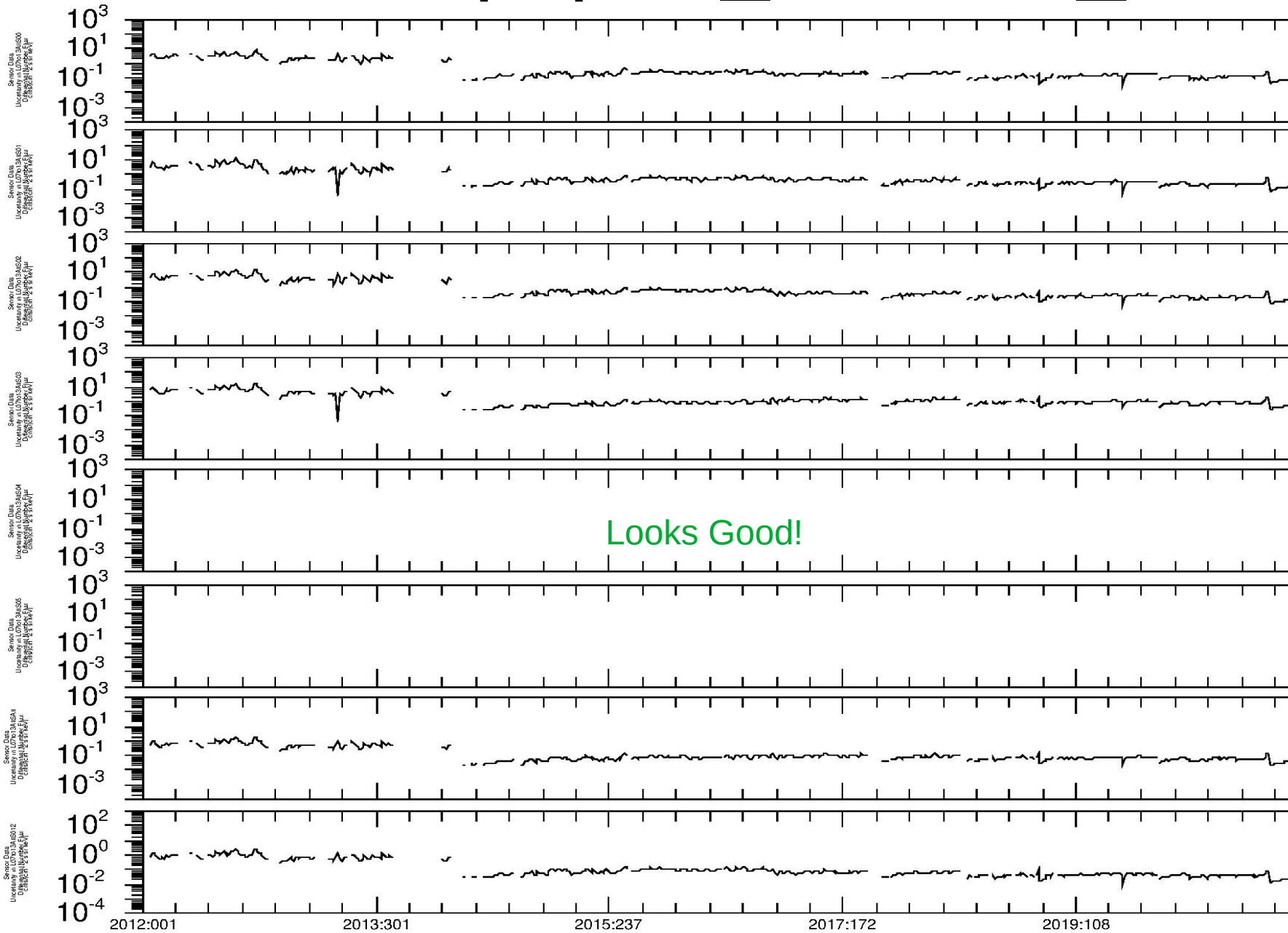
nh-x-pepssi-4-plasma-v1.0/data doubles/pepssi_reduced_lcps*



nh-x-pepssi-4-plasma-v1.0/data doubles/pepssi_reduced_lflux*



nh-x-pepssi-4-plasma-v1.0/data doubles/pepssi_reduced_lflux*



Uncertainty
in
L7to13

Certification Resampled

BACK-UP Slides

PEPSSI Electrons - 3

Why are the fluxes from PEPSSI abnormally high?

