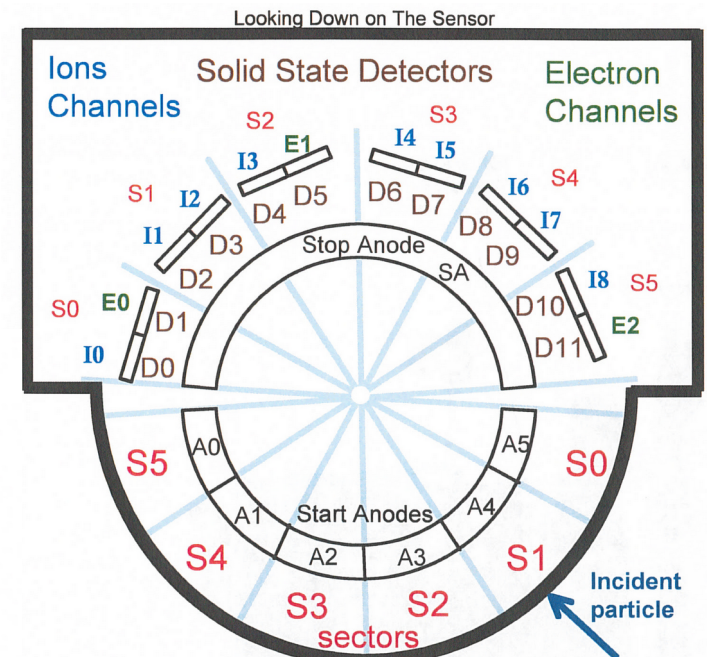
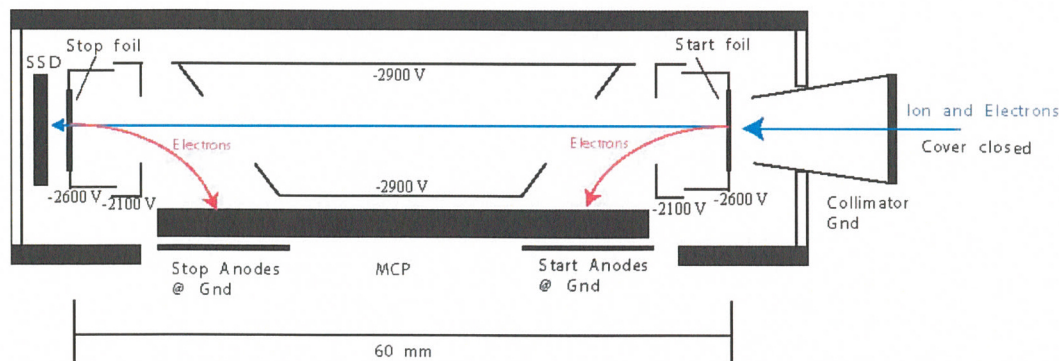


New Horizons Pluto Energetic Particle Spectrometer Science Investigation (PEPSSI)

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-v3.0

CALIBRATED Data Sets:

nh-a-pepssi-3-kem1-v3.0

New Horizons PEPSSI 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

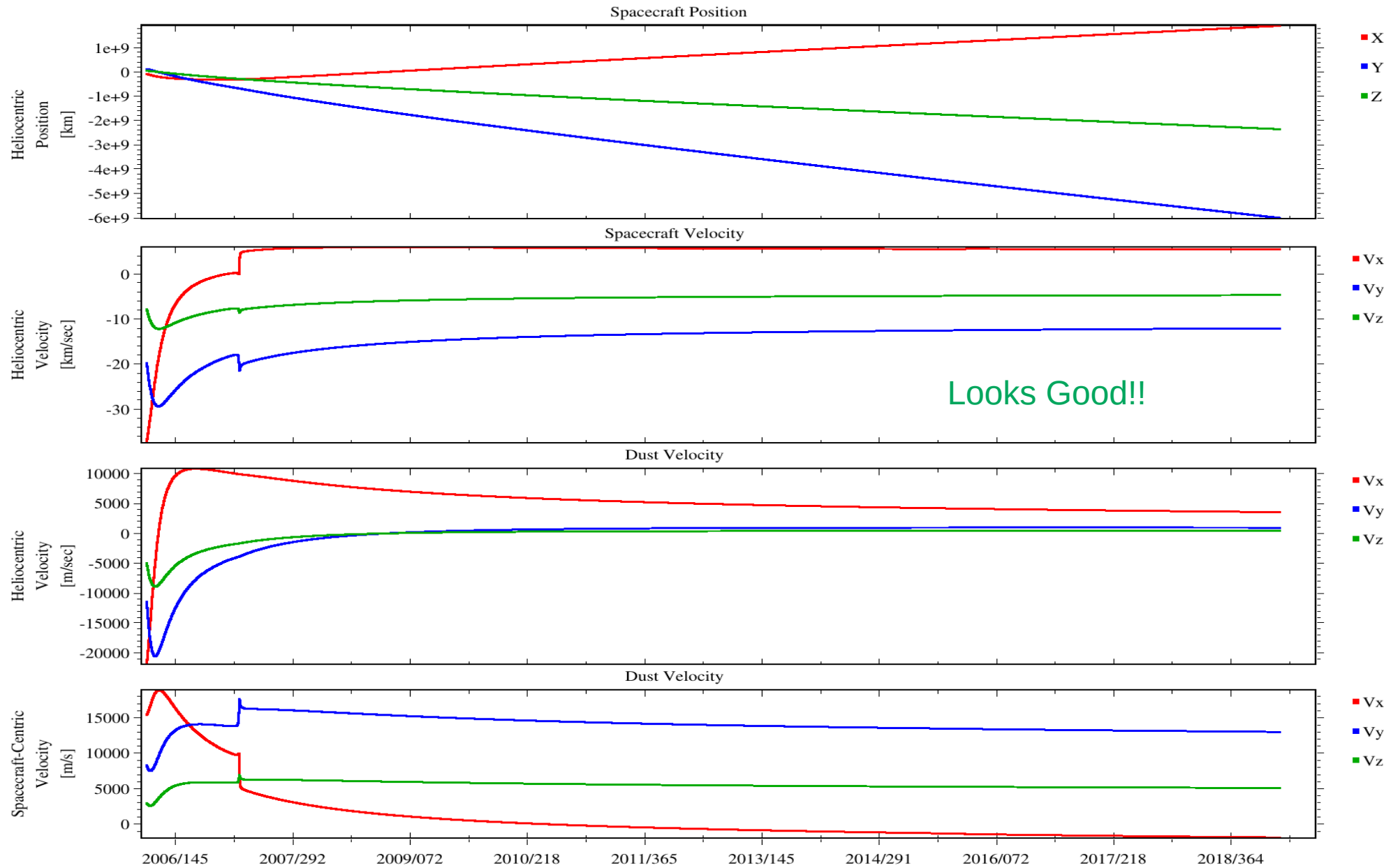
Minor Diagnostics -

Machine: IBM lenovo T60p ThinkPad

Operating System: Fedora 25 linux

Documentation Evaluation

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



nh-a-pepssi-2-kem1-v3.0/catalog
nh-a-pepssi-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-pepssi-2-kem1-v3.0/catalog
nh-a-pepssi-3-kem1-v3.0/catalog
nhsc.cat - 1 of 2

7

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-pepssi-2-kem1-v3.0/catalog
nh-a-pepssi-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, [NASAA02001]), 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:

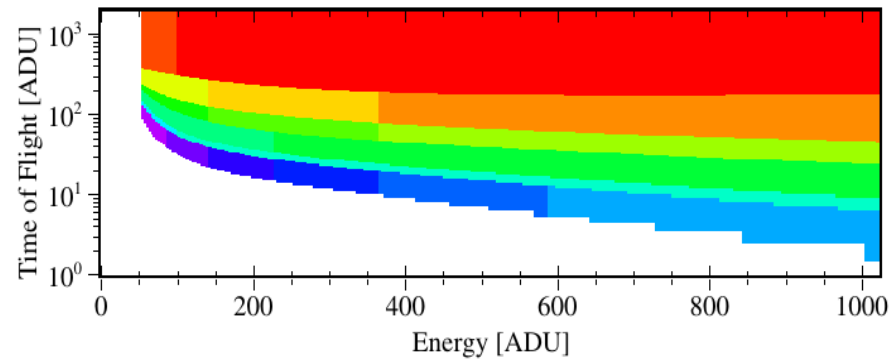
The instrumentation chosen for the payload is adequate to observe and return new information on a multitude of additional objects in the solar system for which the New Horizons spacecraft will encounter, but were mainly chosen to highlight measurement capabilities at Pluto. The seven instruments which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

nh-a-pepssi-2-kem1-v3.0/calib

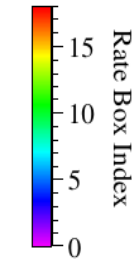
nh-a-pepssi-3-kem1-v3.0/calib

rateboxdefinitionplanes.fit

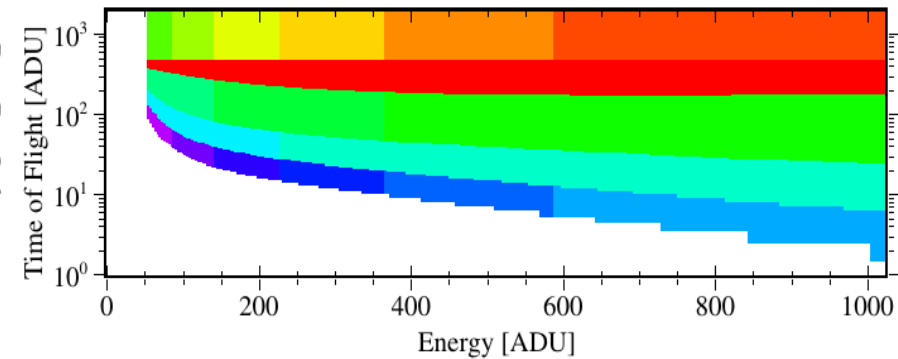
Set 2: Normal Mode After May 24, 2007



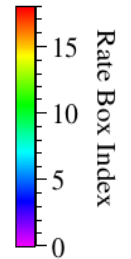
RBI



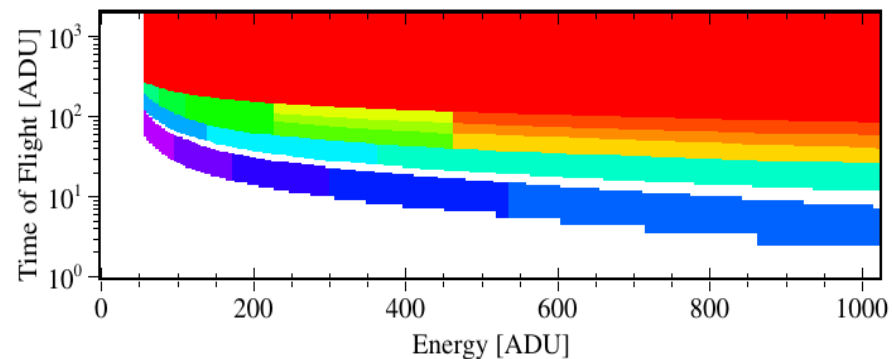
Set 2: Diagnostic Mode After May 24, 2007



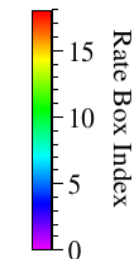
RBI



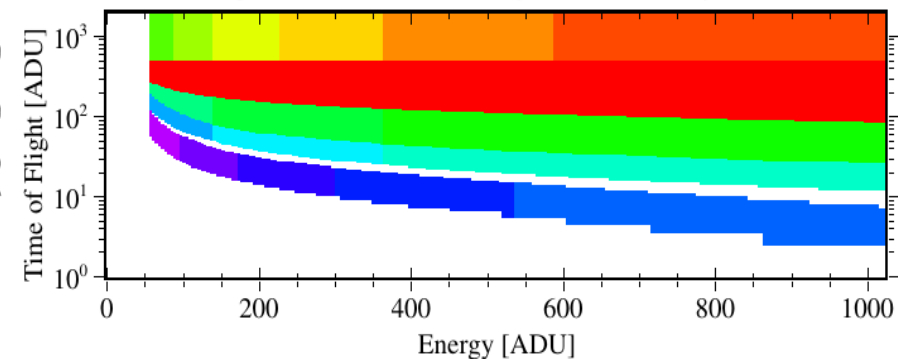
Set 1: Normal Mode Between July 7, 2006 and May 25, 2007



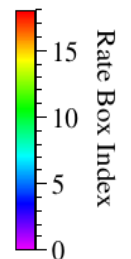
RBI



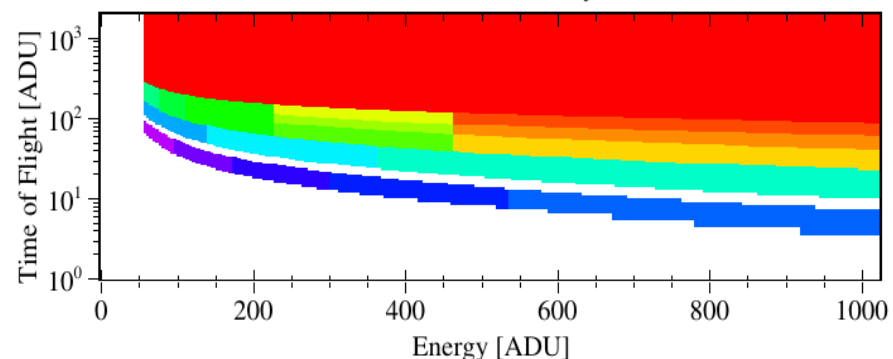
Set 1: Diagnostic Mode Between July 7, 2006 and May 25, 2007



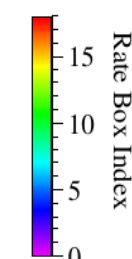
RBI



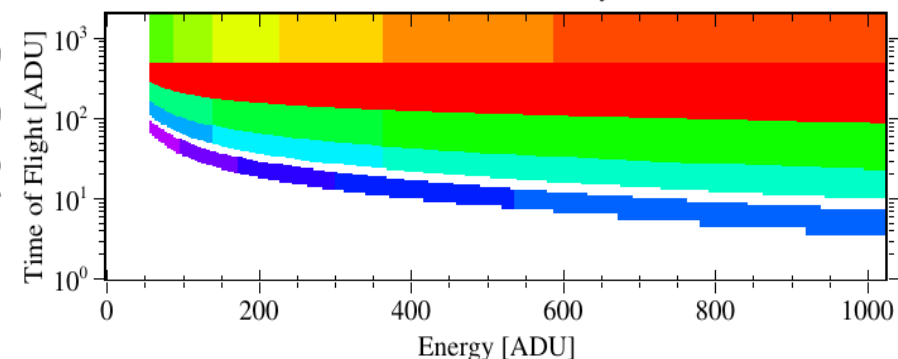
Set 0: Normal Mode Before July 7, 2006



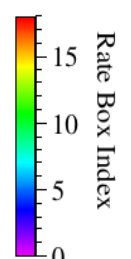
RBI



Set 0: Diagnostic Mode Before July 7, 2006



RBI



Data Evaluation

pep_0408606717_0x691_sci.tbl

EXTENSION_PHA_HIGH_ION_TABLE

This is an example of a correct definition for a proton. The description reflects the species.

```

OBJECT          = COLUMN
NAME            = "H_Incident_Energy"
BYTES          = 8
COLUMN_NUMBER  = 10
DATA_TYPE      = "IEEE_REAL"
START_BYTE    = 48
DESCRIPTION    = "
                Incident Energy if proton(keV)
"
UNIT          = "keV"
END_OBJECT    = COLUMN

```

```

OBJECT          = COLUMN
NAME            = "S_Incident_Energy"
BYTES          = 8
COLUMN_NUMBER  = 15
DATA_TYPE      = "IEEE_REAL"
START_BYTE    = 82
DESCRIPTION    = "
                Incident Energy if proton(keV)
"
UNIT          = "keV"
END_OBJECT    = COLUMN

```

This is an incorrect definition for sulfur
Because the description indicates
That it is a proton instead of sulfur

pep_0408606717_0x691_sci.tbl

EXTENSION_PHA_LOW_ION_TABLE

```

OBJECT          = COLUMN
  NAME          = "Mass_Number"
  BYTES         = 8
  COLUMN_NUMBER = 13
  DATA_TYPE    = "IEEE_REAL"
  START_BYTE    = 66
  DESCRIPTION   = "
      Auto description failed: Mass_Number
      - Description inherent in the name?
      - See /DOCUMENT/ for more details
  "
END_OBJECT     = COLUMN
-----
OBJECT          = COLUMN
  NAME          = "Energy_Per_Nucleon"
  BYTES         = 8
  COLUMN_NUMBER = 7
  DATA_TYPE    = "IEEE_REAL"
  START_BYTE    = 38
  DESCRIPTION   = "
      Auto description failed: Energy_Per_Nucleon
      - Description inherent in the name?
      - See /DOCUMENT/ for more details
  "
END_OBJECT     = COLUMN

```

```

OBJECT          = COLUMN
  NAME          = "Helium_ambient"
  BYTES         = 8
  COLUMN_NUMBER = 8
  DATA_TYPE    = "IEEE_REAL"
  START_BYTE    = 39
  DESCRIPTION   = "
      Auto description failed: Helium_ambient
      - Description inherent in the name?
      - See /DOCUMENT/ for more details
  "
END_OBJECT     = COLUMN
OBJECT          = COLUMN
  NAME          = "Helium_incident"
  BYTES         = 8
  COLUMN_NUMBER = 9
  DATA_TYPE    = "IEEE_REAL"
  START_BYTE    = 47
  DESCRIPTION   = "
      Auto description failed: Helium_incident
      - Description inherent in the name?
      - See /DOCUMENT/ for more details
  "
END_OBJECT     = COLUMN

```

Examples of software failures which automatically populate description. Errors are observed in multiple extension tables.

nh-a-pepssi-3-kem1-v3.0/data

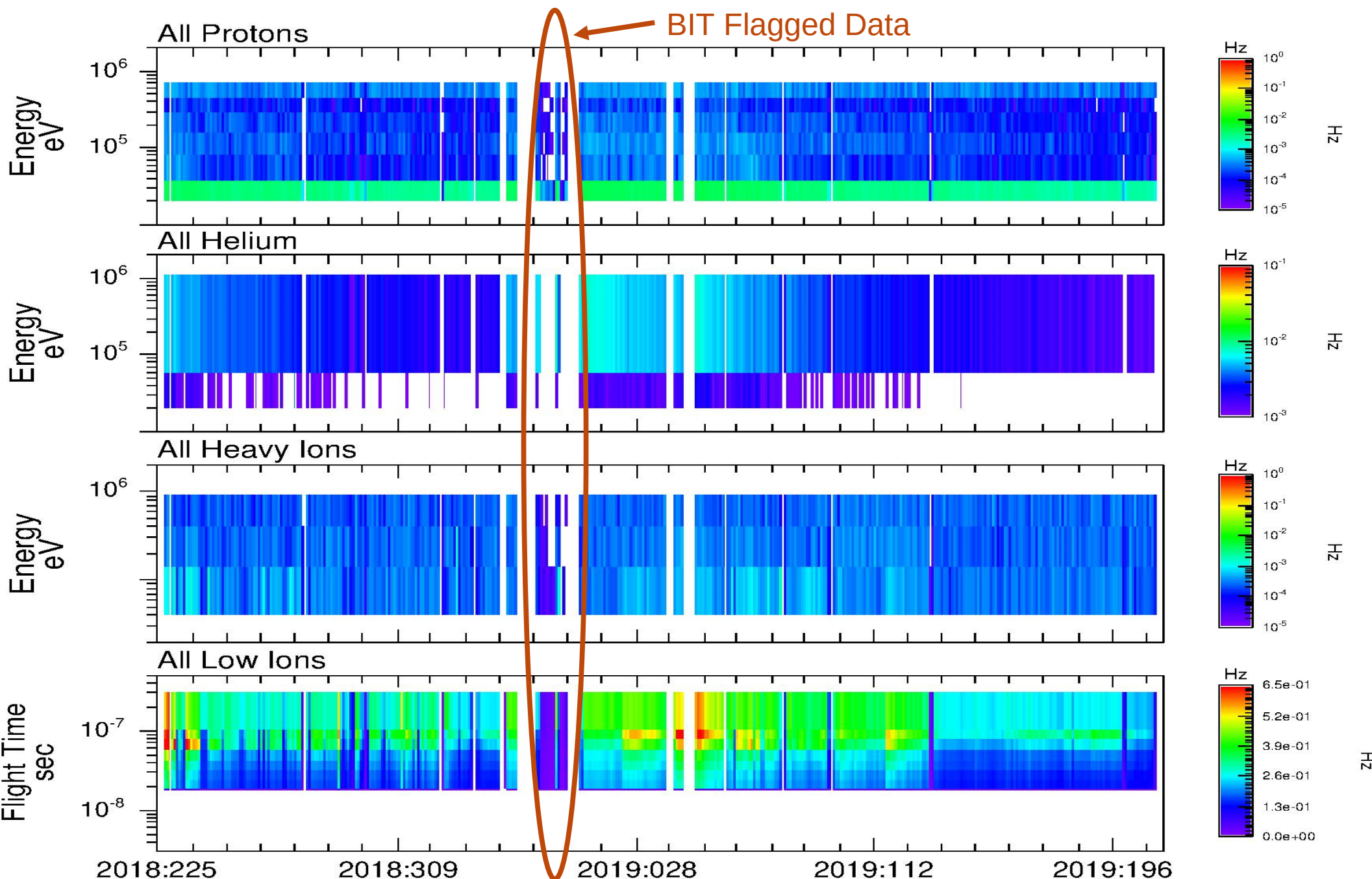
PEPSSI FIT File Structure

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-v2.0/data Quick Look Spectrograms

14



nh-a-pepssi-3-kem1-v3.0/data

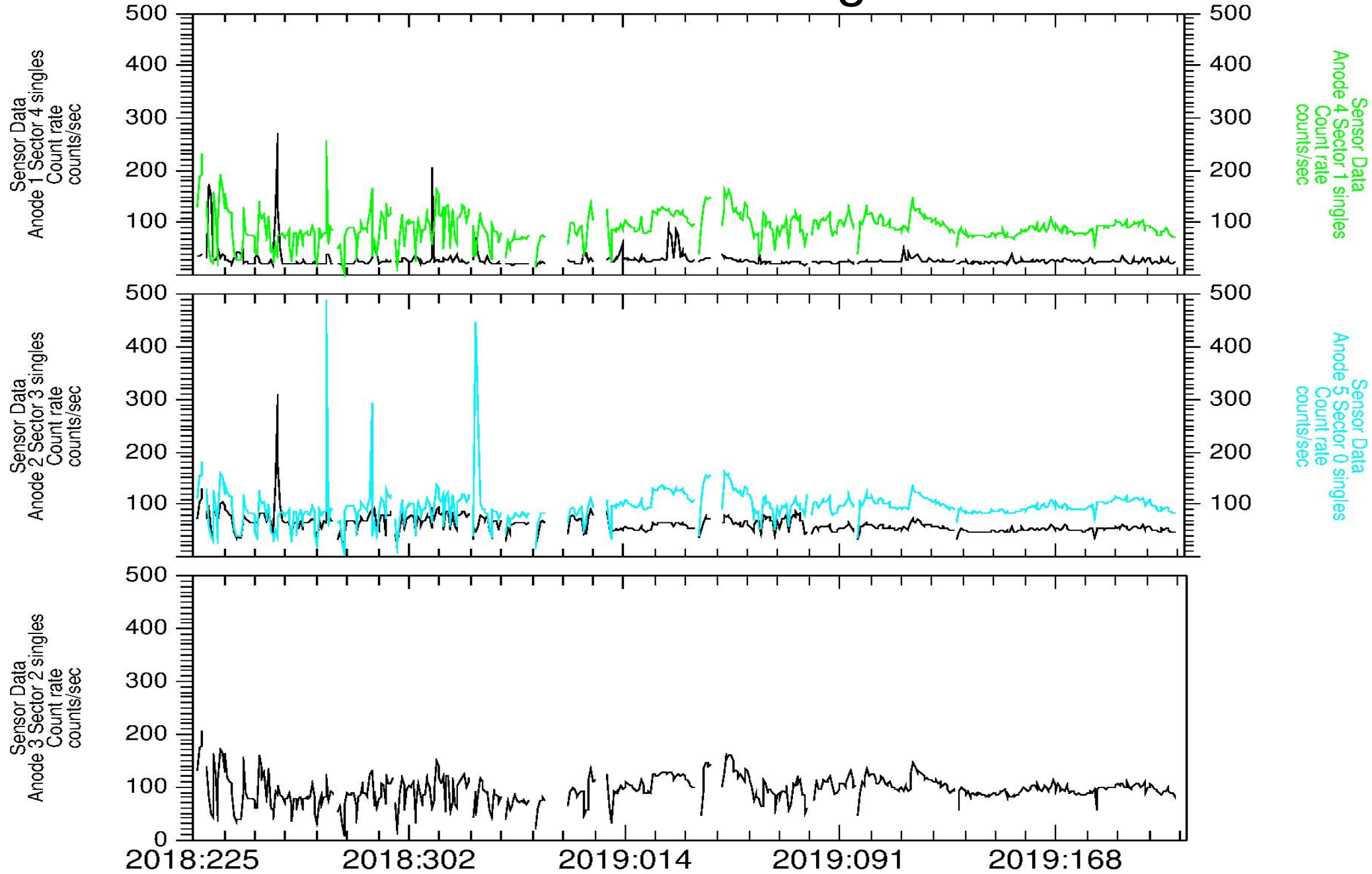
PEPSSI FIT File Structure

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

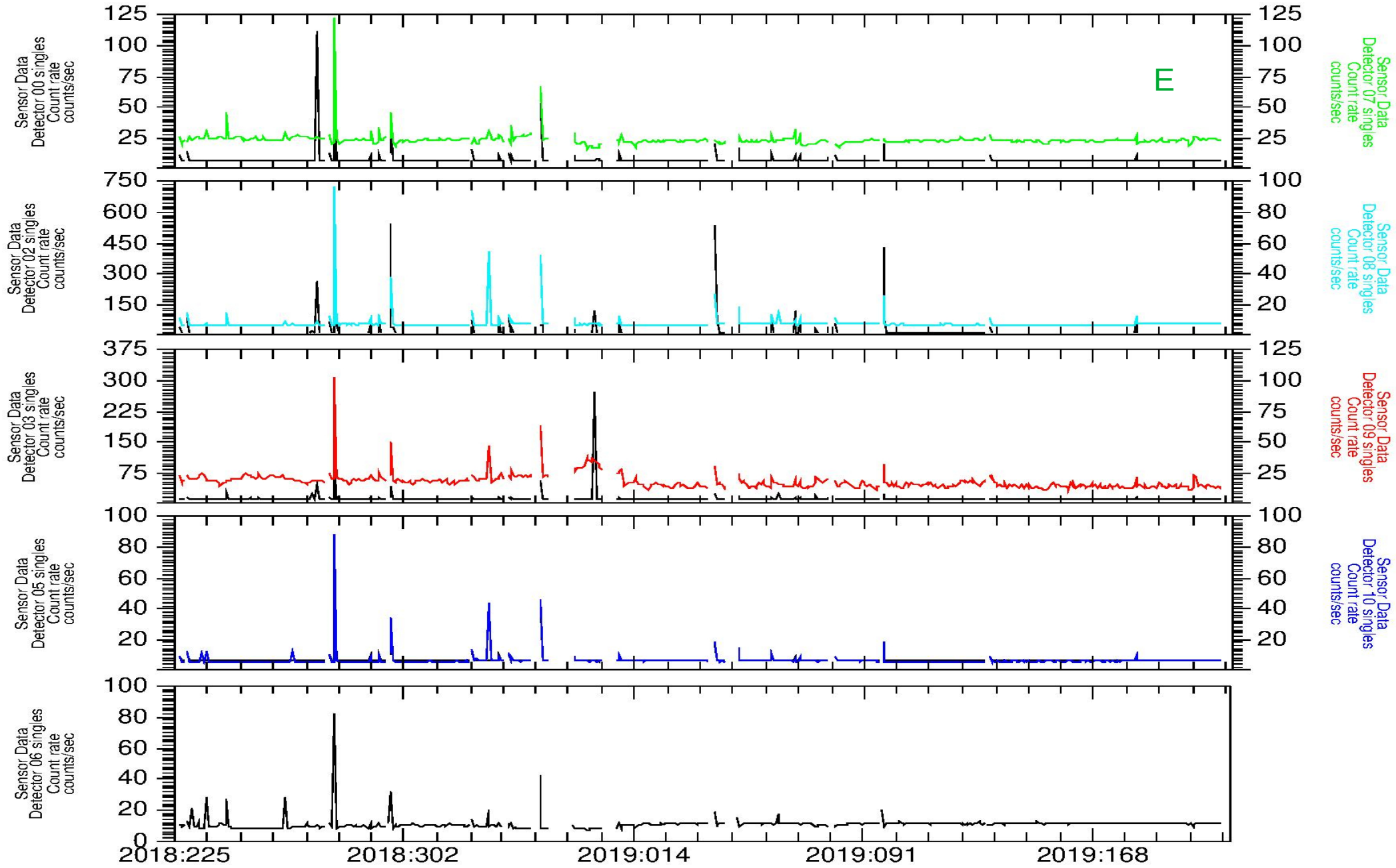
nh-a-pepssi-3-kem1-v3.0/data

FLUX Anode Singles



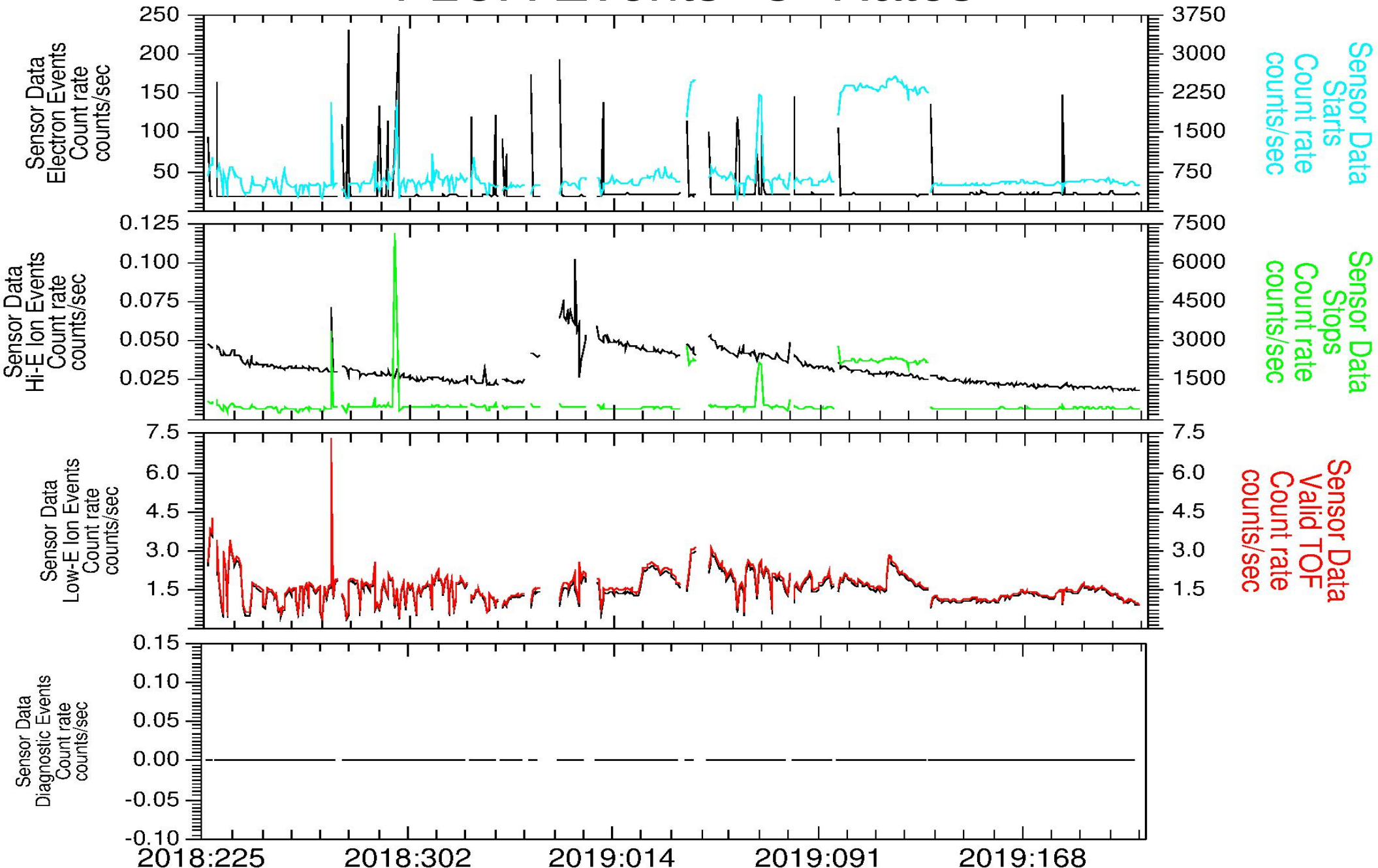
nh-a-pepssi-3-kem1-v3.0/data

FLUX Detector Singles



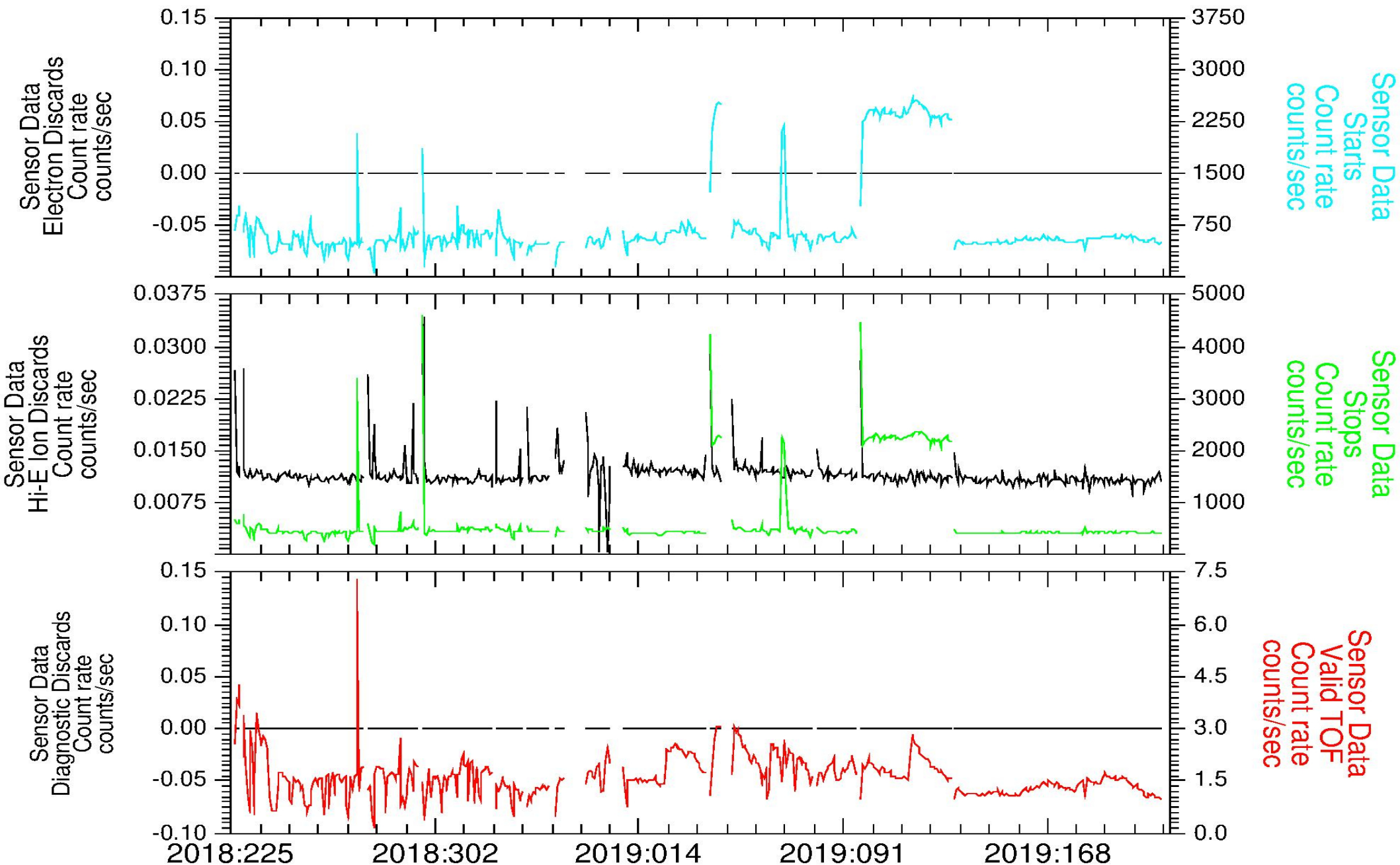
nh-a-pepssi-3-kem1-v2.0/data

FLUX Events "C" Rates

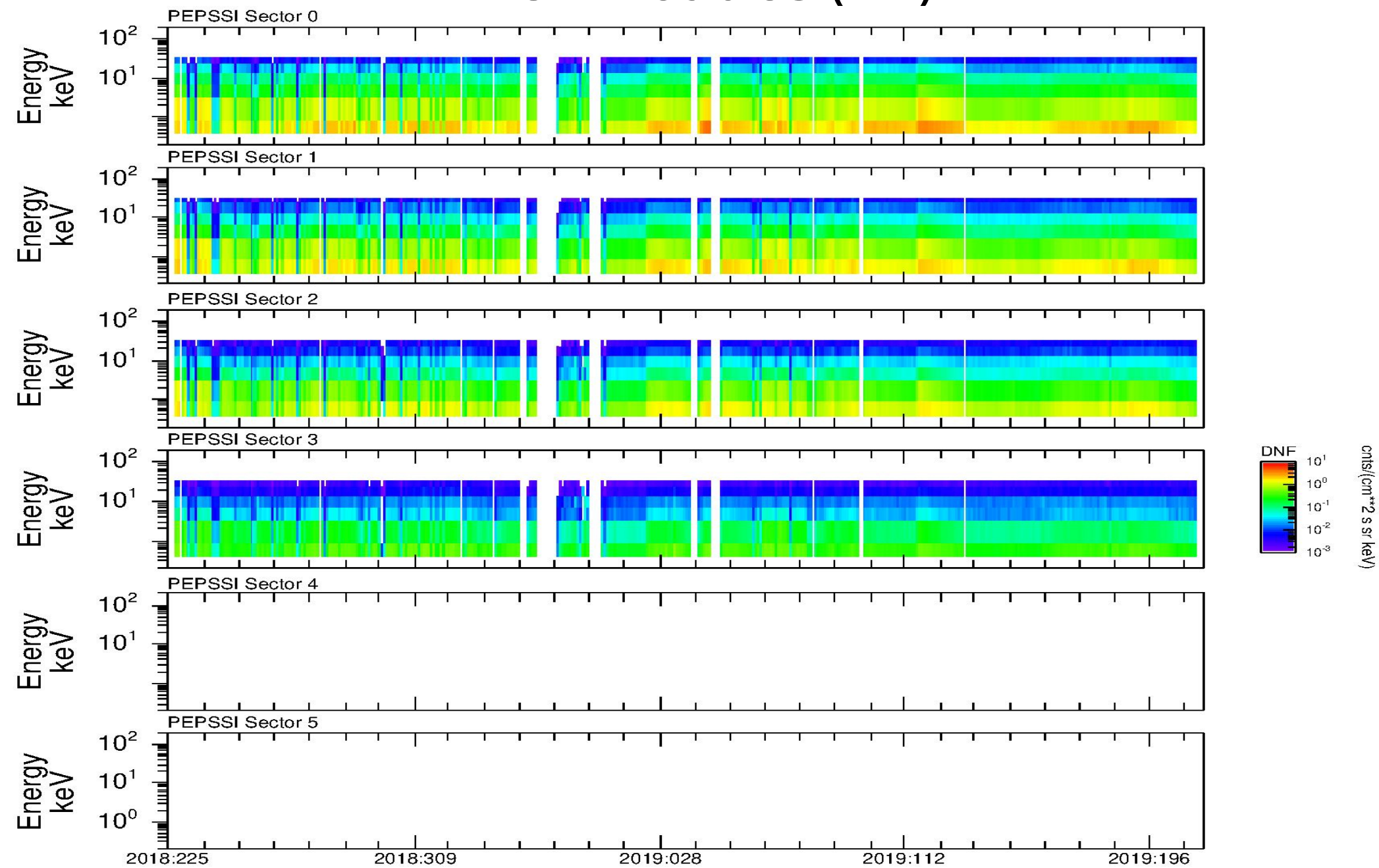


nh-a-pepssi-3-kem1-v3.0/data FLUX Discards “J” Rates

19

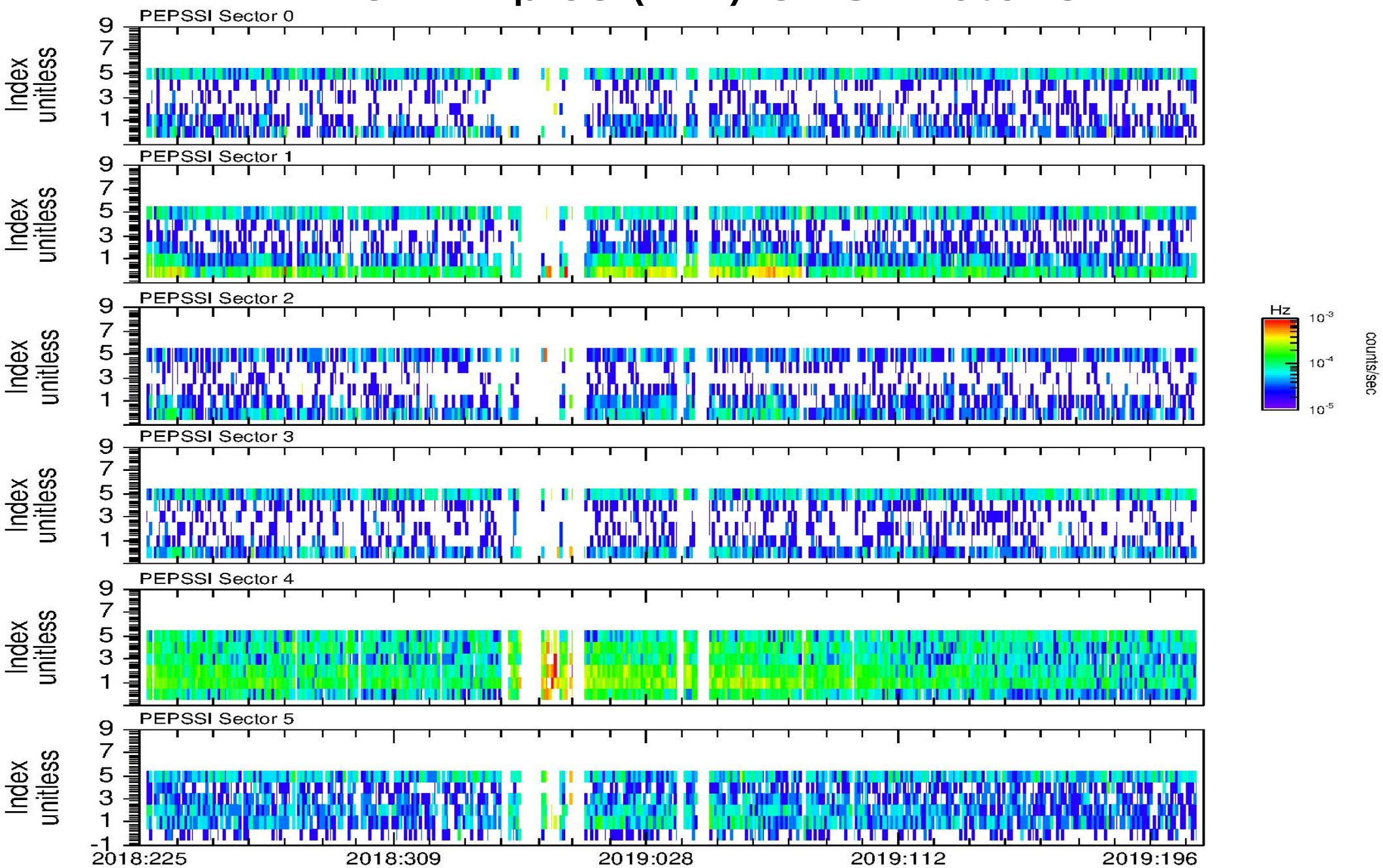


nh-a-pepssi-3-kem1-v3.0/data FLUX Doubles ("L")

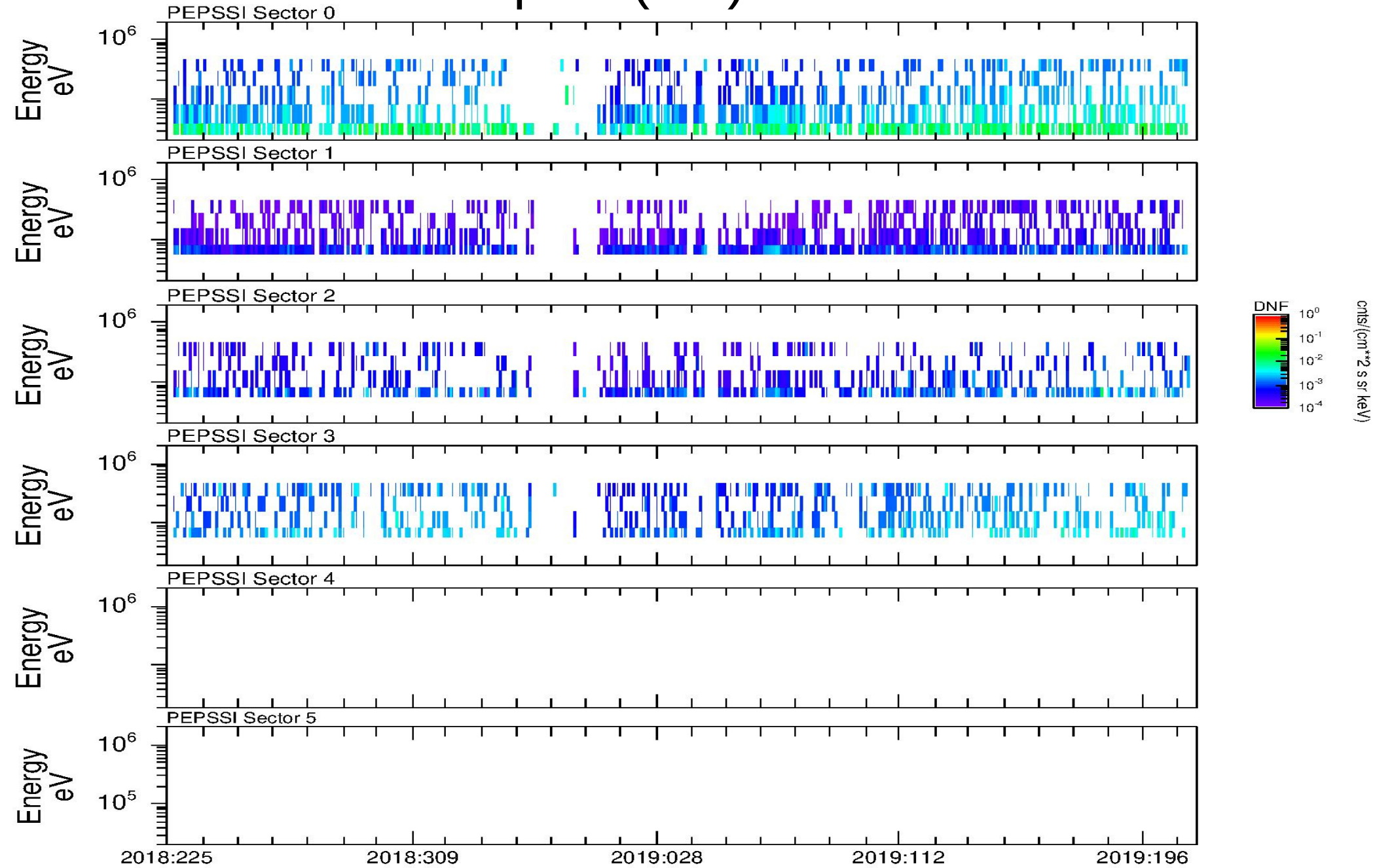


nh-a-pepssi-3-kem1-v3.0/data FLUX Triples ("D") CPS Protons

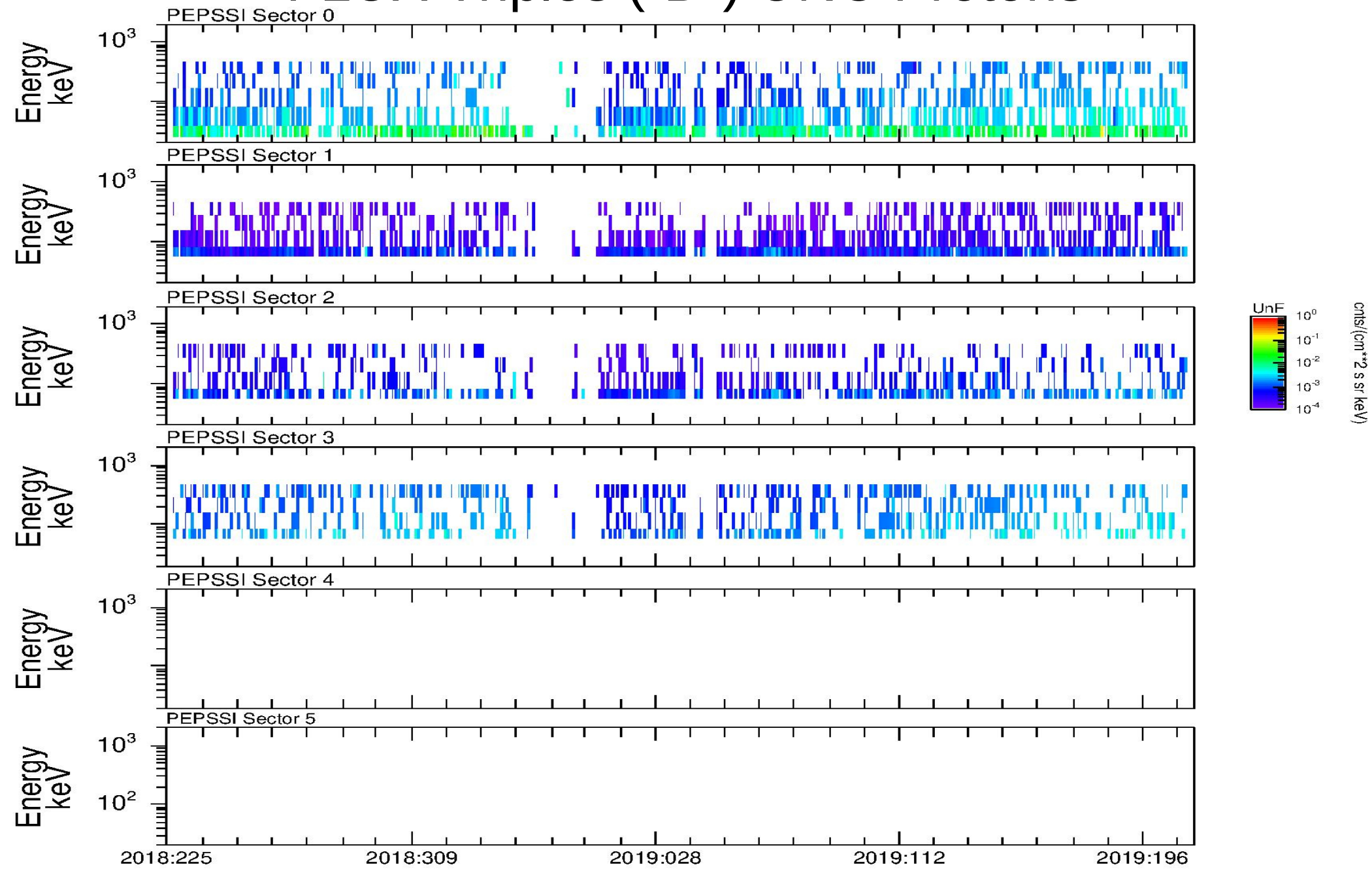
21



nh-a-pepssi-3-kem1-v3.0/data FLUX Triples ("D") DNF Protons



nh-a-pepssi-3-kem1-v3.0/data FLUX Triples ("D") UNC Protons



nh-a-pepssi-3-kem1-v3.0/data

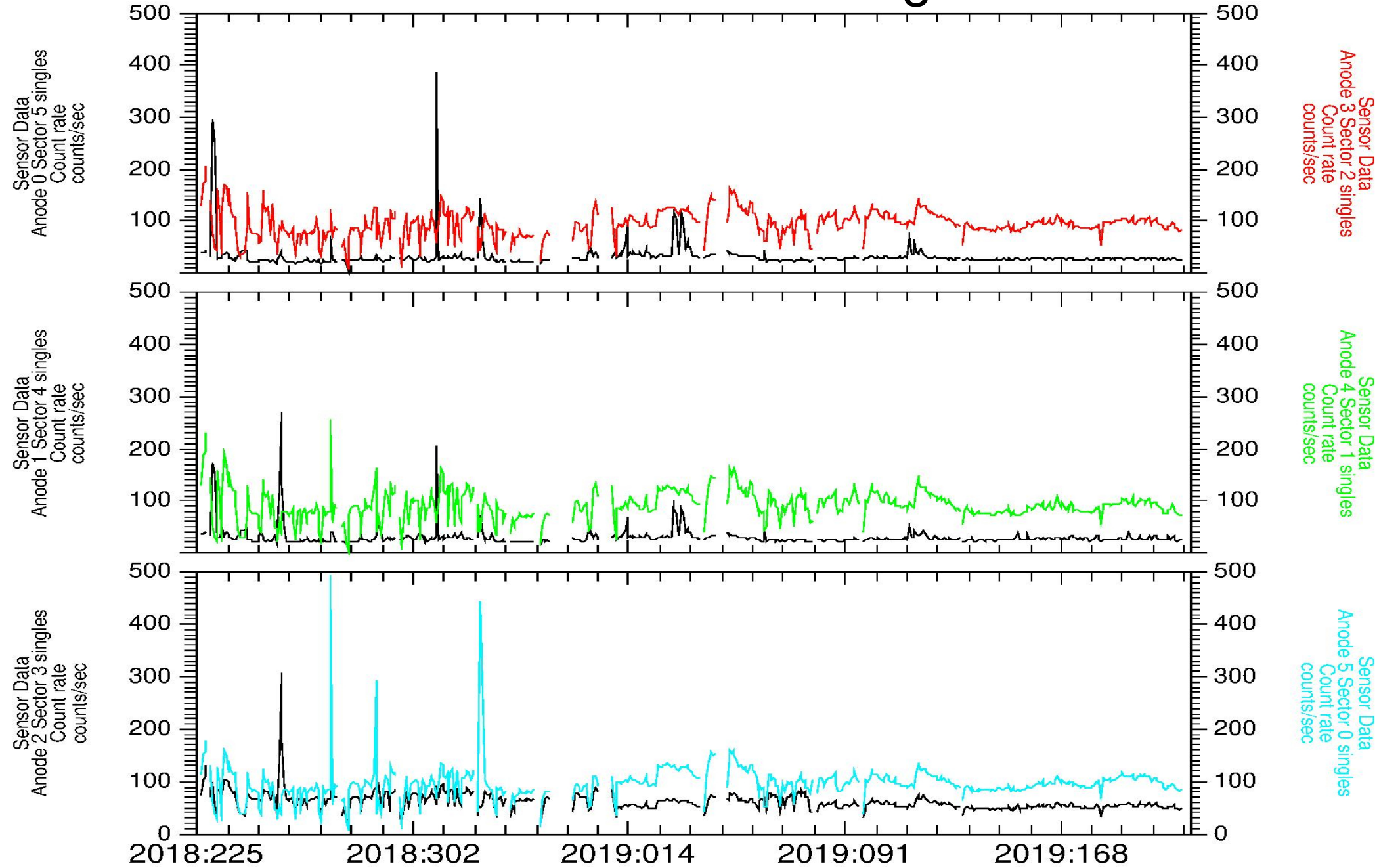
PEPSSI FIT File Structure

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

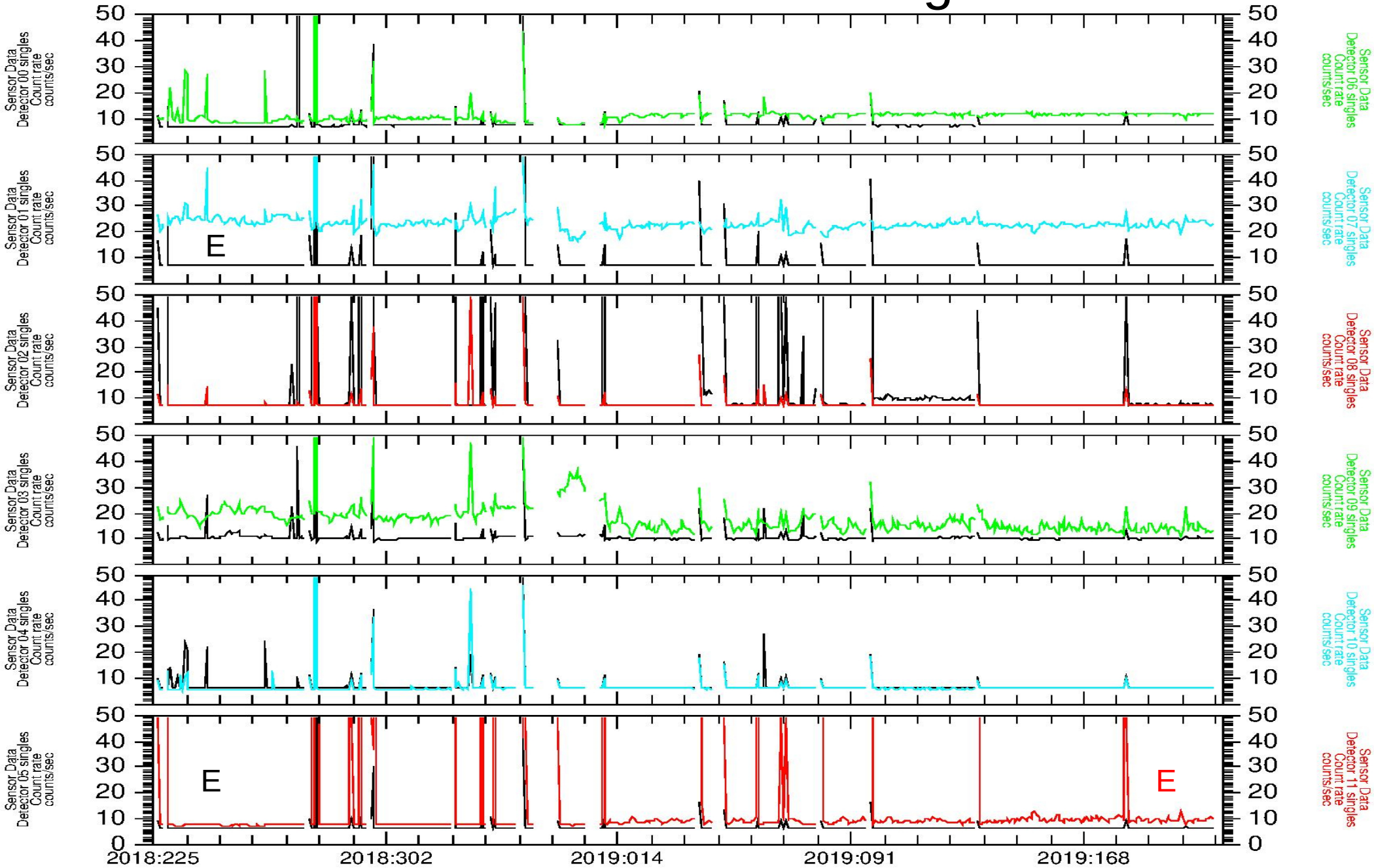
Index	Extension	Type	Dimension	View				
0	Primary	Image	1017 X 614	Header	Image	Table		
1	SPEC_Protons	Image	1440 X 6	Header	Image	Table		
2	SPEC_Helium	Image	1440 X 2	Header	Image	Table		
3	SPEC_Heavies	Image	1440 X 3	Header	Image	Table		
4	SPEC_Electrons	Image	1440 X 3	Header	Image	Table		
5	SPEC_LowIon	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-v3.0/data

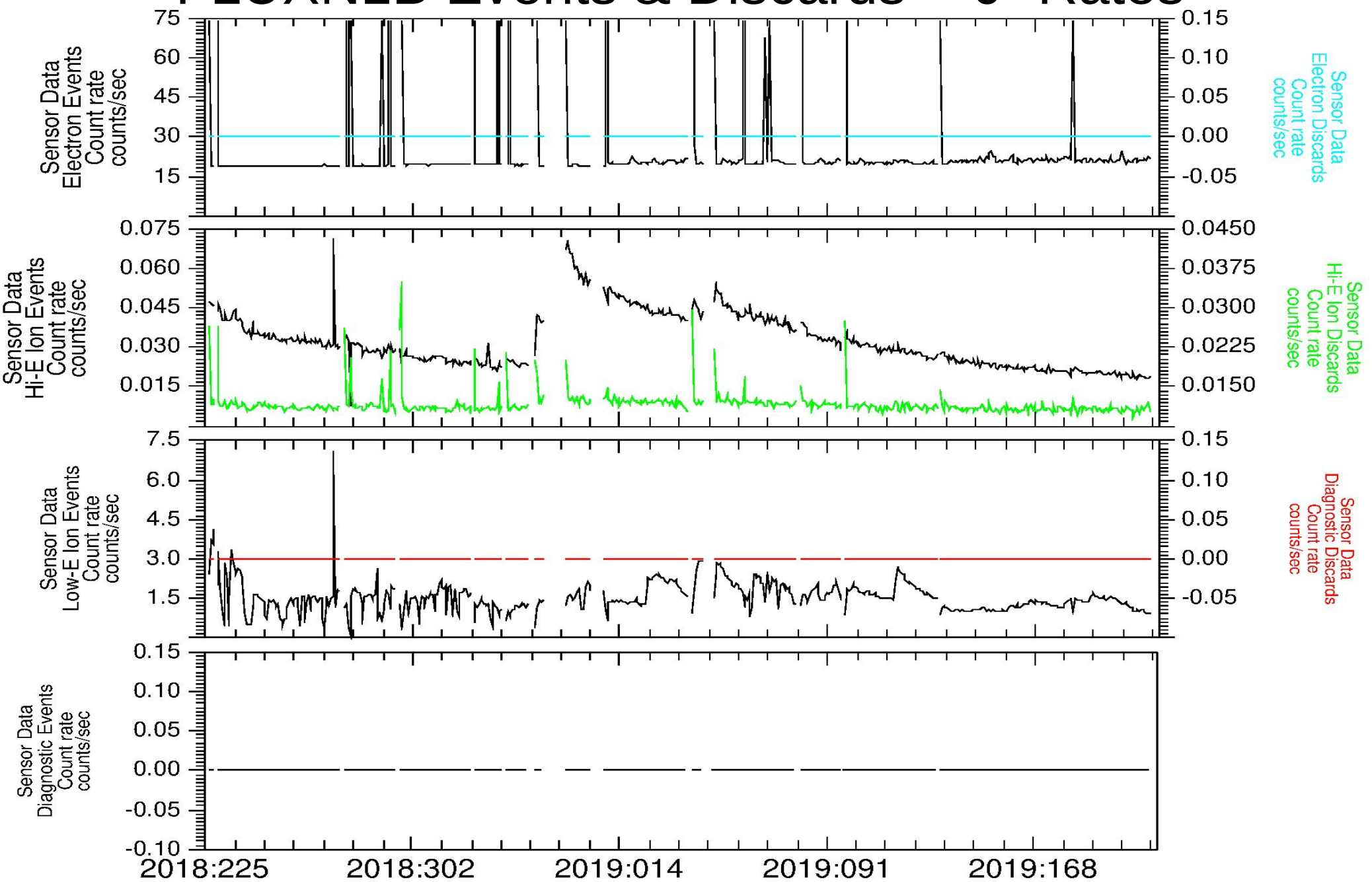
FLUXN1B Anode Singles



nh-a-pepssi-3-kem1-v3.0/data FLUXN1B Detector Singles

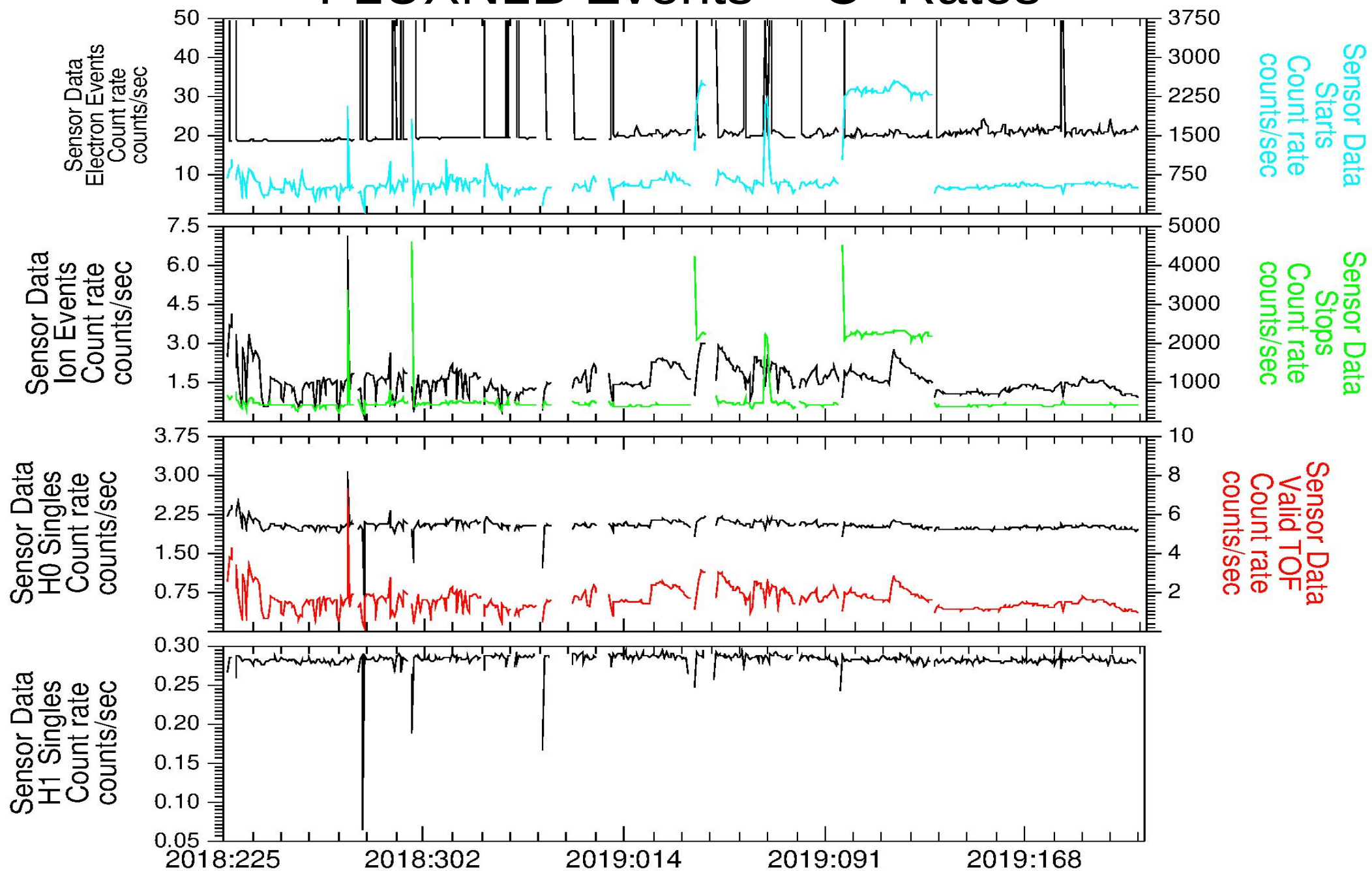


nh-a-pepssi-3-kem1-v3.0/data FLUXN1B Events & Discards - "J" Rates

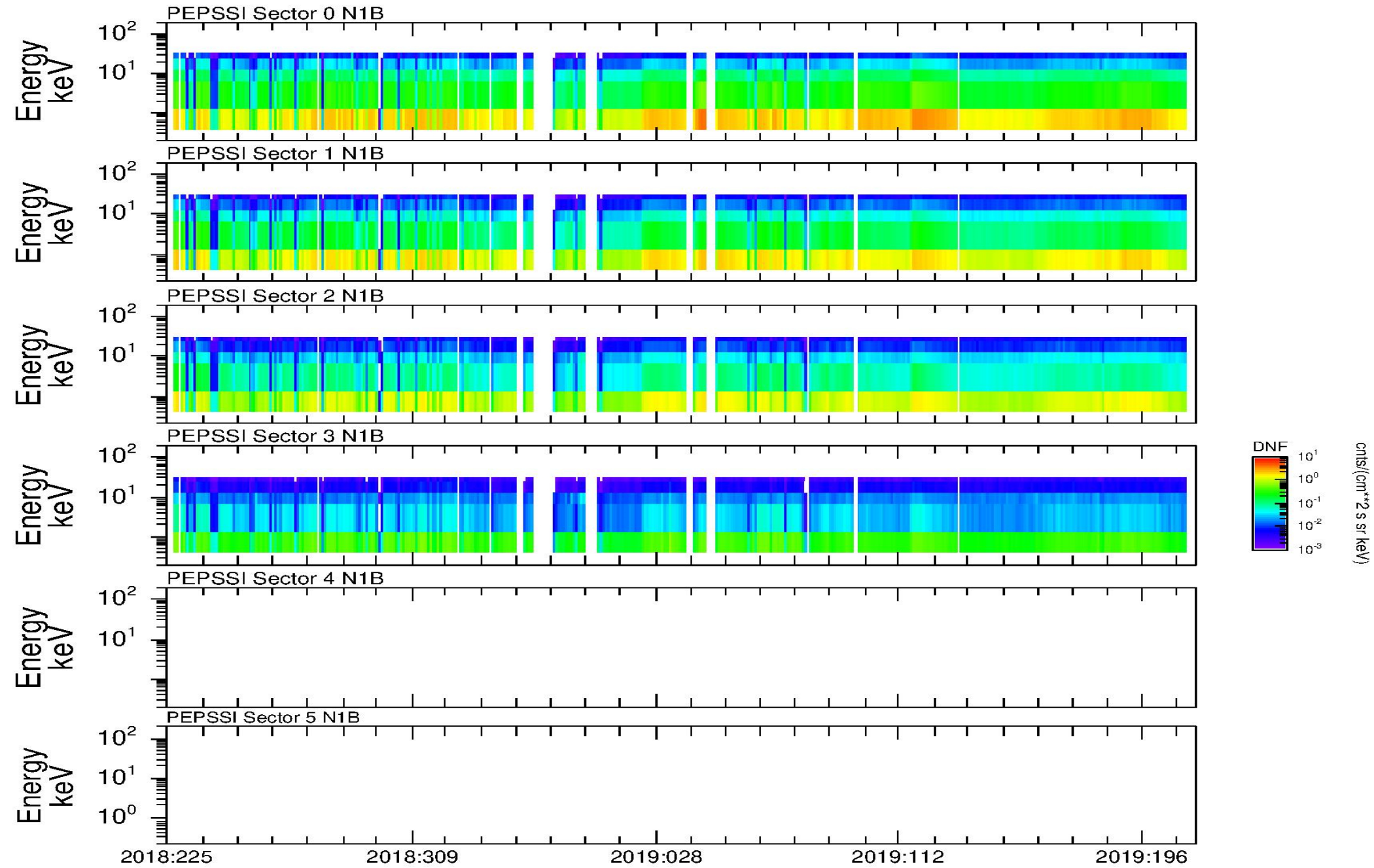


nh-a-pepssi-3-kem1-v3.0/data FLUXN1B Events - "C" Rates

28

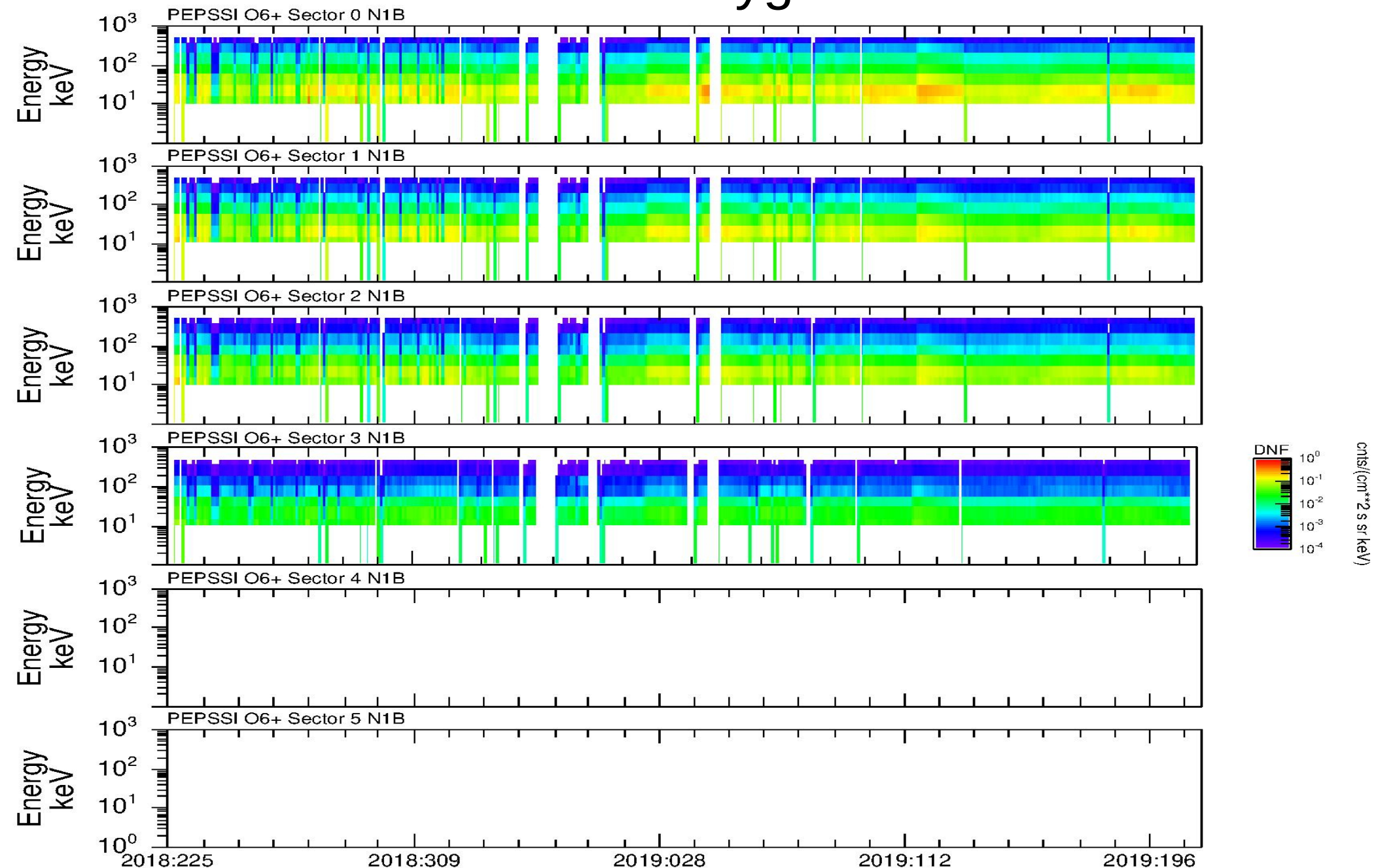


nh-a-pepssi-3-kem1-v3.0/data FLUXN1B Proton Flux



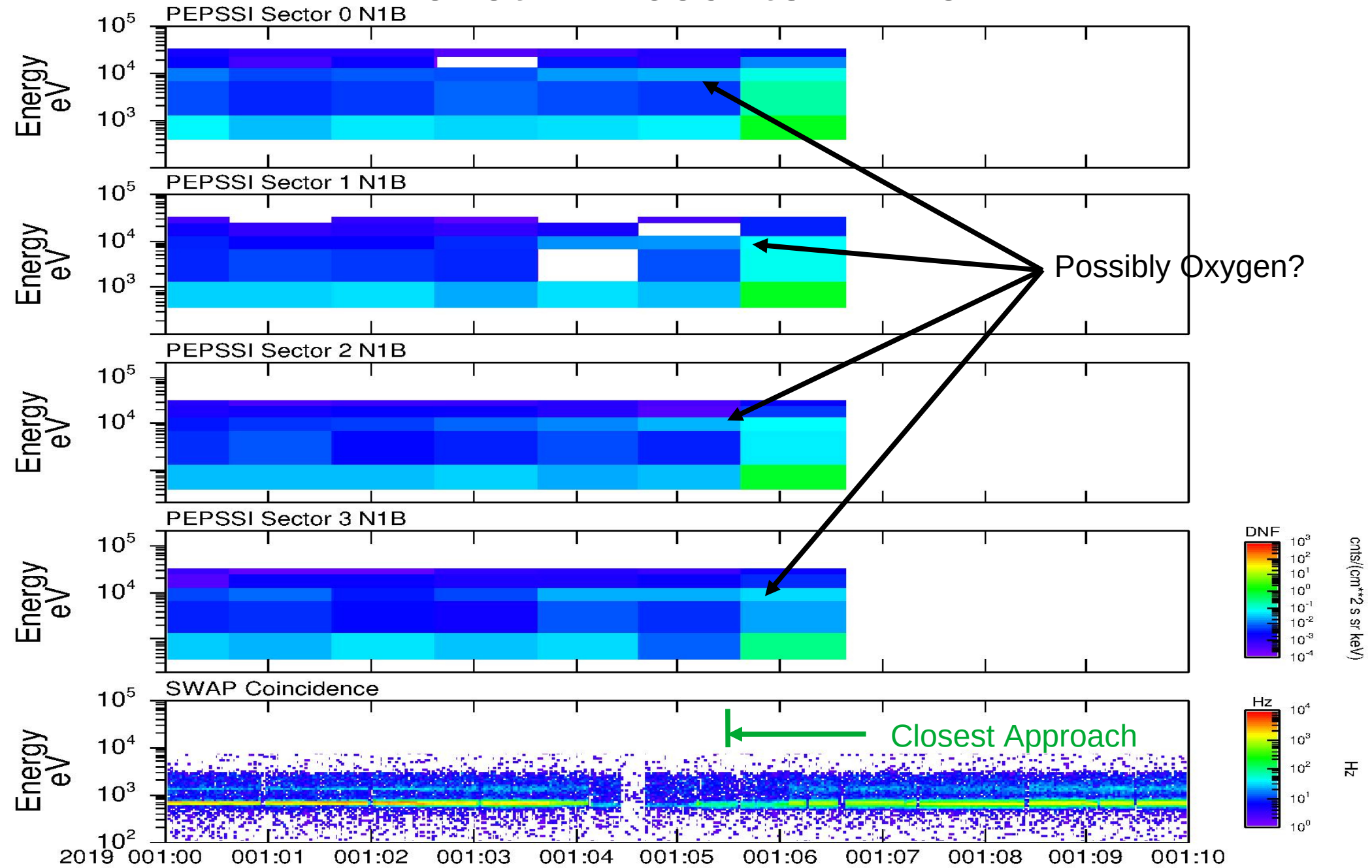
nh-a-pepssi-3-kem1-v3.0/data FLUXN1B Oxygen Flux

30



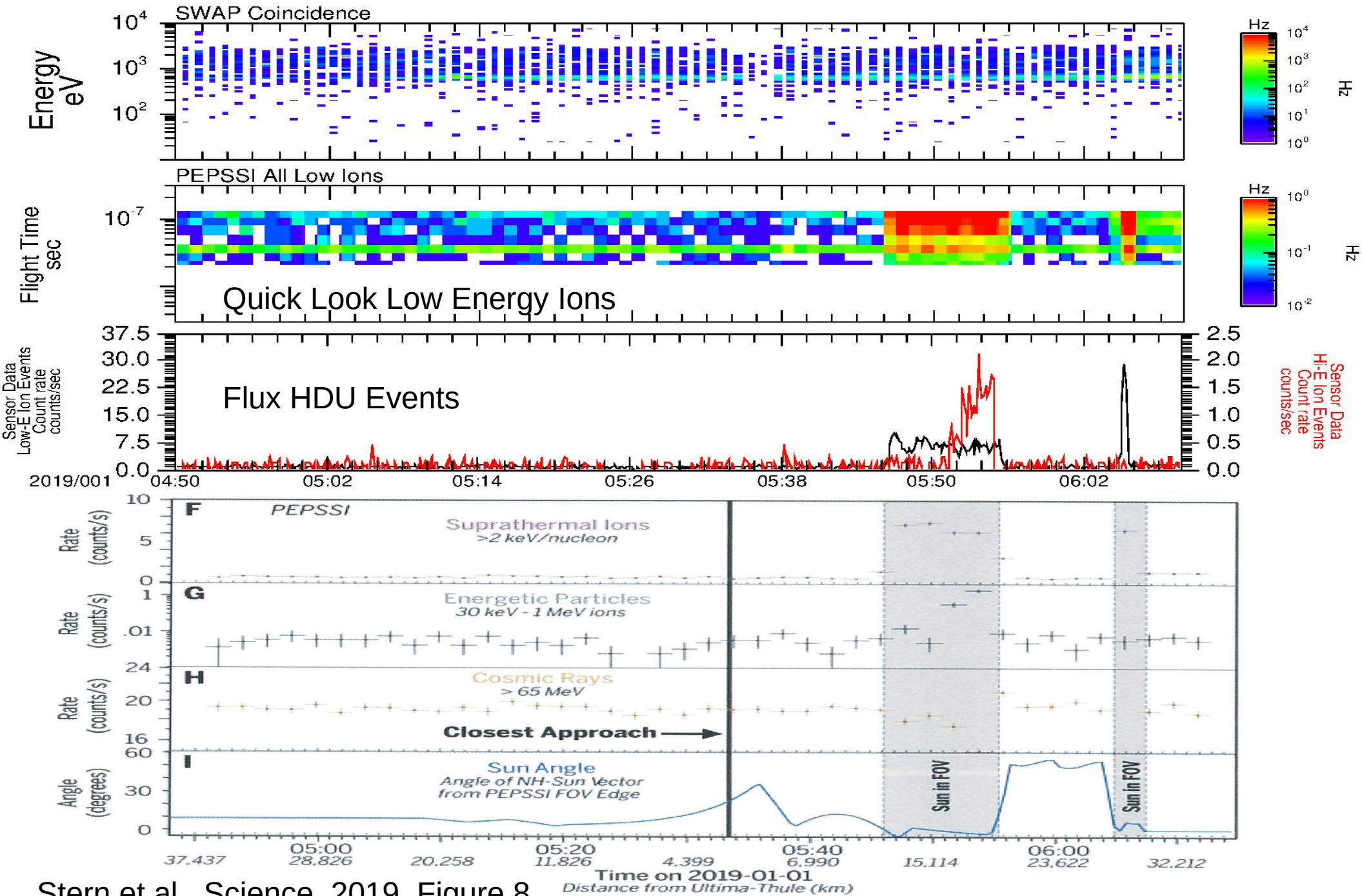
PEPSSI-SWAP

Arrokoth Encounter – 1 of 2



PEPSSI-SWAP Arrokoth Encounter – 2 of 2

32



Stern et al., Science, 2019, Figure 8

Certification

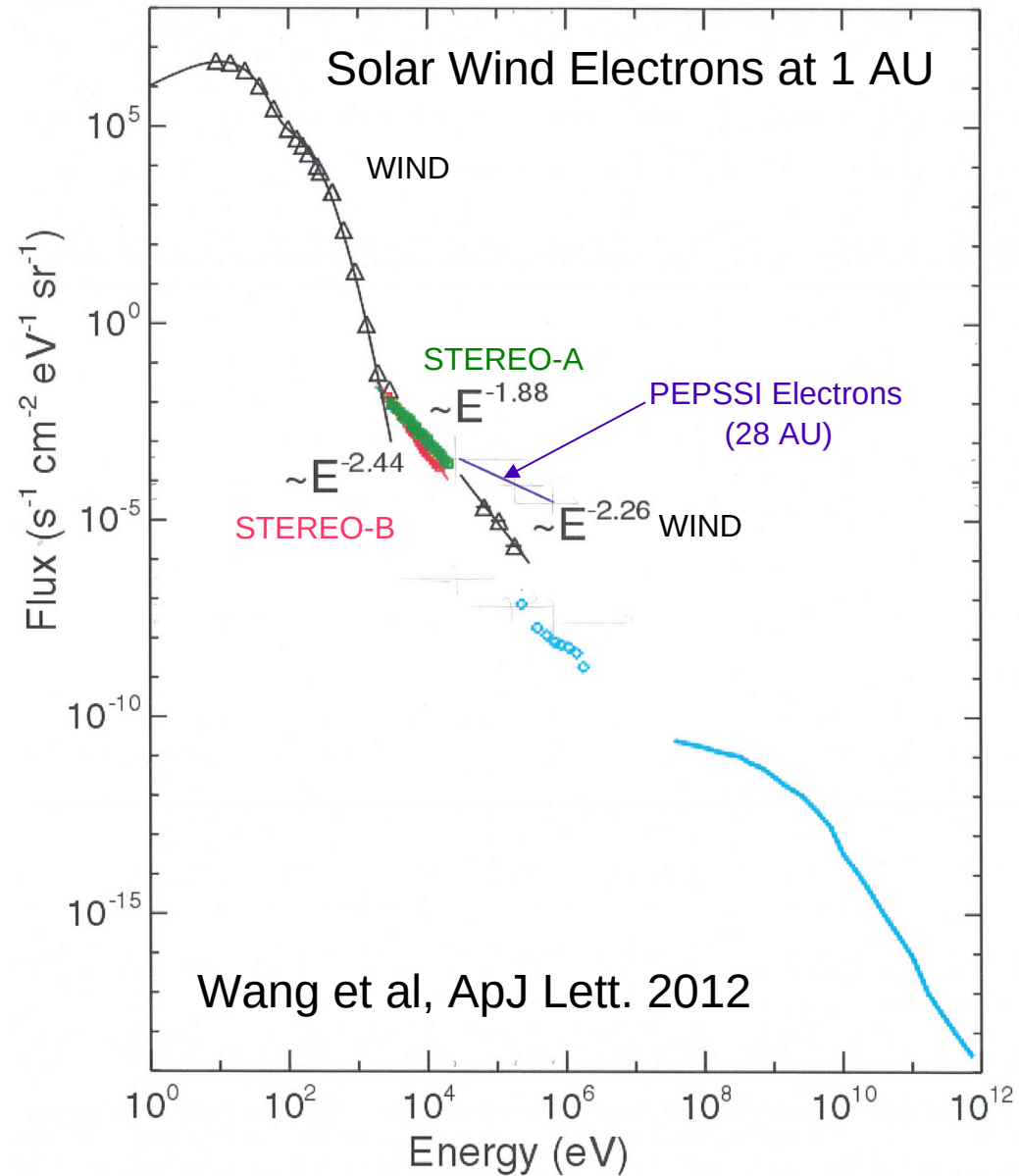
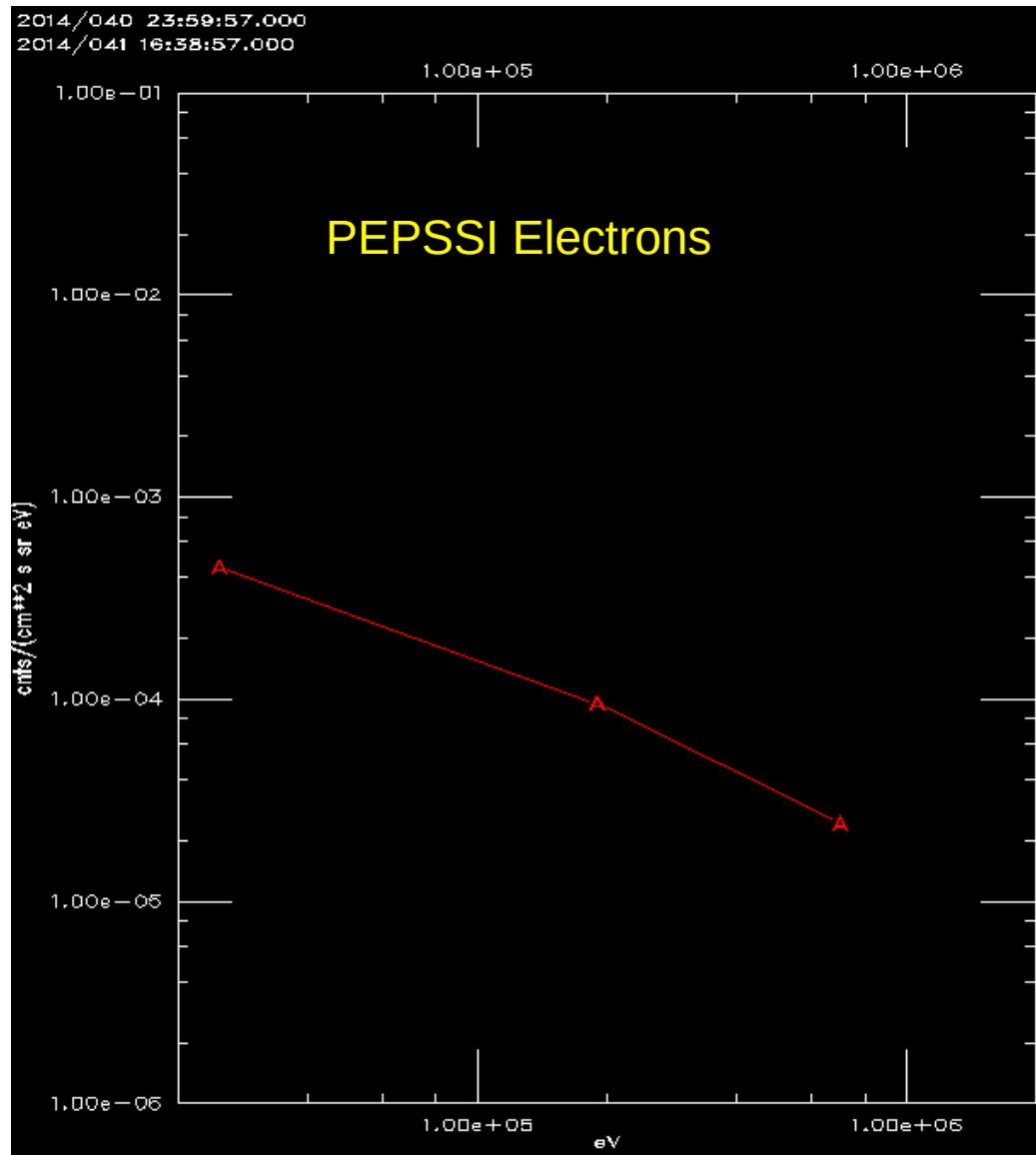
These PEPSSI data themselves look good; however, the data label files have too many issues to release the data to the public.

Multiple description fields are affected on every single label file; however, all other fields seem to be correct. Does this require a delta review which covers only the label files?

BACK-UP Slides

PEPSSI Electrons - 3

Why are the fluxes from PEPSSI abnormally high?



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

GOOD

nh-a-pepssi-2-kem1-v3.0
nh-a-pepssi-3-kem1-v3.0
voldesc.txt

GOOD

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

GOOD

nh-a-pepssi-2-kem1-v3.0/index
nh-a-pepssi-3-kem1-v3.0/index
checksum.tbl & checksum.tab

GOOD

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

GOOD

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

GOOD

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

GOOD

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

GOOD

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

GOOD

nh-a-pepssi-3-kem1-v3.0/document
nh_fov.lbl & nh_fov.pdf

GOOD

nh-a-pepssi-3-kem1-v3.0/document
nh_met2utc.tbl & nh_met2utc.tab

GOOD

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

GOOD

nh-a-pepssi-3-kem1-v3.0/document
nh_pepssi_v110_ti.txt

GOOD

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

GOOD

nh-a-pepssi-3-kem1-v3.0/document
pep_bti.lbl & pep_bti.pdf

GOOD

nh-a-pepssi-3-kem1-v3.0/document
pepssi_ssr.lbl & pepssi_ssr.pdf

GOOD

nh-a-pepssi-3-kem1-v3.0/document
quat_xyz_instr_to_j2k.lbl
quat_xyz_instr_to_j2k.asc

GOOD

nh-a-pepssi-3-kem1-v3.0/document
seq_pepssi_kem1.tbl
seq_pepssi_kem1.tab

GOOD

nh-a-pepssi-3-kem1-v3.0/document
soc_inst_icd.tbl

GOOD

nh-a-pepssi-3-kem1-v3.0/document
soc_inst_icd.pdf

GOOD

nh-a-pepssi-2-kem1-v3.0/catalog
nh-a-pepssi-3-kem1-v3.0/catalog
catinfo.txt

GOOD

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

GOOD

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

GOOD

nh-a-pepssi-2-kem1-v2.0/catalog
nh-a-pepssi-3-kem1-v2.0/catalog
ref.cat

GOOD

nh-a-pepssi-2-kem1-v3.0/calib
nh-a-pepssi-3-kem1-v3.0/calib
hk_n1_input_20050228.lbl
hk_n1_input_20050228.tab

GOOD

nh-a-pepssi-2-kem1-v3.0/calib
nh-a-pepssi-3-kem1-v3.0/calib
hk_stat_input_20041016.tbl
hk_stat_input_20041016.tab

GOOD

nh-a-pepssi-2-kem1-v3.0/calib
nh-a-pepssi-3-kem1-v3.0/calib
rateboxdefinitionplanes.lbl

GOOD

nh-a-pepssi-3-kem1-v3.0/calib/calpars
calpinfo.txt

GOOD

nh-a-pepssi-3-kem1-v3.0/calib/calpars
calpar_columns.fmt

GOOD

nh-a-pepssi-3-kem1-v3.0/calib/calpars
pep_0425627517_0x691_calpar.tab

GOOD