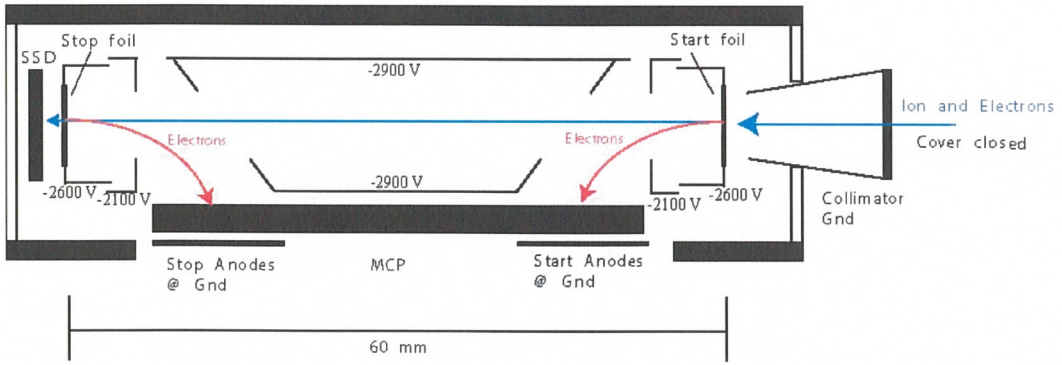
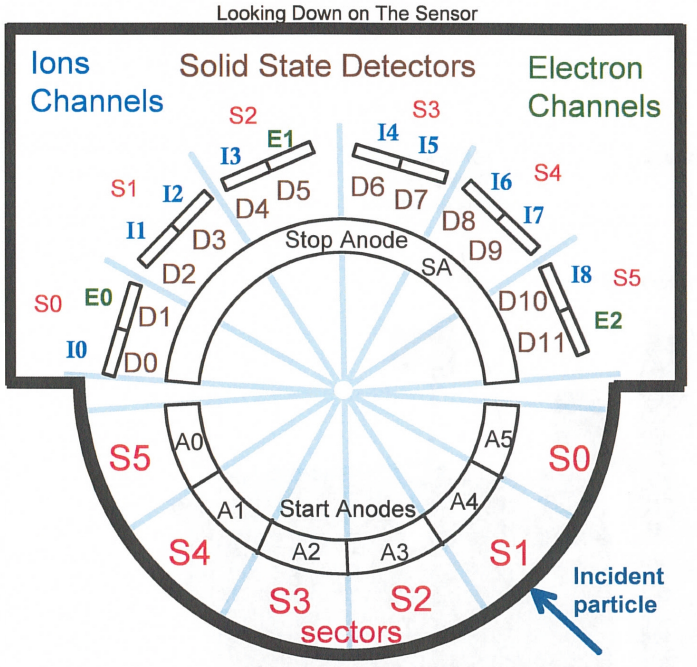
New Horizons Pluto Energetic Particle Spectrometer Science Investigation (PEPSSI)

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 ->

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0

CALIBRATED ->

NH-X-PEPSSI-3-PLUTOCRUISE-V1.0

New Horizons PEPSSI Data Set Evaluation Tools

Staging and Evaluation -

Machine: Dell Precision T3400

Operating System: Fedora 18 linux

Data Processing -

Machine: Sun Ultra-350

Operating System: Sun Solaris OS 5.9

Minor Diagnostics -

Machine: IBM lenovo T60p ThinkPad

Operating System: openSUSE 10.2

Documentation Evaluation

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
aareadme.txt and document/aareadme_bu.txt

- Required Reading Summary List, CATALOG subdirectory, NH_TRAJECTORY.* does not exist. The text should be changed to refer to the proper trajectory file in the DOCUMENT directory.

- Required Reading Summary List, DOCUMENT subdirectory, PAYLOAD.* is named PAYLOAD_SSR.*

- Required Reading, Details, SOC Instrument Control Document, 2nd paragraph, 2nd line, the file "SOC_INST_ICD.DOC" is not in the DOCUMENT directory as claimed. This information can be found in the file "SOC_INST_ICD.PDF".

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
aareadme.txt and document/aareadme_bu.txt

- Volume Contents, under DOCUMENT list, the files QUAT_ZXYZ_J2K_TO_INSTR.LBL and QUAT_ZXYZ_J2K_TO_INSTR.ASC do not exist. (FYI-The files QUAT_AXYZ_INSTR_TO_J2K.LBL and QUAT_AXYZ_INSTR_TO_J2K.ASC exist in that directory. The project should consider changing the extension of this file from “ASC” to “TXT”.)

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
catalog/personnel.cat

- Contact information for Alan Stern is not correct.

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
catalog/ref.cat – 1 of 2

- Unable to locate the following reference, so it was sent to the SwRI library to locate:

```
OBJECT            = REFERENCE
REFERENCE_KEY_ID  = "ASMAR&HERRERA1993"
REFERENCE_DESC    = "Asmar, S.W., and R.G. Herrera, Radio Science
Handbook, JPL D-7938, Vol. 4 Jet Propulsion Laboratory, Pasadena, CA 1993."
END_OBJECT        = REFERENCE
```

  Response back was its access was limited and access controlled under ITAR. So why is this reference included within the PDS archive? Why isn't there a non-ITAR version published which can be referenced?

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
catalog/ref.cat – 2 of 2

- Unable to locate the following reference, so it was sent to the SwRI library to locate:

OBJECT = REFERENCE
REFERENCE_KEY_ID = "LUNINEETAL1995"
REFERENCE_DESC = "Lunine, J. I., et al., Report of the Pluto-Kuiper Express Science Definition Team (NASA, unpublished), 1995."
END_OBJECT = REFERENCE

Response back was that the SwRI library could not locate this reference. So why is this reference included within the PDS archive? Why is any inaccessible reference included in the NASA reference catalog?

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
catalog/dataset.cat

- There is disagreement between the ApID range and the defined ApIDs in the Data section:

Instrument	Instrument designators	ApIDs
PEPSSI	PEP	0X691 - 0X696 *

* Not all values in this range are used

The above table defines the ApID range while the table below defines their meaning. Notice that ApIDs 0X697 and 0X698 are not included Within the ApID range definition made in the above table.

ApIDs	Data product description/Prefix(es)
0x691	PEPSSI High Priority Science/PEP
0x692	PEPSSI Medium Priority Science/PEP
0x693	PEPSSI Low Priority Science (Up to 500 PHA events)/PEP
0x694	PEPSSI Low Priority Science (Up to add'l 500 PHA events)/PEP
0x695	PEPSSI High Priority Science/PEP
0x696	PEPSSI Medium Priority Science/PEP
0x697	PEPSSI Low Priority Science (Up to 500 PHA events)/PEP
0x698	PEPSSI Low Priority Science (Up to add'l 500 PHA events)/PEP

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
catalog/nh.cat

- Data cover roughly Sep 2007 - Jul 2010 but the "Pluto Cruise" mission phase covers 2007-06-27 to 2014-12-31, according to this file. Why are the data are limited to a subset of the mission phase? It seems like either the AAREADME or the mission catalog should explain this. A data cut-off of 2010 for a review in 2014 seems like a longer than normal validation period.

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
catalog/pepssi.cat

- Instrument Overview, Specifications, Energy Range values disagree with that claimed in the succeeding paragraph.

- Detector, Summary, second sentence disagrees with the Details section. Additional sources indicate that this sentence describes the sister instrument on Messenger.

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
calib/calinfo.txt

- The test of the calinfo.txt file states: “[calib] Directory containing calibration files for LEISA data.” LEISA is not part of the PEPSSI instrument, it is part of the RALPH instrument. However, listed in the calinfo.txt file are those for the PEPSSI instrument.

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/nh_pepssi_v110_ti.txt

- Incomplete sentence in second paragraph: “Field(s) Of View (FOV(s)). As such, and also because it is not likely to be updated in a timely fashion as “

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/soc_inst_icd.pdf – 1 of 6

- General Comment: Through out this document, multiple figure numbers are repeated presenting different pictures. The user is confused which figure is cited and discussed in the text. In addition to repeated figure numbers, figures are placed in a non-sequential order adding to the confusion. The figure numbering method is inconsistent between figures and figures exist without figure numbers or captions. A complete revision of the text and figures needs to occur so that the citations point to the proper figures and there is only one unique figure number per picture.

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/soc_inst_icd.pdf – 2 of 6

- PEPSSI Figure 7, cited on page 66, should be the Figure 7 shown on page 93 and NOT the Figure 7 shown on page 98.

- PEPSSI Figure 8, cited on page 66, should be the Figure 8 shown on page 94 and NOT the Figure 8 shown on pages 99 and 100.

- Unable to locate PEPSSI Figure 6, cited on page 68.

- PEPSSI Figure 7, cited on page 68 is probably the Figure 7 shown on page 98 and NOT the Figure 7 shown on page 93.

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/soc_inst_icd.pdf – 3 of 6

- PEPSSI page 69, what is section ???1.2.1.7 below?

a. Instrument Status information has been calibrated to physical units where applicable (see discussion in section ???1.2.1.7 below).

- PEPSSI Section 11.3.3 Header with Keywords is blank. Was there supposed to be text here?

- PEPSSI Section 11.4.1.1 IDL L1 to Pre-L2 step, paragraph 1 on page 70: reference to section 11.3.1.2 below does not exist.

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/soc_inst_icd.pdf – 4 of 6

- PEPSSI Figure 6, cited on page 79 is out of order.

- PEPSSI Figure 6, cited on page 82 is not the correct figure.

- PEPSSI Figure 7, cited on page 86 is probably the Figure 7 shown on page 98 and NOT the Figure 7 shown on page 93.

- There are no files identified as instrument configuration files and no “instrument_config” directory tree in the PDS data set as stated:

description of the Rate Box definition files. The binary files can be found in the instrument_config/ directory tree of the PEPSSI PDS data set.

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/soc_inst_icd.pdf – 5 of 6

- PEPSSI on page 86, why is there a section 11.4.3.5.1 but no section 11.4.3.5.2?

- PEPSSI section 11.4.4 on page 88, expected to find the “PEPSSI_BTI.TXT” file, but no file was found.

- Various documents describing the PEPSSI energy ranges (inst.cat, pepssi_ssr.pdf, soc_inst_icd.pdf) show different values for the same channels:

SSR - Table 1, page 13 and pepssi.cat (table at top)

Species	Energy Measurement Range		
	Energy + TOF Measure	Energy-Only Measure	TOF-Only Measure
Energetic Electrons	Not Applicable	25 keV to 500 keV	Not Applicable
Protons	25 keV to 1 MeV	Not Applicable	700 eV
Atomic Ions, e.g., CNO group, Mg^+, Si^+, Ne^+	60 keV to 1 MeV	Not Applicable	15 keV
Molecular Ions e.g., N_2, O_2	100 keV to 1 MeV	Not Applicable	30 keV

ICD page 66/67 last/first paragraph and pepssi.cat (text - detector details)

species	Energy
Electrons	20-700 keV
Protons	15-1000 keV
Atomic Ions	80-1000 keV

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/soc_inst_icd.pdf – 6 of 6

- Page 78 11.4.3 Para 1: "Each file will contain exactly one observing day worth of data (i.e. one UTC day from hour 0 – 23:59:59.999…)." What happens to data acquired during leap seconds?

- Expected to find a discussion on the meaning and use of checksum values in Section 6 since it seems to be universal to the project. Should it not be included within the ICD?

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/samples/pep_0112341117_691_s_1_07.asc

- The fifth table entry shows a rate box of “R00B(787.60,1145.14)keV”. No document has an explanation of a rate box “R00B”.

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
General

- There is missing information discussing the effect of spacecraft spin on the PEPSSI data. It is surmised that spacecraft spin information along with the instrument pixel vectors (provided in the DOCUMENT directory) could be used to resort some of the PEPSSI level 2 data in order to generate a sky map to reveal the directions of fluxes. It is not clear how much of the variation observed in the PEPSSI data is due to orientation. This should be discussed.

Data Evaluation

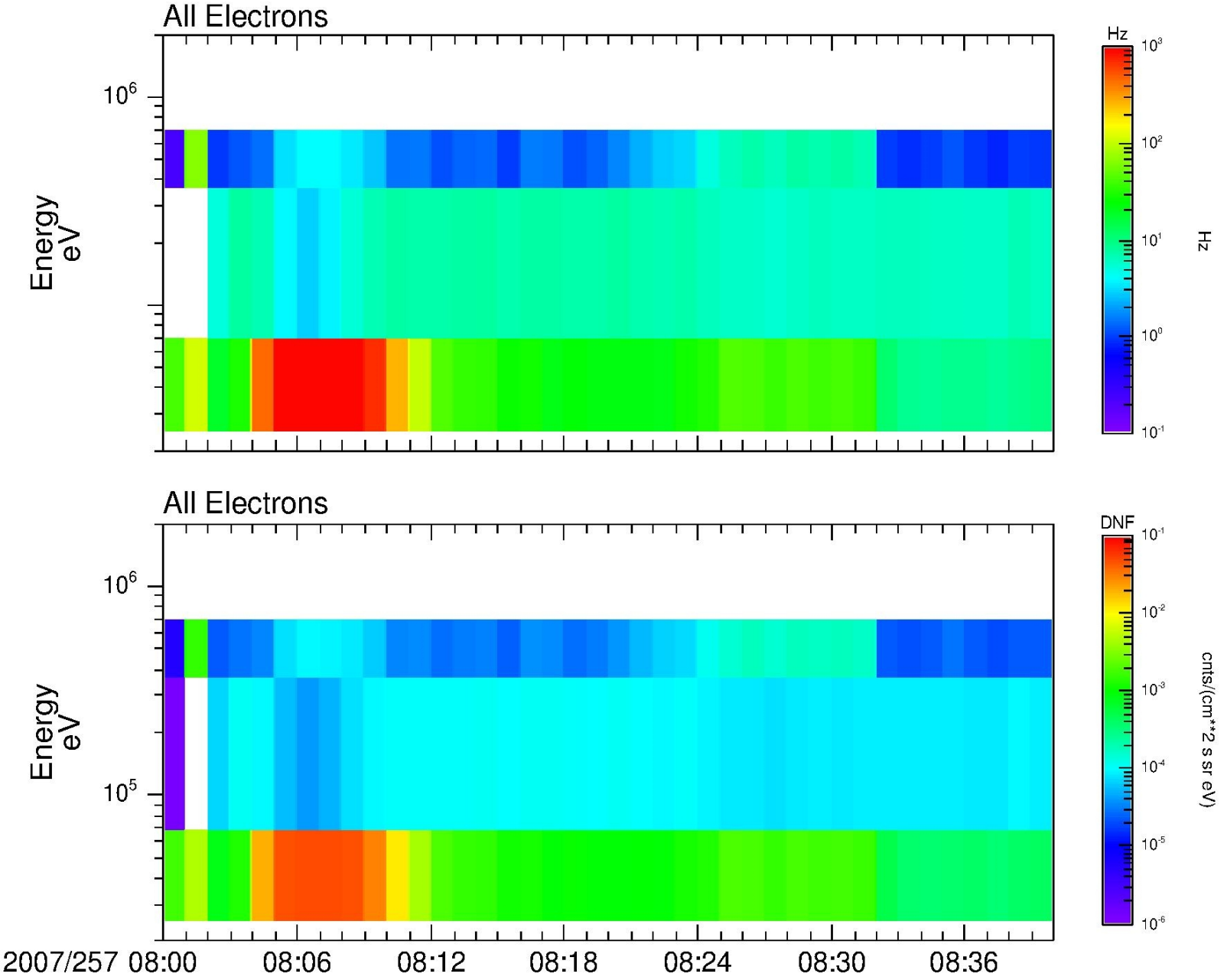
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
Timing -1 of 2

- The File pep_0052033917_0x691_sci_1, the lbl file has the note “PHA spectrogram of weighted (Note 1) event counts between start and end times for each energy and TOF bin”. The lbl Start and End times agree with the “MET” and “METEND” times in the Primary HDU which contains notes “(used in file creation code)”, suggesting that the times given are only for the file name. There is also a keyword “STARTMET” in the Primary HDU (“5.2062744E7 / Actual time stamp”) which does not agree with the “MET” time. However, given the number of time entries from the SPEC_ headers (“1440”), the time width represented (“0.016666666666666666” hours) suggests that the “STARTMET” is not the correct time stamp to use and that the “MET” time from the Primary HDU should be used. Since no time stamps are given in the spectrogram data and no definitive document on timing, the user is left with an uncertainty which time should really be used. This should be fixed.

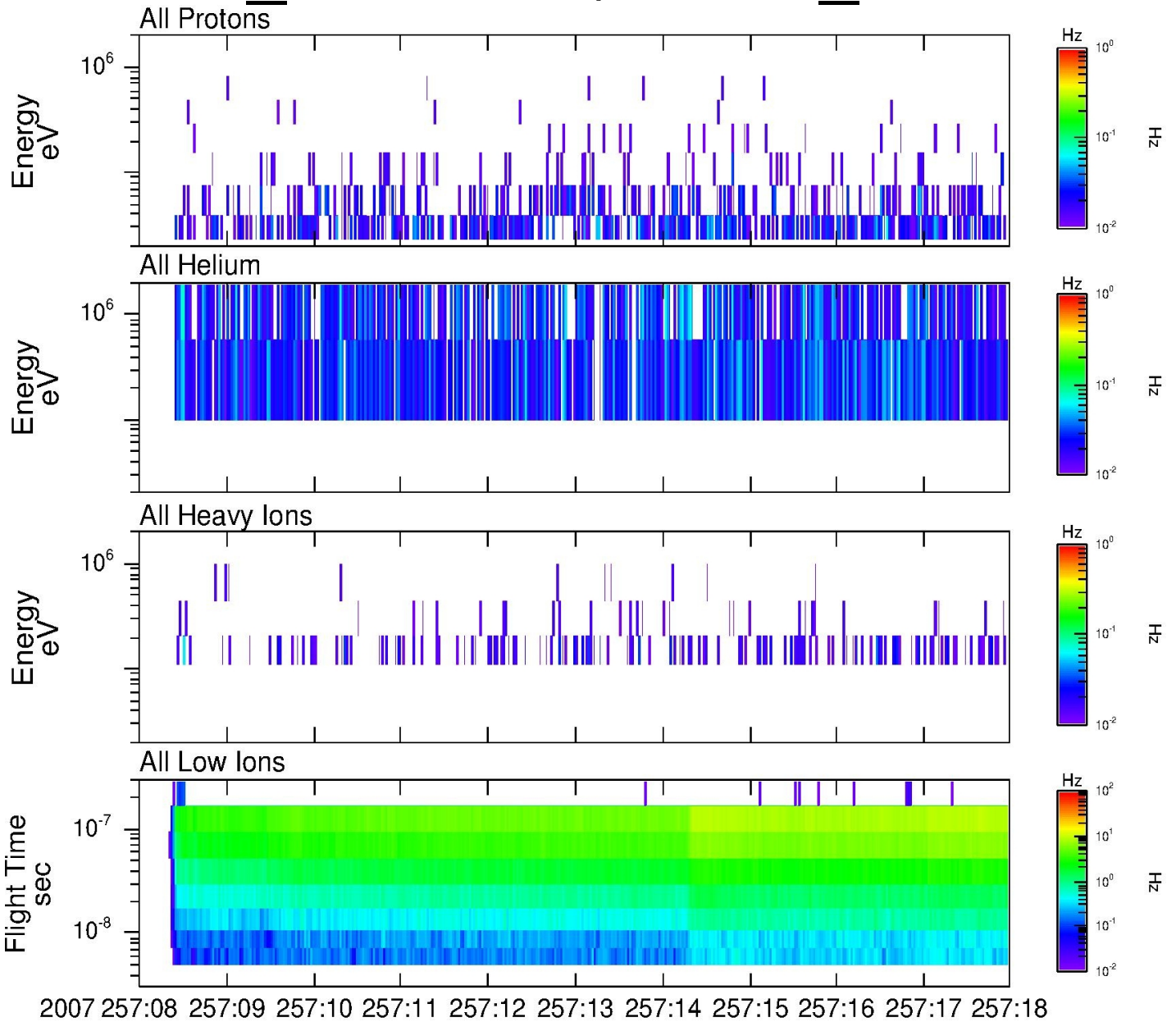
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
Timing -2 of 2

- The File pep_0052033917_0x691_sci_1, the lbl file notes that the time is given in column 1 as “ET” with the time duration given in column 4 of the “FLUX” HDU. It is unclear whether the time stamp is the beginning, middle, end, or at some other location within the accumulation window. This needs to be clarified.

NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
SPEC_ELECTRONS (MET Timing)



NH-X-PEPSSI-3-PLUTOCRUISE-V1.0 SPEC_PROTONS, SPEC_HELIUM, SPEC_HEAVIES, SPEC_LOWION



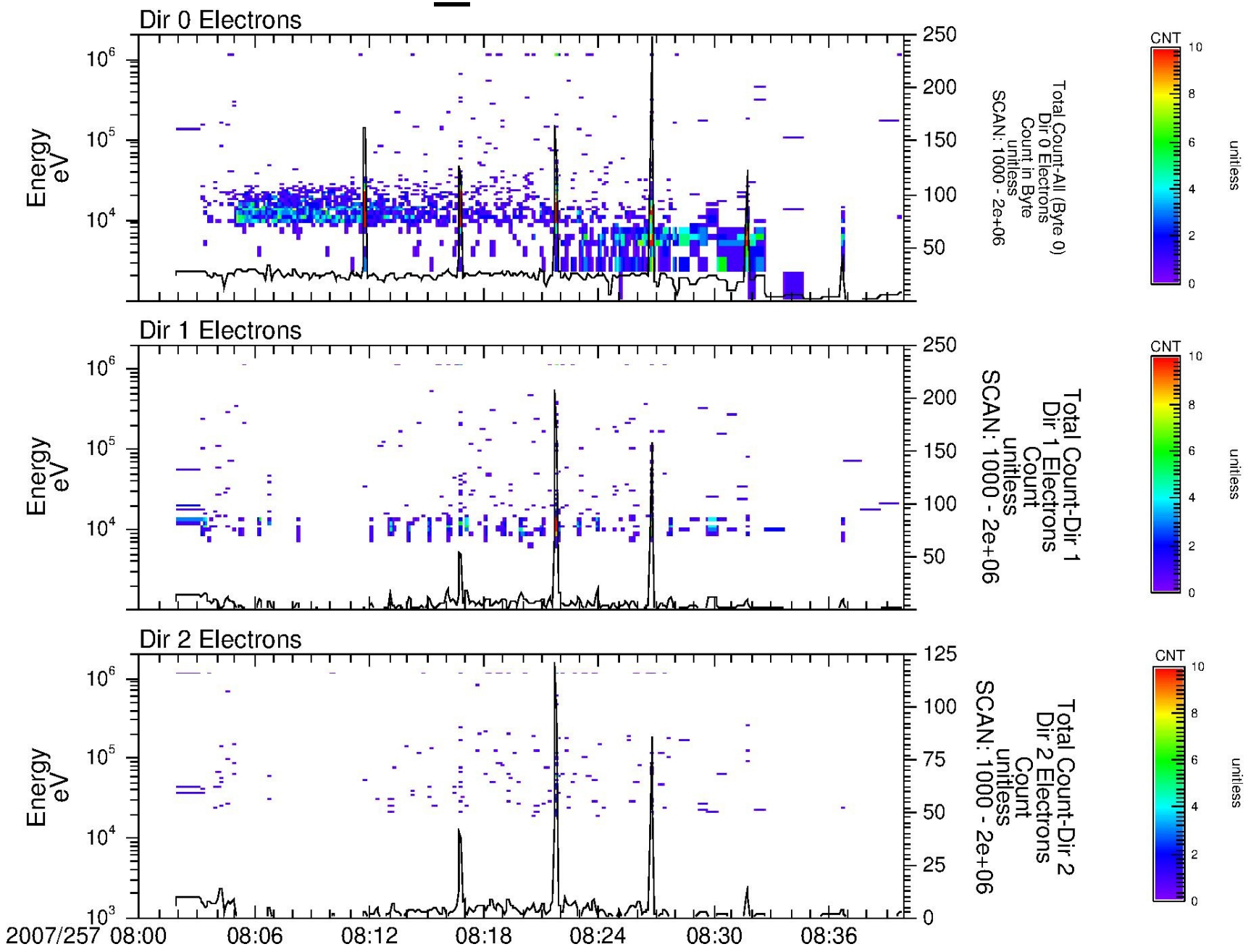
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0 Spectrograms - Conclusion

- Primary HDU “MET” timing was assumed. Spectrograms plotted correctly, but not all pixels had data.

PHA Timing

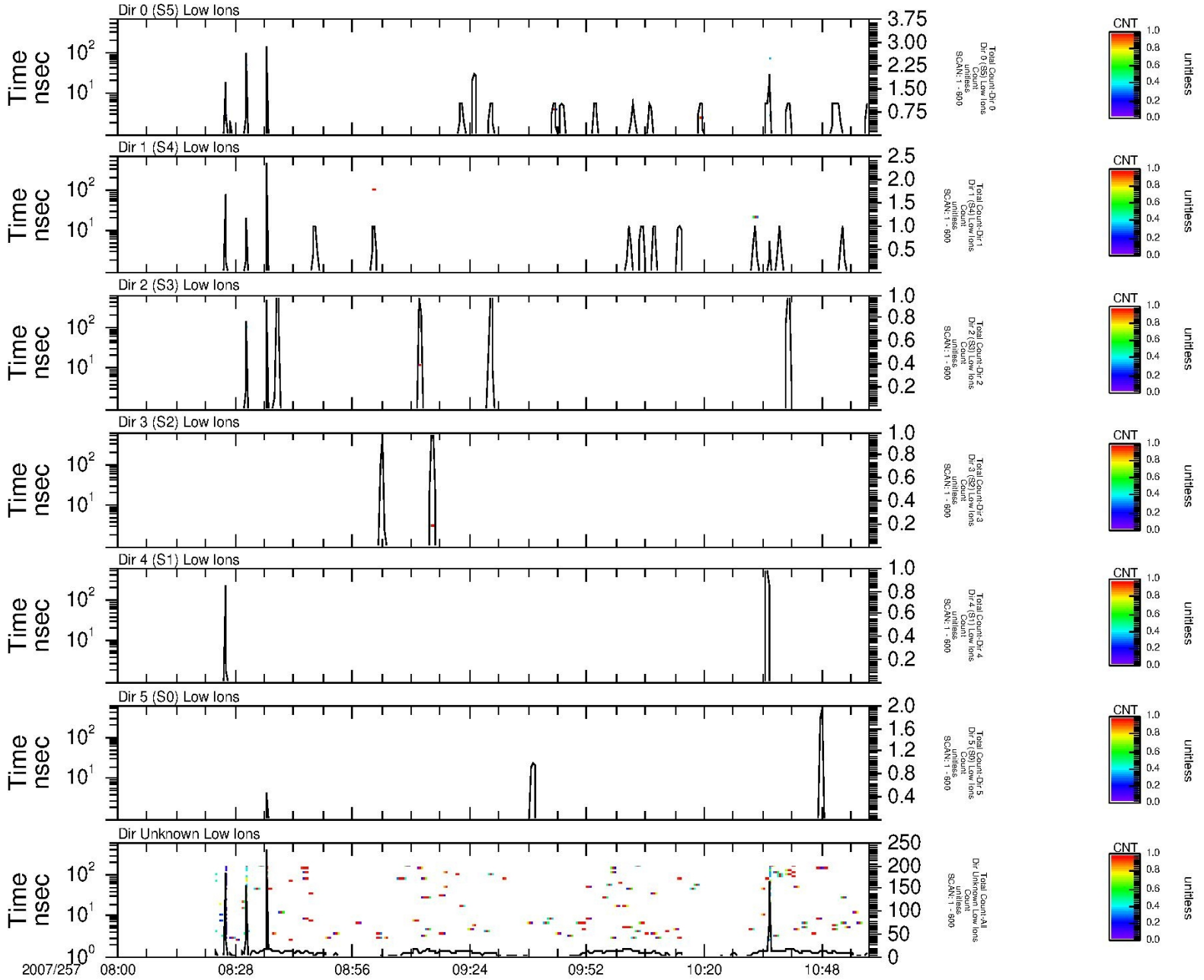
- PHA time stamps were collected and unique time stamps were identified. Data was counted for each unique time stamp. These data are presented in the following spectrograms of PHA data where PAD data was collected and averaged per spectrogram pixel. Spectrogram pixel width is dependent on the time chosen for the display, where larger time ranges average a larger quantity of PHA data.

NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
PHA_ELECTRONS



NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
PHA_HIGH_ION

NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
PHA_LOW_ION



NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
PHA Data - Conclusion

- PHA data spectrograms plotted correctly.

Back-Up Slides

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
voldesc.cat

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
catalog/catinfo.txt

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
catalog/nhsc.cat

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
calib/hk_n1_input_20050228.lbl
calib/hk_n1_input_20050228.tab

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
calib/hk_stat_input_20041016.lbl
calib/hk_stat_input_20041016.tab

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
index/indxinfo.txt

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
index/checksum.lbl
index/checksum.tab

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
index/index.lbl
index/index.tab

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
index/slimindx.lbl
index/slimindx.tab

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/docinfo.txt

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/nh_fov.lbl
document/nh_fov.png

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/nh_met2utc.lbl
document/nh_met2utc.tab

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/nh_trajectory.lbl
document/nh_trajectory.tab

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/nh_mission_trajectory.lbl
document/nh_mission_trajectory.tab

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/payload_ssr.lbl
document/payload_ssr.pdf

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/pepssi_ssr.lbl
document/pepssi_ssr.pdf

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/quat_axyz_instr_to_j2k.lbl
document/quat_axyz_instr_to_j2k.asc

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/seq_pepssi_plutocruise.lbl
document/seq_pepssi_plutocruise.tab

GOOD

NH-X-PEPSSI-2-PLUTOCRUISE-V1.0
NH-X-PEPSSI-3-PLUTOCRUISE-V1.0
document/soc_inst_icd.lbl

GOOD