New Horizons

Student Dust Counter (SDC)
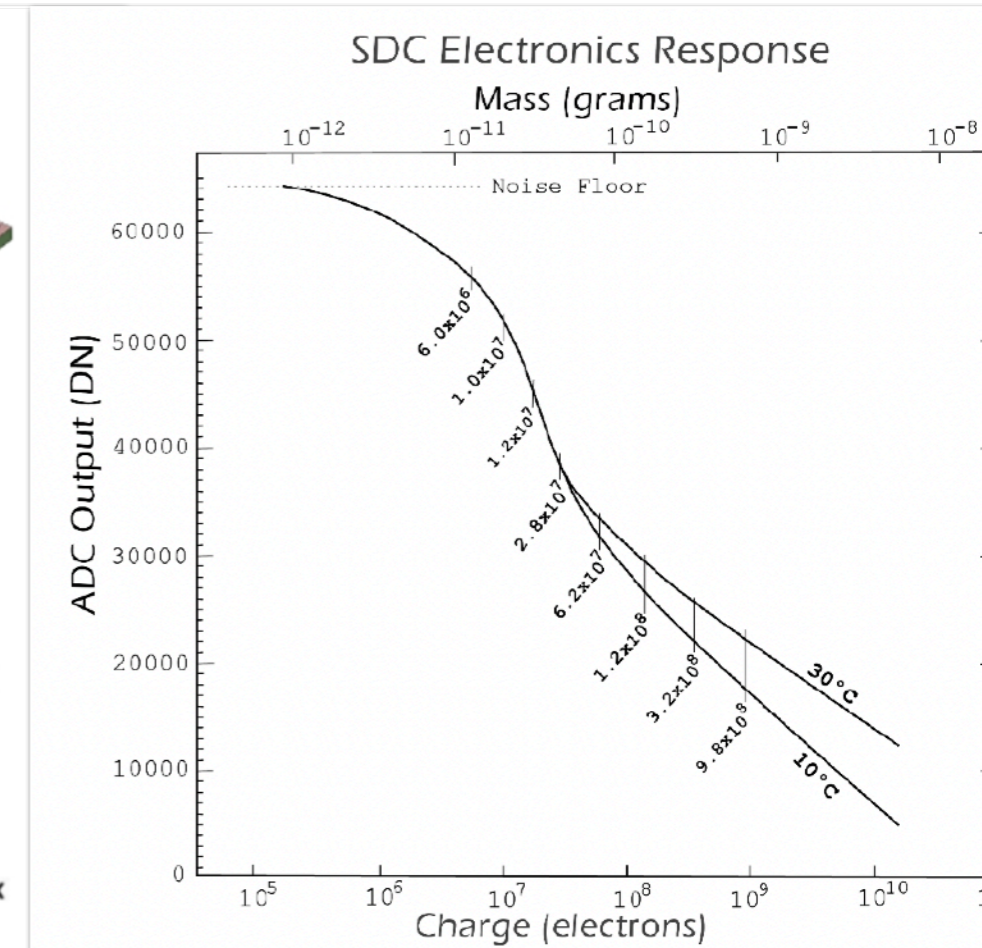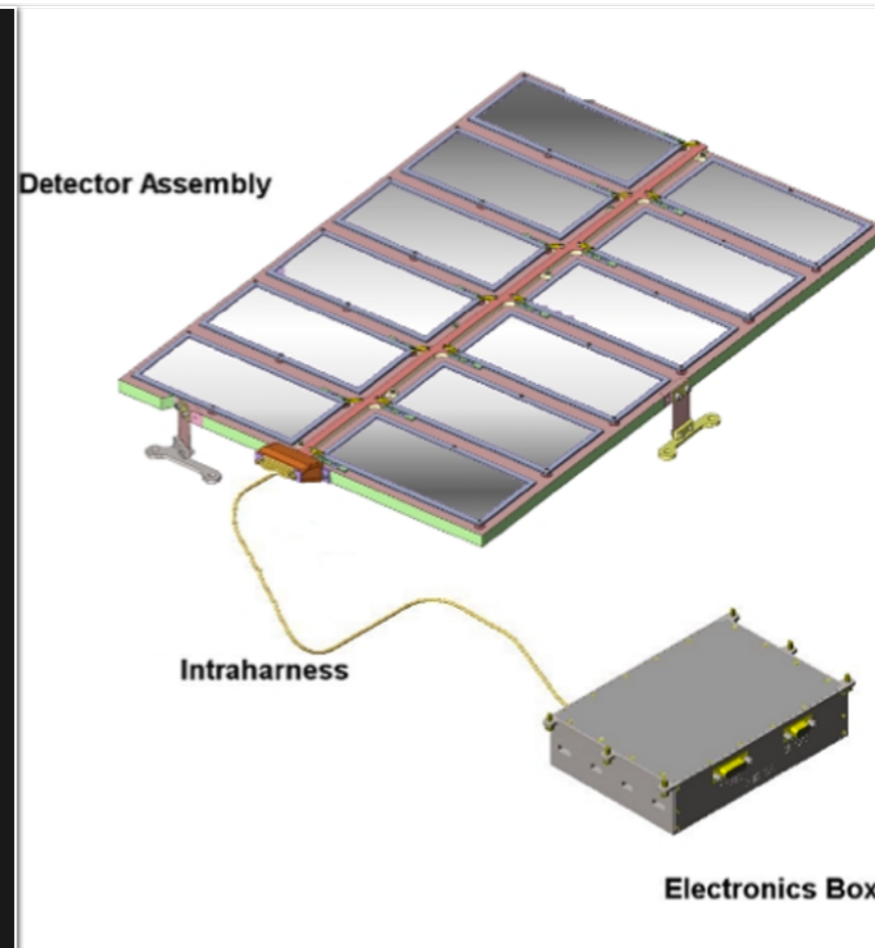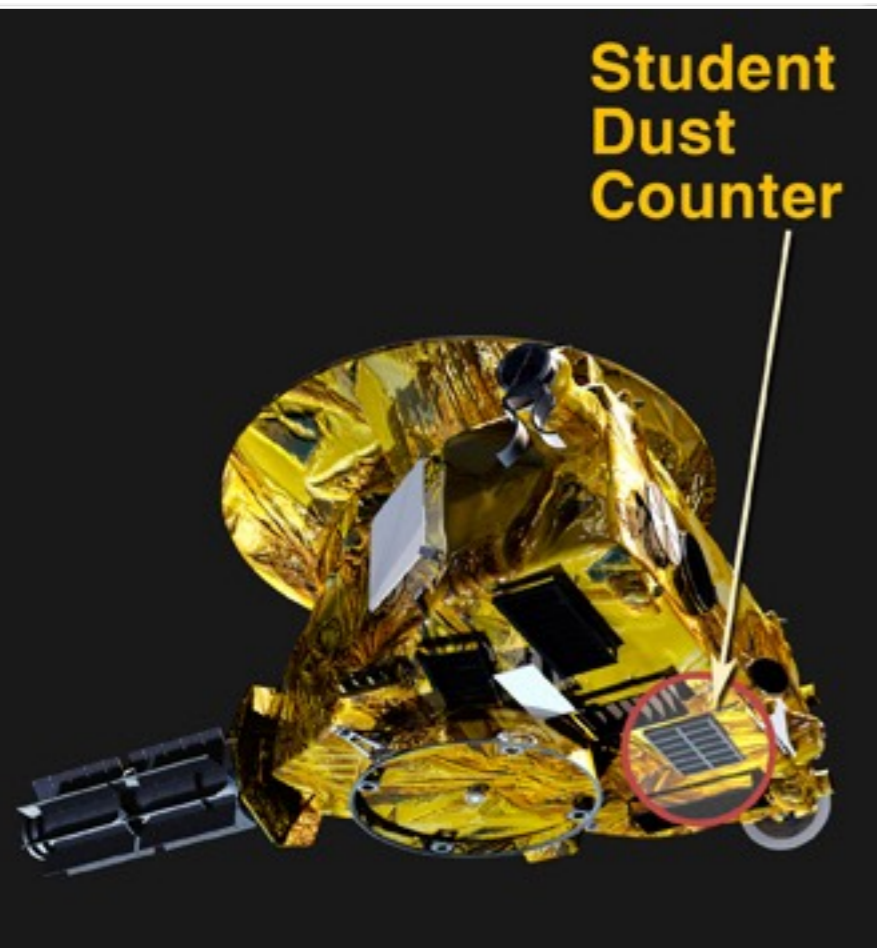
PDS Peer Review

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SDC instrument:
- 14 PVDF detectors: 12 science (with 1 defunct), 2 reference
- Electronics box for signal processing, telemetry/commands

Principle of operation:
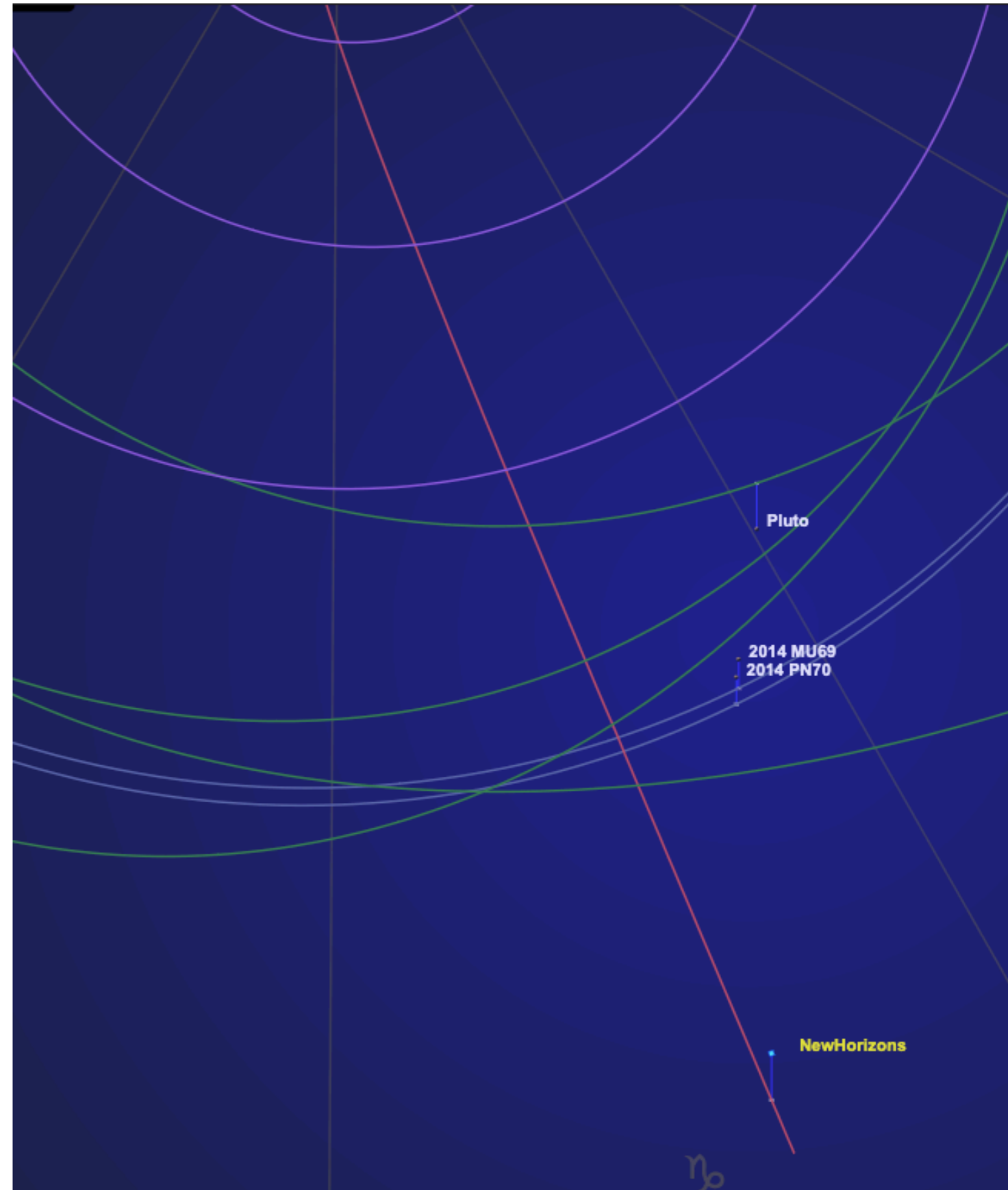- Impacts on PVDF create PVDF depolarization charge
- Measured charge relates to mass of impactor, if velocity known

Calibration curves:
- Relate ADC counts to depolarization charge
- Depend on detector # and temperature of electronics box

Data set

Data set under review:
- KEM1
  - 2022/04/09 to 2022/09/30
- KEM2
  - 2022/09/30 to 2024/04/02
- File cadence: ~daily
- Contents: .fits / .lbl

Data set

raw data:
- sdc_0515865127_0x700_sci.fit
- ADC (engineering) units

cal data:
- sdc_0539690320_0x700_sci.fit
- Physical units (e.g. grams)

Ancillary data:
- Calibration curves used for raw to cal
- Detection threshold values
- Data flags
- Spacecraft ephemeris data (pointing, velocity)
- Documentation for New Horizons / SDC
    - including channel map

Documentation

Can the dataset be understood without any external documentation it references, or should the information in said external references be incorporated into the dataset?

- One needs to refer to the instrument paper / SOC ICD / other documents to understand / interpret the data
  - These references are present in the PDS 'document' folder

If reviewing calibrated data, does the documentation fully explain the calibration process and contain all necessary parameters needed to repeat it?

- Yes
  - Calibration process is well documented in soc_inst_icd.pdf and calinfo.txt
  - The calibration process can be repeated from these documents

Documentation

Does the dataset contain all documentation needed to use and understand its data without prior knowledge?

- Yes
    - All required information to understand and use the data is contained in the documentation

Is the provided documentation well organized, clear and self-consistent?

- Yes.
    - Documentation was straightforward to navigate
    - Mostly clear (see above)
    - Was self-consistent
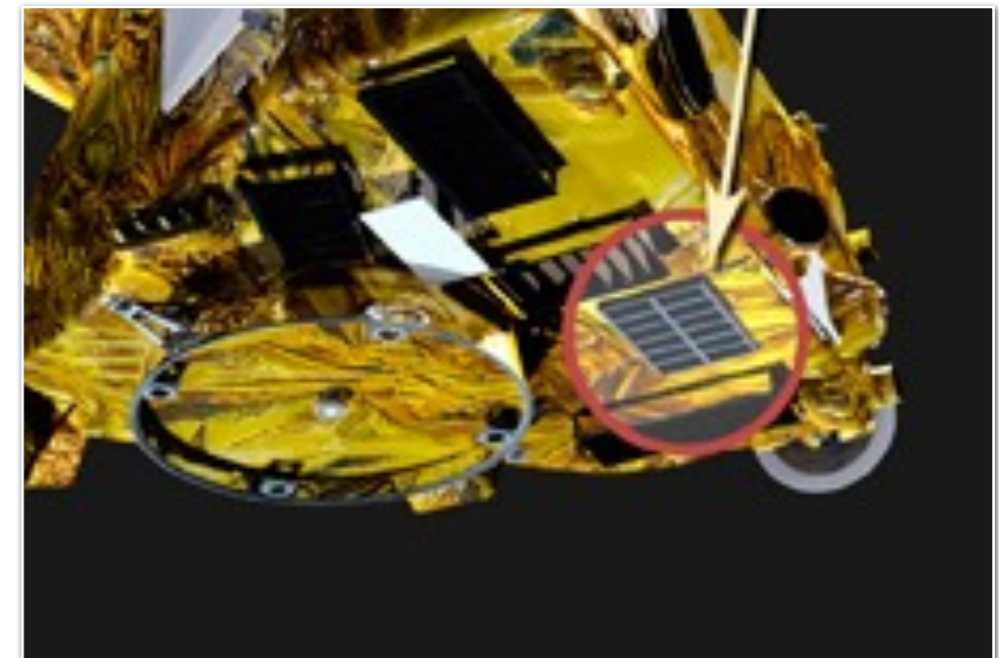
Are the descriptions and scientific content contained inside the PDS labels sufficient to understand their corresponding data products?

Yes.

Filename: kem2_raw/sdc_0574375974_0x700_eng.fit

```
No.  Name          Ver  Type         Cards  Dimensions  Format
0    PRIMARY        1 PrimaryHDU      299    ()
1    DATA           1 BinTableHDU      27    19R x 6C   [B, B, B, I, I, J]
2    HOUSEKEEPING_SDC    1 BinTableHDU    29    1R x 9C   [J, B, B, B, B, B, B, B, B]
3    HOUSEKEEPING_0X004   1 BinTableHDU    89    7R x 37C   [J, B, B, B, B, B, B, I, B, B,
B, B, B, B, B, B, B, B, B, B, B, B, B, B, B, B, B, B, B, B, B, B, B, B, B, J, B]
4    HOUSEKEEPING_0X00D   1 BinTableHDU    27    4R x 8C   [J, B, B, B, B, B, B, B]
5    HOUSEKEEPING_0X00A   1 BinTableHDU    29    3R x 5C   [J, I, I, I, I]
6    THRUSTERS      1 BinTableHDU     121    2R x 28C   [J, I, J, J, J, J, J, J, J, J, J, J, J, J, J,
J, J, J, J, J, J, J, J, J, J, J, J, J]
```

Housekeeping described in
    documentation

Not always data in Thruster flag
(maybe only used when thrusters active?)

Are the descriptions and scientific content contained inside the PDS labels sufficient to understand their corresponding data products?

Yes.

file: kem2_raw/
sdc_0574375974_0x700_eng.fit

```
XTENSION= 'BINTABLE'           / binary table extension
BITPIX  =                8 / array data type
NAXIS   =                2 / number of array dimensions
NAXIS1  =               44 / length of dimension 1
NAXIS2  =                7 / length of dimension 2
PCOUNT  =                0 / number of group parameters
GCOUNT  =                1 / number of groups
TFIELDS =               37 / number of table fields
TTYPE1  = 'MET    '
TFORM1  = 'J      '
TSCAL1  =                1
TZERO1  =       2147483648
TTYPE2  = 'CDH_SDC_HEARTBEAT'
TFORM2  = 'B      '
TTYPE3  = 'CDH_SDC_BOOT_APPL'
TFORM3  = 'B      '
TTYPE4  = 'CDH_SDC_TURN_OFF_REQ'
TFORM4  = 'B      '
TTYPE5  = 'CDH_SDC_STAT_SPARE'
TFORM5  = 'B      '
TTYPE6  = 'CDH_SDC_CMD_ACC'
TFORM6  = 'B      '
TTYPE7  = 'CDH_SDC_CMD_REJ'
TFORM7  = 'B      '
TTYPE8  = 'CDH_SDC_LAST_CMD_EXEC'
TFORM8  = 'I      '
TSCAL8  =                1
TZERO8  =            32768
TTYPE9  = 'CDH_SDC_P5_VOLT'
TFORM9  = 'B      '
TTYPE10 = 'CDH_SDC_FLASH_VOLT'
TFORM10 = 'B      '
TTYPE11 = 'CDH_SDC_P2_5_FPGA_VOLT'
TFORM11 = 'B      '
TTYPE12 = 'CDH_SDC_M5_VOLT'
```

Are the descriptions and scientific content contained inside the PDS labels sufficient to understand their corresponding data products?

Yes.

file: kem2_raw/
sdc_0574375974_0x700_eng.fit

Copy#, Channel ID, Zero Fill, Threshold, Magnitude, Timestamp

```
(0,  7, 0, 63547, 60455,   574346787)
(0,  8, 0, 63523, 61856,   574346787)
(0,  9, 0, 63542, 59362,   574346787)
(0, 11, 0, 63557, 59776,   574346787)
(0, 12, 0, 63450, 55948,   574346787)]
[(0, 13, 0, 63589, 60480,   574346787)
(0,  0, 0, 63542, 60913,   574346787)
(0,  1, 0, 63562, 62750,   574346787)
(0,  2, 0, 63537, 62670,   574346787)
(0,  4, 0, 63541, 59781,   574346787)
(0,  5, 0, 63544, 62926,   574346787)
(0,  6, 0, 63593, 61669,   574346787)
(0,  7, 0, 63547, 61757,   574346787)
(0,  8, 0, 63523, 63021,   574346787)
(0,  9, 0, 63542, 61854,   574346787)
(0, 11, 0, 63557, 58782,   574346787)
(0, 13, 0, 63589, 63064,   574346787)
(0,  9, 0, 63542, 62957,   574346787)
(0,  4, 0, 63541, 62607,   574348543)
(0,  0, 0, 63542, 63098,   574349183)
(0, 13, 0, 63589, 61956,   574354093)
(0,  4, 0, 63541, 62702,   574358283)
(0, 12, 0, 63450, 62951,   574358946)
(0, 11, 0, 63557, 63482,   574361025)]
```

Same time stamp, same channel, different magnitudes? (expected?)

Are the descriptions and scientific content contained inside the PDS labels sufficient to understand their corresponding data products?

Yes.

Filename:
sdc_0539690320_0x700_sci.fit

```
XTENSION= 'BINTABLE'          /Binary table written by
MWRFITS v1.4a
BITPIX  =                8 /Required value
NAXIS   =                2 /Required value
NAXIS1  =               82 /Number of bytes per row
NAXIS2  =               30 /Number of rows
PCOUNT  =                0 /Normally 0 (no varying arrays)
GCOUNT  =                1 /Required value
TFIELDS =               11 /Number of columns in table
COMMENT
COMMENT  *** End of mandatory fields ***
COMMENT
EXTNAME = 'CALIBRATED_DATA'   /
SDC_VER = '5.0.0   '          /
COMMENT
COMMENT  *** Column names ***
COMMENT
TTYPE1  = 'UTC_TIME '         /
TTYPE2  = 'MET      '         /
TTYPE3  = 'CHANNEL '          /
TTYPE4  = 'CHARGE  '          /
TTYPE5  = 'MASS    '          /
TTYPE6  = 'MASS_THRSH '       /
TTYPE7  = 'M_SIGPLUS '        /
TTYPE8  = 'M_SIGMINUS '       /
TTYPE9  = 'COINCIDENT_QUALITY_FLAG ' /
TTYPE10 = 'THRUSTER_QUALITY_FLAG ' /
TTYPE11 = 'IMP_VEL '          /
```

Are the descriptions and scientific content contained inside the PDS labels sufficient to understand their corresponding data products?

Yes.

Is all significant meta data included directly in the PDS labels?

Yes.

Do the labels provide all essential description of data values directly in the label, instead of deferring them to external references or documentation?

Yes.

Can the data be read programmatically using only the information contained in the PDS labels?
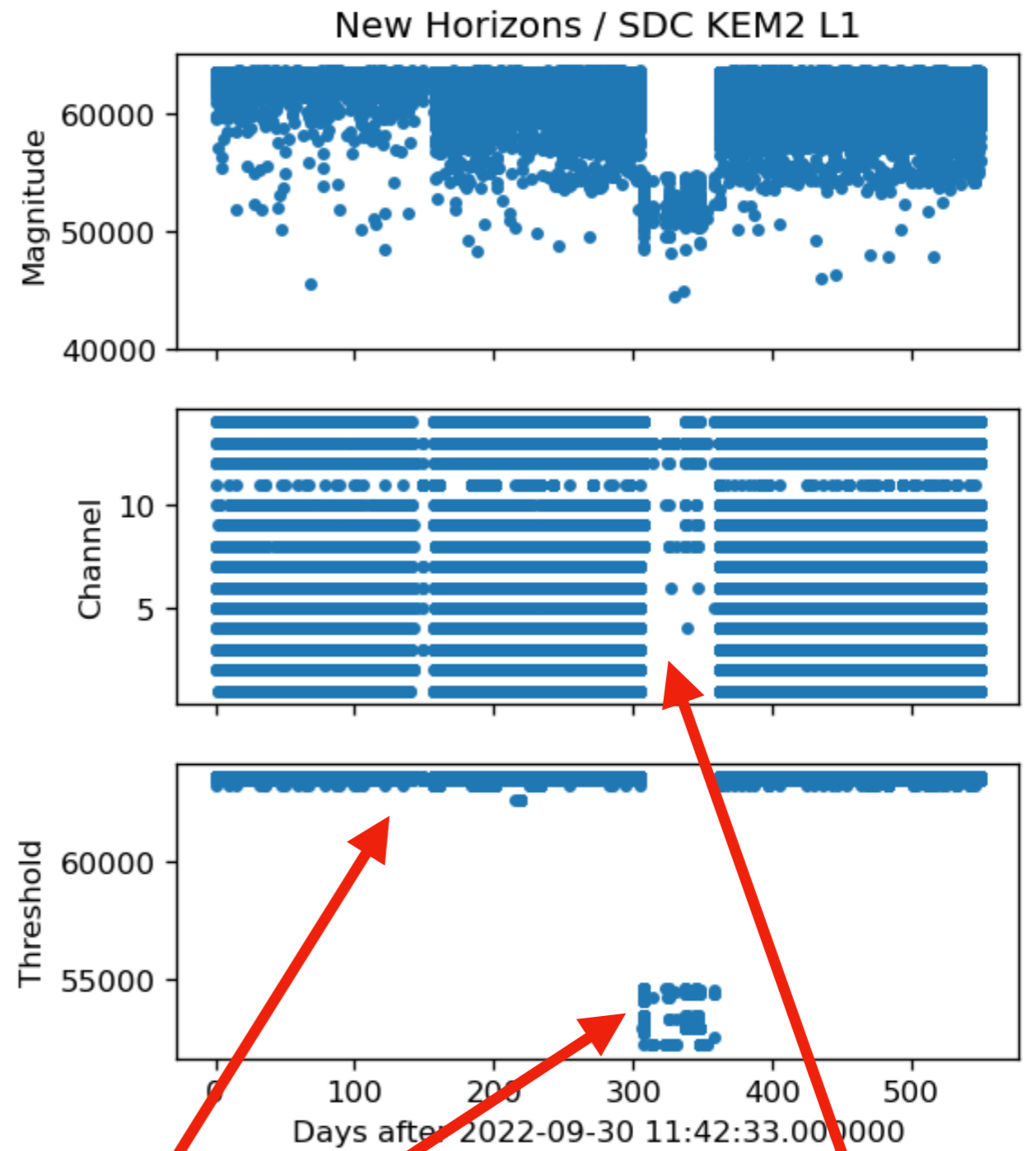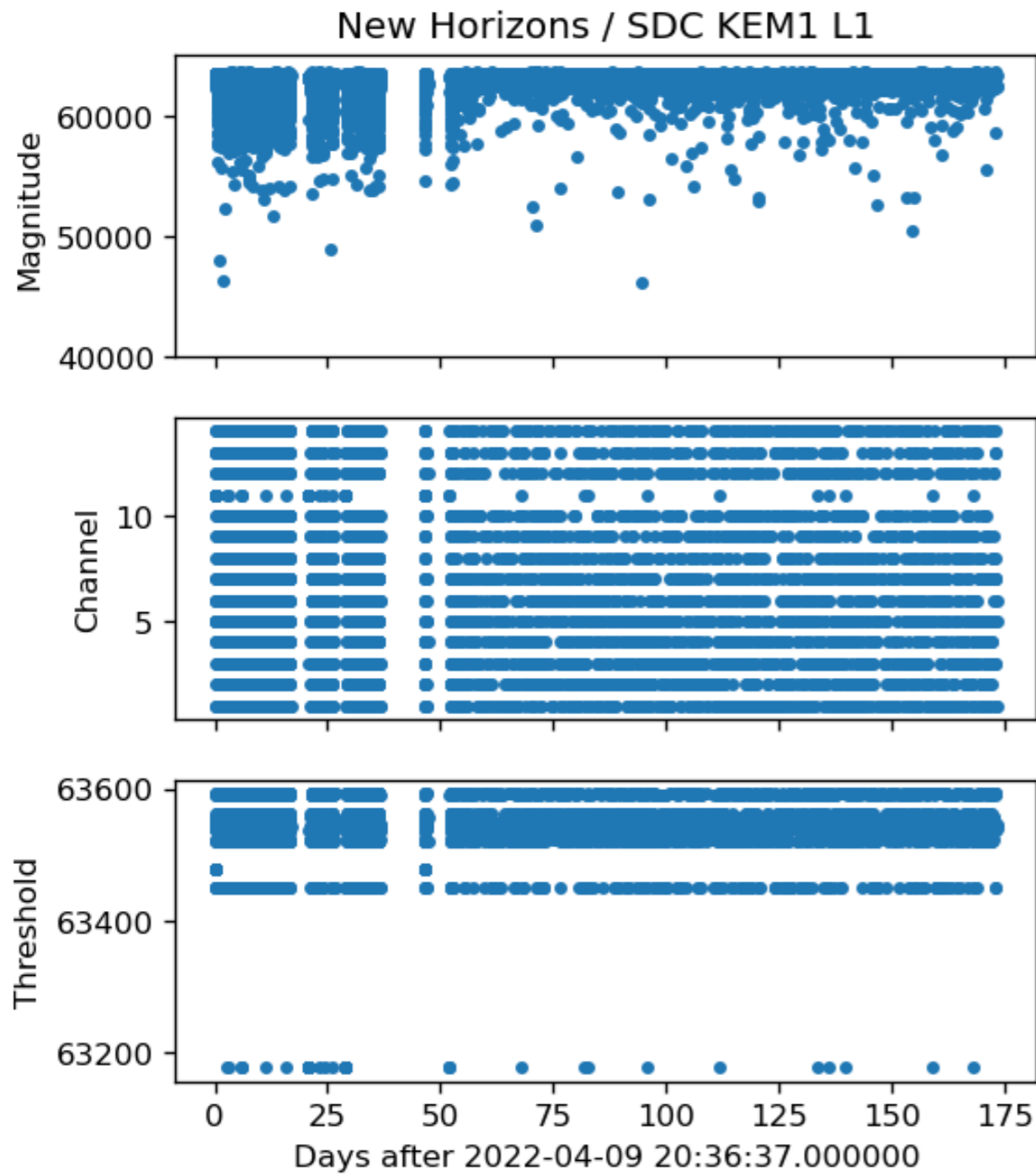
Yes.
   Used astropy packages

Data

Does the data look physically reasonable when examining it by eye or via a display tool?

Yes

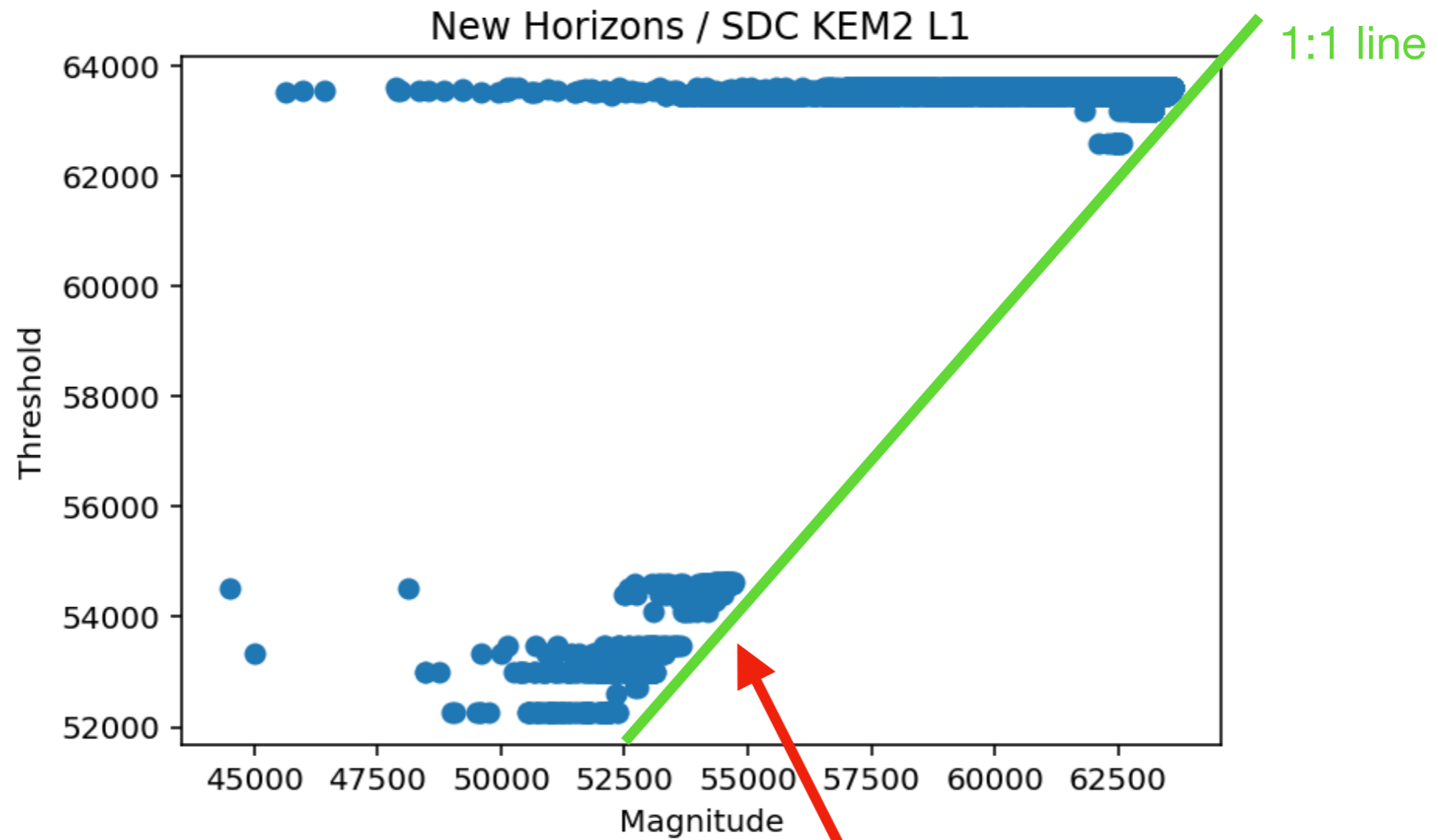When displaying the data as plots or images, are there any unexpected deviations?

Maybe. See next slides

New Horizons / SDC KEM1 L1

New Horizons / SDC KEM2 L1

All thresholds set to minimum?

Was threshold change expected?

Most hits on upper channels
(usually less counts)

New Horizons / SDC KEM2 L1

1:1 line

Double checking: all magnitudes must be <u>below</u> threshold value to be recorded?

Data

- Ch 1 - 7 see different hits than 8 - 14

- Min mass different on every channel

- Similar # valid hits on calibration channel compared to science channels?

Channel	Min Mass (g)	Total hits	Total valid hits (non-COIN)
1	2.28E-12	2160	940
2	2.37E-12	2059	827
3	2.36E-12	2106	877
4	2.28E-12	2070	819
5	2.22E-12	2137	861
6	2.36E-12	2088	872
Calibration channel 7	1.87E-12	2087	869
8	2.51E-12	1842	604
9	2.54E-12	1864	626
10	2.49E-12	1806	578
Damaged channel 11	2.78E-12	466	360
12	2.54E-12	1979	727
13	2.55E-12	2150	645
Calibration channel 14	2.16E-12	1920	663

Data

- Periodic behavior of channel 11 ?

Data
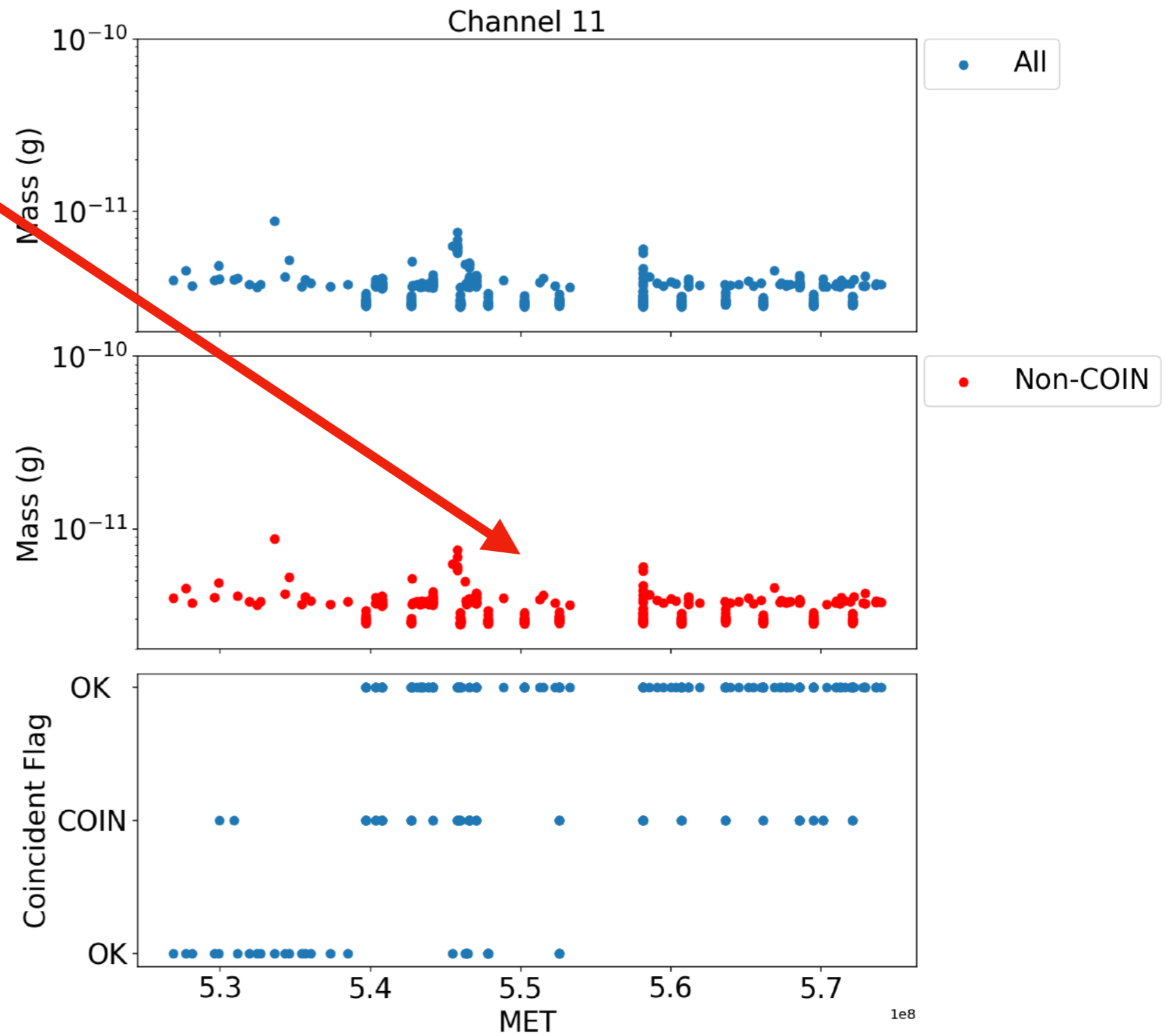
- Expected behavior?
  - filters out most high mass events