Rosetta Archive Enhancement Data Review: Report for the SREM Experiment

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Summary

Introduction

The ESA Standard Radiation Environment Monitor (SREM) provides minimum intrusive particle radiation detectors for space weather applications.

- SREM was designed to measure electrons with energies $E > 0.5$ MeV and protons with energies $E >$10 MeV.
- The SREM unit consists of three silicon diode detectors (D1, D2 and D3) in a two-detectors-head configuration.
- One system is a single silicon diode detector (D3).
- The other system uses two silicon diodes (D1/D2) one after the other.

Introduction

The SREM provides count rates.

- TC* are “total count-rate” channels
- C* coincidence channels (providing energy spectral information), S25 → pure proton channels
- S* are channels for single events
- S15 and C4 can be contaminated by electron counts

LIST OF THE SREM CHANNELS AND THE CORRESPONDING ENERGY RANGES OF DETECTED PROTONS AND ELECTRONS [3]

SREM	Proton Energy [MeV]		Electron Energy [MeV]	
Bin	E_{min}	E_{max}	E_{min}	E_{max}
TC1	27	∞	2.00	∞
S12	26	∞	2.08	∞
S13	27	∞	2.23	∞
S14	24	542	3.20	∞
S15	23	434	8.18	∞
TC2	49	∞	2.80	∞
S25	48	270	–	–
C1	43	86	–	–
C2	52	278	–	–
C3	76	450	–	–
C4	164	∞	8.10	∞
TC3	12	∞	0.80	∞
S32	12	∞	0.75	∞
S33	12	∞	1.05	∞
S34	12	∞	2.08	∞

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Introduction

The SREM provides also differential fluxes for electrons and protons.

13 energy channels for proton fluxes:
11.0- 14.0 MeV . . . 195.0-247.7 MeV

10 energy channels for electron fluxes:
0.65-0.73 MeV . . . 1.93-2.18 MeV

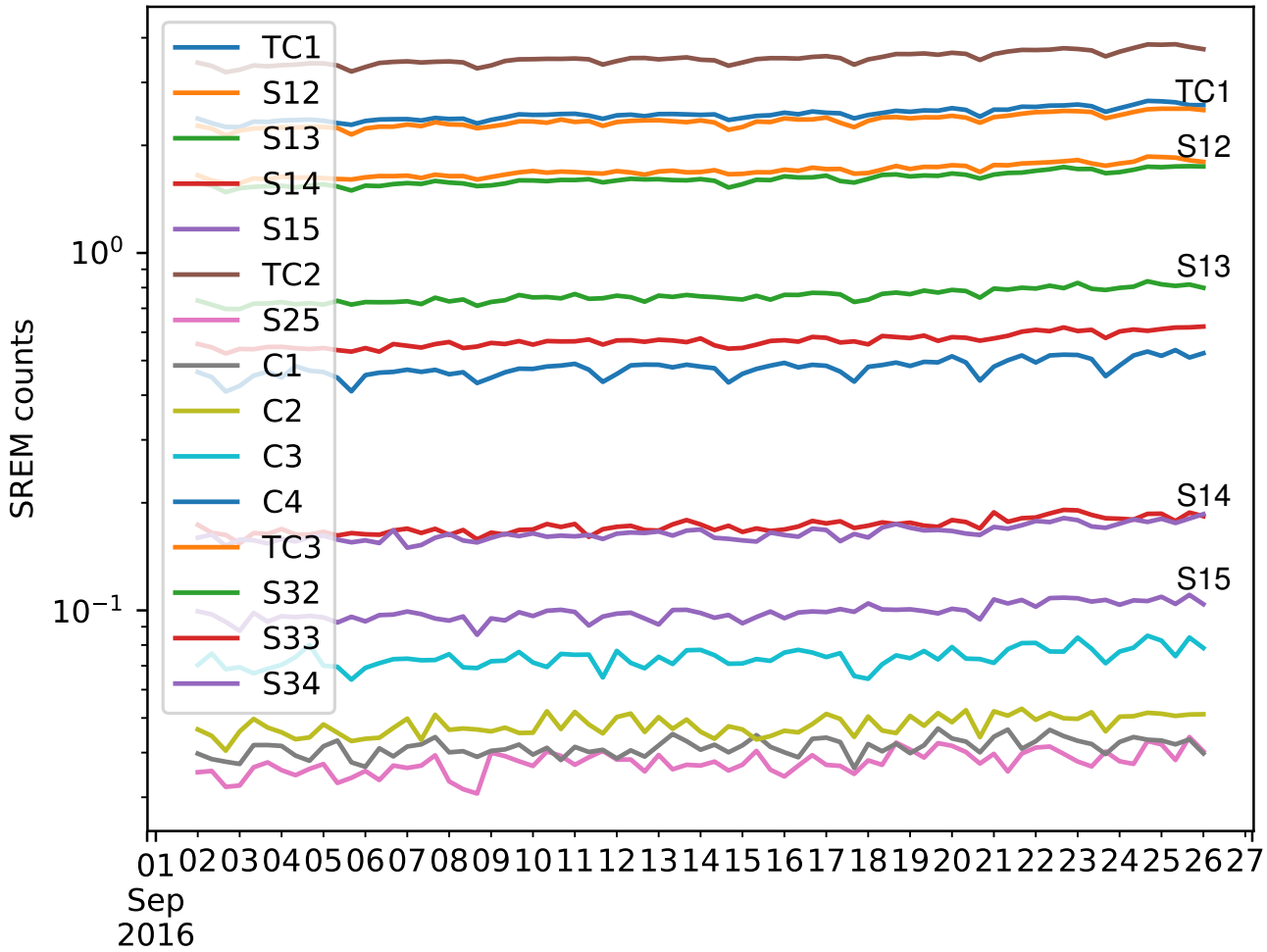
LIST OF THE SREM CHANNELS AND THE CORRESPONDING ENERGY RANGES OF DETECTED PROTONS AND ELECTRONS [3]

SREM	Proton Energy	[MeV]	Electron Energy	[MeV]
Bin	E_{min}	E_{max}	E_{min}	E_{max}
TC1	27	∞	2.00	∞
S12	26	∞	2.08	∞
S13	27	∞	2.23	∞
S14	24	542	3.20	∞
S15	23	434	8.18	∞
TC2	49	∞	2.80	∞
S25	48	270	–	–
C1	43	86	–	–
C2	52	278	–	–
C3	76	450	–	–
C4	164	∞	8.10	∞
TC3	12	∞	0.80	∞
S32	12	∞	0.75	∞
S33	12	∞	1.05	∞
S34	12	∞	2.08	∞

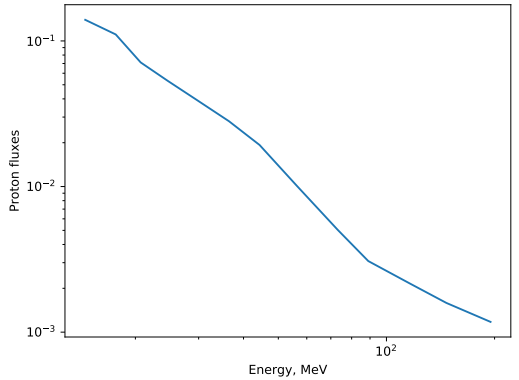
Counts

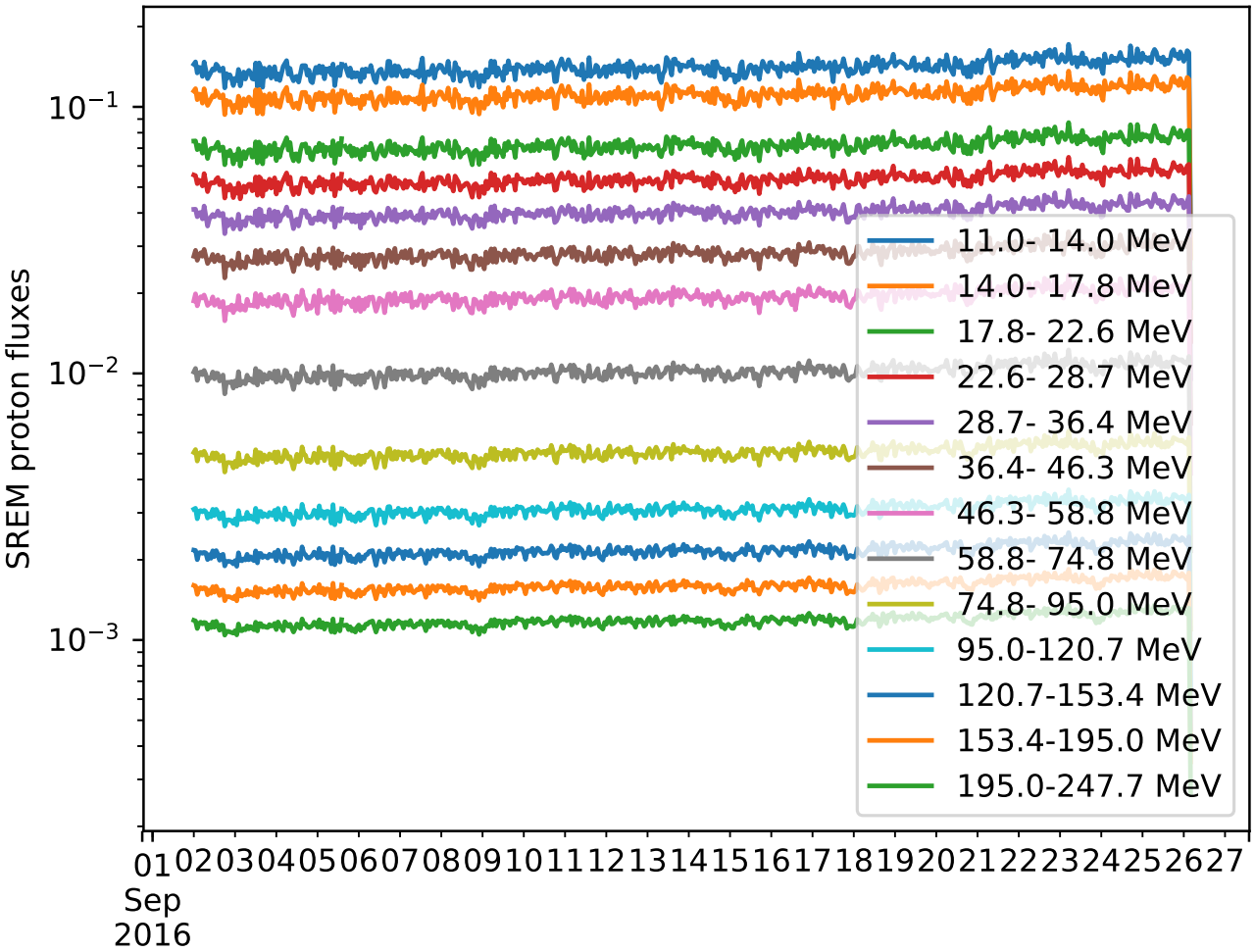
List of the SREM Channels and the Corresponding Energy Ranges of Detected Protons and Electrons [3]

SREM	Proton Energy	[MeV]	Electron Energy	[MeV]
Bin	E_{min}	E_{max}	E_{min}	E_{max}
TC1	27	∞	2.00	∞
S12	26	∞	2.08	∞
S13	27	∞	2.23	∞
S14	24	542	3.20	∞
S15	23	434	8.18	∞
TC2	49	∞	2.80	∞
S25	48	270	–	–
C1	43	86	–	–
C2	52	278	–	–
C3	76	450	–	–
C4	164	∞	8.10	∞
TC3	12	∞	0.80	∞
S32	12	∞	0.75	∞
S33	12	∞	1.05	∞
S34	12	∞	2.08	∞

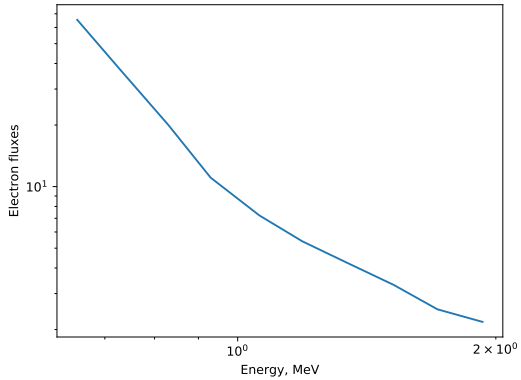


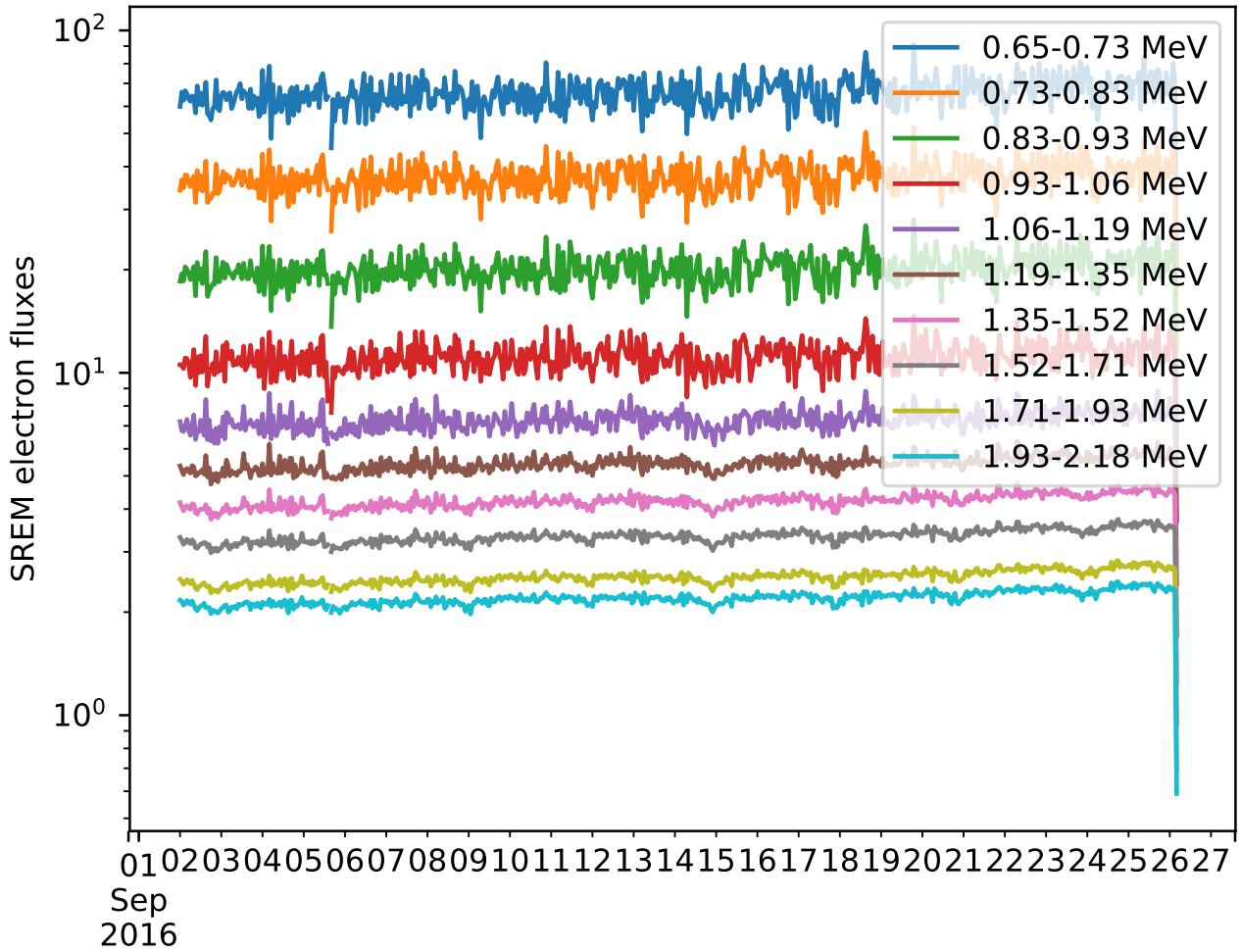
Proton fluxes





Electron fluxes





Review Item Discrepancy: minor issues

SREM-EU-EK-001 (minor)

“ data format”

- For both LEVEL = 0 and LEVEL = 2 data in TAB files, I find the data format inconvenient to read. The data are split into several, subsequently written data sets. Some of these have one column (time, quality), others have many columns, while the number of rows is the same (except for metadata). It would be much more convenient to have all of the data in one big table. In Python/Pandas, e.g., one can read such a text file with one simple command, and without having to parse the LBL file.

Recommendation: Save the data in a standard format. Consider HDF5, which is widely used and supported by all the major languages. Because it is a common standard, libraries for HDF5 I/O are easy install.

Review Item Discrepancy: minor issues

SREM-EU-EK-002 (minor)

“ name of data files”

- Raw data (CODMAC L2) in the dataset RO-C-SREM-2* have naming SREM_L0* and calibrated data in the dataset RO-C-SREM-3* (CODMAC L3) have naming SREM_L2*. I think the names of the data files should be consistent with their levels. It is unclear why there is a jump from L0 to L2, skipping L1.

Recommendation: The names of the files and their levels listed in the SREM_EAICD document in Sections 4.1.1 and 4.1.2 should be consistent.

Review Item Discrepancy: METADATA

SREM-EU-EK-004 (major)

“Timetags”

- The description of time tags is absent in both datasets.
  1) It has to be specified if the time tags are the start or middle or the end of the time interval when the particle measurements were conducted.
  2) The time step has to be specified.
  3) Time units has to be specified.

Recommendation: Add description of the time tags.

Review Item Discrepancy: METADATA

SREM-EU-EK-006 (major)

“Energy ranges for Level 3 data”

- 1) SREM_PROTON_ENERGY_TABLE should mention the dimension of the energies ("MeV"?).
  2) I do not see a consistence between energy mentioned in SREM_PROTON_ENERGY_TABLE and SREM_PROTON_LABEL_TABLE. Which energies do show values SREM_PROTON_ENERGY_TABLE? Is it the lowest energy of the energy channel, the highest energy of the energy channel or this is an effective energy of the energy channel? Some values are even out of the energy range mention in energy labels.

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Review Item Discrepancy: METADATA

SREM-EU-EK-006 (major)

“Energy ranges for Level 3 data”

- Example:
  "SREM proton energy table"
  1.4500E+01, 1.7630E+01, 2.0690E+01, 2.4620E+01, . . . , 8.9000E+01, 1.1640E+02, 1.4688E+02, **1.9490E+02**
  "SREM proton energy label table"
  11.0- 14.0 MeV, 14.0- 17.8 MeV, 17.8- 22.6 MeV, 22.6-28.7 MeV, . . . , 95.0-120.7 MeV,120.7-153.4 MeV,153.4-195.0 MeV, **195.0-247.7 MeV**

Recommendation: 1) Add dimension to the energy ranges. 2) Correct the SREM_PROTON_ENERGY_TABLE or SREM_PROTON_LABEL_TABLE, they have to be consistent.

Review Item Discrepancy: METADATA

SREM-EU-EK-008 (major)

“FILL values”

- In the METADATA it has to be specified what are the FILL values in your data set. For example, I suppose that in the raw data, the FILL Values are equal to -1.0000000E+31. For flux values, I suppose the FILL values are equal to 0.0000E+00? Or during this time the fluxes were measured as "0"? This has to be specified.

Recommendation: Specify FILL Values in the datasets

Review Item Discrepancy: METADATA

SREM-EU-EK-011 (major)

“flux units”

- The flux units are absent in the METADATA of calibrated data.

Recommendation: To add flux units.

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Review Item Discrepancy: DATA

SREM-EU-EK-009 (major)

“Calibration factors”

- I could not reproduce conversion of the fluxes back to the raw data, as the calibration factors are nowhere specified.

Recommendation: Specify the calibration factors.

Review Item Discrepancy: DATA

SREM-EU-EK-012 (major)

“values of fluxes”

- I have compared the proton fluxes at different energy channels with those measured by STEREO/HET. I see the difference in about 3 orders of magnitude in the values. I am not sure if this is just because of different flux units (STEREO/HET data have units 1/(cm^2*s*sr* MeV)) or something else.

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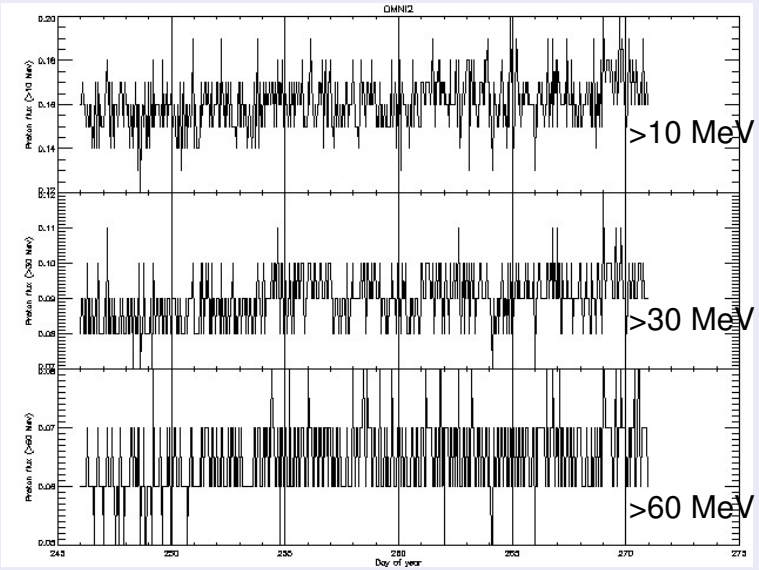
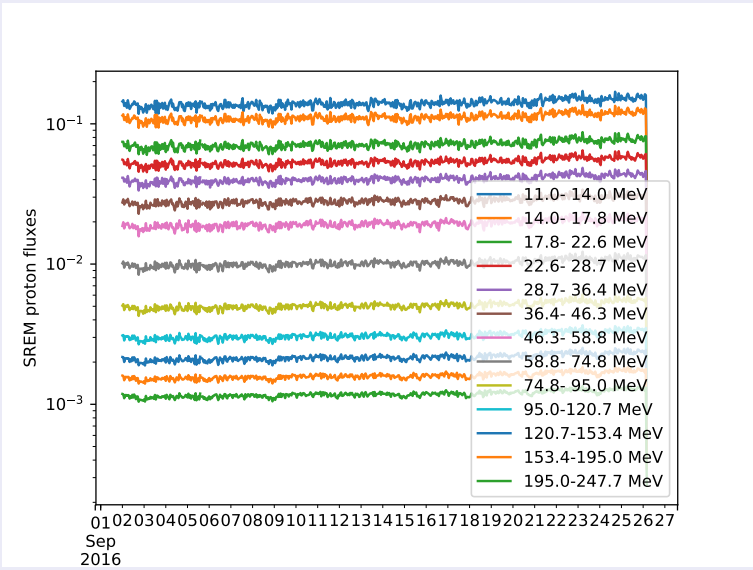
SREM-EU-EK-012 (major)

"values of fluxes"

- Proton fluxes from OMNIWeb





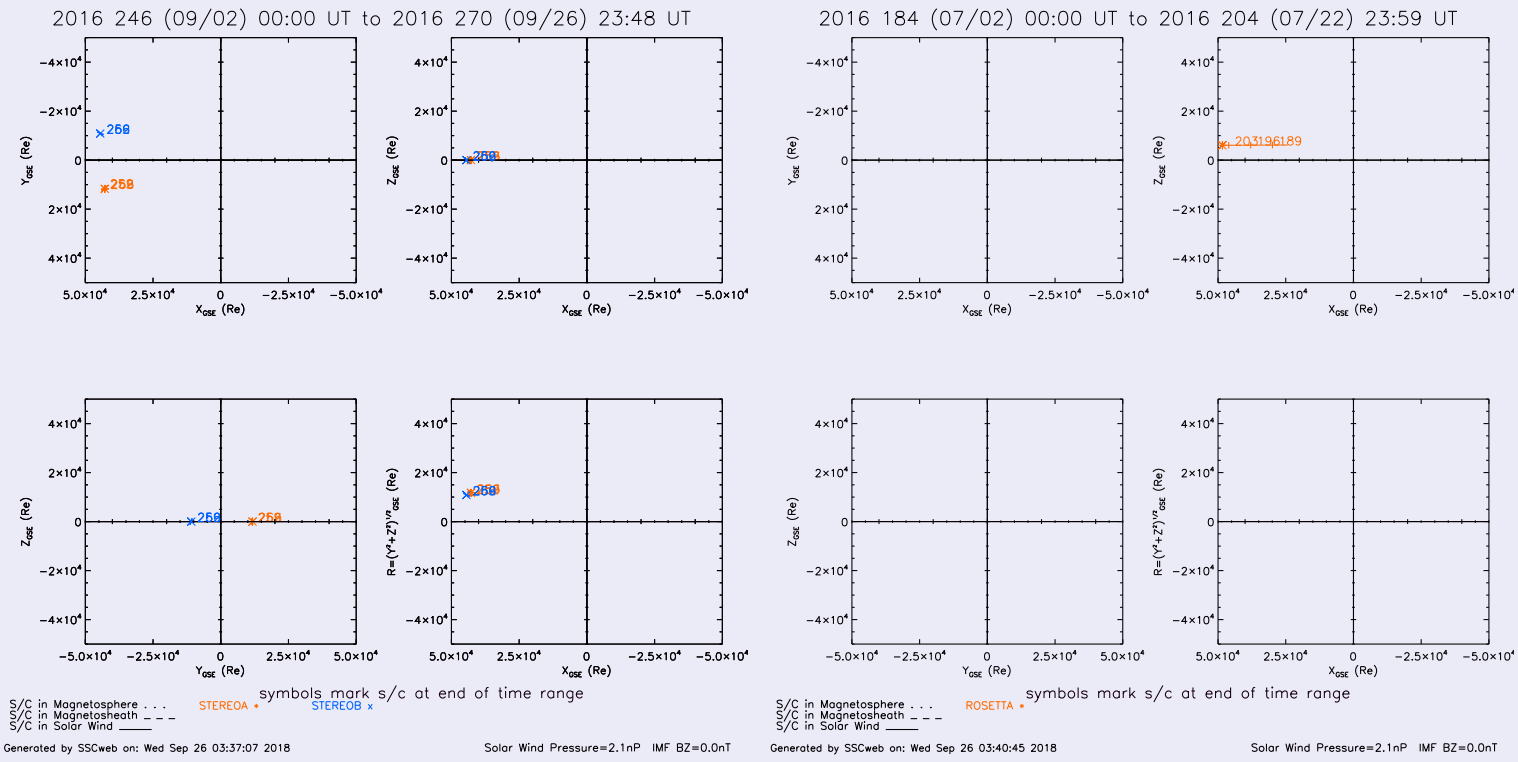
Proton fluxes 1/(cm^2 s sr)

Review Item Discrepancy

SREM-EU-EK-012 (major)

“values of fluxes”

- Location of STEREO-A/B and Rosetta

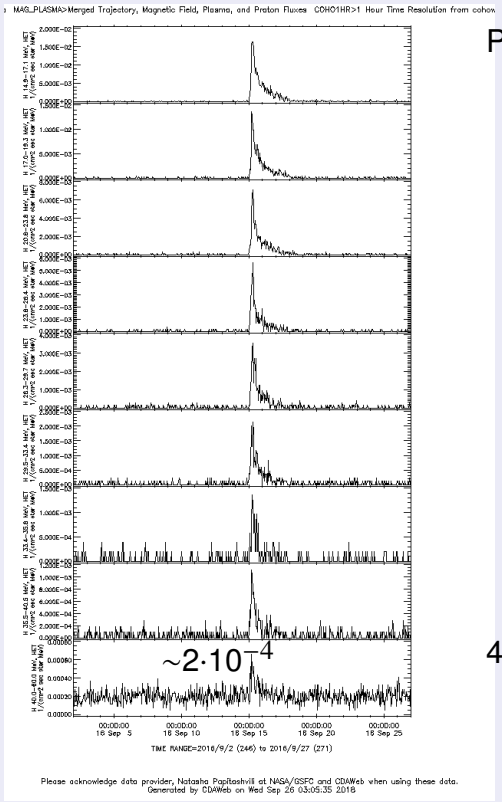


Review Item Discrepancy

SREM-EU-EK-012 (major)

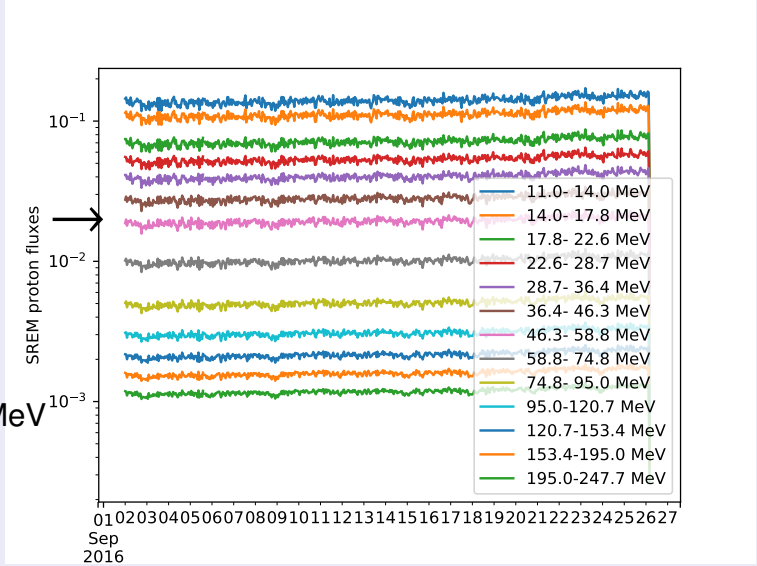
“values of fluxes”

- Proton fluxes from STEREO-A



Proton fluxes 1/(cm^2 s sr MeV)

40–80 MeV



Recommendation: To do cross-calibration with other spacecraft measurements.

Review Item Discrepancy: DATA

SREM-EU-EK-013 (major)

“missing standard deviations”

- Missing standard deviations for counts and fluxes

Recommendation: Add standard deviations for counts and fluxes

Summary

- It was exciting to learn that Rosetta has energetic particle measurements.

- The metadata of the SREM dataset have to be more specific and consistent.
- The validity of the data has to be check by cross-calibrations.