

SPARTA

two data format converters in one

Arnaud Masson

17/10/2019

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European Space Agency

Outline



1. Scope of the ESA SPace dAta foRmat TrAnslator (SPARTA)
2. Data mapping by SPARTA
3. Metadata mapping by SPARTA
4. Documentation mapping by SPARTA
5. Open access and future of SPARTA

1. Scope of the ESA SPace dAta foRmat TrAnslator (SPARTA)



SPARTA converts all science datasets for the Cluster mission, **including 3D** in testing phase

From CEF to CDF ISTP

CEF: (ascii) Cluster Exchange Format

SPARTA converts calibrated datasets from 4 Rosetta RPC plasma instruments (IES, LAP, MAG, MIP)

From PDS3 to CDF ISTP

To improve usability of planetary plasma in-situ data

1. SPace dAta foRmat TrAnslator (SPARTA)



MMS

POES THEMIS THEMIS Derived Products WIND

ACE BARREL ELFIN Lomo FAST GOES Geomagnetic Indices IUGONET MAVEN_PFP MMS OMNI

MMS Data Selection:

Start Time: 2007-03-23/00:00:00

Stop Time: 2007-03-24/00:00:00

☒ Use Single Day

Instrument Type: FGM

Probe:	Data Rate:	Level:	Data Type:
MMS 1	srvy	L2	
MMS 2	brst		
MMS 3			
MMS 4			

Clear Probe Clear Rate Clear Levels Clear Type

Data Loaded:

- Geomagnetic Indices
 - Kyoto
 - WDC
 - kyoto_dst [2007-03-23/00:00:00 to 2007-03-24/00:00:00]

Delete All Data

Done

0: Status information is displayed here.

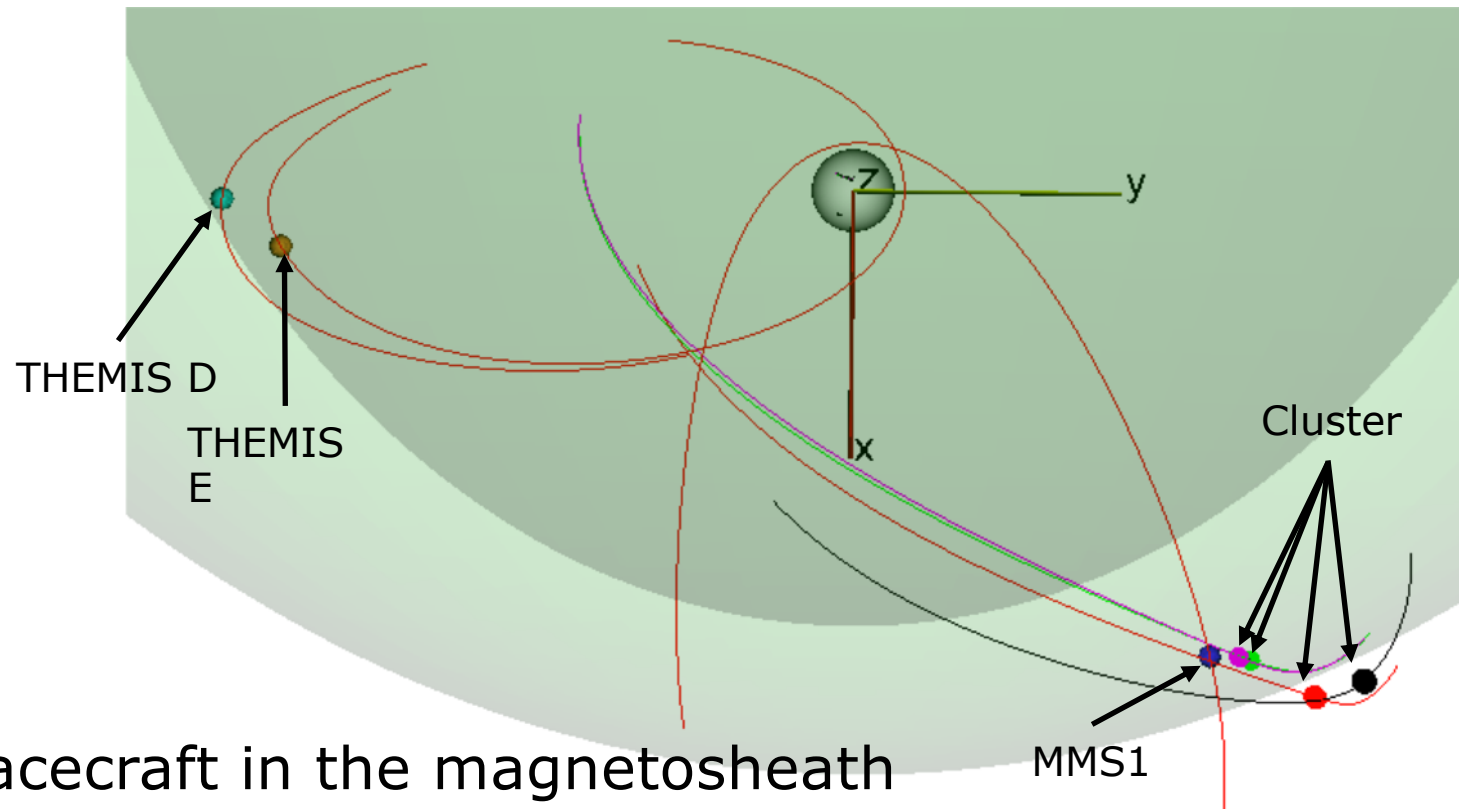
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Earth Science and Technology Division | 17/10/2019 | Slide 4



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2019/01/13 08:40



All spacecraft in the magnetosheath
Except C1 and C2 just upstream of shock

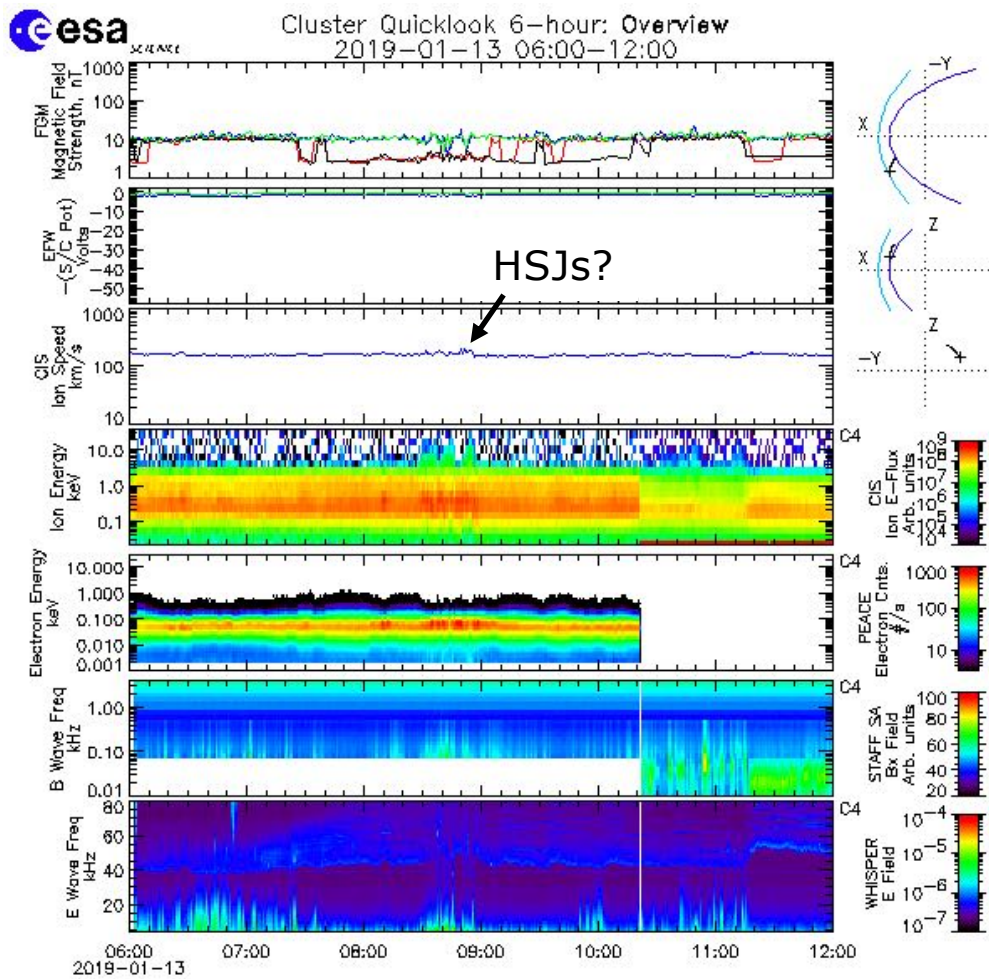
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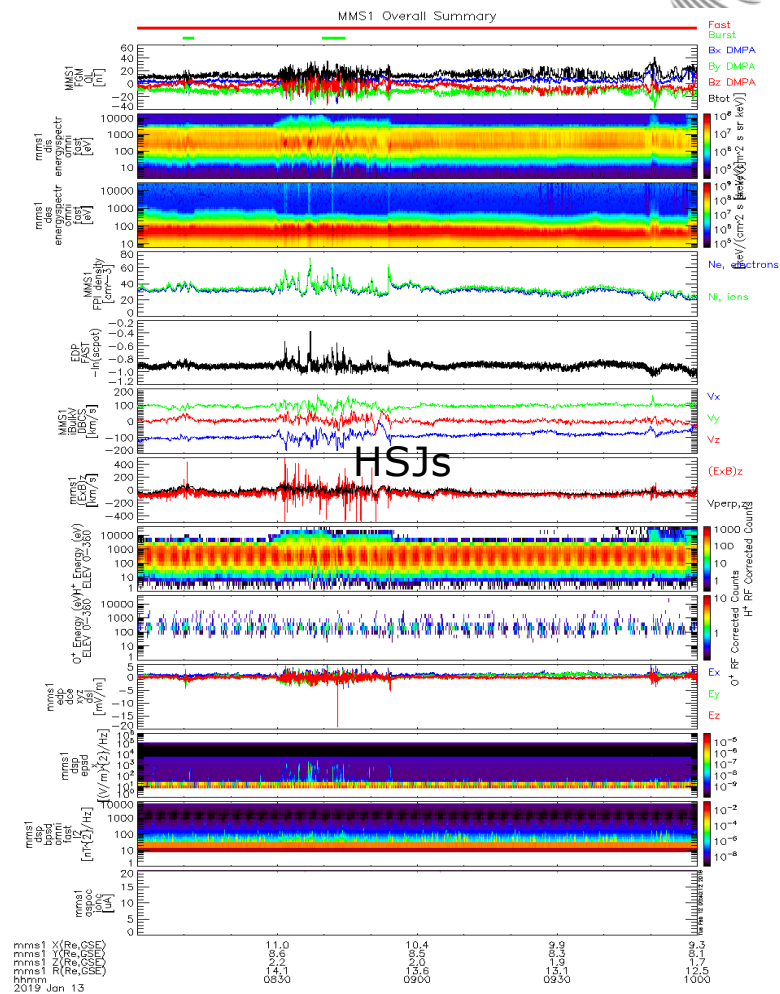
Cluster 4



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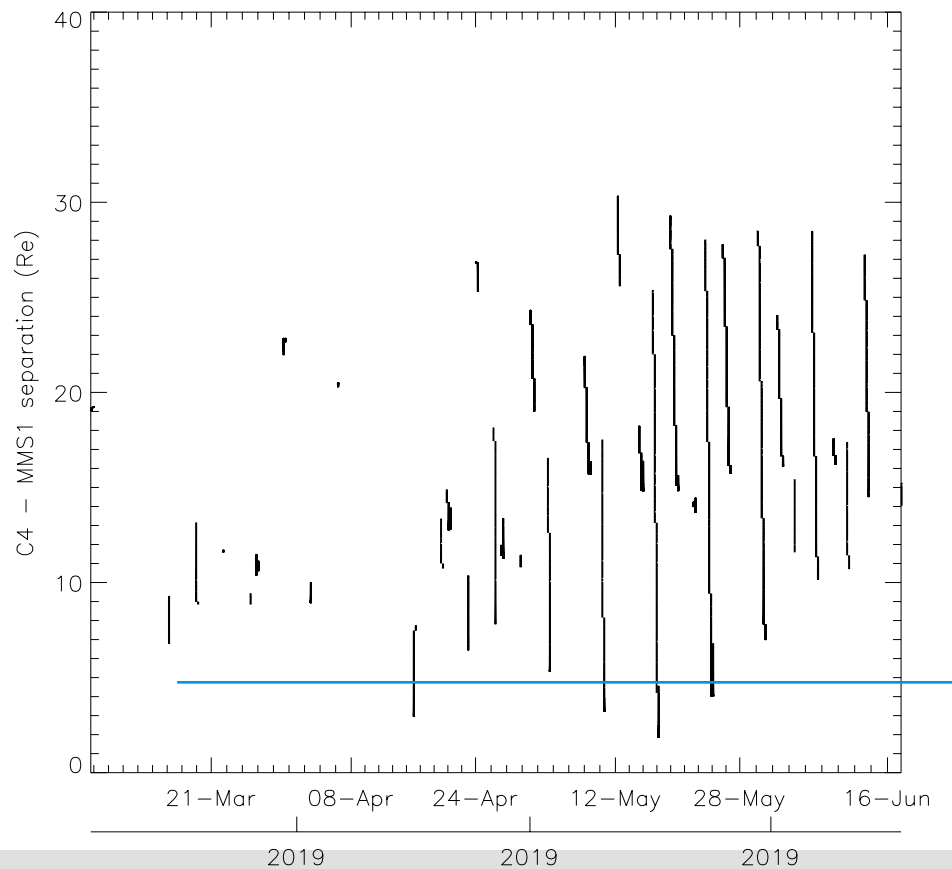
<http://www.cluster.rl.ac.uk/gadswab/>

MMS1

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Cluster-MMS-THEMIS conjunctions



Intervals when
separation C4
and MMS1 in
magnetosheath
(March-June
2019)

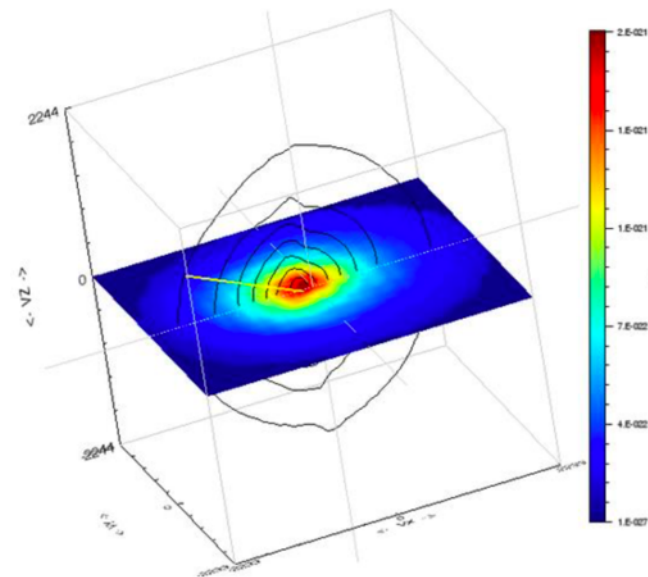
SPARTA => integration in SPEDAS



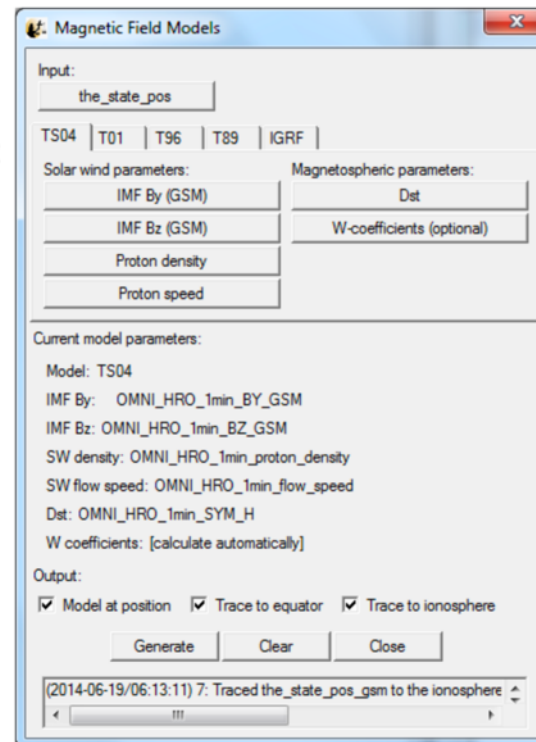
Cluster, MMS, THEMIS combined plots

3D Distribution function visualization

2015-08-15/12:50:03.923 - 12:50:57.923 (velocity)



- The GUI is now able to:
 - Model the field at the spacecraft position
 - Trace field from position to the ionosphere and equator



PDS3 to CDF ISTP conversion by SPARTA



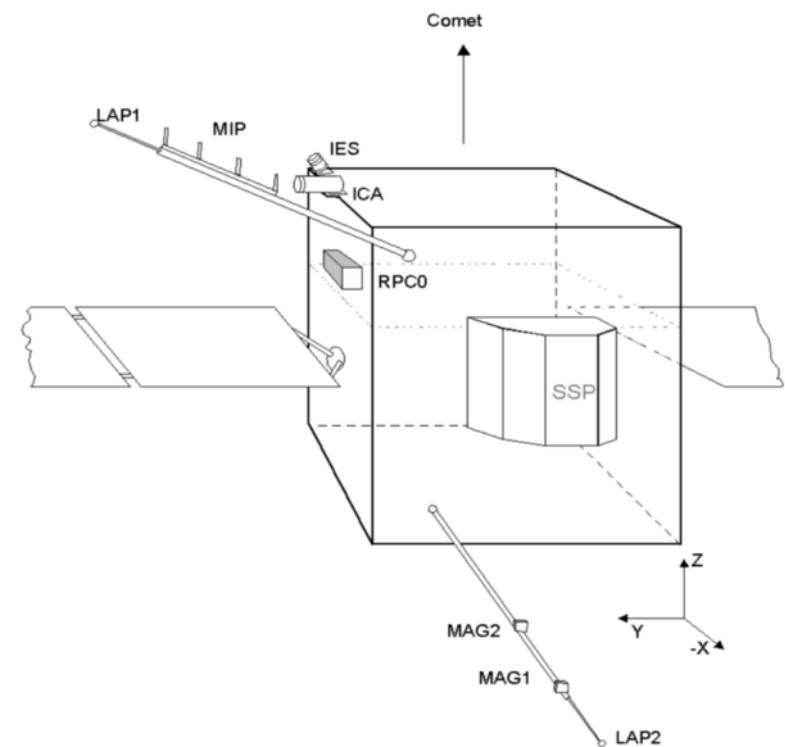
SPARTA converts calibrated datasets from
4 Rosetta RPC instruments
(IES, LAP, MAG, MIP)

Available of the PSA

MAG best calibrated datasets (CLC, CLG, CLH, CLF, CLB)
IES all calibrated L3 datasets (3D) and **L5 (moments)**

MIP **L5 datasets** derived products (Ne)
LAP **L5 datasets** (Ne, Te, Vi, Iph, Vph, Vsc...)

In red: not yet public



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MISSIONS

Rosetta

Lander

Orbiter

BepiColombo

Chandrayaan-1

ExoMars 2016

Giotto

Ground Based

Hubble

TARGETS

INSTRUMENTS

ROSINA

RPC

ICA

IES

LAP

MAG

MIP

RSI

VIRTIS (Rosetta)

INSTRUMENT TYPES

TIME

2016-09-29 00:00:00.000

2019-09-30 23:59:59.999

PROCESSING LEVEL

Level 1 || Telemetry

Level 2 || Raw

Partially Processed

Level 3 || Calibrated

Level 4 || Derived

Level 5 || Derived

Level 6 || Derived

Number of selected items: 3

Filter by string in the current page

TABLE VIEW

	Postcard	Product Identifier	Observation Start Time	Observation Stop Time	Target	Mission	Instrument	Processing Level
☒	N/A	RPCIES2016274_L3ELC_FLUX_V1	2016-09-30 00:00:52.533	2016-09-30 10:34:28.545	67P/C-G	Rosetta	RPC	3
☒	N/A	RPCIES2016274_L3ION_FLUX_V1	2016-09-30 00:00:52.533	2016-09-30 10:34:28.545	67P/C-G	Rosetta	RPC	3
☐	N/A	RPCMAG160930T0000_CLA_IB_M3	2016-09-30 00:00:23.391	2016-09-30 10:39:24.468	67P/C-G	Rosetta	RPC	3
☐	N/A	RPCMAG160930T0000_CLA_OB_M3	2016-09-30 00:00:23.391	2016-09-30 10:39:25.419	67P/C-G	Rosetta	RPC	3
☐	N/A	RPCMAG160930T0000_CLB_IB_M3	2016-09-30 00:00:23.391	2016-09-30 10:39:24.468	67P/C-G	Rosetta	RPC	3
☐	N/A	RPCMAG160930T0000_CLB_OB_M3	2016-09-30 00:00:23.391	2016-09-30 10:39:25.419	67P/C-G	Rosetta	RPC	3
☐	N/A	RPCMAG160930T0000_CLC_IB_M3	2016-09-30 00:00:23.391	2016-09-30 10:39:24.468	67P/C-G	Rosetta	RPC	3
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☐	N/A	RPCMAG160930T0000_CLA_HK	2016-09-30 00:00:20.772	2016-09-30 10:39:16.784	67P/C-G	Rosetta	RPC	3
☐	N/A	RPCMAG160929T1211_CLA_IB_M3	2016-09-29 12:11:57.425	2016-09-29 23:59:59.367	67P/C-G	Rosetta	RPC	3
☐	N/A	RPCMAG160929T1211_CLA_OB_M3	2016-09-29 12:11:57.425	2016-09-29 23:59:59.967	67P/C-G	Rosetta	RPC	3
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☐	N/A	RPCIES2016273_L3ELC_FLUX_V1	2016-09-29 00:03:00.498	2016-09-29 23:58:44.533	67P/C-G	Rosetta	RPC	3
☐	N/A	RPCIES2016273_L3ION_FLUX_V1	2016-09-29 00:03:00.498	2016-09-29 23:58:44.533	67P/C-G	Rosetta	RPC	3
☐	N/A	RPCMAG160929T0000_CLA_IB_M2	2016-09-29 00:00:59.427	2016-09-29 12:11:04.443	67P/C-G	Rosetta	RPC	3
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☐	N/A	RPCMAG160929T0000_CLA_HK	2016-09-29 00:00:20.739	2016-09-29 23:59:48.772	67P/C-G	Rosetta	RPC	3
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Items/page: 5000

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MISSIONS
Rosetta
Lander
Orbiter
BepiColombo
Chandrayaan-1
ExoMars 2016
Giotto
Ground Based
Hubble

TARGETS

INSTRUMENTS
ROSINA
RPC
ICA
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LAP
MAG
MIP
RSI
VIRTIS (Rosetta)

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☐	N/A	RPCIES2016274_L3ELC_FLUX_V1	2016-09-30 00:00:52.533	2016-09-30 10:34:28.545	67P/C-G	Rosetta	3
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☐	N/A	RPCMAG160928T0000_CLA_IB_M2	2016-09-28 00:01:09.665	2016-09-28 00:00:03.645	67P/C-G	Rosetta	3

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PRODUCTS SELECTED FOR DOWNLOAD (3)

Total size of selected Products: 236.16 Mb

Postcard	Product Identifier	Mission	Version	
N/A	RPCIES2016274_L3ELC_FLUX_V1	Rosetta	1.0	
N/A	RPCIES2016274_L3ION_FLUX_V1	Rosetta	1.0	
N/A	RPCMAG160930T0000_CLC_OB_M3	Rosetta	9.0	

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DOWNLOAD OPTIONS

Select the data format

CDF

Original Format

CDF

☐ Product documentation

☐ Mission documentation

☐ Only images

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Table with 10 columns: Product Identifier, Date, Time, Instrument, Mission, Product Name, Version, etc.

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SPARTA PDS3 to CDF ISTP compliant conversion



SPARTA is the first PDS3 to CDF ISTP converter

Goal: to offer PDS3 or CDF version of best calibrated products through PSA

Checked with SKTeditor

Validated by PItteam

Only works for 4 Rosetta RPC experiments at the moment (ICA on-going)

Will be expended to all ESA PDS3 datasets (MEX, VEX)

A scientist in the loop is needed to provide ISTP required metadata

In the process of making SPARTA open source (Oct. 2019) for datasets from other planetary missions to be converted to daily CDF ISTP compliant files

SPARTA CEF to CDF ISTP compliant conversion



Compulsory set of global attributes

- Project
- Source_name
- Discipline
- Data_type
- Descriptor
- Data_version
- Logical_file_id
- PI_name
- PI_affiliation
- TEXT
- Instrument_type
- Mission_group
- Logical_source
- Logical_source_description

Compulsory set of variable attributes

- CATDESC
- DEPEND_0
- DEPEND_i (when applicable)
- DISPLAY_TYPE
- FIELDNAM
- FILLVAL
- FORMAT/FORM_PTR
- LABLAXIS/LABL_PTR_i
- UNITS/UNIT_PTR
- VALIDMIN
- VALIDMAX
- VAR_TYPE

SPARTA CEF to CDF ISTP compliant conversion



CDF required variable attribute	CEF variable keyword
CATDESC	CATDESC
DEPEND_0	DEPEND_0
DEPEND_i	DEPEND_i
DISPLAY_TYPE	Not available but straightforward to implement
FIELDNAM	FIELDNAM
FILLVAL	FILLVAL
FORMAT	VALUE_TYPE and SIGNIFICANT_DIGITS
LABLAXIS	LABLAXIS
LABL_PTR_1	LABEL_1 for data of the following form: •1D time_series •2D spectrogram Also needed for 1D and 2D support_data without a LABLAXIS
UNITS	UNITS
VALIDMIN	Either extracted from the documentation or interacted with the PI team, or calculated on the fly
VALIDMAX	Like VALIDMIN
VAR_TYPE	PARAMETER_TYPE but any entry shall be in lower case (first letter is upper case in VAR_TYPE); see section 5.1

Cluster File naming: ISTP standard

Formats that currently accepted:

Source_datatype_descriptor_yyyymmdd_vxx (xx=01, 02, etc.)

Source_descriptor_datatype_yyyymmdd_vxx

Where the "Source_descriptor_datatype" portion of the file name often has addition underscores and dashes, e.g.

mms1_mec_brst_l2_ephts04d, mms1_scm_brst_l2_schb, rbsp-a_hfr-waveform_emfisis-l2

Then additional variants for the time and version portions of the file name:

yyydoy_vxx (ISIS)

yyyymmddTss_vxxx.yyy.zzz (RBSP - "X.Y.Z-R")

yyyymmddhhmmss_vxxx.yyy.zzz (MMS followed RBSP's versioning)

Where the vxxx.yyy.zzz = X is the major (interface) number, Y is the minor (quality number), Z is the revision number and R is an optional release number, e.g. "v1.1.1", "v1.2.1", v2.2.1-100"

Cluster File naming: non-compliance with ISTP standard



CDF Regular (CEF converted into CDF files with no ISTP compliance)
dataset_ID__startdate_starttime_enddate_endtime_version.cdf

CDF ISTP compliant
dataset_ID__startdateTstarttime_enddateTendtime_version.cdfversion.istp.cdf

where dataset_ID can be decomposed as
Spacecraft_DataType_Instrument_dataset
and cdfversion a two digits number corresponding the to CDF version of the file, for instance

C3_CP_ASP_IONC__20010901T000000_20010906T000000_V051020.37.istp.cdf

Cluster row majority possible?

Rational for column majority for CDF ISTP?

Could row majority be accepted as ISTP compliant?

BACKUP SLIDES

1. Why SPARTA?



Rosetta RPCIES 3D electron differential energy flux daily TAB file within a PDS3 dataset

File Path: C:\Documents\Rosetta_Science_Land\SPARTA\RosettaRPC\RPCIES\RO-C-APCIES-3-PRD-V1.0\2014\10\23\RPCIES2014296_L3BLC_FLUX_V1.TAB

	SCeventTime(UTC)	Mode	StartingStep	EndingStep	StartingStep	EndingStep	A0B0	A0B1	A0B2	A0B3	A0B4	A0B5	A0B6	A0B7	A0B8	A0B9	A0B10	A0B11	A0B12	A0B13	A0B14	A0B15	CycleStart	qityflag
1	2014-296700-03:45:509	0B33	0	1	0	1	3.3276E+12	2.4960E+12	2.4960E+12	1.8209E+12	1.8209E+12	2.8562E+12	2.8562E+12	3.2290E+12	3.2290E+12	1.8978E+12	-4.0000E+00	4.2370E+12	4.2370E+12	4.8707E+12	4.8707E+12	256	00000	
2	2014-296700-03:45:509	0B33	0	1	2	3	2.5020E+12	1.9430E+12	1.9430E+12	5.5318E+11	5.5318E+11	1.2872E+12	1.2872E+12	2.4817E+12	2.4817E+12	1.4508E+12	-4.0000E+00	4.7990E+12	4.7990E+12	2.3080E+12	2.3080E+12	256	00000	
3	2014-296700-03:45:509	0B33	0	1	4	5	2.1897E+12	2.1897E+12	2.1897E+12	7.0085E+11	7.0085E+11	1.8204E+12	1.8204E+12	2.3610E+12	2.3610E+12	2.8796E+12	-4.0000E+00	4.8255E+12	4.8255E+12	2.5196E+12	2.5196E+12	256	00000	
4	2014-296700-03:45:509	0B33	0	1	6	7	1.8793E+12	1.3094E+12	1.3094E+12	6.7008E+11	6.7008E+11	9.4877E+11	9.4877E+11	2.3950E+12	2.3950E+12	1.8288E+12	-4.0000E+00	3.5451E+12	3.5451E+12	2.2636E+12	2.2636E+12	256	00000	
5	2014-296700-03:45:509	0B33	0	1	8	9	1.8335E+12	1.8607E+12	1.8607E+12	6.2628E+11	6.2628E+11	8.9307E+11	8.9307E+11	2.2800E+12	2.2800E+12	1.2740E+12	-4.0000E+00	2.7097E+12	2.7097E+12	2.1882E+12	2.1882E+12	256	00000	
6	2014-296700-03:45:509	0B33	0	10	11	11	1.8005E+12	1.7781E+12	1.7781E+12	6.7081E+11	6.7081E+11	9.3795E+11	9.3795E+11	2.8680E+12	2.8680E+12	5.9237E+11	-4.0000E+00	3.8400E+12	3.8400E+12	2.1356E+12	2.1356E+12	256	00000	
7	2014-296700-03:45:509	0B33	0	1	12	13	1.7820E+12	1.6639E+12	1.6639E+12	5.9280E+11	5.9280E+11	1.8092E+12	1.8092E+12	2.5631E+12	2.5631E+12	1.8895E+12	-4.0000E+00	3.2820E+12	3.2820E+12	1.6521E+12	1.6521E+12	256	00000	
8	2014-296700-03:45:509	0B33	0	1	14	15	2.0796E+12	1.6432E+12	1.6432E+12	5.6368E+11	5.6368E+11	8.8988E+11	8.8988E+11	2.3925E+12	2.3925E+12	1.7444E+12	-4.0000E+00	2.9021E+12	2.9021E+12	1.6431E+12	1.6431E+12	256	00000	
9	2014-296700-03:45:509	0B33	2	3	0	1	1.8717E+13	1.2618E+13	1.2618E+13	1.8862E+13	1.8862E+13	1.4438E+13	1.4438E+13	7.4433E+12	7.4433E+12	2.7871E+12	-4.0000E+00	3.3885E+13	3.3885E+13	1.7883E+13	1.7883E+13	256	00000	
10	2014-296700-03:45:509	0B33	2	3	2	3	7.8059E+12	6.7479E+12	6.7479E+12	3.8381E+12	3.8381E+12	4.4736E+12	4.4736E+12	7.8208E+12	7.8208E+12	3.5878E+12	-4.0000E+00	3.3412E+13	3.3412E+13	7.4228E+12	7.4228E+12	256	00000	
11	2014-296700-03:45:509	0B33	2	3	4	5	7.3748E+12	6.5545E+12	6.5545E+12	5.5445E+12	5.5445E+12	9.1679E+12	9.1679E+12	5.5400E+12	5.5400E+12	3.6778E+12	-4.0000E+00	3.2813E+13	3.2813E+13	5.7688E+12	5.7688E+12	256	00000	
12	2014-296700-03:45:509	0B33	2	3	6	7	7.1888E+12	5.7721E+12	5.7721E+12	5.5048E+12	5.5048E+12	7.8123E+12	7.8123E+12	4.6983E+12	4.6983E+12	4.2005E+12	-4.0000E+00	2.1842E+13	2.1842E+13	5.2188E+12	5.2188E+12	256	00000	
13	2014-296700-03:45:509	0B33	2	3	8	9	5.6116E+12	5.5005E+12	5.5005E+12	5.5005E+12	5.5005E+12	5.5516E+12	5.5516E+12	4.1378E+12	4.1378E+12	2.7796E+12	-4.0000E+00	1.9584E+13	1.9584E+13	5.5415E+12	5.5415E+12	256	00000	
14	2014-296700-03:45:509	0B33	2	3	10	11	5.1382E+12	5.1338E+12	5.1338E+12	5.1338E+12	5.1338E+12	5.5788E+12	5.5788E+12	4.1825E+12	4.1825E+12	1.8884E+12	-4.0000E+00	4.8278E+12	4.8278E+12	4.8278E+12	4.8278E+12	256	00000	
15	2014-296700-03:45:509	0B33	2	3	12	13	5.3918E+12	5.1888E+12	5.1888E+12	5.3613E+12	5.3613E+12	4.9678E+12	4.9678E+12	4.1461E+12	4.1461E+12	1.6886E+12	-4.0000E+00	1.6788E+12	1.6788E+12	4.7384E+12	4.7384E+12	256	00000	
16	2014-296700-03:45:509	0B33	2	3	14	15	6.4817E+12	5.8977E+12	5.8977E+12	5.3663E+12	5.3663E+12	5.6367E+12	5.6367E+12	4.5244E+12	4.5244E+12	2.7588E+12	-4.0000E+00	1.6833E+13	1.6833E+13	4.3954E+12	4.3954E+12	256	00000	
17	2014-296700-03:45:509	0B33	4	5	0	1	1.8893E+13	1.6663E+13	1.6663E+13	1.4053E+13	1.4053E+13	1.8834E+13	1.8834E+13	8.8613E+12	8.8613E+12	3.2634E+12	-4.0000E+00	6.1968E+13	6.1968E+13	1.6586E+13	1.6586E+13	256	00000	
18	2014-296700-03:45:509	0B33	4	5	2	3	1.3276E+13	1.2288E+13	1.2288E+13	8.3953E+12	8.3953E+12	1.4237E+13	1.4237E+13	8.5816E+12	8.5816E+12	4.9516E+12	-4.0000E+00	5.7687E+13	5.7687E+13	8.8832E+12	8.8832E+12	256	00000	
19	2014-296700-03:45:509	0B33	4	5	4	5	1.1680E+13	1.8102E+13	1.8102E+13	1.8102E+13	1.8102E+13	1.4889E+13	1.4889E+13	7.8168E+12	7.8168E+12	7.8709E+12	-4.0000E+00	4.4946E+13	4.4946E+13	9.4341E+12	9.4341E+12	256	00000	
20	2014-296700-03:45:509	0B33	4	5	6	7	1.1154E+13	1.8017E+13	1.8017E+13	1.1894E+13	1.1894E+13	1.8287E+13	1.8287E+13	8.8895E+12	8.8895E+12	5.8158E+12	-4.0000E+00	3.2273E+13	3.2273E+13	8.4756E+12	8.4756E+12	256	00000	
21	2014-296700-03:45:509	0B33	4	5	8	9	9.8842E+12	9.7888E+12	9.7888E+12	9.7888E+12	9.7888E+12	1.0748E+13	1.0748E+13	8.8989E+12	8.8989E+12	5.8158E+12	-4.0000E+00	3.5985E+13	3.5985E+13	8.3798E+12	8.3798E+12	256	00000	
22	2014-296700-03:45:509	0B33	4	5	10	11	9.2788E+12	8.9788E+12	8.9788E+12	9.8522E+12	9.8522E+12	1.8857E+13	1.8857E+13	7.1452E+12	7.1452E+12	4.4392E+12	-4.0000E+00	1.4874E+13	1.4874E+13	8.8916E+12	8.8916E+12	256	00000	
23	2014-296700-03:45:509	0B33	4	5	12	13	9.8311E+12	9.6867E+12	9.6867E+12	1.8129E+13	1.8129E+13	9.8812E+12	9.8812E+12	8.1438E+12	8.1438E+12	5.8147E+12	-4.0000E+00	3.8485E+13	3.8485E+13	7.7853E+12	7.7853E+12	256	00000	
24	2014-296700-03:45:509	0B33	4	5	14	15	9.7236E+12	9.3752E+12	9.3752E+12	1.8208E+13	1.8208E+13	1.8998E+13	1.8998E+13	8.2974E+12	8.2974E+12	4.9814E+12	-4.0000E+00	3.4173E+13	3.4173E+13	7.5797E+12	7.5797E+12	256	00000	
25	2014-296700-03:45:509	0B33	6	7	0	1	1.7575E+13	1.7575E+13	1.7575E+13	1.6021E+13	1.6021E+13	2.2493E+13	2.2493E+13	9.7847E+12	9.7847E+12	4.8161E+12	-4.0000E+00	7.4083E+13	7.4083E+13	2.6984E+13	2.6984E+13	256	00000	
26	2014-296700-03:45:509	0B33	6	7	2	3	1.8335E+13	1.6295E+13	1.6295E+13	1.1785E+13	1.1785E+13	1.9998E+13	1.9998E+13	1.1564E+13	1.1564E+13	7.5648E+12	-4.0000E+00	6.1749E+13	6.1749E+13	1.2168E+13	1.2168E+13	256	00000	
27	2014-296700-03:45:509	0B33	6	7	4	5	1.3886E+13	1.1788E+13	1.1788E+13	1.3456E+13	1.3456E+13	1.9422E+13	1.9422E+13	1.8719E+13	1.8719E+13	1.8708E+13	-4.0000E+00	5.9836E+13	5.9836E+13	1.1498E+13	1.1498E+13	256	00000	
28	2014-296700-03:45:509	0B33	6	7	6	7	1.4286E+13	1.3386E+13	1.3386E+13	1.3543E+13	1.3543E+13	1.1888E+13	1.1888E+13	1.1270E+13	1.1270E+13	1.1965E+13	-4.0000E+00	5.9125E+13	5.9125E+13	1.1874E+13	1.1874E+13	256	00000	
29	2014-296700-03:45:509	0B33	6	7	8	9	1.2386E+13	1.2386E+13	1.2386E+13	1.1398E+13	1.1398E+13	1.3875E+13	1.3875E+13	1.8279E+13	1.8279E+13	9.2997E+12	-4.0000E+00	3.9864E+13	3.9864E+13	1.8538E+13	1.8538E+13	256	00000	
30	2014-296700-03:45:509	0B33	6	7	10	11	1.8822E+13	1.8914E+13	1.8914E+13	1.8914E+13	1.8914E+13	1.2372E+13	1.2372E+13	9.9418E+12	9.9418E+12	6.3746E+12	-4.0000E+00	3.4188E+13	3.4188E+13	1.4312E+13	1.4312E+13	256	00000	

Can you see anything???



SCEventTime(UTC),	Mode,	StartEngStep,	EndEngStep,	StartAngStep,	EndAngStep,	Az00,
2014-296T00:03:45.569,	0833,	0,	1,	0,	1,	3.3278E+12,
2014-296T00:03:45.569,	0833,	0,	1,	2,	3,	2.5026E+12,
2014-296T00:03:45.569,	0833,	0,	1,	4,	5,	2.1897E+12,
2014-296T00:03:45.569,	0833,	0,	1,	6,	7,	1.8793E+12,
2014-296T00:03:45.569,	0833,	0,	1,	8,	9,	1.8332E+12,
2014-296T00:03:45.569,	0833,	0,	1,	10,	11,	1.8005E+12,
2014-296T00:03:45.569,	0833,	0,	1,	12,	13,	1.7828E+12,
2014-296T00:03:45.569,	0833,	0,	1,	14,	15,	2.0704E+12,
2014-296T00:03:45.569,	0833,	2,	3,	0,	1,	1.0717E+13,
2014-296T00:03:45.569,	0833,	2,	3,	2,	3,	7.8659E+12,
2014-296T00:03:45.569,	0833,	2,	3,	4,	5,	7.3740E+12,
2014-296T00:03:45.569,	0833,	2,	3,	6,	7,	7.1988E+12,
2014-296T00:03:45.569,	0833,	2,	3,	8,	9,	5.6116E+12,
2014-296T00:03:45.569,	0833,	2,	3,	10,	11,	5.1382E+12,
2014-296T00:03:45.569,	0833,	2,	3,	12,	13,	5.3910E+12,
2014-296T00:03:45.569,	0833,	2,	3,	14,	15,	6.4817E+12,
2014-296T00:03:45.569,	0833,	4,	5,	0,	1,	1.8035E+13,
2014-296T00:03:45.569,	0833,	4,	5,	2,	3,	1.3279E+13,
2014-296T00:03:45.569,	0833,	4,	5,	4,	5,	1.1609E+13,
2014-296T00:03:45.569,	0833,	4,	5,	6,	7,	1.1154E+13,
2014-296T00:03:45.569,	0833,	4,	5,	8,	9,	9.8042E+12,
2014-296T00:03:45.569,	0833,	4,	5,	10,	11,	9.2788E+12,
2014-296T00:03:45.569,	0833,	4,	5,	12,	13,	9.0311E+12,
2014-296T00:03:45.569,	0833,	4,	5,	14,	15,	9.7253E+12,
2014-296T00:03:45.569,	0833,	6,	7,	0,	1,	1.7575E+13,
2014-296T00:03:45.569,	0833,	6,	7,	2,	3,	1.8335E+13,
2014-296T00:03:45.569,	0833,	6,	7,	4,	5,	1.3830E+13,
2014-296T00:03:45.569,	0833,	6,	7,	6,	7,	1.4206E+13,
2014-296T00:03:45.569,	0833,	6,	7,	8,	9,	1.2306E+13,
2014-296T00:03:45.569,	0833,	6,	7,	10,	11,	1.0822E+13,

Rosetta RPCIES: 3D electron differential energy flux data content (TAB), on 23-10-2014

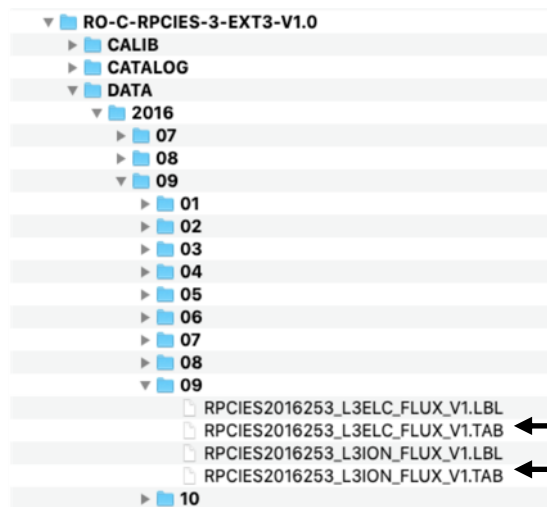
ESA UNCLASSIFIED - For Official Use

Arnaud Masson | 3rd IHDEA meetng, near GSFC | 17/10/2019 | Slide 23

2. SPARTA data mapping



Daily PDS3 TAB file content mapped to the variable Data_3D_DEFlux

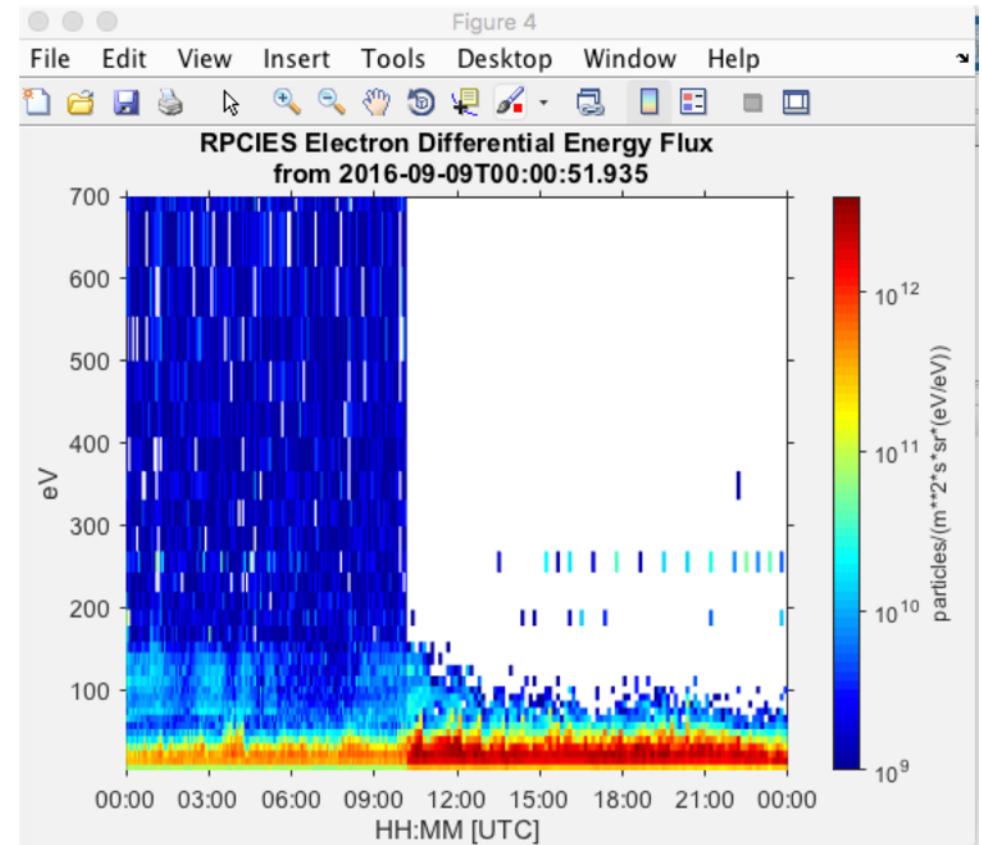


Diff. energy flux
Electrons data
Ions data

For each day, two CDF files are generated

Rosetta_RPCIES_l3elc_flux_20160909_V1.0.cdf
Rosetta_RPCIES_l3ion_flux_20160909_V1.0.cdf

Best resolution fixed size matrix to cope with mode changes
16 azimuth x 16 elevation x 128 energies x Nb of time steps
16 azimuth x 16 elevation x 128 energies x Nb of time steps



3. SPARTA metadata mapping



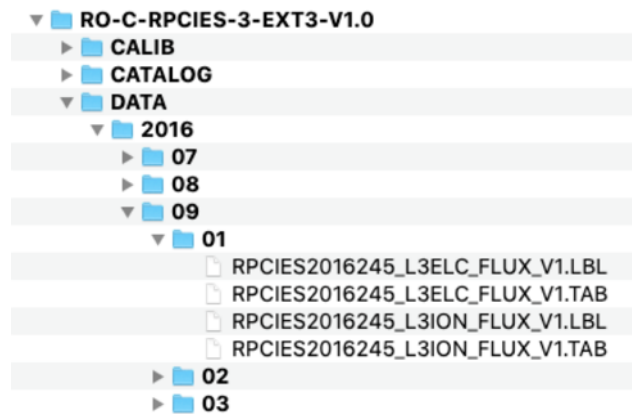
Compulsory ISTP global attributes

Project: {'ROSETTA'}
Discipline: {'Space Physics>Interplanetary Studies'}
Source_name: {'ROSETTA>International Rosetta mission'}
Data_type: {'L3ELC_FLUX>IES calibrated differential electron energy flux'}
Descriptor: {'RPCIES>Rosetta Plasma Consortium - Ion and Electron Sensor'}
Data_version: {'1.0'}
TEXT: see [here](#)
Logical_file_id: {'Rosetta_RPCIES_l3elc_flux_20160930_V1.0'}
Logical_source: {'rosetta_rpcies_l3elc_flux'}
Logical_source_description: {4×1 cell}
PI_name: {'Dr. James L. Burch'}
PI_affiliation: {'Southwest Research Institute, San Antonio, Texas, USA'}
Instrument_type: {'Particles (space)'}
Mission_group: {'Rosetta'}
Generated_by: {'BRAD TRANTHAM'}
Generation_date: {'20180710'}
File_naming_convention: {'source_descriptor_datatype_yyyyMMdd'}

These global attributes are listed at the top of the global attributes' list

3. SPARTA metadata mapping (2/3)

How PDS3 LBL metadata content is mapped into CDF global attributes?



LABEL FILES
Electrons
Ions

RO-C-RPCIES-3-EXT3-V1.0	Today, 17:07
CALIB	Today, 16:56
CATALOG	Today, 17:01
DATA	Today, 17:01
2016	Today, 17:05
07	Today, 17:04
08	Today, 17:05
09	Today, 17:07
01	Today, 17:05
RPCIES2016245_L3ELC_FLUX_V1.LBL	Today, 17:05
RPCIES2016245_L3ELC_FLUX_V1.TAB	Today, 17:05
RPCIES2016245_L3ION_FLUX_V1.LBL	Today, 17:05
RPCIES2016245_L3ION_FLUX_V1.TAB	Today, 17:05
02	Today, 17:05
03	Today, 17:05
04	Today, 17:05

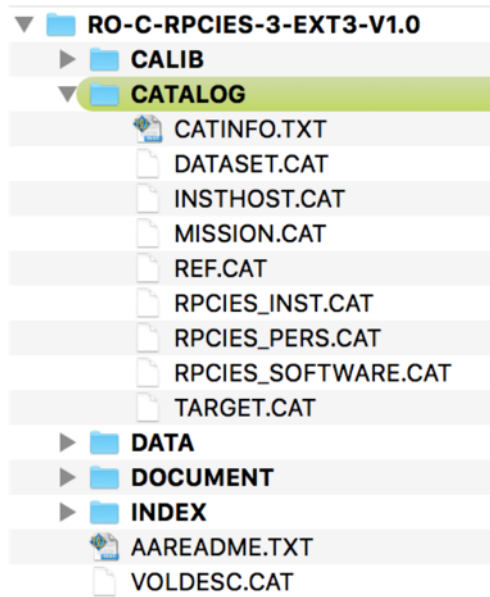
1 of 123 selected, 345.5 GB available
Preview

Enable editing

PDS_VERSION_ID	= PDS3
DATA_SET_ID	= "RO-C-RPCIES-3-EXT3-V1.0"
DATA_SET_NAME	= " "
ROSETTA-ORBITER 67P RPCIES 3 EXT3 V1.0	= "ELECTRON"
STANDARD_DATA_PRODUCT_ID	= "RPCIES2016245_L3ELC_FLUX_V1"
PRODUCT_ID	= "RDR"
PRODUCT_TYPE	= "3"
PROCESSING_LEVEL_ID	= "1.0"
PRODUCT_CREATION_TIME	= 2017-06-23T21:32:17.920
PRODUCT_VERSION_ID	= "3"
LABEL_REVISION_NOTE	= "RELEASE VERSION 1.0"
INSTRUMENT_MODE_ID	= "N/A"
INSTRUMENT_MODE_DESC	= "N/A"
ROSETTA_PIPELINE_VERSION_ID	= "887dd40db5bdfad3fc9763e891559a1850c34f3c"
RECORD_TYPE	= FIXED_LENGTH
RECORD_BYTES	= 399
FILE_RECORDS	= 20957
MDS_CHECKSUM	= "f538f67254097e130e804853be2fe38e"
START_TIME	= 2016-09-01T00:05:07.710
STOP_TIME	= 2016-09-01T23:58:43.738
SPACECRAFT_CLOCK_START_COUNT	= "1/431390019"
SPACECRAFT_CLOCK_STOP_COUNT	= "1/431395035"
MISSION_NAME	= "INTERNATIONAL ROSETTA MISSION"
MISSION_ID	= "ROSETTA"
MISSION_PHASE_NAME	= "ROSETTA EXTENSION 3"
TARGET_NAME	= "67P/CHURYUMOV-GERASIMENKO 1 (1969 R1)"
TARGET_TYPE	= "COMET"
INSTRUMENT_HOST_NAME	= "ROSETTA-ORBITER"
INSTRUMENT_HOST_ID	= "R0"
INSTRUMENT_ID	= "RPCIES"
INSTRUMENT_NAME	= " "
ROSETTA PLASMA CONSORTIUM - ION AND ELECTRON SENSOR	= "PLASMA INSTRUMENT"
INSTRUMENT_TYPE	= "PLASMA INSTRUMENT"
COORDINATE_SYSTEM_ID	= "N/A"
COORDINATE_SYSTEM_NAME	= "N/A"
NOTE	= "The values of the keywords SC_SUN_POSITION_VECTOR, SC_TARGET_POSITION_VECTOR, SC_TARGET_VELOCITY_VECTOR are related to the Comet-centered Solar Orbital frame. The values of SUB_SPACECRAFT_LATITUDE and SUB_SPACECRAFT_LONGITUDE refer to the Cheops reference frame. All values are computed for the time t=START_TIME. Distances are given in <km>, velocities in <km/s>, and angles in <deg>." Unit for SC_SUN_POSITION_VECTOR is km Unit for SC_TARGET_POSITION_VECTOR is km Unit for SC_TARGET_VELOCITY_VECTOR is km/s Unit for SPACECRAFT_ALTITUDE is km
PRODUCER_ID	= "RPC_IES_TEAM"
PRODUCER_FULL_NAME	= "BRAD TRANTHAM"
PRODUCER_INSTITUTION_NAME	= "SOUTHWEST RESEARCH INSTITUTE, SAN ANTONIO"
DATA_QUALITY_ID	= "1"
DATA_QUALITY_DESC	= "Data quality assessed and indicated by values in the quality flag"
SC_SUN_POSITION_VECTOR	= (5.243E8, 1.621E8, 3.001E7)
SC_TARGET_POSITION_VECTOR	= (8.863E8, -1.259E1, 3.102E0)
SC_TARGET_VELOCITY_VECTOR	= (2.25E-5, -4.728E-6, 1.424E-4)
SPACECRAFT_ALTITUDE	= 1.348E1
SUB_SPACECRAFT_LATITUDE	= 4.518E0
SUB_SPACECRAFT_LONGITUDE	= -3.377E1
DESCRIPTION	= "This file contains calibrated differential electron energy flux using IES data acquired during the xtension 3 phase between



3. SPARTA metadata mapping (3/3)



PDS3 Catalog files		CDF/ISTP global attributes
MISSION.CAT	----->	Rosetta_mission_cat
INSTHOST.CAT	----->	Rosetta_insthost_cat
TARGET.CAT	----->	Rosetta_target_cat
REF.CAT	----->	Rosetta_ref_cat
RPCIES_INST.CAT	----->	RPCIES_inst_cat
RPCIES_SOFTWARE.CAT	----->	RPCIES_software_cat
RPCIES_PERS.CAT	----->	RPCIES_pers_cat
DATASET.CAT	----->	Dataset_cat

```
>> info=pdfcdfinfo('Rosetta_RPCIES_l3elc_flux_20160930_V1.0.cdf');
>> info.GlobalAttributes
ans =
struct with fields:
    Project: {'ROSETTA'}
    Discipline: {'Space Physics>Interplanetary Studies'}
    Source_name: {'ROSETTA>International Rosetta mission'}
    Data_type: {'L3ELC_FLUX>IES calibrated differential electron energy flux'}
    Descriptor: {'RPCIES>Rosetta Plasma Consortium - Ion and Electron Sensor'}
    Data_version: {'1.0'}
    TEXT: {15x1 cell}
    Logical_file_id: {'Rosetta_RPCIES_l3elc_flux_20160930_V1.0'}
    Logical_source: {'rosetta_rpcies_l3elc_flux'}
    Logical_source_description: {4x1 cell}
    PI_name: {'Dr. James L. Burch'}
    PI_affiliation: {'Southwest Research Institute, San Antonio, Texas, USA'}
    Instrument_type: {'Particles (space)'}
    Mission_group: {'Rosetta'}
    Generated_by: {'BRAD TRANTHAM'}
    Generation_date: {'20180612'}
    File_naming_convention: {'source_descriptor_datatype_yyyyMMdd'}
    Pds_version_id: {'PDS3'}
    Pds_data_set_id: {'R0-C-RPCIES-3-EXT3-V1.0'}
    Pds_data_set_name: {'ROSETTA-ORBITER 67P RPCIES 3 EXT3 V1.0'}
    Pds_standard_data_product_id: {'ELECTRON'}
    Pds_product_id: {'RPCIES2016274_L3ELC_FLUX_V1'}
    Pds_product_type: {'RDR'}
    Pds_processing_level_id: {'3'}
    Pds_product_creation_time: {'2017-06-23T21:30:33.908'}
    Pds_product_version_id: {'1.0'}
    Pds_label_revision_note: {'RELEASE VERSION 1.0'}
    Pds_instrument_mode_id: {'N/A'}
    Pds_instrument_mode_desc: {'N/A'}
    Pds_record_type: {'FIXED_LENGTH'}
    Pds_record_bytes: {'399'}
    Pds_file_records: {'73985'}
    Pds_md5_checksum: {'N/A'}
    Pds_start_time: {'2016-09-30T00:00:52.533'}
    Pds_stop_time: {'2016-09-30T10:34:28.545'}
    Pds_spacecraft_clock_start_count: {'1/433814363'}
    Pds_spacecraft_clock_stop_count: {'1/433852379'}
    Pds_mission_name: {'INTERNATIONAL ROSETTA MISSION'}
    Pds_mission_id: {'ROSETTA'}
    Pds_mission_phase_name: {'ROSETTA EXTENSION 3'}
    Pds_target_name: {'67P/CHURYUMOV-GERASIMENKO 1 (1969 R1)'}
    Pds_target_type: {'COMET'}
    Pds_instrument_host_id: {'R0'}
    Pds_instrument_host_name: {'ROSETTA-ORBITER'}
    Pds_instrument_id: {'RPCIES'}
    Pds_instrument_name: {'ROSETTA PLASMA CONSORTIUM - ION AND ELECTRON SENSOR'}
    Pds_coordinate_system_id: {'N/A'}
    Pds_coordinate_system_name: {'N/A'}
    Pds_note: {11x1 cell}
    Pds_producer_id: {'RPCIES_TEAM'}
    Pds_producer_full_name: {'BRAD TRANTHAM'}
    Pds_producer_institution_name: {'SOUTHWEST RESEARCH INSTITUTE, SAN ANTONIO'}
    Pds_data_quality_id: {'1'}
    Pds_data_quality_desc: {'Data quality assessed and indicated by values in the quality flag'}
    Pds_sc_sun_position_vector: {3x1 cell}
    Pds_sc_target_position_vector: {3x1 cell}
    Pds_sc_target_velocity_vector: {3x1 cell}
    Pds_spacecraft_altitude: {'1.695E1'}
    Pds_sub_spacecraft_latitude: {'-4.262E1'}
    Pds_sub_spacecraft_longitude: {'-1.587E2'}
    Pds_description: {4x1 cell}
    Rosetta_pipeline_version_id_061: {'887dd40db5bdfad3fc9763e891559a1850c34f3c'}
    Rosetta_mission_cat: {2270x1 cell}
    Rosetta_insthost_cat: {2263x1 cell}
    Rosetta_target_cat: {1522x1 cell}
    Rosetta_ref_cat: {1674x1 cell}
    RPCIES_inst_cat: {426x1 cell}
    RPCIES_software_cat: {2x1 cell}
    RPCIES_pers_cat: {129x1 cell}
    Dataset_cat: {70x1 cell}
    Quality_flags_description: {27x1 cell}
    Software_version: {'SPARTA DEVELOPMENT'}
```

CDF ISTP required and recommended
Global attributes

PDS3 keywords mapped to CDF
Global attributes

MISSION.CAT
INSTHOST.CAT
TARGET.CAT
REF.CAT
INST.CAT
SOFTWARE.CAT
PERSON.CAT
DATASET.CAT

3. SPARTA metadata mapping TEXT global attribute



Compulsory ISTP global attributes

Project: {'ROSETTA'}
Discipline: {'Space Physics>Interplanetary Studies'}
Source_name: {'ROSETTA>International Rosetta mission'}
Data_type: {'L3ELC_FLUX>IES calibrated differential electron energy flux'}
Descriptor: {'RPCIES>Rosetta Plasma Consortium - Ion and Electron Sensor'}
Data_version: {'1.0'}
TEXT: see [here](#)
Logical_file_id: {'Rosetta_RPCIES_l3elc_flux_20160930_V1.0'}
Logical_source: {'rosetta_rpcies_l3elc_flux'}
Logical_source_description: {'4x1 cell'}
PI_name: {'Dr. James L. Burch'}
PI_affiliation: {'Southwest Research Institute, San Antonio, Texas, USA'}
Instrument_type: {'Particles (space)'}
Mission_group: {'Rosetta'}
Generated_by: {'BRAD TRANTHAM'}
Generation_date: {'20180710'}
File_naming_convention: {'source_descriptor_datatype_yyyyMMdd'}

These global attributes are listed at the top of the global attributes' list

Arnaud Masson | 3rd IHDEA meeintg, near GSFC | 17/10/2019 | Slide 30

4. Variable attributes

To be ISTP compliant, the following variable attributes are compulsory (in bold) or recommended

FIELDNAM for all variables

CATDESC for all variables

VAR_TYPE for all variables (CDF specific)

UNITS for data and support data

FORMAT for all variables not using FORM_PTR

FILLVAL for data, Record Varying (RV) support_data, and RV metadata

VALIDMIN for data and RV support_data

VALIDMAX for data and RV support_data **DEPEND_0** for data, RV support_data, and RV metadata

DISPLAY_TYPE for data

LABLAXIS for data of type image, scalar time series and 1D spectrogram

LABL_PTR_1 for vectors

Additional variable attributes are recommended

TIME_BASE (recommended for time variables) or optional like SI_CONVERSION

All these variable attributes are explained in more detailed in section 6. The values of these variable attributes have been mapped from the PDS3 LBL files. The variable attributes' values are detailed below

4. Variable attributes



CDF variable name	LABLAXIS	VAR_TYPE	UNITS
Time.UTC	UTC time	support_data	ms
Data_3D_DEFlux	Diff. energy flux	data	particles/(m**2*s*sr*(eV/eV))
Uncertainty_3D_DEFlux	Diff. energy flux uncertainty	data	particles/(m**2*s*sr*(eV/eV))
Azimuth_angles	Azimuth range	support_data	deg
Azimuth_anode	Anode reference number	support_data	
Elevation_angles	Elevation range	support_data	deg
Elevation_step_number	Elevation step number	support_data	
Energy	Energy values	support_data	eV
Energy_step_number	Energy step number	support_data	
Background_counts	Bgd counts	data	counts/s
Instrument_mode	IES mode	metadata	
Cycle_duration	Cycle duration	data	s
Quality_flags	Quality flags	metadata	
Azimuth	Central azimuth	support_data	deg
Elevation	Central elevation	support_data	deg

4. Variable attributes



CDF variable name	VALIDMIN	VALIDMAX	DISPLAY_TYPE	DEPEND_0	DEPEND_1
Time.UTC	On the fly	On the fly			
Data_3D_DEFlux	-100	1.0E20	spectrogram	TIME.UTC	Azimuth
Uncertainty_3D_DEFlux	-100	1.0E20	spectrogram	TIME.UTC	Azimuth
Azimuth_angles	0	360	no_plot	TIME.UTC	
Azimuth_anode	0	15	no_plot	TIME.UTC	
Elevation_angles	0	360	no_plot	TIME.UTC	
Elevation_step_number	0	15	no_plot		

5. Technical note and interaction with the PI team



ROSINA

Rosetta Orbiter Spectrometer for Ion and Neutral Analysis
Contains two sensors which will determine the composition of the comet's atmosphere and ionosphere, the velocities of electrified gas particles, and reactions in which they take part. It will also investigate possible asteroid outgassing.

- Browse ROSINA FTP Directory
- Read ROSINA Instrument Catalog
- Download ROSINA EAICD
- Download ROSINA Quick User Guide

Be aware that ROSINA AST2 (Lutetia Flyby) data are still under review and need to be used with caution.

RPC

Rosetta Plasma Consortium
In this instrument, five sensors measure the physical properties of the nucleus, examine the structure of the inner coma, monitor cometary activity, and study the comet's interaction with the solar wind. Note that each instrument in the consortium has their own EAICD and catalog file. These can be accessed within the datasets using the ftp links below.

- Browse RPCICA FTP Directory
- Browse RPCIES FTP Directory
- Browse RPCIAP FTP Directory
- Browse RPCMAG FTP Directory
- Browse RPCMIP FTP Directory
- Download RPC Quick User Guide
- Mapping of Rosetta RPC Datasets to CDF ISTP Compliant Files

Be aware that RPCICA AST2 (Lutetia Flyby) data are still under review and need to be used with caution.

RSI

Radio Science Investigation
Shifts in the spacecraft's radio signals are used to measure the mass, density and gravity of the nucleus, to define the comet's orbit, and to study the inner coma. RSI will also be used to study the solar corona during the periods when the spacecraft, as seen from Earth, is passing behind the Sun.

- Browse RSI FTP Directory
- Read RSI Instrument Catalog
- Download RSI EAICD
- Download RSI Quick User Guide

VIRTIS

Visible and Infrared Thermal Imaging Spectrometer
VIRTIS will map and study the nature of the solids and the temperature on the surface of the nucleus. Comet gases will be identified, and the physical conditions of the coma will be characterised. VIRTIS data were used to help identify the best landing site for Philae.

- Browse VIRTIS FTP Directory
- Read VIRTIS Instrument Catalog
- Download VIRTIS EAICD
- Download VIRTIS Quick User Guide

Be aware that VIRTIS AST2 (Lutetia Flyby) data are still under review and need to be used with caution.

PHILAE LANDER INSTRUMENTS

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<https://www.cosmos.esa.int/web/psa/rosetta>

Soon will be delivered with the CDF files

5. Technical note and interaction with the PI team

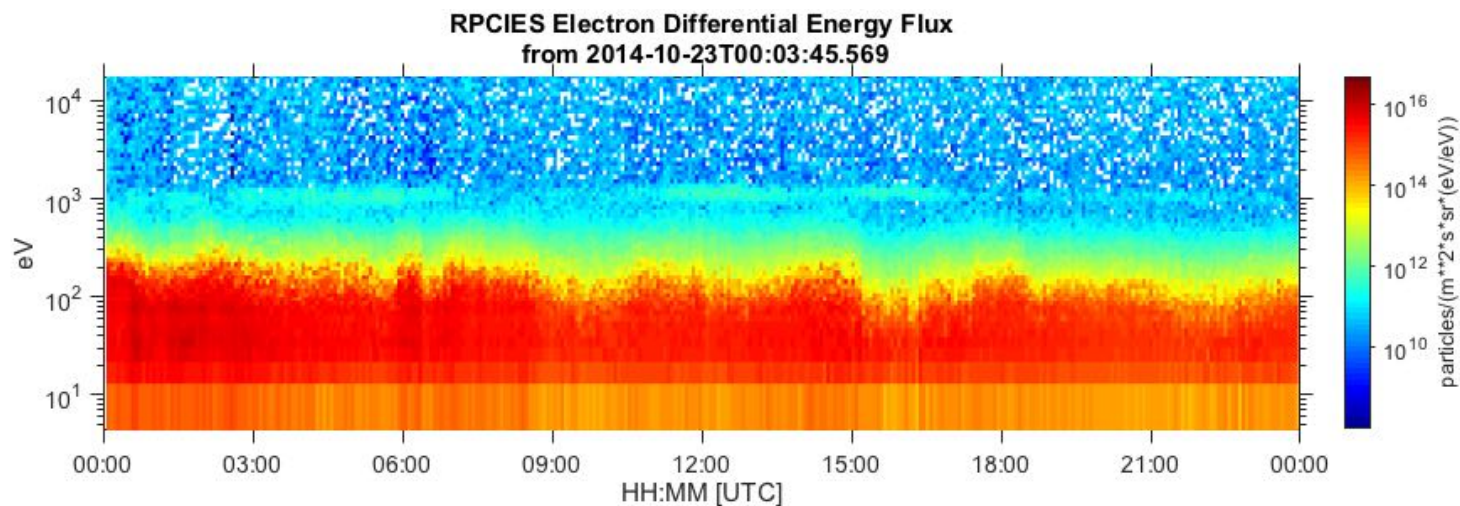


```
function [DEFomni,DEF]=plotRPCIESomniDEF(filename)
data=spdfcdfread(filename);
metadata=spdfcdfinfo(filename);

time=data{1};
energy=data{8};
DEF=data{2};

DEF(DEF<1)=NaN;
nts=length(time);
DEFomni=reshape(sum(reshape(DEF,256,128,nts),'omitnan'),128,nts);
DEFomni(DEFomni<1)=NaN;
```

```
figure
pcolor(time,energy,log(DEFomni));
```



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