Improving FAIR for HDRL's Metadata *Mapping to Schema.org and DataCite*

Rebecca Ringuette, Zach Boquet*, Tressa Helvey

*Presenter

Presented to the IVOA Semantics Session on June 3, 2025



Motivation

Open Transparent Science

Scientific processes and results should be as open as possible to encourage further study and increase public trust.

Open Available Science

Data, tools, software, documentation, and publications should be available to all (FAIR).

Open Reproducible Science

Scientific process and results should be open such that they are reproducible by members of the community.

Open Collaborative Science

Processes and participants should welcome participation by and collaboration with other researchers and organizations.

https://science.nasa.gov/open-science/







Scope

We improve the mapping from SPASE to Schema.org and DataCite.
This will significantly improve FAIR for HDRL's datasets.

BUT

- FAIR concerns more than the metadata.
- FAIR is one of four components of Open Science (Available).
- HDRL metadata is one (important!) item of several to assess at HDRL.







Why Schema.org and DataCite Metadata?

- Services external to HDRL use the DataCite DOI and schema.org metadata for many purposes, including assessing FAIR.
- Enriching our mapping to schema.org metadata increases our interoperability with other sciences, placing HDRL's research artifacts alongside others.
- Schema.org metadata is used by internet search engines.
- DataCite is considered by publishers to be the "record of truth".
- NASA SMD best practice is to use DataCite to create DOIs.
- Important for both records (DataCite and schema.org) to have identical metadata.

Enriching our mappings to external structures increases the return on investment for HDRL's metadata.

02 Methods

- **Detected Issues**
- Mapping and Implementation



Detected Issues

@context:	" <u>https://schema.org/</u> "				
@type:	"Dataset"				
▼ name:	"MMS 4 Hot Plasma Composit	ion Analyzer (HPCA) Ions, Level 2 (L2), Burst			
alternateName:	"MMS4_HPCA_BRST_L2_ION"				
dateModified:	"2023-03-04"	'2023-03-04 ''			
identifier:	"https://doi.org/10.48322/6cfb-rq65"				
<pre>vublication:</pre>	"Fuselier, Stephen, A.; Yo	ung, David, T.; Gomez, Roman, G.; Burch, Jame			
datePublished:	"2022-01-01"				
🔻 creator:					
@type:	"Person"				
🔻 name:	"Fuselier, Stephen, A.; Yo	ung, David, T.; Gomez, Roman, G.; Burch, Jame			
<pre>volisher:</pre>					
@type:	"Organization"				
name:	"NASA Space Physics Data F	acility"			
<pre> creditText: </pre>	"Please acknowledge S.A. Fuselier, D.T. Young, R.G. Gomez, and J.L. Bur				
▼ description:	"Hot Plasma Composition Analyzer (HPCA) Ions, Level 2, Burst Survey, 0. range from 1 eV to 40 keV. An electrostatic energy analyzer (ESA) that product is an array of counts for 5 ion species, at 63 energies, for ea spacecraft spin period nominally has 16 azimuths. The five ion species				
▼ abstract:	"Hot Plasma Composition Analyzer (HPCA) Ions, Level 2, Burst Survey, 0. range from 1 eV to 40 keV. An electrostatic energy analyzer (ESA) that product is an array of counts for 5 ion species, at 63 energies, for ea spacecraft spin period pominally bas 16 azimuths. The five ion species				
temporalCoverage:	"2015-09-01T12:11:00/"				
genre:	"EnergeticParticles"				
keywords:	[]				
license:	"https://cdla.io/permissiv	<u>e-1-0/</u> "			
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@type:	"Audience"				
▼ audienceType:		Empeaded			
	"Space Physicist"	icon_ld in SDASE			
		JSON-IU IN SPASE			
	space community				
	"Data Scientists"	landing nage			

https://doi.org/10.48322/6cfb-rq65

The citation for the dataset should not be included in the metadata. (publication)

Don't merge multiple authors or creators in the same author or creator field. (author)

 The keyword field is the appropriate choice for keywords, not genre. (genre, keywords)

Incorrect license. (license)

- The hpde.io URL of the SPASE landing page is not included. (identifier and subjectOf)
- Adds metadata not found in the SPASE record (!).

MMS 4 Hot Plasma Composition Analyzer (HPCA) lons, Level 2 (L2), Burst Mode, 0.625 🗙 Q

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Google

MMS 4 Hot Plasma Composition Analyzer (HPCA) lons, Level 2... hpde.io

Updated Mar 4, 2023 + more versions

MMS 3 Hot Plasma Composition Analyzer (HPCA) lons, Level 2... heliophysicsdata.gsfc.nasa.gov

application/x-cdf +2 Updated Mar 4, 2023 + more versions

MMS 2 Hot Plasma Composition Analyzer (HPCA) lons, Level 2... hpde.io

heliophysicsdata.gsfc.nasa.gov

Updated Mar 4, 2023 + more versions



NASA

MMS 4 Hot Plasma Composition Analyzer (HPCA) lons, Level 2 (L2), Burst Mode, 0.625 s

Data := See More Versions

MMS4 HPCA BRST L2 ION



Unique identifier

https://doi.org/10.48322/6cfb-rq65

Dataset updated

Mar 4, 2023

Dataset provided by

NASA

Authors

Fuselier, Stephen, A.; Young, David, T.; Gomez, Roman, G.; Burch, James, L.

License

https://cdla.io/permissive-1-0/

Description

Hot Plasma Composition Analyzer (HPCA) lons, Level 2, Burst Survey, 0.625 s Data. The MMS HPCA instruments measure the energy and composition of magnetospheric plasmas in the energy range from 1 eV to 40 keV. An electrostatic energy analyzer (ESA) that is optically coupled to a carbon-foil based Time-of-Flight (TOF) section comprises each HPCA. The basic HPCA data product is an array of counts for 5 ion species, at 63 energies, for each of 16 elevation anodes. Sixteen basic products, also called azimuths, are acquired every 0.625 s; half a spacecraft spin period nominally has 16 azimuths. The five ion species are protons (H+), alpha particles (He++), helium ions (He+), singly charged Oxygen (O+), and background counts.

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@context:	" <u>https://schema.org/</u> "		@context:	
@type:	"Dataset"		@type:	
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alternateName:	"MMS4_HPCA_BRST_L2_ION"			▼ identifie
dateModified:	"2023-03-04"			@type:
identifier:	" <u>https://doi.org/10.48322/6cfb-rq65</u> "			proper
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@type:	"Organization"			fam
name:	"NASA Space Physics Data Facility"			🔻 aff
▼ creditText:	"Please acknowledge S.A. Fuselier, D.	T. Young, R.G. Gomez, and J.L. Bu		
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temporalCoverage:	"2015-09-01T12:11:00/"		mismatch!	
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	"https://hpde.io/NASA/NumericalDa	a/MMS/4/HotPLasmaCompositionAnalyzer/	
	"MMS 4 Hot Plasma Composition Ana	lyzer (HPCA) Ions, Level 2 (L2), Burst	
	"Stephen A. Fuselier"		
Name:	"Stephen A."		
yName:	"Fuselier"		
iation:			
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1:	" <u>https://ror.org/03tghng59</u> "	RORS are not	
me:	"Southwest Research Institute"	in CDACEI	
	"Person"	III SPASE!	

"http://schema.org"

"https://doi.org/10.48322/6cfb-rg65"

RORs are not in SPASE!

"Hot Plasma Composition Analyzer (HPCA) Ions, Level 2, Burst Survey, 0. range from 1 eV to 40 keV. An electrostatic energy analyzer (ESA) that product is an array of counts for 5 ion species, at 63 energies, for ea spacecraft spin period nominally has 16 azimuths. The five ion species "https://creativecommons.org/publicdomain/zero/1.0/legalcode"

hed:

"http://datacite.org/schema/kernel-4"

"Organization"

From DataCite

Mapping and Implementation

- Began with the existing external standards and mappings.
- Formed an informal working group (international participation for soso).
- Collaborated with the community surrounding the existing standards for additional input.
- Input also obtained from SPASE and SMWT groups.
- Implemented the mapping in Python software following best practices.
- Incorporated our implemented mapping into existing open source software (schema.org) or new open source software (DataCite).

Results

03

QR code to folder on github with full JSON files:
Reviewing updated <u>schema.org</u> JSON vs. updated DataCite JSON



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@id:	" <u>https://doi.org/10.48322/6cfb-rq65</u> "		contributors:		
@type:	"Dataset"		creators:		
alternateName:	"MMS4_HPCA_BRST_L2_ION"		▼ 0:		
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contributor:			▼ name:	"Southwest Research Institute, also affiliat	ed with the Universi
▼ creator:		Authors		Texas at San Antonio"	
♥@list:		Autilois	familyName:	"Fuselier"	
▼ 0:		match!	givenName:	"Stephen A."	
@type:	"Person"		name:	"Fuselier, Stephen A."	
🔻 affiliation:			nameType:	"Personal"	
@type:	"Organization"		▼1:		
🔻 name:	"Southwest Research Institute, also affiliated with Antonio"	the University of Texas at San	▼ affiliation: name:	"Southwest Research Institute"	
familyName:	"Fuselier"		familyName:	"Young"	
givenName:	"Stephen A."		givenName:	"David T."	
name:	"Fuselier, Stephen A."		name:	"Young, David T."	
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@id:	" <u>https://orcid.org/0000-0001-9473-7000</u> "		nameIdentifier:	" <u>https://orcid.org/0000-0001-9473-7000</u> "	
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▼ affiliation:			schemeUri:	" <u>https://orcid.org</u> "	
@type:	"Organization"		nameType:	"Personal"	
name:	"Southwest Research Institute"		- 2:		
familyName:	"Young"		▼ affiliation:		
givenName:	"David T."	ROR and ORCID's	name:	"Southwest Research Institute"	
▼ identifier:			familyName:	"Gomez"	
@id:	" <u>https://orcid.org/0000-0001-9473-7000</u> "	only appear if in the	givenName:	"Roman G."	
@type:	"PropertyValue"		name:	"Gomez, Roman G."	
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value:	"orcid:0000-0001-9473-7000"		nameIdentifierScheme	e: "ORCID"	
name:	"Young, David T."		schemeUri:	" <u>https://orcid.org</u> "	
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@type:	"EntryPoint"			relatedIdentifier:	" <u>https://hpde.io/SMWG/Inst</u>	rument/MMS/4/FIELDS/FGM"	
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✓ description:	"Download dataset labeled by id in CSV f dates"	format based on the requested start and end		relationType:	"IsCollectedBy"		
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Conclusions

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Next StepsNeed for an IVOA API

03

Next Steps

- Current F-UJI FAIR scores are very low for NASA SPASE records.
- Implementing these tools in HDRL's landing page and DOI pipelines is expected to significantly increase these scores.
- Expect iterations to improve these results and a custom FAIR analysis.

MMS 4 Hot Plasma Composition Analyzer (HPCA) Ions, Level 2 (L2), Burst Mode, 0.625 s Data

	Save ↓(JSON) ⊡ New
FAIR level: ⑦	initial
Resource PID/URL:	https://hpde.io/NASA/NumericalData/MMS/4/HotPlasmaCompositionAnalyzer/Burst/Level2/Ion/PT0.6255
DataCite support:	enabled
Metric Version:	metrics_v0.5
Metric Specification:	https://doi.org/10.5281/zenodo.6461229
Software version:	3.4.0
Download assessment results:	(JSON)
Save and share assessment results:	

Summary:



	Score earned:		Fair level:	
Findable:	6 of 7	O	moderate	
Accessible:	1 of 3	0	initial	
Interoperable:	2 of 4	0	initial	
Reusable:	5 of 10	0	initial	

https://www.f-uji.net/index.php

https://hpde.io/NASA/NumericalData/MMS/4/HotPlasmaCompositionAnalyzer/Burst/Level2/Ion/PT0.625S

IVOA Facility API

- Interest in an IVOA API for instruments, missions, and observatories to improve metadata quality.
- Need matches based on partial text searches similar to the UAT.
- Components needed
 - Item type (e.g. instrument vs mission)
 - Full name
 - Acronym / short name
 - Landing page URL
 - Term code
 - Global unique PID
 - Scheme name and URI



UNIFIED ASTRONOMY THESAURUS

a community supported, open source project from the American Astronomical Society

Select Concepts Explore v Contribute v Updates About v Contact v

SELECT UAT CONCEPTS

AAS uses the <u>Unified Astronomy Thesaurus</u> (UAT) to define keywords. Please use the entry box and drop down menu below to auto-complete, search for, and obtain UAT concepts for your manuscript submission to AAS Publishing (*The Astronomical Journal*, *The Astrophysical Journal*

Added Concepts		Concept: Solar corona +			
Solar corona (1483)	Remove ×	More General Concepts:			
solar coro		Solar atmosphere +			
		More Specific Concepts:			
Active <mark>solar coro</mark> na 📵		Active solar corona +			
Quiet <mark>solar coro</mark> na 🕚		Quiet solar corona +			
Solar corona 🖲		Solar E corona 🕇			
Solar coronal boating		Solar F corona +			
		Solar K corona 🕇			
Solar coronal holes U		Solar coronal heating +			
Solar coronal lines 0		Solar coronal holes +			
Solar coronal loops 💿	1	Solar coronal lines +			
Solar coronal mass ejection shocks 🕕	•	Solar coronal loops +			
Solar coronal mass elections		Solar coronal plumes 🕂			

https://astrothesaurus.org/concept-select/

Thank You

CREDITS: This presentation template was created by <u>Slidesgo</u>, and includes icons by <u>Flaticon</u>, and infographics & images by <u>Freepik</u>



Summary of <u>Schema.org</u> Improvements https://doi.org/10.48322/6cfb-rg65

- The citation is no longer included in the metadata.
- No merged author/creator string. ORCiD and ROR capability has been added.
- Genre values have been correctly identified and moved to the measurementMethod property.
- Incorrect license removed.
- The hpde.io URL of the SPASE landing page is now included as well as its DOI.
- Removed metadata not found in the SPASE record, such as audienceType.
- Contributors have been properly recognized.
- Informational links and links to retrieve data are now included.
- Instruments, observed regions, and parameters now included as well.

Summary of DataCite Improvements https://doi.org/10.48322/6cfb-rg65

- MeasurementTypes and observed regions now included as "Subjects".
- Related links such as instruments and informational URLs are now included as related ldentifiers.
- Contributors have been properly recognized.
- PriorIDs have been added.
- ORCiD's and affiliation ROR's for creators and contributors have been corrected to only be included if present in the related Person SPASE record.
- SPASE ResourceType has been added as a "resourceType".
- TemporalCoverage has been added as a date.