Simulation Extenstions
for the
Space Physics Archive Search and Extract (SPASE) Data Model

from the SPASE Consortium

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1. Executive Summary

The Space Physics Archive Search and Extract (SPASE) consortium has defined a base information model for describing scientific data and related resources. This document defines a set of extensions for describing the simulation models, runs and the resulting data (numerical or display).

The SPASE Simulation Extensions were originally developed by the Integrated Medium for Planetary Exploration (IMPEx) project, a European Union (EU) Seventh Framework Programme sponsored project, which was subsequently endorsed by the SPASE consortium.

The SPASE group website is located at http://www.spase-group.org/

A PDF version of this document can be downloaded from the SPASE site.

2. Introduction

The SPASE (Space Physics Archive Search and Extract) Data Model is a set of terms and values along with the relationships between them that allow describing all the resources in a heliophysics data environment. It is the result of many years of effort by an international collaboration (see http://spase-group.org) to unify and improve on existing Space and Solar Physics data models. The intent of this Data Model is to provide the means to describe resources, most importantly scientifically useful data products, in a uniform way so they may be easily registered, found, accessed, and used.

2.1. History of Development

The original implementation of the SPASE Simulation Extensions was developed by the EU FP7 IMPEx project (http://impex-fp7.oeaw.ac.at/). In 2014 the SPASE consortium endorsed and adopted the extensions as a part of the SPASE Data Model.

3. Guide to the SPASE Data Model

3.1. Resource Types

The top level entity in the SPASE data model is a Resource. There are 4 different types of resources in the Simulation Extensions. These extensions can be used along side the resources found in the SPASE Base Data Model. Each resource type consists of a set of attributes that characterize the resource. The Simulation Extensions are:

SimulationRun,
SimulationModel,
NumericalOutput, and
DisplayOutput

The Simulation Extensions also override the Granule and Particle classes in the base SPASE schema.

4. The Data Model Presented Hierarchically

The taxonomy tree shows the inter-relationship of elements in the data model. This provides a "big picture" view of the SPASE data model. This taxonomy is implementation neutral. Details for each element are contained in the data dictionary.

Notes: Occurrence specifications are enclosed in parenthesis: 0 = optional, 1 = required, * = zero or more, + = 1 or more

+ Spase (1)
| + Version (1)
| + Catalog (+ of A)
| + DisplayData (+ of A)
| + NumericalData (+ of A)
| + Document (+ of A)
| + Granule (+ of A)
| | + ResourceID (1)
| | + ReleaseDate (1)
| | + ExpirationDate (0)
| | + ParentID (1)
| | + PriorID (*)
| | + StartDate (1 of B)
| | + RegionBegin (1 of B)
| | + StopDate (1 of C)
| | + RegionEnd (1 of C)
| | + Source (+)
| + Instrument (+ of A)
| + Observatory (+ of A)
| + Person (+ of A)
| + Registry (+ of A)
| + Repository (+ of A)
| + Service (+ of A)
| + Annotation (+ of A)
| + SimulationModel (+ of A)
| | + ResourceID (1)
| | + ResourceHeader (1)
| | + Versions (0)
| | | + ModelVersion (*)
| | | | + VersionTag (0)
| | | | + ReleaseDate (1)
| | | | + Description (0)
| | | | + Caveats (0)
| | + SimulationType (1)
| | + CodeLanguage (0)
| | + TemporalDependence (0)
| | + SpatialDescription (0)
| | | + Dimension (1)
| | | + CoordinateSystem (1)
| | | + Units (1)
| | | + UnitsConversion (0)
| | | + CoordinatesLabel (0)

```
|       |       |       + CutsDescription (1 of D)
|       |       |       + PlaneNormalVector (1 of E)
|       |       |       + PlanePoint (1 of E)
|       |       |       + CubesDescription (1 of D)
|       |       |       + RegionBegin (1 of F)
|       |       |       + RegionEnd (1 of F)
|       |       |       + Step (0)
|       |       + SimulatedRegion (*)
|       |       + InputProperties (0)
|       |       |       + Property (*)
|       |       |       |       + Name (0)
|       |       |       |       + Description (0)
|       |       |       |       + Caveats (0)
|       |       |       |       + PropertyQuantity (1)
|       |       |       |       + Qualifier (*)
|       |       |       |       + Units (0)
|       |       |       |       + UnitsConversion (0)
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|       |       |       |       + PropertyValue (0)
|       |       |       |       + PropertyTableURL (0)
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|       |       |       |       + ValidMax (0)
|       |       |       |       + PropertyModel (0)
|       |       |       |       + ModelURL (0)
|       |       + OutputParameters (0)
|       |       |       + Parameter (*)
|       |       + ModelURL (0)
|       + SimulationRun (+ of A)
|       |       + ResourceID (1)
|       |       + ResourceHeader (1)
|       |       + AccessInformation (*)
|       |       + ProviderResourceName (0)
|       |       + ProviderProcessingLevel (0)
|       |       + ProviderVersion (0)
|       |       + Model (0)
|       |       |       + ModelID (0)
|       |       |       + VersionTag (0)
|       |       + TemporalDependence (0)
|       |       + SimulatedRegion (+)
|       |       + LikelihoodRating (0)
|       |       + Caveats (0)
|       |       + Keyword (*)
|       |       + InputResourceID (*)
|       |       + SimulationTime (0)
|       |       |       + Description (0)
|       |       |       + Caveats (0)
|       |       |       + Duration (0)
|       |       |       + TimeStart (0)
|       |       |       + TimeStop (0)
|       |       |       + TimeStep (0)
|       |       |       + DiagnosisTimeStep (0)
```

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|       |       |       |       + TimeStart (1)
|       |       |       |       + Duration (1)
|       |       |       |       + SavedQuantity (*)
|       |       + SimulationDomain (0)
|       |       |       + CoordinateSystem (1)
|       |       |       + Description (0)
|       |       |       + Caveats (0)
|       |       |       + SpatialDimension (1)
|       |       |       + VelocityDimension (0)
|       |       |       + FieldDimension (0)
|       |       |       + Units (1)
|       |       |       + UnitsConversion (0)
|       |       |       + CoordinatesLabel (0)
|       |       |       + ValidMin (0)
|       |       |       + ValidMax (0)
|       |       |       + GridStructure (0)
|       |       |       + GridCellSize (0)
|       |       |       + Symmetry (0)
|       |       |       + BoundaryConditions (0)
|       |       |       |       + ParticleBoundary (0)
|       |       |       |       + FieldBoundary (0)
|       |       + RegionParameter (+ of G)
|       |       |       + SimulatedRegion (0)
|       |       |       + Description (0)
|       |       |       + Caveats (0)
|       |       |       + Radius (0)
|       |       |       + SubLongitude (0)
|       |       |       + Period (0)
|       |       |       + ObjectMass (0)
|       |       |       + InputTableURL (0)
|       |       |       + Property (*)
|       |       |       |       + Name (0)
|       |       |       |       + Description (0)
|       |       |       |       + Caveats (0)
|       |       |       |       + PropertyQuantity (1)
|       |       |       |       + Qualifier (*)
|       |       |       |       + Units (0)
|       |       |       |       + UnitsConversion (0)
|       |       |       |       + PropertyLabel (0)
|       |       |       |       + PropertyValue (0)
|       |       |       |       + PropertyTableURL (0)
|       |       |       |       + ValidMin (0)
|       |       |       |       + ValidMax (0)
|       |       |       |       + PropertyModel (0)
|       |       |       |       + ModelURL (0)
|       |       + InputParameter (+ of G)
|       |       |       + Name (1)
|       |       |       + Description (0)
|       |       |       + Caveats (0)
|       |       |       + SimulatedRegion (*)
|       |       |       + InputTableURL (*)
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|       |       |       + Qualifier (*)
|       |       |       + ParameterQuantity (0)
|       |       |       + Property (+)
|       |       |       |       + Name (0)
|       |       |       |       + Description (0)
|       |       |       |       + Caveats (0)
|       |       |       |       + PropertyQuantity (1)
|       |       |       |       + Qualifier (*)
|       |       |       |       + Units (0)
|       |       |       |       + UnitsConversion (0)
|       |       |       |       + PropertyLabel (0)
|       |       |       |       + PropertyValue (0)
|       |       |       |       + PropertyTableURL (0)
|       |       |       |       + ValidMin (0)
|       |       |       |       + ValidMax (0)
|       |       |       |       + PropertyModel (0)
|       |       |       |       + ModelURL (0)
|       |       + InputPopulation (+ of G)
|       |       |       + Name (1)
|       |       |       + Set (*)
|       |       |       + ParameterKey (0)
|       |       |       + Description (0)
|       |       |       + Caveats (0)
|       |       |       + SimulatedRegion (*)
|       |       |       + Qualifier (*)
|       |       |       + ParticleType (0)
|       |       |       + ChemicalFormula (0)
|       |       |       + AtomicNumber (0)
|       |       |       + PopulationMassNumber (0)
|       |       |       + PopulationChargeState (0)
|       |       |       + PopulationDensity (0)
|       |       |       + PopulationTemperature (0)
|       |       |       + PopulationFlowSpeed (0)
|       |       |       + Distribution (0)
|       |       |       + ProductionRate (0)
|       |       |       + TotalProductionRate (0)
|       |       |       + InputTableURL (0)
|       |       |       + DensityProfile (0)
|       |       |       + ModelURL (0)
|       |       + InputField (+ of G)
|       |       |       + Name (1)
|       |       |       + Set (*)
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|       |       |       + SimulatedRegion (*)
|       |       |       + CoordinateSystem (0)
|       |       |       + Qualifier (*)
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|       |       |       + Units (0)
|       |       |       + UnitsConversion (0)
```

```
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|       |       |       + ModelURL (0)
|       |       + InputProcess (+ of G)
|       |       |       + Name (1)
|       |       |       + Set (*)
|       |       |       + ParameterKey (0)
|       |       |       + Description (0)
|       |       |       + Caveats (0)
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|       |       |       + Units (0)
|       |       |       + UnitsConversion (0)
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|       |       |       + ProcessCoeffType (0)
|       |       |       + ProcessModel (0)
|       |       |       + ModelURL (0)
|       |       + Extension (*)
|       + NumericalOutput (+ of A)
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|       |       + ResourceHeader (1)
|       |       + AccessInformation (+)
|       |       + ProcessingLevel (0)
|       |       + ProviderResourceName (0)
|       |       + ProviderProcessingLevel (0)
|       |       + ProviderVersion (0)
|       |       + SimulatedInstrumentID (*)
|       |       + MeasurementType (+)
|       |       + TemporalDescription (0 of H)
|       |       + SpatialDescription (0 of H)
|       |       |       + Dimension (1)
|       |       |       + CoordinateSystem (1)
|       |       |       + Units (1)
|       |       |       + UnitsConversion (0)
|       |       |       + CoordinatesLabel (0)
|       |       |       + CutsDescription (1 of D)
|       |       |       + PlaneNormalVector (1 of E)
|       |       |       + PlanePoint (1 of E)
|       |       |       + CubesDescription (1 of D)
|       |       |       + RegionBegin (1 of F)
|       |       |       + RegionEnd (1 of F)
|       |       |       + Step (0)
|       |       + SpectralRange (*)
|       |       + SimulatedRegion (*)
|       |       + Caveats (0)
|       |       + Keyword (*)
|       |       + InputResourceID (*)
```

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|       |       |       + Qualifier (*)
|       |       |       + Units (0)
|       |       |       + UnitsConversion (0)
|       |       |       + PropertyLabel (0)
|       |       |       + PropertyValue (0)
|       |       |       + PropertyTableURL (0)
|       |       |       + ValidMin (0)
|       |       |       + ValidMax (0)
|       |       |       + PropertyModel (0)
|       |       |       + ModelURL (0)
|       |       + Extension (0)
|       + DisplayOutput (+ of A)
|       |       + ResourceID (1)
|       |       + ResourceHeader (1)
|       |       + AccessInformation (+)
|       |       + ProcessingLevel (0)
|       |       + ProviderResourceName (0)
|       |       + ProviderProcessingLevel (0)
|       |       + ProviderVersion (0)
|       |       + SimulatedInstrumentID (*)
|       |       + MeasurementType (+)
|       |       + TemporalDescription (0 of H)
|       |       + SpatialDescription (0 of H)
|       |       |       + Dimension (1)
|       |       |       + CoordinateSystem (1)
|       |       |       + Units (1)
|       |       |       + UnitsConversion (0)
|       |       |       + CoordinatesLabel (0)
|       |       |       + CutsDescription (1 of D)
|       |       |       + PlaneNormalVector (1 of E)
|       |       |       + PlanePoint (1 of E)
|       |       |       + CubesDescription (1 of D)
|       |       |       + RegionBegin (1 of F)
|       |       |       + RegionEnd (1 of F)
|       |       |       + Step (0)
|       |       + SpectralRange (*)
|       |       + DisplayCadence (0)
|       |       + SimulatedRegion (*)
|       |       + Caveats (0)
|       |       + Keyword (*)
|       |       + InputResourceID (*)
|       |       + Parameter (*)
|       |       + SimulationProduct (0)
|       |       + Property (*)
```

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| | | + Description (0)
| | | + Caveats (0)
| | | + PropertyQuantity (1)
| | | + Qualifier (*)
| | | + Units (0)
| | | + UnitsConversion (0)
| | | + PropertyLabel (0)
| | | + PropertyValue (0)
| | | + PropertyTableURL (0)
| | | + ValidMin (0)
| | | + ValidMax (0)
| | | + PropertyModel (0)
| | | + ModelURL (0)
| | + Extension (0)

5. Guidelines for Metadata Descriptions of Products

The following sections describe the details of the SPASE Simulation Extensions to the Base Data Model. There is a richness in the available metadata that allows very detailed descriptions of products. While there are optional elements, please remember that the better data are described, the easier they will be to use.

To determine what level of detail that is needed, we recommend considering not only what the user needs to find the data, but also what is necessary to know if the data will be useful for the requestor’s purpose. The user might get this information by contacting you, but if the data were moved somewhere else and only the data description were available to determine the utility of the data, consider if the user would have sufficient information to know if this is the right data set and what problems might be associated with the use of these data. Also consider if additional documentation is necessary and if so create an Document resource and associate it with the data resource. An "Information URL" may also be used to provide links to more detailed information.

In summary, products need not be described in minute detail, but users will need, at minimum, information for assessing what the data products represent and where to find them. Of course it is also useful to include information on how the data can be applied and common pitfalls in their use, but the first need is to make the products usefully visible.

6. Examples

As an example let us describe a person using SPASE metadata. This person is "John Smith" from Smith Foundation. While the SPASE data model is implementation neutral, XML representation is preferred. This example uses the SPASE XML form.

```
<?xml version="1.0" encoding="UTF-8" ?>
<Spase>
  <Version>2.0.0</Version>
   <Person>
     <ResourceID>spase://person/jsmith@smith.org</ResourceID>
     <PersonName>John Smith</PersonName>
     <OrganizationName>Smith Foundation</OrganizationName>
     <Address>1 Main St., Smithville, MA</Address>
     <Email>jsmith@smith.org</Email>
     <PhoneNumber>1-800-555-1212</PhoneNumber>
  </Person>
</Spase>
```

For a more extensive example let us consider a collection of numerical data from the magnetometer on the ACE spacecraft. This data set has been averaged to 1 minute intervals (cadence) and spans the beginning of the mission to the end of 2004 (1997-09-01 through 2004-12-31). The ACE spacecraft orbits the L1 point between the Earth and the Sun. While the SPASE data model is implementation neutral, XML representation is preferred. This example uses the SPASE XML form. The presented URLs are fictitious and will not direct you to the actual data.

```
<?xml version="1.0" encoding="UTF-8" ?>
<Spase>
  <Version>2.0.0</Version>
  <NumericalData>
     <ResourceID>spase://VMO/NumericalData/ACE/MAG/200301</ResourceID>
     <ResourceHeader>
        <ResourceName>ACEMAG200301</ResourceName>
        <ReleaseDate>2006-07-26T00:00:00.000</ReleaseDate>
        <Acknowledgement>
           User will acknowledge the data producer and instrument P.I. in any

           publication resulting from the use of these data.
        </Acknowledgement>
      <Description>
         ACE MFI 1-minute averaged magnetic-field data in GSE coordinates
         from Jan 2003. These data have been derived from the 16 second
         resolution ACE MFI which were linearly interpolated to a 1-minute
         time grid with time stamps at second zero of each minute.
      </Description>

      <Contact>
         <Role>PrincipalInvestigator</Role>
         <PersonID>spase://SMWG/Person/Norman.F.Ness</PersonID>
      </Contact>

      <Contact>
         <Role>Co-Investigator</Role>
         <PersonID>spase://SMWG/Person/Charles.Smith</PersonID>
      </Contact>

      <Contact>
         <Role>DataProducer</Role>
```

```
            <PresonID>spase://SMWG/Person/James.M.Weygand</PresonID>
         </Contact>
      </ResourceHeader>

      <AccessInformation>
         <AccessRights>Open</AccessRights>
         <AccessURL>

<URL>http://www.igpp.ucla.edu/getResource?format=text&id=spase://UCLA/ACEMAG200
301</URL>
         </AccessURL>
         <Format>Text</Format>
         <Encoding>GZIP</Encoding>
      </AccessInformation>

      <InstrumentID>spase://SMWG/ACE/MAG</InstrumentID>
      <MeasurementType>MagneticField</MeasurementType>

      <TemporalDescription>
         <TimeSpan>
           <StartDate>1997-01-01T00:00</StartDate>
           <StopDate>2004-01-31T23:59</StopDate>
         </TimeSpan>
         <Cadence>PT1M</Cadence>
      </TemporalDescription>

      <InstrumentRegion>Heliosphere.NearEarth</InstrumentRegion>
      <ObservedRegion>Heliosphere.NearEarth</ObservedRegion>

      <Parameter>
         <Name>SAMPLE_TIME_UTC</Name>
         <ParameterKey>time</ParameterKey>
         <Description>
          Sample UTC in the form DD MM YYYY hh mm ss where
            DD   = day of month (01-31)
            MM   = month of year (01-12)
            YYYY = Gregorian Year AD
            hh   = hour of day     (00:23)
            mm   = minute of hour  (00-59)
            ss   = second of minute (00-60).
         </Description>
         <Support>
           <SuportQuantity>Temporal</SuportQuantity>
         </Support>
      </Parameter>

      <Parameter>
         <Name>MAGNETIC_FIELD_VECTOR</Name>
         <Units>nT</Units>
         <CoordinateSystem>
            <CoordinateRepresentation>Cartesian</CoordinateRepresentation>
            <CoordinateSystemName>GSE</CoordinateSystemName>
         </CoordinateSystem>
         <Description>
             Magnetic field vector in GSE Coordinates (Bx, By, Bz).
         </Description>
         <Field>
            <Qualifier>Vector</Qualifier>
            <FieldQuantity>Magnetic</FieldQuantity>
        </Field>
      </Parameter>

      <Parameter>
         <Name>SPACECRAFT_POSITION_VECTOR</Name>
```

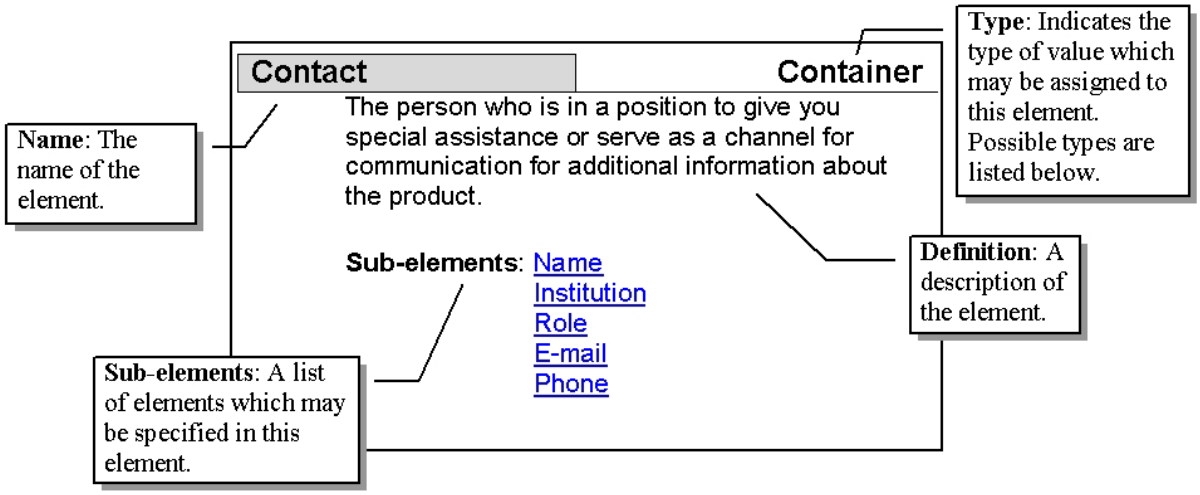
```
      <CoordinateSystem>
         <CoordinateRepresentation>Cartesian</CoordinateRepresentation>
         <CoordinateSystemName>GSE</CoordinateSystemName>
      </CoordinateSystem>
      <Units>EARTH RADII</Units>
      <UnitsConversion>6378.16 km</UnitsConversion>
      <Description>
         ACE spacecraft location in GSE coordinates (X,Y,Z)."
      </Description>
      <Support>
        <SuportQuantity>Positional</SupportQuantity>
      </Support>
   </Parameter>

  </NumericalData>
</Spase>
```

7. Definitions of the Data Model Terms

How to Read a Definition

Each element has certain attributes and context for use. The details for each element are presented in the following form:



Boundary:

FloatSequence:

StringSequence:

Value:

Axial — Item

Axial symmetry.

BackWall — Text

Back wall of the simulation domain by which the plasma flow may exit the simulation.

BoundaryConditions — Container

Parameters associated to the simulation boundaries.

Sub-elements:
FieldBoundary
ParticleBoundary

CEF1 — Item

Cluster Exchange Format (CEF), version 1, is a self-documenting ASCII format designed for the exchange of data. The metadata contains information compatible with the ISTP recommendations for CDF.

CEF2 — Item

Cluster Exchange Format (CEF), version 2, is a self-documenting ASCII format designed for the exchange of data and introduced for Cluster Active Archive. Compared to version 1, the metadata description of vectors and tensors is different.

Central — Item

Central Symmetry.

ChargeExchange — Item

Chemical process involving a charge transfer from an ion (which becomes neutral) to a neutral (which becomes ionized).

ChemicalFormula — Text

Chemical formula representing a population of particle.

CodeLanguage — Text

Language in which a numerical code is written.

CoordinatesLabel — StringSequence

A string list of the labels of each dimension of the spatial domain.

CrossSection — Item

Cross section of the reaction, when the reaction implies the collision of two particles.

DensityProfile — Text

Density profile of the particles in a population.

DiagnosisTimeStep — Container

Time at which a diagnosis is performed and quantity saved.

Sub-elements: TimeStart
Duration

Sub-elements:
Duration
SavedQuantity
TimeStart

Dimension — Count

The nnu8mber of items along one axis.

DisplayOutput — Container

A graphical representation of data wherein the underlying numeric values are not (readily)

accessible for analysis.. Examples are line plots and spectrograms. A Display Data resource is a type of "data product" which is a set of data that is uniformly processed and formatted, from one or more instruments, typically spanning the full duration of the observations of the relevant instrument(s). A data product may consist of a collection of granules of successive time spans, but may be a single high-level entity.

Sub-elements:

AccessInformation
Caveats
DisplayCadence
Extension
InputResourceID
Keyword
MeasurementType
Parameter
ProcessingLevel
Property
ProviderProcessingLevel
ProviderResourceName
ProviderVersion
ResourceHeader
ResourceID
SimulatedInstrumentID
SimulatedRegion
SimulationProduct
SpatialDescription
SpectralRange
TemporalDescription

DissociativeRecombination	Item

Chemical process by which an ion is neutralized by capturing an electron, and splits in two new neutral species.

Distribution	Text

Velocity distribution of the particles in a population.

Duration	Duration

Duration of the simulation.

ElectronImpact	Item

Chemical process by which a neutral is ionized thanks to the energy from the impact of an electron.

ElementBoundary	Container

Parameters associated to the simulation boundaries.

Sub-elements:

BackWall
Caveats
FrontWall
Obstacle
SideWall

FieldBoundary	+ElementBoundary

Parameters associated with the field boundaries of the simulation.

FieldDimension	Count

Number of field dimensions in the simulation domain.

FieldModel	Text

Field model imposed in the simulation run.

FieldValue	StringSequence

A string list of the values of the input parameter.

FrequencyToGyrofrequencyRatio — Item

The ratio of the characteristic frequency of a medium to gyrofrequency of a particle.

FrontWall — Text

Front wall of the simulation domain by which the plasma flow may be injected.

Ganymede — Item

The biggest moon of Jupiter planet in our solar system.

Granule — Container

Overrides Granule in base schema. An accessible portion of another resource. A Granule may be composed of one or more physical pieces (files) which are considered inseparable. For example, a data storage format that maintains metadata and binary data in separate, but tightly coupled files. Granules should not be used to group files that have simple relationships or which are associated through a parent resource. For example, each file containing a time interval data for a Numerical Data resource would each be considered a Granule. The ParentID of a Granule resource must be a NumericalData resource. The attributes of a Granule supersede the corresponding attributes in the NumericalData resource.

Sub-elements:

ExpirationDate
ParentID
PriorID
RegionBegin
RegionEnd
ReleaseDate
ResourceID
Source
StartDate
StopDate

GridCellSize — FloatSequence

A string list of the cell sizes in each dimension.

GridStructure — Text

Structure of the simulation grid.

HDF4 — Item

Hierarchical Data Format, Version 4

HDF5 — Item

Hierarchical Data Format, Version 5

Hybrid — Item

A numerical scheme simulating ions as particles and electrons as a fluid.

Incident — Item

Direction-dependent property.

InputField — Container

Parameters associated to a field imposed in the simulation

Sub-elements:

Caveats
CoordinateSystem
Description
FieldModel
FieldQuantity
FieldValue
InputLabel
InputTableURL

ModelURL
Name
ParameterKey
Qualifier
Set
SimulatedRegion
Units
UnitsConversion
ValidMax
ValidMin

InputLabel — StringSequence

A string list of the labels of each dimension of the input parameter.

InputParameter — Container

A container of information regarding an input parameter of the simulation run.

Sub-elements:

Caveats
Description
InputTableURL
Name
ParameterQuantity
Property
Qualifier
SimulatedRegion

InputProcess — Container

Parameters associated to a chemical process happening in the simulation

Sub-elements:

Caveats
Description
ModelURL
Name
ParameterKey
ProcessCoeffType
ProcessCoefficient
ProcessModel
ProcessType
Set
SimulatedRegion
Units
UnitsConversion

InputProperties — Container

Properties

Sub-elements:

Property

InputTableURL — URL

A URL to a table containing input parameters.

LikelihoodRating — Enumeration

The probability that something is true or possible.

Model — Container

Attributes of a model.

Sub-elements:

ModelID
VersionTag

ModelID — ID

A string defining the ID of the model.

ModelURL — URL

URL pointing toward the description of a model used in the definition of a property or an input.

ModelVersion — Container

The version number of the model.

Sub-elements:

Caveats
Description
ReleaseDate
VersionTag

NumericalOutput — Container

Data stored as numerical values in a specified format. A Numerical Data resource is a type of "data product" which is a set of data that is uniformly processed and formatted, from one or more instruments, typically spanning the full duration of the observations of the relevant instrument(s). A data product may consist of a collection of granules of successive time spans, but may be a single high-level entity.

Sub-elements:

AccessInformation
Caveats
Extension
InputResourceID
Keyword
MeasurementType
Parameter
ProcessingLevel
Property
ProviderProcessingLevel
ProviderResourceName
ProviderVersion
ResourceHeader
ResourceID
SimulatedInstrumentID
SimulatedRegion
SimulationProduct
SpatialDescription
SpectralRange
TemporalDescription

ObjectMass — Value

Mass of an object referenced as a simulated region.

Obstacle — Text

Obstacle in the simulation domain.

OutputParameters — Container

A container of information regarding the output parameters of the simulation run.

Sub-elements:

Parameter

PIC — Item

A numerical scheme simulating ions and electrons as macroparticles.

Paraboloid — Item

A shape generated by the rotation of a parabola around its axis of symmetry.

ParameterQuantity — Enumeration

The value associated with a parameter.

Allowed Values:

Particle — Container

Overrides Particle in base schema. A description of the types of particles observed in the measurement. This includes both direct observations and inferred observations.

Sub-elements:

AtomicNumber
AzimuthalAngleRange
ChemicalFormula
EnergyRange
ParticleQuantity
ParticleType
PolarAngleRange
Population
PopulationChargeState
PopulationMassNumber
Qualifier

ParticleBoundary +ElementBoundary

Parameters associated with the particles at the boundaries of the simulation.

Period Value

A length or era of time.

PhotoIonization Item

Chemical process by which a neutral is ionized thanks to the energy from a photon.

Plane Item

Symmetry across a plane.

PlaneNormalVector FloatSequence

A list of the component in each dimension of the vector normal to a plane.

PlanePoint FloatSequence

A list of the component in each dimension of a point in plane.

Population String

A concise description of a particle population, for references.

PopulationChargeState Numeric

Charge of a particle in a population, in units of the charge of a proton. Charge state of a bare proton = 1.

PopulationDensity Value

The number of particles per unit volume.

PopulationFlowSpeed Value

The rate at which particles or energy is passing through a unit area in a unit time.

PopulationMassNumber Value

The total number of protons and neutrons (together known as nucleons) in an atomic nucleus.

PopulationTemperature Value

A measure of the kinetic energy of random motion with respect to the average. Temperature is properly defined only for an equilibrium particle distribution (Maxwellian distribution).

ProcessCoeffType Enumeration

Whether the simulation results are obtained from a stationary solution or are dynamically computed.

Allowed Values:

CrossSection
Frequency
Other

Rate

ProcessCoefficient — Text

Coefficient associated to a chemical process.

ProcessModel — Text

Model used to describe a chemical process.

ProcessType — Enumeration

Type of chemical process.
Allowed Values:
ChargeExchange
DissociativeRecombination
ElectronImpact
PhotoIonization

ProductionRate — Value

The number of items that can be produced during a given period of time.

Property — Container

A container of information regarding a property of an input parameter.
Sub-elements:
Caveats
Description
ModelURL
Name
PropertyLabel
PropertyModel
PropertyQuantity
PropertyTableURL
PropertyValue
Qualifier
Units
UnitsConversion
ValidMax
ValidMin

PropertyLabel — StringSequence

A string list of the labels of each dimension of the property.

PropertyModel — Text

Model used to define a property.

PropertyQuantity — Enumeration

The value associated with a property.
Allowed Values:

PropertyTableURL — URL

A URL to a table containing property values.

PropertyValue — StringSequence

A string list of the values of the property.

Radius — Value

The length of a line segment from a center point to the perimeter.

Rate — Item

Reaction rate: reaction production per unit of time.

RegionBegin — FloatSequence

The values that define the start point of a region.

RegionEnd — FloatSequence

The values that define the ending point of a region.

RegionParameter — Container

Radius of the Region in the simulation.
Sub-elements:
Caveats
Description
InputTableURL
ObjectMass
Period
Property
Radius
SimulatedRegion
SubLongitude

Remote1AU — Item

A roughly toroidal region that includes the Earth's orbit, but exclusive of the region near the Earth.

SavedQuantity — Enumeration

Quantities that are saved during a given diagnosis.
Allowed Values:

SideWall — Text

Side walls of the simulation domain.

SimulatedInstrumentID — ID

The identifier of the a simulated instrument description.

SimulatedRegion — Enumeration

The portion of space simulated by the code at the time of a diagnosis. A region is distinguished by certain natural features or physical characteristics. It is the location of the observatory for in situ data, the location or region sensed by remote sensing observatories and the location-of-relevance for parameters that are derived from observational data.
Allowed Values:

SimulationDomain — Container

Parameters associated to the simulation spatial domain.
Sub-elements:
BoundaryConditions
Caveats
CoordinateSystem
CoordinatesLabel
Description
FieldDimension
GridCellSize
GridStructure
SpatialDimension
Symmetry
Units
UnitsConversion
ValidMax
ValidMin
VelocityDimension

SimulationModel — Container

Descriptor of a simulation model: type of numerical scheme, versions,...
Sub-elements:

CodeLanguage
InputProperties
ModelURL
OutputParameters
ResourceHeader
ResourceID
SimulatedRegion
SimulationType
SpatialDescription
TemporalDependence
Versions

SimulationProduct — Enumeration

The type of product produced from the simulation.

Allowed Values:

2DCuts
3DCubes
Lines
SpatialSeries
Spectra
TimeSeries

SimulationRun — Container

Description of a simulation run, including the code ID, the run spatial and temporal description, and all the relevant inputs.

Sub-elements:

AccessInformation
Caveats
Extension
InputField
InputParameter
InputPopulation
InputProcess
InputResourceID
Keyword
LikelihoodRating
Model
ProviderProcessingLevel
ProviderResourceName
ProviderVersion
RegionParameter
ResourceHeader
ResourceID
SimulatedRegion
SimulationDomain
SimulationTime
TemporalDependence

SimulationTime — Container

Parameters associated to the simulation time.

Sub-elements:

Caveats
Description
DiagnosisTimeStep
Duration
TimeStart
TimeStep
TimeStop

SimulationType — Enumeration

A characterization of the numerical scheme used in the simulation

Allowed Values:

Hybrid

MHD
PIC
Paraboloid
Test_Particle

Spase — Container

Overrides Spase in the base schema. Space Physics Archive Search and Extract (SPASE). The outermost container or envelope for SPASE metadata. This indicates the start of the SPASE metadata.

Sub-elements:

Annotation
Catalog
DisplayData
DisplayOutput
Document
Granule
Instrument
NumericalData
NumericalOutput
Observatory
Person
Registry
Repository
Service
SimulationModel
SimulationRun
Version

SpatialDescription — Container

A characterization of the spatial extent over which the measurement was taken.

Sub-elements:

CoordinateSystem
CoordinatesLabel
CubesDescription
CutsDescription
Dimension
PlaneNormalVector
PlanePoint
RegionBegin
RegionEnd
Step
Units
UnitsConversion

SpatialDimension — Count

Number of spatial dimensions in the simulation domain.

SpecificSimulatedRegion — Enumeration

Identifiers for areas of the physical world which may be occupied or observed.

Allowed Values:

Callisto
Enceladus
Europa
Ganymede
Incident
Io
Planet
Rhea
Titan
Title

Step — Text

Spatial step between two elements of the diagnosis.

StokesParameters — Item

A set of four parameters (usually called I,Q, U and V) which describe the polarization state of an electromagnetic wave propagating through space.

SubLongitude — Value

The longitude on the surface of an object which is directly below another object.

Symmetry — Enumeration

Symmetry of the simulation domain.

Allowed Values:

Axial
Central
None
Plane

TemporalDependence — Enumeration

Whether the simulation results are obtained from a stationary solution or are dynamically computed.

Allowed Values:

No
Yes

TestParticle — Item

A numerical scheme simulating the motion of charged particles in a prescribed field.

TimeStart — Time

Time at which the coverage by the element start.

TimeStep — Duration

Time Step.

TimeStop — Time

Time at which the coverage by the element stop.

TotalProductionRate — Value

The total number of items that can be produced during a given period of time.

VelocityDimension — Count

Number of velocity dimensions in the simulation domain.

VersionTag — Text

The text string for a version indicator.

Versions — Container

A container of one or more sets of version information.

Sub-elements:

ModelVersion

8. Enumeration of Selected Quantities

Lists are either "open" or "closed". The items in a "closed" list are determined by the SPASE model and definitions of each item is in the SPASE data dictionary. The items in an "open" list are determined by an external control authority. The URL for the control authority is indicated in the definition of each "open" list.

ParameterQuantity List — Union

ProcCoefType List — Closed

Whether the simulation results are obtained from a stationary solution or are dynamically computed.

Term	Definition
CrossSection	Cross section of the reaction, when the reaction implies the collision of two particles.
Rate	Reaction rate: reaction production per unit of time.

ProcessType List — Closed

Type of chemical process.

Term	Definition
ChargeExchange	Chemical process involving a charge transfer from an ion (which becomes neutral) to a neutral (which becomes ionized).
DissociativeRecombination	Chemical process by which an ion is neutralized by capturing an electron, and splits in two new neutral species.
ElectronImpact	Chemical process by which a neutral is ionized thanks to the energy from the impact of an electron.
PhotoIonization	Chemical process by which a neutral is ionized thanks to the energy from a photon.

Product List — Closed

SavedQuantity List — Union

Quantities that are saved during a given diagnosis.

SimulatedRegion List — Union

Identifiers for areas of the physical world which may be occupied or observed.

SimulationType List — Closed

A characterization of the numerical scheme used in the simulation.

Term	Definition
Hybrid	A numerical scheme simulating ions as particles and electrons as a fluid.
PIC	A numerical scheme simulating ions and electrons as

	macroparticles.
Paraboloid	A shape generated by the rotation of a parabola around its axis of symmetry.

SpecificSimulatedRegion List — Closed

Identifiers for areas of the physical world which may be occupied or observed.

Term	Definition
Ganymede	The biggest moon of Jupiter planet in our solar system.
Incident	Direction-dependent property.

Symmetry List — Closed

Symmetry of the simulation domain.

Term	Definition
Axial	Axial symmetry.
Central	Central Symmetry.
Plane	Symmetry across a plane.

YN List — Closed

Yes or No

9. Bibliography

National Solar Observatory Sacramento Peak
http://www.sunspot.noao.edu/sunspot/pr/glossary.html

Terms and Definitions
http://www.pgd.hawaii.edu/eschool/glossary.htm

International System of Units (SI)
http://www.bipm.fr/en/si
Base units: http://www.bipm.fr/en/si/si_brochure/chapter2/2-1/#symbols
and those for Common derived units: http://www.bipm.fr/en/si/derived_units/2-2-2.html

ISO 8601:2004 - Date Format
http://en.wikipedia.org/wiki/ISO_8601
- or -
http://www.iso.ch/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=40874
- or -
http://www.iso.org/iso/en/prods-services/popstds/datesandtime.html

RFC 3339 - Date and Time on the Internet
The basis for the ISO 8601 standard. http://www.ietf.org/rfc/rfc3339.txt

RFC 1014 - XDR: External Data Representation standard
http://www.faqs.org/rfcs/rfc1014.html

10. Index

11. Change History

1.0.0	
2014-05-19	Released.