



“Can Your Application Use Our Data?”

Review of IVOA Spectrum/SED Model Implementations

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Overview

Goal

- To give client-side (Iris, SEDLib) perspective of different interpretations of the Spectrum and SED models.
- To use these different interpretations to indicate portions of the current IVOA standards and models which may be unclear and/or could benefit from further discussion (no right, no wrong!).

Method

- We've collected four samples of files containing Spectrum or Photometry data which are in some way connected with a VO/IVOA project.
- For each of these files, we've outlined the overall structure and compared the serializations against the relevant models.
- For this pass, we are not too concerned with the fine level details such as column names, IDs, descriptions, UCD strings or Unit formats.
- We are more concerned with how they encapsulated the model information and see where these interpretations reflect ambiguities in the model and standards.



Sources Used

1) NASA/IPAC Extragalactic Database (NED)

<http://vo.ned.ipac.caltech.edu/>

- SED product in VOTable format generated using their VAO SED service being developed as part of the VAO SED Analysis project (Iris).

2) Spanish Virtual Observatory (SVO)

<http://sdc.cab.inta-csic.es/vosed/>

- SED product in VOTable format generated using VOSED application.

3) MAST

<http://archive.stsci.edu/pub/vospectra/hut2/>

- Spectrum product in FITS format from Hopkins Ultraviolet Telescope (HUT).
Registered HUT SSAP service - `ivo://mast.stsci/ssap/hut`

4) CDS

Photometry data provided by Mark Allen

- Described in Sebastien's talk at the last interop

<http://www.ivoa.net/cgi-bin/twiki/bin/view/IVOA/InterOpMay2011SED>

- Contains Photometry data extracted from catalogues in VOTable format.

NED Example

VOTABLE: xmlns:spec="http://www.ivoa.net/xml/Spectrum/Spectrum-1.01.xsd"

RESOURCE: utype="spec:Sed"

TABLE: utype="spec:Spectrum"

PARAM: utype="spec:Spectrum.DataModel" (value = "Spectrum 1.03")

GROUP: utype="spec:Spectrum.Curation"

PARAM: utype="spec:Spectrum.Curation.Publisher"

GROUP: utype="spec:Spectrum.Char"

GROUP: utype="spec:Spectrum.Char.SpectralAxis"

PARAM: utype="spec:Spectrum.Char.SpectralAxis.Name"

PARAM: utype="spec:Spectrum.Char.SpectralAxis.Ucd"

GROUP: utype="spec:Spectrum.Data.FluxAxis"

FIELDref: ref="DataFluxValue"

FIELDref: ref="DataFluxStatErr"

PARAM: utype="spec:Spectrum.Data.FluxAxis.Ucd"

GROUP: utype="spec:Spectrum.Data.SpectralAxis.Published"

FIELDref: ref="DataPointNumber"

FIELDref: ref="DataSpectralPassBand"

GROUP: utype="spec:Spectrum.Data.FluxAxis.Published"

FIELDref: ref="DataFluxPublishedValue"

FIELDref: ref="DataFluxPublishedStatErr"

FIELD: utype="spec:Spectrum.Data.FluxAxis.Value"

FIELD: utype="spec:Spectrum.Data.FluxAxis.Published.Value"

SVO Example

VOTABLE: xmlns:sed="http://www.ivoa.net/xml/SedModel/v0.93"

RESOURCE: utype="SED"

TABLE: utype="Spectrum"

PARAM: utype="DataModel" (value = "Spectrum-1.0")

GROUP: utype="Char"

GROUP: utype="Char.SpectralAxis"

PARAM: utype="spec:Spectrum.Char.SpectralAxis.UCD"

PARAM: utype="spec:Spectrum.Char.SpectralAxis.Unit"

GROUP: utype="Curation"

PARAM: utype="Curation.Publisher"

GROUP: utype="Data"

GROUP: utype="Data.SpectralAxis"

FIELDref ref="SpectralAxis"

GROUP: utype="Data.FluxAxis"

FIELDref ref="FluxAxis"

GROUP: name="1"

PARAM name="SourceServiceName"

PARAM name="SourceTitle"

PARAM name="SourceDataLink"

PARAM name="SourceId"

FIELD: name="WAVE0" unit="m"

FIELD: ID="SpectralAxis" name="WAVE" unit="m" utype="Data.SpectralAxis.Value"

FIELD: ID="FluxAxis" name="FLUX" unit="W/m²/m" utype="Data.FluxAxis.Value"

MAST/HUT Example

FITS Serialization:

Table HDU

```
VOCLASS = 'SPECTRUM V1.0' / VO Data Model
VOSEGT   = 'SPECTRUM'     / Segment type

TTYPE1 = 'WAVE '
TTYPE2 = 'FLUX '
TTYPE3 = 'SIGMA '

TUNIT1 = 'angstrom' / wavelength unit is Angstrom
TUCD1  = 'em.wl'    / Wavelength UCD
TUTYP1 = 'Spectrum.Data.SpectralAxis.Value' / Wavelength UTYPE
```

TARGET KEYWORDS

```
OBJECT = 'NGC4151' / proposer's target name
TITLE  = 'ngc4151_141, NGC4151' / Program Identification
RA_TARG = 182.6354064941 / [deg] right ascension of target
DEC_TARG = 39.4057006836 / [deg] declination of target
```

COVERAGE: SPATIAL

```
RA      = 182.6354064941 / [deg] project-defined right ascension
DEC     = 39.4057006836 / [deg] project-defined declination
APERTURE = '17' / [arcsec] Aperture (radius or lengthxwidth)
```

CDS Example

VOTABLE:

RESOURCE: ID="yCat_2246" name="II/246"

TABLE: ID="II_246_out" name="II/246/out"

GROUP: utype="phfdm:PhotometryPoint"

PARAM: utype="phfdm:PhotometryFilter.uniqueIdentifier"

PARAM: utype="phfdm:PhotometryFilter.meanFrequency"

PARAM: utype="phfdm:PhotometryFilter.effectiveWidth"

PARAM: utype="phfdm:PhotometryFilter.zeroPoint"

FIELDref ref="f1v" utype="spec:Spectrum.Data.FluxAxis.Value"

FIELDref ref="f1e" utype="spec:Spectrum.Data.FluxAxis.Accuracy.StatError"

{Above Group repeated 3 total with Filter "2MASS:Ks, "2MASS:H", "2MASS:J" }

FIELD	name="RAJ2000"	datatype="double"	unit="deg" ref="J2000"
FIELD	name="DEJ2000"	datatype="double"	unit="deg" ref="J2000"
FIELD	name="2MASS"	datatype="char"	
FIELD	name="Jmag"	datatype="float"	unit="mag"
FIELD	name="e_Jmag"	datatype="float"	unit="mag"
FIELD	name="Hmag"	datatype="float"	unit="mag"
FIELD	name="e_Hmag"	datatype="float"	unit="mag"
FIELD	name="Qflg"	datatype="char"	
FIELD	name="Xflg"	datatype="unsignedByte"	
FIELD ID="f1v"	name="Kmag"	datatype="float"	unit="Jy"
FIELD ID="f1e"	name="e_Kmag"	datatype="float"	unit="Jy"
FIELD ID="f2v"	name="Hmag"	datatype="float"	unit="Jy"
FIELD ID="f2e"	name="e_Hmag"	datatype="float"	unit="Jy"

Required Elements

List of 'mandatory' items as defined by the Spectrum Data Model

	NED	HUT	SVO	CDS
Spectrum.DataModel	Y	Y	Y	N
Spectrum.Curation.Publisher	Y	Y	Y	N
Spectrum.DataID.Title	Y	Y	N	N
Spectrum.Target.Name	Y	Y	N	N
Spectrum.Char.FluxAxis.ucd	Y	Y	N	N
Spectrum.Char.FluxAxis.unit	N*	Y	N*	N
Spectrum.Char.SpectralAxis.ucd	Y	Y	Y	N
Spectrum.Char.SpectralAxis.unit	Y	Y	Y*	N
Spectrum.Char.SpatialAxis.Coverage.Location.Value	Y	Y	N	N
Spectrum.Char.SpatialAxis.Coverage.Bounds.Extent	Y+	Y	N	N
Spectrum.Char.TimeAxis.Coverage.Location.Value	Y+	Y	N	N
Spectrum.Char.TimeAxis.Coverage.Bounds.Extent	Y+	N	N	N
Spectrum.Char.SpectralAxis.Coverage.Location.Value	Y+	Y	N	N
Spectrum.Char.SpectralAxis.Coverage.Bounds.Extent	Y+	Y	N	N
Spectrum.Char.SpectralAxis.Coverage.Bounds.Start	Y+	Y	N	N
Spectrum.Char.SpectralAxis.Coverage.Bounds.Stop	Y+	Y	N	N
Spectrum.Data.FluxAxis.Value	Y	Y	Y	Y
Spectrum.Data.SpectralAxis.Value	Y	Y	Y	N
	---	---	---	---
	of 18	17	5	1

* avail. via 'Data' + value is NULL



Summary

IVOA Standards need to provide more clarification on

- Namespace declarations and usage
 - * 'spec' universally and forever mapped to the Spectrum Model?
 - * or should they be declared using xml:ns and mapped to a schema.
- Model sharing and how to specify Utypes for 'borrowed' elements.
- Extensibility
 - * how to define extended content.
 - + if inside the model/namespace, it should have objects defined and a mechanism for assigning a UType within the namespace
 - + if not, then the elements are outside the model and should not be addressed by it.

FITS serialization

- Without integration of Utypes and namespaces, this format seems limited to representing only elements from a single model without a LOT of oversight to ensure that mappings are unambiguous across related models.

Summary (cont.)

SED Model

- really need a recommended model to code to.
- given these examples, a reasonable V1.0 maybe could be little more than a container of Spectrum (Segment?) instances.

Spectrum model

- are mandatory elements really Mandatory?
 - * these elements are either being ignored or included with empty values just to be compliant.
- UType specification is confusing
 - * is "Spectrum" portion required or optional?
 - * should it be "Segment"?

Suggestion:

Looking at models from a client perspective provides insight into different aspects of a model's effectiveness. We suggest that client libraries implementing the models be requested as reference implementations.



Related talks

SED, Spectrum and Phot DM – DM-1 session (after the break)

VAO SED implementation (Iris) demo – Apps-3 session Wed

All talks in the Utypes session – DM-2 session Wed