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Virtual
Observatory
Alliance*

IVOA Dataset Metadata Model

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Abstract

This document provides a data model describing the structure and content of generic Dataset metadata for the IVOA. This is a high-level model which is to be referenced and extended by other models describing specific types of Datasets and Data products. In this document, we specify the generic Dataset, as well as an ObservationDataset model which covers the class of Datasets which are derived from an Observation. At the time of this writing, there is no formal Observation-Experiment model for the IVOA, so we include a hypothetical Observation-Experiment model to serve as a placeholder.

Status of This Document

This is an IVOA Working Draft for review by IVOA members and other interested parties. It is a draft document and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use IVOA Working Drafts as reference materials or to cite them as other than "work in progress".

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2014 Sep 30: Draft revised with STC2 prototype, initial draft feedback, and updates due to Cube model development.

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- Incorporate comments from Spectral2.0 feedback related to Dataset metadata.
- Format change to better illustrate data type and multiplicity of elements.
- Update STC2 prototype to current state of development.
- General review of element descriptions for clarity.

2015 Oct 07:

- Update Acknowledgments for European contributors
- Generalize Derived object using ObsConfig pattern
- Remove Redshift type (used in Derived)
- Update STC2 prototype to 2015-05-04 model descriptions (except for Transform model)
- Update reference to VO-DML specification (2015-02-06 version)
- Make section references links.

2015 Oct 18:

- Update STC2 prototype to 2015-10-14 model diagrams
 - o Frame - Transform relation.

2016 Mar 09:

- Update elements for vo-dml compatibility
 - o Curation.reference, DataID.collection, DataID.contributor
 - o Enumerations (SpectralBandType)
- Added simple Party model for Entity types
 - o Curation.publisher, Curation.contact, DataID.creator, DataID.contributor
- Restructured ObsConfig, folding in content concepts, not just content.
- Normalized Curation.rights from string to AccessRights type.
- Update STC2 prototype
 - o duplicate packaging
 - o mods for vo-dml compliance, PixelSpace, PixelCoordinate, Transforms.

2016 Apr 12:

- restore Curation.rights to attribute of type RightsType, delete AccessRights type.
- reduce Party types to just Organization and Individual.
- enhanced language in Publication.refCode description.
- moved ObsDataset and associated elements to Observation-Experiment package
- added list of figures

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1 Introduction

1.1 Motivation

All IVOA datasets must contain a common set of metadata elements to facilitate the registration, discovery, and interoperability of these datasets. To date, individual IVOA data models have independently defined this metadata within the separate documents. This has resulted in some level of inconsistency between models, as well as document bloat, and some ambiguity as to the hierarchy and relation of models to each other. For example, the ObsCore-1.0 model describes itself as defining "the core components of the Observation data model", but there is no formal definition of an Observation data model in the IVOA. Without this higher-level document, it is difficult for detailed models to properly reference and/or extend this content consistently.

With the development of the Cube model, significant effort has been made to properly model this high-level metadata, and separate the components related to the generic dataset, a dataset derived from an observation, and the observation itself. This document represents the results of that effort. Here, we define the generic dataset metadata, and provide an example for extending this with metadata related to datasets resulting from a specific process (Observation). As such, the ObsCore model should be considered a 'view' of this model, highlighting the core components required for supporting TAP services.

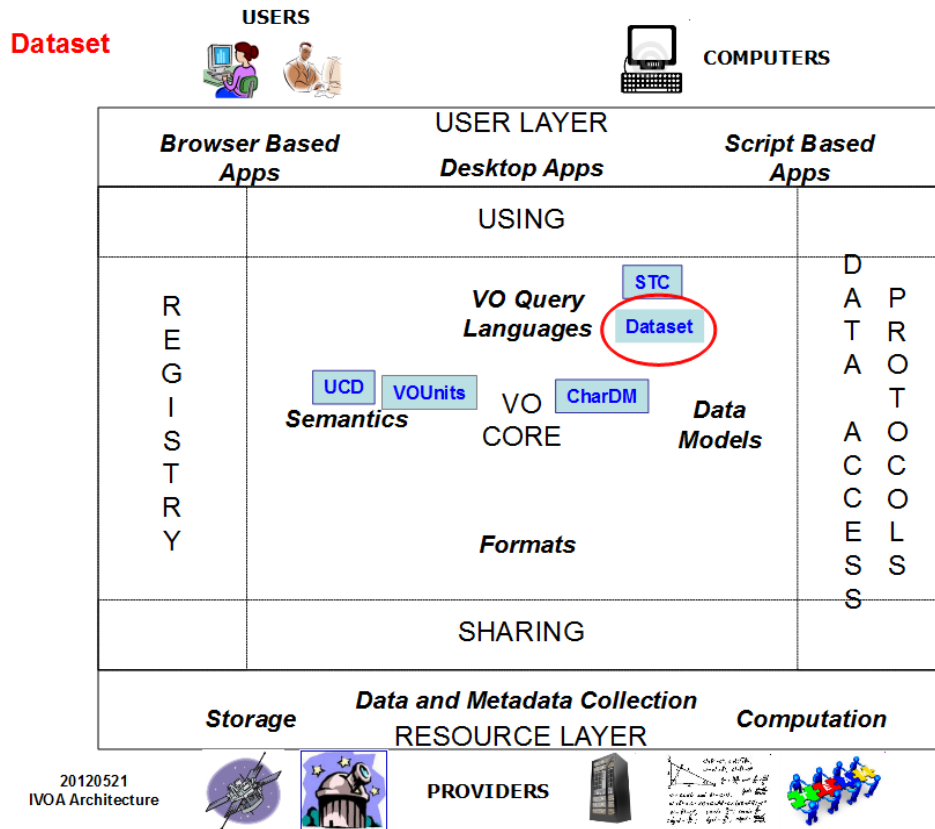
The descriptions of many elements of this model are a result of reviewing and combining those contained in the ObsCore (1.0), Spectral (2.0), and Characterisation (1.13) models. As such, it represents a uniform, consistent description set. Future revisions of those documents should be defined with respect to this model.

1.2 Requirements

The primary goals of this document are:

- to provide a specification of generic dataset metadata sufficient to support current IVOA data product models and access protocols.
- to specify metadata associated with an Observation (experiment) which are to be included in datasets derived from observations (ObsDataset).

1.3 Role in the IVOA Architecture



1.4 Model Dependencies

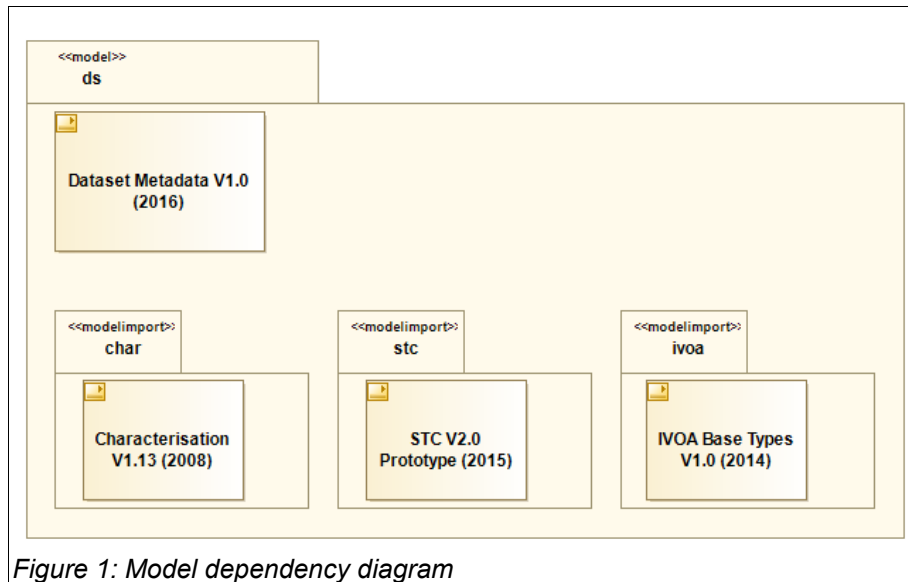


Figure 1: Model dependency diagram

The Dataset model is built on other data models as indicated in Figure 1. The `<<model>>` and `<<modelimport>>` stereotypes provide information identifying the model, its version, any dependencies, and URLs to find more information about the model definitions including HTML and schema documentation. See Appendix B for more information about the content of these stereotypes and how they are used in serializations.

1.5 Structure of this Documentation

- + Major sections for each model area (Dataset, Observation, etc.).
- + First subsection in each section is the primary element within that model
- + Subsequent subsections for secondary elements, generally in alphabetical order, but occasionally a logical grouping of related objects makes more sense.
- + Each subsection has sub-subsections for each attribute/relation
 - attributes show the full definition including datatype and usage.
 - relations describe the usage of the object in that context, the type of the target of the relation, and a reference to the full definition of that type.
- + Capitalization convention
 - Objects and complex data types are expressed in PascalCase
 - Attributes are camelCase
 - Primitive data types (string, double, etc.) are lower case

2 Dataset Model

This section describes the generic, high-level metadata associated with an IVOA Dataset. Since serialization format choices may effect the number of files or components which comprise a dataset, we define an IVOA Dataset as "a file or files which are considered to be a single deliverable". Examples of viable datasets include:

- + An individual data product, such as a Spectrum, or Image.
- + A 'tar' file or directory of processed observational data files.

This metadata identifies the dataset, and provides information regarding the ownership, rights and associations with other datasets. The primary purpose of this metadata is to facilitate the registry and discovery of datasets within the IVOA community.

Several of the objects modeled here are based on descriptions given in the IVOA document, "Resource Metadata for the Virtual Observatory; Version 1.12" [1] (Resource Metadata). Where applicable, we provide the appropriate citation in the text below.

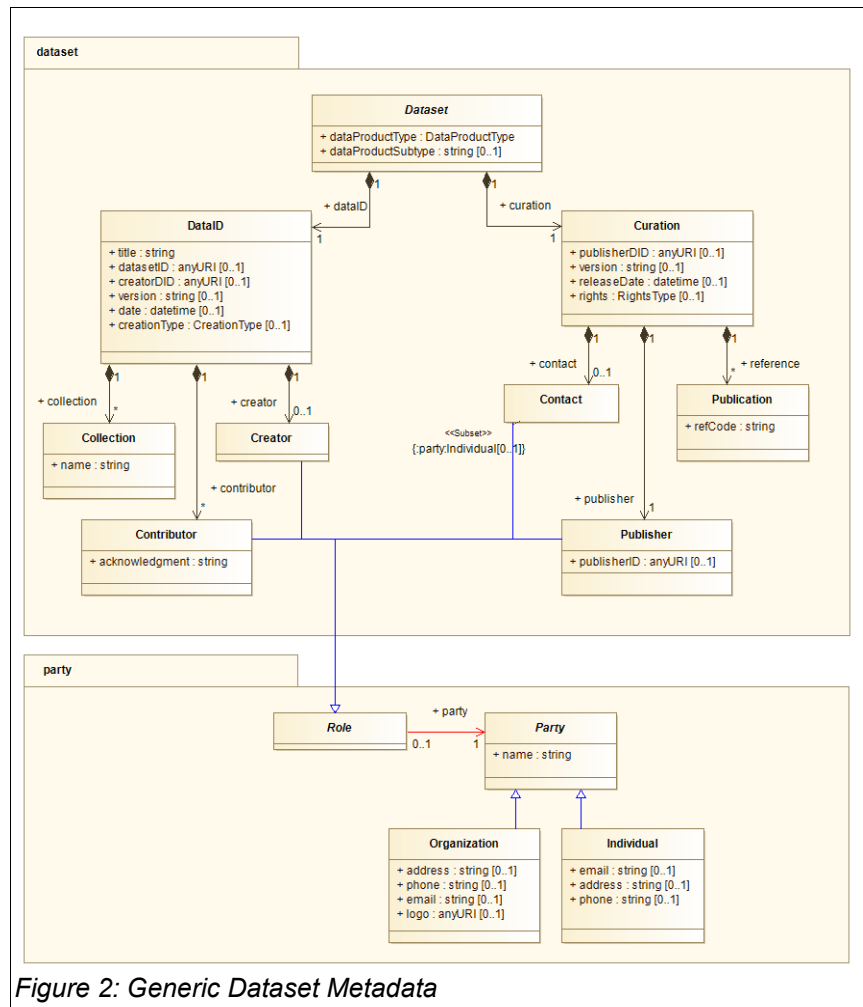


Figure 2: Generic Dataset Metadata

2.1 Dataset

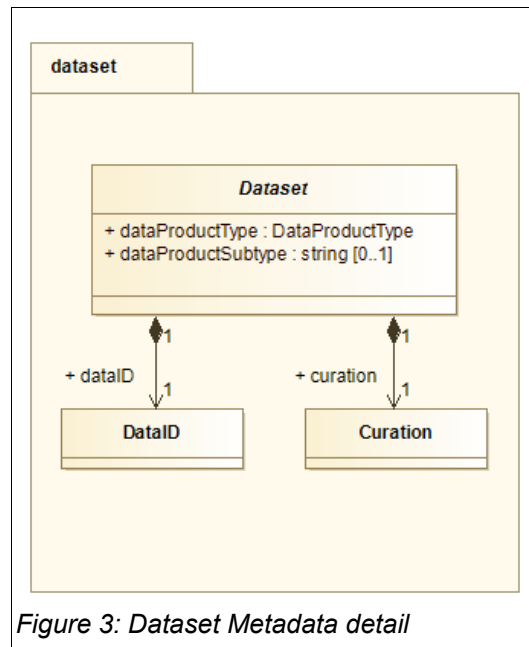


Figure 3: Dataset Metadata detail

Abstract object for the generic IVOA Dataset. It is intended to be useful for any type of data. Specific dataset models should extend this object, providing detailed definitions and additional content as appropriate for that type of dataset.

2.1.1 Dataset.dataProductType

type: DataProductType
multiplicity: 1

type-detail: Section [5.2.2](#)

Describes the high level scientific classification of the data content. Values are restricted to the DataProductType enumeration set and convey the general idea of the content and organization of a dataset.

2.1.2 Dataset.dataProductSubtype

type: string
multiplicity: 0..1

type-detail: Section [5.1](#)

Secondary type classification for the dataset. This field is intended to precisely specify the scientific nature of the data product, possibly in terms relevant only to a specific archive or data collection. For example, dataProductType='image' could have associated dataProductSubtype='src.image', 'bkg.image', 'PixelMask', etc. Values are unrestricted strings.

2.1.3 Dataset.curation

type: Curation
multiplicity: 1

type-detail: Section [2.6](#)

Provides metadata related to the entity responsible for the curation of the dataset.

2.1.4 Dataset.dataID

type: DataID
multiplicity: 1

type-detail: Section [2.7](#)

DataID provides high level identification metadata for the dataset itself, and any associations with various collections.

2.2 Collection

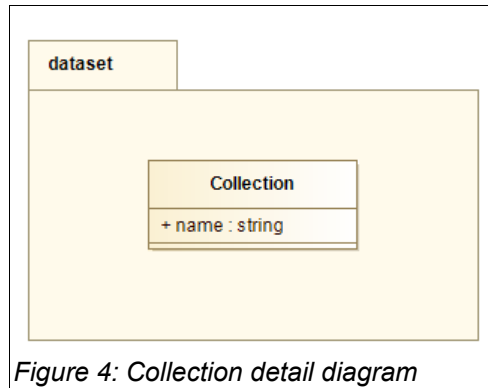


Figure 4: Collection detail diagram

A generic organizational construct which allows Datasets to be associated with each other by a set of Collection properties. Datasets tagged with the same Collection properties can be assumed to have some degree of compatibility.

2.2.1 Collection.name

type: string
multiplicity: 1

type-detail: Section [5.1](#)

The values are generally defined by the creating entity. Examples: "WFC", "Sloan", "BFS Spectrograph", "MSX Galactic Plane Survey".

2.3 Contact

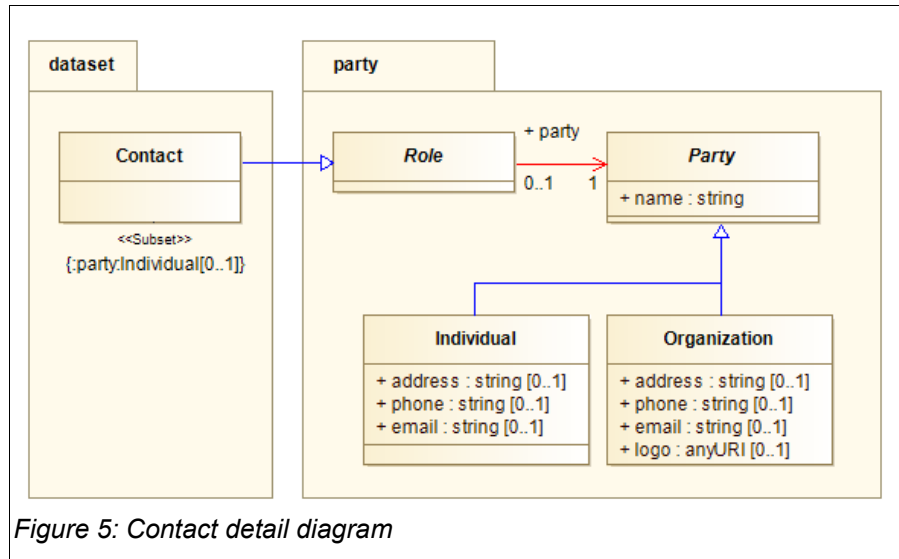


Figure 5: Contact detail diagram

Contact information for a person or entity.

Contact is modeled as a Role played by a particular person or entity (Party). We subset the type of Party to include only Individuals. This includes both a physical person, or proxy service such as a helpdesk.

Party package is described in Section [4](#)

2.4 Contributor

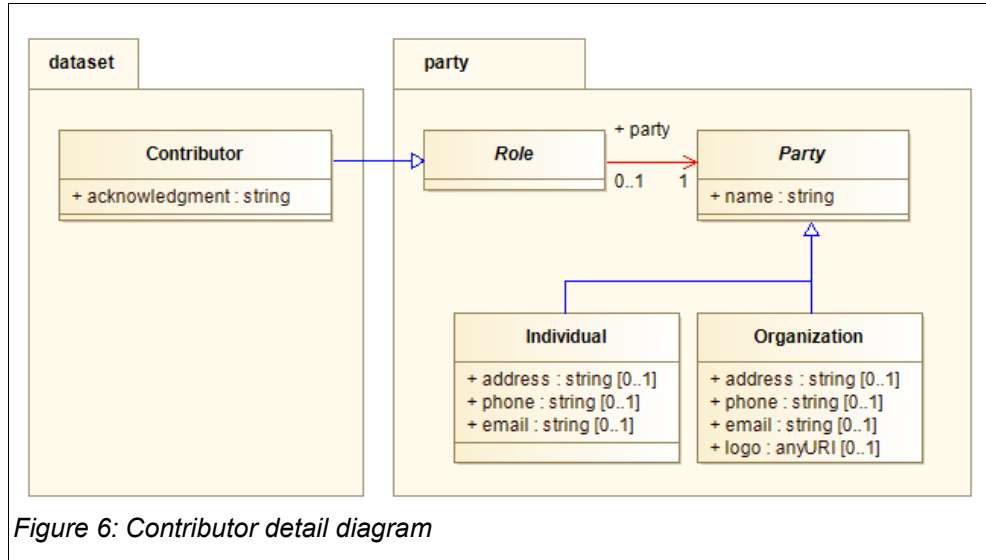


Figure 6: Contributor detail diagram

Contributor is modeled as a Role played by a Party or entity who participated in the generation of the Dataset.

Party package is described in Section [4](#)

2.4.1 Contributor.acknowledgment

type: string

type-detail: Section [5.1](#)

multiplicity: 1

Acknowledgment expression for the contributor. Users of the dataset should include these in subsequent credits and acknowledgements. The expression should be formatted as desired by the contributor.

2.5 Creator

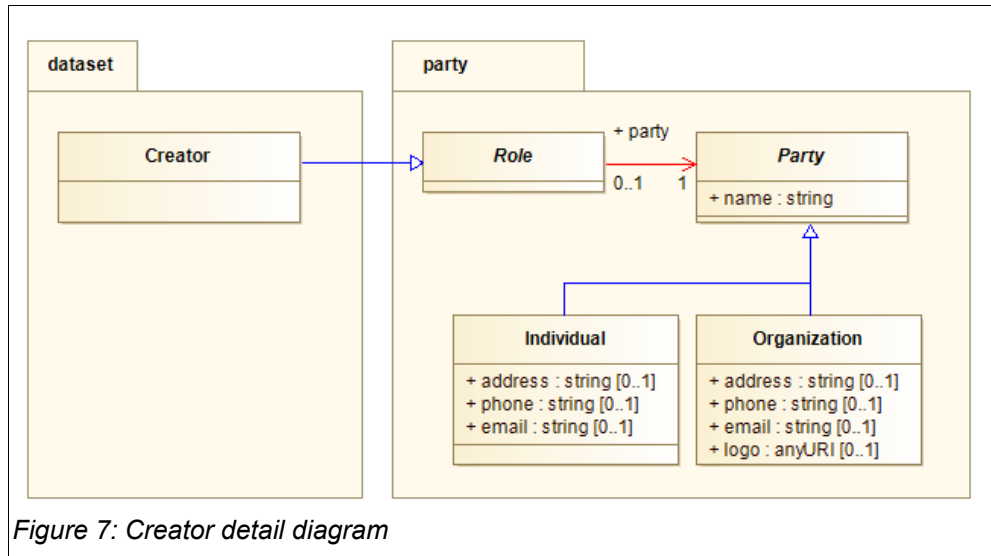


Figure 7: Creator detail diagram

Creator is modeled as a Role played by the organization or entity which created the Dataset.

Party package is described in Section [4](#)

2.6 Curation

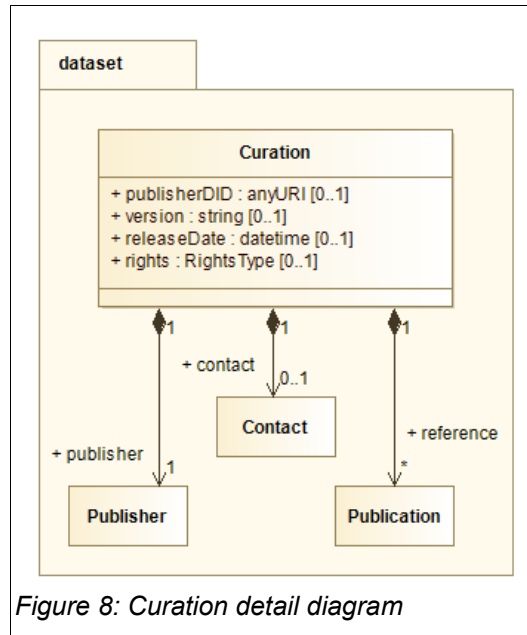


Figure 8: Curation detail diagram

The Curation object provides metadata assigned by the entity responsible for the support of the dataset content as well as identifying metadata about that entity. It is assembled from definitions provided by the IVOA Resource Metadata document. Here, we provide a brief description of each field for easy reference, along with a notation of its mapping to the Resource Metadata document (RM:field), where the reader may find more detailed information.

2.6.1 Curation.contact

type: Contact
multiplicity: 0..1

type-detail: Section [2.3](#)

Contact information of the person/entity responsible for the content of the dataset. We recommend using a generic 'helpdesk' type contact rather than individuals whose information may more easily become obsolete. (RM:Curation.Contact)

2.6.2 Curation.publisher

type: Publisher
multiplicity: 1

type-detail: Section [2.9](#)

The entity making the data available. (RM:Curation.Publisher)

2.6.3 Curation.publisherDID

type: anyURI
multiplicity: 0..1

type-detail: [Section 5.1](#)

IVOA dataset identifier assigned by the publisher to uniquely identify the dataset within its holdings. Typically, the basis of this identifier will be the publisher ID. However, if the publisher chooses to use a 'global index service' such as ADS to obtain persistent identifiers for their datasets, rather than generate their own, that identifier should be used both here and for DataID.datasetID. Note: this model also defines a creator dataset ID (DataID.creatorDID), these will differ if the publishing entity is not the creator of the dataset. Values are to be expressed as dataset identifiers using the syntax described in "IVOA Identifiers"[2].

2.6.4 Curation.reference

type: Publication
multiplicity: 0..*

type-detail: [Section 2.8](#)

Zero or more bibliographic or documentation references associated with the dataset. Each instance provides a single forward link to a major publication which references the dataset. (RM:General.Source)

2.6.5 Curation.releaseDate

type: datetime
multiplicity: 0..1

type-detail: [Section 5.1.3](#)

Date the curated dataset was last modified. (RM:Curation.Date)

2.6.6 Curation.rights

type: RightsType
multiplicity: 0..1

type-detail: [Section 5.2.3](#)

Indicates the level of access being granted. Values are restricted to the RightsType enumeration set. (RM:Collection.Rights)

2.6.7 Curation.version

type: string
multiplicity: 0..1

type-detail: [Section 5.1](#)

Version of the curated dataset, assigned by the publisher. This is an independent versioning from DataID.version that allows the publisher to track changes to the high level dataset metadata (e.g. curation metadata, identifiers, etc.) without effecting the creator defined dataset version. The value may be based on the DataID.version (e.g. by adding a sub-version extension), or an independent versioning. There are no format restrictions on the value. (RM:Curation.Version)

2.7 DataID

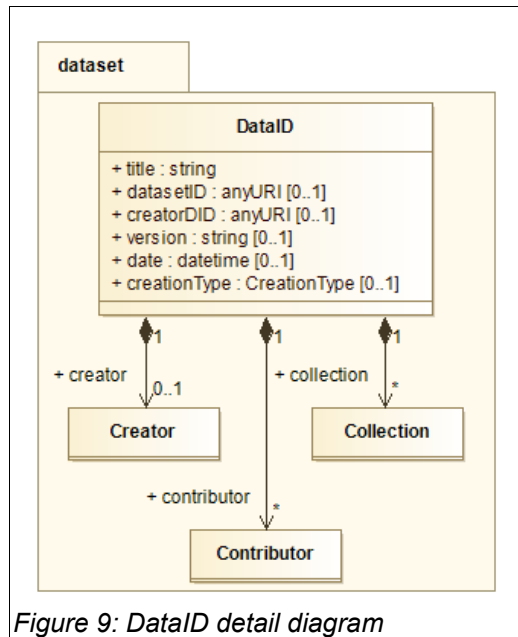


Figure 9: DataID detail diagram

The Data Identification object (DataID) stores the dataset identifiers and other metadata typically assigned by the dataset creator.

The Dataset IDs in this object must comply with the syntax for dataset identifiers defined in the "IVOA Identifiers" [2] document, including the use of 'stop' characters to identify specific datasets that are not individually in the registry. e.g., `ivo://example.net/aservice?2013/5/2342`.

Much of the content of this object is assembled from various definitions in the IVOA Resource Metadata document. Here, we provide a brief description of each field for easy reference, along with a notation of its mapping to the Resource Metadata document (RM:field), where the reader may find more detailed information.

2.7.1 DataID.collection

type: Collection
multiplicity: 0..*

type-detail: Section [2.2](#)

The dataset is associated with zero or more Collections (instrument name, survey name, etc.) . Each instance identifies a tag indicating some degree of compatibility with other data sharing the same Collection properties.

2.7.2 DataID.contributor

type: Contributor
multiplicity: 0..*

type-detail: Section [2.4](#)

Persons or entities who contributed to the generation of the scientific content of the dataset. Users of the dataset should include these in subsequent credits and acknowledgements. (RM:Curation.Contributor)

2.7.3 DataID.creationType

type: CreationType
multiplicity: 0..1

type-detail: Section [5.2.1](#)

The dataset creation type describes the nature or genre of the content. Values are restricted to the CreationType enumeration set. (RM:General.Type)

Note: This field provides information about the process by which the dataset was created. As the Observation/Experiment model matures, this may evolve into a provenance element on the Experiment type.

2.7.4 DataID.creator

type: Creator
multiplicity: 0..1

type-detail: Section [2.5](#)

The institution or entity which created the dataset. (RM:Curation.Creator)

2.7.5 DataID.creatorDID

type: anyURI
multiplicity: 0..1

type-detail: Section [5.1](#)

The dataset identifier assigned by the creator. Here, the authority-id of the identifier must be that of the creator. It is used to identify the original exposure of the dataset in an archive, and will remain static regardless of where the dataset is published. The creator ID will not necessarily change even if the VO object in question is a cutout or is otherwise further processed.

2.7.6 DataID.datasetID

type: anyURI
multiplicity: 0..1

type-detail: Section [5.1](#)

If the dataset is registered with an external 'global index service' such as ADS, the publisher may include that identifier here. This provides a common, persistent identifier for the dataset, and possible access point to follow for information on publications and other related datasets. Note: the same dataset published at more than one location would have different Curation.publisherDID values, but the same DataID.datasetID. eg: "ivo://ADS/Sa.CXO?obsid=1234", "ivo://ADS/sh.hut#ngc4151_141"

2.7.7 DataID.date

type: datetime
multiplicity: 0..1

type-detail: Section [5.1.3](#)

Data processing or creation date (RM:Curation.Date).

2.7.8 DataID.title

type: string
multiplicity: 1

type-detail: Section [5.1](#)

A free form string giving a title for the dataset. (RM:Identity.Title)

2.7.9 DatalD.version

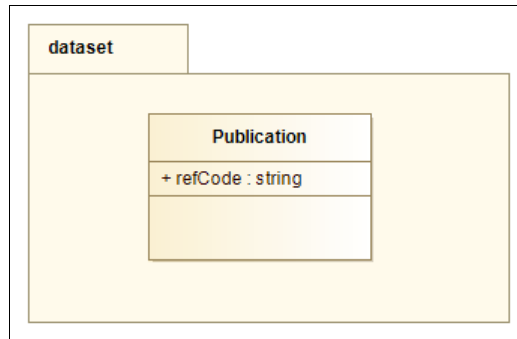
type: string

type-detail: [Section 5.1](#)

multiplicity: 0..1

Version assigned by the creator, reflecting the production version of the dataset. This value should only be changed by the creator, upon the new release of a dataset. There are no format restrictions or specifications on the versioning scheme.

2.8 Publication



Any referenceable publication associated with a Dataset.

2.8.1 Publication.refCode

type: string
multiplicity: 1

type-detail: [Section 5.1](#)

Reference code of the publication. Values should be expressed as a URI formatted in accordance to an accepted schema. For example: a 'doi' should use the form described by the doi schema (<http://doi.org>); bibcode according to the bibcode pattern, namely a 19 character string beginning with 4 digits. Free text references are allowed, but discouraged. If used, they must not start with the pattern "[a-zA-Z]++:" to ensure they are not interpreted as URIs.

2.9 Publisher

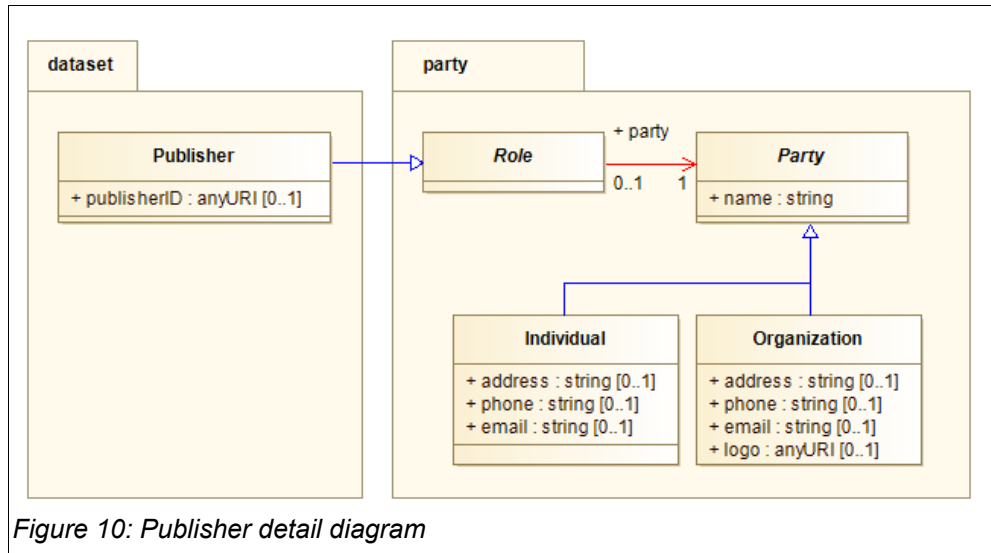


Figure 10: Publisher detail diagram

Publisher is modeled as a Role played by the organization or entity making the Dataset available.

Party package is described in Section [4](#)

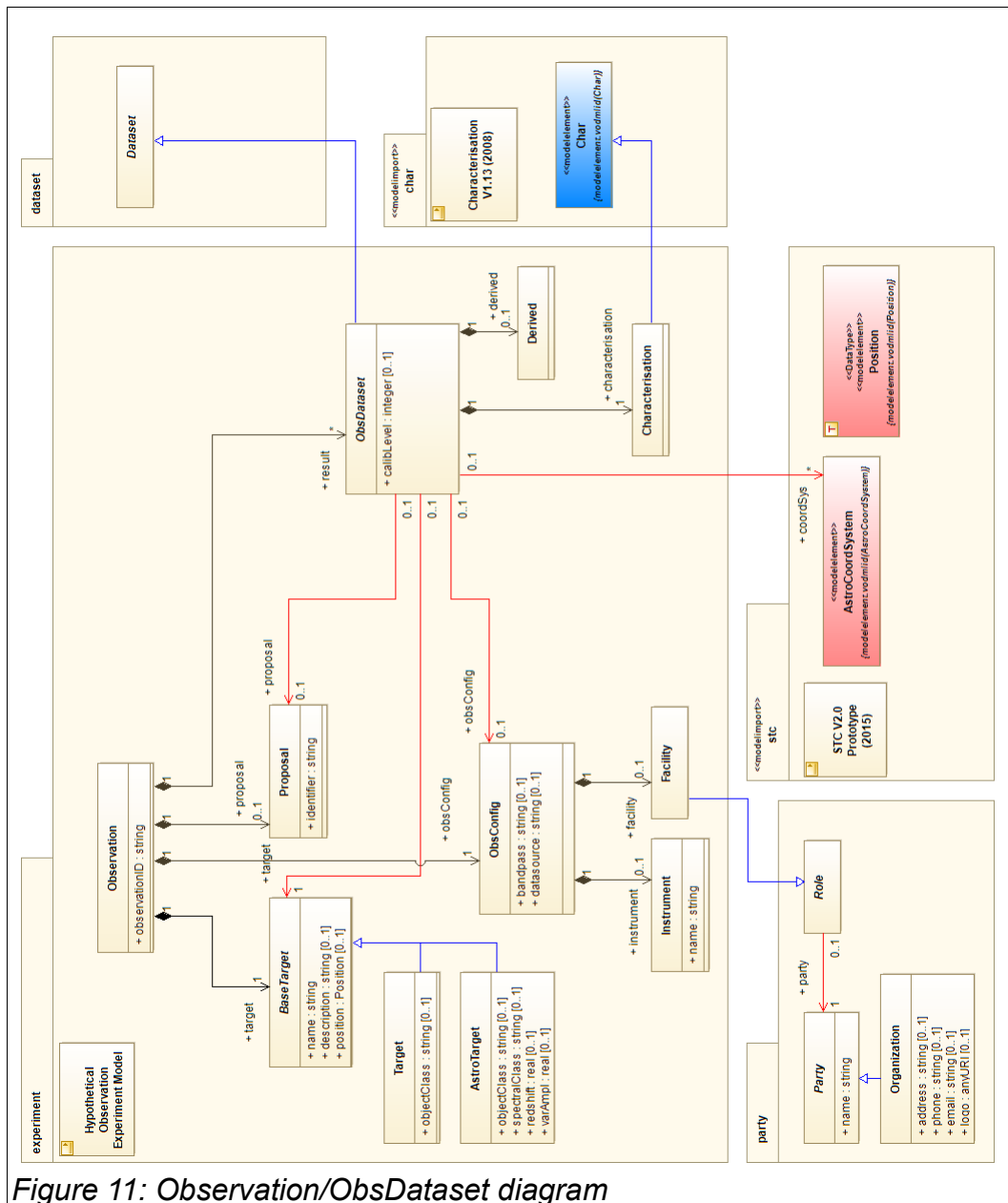
2.9.1 Publisher.publisherID

type: anyURI

type-detail: Section [5.1](#)

multiplicity: 0..1

IVOA resource identifier associated with the publisher and registered with an IVOA compliant registry (eg: `ivo://mast.stsci.edu`). Values are to be expressed using the syntax described in "IVOA Identifiers"[2].



3 Observation-Experiment

An Observation Dataset (ObsDataset) is modeled as the result of an Observation, and refers to several elements related to the Observation and its configuration. As of the time of this writing, there is no IVOA recommendation for a general Observation data model. The Provenance data model, in progress, will define the pattern for describing the relation between actions and results, and how to record these in datasets. In lieu of these standards, this document defines a straw-man Observation model.

3.1 Observation

Head class for an Observation Experiment.

The Observation is modeled as a type of 'Experiment', with some basic structure defined to provide metadata about the observation target and configuration. The product, or 'result' of the Observation is zero or more ObsDataset objects. This pattern is inspired by, and compatible with the Simulation Data Model [6], where a 'Simulation' can be considered another form of 'Experiment' or perhaps even another form of 'Observation'.

3.1.1 Observation.observationID

type: string
multiplicity: 1

type-detail: [Section 5.1](#)

Internal ID determined by the data provider to uniquely identify the observation within the institution or entity performing the observation.

3.1.2 Observation.target

type: BaseTarget
multiplicity: 1

type-detail: [Section 3.4](#)

The target of the observation. The content of this object may vary greatly depending on the goals and nature of the observation. For example, the 'target' could be a galaxy, stellar object, planet, or calibration source. As such, we allow the BaseTarget class here, and permit users to define and use more content rich flavors according to their needs.

3.1.3 Observation.obsConfig

type: ObsConfig
multiplicity: 1

type-detail: [Section 3.11](#)

Observation configuration metadata, provides information about who, where, and how the observation was conducted.

3.1.4 Observation.proposal

type: Proposal
multiplicity: 0..1

type-detail: [Section 3.12](#)

Identifies any proposal related to the observation. This field may be used to gather all observations and products related to a particular proposal.

3.1.5 Observation.result

type: ObsDataset
multiplicity: 0..*

type-detail: [Section 3.2](#)

The result of an observation is zero or more Observation Datasets

3.2 ObsDataset

ObsDataset is an abstract extension of Dataset defining additional metadata relevant to Datasets which are derived from Observations. This metadata gives a high-level summary of the coverage of the dataset in coordinate space, as well as the coordinate systems used, and general information about the observation itself.

3.2.1 ObsDataset.calibLevel

type: integer
multiplicity: 0..1

type-detail: [Section 5.1](#)

High level classification for the calibration level of a particular dataset as a whole. The calibration level concept conveys to the user information on how much data reduction/processing has been applied to the data. It is up to the data providers to consider how to map their own internal classification to the scale defined here.

Scale:

- 0 - Raw instrumental data, in a proprietary or internal data-provider defined format.
- 1 - Instrumental data in a standard format (FITS, VOTable, etc)
- 2 - Calibrated, science ready data with the instrument signature removed.
- 3 - Enhanced data products like mosaics, resampled or drizzled images, or heavily processed survey fields. Level 3 data products may represent the combination of data from multiple primary observations.

3.2.2 ObsDataset.characterisation

type: Characterisation
multiplicity: 1

type-detail: [Section 3.5](#)

Characterisation provides a 'characteristic' view of the dataset coordinate space. For each represented domain (spatial, spectral, temporal, etc), characterisation provides metadata summarizing the coverage, resolution, representative accuracies, etc. for the dataset as a whole.

3.2.3 ObsDataset.coordSys

type: AstroCoordSystem
multiplicity: 0..*

type-detail: [Section 6.1.2](#)

Zero or more references to coordinate system definitions associated with the dataset. Since multiple data products may contribute to the content of a dataset, this element provides convenient, high-level access to definitions which may be distributed among lower-level objects.

3.2.4 ObsDataset.derived

type: Derived
multiplicity: 0..1

type-detail: [Section 3.6](#)

Provides a high level summary of certain properties of the dataset. Its primary purpose is to support high level filtering of datasets during data discovery.

3.2.5 ObsDataset.obsConfig

type: ObsConfig
multiplicity: 0..1

type-detail: Section [3.11](#)

Reference to ObsConfig object from Observation. This object provides some high-level metadata related to the observation configuration.

3.2.6 ObsDataset.observationID

type: id
multiplicity: n/a

type-detail: n/a

Implicit element of the ObsDataset object due to the composition relation to Observation. This is an internal ID determined by the data provider to identify the Observation from which the dataset was produced.

3.2.7 ObsDataset.proposal

type: Proposal
multiplicity: 0..1

type-detail: Section [3.12](#)

Reference to Proposal object from Observation. This object provides metadata identifying any proposal related to the observation which produced the dataset.

3.2.8 ObsDataset.target

type: BaseTarget
multiplicity: 1

type-detail: Section [3.4](#)

Reference to a BaseTarget object from Observation. Provides metadata describing the target of the observation.

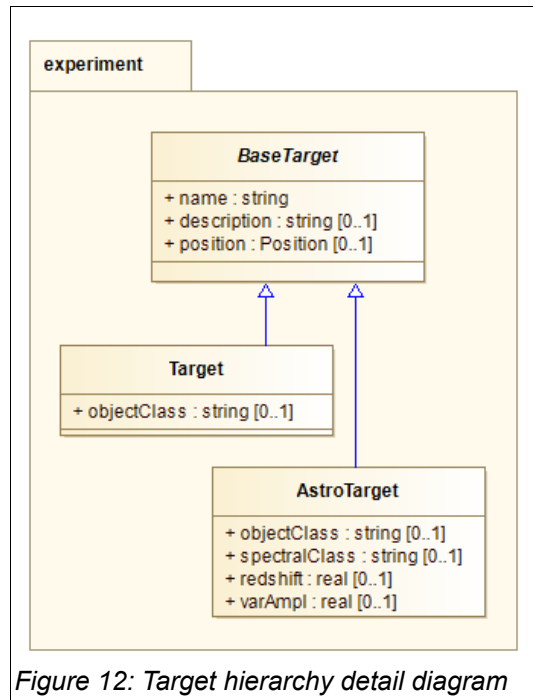


Figure 12: Target hierarchy detail diagram

3.3 AstroTarget

Extension of BaseTarget specialized for astronomical objects. The AstroTarget defines additional astronomical properties of the target.

3.3.1 AstroTarget.name

type: string
multiplicity: 1

type-detail: [Section 5.1](#)

When referring to an astronomical target, one may specify a particular object, or a more general target such as the name of a survey field. When specifying a particular object, it is highly recommended to use a name suitable for input to a name resolver.

3.3.2 AstroTarget.position

type: Position
multiplicity: 0..1

type-detail: [Section 6.5.2](#)

In the context of the astronomical target, this field gives the nominal RA and Dec location for the target. For example, the catalog position of the source.

3.3.3 AstroTarget.objectClass

type: string
multiplicity: 0..1

type-detail: [Section 5.1](#)

General classification or type of the target. This field supports the discovery of data pertaining to a common class of object, e.g. "Star", "Galaxy", "AGN". At the time of this writing, there is no

IVOA recommended vocabulary for this field. The SIMBAD and NED databases use defined vocabularies for astronomical object classifications which may serve as the basis for such.

3.3.4 **AstroTarget.spectralClass**

type: string

type-detail: Section [5.1](#)

multiplicity: 0..1

Spectral class of the object. As with objectClass, there is no IVOA recommended vocabulary for specifying the spectral class of an object. There is an IVOA Note on the subject entitled "An encoding system to represent stellar spectral classes in archival databases and catalogs"[7], describing an encoding system which has been adopted by the MAST archive.

3.3.5 **AstroTarget.redshift**

type: real

type-detail: Section [5.1](#)

multiplicity: 0..1

This field gives the canonical redshift of the astronomical object. It is normally used to store the cosmological redshift of extragalactic objects, although it may also be used to store the observed redshift of Galactic sources if that information is felt by the data provider to be useful.

3.3.6 **AstroTarget.varAmpl**

type: real

type-detail: Section [5.1](#)

multiplicity: 0..1

Canonical variability amplitude attributed to the target.

3.4 BaseTarget

Abstract base class for the Target object tree. The target object provides identifying metadata related to the subject or goal of the experiment. For an Observational experiment, this would typically be an astronomical object. The BaseTarget class defines high-level identifying information, and must be extended for particular classes of Target which may define additional characteristics.

3.4.1 BaseTarget.name

type: string

type-detail: [Section 5.1](#)

multiplicity: 1

The target name. The primary purpose of this field is to provide the user with a recognizable identity of the particular subject or goal. However, since this may be a query-able field in data discovery protocols, care should be taken to use values which follow conventions for the domain appropriate for the data. For an astronomical object, this may be a name suitable for use within a domain-specific resolution service. Simulated data might also use this sort of name (if simulating a particular object), or a more generic term such as "G2V star".

3.4.2 BaseTarget.description

type: string

type-detail: [Section 5.1](#)

multiplicity: 0..1

Free form description of target.

3.4.3 BaseTarget.position

type: Position

type-detail: [Section 6.5.2](#)

multiplicity: 0..1

This field provides the spatial location of the target. The value is a STC Position object which supports all required dimensionality and coordinate frame specification needs.

3.5 Characterisation

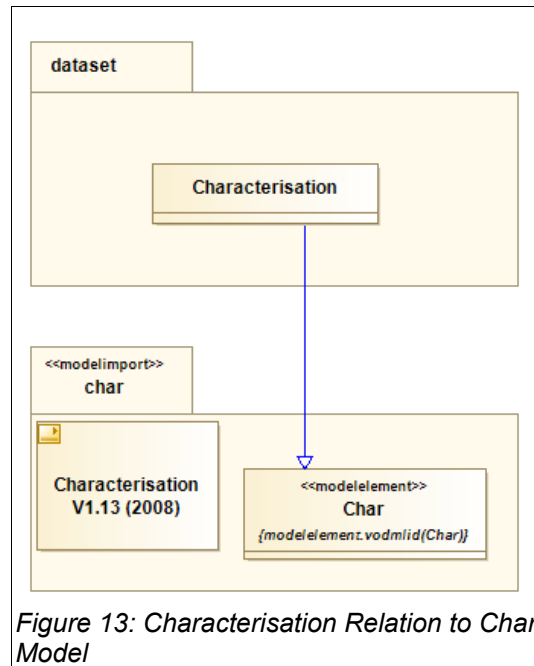


Figure 13: Characterisation Relation to Char Model

This Characterisation object is a direct extension of the Characterisation object from the IVOA Characterisation Data Model Standard [3]. This provides a local object which may be contained in a 'composition' relation within this model (specifically ObsDataset). This object may be extended and/or modified by specific Dataset models as needed.

Characterisation provides a broad scale description of the coordinate space occupied by the dataset in each of the axis domains. This includes axes not directly represented in the dataset 'data', for example, the Time axis of a 2D spatial image. As such, there is a strong correlation between Characterisation and Data objects. In some cases, the values may be directly derived from the data, in others, they provide supporting metadata about the broader domain. For example, the Accuracy fields in Characterisation represent typical accuracy for the dataset, while those within Data provide per-data-point errors.

3.6 Derived

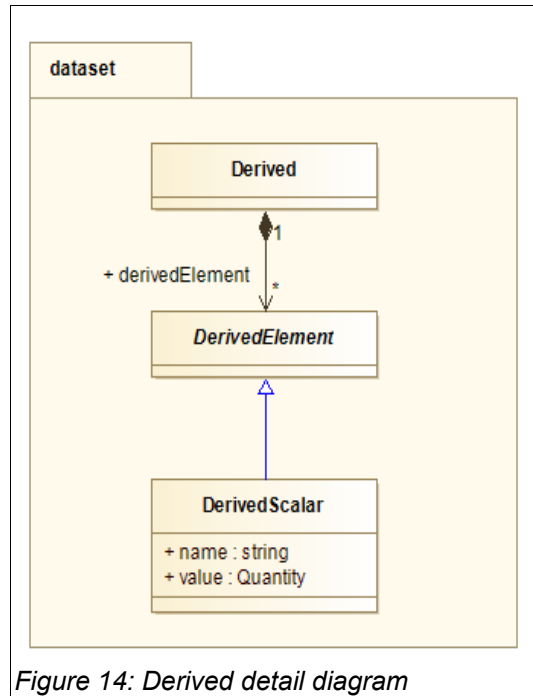


Figure 14: Derived detail diagram

The Derived (short for Derived Data) object holds derived information obtained by evaluating or analyzing the contents of the dataset. The specific content of this object is strongly dependent on the specific type of dataset, so we provide a generic model which may be specialized in other models to define elements appropriate for that type of dataset.

The primary purpose of this object is to provide a common framework in which specific information may be placed to aid in discovery and filtering of datasets in various access protocols.

3.6.1 Derived.derivedElement

type: DerivedElement

type-detail: [Section 3.7](#)

multiplicity: 0..*

Collection of zero or more DerivedElement objects, each of which provides a specific quantity obtained by analyzing the dataset content.

3.7 DerivedElement

Abstract base for defining derived data elements. Typically, models for specific data products would extend this object to define various elements appropriate for that model. For example, the Spectrum model could define signal-to-noise ratio (SNR), or TimeSeries could define period, or variability. We put no restriction on the DerivedElement content since the result could be a simple value or a complex object. However, it is recommended that extensions be simple and compact in keeping with the primary intent of use in data discovery.

3.8 DerivedScalar

Simple extension of DerivedElement class which can serve many use cases. Usages of this object in other models to define specific elements should explicitly define the element name, and the process by which the value is determined.

3.8.1 DerivedScalar.name

type: string
multiplicity: 1

type-detail: Section [5.1](#)

Name identifying the derived element.

3.8.2 DerivedScalar.value

type: Quantity
multiplicity: 1

type-detail: Section [5.1](#)

Value of the derived element.

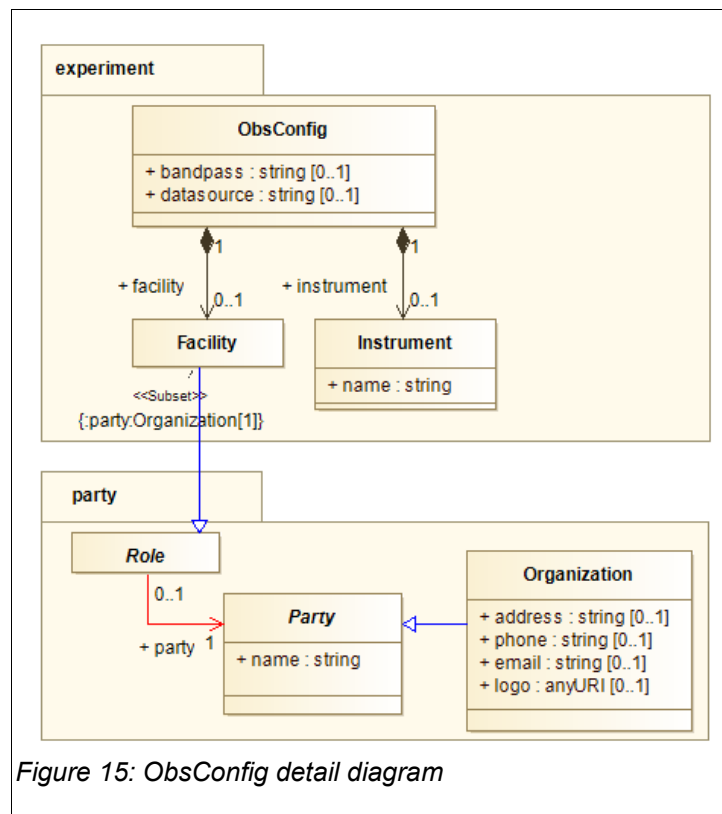


Figure 15: ObsConfig detail diagram

3.9 Facility

The Facility performing the observation. This is modeled as the Role played by a particular Organization (Party entity).

3.10 Instrument

The instrument used to create the data. This can be a specific instrument, general type or something else, such as a program in the case of theoretical data. (RM:Collection.Instrument)

3.10.1 Instrument.name

type: string

type-detail: Section [5.1](#)

multiplicity: 1

Name of the instrument.

3.11 ObsConfig

ObsConfig describes all Observation Configuration metadata. We define a small set of configuration elements which are required as Provenance in the observation dataset.

3.11.1ObsConfig.bandpass

type: string

type-detail: [Section 5.1](#)

multiplicity: 0..1

Describes the Spectral domain of the Observation in very general sense.

The value may be expressed in terms of general spectral bands, or specific bandpass names. If multiple bands are covered, the value may be a comma delimited combination of appropriate bands. If expressed as general bands, the value(s) must be selected from the enumerated set given by the SpectralBand type. There is no controlled vocabulary for specific bandpass names as the list is too long to enumerate. Effort should be made to use highly recognized bandpass names (eg: "U","V","B","R","I", "H-alpha").

This field corresponds to both the Coverage.Spectral and Coverage.Spectral.Bandpass fields of the Resource Metadata document.

3.11.2ObsConfig.dataSource

type: string

type-detail: [Section 5.1](#)

multiplicity: 0..1

Describes the original source of the data in a very general fashion. In other words, "What sort of observation originally generated the data?" Suggested values include:

- **survey:** Survey data typically covers some region of observational parameter space with as complete as possible coverage within that region.
- **pointed:** Pointed data of a particular object or field.
- **theory:** Theory data, generated based on a theoretical model.
- **artificial:** Artificial, or simulated data. Similar to 'theory', but not necessarily based on a theoretical model.
- **custom:** Custom data, as part of a specific research project.

3.11.3ObsConfig.facility

type: Facility

type-detail: [Section 3.9](#)

multiplicity: 0..1

Metadata pertaining to the facility performing the observation.

3.11.4ObsConfig.instrument

type: Instrument

type-detail: [Section 3.10](#)

multiplicity: 0..1

Metadata pertaining to the instrument used to create the data.

3.12 Proposal

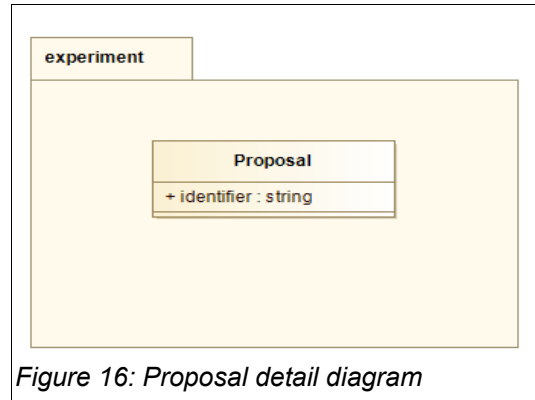


Figure 16: Proposal detail diagram

Metadata related to the proposal or document which spawned the observation.

3.12.1 Proposal.identifier

type: string

type-detail: [Section 5.1](#)

multiplicity: 0..1

Tag used to uniquely identify a particular proposal within the institution or entity.

3.13 Target

Extension of BaseTarget, this is a general purpose Target object.

3.13.1 Target.objectClass

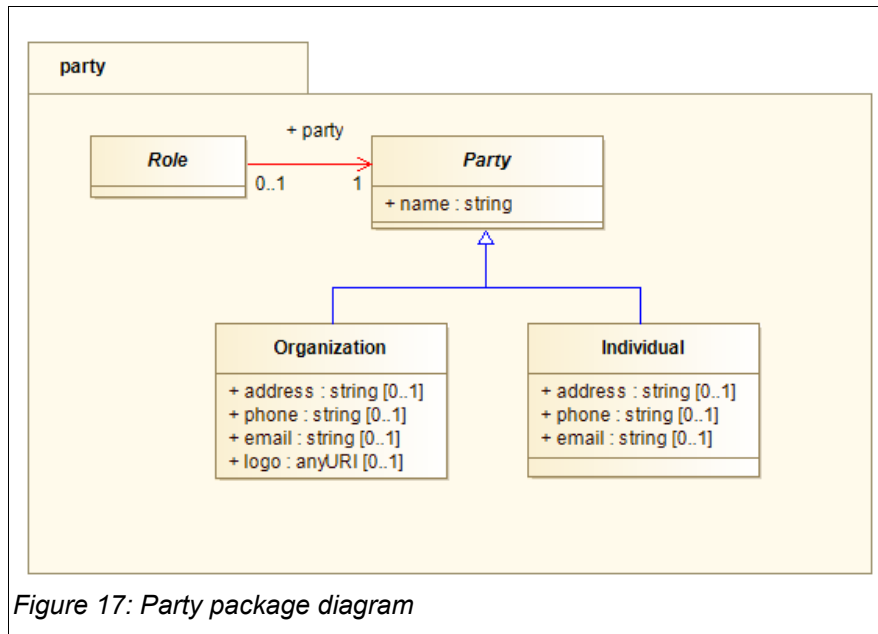
type: string

type-detail: [Section 5.1](#)

multiplicity: 0..1

General classification or type of the target. This field supports the discovery of data pertaining to a common class of object, e.g. "Star", "Galaxy", "AGN". At the time of this writing, there is no IVOA recommended vocabulary for this field. The SIMBAD and NED databases use defined vocabularies for astronomical object classifications which may serve as the basis for such.

4 Party Package



We include a simple Party model for associating an Entity with a Role that Entity is playing. For example, a particular Individual can be both a Contact and Publisher of a dataset.

4.1 Role

Abstract class for the entity role. Models should extend this class to define local roles which are played by various entities/parties.

4.1.1 Role.party

type: Party
multiplicity: 1

type-detail: [Section 4.2](#)

Reference to the Party or Entity which is associated with this role.

4.2 Party

Abstract head of the set of classes describing various entities.

4.2.1 Party.name

type: string
multiplicity: 1

type-detail: [Section 5.1](#)

Name of the Party or entity. All entities are assumed to have a name.

4.3 Individual

Party which describes an individual or representative.

4.3.1 Individual.address

type: string
multiplicity: 0..1

type-detail: [Section 5.1](#)

Mailing address for the Individual. The value is expressed as a single string containing all components of the address.

4.3.2 Individual.email

type: string
multiplicity: 0..1

type-detail: [Section 5.1](#)

E-mail address of the Individual.

4.3.3 Individual.phone

type: string
multiplicity: 0..1

type-detail: [Section 5.1](#)

Phone number associated with the Individual. The value is expressed as a string according to the format appropriate for the locale.

4.4 Organization

Extension of Party for any Organization or Institution.

4.4.1 Organization.address

type: string
multiplicity: 0..1

type-detail: [Section 5.1](#)

Mailing address. The value is expressed as a single string containing all components of the address.

4.4.2 Organization.email

type: string
multiplicity: 0..1

type-detail: [Section 5.1](#)

E-mail address of the Organization.

4.4.3 Organization.logo

type: anyURI
multiplicity: 0..1

type-detail: [Section 5.1](#)

URL pointer to a graphical logo associated with the Organization.

4.4.4 Organization.phone

type: string
multiplicity: 0..1

type-detail: [Section 5.1](#)

Phone number. The value is expressed as a string according to the format appropriate for the locale.

5 Data Types

5.1 Base Data Types

Provides a set of standardized primitive data types as well as types for representing quantities (values with associated units and ucd). We provide a diagram of the model here, and refer the reader to Appendix E of the VO-DML modeling specification document[8] for more information.

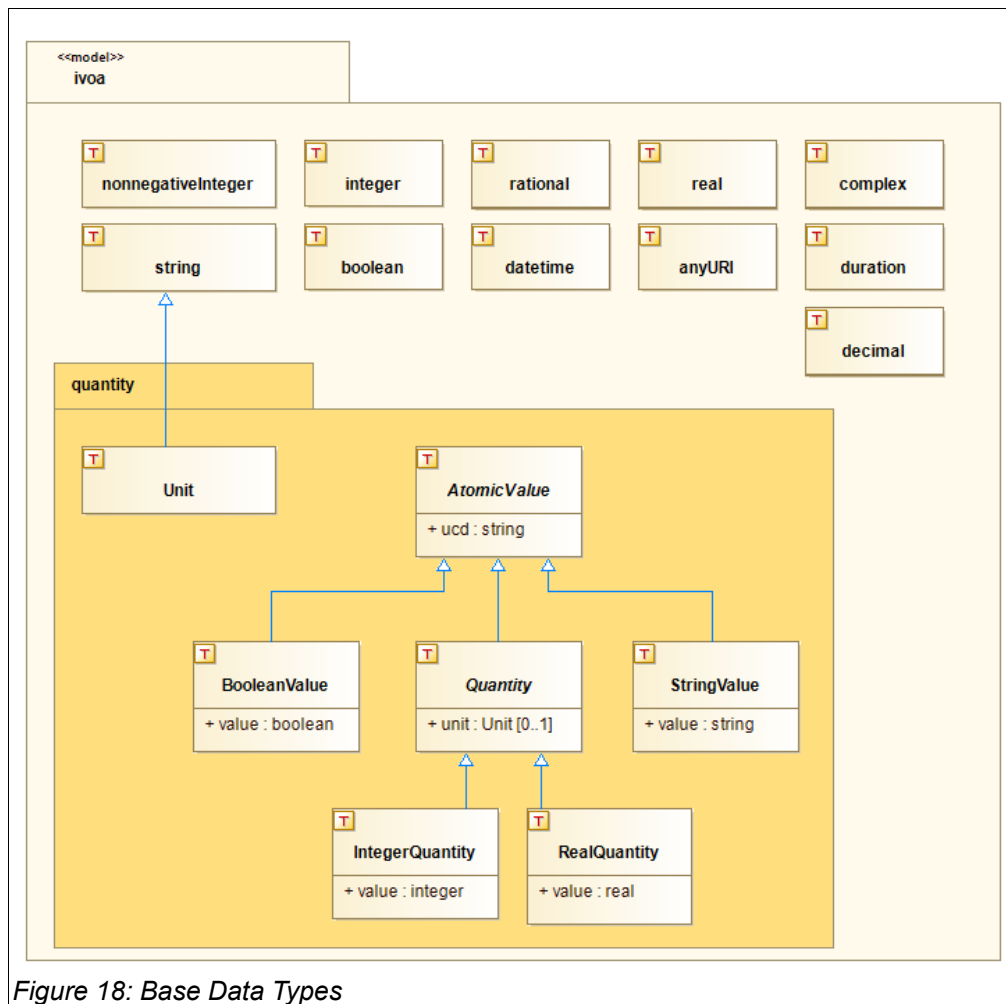


Figure 18: Base Data Types

5.1.1 Units

This model requires the use of the IVOA VOUnits Standard[9] for representing units of physical quantities. This standard reconciles common practices and current standards for use within the IVOA community.

5.1.2 UCDs

This model requires the ucd field to comply with syntax defined in "An IVOA Standard for Unified Content Descriptors"[11].

5.1.3 Dates

The 'datetime' datatype is for expressing date-time values. The string representation of a datetime value should follow the FITS convention for representing dates. The FITS standard is effectively ISO8601 format without the "Z" tag to indicate UTC (YYYY-MM-DDThh:mm:ss). Values are nominally expressed in UTC.

5.2 Dataset Model DataTypes

The Dataset model has gathered and homogenized data type definitions from previous specifications like ObsCore (DataProductType), VOResource (RightsType), and VODataservice (SpectralBandType).

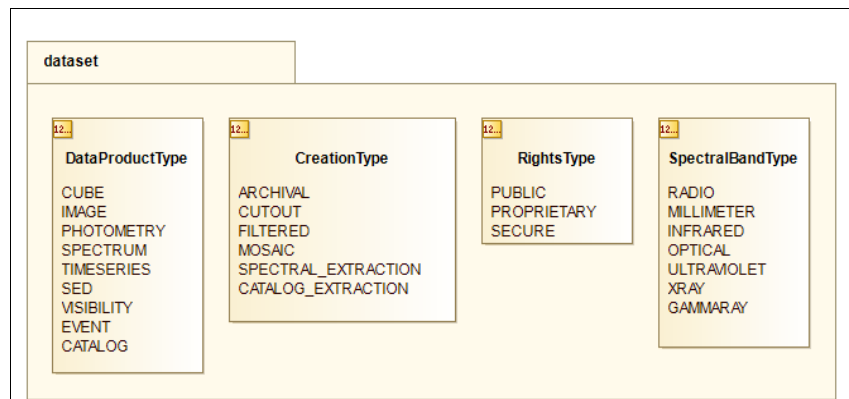


Figure 19: Dataset model datatypes

5.2.1 CreationType

Enumeration of dataset creation types. Allowed values are:

Token	Label	Meaning
ARCHIVAL	archival	Indicates that it is one of a collection of datasets generated in a systematic, homogeneous way and is stored statically (or at least versioned). It will be possible to regenerate this dataset at a later date. The remaining types imply on-the-fly manipulation.
CUTOUT	cutout	Indicates that the dataset was created "on-the-fly", by subsetting, but not by modifying values.
FILTERED	filtered	May involve excluding data prior to binning into samples, also "on-the-fly"
MOSAIC	mosaic	Combines multiple original datasets "on-the-fly"
SPECTRAL_EXTRACTION	spectral extraction	Has been extracted, for example, from a spectral data cube.
CATALOG_EXTRACTION	catalog extraction	Has been extracted from a catalog.

5.2.2 DataProductType

Enumeration identifying the high level classification of a data product. Allowed values are:

Token	Label	Meaning
CUBE	cube	A multidimensional astronomical image of three (3) or more axes.
IMAGE	image	A two (2) dimensional astronomical image.
PHOTOMETRY	photometry	Dataset with spectral coverage with irregular gaps.
SPECTRUM	spectrum	Dataset where spectral coverage is the primary attribute, in contiguous bins. e.g. a 1D spectrum or a long slit spectrum.
TIMESERIES	timeseries	Dataset presenting some quantity varying as a function of time. A light curve is a typical example of a timeseries dataset.
SED	sed	A spectral energy distribution, an advanced data product often produced by combining data from multiple observations.
VISIBILITY	visibility	A visibility (radio) dataset. Typically this is instrumental data, and is often a complex object containing multiple files or other substructures. A visibility dataset may contain data with spatial, spectral, time, and polarization information for each measured visibility.
EVENT	event	An event counting dataset (e.g. X-ray). An event dataset may contain data with spatial, spectral, and time information for each measured event.
CATALOG	catalog	A catalog.

5.2.3 RightsType

Enumeration indicating access rights levels. Allowed values are:

Token	Label	Meaning
PUBLIC	public	unrestricted, public access is allowed, without authentication.
SECURE	secure	authenticated, public access is allowed.
PROPRIETARY	proprietary	only proprietary access is allowed with authentication.

5.2.4 SpectralBandType

Enumeration of generic spectral bands:

Token	Label	Meaning (λ =wavelength, ν =frequency, E=energy)
RADIO	Radio	$\lambda \geq 10 \text{ mm}; \nu \leq 30 \text{ GHz}$
MILLIMETER	Millimeter	$0.1 \text{ mm} \leq \lambda \leq 10 \text{ mm}; 3000 \text{ GHz} \geq \nu \geq 30 \text{ GHz}$
INFRARED	Infrared	$1 \mu \leq \lambda \leq 100 \mu$
OPTICAL	Optical	$0.3 \mu \leq \lambda \leq 1 \mu$
ULTRAVIOLET	Ultraviolet	$100 \text{ \AA} \leq \lambda \leq 3000 \text{ \AA}; 1.2 \text{ eV} \leq E \leq 120 \text{ eV}$
XRAY	X-ray	$0.1 \text{ \AA} \leq \lambda \leq 100 \text{ \AA}; 0.12 \text{ keV} \leq E \leq 120 \text{ keV}$
GAMMARAY	Gamma-ray	$E \geq 120 \text{ keV}$

6 STC 2.0 Prototype Data Model

At the time of this writing, the IVOA data model working group is formalizing a revision of the current STC recommendation (1.33). This new STC model is targeted for use within this document and for the N-Dimensional Cube model. We provide here, a prototype definition of the STC-2.0 data model which is a best approximation of the content and structure of that work. The objects and types presented here are sufficient to support the development of this work, but are not comprehensive of the scope and content of the STC model.

This section should be removed upon the completion of the STC-2.0 model, and related documents updated to that specification.

6.1 Physical Coordinate Systems

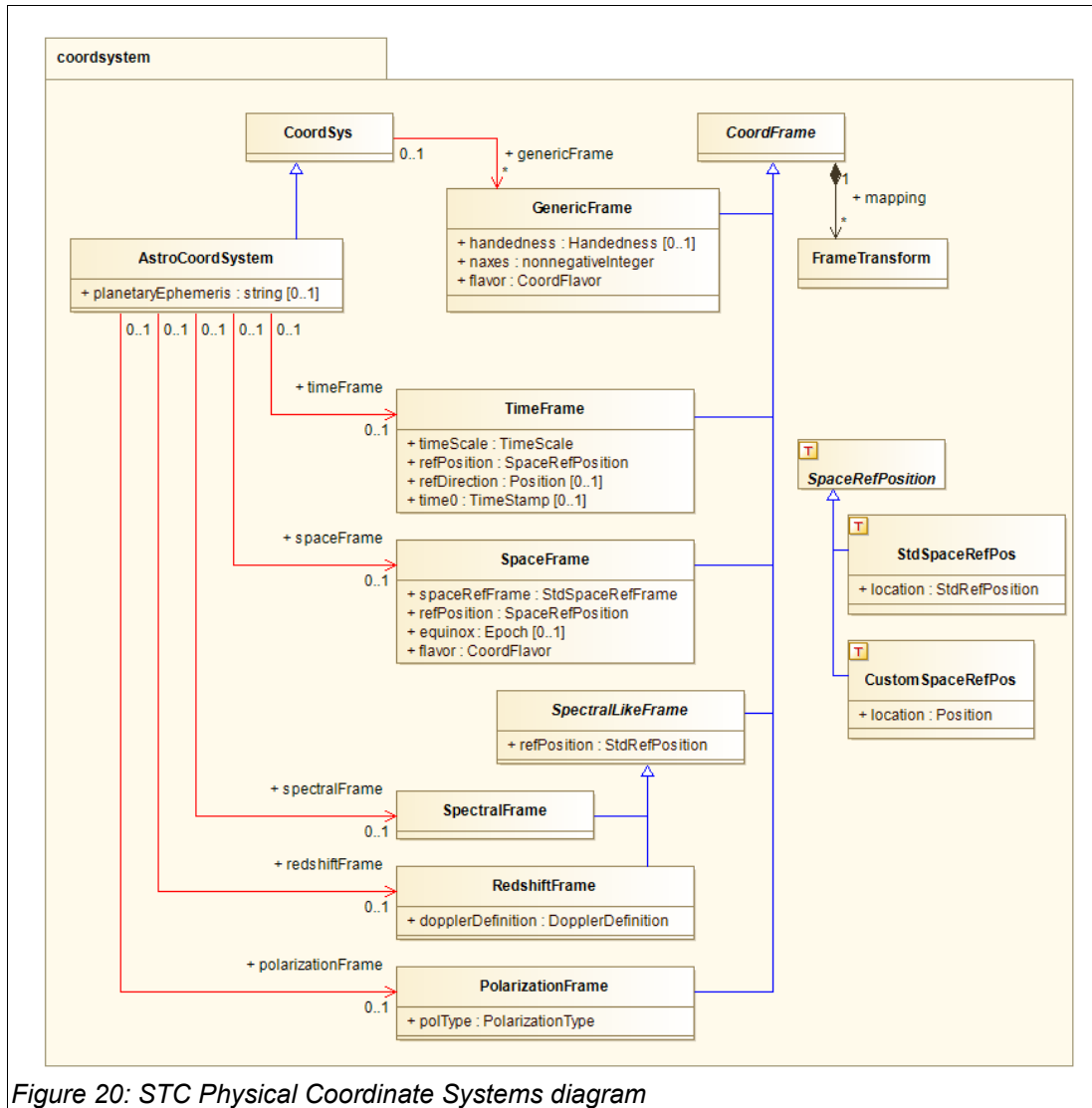


Figure 20: STC Physical Coordinate Systems diagram

In this section we define objects describing physical coordinate systems.

6.1.1 CoordSys

Head of the coordinate system hierarchy for physical systems. Coordinate systems are a collection of coordinate frames which completely define the space in all domains.

6.1.1.1 CoordSys.genericFrame:GenericFrame

type: GenericFrame

type-detail: Section [6.1.4](#)

multiplicity: 0..*

Zero or more coordinate frames not represented by the specialized frames.

6.1.2 AstroCoordSystem

Extension of CoordSys specialized for astronomical systems. This container holds a reference to zero or one of each specialized domain frame.

6.1.2.1 AstroCoordSystem.planetaryEphemeris

type: string

type-detail: Section [5.1](#)

multiplicity: 0..1

Required for any position related to a solar system entity other than the geocenter. Default = "DE405"

6.1.2.2 AstroCoordSystem.polarizationFrame

type: PolarizationFrame

type-detail: Section [6.1.5](#)

multiplicity: 0..1

Reference to zero or one Polarization frame.

6.1.2.3 AstroCoordSystem.redshiftFrame

type: RedshiftFrame

type-detail: Section [6.1.6](#)

multiplicity: 0..1

Reference to zero or one Redshift frame.

6.1.2.4 AstroCoordSystem.spaceFrame

type: SpaceFrame

type-detail: Section [6.1.7](#)

multiplicity: 0..1

Reference to zero or one Space frame.

6.1.2.5 AstroCoordSystem.spectralFrame

type: SpectralFrame

type-detail: Section [6.1.8](#)

multiplicity: 0..1

Reference to zero or one Spectral frame.

6.1.2.6 AstroCoordSystem.timeFrame

type: TimeFrame

type-detail: Section [6.1.10](#)

multiplicity: 0..1

Reference to zero or one Time frame.

6.1.3 CoordFrame

Abstract head of the Coordinate Frame hierarchy. A Coordinate frame defines the physical domain in which other objects reside. We provide specialized frames for each of the primary astronomical domains, and a generic frame which may be used for domains not represented here.

6.1.3.1 CoordFrame.mapping

Collection of zero or more FrameTransform objects, each of which defines the mapping from the associated CoordFrame to another via a series of Transform operations.

6.1.4 GenericFrame

Generic coordinate frame for use describing domains not represented by the specialized frames.

6.1.4.1 GenericFrame.handedness

type: Handedness
multiplicity: 0..1

type-detail: Section [6.11.4](#)

Handedness of the frame. Values are restricted to the Handedness enumeration list, the default is "left".

6.1.4.2 GenericFrame.naxes

type: nonnegativeinteger
multiplicity: 1

type-detail: Section [5.1](#)

Number of axes in the domain.

6.1.4.3 GenericFrame.flavor

type: CoordFlavor
multiplicity: 1

type-detail: Section [6.11.1](#)

Specifies the structure of the frame. Values are restricted to the CoordFlavor enumeration set, (e.g. cartesian, spherical, polar, etc.).

6.1.5 PolarizationFrame

Coordinate frame for the Polarization domain.

6.1.5.1 PolarizationFrame.polType:PolarizationType

type: PolarizationType
multiplicity: 1

type-detail: Section [6.11.5](#)

Specifies the type of polarization. Values are restricted to the PolarizationType enumeration set

6.1.6 RedshiftFrame

This extension of the SpectralLikeFrame serves as the coordinate frame for the Redshift domain.

6.1.6.1 RedshiftFrame.dopplerDefinition

type: DopplerDefinition
multiplicity: 1

type-detail: Section [6.11.2](#)

Specifies what the definition of redshift is, and how it should be translated to doppler velocity.

6.1.7 SpaceFrame

Coordinate frame for the Spatial domain.

6.1.7.1 SpaceFrame.spaceRefFrame

type: StdSpaceRefFrame
multiplicity: 1

type-detail: Section [6.11.11](#)

Spatial reference frame specifying the orientation of the frame. Values are restricted to the stdSpaceRefFrame enumeration set

6.1.7.2 SpaceFrame.refPosition

type: SpaceRefPosition
multiplicity: 1

type-detail: Section [6.1.11](#)

Origin of the spatial coordinate.

6.1.7.3 SpaceFrame.equinox

type: Epoch
multiplicity: 0..1

type-detail: Section [6.12.5](#)

The epoch for the coordinate system. Fixes the orientation of the system.

6.1.7.4 SpaceFrame.flavor

type: CoordFlavor
multiplicity: 1

type-detail: Section [6.11.1](#)

Specifies the structure of the frame. Values are restricted to the CoordFlavor enumeration set, (e.g. cartesian, spherical, polar, etc.).

6.1.8 SpectralFrame

This extension of the SpectralLikeFrame serves as the coordinate frame for the Spectral domain. No additional attributes are defined for this frame.

6.1.9 SpectralLikeFrame

Abstract parent for coordinate frames in the overall Spectral domain.

6.1.9.1 SpectralLikeFrame.refPosition

type: StdRefPosition
multiplicity: 1

type-detail: Section [6.11.12](#)

Origin of the Spectral coordinate frame. For the spectral frame, this must be one of the enumerated standard reference positions.

6.1.10 TimeFrame

Coordinate frame for the Time domain.

6.1.10.1 TimeFrame.timeScale

type: TimeScale
multiplicity: 1

type-detail: Section [6.11.13](#)

IAU recognized time scale.

6.1.10.2 TimeFrame.refPosition

type: SpaceRefPosition
multiplicity: 1

type-detail: Section [6.1.11](#)

Spatial origin of the time coordinate frame.

6.1.10.3 TimeFrame.refDirection

type: Position
multiplicity: 0..1

type-detail: Section [6.5.2](#)

Direction of origin.

6.1.10.4 TimeFrame.time0

type: Timestamp
multiplicity: 0..1

type-detail: Section [6.12.20](#)

Temporal origin of the time frame. For TimeOffset coordinates, this indicates the time of the triggering event.

6.1.11 SpaceRefPosition

Abstract head of the reference position data type. Spatial reference positions may be described either as an explicit spatial coordinate, or using one of the standard reference position locations. This type facilitates the use of either form in objects.

6.1.12 CustomRefPosition

Custom reference position, represented by a spatial coordinate.

6.1.12.1 CustomRefPosition.location

type: Position
multiplicity: 1

type-detail: Section [6.5.2](#)

Spatial coordinates for the origin of a Coordinate Frame.

6.1.13 StdSpaceRefPos

Reference position expressed as a known standard origin.

6.1.13.1 StdSpaceRefPos.location

type: StdRefPosition
multiplicity: 1

type-detail: Section [6.11.12](#)

Origin location selected from the list of standard reference positions.

6.2 Coordinates

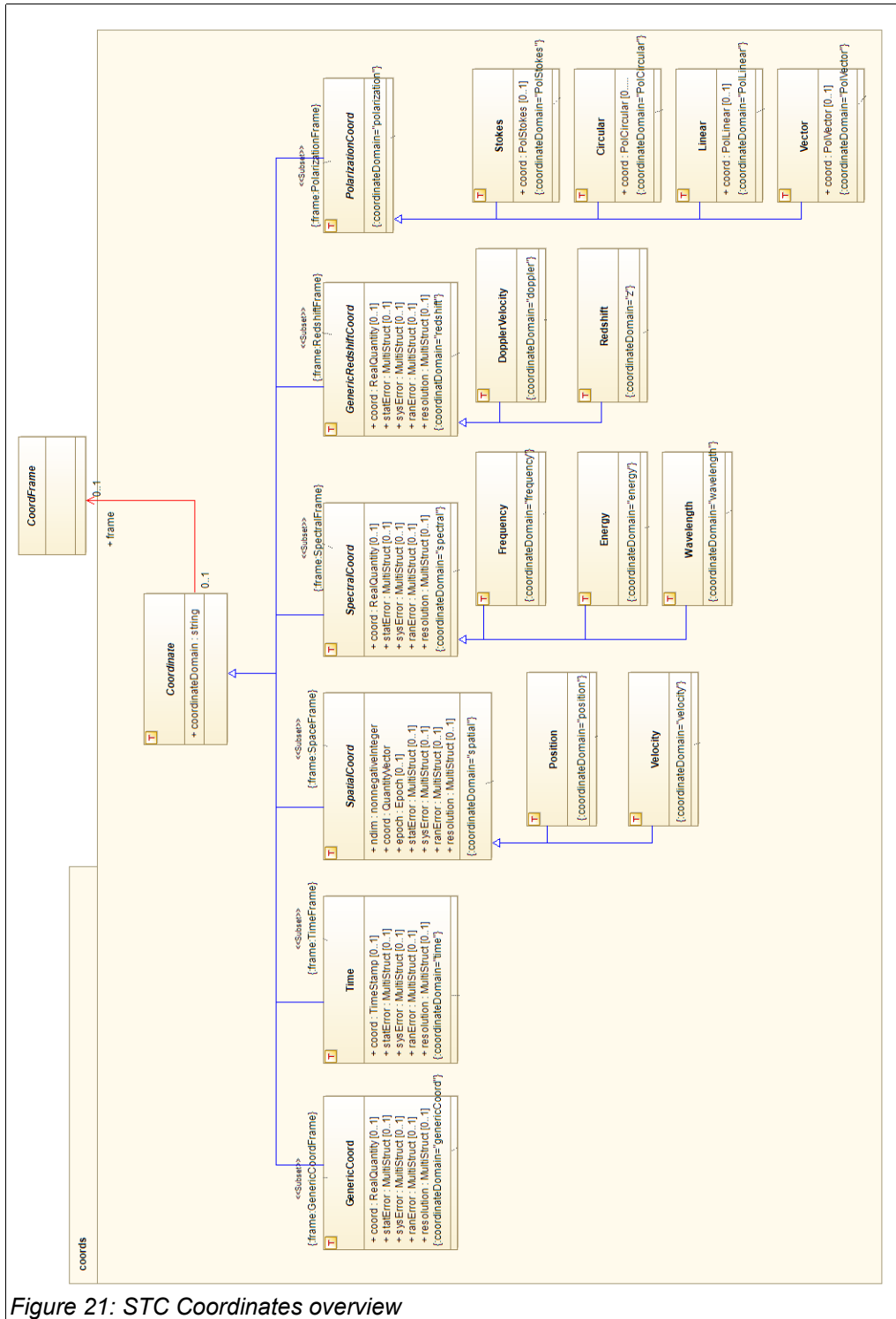


Figure 21: STC Coordinates overview

6.2.1 Coordinate

Abstract head of the Coordinate hierarchy, this object provides a specific location in some domain.

6.2.1.1 Coordinate.coordinateDomain

type: string

type-detail: [Section 5.1](#)

multiplicity: 1

String whose value expresses a skos concept representing the physical domain in which the coordinate belongs. The value is used to define domain specific constraints, (e.g. for units), and ensure consistency between the various attributes (e.g. associating a time frame with a spatial coordinate).

6.2.1.2 Coordinate.frame

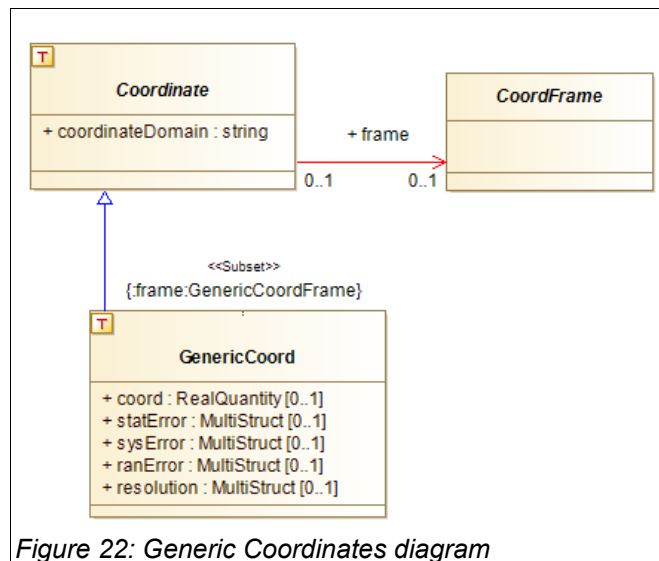
type: CoordFrame

type-detail: [Section 6.1.3](#)

multiplicity: 0..1

Reference to zero or one CoordFrame describing the domain of the coordinate.

6.2.2 GenericCoord



Realizable 1D ScalarCoord for use when a specialized domain type does not apply. The expectation is that only the spatial domain requires more than one dimension.

6.2.2.1 GenericCoord.frame

type: GenericFrame

type-detail: [Section 6.1.4](#)

multiplicity: 0..1

The GenericCoord subsets, or constrains, the frame attribute to the generic frame type. Reference to zero or one GenericFrame describing the domain of the coordinate.

6.2.2.2 GenericCoord.coord

type: RealQuantity
multiplicity: 0..1

type-detail: Section [5.1](#)

Coordinate value, complete with associated unit and ucd.

6.2.2.3 GenericCoord.statError

type: MultiStruct
multiplicity: 0..1

type-detail: Section [6.12.11](#)

Statistical error associated with the coordinate value, if any, is provided by zero or one MultiStruct objects which facilitate a variety of representations of the error with respect to the value. In this context, the MultiStruct flavor should be set to 'error'.

6.2.2.4 GenericCoord.sysError

type: MultiStruct
multiplicity: 0..1

type-detail: Section [6.12.11](#)

Systematic error associated with the coordinate value, if any, is provided by zero or one MultiStruct objects which facilitate a variety of representations of the error with respect to the value. In this context, the MultiStruct flavor should be set to 'error'.

6.2.2.5 GenericCoord.ranError

type: MultiStruct
multiplicity: 0..1

type-detail: Section [6.12.11](#)

Other random error associated with the coordinate value, if any, is provided by zero or one MultiStruct objects which facilitate a variety of representations of the error with respect to the value. In this context, the MultiStruct flavor should be set to 'error'.

6.2.2.6 GenericCoord.resolution

type: MultiStruct
multiplicity: 0..1

type-detail: Section [6.12.11](#)

Coordinate resolution. In this context, the MultiStruct flavor should be set to 'resolution'.

6.3 Polarization Coordinates

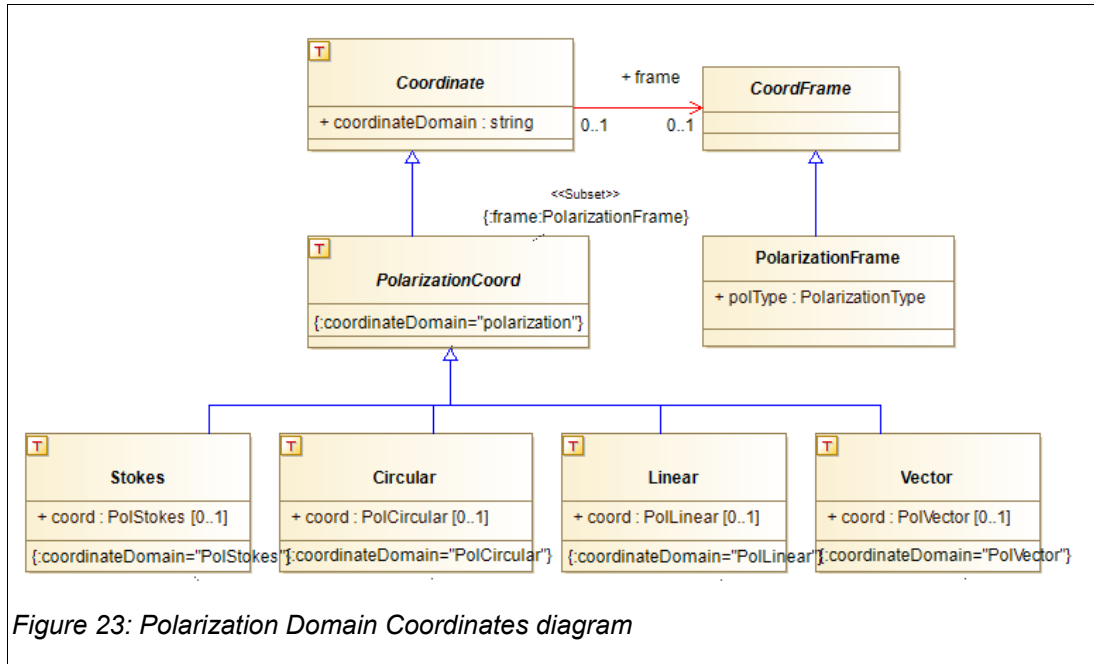


Figure 23: Polarization Domain Coordinates diagram

6.3.1 PolarizationCoord

Abstract head of Coordinate specialized to the Polarization domain. This class is responsible for ensuring that all quantities and errors are compatible with this domain.

6.3.1.1 PolarizationCoord.coordinateDomain

type: string
multiplicity: 1

type-detail: [Section 5.1](#)

The PolarizationCoord subsets, or constrains, the coordinate domain value to the 'polarization' concept.

6.3.1.2 PolarizationCoord.frame

type: PolarizationFrame
multiplicity: 0..1

type-detail: [Section 6.1.5](#)

Reference to zero or one PolarizationFrame describing the domain of the coordinate.

6.3.2 Circular

Extension of PolarizationCoord specialized for the Circular Polarization type.

6.3.2.1 Circular.coord:PolCircular

type: PolCircular
multiplicity: 0..1

type-detail: [Section 6.11.7](#)

Coordinate value is one of the enumerated set defined by PolCircular

6.3.3 Linear

Extension of PolarizationCoord specialized for the Linear Polarization type.

6.3.3.1 Linear.coord:PolLinear

type: PolLinear
multiplicity: 0..1

type-detail: Section [6.11.8](#)

Coordinate value is one of the enumerated set defined by PolLinear

6.3.4 Stokes

Extension of PolarizationCoord specialized for the Stokes Polarization type.

6.3.4.1 Stokes.coord:PolStokes

type: PolStokes
multiplicity: 0..1

type-detail: Section [6.11.6](#)

Coordinate value is one of the enumerated set defined by PolStokes

6.3.5 Vector

Extension of PolarizationCoord specialized for the Vector Polarization type.

6.3.5.1 Vector.coord:PolVector

type: PolVector
multiplicity: 0..1

type-detail: Section [6.11.9](#)

Coordinate value is one of the enumerated set defined by PolVector

6.4 Redshift Coordinates

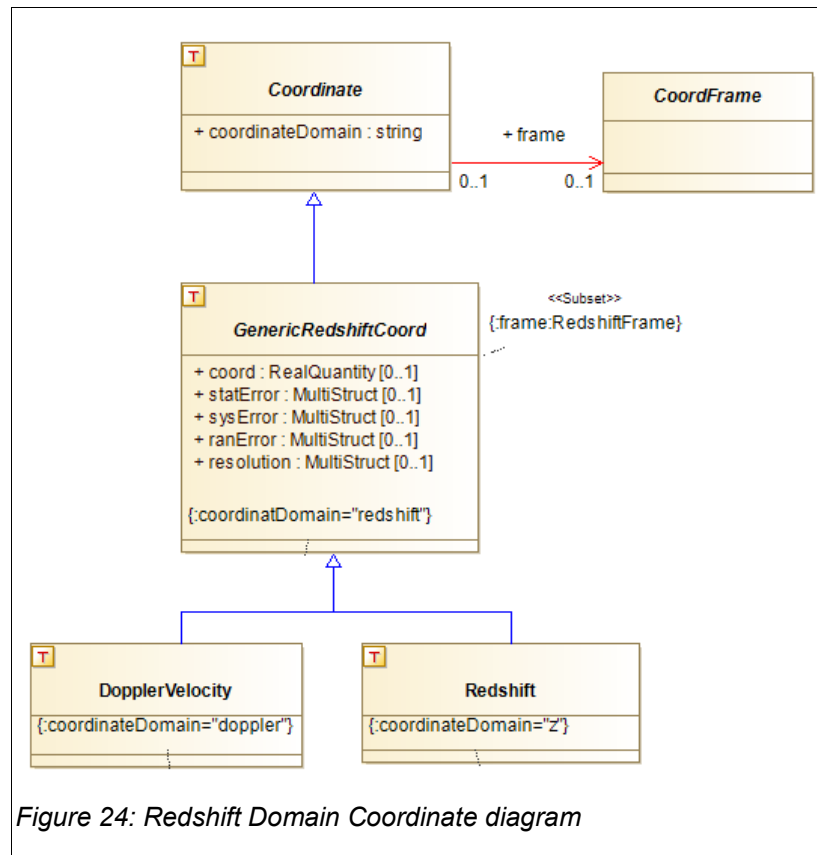


Figure 24: Redshift Domain Coordinate diagram

6.4.1 GenericRedshiftCoord

Extension of `ScalarCoordinate` type specialized to the Redshift domain. This class is responsible for ensuring that all quantities and errors are compatible with this domain.

6.4.1.1 GenericRedshiftCoord.coordinateDomain

type: string
multiplicity: 1

type-detail: Section [5.1](#)

The `GenericRedshiftCoord` subsets, or constrains, the coordinate domain value to the 'redshift' concept.

6.4.1.2 GenericRedshiftCoord.frame

type: `RedshiftFrame`
multiplicity: 0..1

type-detail: Section [6.1.6](#)

The `GenericRedshiftCoord` subsets, or constrains, the frame attribute to the type appropriate for the Redshift domain. Reference to zero or one `RedshiftFrame` describing the domain of the coordinate.

6.4.1.3 GenericRedshift.coord

type: RealQuantity
multiplicity: 1

type-detail: Section [5.1](#)

Coordinate value, complete with associated unit and ucd.

6.4.1.4 GenericRedshift.statError

type: MultiStruct
multiplicity: 0..1

type-detail: Section [6.12.11](#)

Statistical error associated with the coordinate value, if any, is provided by zero or one MultiStruct objects which facilitate a variety of representations of the error with respect to the value. In this context, the MultiStruct flavor should be set to 'error'.

6.4.1.5 GenericRedshift.sysError

type: MultiStruct
multiplicity: 0..1

type-detail: Section [6.12.11](#)

Systematic error associated with the coordinate value, if any, is provided by zero or one MultiStruct objects which facilitate a variety of representations of the error with respect to the value. In this context, the MultiStruct flavor should be set to 'error'.

6.4.1.6 GenericRedshift.ranError

type: MultiStruct
multiplicity: 0..1

type-detail: Section [6.12.11](#)

Other random error associated with the coordinate value, if any, is provided by zero or one MultiStruct objects which facilitate a variety of representations of the error with respect to the value. In this context, the MultiStruct flavor should be set to 'error'.

6.4.1.7 GenericRedshift.resolution

type: MultiStruct
multiplicity: 0..1

type-detail: Section [6.12.11](#)

Coordinate resolution. In this context, the MultiStruct flavor should be set to 'resolution'.

6.4.2 DopplerVelocity

6.4.2.1 DopplerVelocity.coordinateDomain

type: string
multiplicity: 1

type-detail: Section [5.1](#)

The DopplerVelocity subsets, or constrains, the coordinate domain value to the 'redshift' concept.

6.4.3 Redshift

6.4.3.1 RedshiftCoord.coordinateDomain

type: string
multiplicity: 1

type-detail: Section [5.1](#)

The Redshift subsets, or constrains, the coordinate domain value to the 'z' concept.

6.5 Spatial Coordinates

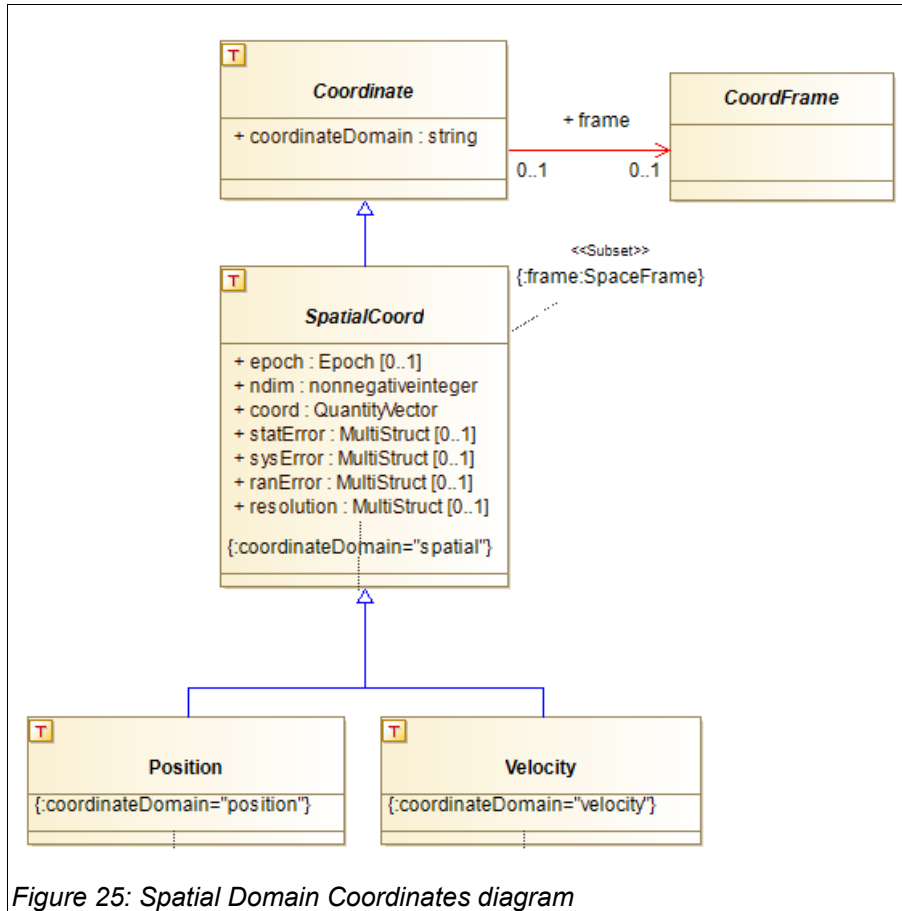


Figure 25: Spatial Domain Coordinates diagram

6.5.1 SpatialCoord

Abstract extension of Coordinate type specialized to the Spatial domain. This class is responsible for ensuring that all quantities and errors are compatible with this domain.

6.5.1.1 SpatialCoord.frame

type: SpaceFrame
multiplicity: 0..1

type-detail: Section [6.1.7](#)

The SpaceCoord subsets, or constrains, the frame attribute to the type appropriate for the Space domain. Reference to zero or one SpaceFrame describing the domain of the coordinate.

6.5.1.2 SpatialCoord.ndim

type: nonnegativeinteger
multiplicity: 1

type-detail: Section [5.1](#)

Number of spatial dimensions.

6.5.1.3 SpatialCoord.coord

type: QuantityVector
multiplicity: 1

type-detail: Section [6.12.14](#)

Coordinate value, complete with associated unit and ucd.

6.5.1.4 SpatialCoord.statError

type: MultiStruct
multiplicity: 0..1

type-detail: Section [6.12.11](#)

Statistical error associated with the coordinate value, if any, is provided by zero or one MultiStruct objects which facilitate a variety of representations of the error with respect to the value. In this context, the MultiStruct flavor should be set to 'error'.

6.5.1.5 SpatialCoord.sysError

type: MultiStruct
multiplicity: 0..1

type-detail: Section [6.12.11](#)

Systematic error associated with the coordinate value, if any, is provided by zero or one MultiStruct objects which facilitate a variety of representations of the error with respect to the value. In this context, the MultiStruct flavor should be set to 'error'.

6.5.1.6 SpatialCoord.ranError

type: MultiStruct
multiplicity: 0..1

type-detail: Section [6.12.11](#)

Other random error associated with the coordinate value, if any, is provided by zero or one MultiStruct objects which facilitate a variety of representations of the error with respect to the value. In this context, the MultiStruct flavor should be set to 'error'.

6.5.1.7 SpatialCoord.resolution

type: MultiStruct
multiplicity: 0..1

type-detail: Section [6.12.11](#)

Coordinate resolution. In this context, the MultiStruct flavor should be set to 'resolution'.

6.5.1.8 SpatialCoord.epoch

type: Epoch
multiplicity: 0..1

type-detail: Section [6.12.5](#)

Epoch associated with the particular coordinate. Note: this is independent of the equinox of the associated coordinate system, which fixes the orientation of the system.

6.5.2 Position

Extension of SpatialCoord for positional coordinates.

6.5.2.1 Position.coordinateDomain

type: string
multiplicity: 1

type-detail: Section [5.1](#)

The Position subsets, or constrains, the coordinate domain value to the 'position' concept.

6.5.3 Velocity

Extension of SpatialCoord for velocity coordinates (time derivative of position).

6.5.3.1 Velocity.coordinateDomain

type: string

type-detail: Section [5.1](#)

multiplicity: 1

The Velocity subsets, or constrains, the coordinate domain value to the 'velocity' concept.

6.6 Spectral Coordinates

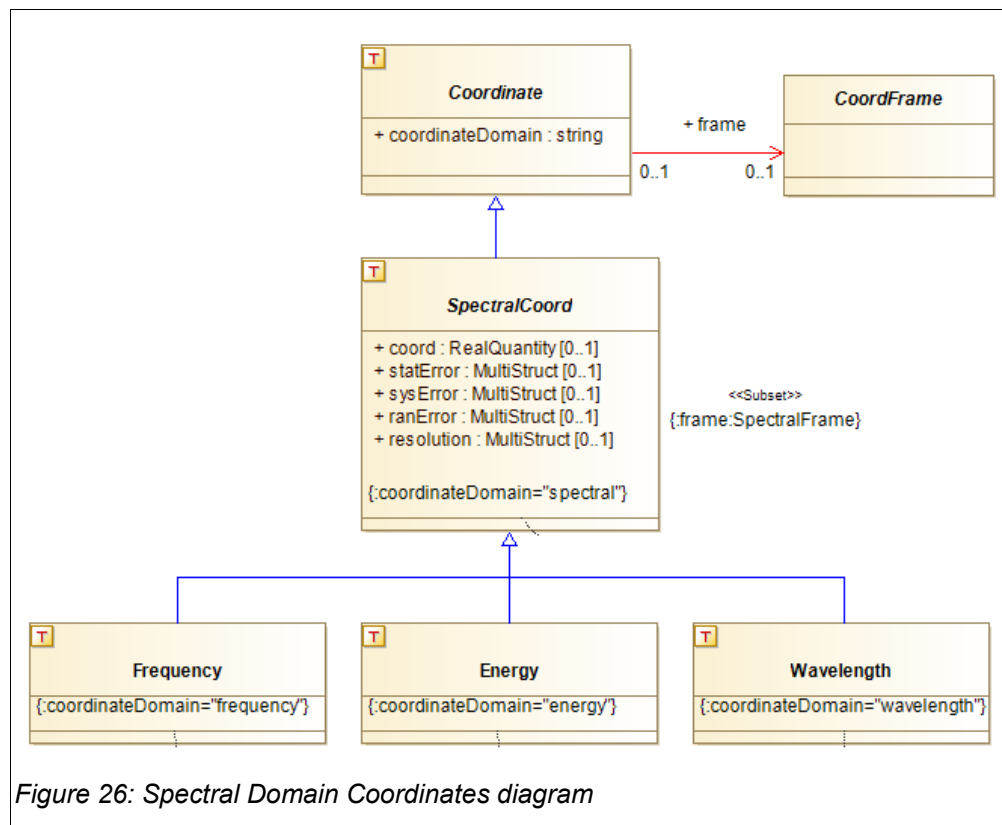


Figure 26: Spectral Domain Coordinates diagram

6.6.1 SpectralCoord

Extension of `ScalarCoordinate` type specialized to the Spectral domain. This class is responsible for ensuring that all quantities and errors are compatible with this domain.

6.6.1.1 SpectralCoord.coordinateDomain

type: string
multiplicity: 1

type-detail: Section [5.1](#)

The `SpectralCoord` subsets, or constrains, the coordinate domain value to the 'spectral' concept.

6.6.1.2 SpectralCoord.frame

type: `SpectralFrame`
multiplicity: 0..1

type-detail: Section [6.1.8](#)

The `SpectralCoord` subsets, or constrains, the frame attribute to the type appropriate for the Spectral domain. Reference to zero or one `SpectralFrame` describing the domain of the coordinate.

6.6.1.3 SpectralCoord.coord

type: RealQuantity
multiplicity: 1

type-detail: [Section 5.1](#)

Coordinate value, complete with associated unit and ucd.

6.6.1.4 SpectralCoord.statError

type: MultiStruct
multiplicity: 0..1

type-detail: [Section 6.12.11](#)

Statistical error associated with the coordinate value, if any, is provided by zero or one MultiStruct objects which facilitate a variety of representations of the error with respect to the value. In this context, the MultiStruct flavor should be set to 'error'.

6.6.1.5 SpectralCoord.sysError

type: MultiStruct
multiplicity: 0..1

type-detail: [Section 6.12.11](#)

Systematic error associated with the coordinate value, if any, is provided by zero or one MultiStruct objects which facilitate a variety of representations of the error with respect to the value. In this context, the MultiStruct flavor should be set to 'error'.

6.6.1.6 SpectralCoord.ranError

type: MultiStruct
multiplicity: 0..1

type-detail: [Section 6.12.11](#)

Other random error associated with the coordinate value, if any, is provided by zero or one MultiStruct objects which facilitate a variety of representations of the error with respect to the value. In this context, the MultiStruct flavor should be set to 'error'.

6.6.1.7 SpectralCoord.resolution

type: MultiStruct
multiplicity: 0..1

type-detail: [Section 6.12.11](#)

Coordinate resolution. In this context, the MultiStruct flavor should be set to 'resolution'.

6.6.2 Energy

6.6.2.1 Energy.coordinateDomain

type: string
multiplicity: 1

type-detail: [Section 5.1](#)

The SpectralCoord subsets, or constrains, the coordinate domain value to the 'energy' concept.

6.6.3 Frequency

6.6.3.1 Frequency.coordinateDomain

type: string
multiplicity: 1

type-detail: [Section 5.1](#)

The SpectralCoord subsets, or constrains, the coordinate domain value to the 'frequency' concept.

6.6.4 Wavelength

6.6.4.1 Wavelength.coordinateDomain

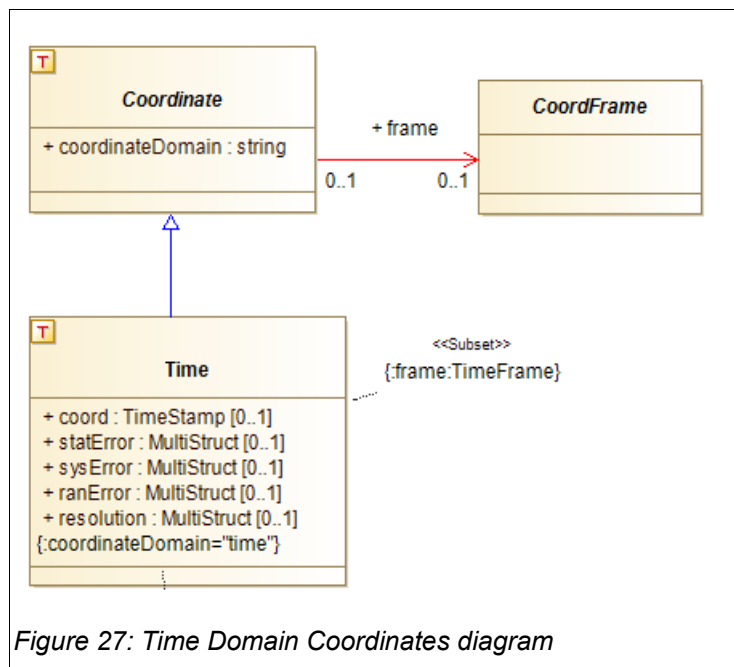
type: string

type-detail: Section [5.1](#)

multiplicity: 1

The SpectralCoord subsets, or constrains, the coordinate domain value to the 'wavelength' concept.

6.7 Time Coordinates



6.7.1 Time

Extension of Coordinate type specialized to the Time domain. This class is responsible for ensuring that all quantities and errors are compatible with this domain.

6.7.1.1 Time.frame

type: TimeFrame
multiplicity: 0..1

type-detail: Section [6.1.10](#)

The TimeCoord subsets, or constrains, the frame attribute to the type appropriate for the Time domain. Reference to zero or one TimeFrame describing the domain of the coordinate.

6.7.1.2 Time.coord

type: TimeStamp
multiplicity: 0..1

type-detail: Section [6.12.20](#)

Coordinate value indicating an instant in time, using any of the TimeStamp data types.

6.7.1.3 Time.statError

type: MultiStruct
multiplicity: 0..1

type-detail: Section [6.12.11](#)

Statistical error associated with the coordinate value, if any, is provided by zero or one MultiStruct objects which facilitate a variety of representations of the error with respect to the value.

6.7.1.4 Time.sysError

type: MultiStruct
multiplicity: 0..1

type-detail: Section [6.12.11](#)

Systematic error associated with the coordinate value, if any, is provided by zero or one MultiStruct objects which facilitate a variety of representations of the error with respect to the value.

6.7.1.5 Time.ranError

type: MultiStruct
multiplicity: 0..1

type-detail: Section [6.12.11](#)

Other random error associated with the coordinate value, if any, is provided by zero or one MultiStruct objects which facilitate a variety of representations of the error with respect to the value.

6.7.1.6 Time.resolution

type: MultiStruct
multiplicity: 0..1

type-detail: Section [6.12.11](#)

Coordinate resolution.

6.8 Pixelated Coordinate Systems

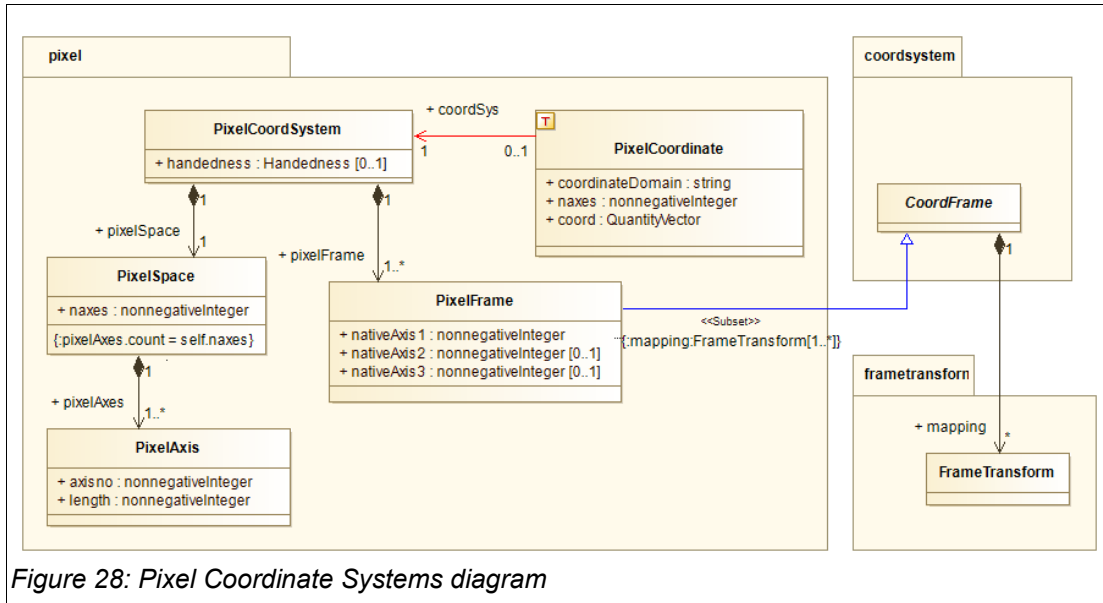


Figure 28: Pixel Coordinate Systems diagram

This section describes objects associated with pixelated coordinate space.

6.8.1 PixelCoordSystem

The PixelCoordSystem holds the complete description of the pixelated coordinate space. The PixelCoordSystem holds a collection of pixel frames, grouping associated axes, and objects describing the number and size of each pixel axis.

6.8.1.1 PixelCoordSystem.handedness

type: Handedness
multiplicity: 0..1

type-detail: Section [6.11.4](#)

Handedness ("left" or "right") of the coordinate system. Default is "left".

6.8.1.2 PixelCoordSystem.pixelFrame

type: PixelFrame
multiplicity: 1..*

type-detail: Section [6.8.4](#)

Collection of one or more pixel frames defining the pixel coordinate system. Each PixelFrame represents a set of associated pixel axes.

6.8.1.3 PixelCoordSystem.pixelSpace

type: PixelSpace
multiplicity: 1

type-detail: Section [6.8.2](#)

Describes the number and span of each pixel axis.

6.8.2 PixelSpace

This object defines the number and size of each pixel axis.

6.8.2.1 PixelSpace.naxes

type: nonnegativeinteger
multiplicity: 1

type-detail: Section [5.1](#)

Number of pixel axes.

6.8.2.2 PixelSpace.pixelAxes

type: PixelAxis
multiplicity: naxes

type-detail: Section [6.8.3](#)

Axis number and size. One per axis.

6.8.3 PixelAxis

This object identifies a pixel axis and defines its size.

6.8.3.1 PixelAxis.axisno

type: nonnegativeinteger
multiplicity: 1

type-detail: Section [5.1](#)

Axis number

6.8.3.2 PixelAxis.length

type: nonnegativeinteger
multiplicity: 1

type-detail: Section [5.1](#)

Length of the pixel axis.

6.8.4 PixelFrame

Specifies a set of pixel axes which are considered a unit. For example, 2 pixel axes which map to a 2-D SpaceFrame. A PixelFrame can have, at most, 3 dimensions.

6.8.4.1 PixelFrame.mapping

type: FrameTransform
multiplicity: 1..*

type-detail: Section [6.9.1](#)

One or more FrameTransform mappings, each mapping defines the transform from this PixelFrame to some physical coordinate frame.

6.8.4.2 PixelFrame.nativeAxis1

type: nonnegativeinteger
multiplicity: 1

type-detail: Section [5.1](#)

This specifies which pixel axis of the pixel space corresponds to dimension 1 of the pixel frame.

6.8.4.3 PixelFrame.nativeAxis2

type: nonnegativeinteger
multiplicity: 0..1

type-detail: Section [5.1](#)

This specifies which pixel axis of the pixel space corresponds to dimension 2 of the pixel frame.

6.8.4.4 PixelFrame.nativeAxis3

type: nonnegativeinteger
multiplicity: 0..1

type-detail: [Section 5.1](#)

This specifies which pixel axis of the pixel space corresponds to dimension 3 of the pixel frame.

6.8.5 PixelCoordinate

PixelCoordinate provides a complete nD location in pixel space. While a physical coordinate has a reference to an associated physical coordinate frame, a pixel coordinate refers back to the full pixel coordinate system.

6.8.5.1 PixelCoordinate.coordinateDomain

type: string
multiplicity: 1

type-detail: [Section 5.1](#)

String indicating the coordinate domain, for pixel coordinates, the value must be 'pixel'.

6.8.5.2 PixelCoordinate.coordSys

type: PixelCoordSystem
multiplicity: 0..1

type-detail: [Section 6.8.1](#)

Reference to the complete pixel coordinate system. This facilitates access to the frame information and transforms to various physical coordinate systems.

6.8.5.3 PixelCoordinate.naxes

type: nonnegativeinteger
multiplicity: 1

type-detail: [Section 5.1](#)

Dimensionality of the pixel coordinate. Must equal the dimensionality of the associated pixel space.

6.8.5.4 PixelCoordinate.coord

type: QuantityVector
multiplicity: 1

type-detail: [Section 5.1](#)

Coordinate value in each dimension, ordered according to the pixel space axis definitions.

6.9 Transforms

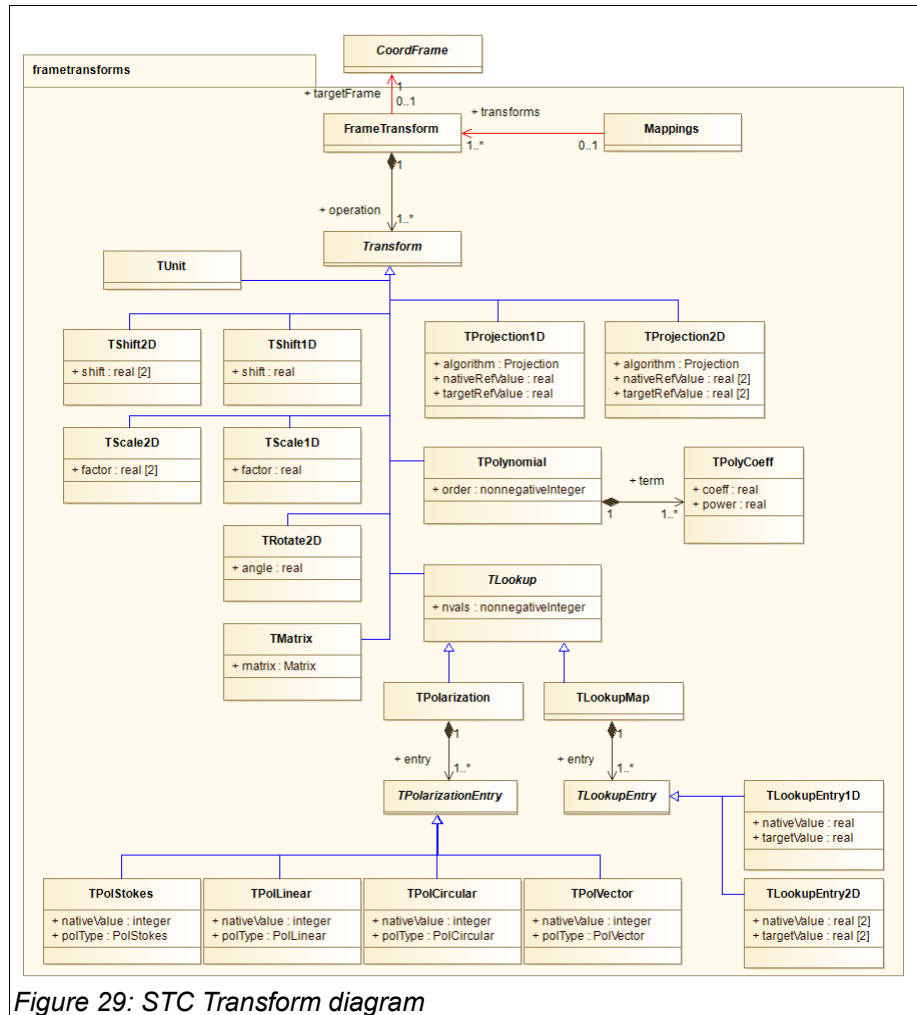


Figure 29: STC Transform diagram

Transforms define the relationship between two coordinate frames. They are used in the conversion of values (Coordinates, Regions, etc) represented in one frame, to the other.

6.9.1 FrameTransform

Bridge class which defines the relationship between two coordinate frames. It identifies the target coordinate frame of the transform, and the operation specification (Transforms) describing the relationship.

6.9.1.1 FrameTransform.targetFrame

type: **CoordFrame**
multiplicity: **1**

type-detail: Section [6.1.3](#)

Reference to the coordinate frame which is the target or destination frame. Any given coordinate frame may be the target of multiple relations.

6.9.1.2 FrameTransform.operation

type: Transform

type-detail: Section [6.9.2](#)

multiplicity: 1..*

Ordered list of operations which define the relation between two coordinate frames.

6.9.2 Transform

Transforms define, provide specifications for, mathematical operations on input objects (e.g. Coordinates), but have no direct knowledge of the physical context of the object. The transform operations defined here are generalized components which can be combined to support a wide range of complex transforms. This includes, but is not limited to, the FITS Linear and WCS coordinate transforms.

6.9.3 TLookup

Abstract head of Lookup map operations.

6.9.3.1 TLookup.nvals

type: nonnegativeinteger

type-detail: Section [5.1](#)

multiplicity: 1

Number of lookup entries provided (length of mapping/table).

6.9.4 TLookupEntry

Abstract head of lookup table entries.

6.9.5 TLookupEntry1D

Lookup table entry in one dimension. Results are determined by linear interpolation of nearest neighbors in the provided lookup table data.

6.9.5.1 TLookupEntry1D.nativeValue

type: real

type-detail: Section [5.1](#)

multiplicity: 1

Originating frame value.

6.9.5.2 TLookupEntry1D.targetValue

type: real

type-detail: Section [5.1](#)

multiplicity: 1

Destination frame value.

6.9.6 TLookupEntry2D

Lookup table in two dimensions. Results are determined by linear interpolation of nearest neighbors in the provided lookup table data.

6.9.6.1 TLookupEntry2D.nativeValue

type: real

type-detail: Section [5.1](#)

multiplicity: 2

Originating frame value.

6.9.6.2 TLookupEntry2D.targetValue

type: real

type-detail: Section [5.1](#)

multiplicity: 2

Destination frame value.

6.9.7 TLookupMap

Extension of TLookup for numerical value mappings.

6.9.7.1 TLookupMap.entry

type: TLookupEntry

type-detail: Section [6.9.4](#)

multiplicity: 1..*

List of lookup entries, each provides a mapping from a native value to corresponding target value.

6.9.8 TMatrix

Matrix operation.

6.9.8.1 TMatrix.matrix

type: Matrix

type-detail: Section [6.12.8](#)

multiplicity: 1

Matrix specification.

6.9.9 TPolarization

Extension of TLookup, specialized for polarization data.

6.9.9.1 TPolarization.entry

type: TPolarizationEntry

type-detail: Section [6.9.10](#)

multiplicity: 1..*

List of lookup mapping records/entries.

6.9.10 TPolarizationEntry

Abstract head of Polarization lookup mappings.

6.9.11 TPolynomial

1-D Polynomial operation

6.9.11.1 TPolynomial.order

type: nonnegativeinteger

type-detail: Section [5.1](#)

multiplicity: 1

Polynomial order or degree

6.9.11.2TPolynomial.term

type: TPolyCoeff
multiplicity: 1..*

type-detail: Section [6.9.12](#)

List of terms comprising the Polynomial expression.

6.9.12 TPolyCoeff

Single monomial term in polynomial expression, aX^n .

6.9.12.1 TPolyCoeff.power

type: real
multiplicity: 1

type-detail: Section [5.1](#)

Power of the monomial term (n).

6.9.12.2 TPolyCoeff.coeff

type: real
multiplicity: 1

type-detail: Section [5.1](#)

Coefficient of the monomial term (a).

6.9.13 TPolCircular

Extension of TPolarizationEntry where results are Circular polarization states.

6.9.13.1 TPolCircular.nativeValue

type: integer
multiplicity: 1

type-detail: Section [5.1](#)

Numerical value to associate with a polarization state.

Two use cases are considered:

1) A numerical value is assigned for each polarization state. For example, the FITS-3.0 "Conventional Stokes values" which assign the numbers (1..4,-1..-8) to various polarization states. In this case, nvals is the number of such states and the nativeValue1 array holds the associated value.

2) A simple list of pixels, where a polarization state is assigned to each pixel. For example, an image with polarization axis, where each index corresponds to a different polarization state. In this case, nvals is the number of pixels, and the nativeValue1 array holds the pixel indexes.

6.9.13.2 TPolCircular.polType

type: PolCircular
multiplicity: 1

type-detail: Section [6.11.7](#)

Corresponding PolCircular state.

6.9.14 TPolLinear

Extension of TPolarizationEntry where results are Linear polarization states.

6.9.14.1 TPolLinear.nativeValue

type: integer
multiplicity: 1

type-detail: Section [5.1](#)

Numerical value to associate with a polarization state. See TPolCircular for use case annotations.

6.9.14.2 TPolLinear.polType

type: PolLinear
multiplicity: 1

type-detail: Section [6.11.8](#)

Corresponding PolLinear state.

6.9.15 TPolStokes

Extension of TPolarizationEntry where results are Stokes polarization states.

6.9.15.1 TPolStokes.nativeValue

type: integer
multiplicity: 1

type-detail: Section [5.1](#)

Numerical value to associate with a polarization state. See TPolCircular for use case annotations.

6.9.15.2 TPolStokes.polType

type: PolStokes
multiplicity: 1

type-detail: Section [6.11.6](#)

Corresponding PolStokes state.

6.9.16 TPolVector

Extension of TPolarizationEntry where results are Vector polarization states.

6.9.16.1 TPolVector.nativeValue

type: integer
multiplicity: 1

type-detail: Section [5.1](#)

Numerical value to associate with a polarization state. See TPolCircular for use case annotations.

6.9.16.2 TPolVector.polType

type: PolVector
multiplicity: 1

type-detail: Section [6.11.9](#)

Corresponding PolVector state.

6.9.17 TProjection1D

WCS Projection operation.

6.9.17.1 TProjection1D.algorithm

type: Projection
multiplicity: 1

type-detail: Section [6.11.10](#)

Projection algorithm to apply.

6.9.17.2 TProjection1D.nativeRefValue

type: real **type-detail:** Section [5.1](#)
multiplicity: 1

Reference value for originating frame (e.g. Reference Pixel)

6.9.17.3 TProjection1D.targetRefValue

type: real **type-detail:** Section [5.1](#)
multiplicity: 1

Reference value at destination frame (e.g. Reference Value)

6.9.18 TProjection2D

WCS Projection operation.

6.9.18.1 TProjection2D.algorithm

type: Projection **type-detail:** Section [6.11.10](#)
multiplicity: 1

Projection algorithm to apply.

6.9.18.2 TProjection2D.nativeRefValue

type: real **type-detail:** Section [5.1](#)
multiplicity: 2

Reference value for originating frame (e.g. Reference Pixel)

6.9.18.3 TProjection2D.targetRefValue

type: real **type-detail:** Section [5.1](#)
multiplicity: 2

Reference value at destination frame (e.g. Reference Value)

6.9.19 TRotate2D

Angular rotation operation.

6.9.19.1 TRotate2D.angle

type: real **type-detail:** Section [5.1](#)
multiplicity: 1

Angle of rotation.

6.9.20 TScale1D

One dimensional multiplication operation

6.9.20.1 TScale1D.factor

type: real **type-detail:** Section [5.1](#)
multiplicity: 1

Scale factor.

6.9.21 TScale2D

Two dimensional multiplication operation

6.9.21.1 TScale2D.factor

type: real
multiplicity: 2

type-detail: Section [5.1](#)

Scale factor in each dimension.

6.9.22 TShift1D

One dimensional Shift operation.

6.9.22.1 TShift1D.shift

type: real
multiplicity: 1

type-detail: Section [5.1](#)

Amount to shift along this dimension.

6.9.23 TShift2D

Two dimensional Shift operation.

6.9.23.1 TShift2D.shift

type: real
multiplicity: 2

type-detail: Section [5.1](#)

Amount to shift in each dimension.

6.9.24 TUnit

Unit transform. Multiplication by 1.

6.10 Mappings

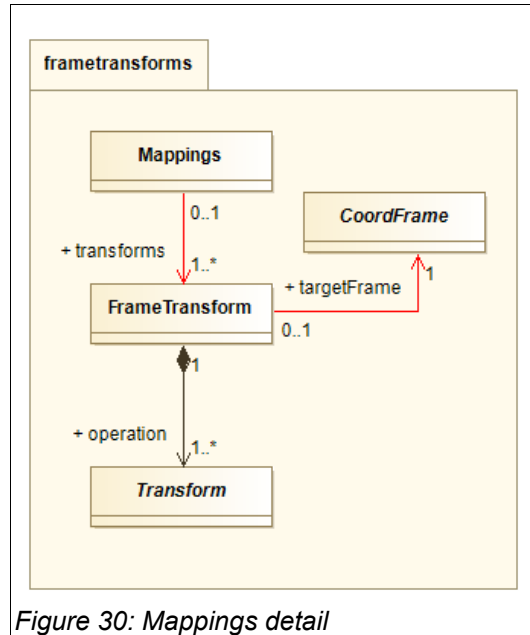


Figure 30: Mappings detail

The Mappings object is a container composed of a set of Frame transforms. This object provides a container to encapsulate and manage a set of coordinate frame transforms associated with a particular object, such as a 2D image. It facilitates the transfer and sharing of this information between applications.

6.10.1 Mappings.transforms

The Mappings container stores references to one or more FrameTransform objects, each of which defines a relation between two coordinate frames.

6.11 STC Model Enumerations

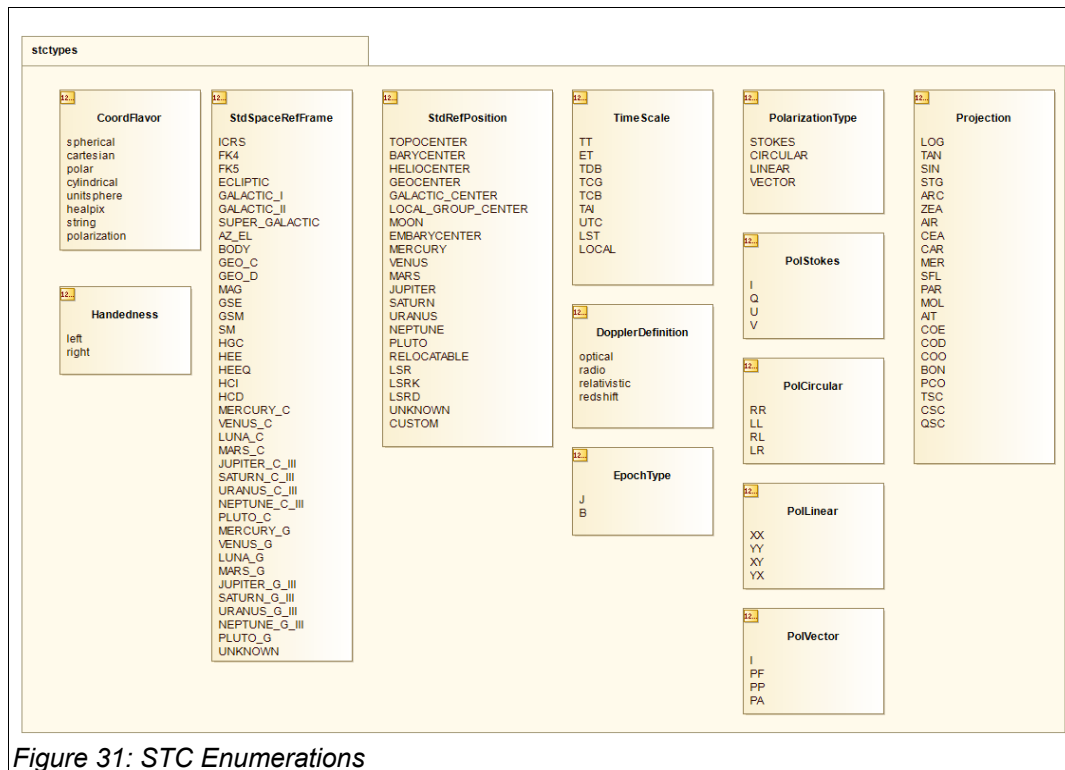


Figure 31: STC Enumerations

6.11.1 CoordFlavor

Token	Meaning
spherical	Spherical 2-D (long,lat) or 3-D (long, lat, rad/elev)
cartesian	Cartesian 1-, 2-, or 3-D coordinates
polar	2-D polar coordinates (radius, posangle)
cylindrical	3-D cylindrical coordinates (radius, posangle, z)
unitsphere	3-D Unit sphere coordinates (direction cosines)
healpix	2-D Healpix coordinates
string	String coordinates
polarization	Polarization coordinates

6.11.2 DopplerDefinition

Token	Meaning
optical	
radio	

relativistic redshift	
--------------------------	--

6.11.3 EpochType

Token	Meaning
J	Julian
B	Besselian

6.11.4 Handedness

Token	Meaning
left	Left handed
right	Right handed

6.11.5PolarizationType

Enumeration of polarization types.

Token	Meaning
STOKES	
CIRCULAR	
LINEAR	
VECTOR	

6.11.6PolStokes

Enumeration of Stokes polarization states.

Token	Meaning
I	Standard Stokes unpolarized
Q	Standard Stokes linear
U	Standard Stokes linear
V	Standard Stokes circular

6.11.7PolCircular

Enumeration of Circular polarization states.

Token	Meaning
RR	Right-right circular
LL	Left-left circular
RL	Right-left cross-circular
LR	Left-right cross-circular

6.11.8PolLinear

Enumeration of Linear polarization states.

Token	Meaning
XX	X parallel linear
YY	Y parallel linear
XY	XY cross linear
YX	YX cross linear

6.11.9PolVector

Enumeration of Vector polarization states.

Token	Meaning
I	
PF	
PP	
PA	

6.11.10 Projection

Enumeration of WCS Projection types.

Token	Meaning
LOG	Linear to logarithmic
TAN	Tangent plane projection
SIN	Sine projection
STG	Stereographic projection
ARC	Zenithal equidistant projection
ZEA	Zenithal equal-area projection
AIR	Airy projection
CEA	Cylindrical equal-area projection
CAR	Plate Carre projection
MER	Mercator projection
SFL	Sanson-Flamsteed projection
PAR	Parabolic projection
MOL	Mollweide projection
AIT	Hammer-Aitoff projection
COE	Conic equal-area projection
COD	Conic equidistant projection
COO	Conic orthomorphic projection
BON	Bonne equal-area projection
PCO	Polyconic projection
TSC	Tangential spherical cube projection

CSC	COBE quadrilatealized spherical cube projection
QSC	Quadrilateralized spherical cube projection

6.11.11 StdSpaceRefFrame

Enumeration of standard Space Reference Frames.

Token	Meaning
ICRS	The ICRS frame
FK4	FK4
FK5	FK5
ECLIPTIC	Ecliptic I,b
GALACTIC_I	Old galactic LI, BI
GALACTIC_II	Galactic LII, BII
SUPER_GALACTIC	SGL, SGB
AZ_EL	Azimuth and elevation
BODY	Generic Body (e.g. planet)
GEO_C	Geocentric corotating
GEO_D	Geodetic ref frame
MAG	Geomagnetic ref frame
GSE	Geocentric Solar Ecliptic
GSM	Geocentric Solar Magnetic
SM	Solar Magnetic
HGC	Heliographic
HEE	Heliocentric Earth Ecliptic
HEEQ	Heliocentric Earth Equatorial
HCI	Heliocentric Inertial
HCD	Heliocentric of Date
MERCURY_C	Corotating planetocentric
VENUS_C	Corotating planetocentric
LUNA_C	Corotating planetocentric
MARS_C	Corotating planetocentric
JUPITER_C_III	Corotating planetocentric
SATURN_C_III	Corotating planetocentric
URANUS_C_III	Corotating planetocentric
NEPTUNE_C_III	Corotating planetocentric
PLUTO_C	Corotating planetocentric
MERCURY_G	Corotating planetographic
VENUS_G	Corotating planetographic
LUNA_G	Corotating planetographic
MARS_G	Corotating planetographic
JUPITER_G_III	Corotating planetographic
SATURN_G_III	Corotating planetographic

URANUS_G_III	Corotating planetographic
NEPTUNE_G_III	Corotating planetographic
PLUTO_G	Corotating planetographic
UNKNOWN	Unknown frame
CUSTOM	Custom frame

6.11.12 StdRefPosition

Enumeration of Standard Reference Positions.

Token	Meaning	Note
TOPOCENTER	Location of the observing device	(telescope)
BARYCENTER	Solar system barycenter	
HELIOCENTER	Center of the Sun	
GEOCENTER	Center of the Earth	
GALACTIC_CENTER	Center of the Galaxy	
LOCAL_GROUP_CENTER	Barycenter of the Local Group	
MOON	Center of the Moon	
EMBARYCENTER	Earth-Moon barycenter	
MERCURY	Center of Mercury	
VENUS	Center of Venus	
MARS	Center of Mars	
JUPITER	Center of Jupiter	
SATURN	Center of Saturn	
URANUS	Center of Uranus	
NEPTUNE	Center of Neptune	
PLUTO	Center of Pluto	
RELOCATABLE	Relative origin	Suitable for simulations
LSR	Local Standard of Rest	Spectral/Redshift domain only
LSRK	Kinematic Local Standard of Rest	Equivalent to LSR
LSRD	Dynamic Local Standard of Rest	Spectral/Redshift domain only
UNKNOWN	Unknown origin	
CUSTOM	Origin specified wrt another system	

6.11.13 TimeScale

Enumeration of time scales.

Token	Meaning
LOCAL	Relocatable (simulation) time
TT	Terrestrial Time
UTC	Coordinated Universal Time
ET	Ephemeris Time
TDB	Barycentric Dynamical Time

TCG	Terrestrial Coordinate Time
TCB	Barycentric Coordinate Time
TAI	International Atomic Time
LST	Local Sidereal Time

6.12 STC Model Base Types

Base data types defined by the STC model.

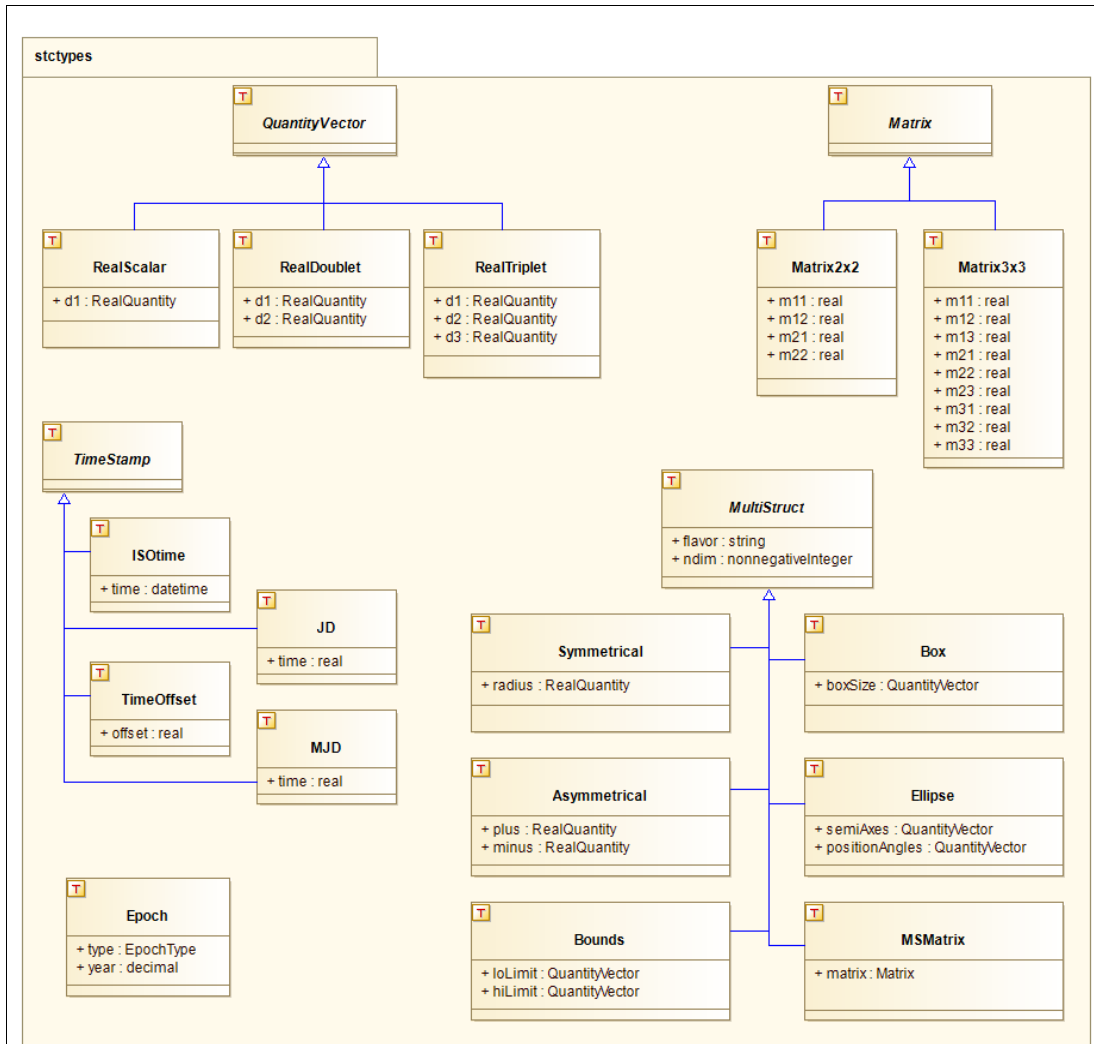


Figure 32: STC Data Types

6.12.1 Asymmetrical

The MultiStruct entity is represented by an asymmetrical distribution about the associated value.

6.12.1.1 Asymmetrical.plus

type: RealQuantity
multiplicity: 1

type-detail: Section 5.1

Relative extension in the positive direction from the associated value. default = Inf.

6.12.1.2Asymmetrical.minus

type: RealQuantity
multiplicity: 1

type-detail: Section [5.1](#)

Relative extension in the negative direction from the associated value. default = Inf.

6.12.2 Bounds

The MultiStruct entity is represented by a range.

6.12.2.1Bounds.loLimit

type: QuantityVector
multiplicity: 1

type-detail: Section [6.12.14](#)

Minimum value of the range.

6.12.2.2Bounds.hiLimit

type: QuantityVector
multiplicity: 1

type-detail: Section [6.12.14](#)

Maximum value of the range.

6.12.3 Box

The MultiStruct entity is represented by a n-D box.

6.12.3.1Box.boxSize

type: QuantityVector
multiplicity: 1

type-detail: Section [6.12.14](#)

Size of box in each dimension.

6.12.4 Ellipse

The MultiStruct entity is represented by an ellipse or ellipsoid.

6.12.4.1Ellipse.semiAxes

type: QuantityVector
multiplicity: 1

type-detail: Section [6.12.14](#)

Size of each semi-axis.

6.12.4.2Ellipse.positionAngles

type: QuantityVector
multiplicity: 1

type-detail: Section [6.12.14](#)

Position angles of the proscribed ellipse.

6.12.5 Epoch

Type for expressing an astronomical epoch date (e.g. "J2000").

6.12.5.1 type

type: EpochType

type-detail: Section [6.11.3](#)

multiplicity: 1

Basis of the epoch, values must be selected from the EpochType enumeration set.

6.12.5.2 year

type: decimal

type-detail: Section [5.1](#)

multiplicity: 1

Epoch date expressed as a decimal (e.g. 2000.0)

6.12.6 ISOtime

A time instant expressed as a subset of the ISO-8601 format.

ie: a string of format "yyyy-mm-ddThh:mm:ss.sss"

6.12.6.1 ISOtime.time

type: datetime

type-detail: Section [5.1.3](#)

multiplicity: 1

ISO time instant value.

6.12.7 JD

Julian day of a particular instant.

6.12.7.1 JD.time

type: real

type-detail: Section [5.1](#)

multiplicity: 1

Decimal number representing the Julian Day of a time instant, to required precision.

6.12.8 Matrix

Abstract head of the matrix classes.

6.12.9 Matrix2x2

Basic 2 x 2 matrix. Contains attribute for each matrix element as real type.

6.12.10 Matrix3x3

Basic 3 x 3 matrix. Contains attribute for each matrix element as real type.

6.12.11 MultiStruct

Abstract head of the MultiStruct hierarchy. This object set represents a multiple-purpose structure which is used to represent Errors, Resolutions, and Sizes in this model.

6.12.11.1 MultiStruct.flavor

type: string

type-detail: Section [5.1](#)

multiplicity: 1

String representing the role that the object plays in the associated object. e.g. "error", "resolution", etc.

6.12.12 MJD

Modified Julian Day of a particular instant. Note: $MJD = JD - 2,400,000.5$.

6.12.12.1 MJD.time

type: real
multiplicity: 1

type-detail: Section [5.1](#)

Decimal number representing the Modified Julian Day of a time instant, to required precision.

6.12.13MSMatrix

The MultiStruct entity is represented by a n-D Matrix.

6.12.13.1 MSMatrix.matrix

type: Matrix
multiplicity: 1

type-detail: Section [6.12.8](#)

matrix elements.

6.12.14 QuantityVector

Abstract head of vector types. This type is intended to be used when it is important to emphasize the dimensionality of a value pair, rather than using an array representation. Each component element is independent, and holds their own values for ucd and unit.

6.12.15 RealDoublet

Type for doublet vector. Holds a pair of RealQuantity types.

6.12.15.1RealDoublet.d1

type: RealQuantity
multiplicity: 1

type-detail: Section [5.1](#)

First value pair element.

6.12.15.2 RealDoublet.d2

type: RealQuantity
multiplicity: 1

type-detail: Section [5.1](#)

Second value pair element.

6.12.16 RealScalar

Type for a singular Quantity vector.

6.12.16.1RealScalar.d1

type: RealQuantity
multiplicity: 1

type-detail: Section [5.1](#)

Scalar value element.

6.12.17 RealTriplet

Type for a triplet vector. Hold a three RealQuantity types.

6.12.17.1 RealTriplet.d1

type: RealQuantity
multiplicity: 1

type-detail: Section [5.1](#)

First triplet element.

6.12.17.2 RealTriplet.d2

type: RealQuantity
multiplicity: 1

type-detail: Section [5.1](#)

Second triplet element.

6.12.17.3 RealTriplet.d3

type: RealQuantity
multiplicity: 1

type-detail: Section [5.1](#)

Third triplet element.

6.12.18 Symmetrical

The MultiStruct entity is represented by a symmetrical distribution about the associated value.

6.12.18.1 Symmetrical.radius

type: RealQuantity
multiplicity: 1

type-detail: Section [5.1](#)

Relative extension from the associated value in all directions.

6.12.19 TimeOffset

Elapsed time since a particular instant.

6.12.19.1 TimeOffset.offset

type: real
multiplicity: 1

type-detail: Section [5.1](#)

Decimal number representing the elapsed time.

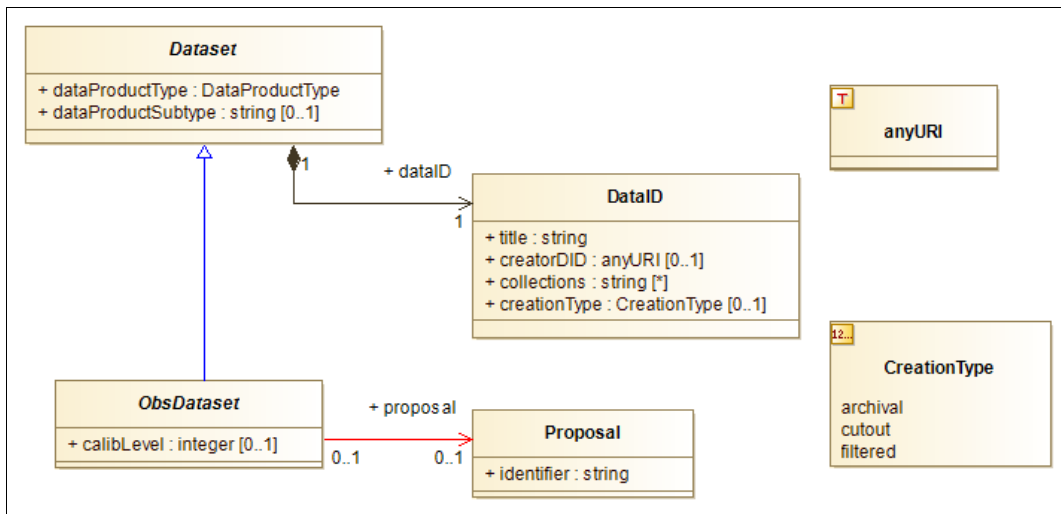
6.12.20 TimeStamp

Type to express an absolute instant in time.

Appendix A: Modeling Conventions

1 Diagram notation

This model follows the VO-DML modeling practices, however, UML representations may vary depending on the tool used. Below, we describe the graphical representation of the modeling concepts and relations.



1.1 Class

Classes are represented by a plain box. The class name is annotated in the top window, abstract classes use italic typeface. Attributes, if any are listed in the lower panel. Attributes may only be of primitive type (real, string, etc), a defined DataType, or an Enumeration type. Relationships to other objects are defined via the composition and reference relation arrows.

1.2 DataType

DataTypes are represented by a box shape similar to Class, but annotated with a "T" symbol in the top left corner.

1.3 Enumerations

Enumerations are represented by a box shape similar to Class, but annotated with a "1,2.." symbol in the top left corner. Enumeration Literals (possible values) are listed below the enumeration class name.

1.4 Generalization

Generalizations are represented by a blue line, with open triangle at the end of the source, or more general, object.

1.5 Composition

The composition relation is indicated by a black line with a solid diamond attached to the containing object, and an arrow pointing to the object being contained. The composition relation is very tight, where the container is responsible for the creation and existence of the target. Any object may be in no more than one composition relation with any container. The attribute name for the composition relation is annotated at the destination of the relation (e.g. "+ dataID"). This is typically a lower-cased version of the destination class name, but this is not required.

1.6 Reference

The reference relation is indicated by a red line, with an arrow pointing to the object being referenced. The reference relation is much looser than composition, the container has no ownership of the target, but merely holds a pointer, or other indirect connection to it. The attribute name is annotated at the destination of the relation (e.g. "+ proposal"). This is typically a lower-cased version of the destination class name, but may be another name indicating the role that the class is playing in this context.

1.7 Multiplicity

All attributes and relations have a multiplicity associated with them. For attributes, the multiplicity is contained within brackets just after the attribute name. If no bracket is displayed, this is equivalent to '[1]'.

- + 1 = one and only one value must be provided.
- + 0..1 = zero or one value may be provided.
- + * = zero or more values may be provided (open ended).

2 Model Identification metadata

Interoperability of datasets requires that there be a standardized method for identifying the specific type of dataset, and which model(s) and versions thereof it conforms to. These elements are not properties of the dataset, but rather, of the Model itself. We provide this information via stereotypes assigned to the model packages (e.g. Dataset, Char, STC, IVOA).

2.1 Model stereotype

The Model stereotype (<<model>>) consists of a set of Model properties which identify a particular model and its dependencies. Each model should specifically state the appropriate values for these properties.

2.1.1 title:string[1]

The model title or long name.

2.1.2 version:string[1]

The version of this model. To be represented as a string with format "<version>.<subversion>"

2.1.3 name:string[1]

Sometimes referred to as 'namespace' or 'prefix', this is a tag which is used to label elements of a particular model. The value must match the name of the model package itself. This string identifies the particular model type (eg. ds, char, stc). Each model must declare a prefix string

which is unique within the IVOA to tag elements from those models. A typical use of the prefix is in the construction of element UTYPE strings.

2.1.4 url:anyURI[1]

A URL from which the full model description may be obtained (e.g. XML schema).

2.1.5 imports:Import[*]

Here, we specify which the models on which this model is dependent. This model uses and/or extends elements from the Characterisation and STC Data models. In this document, we provide descriptions and supporting information about usage of these objects in a particular context. The originating documents, however, remain the definitive source for element definitions.

2.2 Import Stereotype

The <<modelimport>> stereotype is attached to Packages representing imported models. It identifies the model by name, and provides URLs from which the full description may be obtained.

2.2.1 name:string[1]

The name of the imported model. This name MUST match the 'name' property of imported model's Model metadata.

2.2.2 version:string[1]

The version of this model. To be represented as a string with format "<version>.<subversion>"

2.2.3 url:anyURI[1]

A URL from which the full model description may be obtained (e.g. XML schema).

3 Extensibility

There is no formal mechanism in the IVOA defining how users may extend models with their own content. However, the above Model identification metadata provides a simple means to do so. Using this process, a user would model their content as an extension of the IVOA standard.

3.1 Model

3.1.1 name

The user-defined model would need a name unique from that of the standard.

3.1.2 prefix

A unique prefix must be defined for the user-defined model elements. Users must take care not to make use of prefix tags which are associated with current IVOA standards, (e.g. 'cha', 'spec', 'ssa', 'stc'). At the time of this writing, there is no central repository of reserved namespace strings.

3.1.3 imports

The user defined model should declare the IVOA standard being extended as an imported model. Fields for the imported model name and url may be obtained from that standard's documentation.

3.2 Scope

We permit any object modeled in this document to be extended with user-defined content, with the following restrictions:

- Follow VO-DML modeling practices.
- Values of extended content must be consistent with the content of modeled data. That is, using the IVOA base primitive types, Quantity, and STC Coordinates as appropriate.
- Since extended content, by definition, does not follow the corresponding model, it is not possible for general applications to interpret complex structures within that content. It is, therefore, recommended that users define extended content in such a way as to avoid ambiguity between its components.

3.3 Support

Applications should, but are not required to, provide the following support for extended content:

- Retain existence of extended content, including namespace and UTypes.
- Retain association with modeled component.
- Provide access to extended content by users.

Appendix C: Dataset Metadata Model Summary

Dataset Model Identification				
Model Element	Datatype	Mult.	Meaning	value
Model identification				
Model				
model.title	string	1	Data model name	"Dataset Metadata"
model.version	string	1	Data model version	"1.0"
model.name	string	1	Data model short name, prefix tag	"ds"
model.url	anyURI	1	Reference URL for model	<TBD>
Imported Model				
modelimport.name	string	1	Imported model name	"char"
modelimport.version	string	1	Imported model version	"1.13"
modelimport.url	anyURI	1	Reference URL for imported model	<TBD>
modelimport.documentationURL	anyURI	1	Reference URL for imported model documentation	<TBD>
Imported Model				
modelimport.name	string	1	Imported model name	"stc"
modelimport.version	string	1	Imported model version	"2.0"
modelimport.url	anyURI	1	Reference URL for imported model	<TBD>
modelimport.documentationURL	anyURI	1	Reference URL for imported model documentation	<TBD>
Imported Model				
modelimport.name	string	1	Imported model name	"ivoa"
modelimport.version	string	1	Imported model version	"1.0"
modelimport.url	anyURI	1	Reference URL for imported model	<TBD>
modelimport.documentationURL	anyURI	1	Reference URL for imported model documentation	<TBD>

Dataset Model Summary				
Model Element	Datatype	Mult.	Meaning	UCD1+
Dataset Model Elements				
Collection	Collection		Descriptive metadata of a compatible grouping	
Collection.name	string	1	Collection name	
Contact	Contact		Extension of party Role	
Contact.party	<i>Individual</i>	0..1	Entity associated with Contact role.	
Contributor	Contributor		Extension of Role. Entity participated in dataset generation	
Contributor.acknowledgement	string	1	Acknowledgment expression for the contributor	

Dataset Model Summary				
Model Element	Datatype	Mult.	Meaning	UCD1+
Creator	Creator		Extension of Role. Entity which created the dataset	
Curation	Curation			
Curation.contact	Contact	0..1	Contact entity for curation service	
Curation.publisher	Publisher	1	Publisher	meta.curation
Curation.publisherDID	anyURI	0..1	Publisher specified dataset ID	meta.ref.url;meta.curation
Curation.reference	Publication	0..*	Reference to publication associated with the dataset	
Curation.releaseDate	datetime	0..1	Date curated dataset last modified	time.release
Curation.rights	RightsType	0..1	Level of access granted	meta.code
Curation.version	string	0..1	Publisher version of the dataset	meta.version;meta.curation
DataID	DataID			
DataID.collection	Collection	0..*	Collection(s) to which the dataset is a member	meta.id
DataID.contributor	Contributor	0..*	Contributor(s)	
DataID.creationType	CreationType	0..1	Dataset creation type	
DataID.creator	Creator	0..1	Institution or entity which created the dataset	meta.curation
DataID.creatorDID	anyURI	0..1	Creator defined Dataset Identifier	meta.id
DataID.datasetID	anyURI	0..1	IVOA Dataset Identifier	meta.id;meta.dataset
DataID.date	datetime	0..1	Data processing/creation date	time.epoch;meta.dataset
DataID.title	string	1	Dataset title	meta.title;meta.dataset
DataID.version	string	0..1	Version of dataset	meta.version;meta.dataset
Dataset	<i>Dataset</i>			
Dataset.curation	Curation	1	Dataset curation metadata	
Dataset.dataID	DataID	1	Dataset identification metadata	
Dataset.dataProductSubType	string	0..1	Dataset subtype	meta.id
Dataset.dataProductType	DataProductType	1	Dataset or segment type	meta.id
Publication	Publication		Referenceable publication	
Publication.refCode	string	1	URL or Bibcode of the publication	meta.bib.bibcode
Publisher	Publisher			
Publisher.publisherID	anyURI	0..1	URI for VO Publisher	meta.ref.url;meta.curation

Dataset Model Summary				
Model Element	Datatype	Mult.	Meaning	UCD1+
Observation Model Elements				
AstroTarget	AstroTarget		Astronomical target	
AstroTarget.objectClass	string	0..1	Target or object class	src.class
AstroTarget.redshift	real	0..1	Target redshift	src.redshift
AstroTarget.spectralClass	string	0..1	Object spectral class	src.spType
AstroTarget.VarAmpl	real	0..1	Target variability amplitude - typical	src.var.amplitude
BaseTarget	BaseTarget			
BaseTarget.description	string	0..1	Target descriptive text	meta.note;src
BaseTarget.name	string	1	Target name	meta.id;src
BaseTarget.position	Position	0..1	Target location (eg: RA, DEC)	pos[.eq];src
Characterisation	Characterisation		Direct extension of char:Char	
Derived	Derived			
Derived.derivedElement	DerivedElement	0..*	property derived from analysis of data content	
DerivedScalar	DerivedScalar			
DerivedScalar.name	string	1	name of derived property	
DerivedScalar.value	Quantity	1	value of derived property	
Facility	Facility		Extension of Role. Associates Organization as Facility	
Facility.party	Organization	1	Organization responsible for performing the observation	meta.id;instr.tel
Instrument	Instrument		Instrument metadata	
Instrument.name	string	1	Instrument ID	meta.id;instr
ObsConfig	ObsConfig			
ObsConfig.bandpass	string	0..1	General regime in spectral domain	instr.bandpass
ObsConfig.dataSource	string	0..1	Original source/type of data	
ObsConfig.facility	Facility	0..1	Metadata for the facility performing the observation	
ObsConfig.instrument	Instrument	0..1	Metadata for the Instrument which created the data	
ObsDataset	ObsDataset			
ObsDataset.calibLevel	integer	0..1	Calibration level	meta.code;obs.calib
ObsDataset.characterisation	Characterisation	1		
ObsDataset.coordSys	AstroCoordSystem	0..*	Global coordinate systems	
ObsDataset.derived	Derived	0..1	Derived metadata	
ObsDataset.obsConfig	ObsConfig	0..1	Observatino configuration	
ObsDataset.proposal	Proposal	0..1	Proposal information	
ObsDataset.target	<i>BaseTarget</i>	1		
Observation	Observation			
Observation.obsConfig	ObsConfig	1	Observation configuration metadata	
Observation.observationID	string	1	Observation ID	
Observation.proposal	Proposal	0..1	Proposal which spawned the observation	
Observation.result	ObsDataset	0..*	Dataset(s) resulting from the observation	

Dataset Model Summary				
Model Element	Datatype	Mult.	Meaning	UCD1+
Observation.target	BaseTarget	1	Target or goal of the observation	meta.id;obs.proposal
Proposal	Proposal	1	Proposal ID	
Proposal.Identifier	string			
Target	Target			
Target.objectClass	string	0..1	Target or object class	
Party Package Elements				
Individual	Individual	0..1	Entity described as a single individual or representative	meta.ref.url;meta.email
Individual.address	string		address of the Individual	
Individual.email	string		email address of individual	
Individual.phone	string	0..1	phone number for the Individual	
Organizaton	Organization	0..1	Entity represented by an organization	
Organization.address	string		address of the organization	
Organization.email	string		email address for the organization	
Organization.logo	anyURI	0..1	URL for organization logo	
Organization.phone	string	0..1	phone number of the organization	
Party	Party	1	Head of the Entity object tree	
Party.name	string		Entity name	
Role	Role		Role being associated with a particular Party	
Role.party	Party	1	Entity associated with the role.	

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