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Space-Time Coordinate Metadata for the Virtual Observatory

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The UML diagrams on the following pages specify the design of the VO Space-Time Coordinate metadata. Specifically, these metadata describe the volume in coordinate space that is occupied by the data object that they are attached to (or the query, or the resource), with additional information on actual or desired properties of the data along those coordinate axes.
The coordinates that are covered by these metadata are:

- Time
- Spatial position (1-D, 2-D, 3-D; spherical, Cartesian, or unit vector coordinates)
- Spatial velocity (1-D, 2-D, 3-D)
- Redshift (or Doppler velocity)
- Spectrum

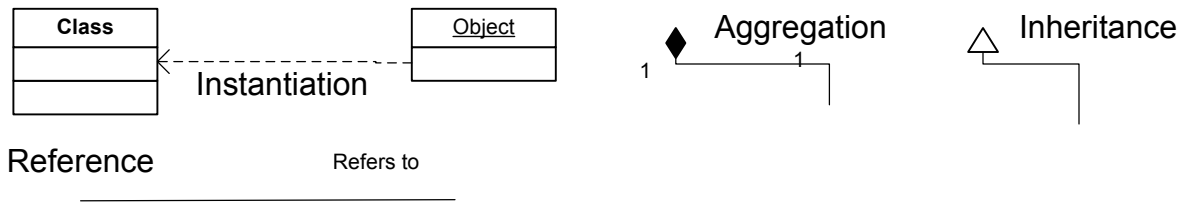
The reason for lumping these 5 coordinates together is that their reference frames are intertwined.
The coordinate axis properties included are:

- Name
- Value
- Error
- Resolution
- Size
- Pixel size

Note that mapping metadata objects are still required to tie pixels to these axes (and vice versa).
The basic building block classes (aggregated into all-encompassing STC class) are:

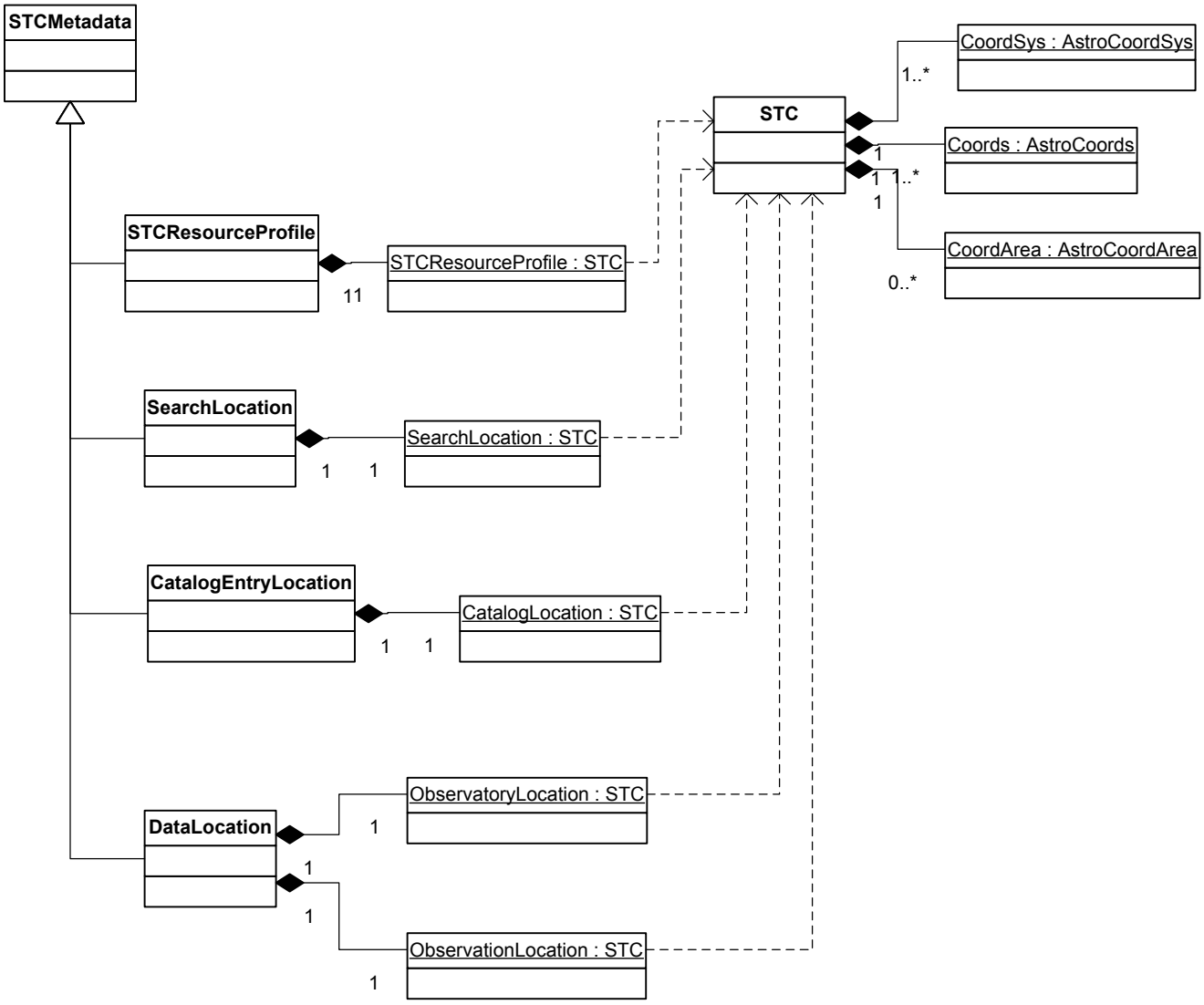
- ***AstroCoordSys***: defines the coordinate systems and reference frames for all coordinates in a fully general way, allowing inclusion of, e.g., terrestrial, solar system, and planetary frames. Note that AstroCoordSys is inherited from a generalized CoordSys which is a collection of one or more CoordFrames. The coordinate frames required in AstroCoordSys are all derived from CoordFrame.
- ***AstroCoords***: defines a position in coordinate space, referenced to an AstroCoordSys, with error, resolution, pixel, etc., information. Inherited from a generalized Coords.
- ***AstroCoordArea***: (derived from CoordArea) defines a volume in coordinate space, again tied to an AstroCoordSys; this includes the more sophisticated ***Region*** specification for 2-D spatial areas.

The following shapes are being used in these UML diagrams:



We grant that one might argue that some of the classes should be aggregates of objects, rather than aggregates of classes, but feel that this does not really affect the essence of this design which is, admittedly, somewhat fuzzy in this respect.
Note that for each of the Coordinate classes derived from the Generic Coordinate base class, the classes that are aggregated into the coordinate class (with the exception of CoordName) are constrained by the derived class. I.e., the CoordValue, CoordError, etc., for TimeCoord, SpatialCoord, RedshiftCoord should probably be classes that are multiply inherited from their generic classes as well as from the types that are shown in their UML diagrams. Similarly, one might wonder about the implied multiple inheritance of CoordInterval in the Coordinate Area diagram.

Space-Time Metadata Top-level Classes

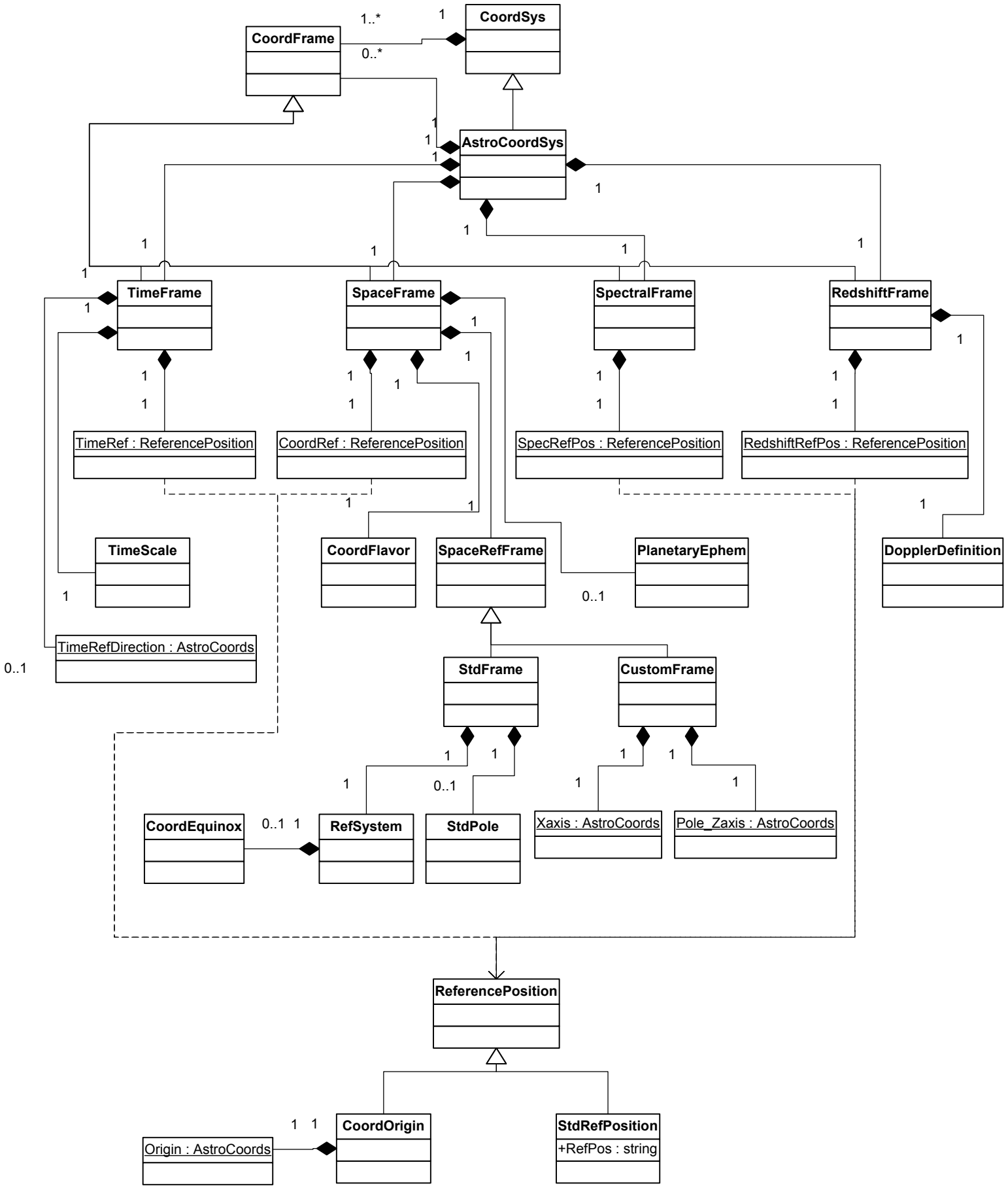


The ***STCMetadata*** class has four derived forms, each of which consists of one or two instantiations of ***STC***:

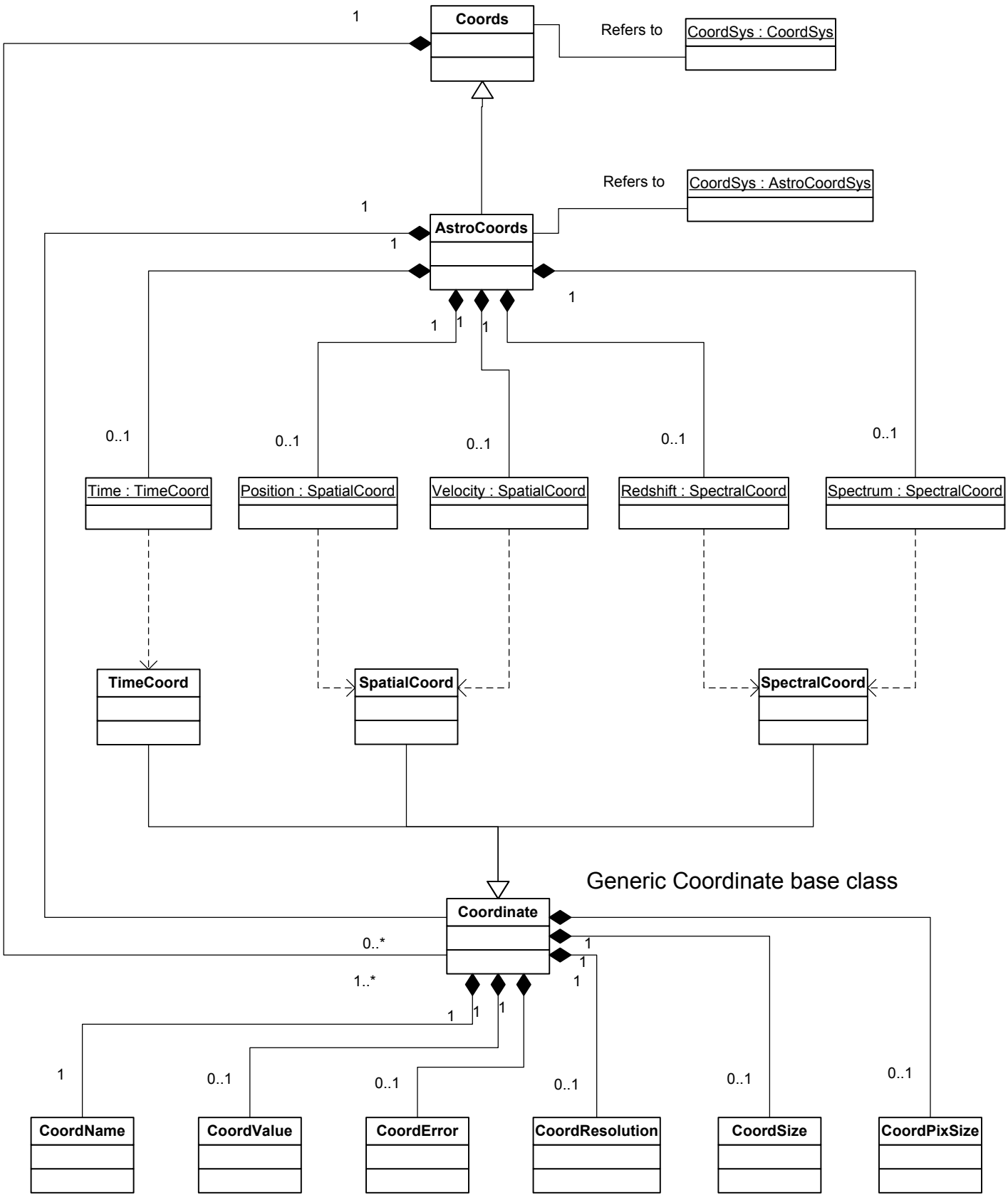
- ***STCResourceprofile***: describes the coverage of a resource.
- ***SearchLocation***: describes the coordinate volume requested in a query, as well as desired resolutions, errors, etc.
- ***CatalogEntryLocation***: describes the coordinate coverage of a set of catalog entries, as well as the coordinates, errors, etc., when these are part of the entries.
- ***DataLocation***: describes the coordinate volume occupied by a particular dataset (***ObservationLocation***), as well as the position of the observatory that produced the dataset (***ObservatoryLocation***); both are needed, in all coordinates, to facilitate transformations.

STC contains one or more instantiations of ***CoordSys***, ***Coords***, and (optionally) ***CoordArea***.

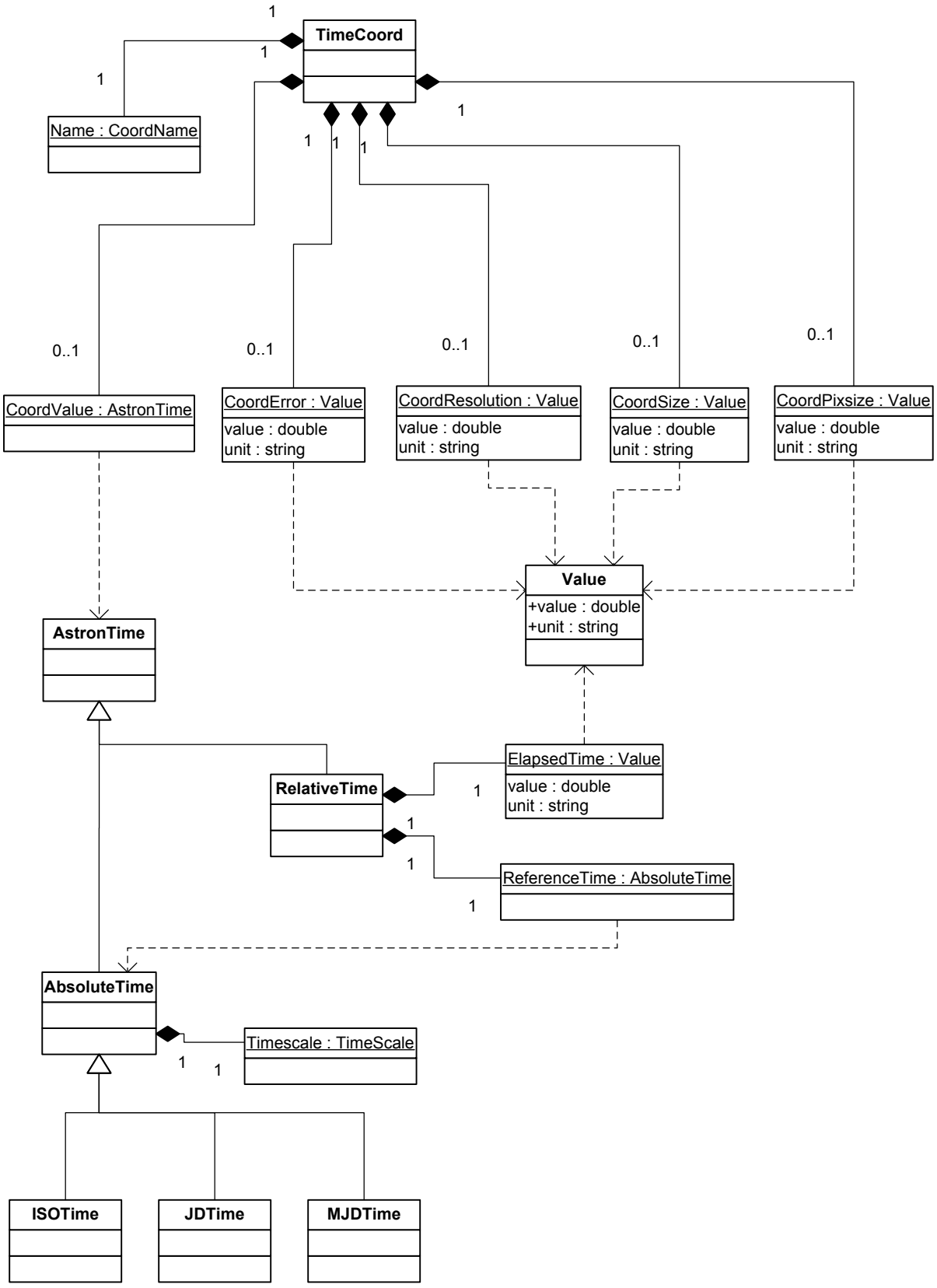
The Coordinate System



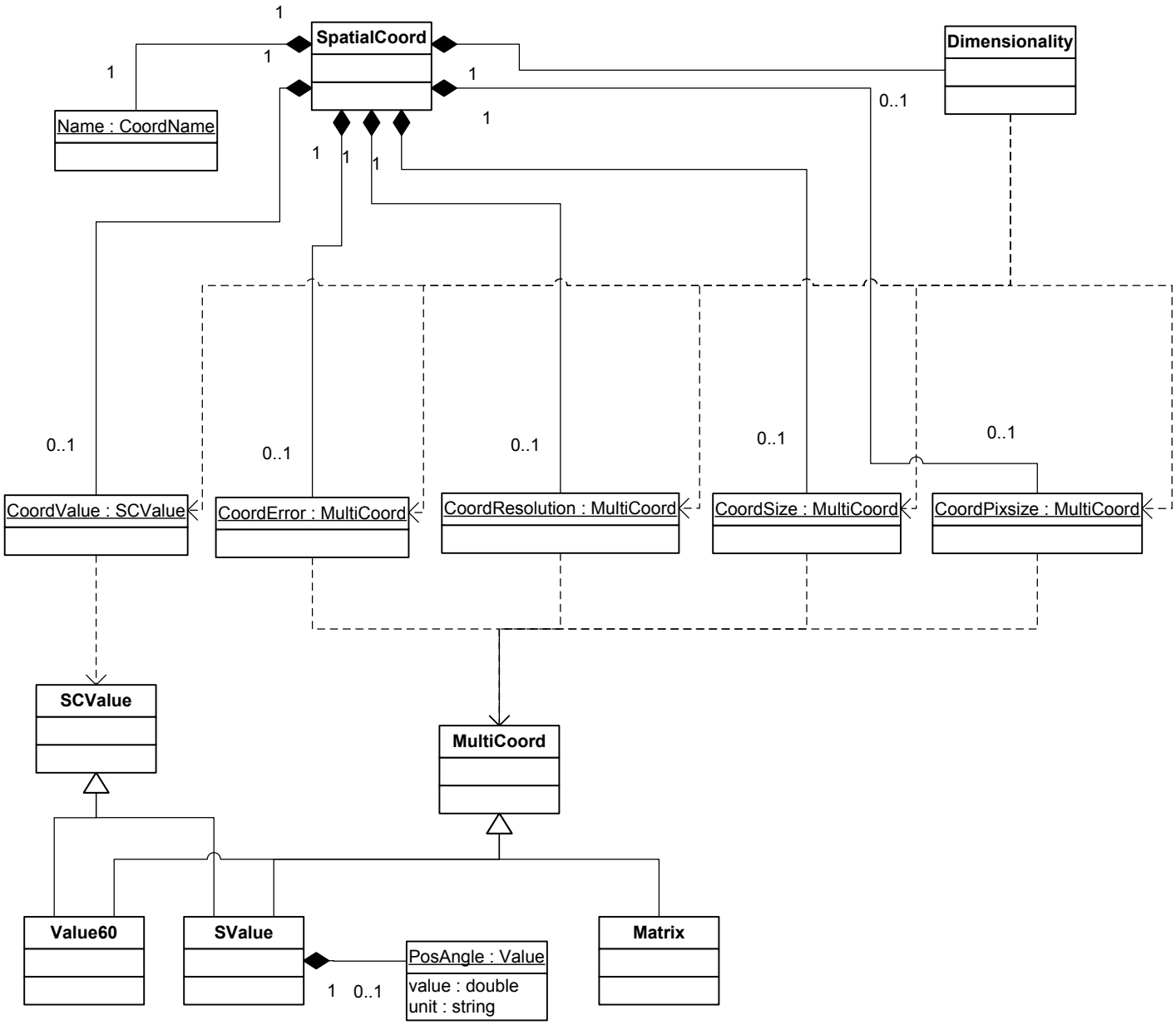
Coords Class - for full coordinate description
AstroCoords - for astronomical coordinates



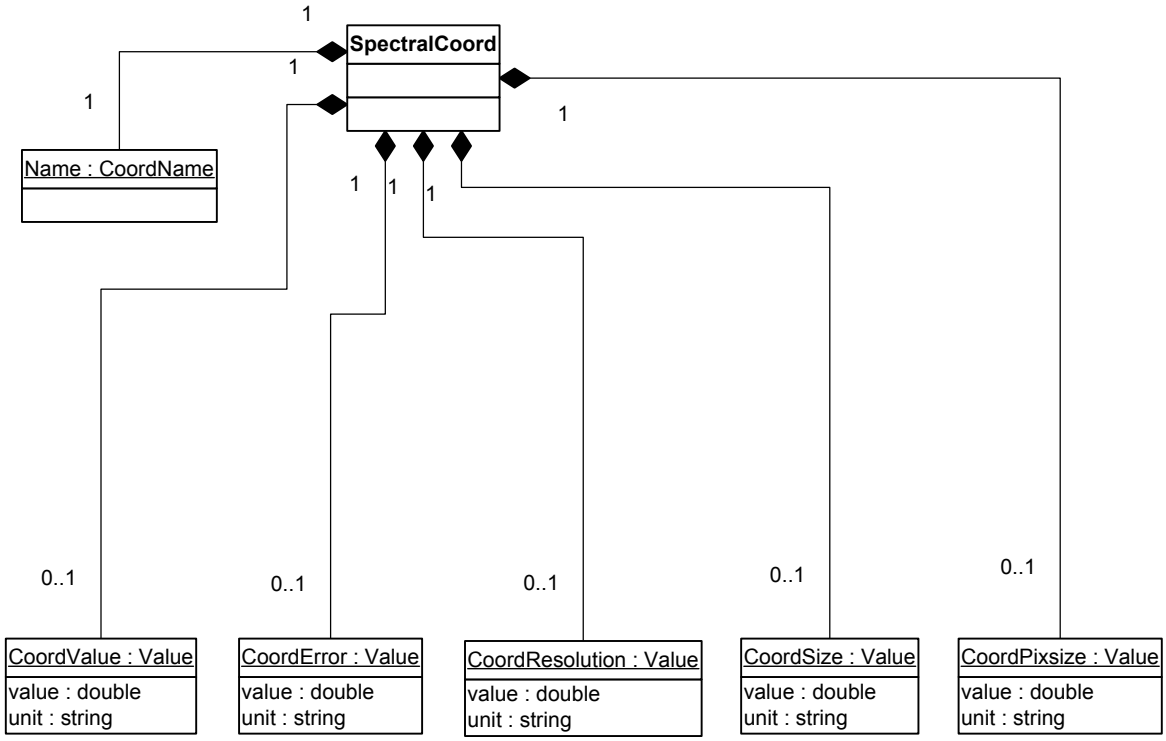
TimeCoord Class - for Time Coordinate



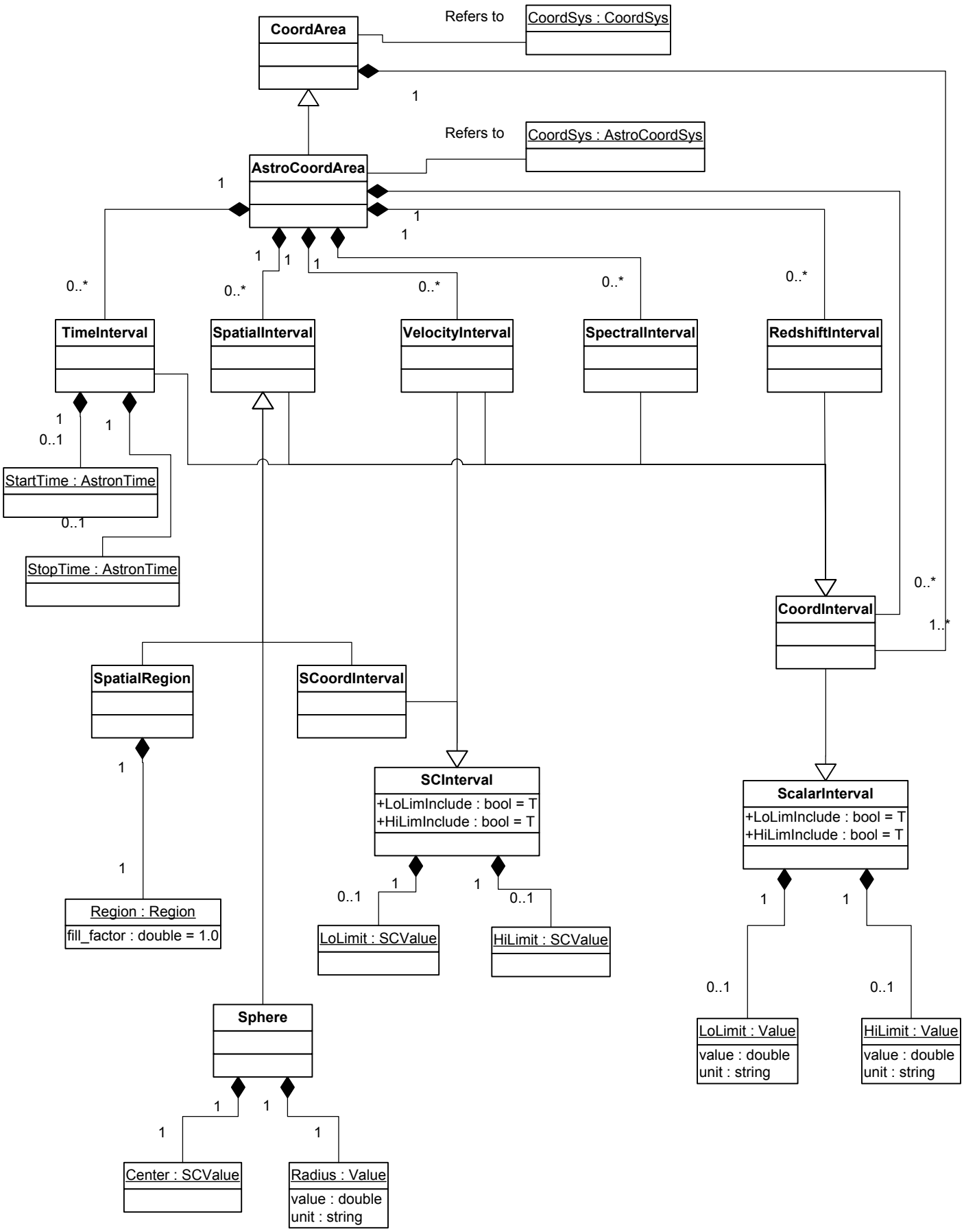
SpatialCoord Class - for Spatial Position and Velocity Coordinates



SpectralCoord Class - for Redshift and Spectral Coordinates



Coordinate Area - the coordinate volume that is taken up



Region (spatial)