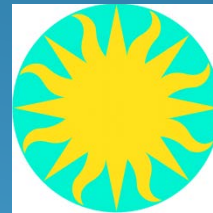


STC-2 Design and Development: Status



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Designing STC-2 in VO-DML

- VO-DML offers a rigorous design framework that improves completeness and consistency
 - With thanks to:
 - Gerard Lemson
 - Omar Laurino
 - Mark Cresitello-Dittmar
 - Markus Demleitner
 - David Berry

Scope

- Metadata to describe the location of a physical or data object in Observation Space:
 - Time
 - Space
 - EM Spectrum
 - Redshift/Doppler velocity
 - Polarization
- These are the independent variables in an observation
- They are (or can be) interrelated
 - It must therefore be possible to provide them in a single self-consistent metadata object

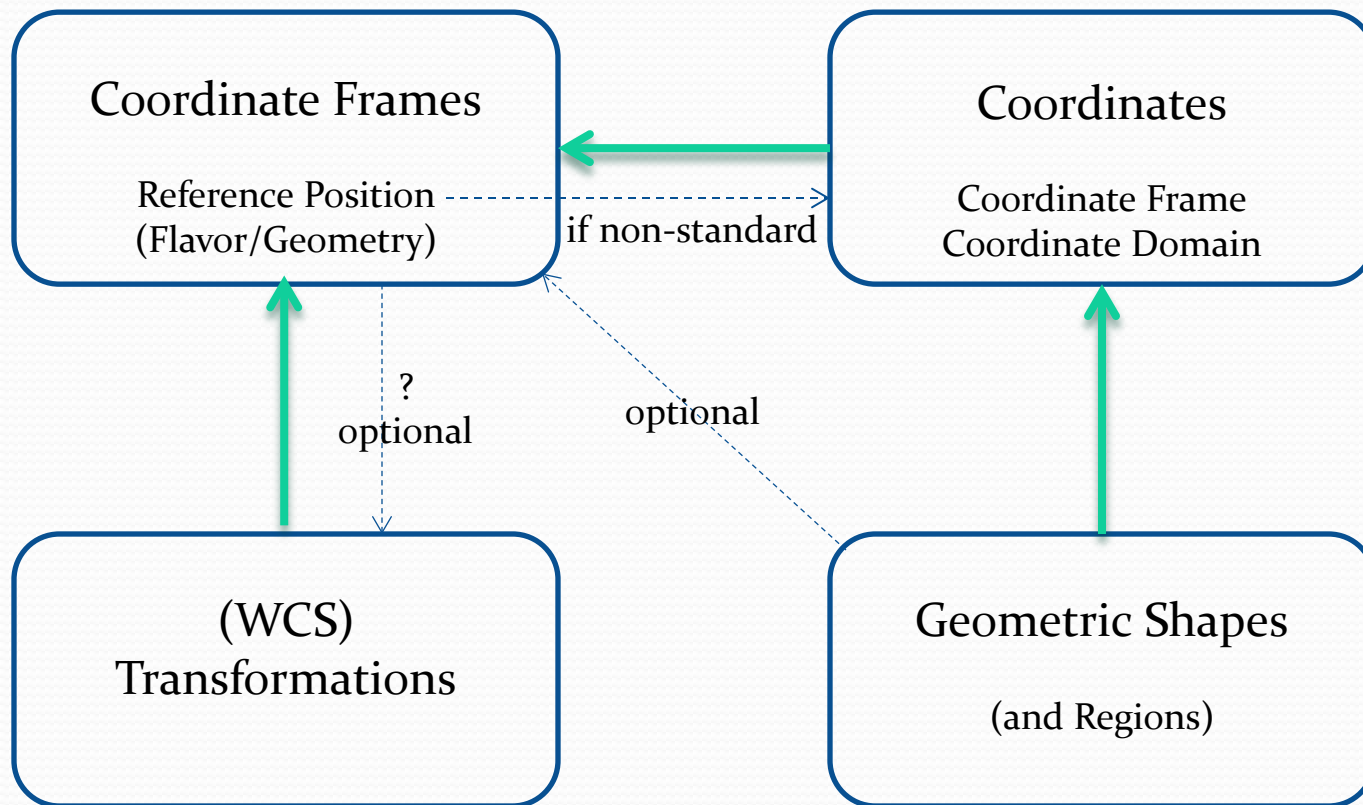
Frames and Coordinates

- Coordinate Frames
 - Frame definition: standard only
 - Reference position: standard
 - Custom optional; creates a dependency on Coordinates pkg
 - Flavor (or Geometry; for spatial frames only)
- Coordinates
 - Contents generally based on RealQuantity (value + unit)
 - Reference to a Coordinate Frame
 - SKOS concept: coordinate domain
 - Constrains allowable units

Transformations

- Transformations have to be defined between coordinate frames
- Therefore all properties required by the transform need to be included in the frame
- That includes the flavor/geometry

Packages



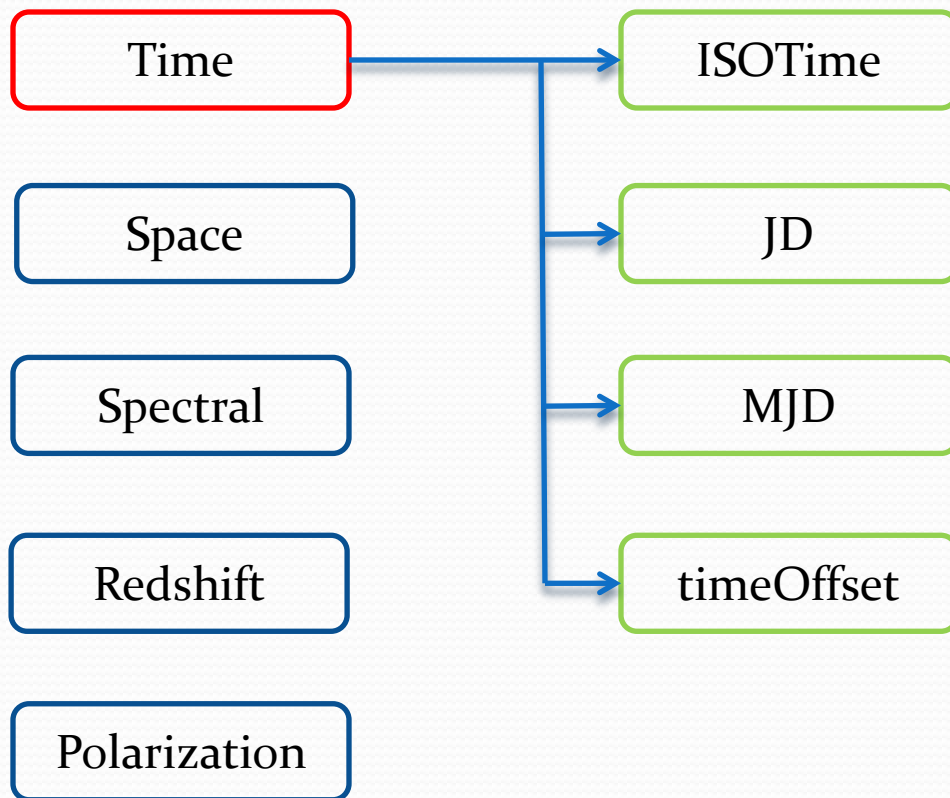
Coordinates

- Implemented as Data Types; low overhead
- Contain:
 - Values
 - Errors on the values
 - Resolution
 - Added refractive index for Spectral/Wavelength ☺
- All elements may refer to 1-D, 2-D, 3-D if spatial
- Most elements are quantities: value and unit
- Reference to appropriate coordinate frame
- Appropriate coordinate domain restriction

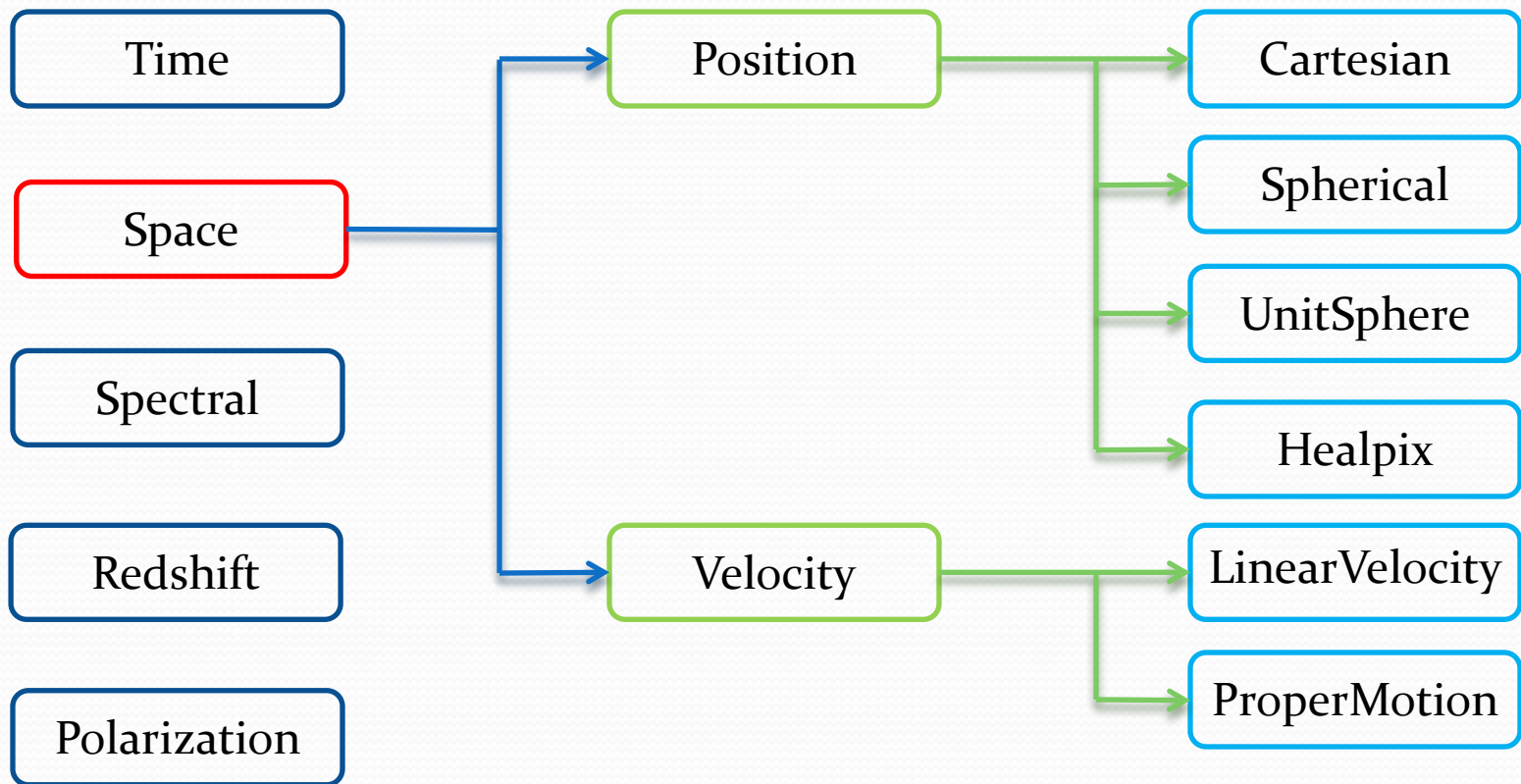
Units Handling

- The units model has not been worked out completely
- Requires a mechanism to restrict units to what is appropriate in the context
- Introduced SKOS concept Coordinate Domain:
 - Within a Coordinate it sets the broadest concept allowable for units
 - Subsetting sets that for each type of coordinate
 - It provides a consistent units constraint mechanism that is independent of context

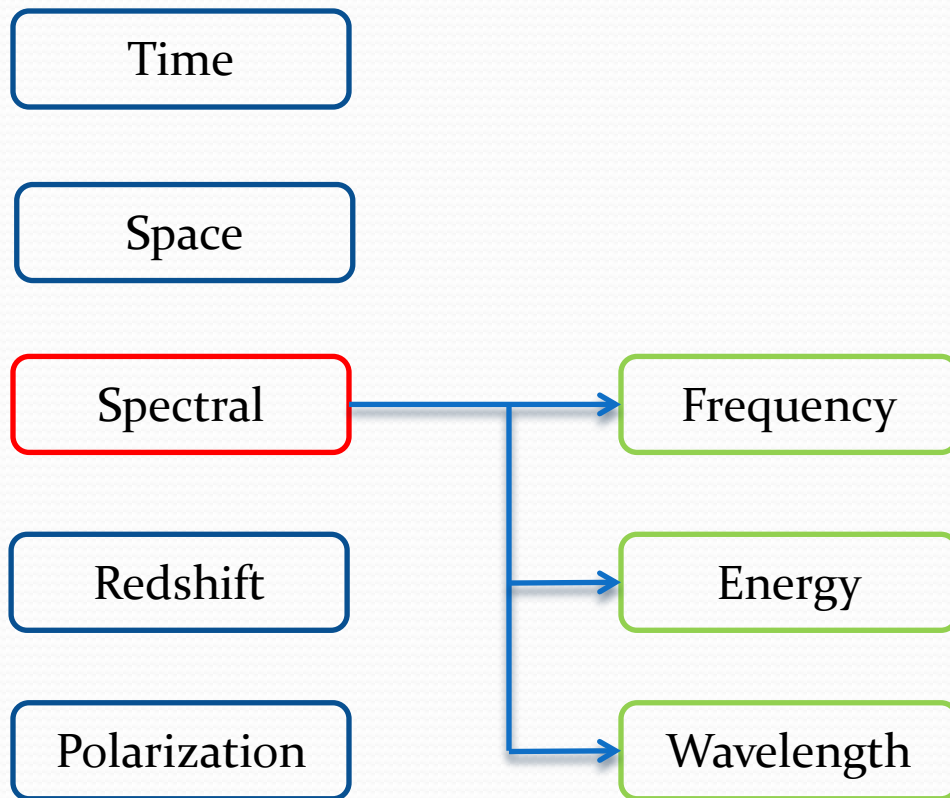
Coordinate Domain Taxonomy



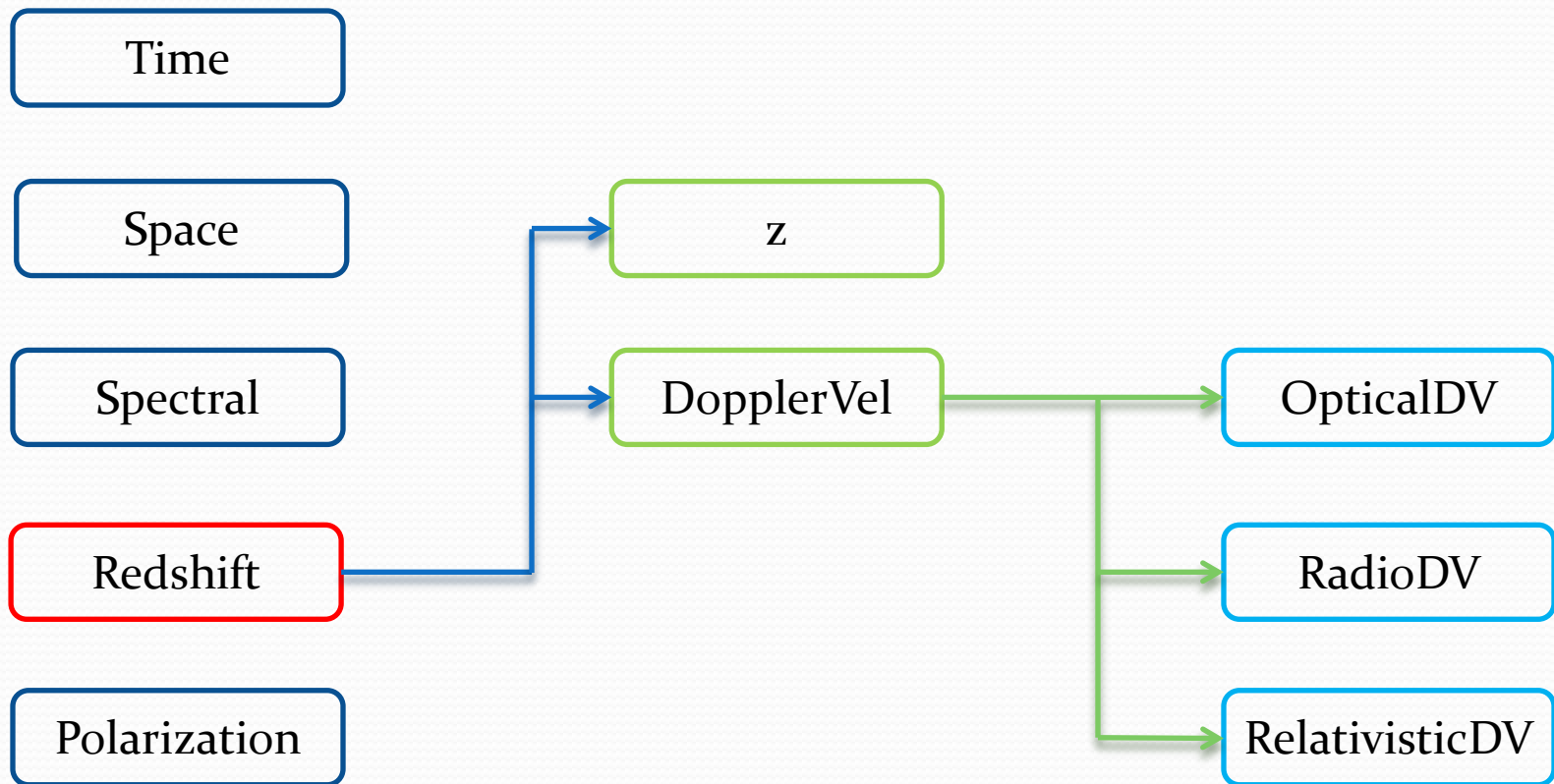
Coordinate Domain Taxonomy



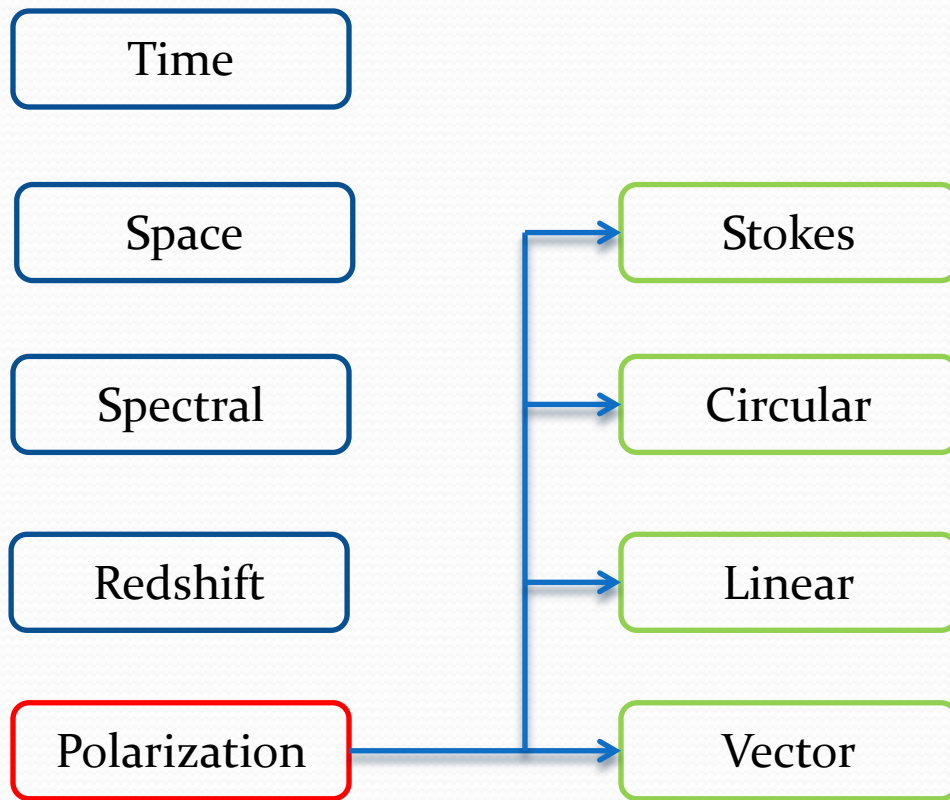
Coordinate Domain Taxonomy



Coordinate Domain Taxonomy



Coordinate Domain Taxonomy



Polarization

- By necessity an enumerated coordinate axis
- Stokes
 - I, Q, U, V
- Circular
 - LL, RR, LR, RL
- Linear
 - XX, YY, XY, YX
- Vector
 - I, PolFlux, PolPercent, PolAngle

Pixel Frames and Coordinates

- Pixel Frames are defined in Transforms; they cannot exist without a transform
- Pixel coordinates are simple n-dimensional values
- The Pixel Space consists of one or more Pixel Frames
- A Pixel Frame maps to a WCS Coordinate Frame
- Multiple mappings are allowed

Generic Coordinates

- Generic Coordinate Frames and Coordinates
- Allow using the same tools for use with, say, dependent variables like flux

Transformations

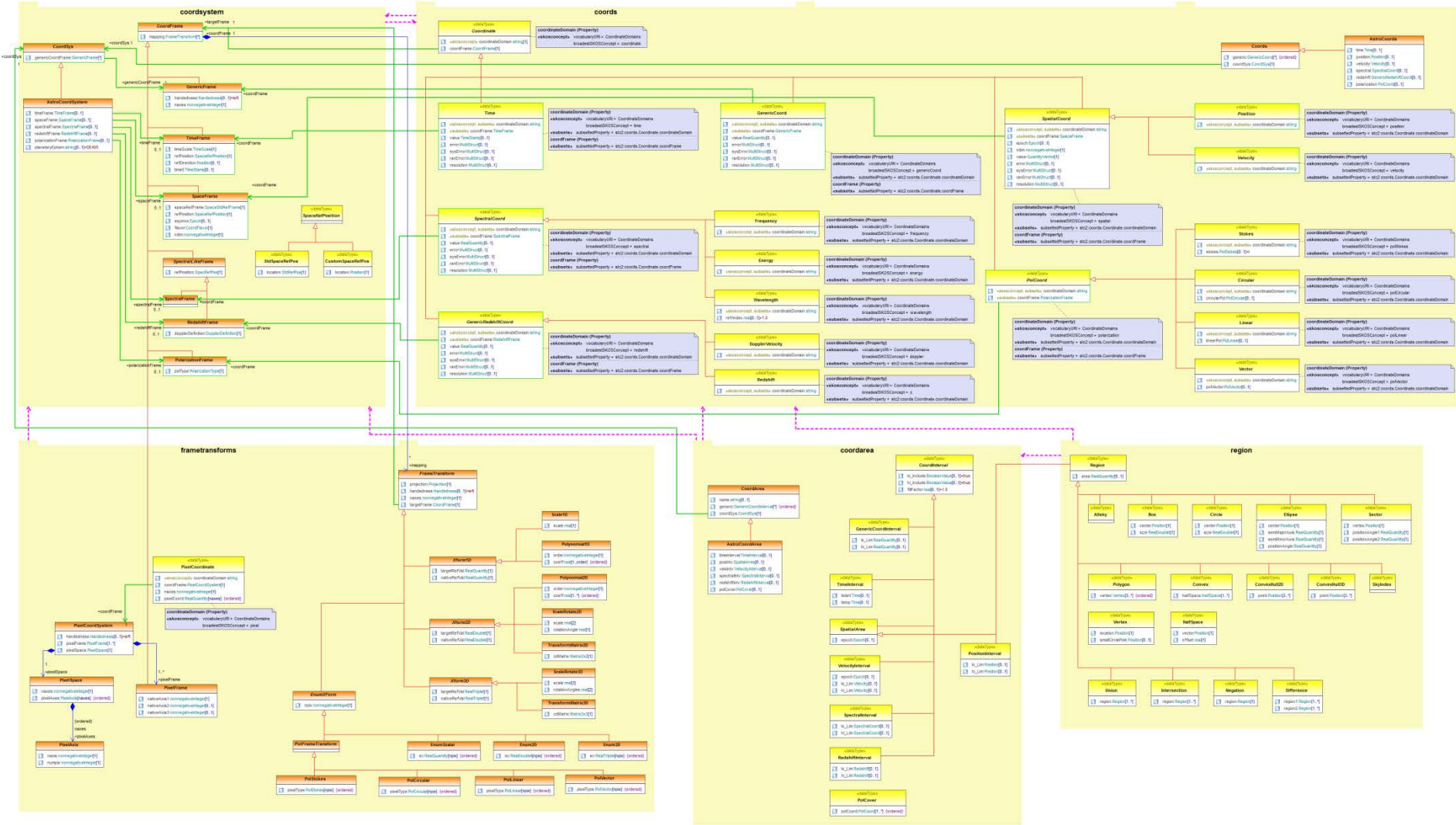
- Define (not implement) a mapping from one Coordinate Frame to another
- Mirrors FITS WCS conventions and standards
- General extension to all Frames, including Generic
- Allow enumerated coordinates
- More this afternoon

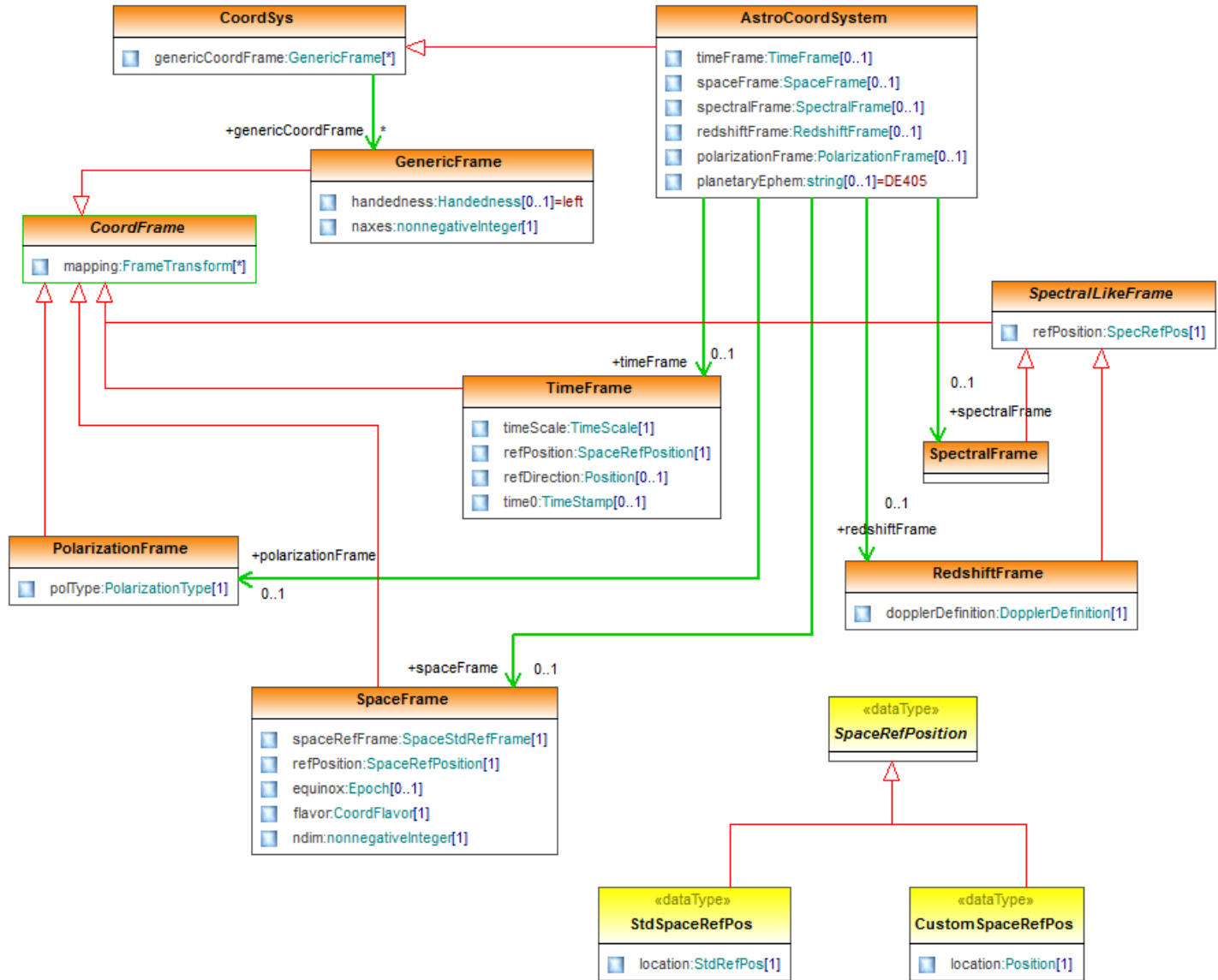
Geometric Shapes

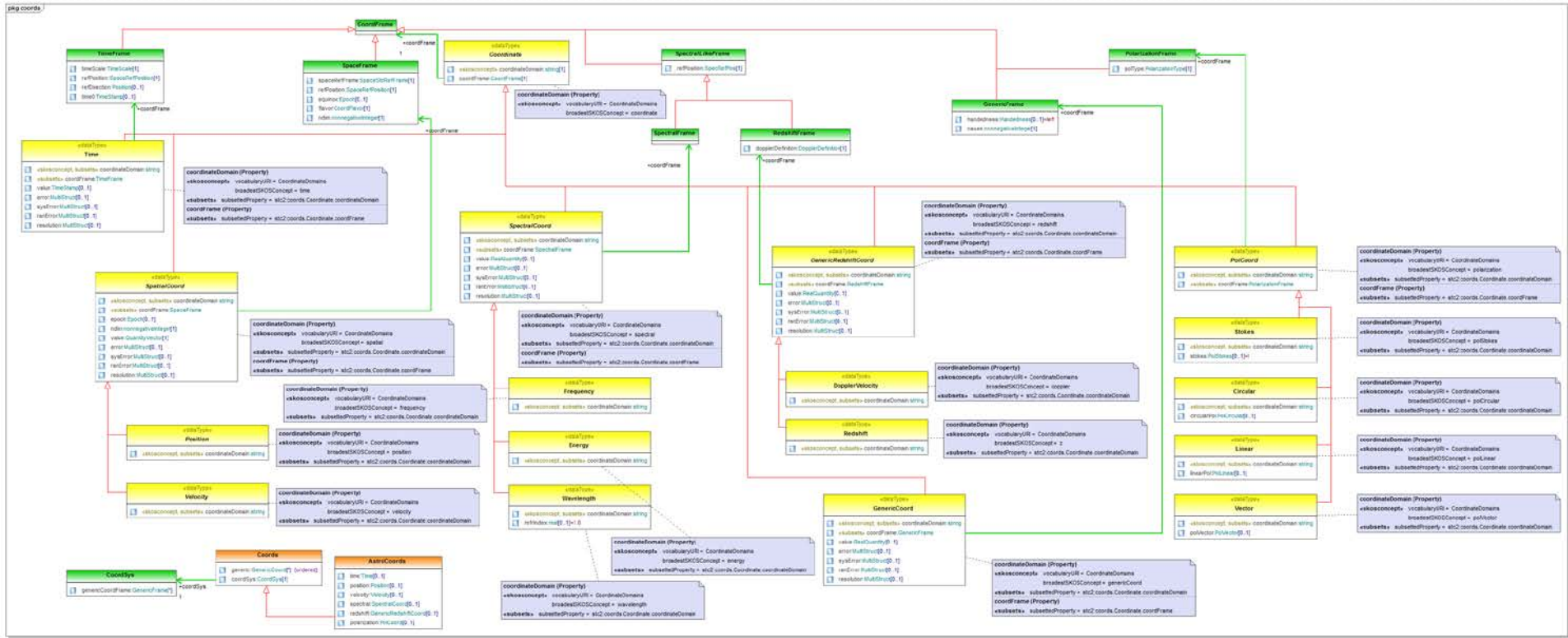
- Specify ranges, areas, volumes in Observing Space
- Specialized set: Regions in 2-D
- Dependent on Coordinates; optionally on Coordinate Systems
- No other packages depend on Geometric Shapes

Remaining to Be Done

- Transformations: FITS-style or AST-style?
- Define specialized coordinate types through subsetting?
- Complete standard frames and positions enumerations
- Complete documentation
- Coordinate with Units DM
- Run it through DML generating script







pkg stctypes

«enumeration» Projection
LIN LOG TAN SIN STG ARC AIR ZEA CEA CAR MER SFL PAR MOL AIT COE COD COO BON PCO TSC CSC QSC POLYNOMIAL ENUMERATION

«enumeration» StdRefPos
GEOCENTER TOPOCENTER BARYCENTER HELIOCENTER etc

«enumeration» SpecRefPos
LSR LSRK LSRD GEOCENTER TOPOCENTER BARYCENTER HELIOCENTER etc

«dataType» Epoch
type:EpochType[1]=J year:decimal[1]

«enumeration» EpochType
J B

«enumeration» TimeScale
TT TAI UTC TDB TCG TCB ET GPS

«enumeration» CoordFlavor
spherical cartesian polar cylindrical unitsphere healpix string polarization

«dataType» Matrix

«dataType» Matrix2x2
m11:real[1] m12:real[1] m21:real[1] m22:real[1]

«dataType» Matrix3x3
m11:real[1] m12:real[1] m21:real[1] m22:real[1] m13:real[1] m31:real[1] m23:real[1] m32:real[1] m33:real[1]

«enumeration» Space StdRefFrame
ICRS FK4 FK5 GALACTIC ECLIPTIC CUSTOM etc

«enumeration» DopplerDefinition
optical radio relativistic redshift

«enumeration» PolarizationType
STOKES CIRCULAR LINEAR VECTOR

«enumeration» Handedness
left right

«enumeration» PolStokes
I Q U V

«enumeration» PolVector
I PF PP PA

«enumeration» PolCircular
RR LL RL LR

«enumeration» PolLinear
XX YY XY YX

«dataType» QuantityVector

«dataType» RealScalar
v1:RealQuantity[1]

«dataType» RealDoublet
v1:RealQuantity[1] v2:RealQuantity[1]

«dataType» RealTriplet
v1:RealQuantity[1] v2:RealQuantity[1] v3:RealQuantity[1]

«dataType» TimeStamp

«dataType» ISOtime
time:datetime[1]

«dataType» JD
time:real[1]

«dataType» MJD
time:real[1]

«dataType» TimeOffset
offset:real[1]

«enumeration» SpaceUnits
m km mm um au pc kpc Mpc deg arcmin arcsec Angstrom

«enumeration» TimeUnits
s d a yr cy

«enumeration» FreqUnits
Hz kHz MHz GHz

«enumeration» EnergyUnits
eV keV MeV GeV

«dataType» MultiStruct
ndim:nonnegativeInteger[1]

«dataType» Symmetrical
radius:RealQuantity[1]

«dataType» Bounds
loLimit:QuantityVector[1] hiLimit:QuantityVector[1]

«dataType» Box
boxSize:QuantityVector[1]

«dataType» Ellipse
semiAxes:QuantityVector[1] positionAngles:QuantityVector[1]

«dataType» MSMatrix
matrix:Matrix[1]

Instance diagram for STC elements in Source Data Model

