Outline

- Resolution of Transformations issue

- Polarization axis

- Items of interest beyond STC
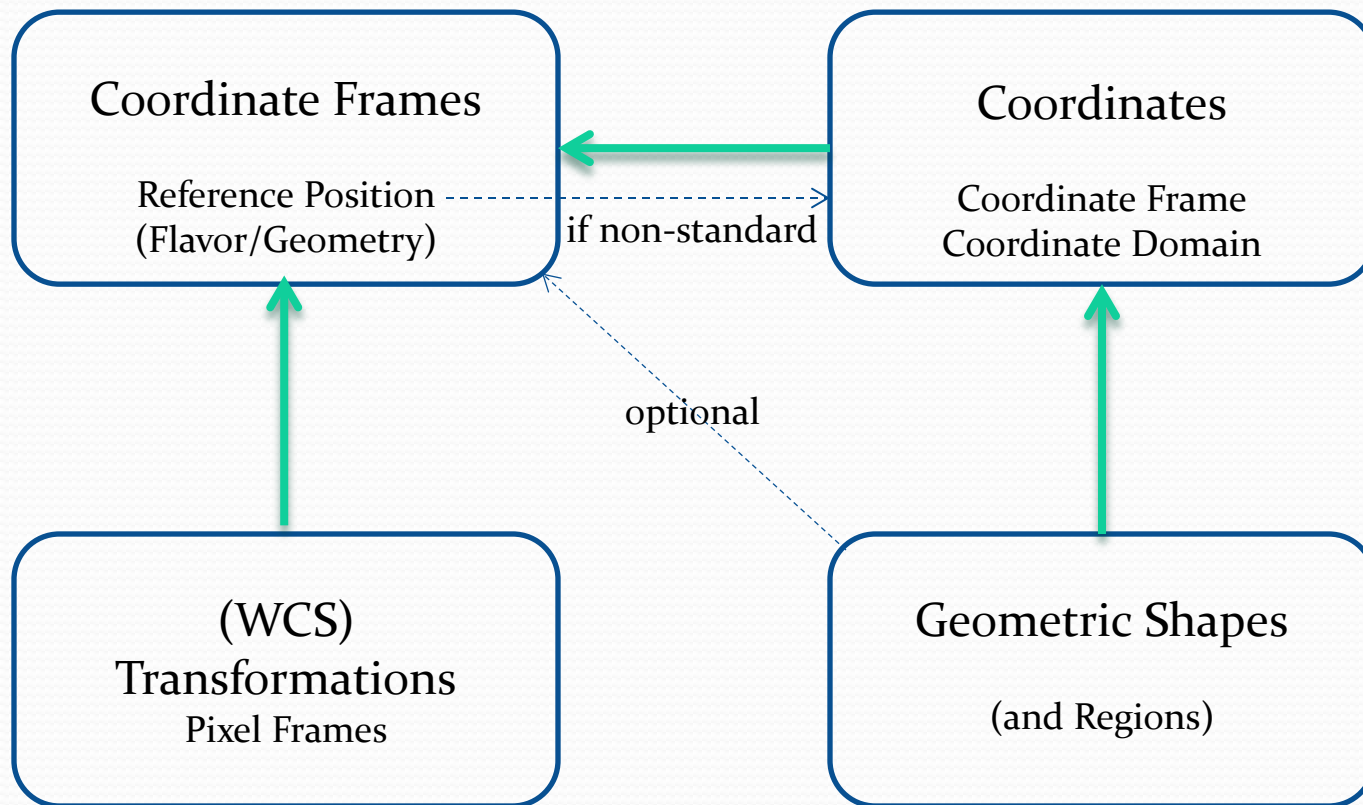
- STC2 Status

- VO-DML issues

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

- Allows enumerated coordinates

Transformations and Frames

- 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

STC2 Packages


```
┌─────────────────────────┐                    ┌─────────────────────────┐
│   Coordinate Frames     │ ◄─────────────     │      Coordinates        │
│                         │                    │                         │
│   Reference Position    │ - - - - - - - - ►  │   Coordinate Frame      │
│   (Flavor/Geometry)     │   if non-standard  │   Coordinate Domain     │
└─────────────────────────┘                    └─────────────────────────┘
         ▲                       optional                   ▲
         │                                                  │
┌─────────────────────────┐                    ┌─────────────────────────┐
│        (WCS)            │                    │   Geometric Shapes      │
│   Transformations       │                    │                         │
│   Pixel Frames          │                    │    (and Regions)        │
└─────────────────────────┘                    └─────────────────────────┘
```

Transforms in STC2

- Transforms are integral parts of coordinate frames
- Based on FITS WCS specification
  - Contain equivalents of the familiar FITS keywords
  - Implemented as sequences of atomic transforms
- Pixel frames to WCS frames
- Between physical coordinate frames
  - Owned by native frame, point to target frame
  - Multiple transforms allowed (FITS alternate coord frames)
- Enumerations
  - Applies to polarization
  - Accommodates sparse data such as photon event lists

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 parallel mappings are allowed

Frame Transforms
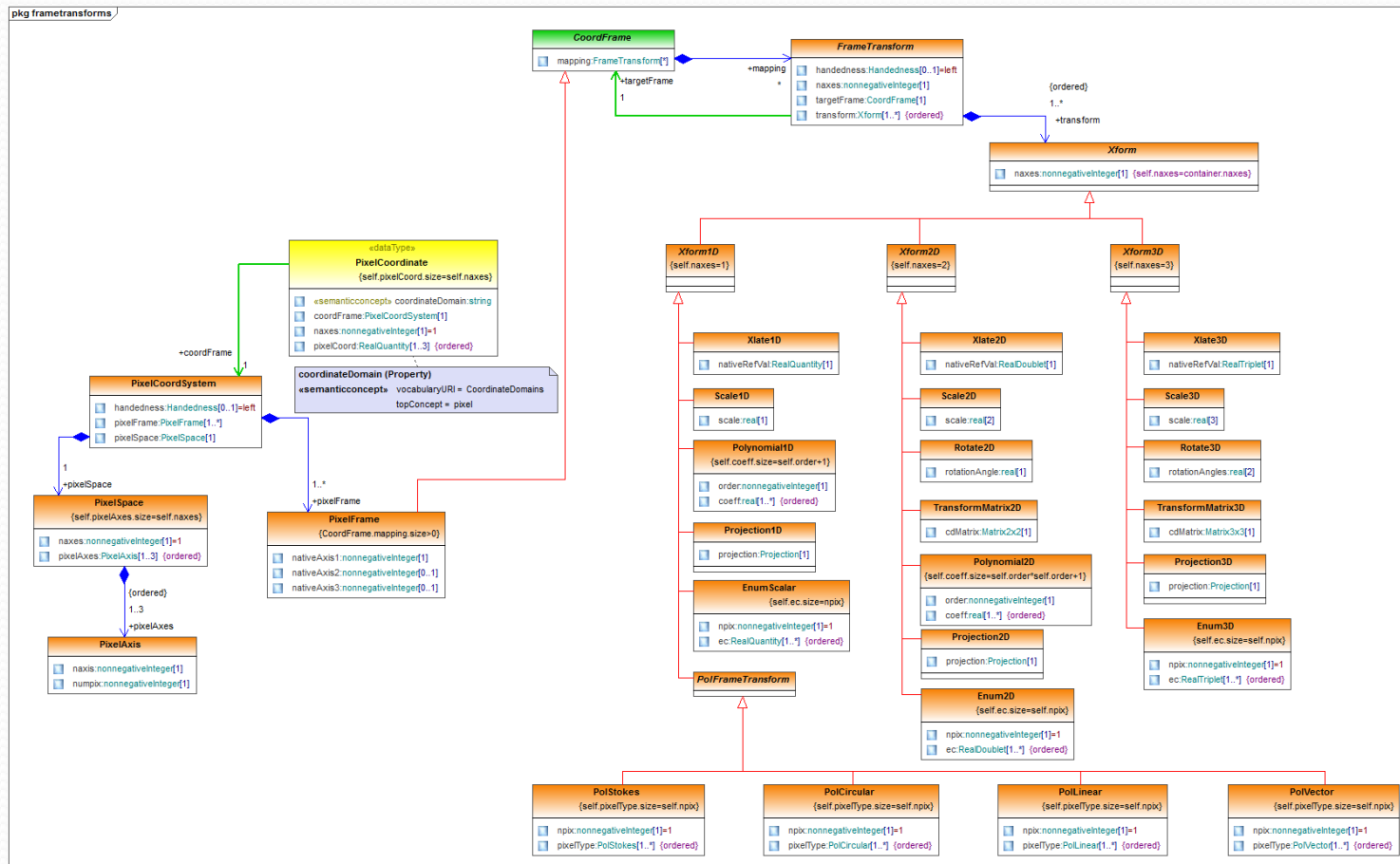
Polarization

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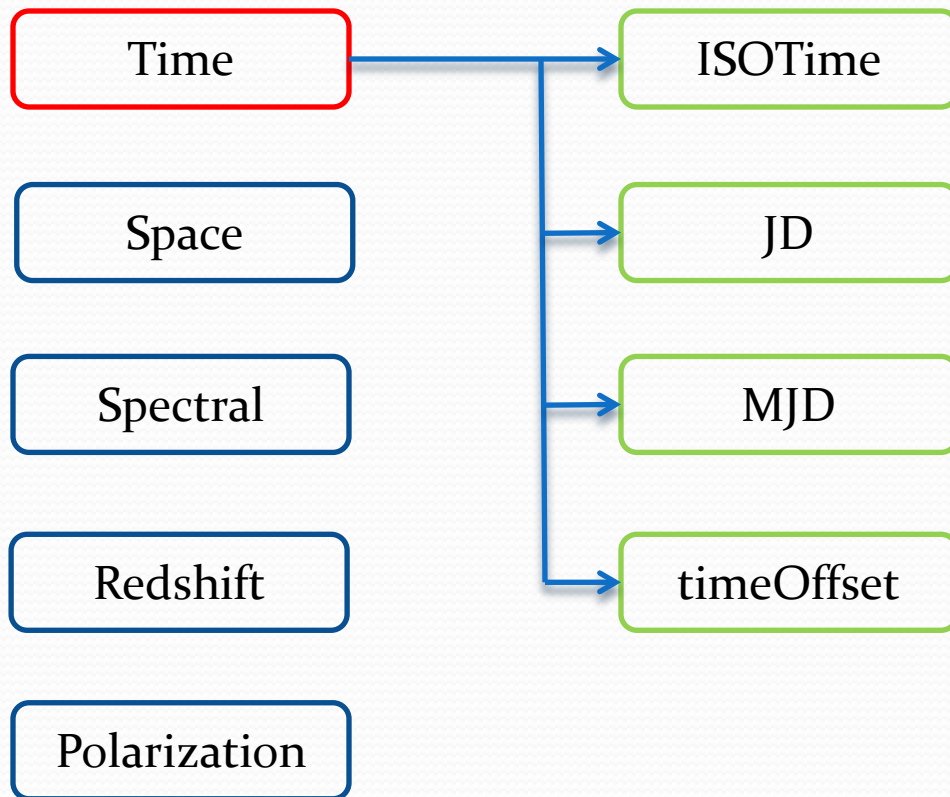- Vector
  - I, PolFlux, PolPercent, PolAngle

Components Useful beyond STC

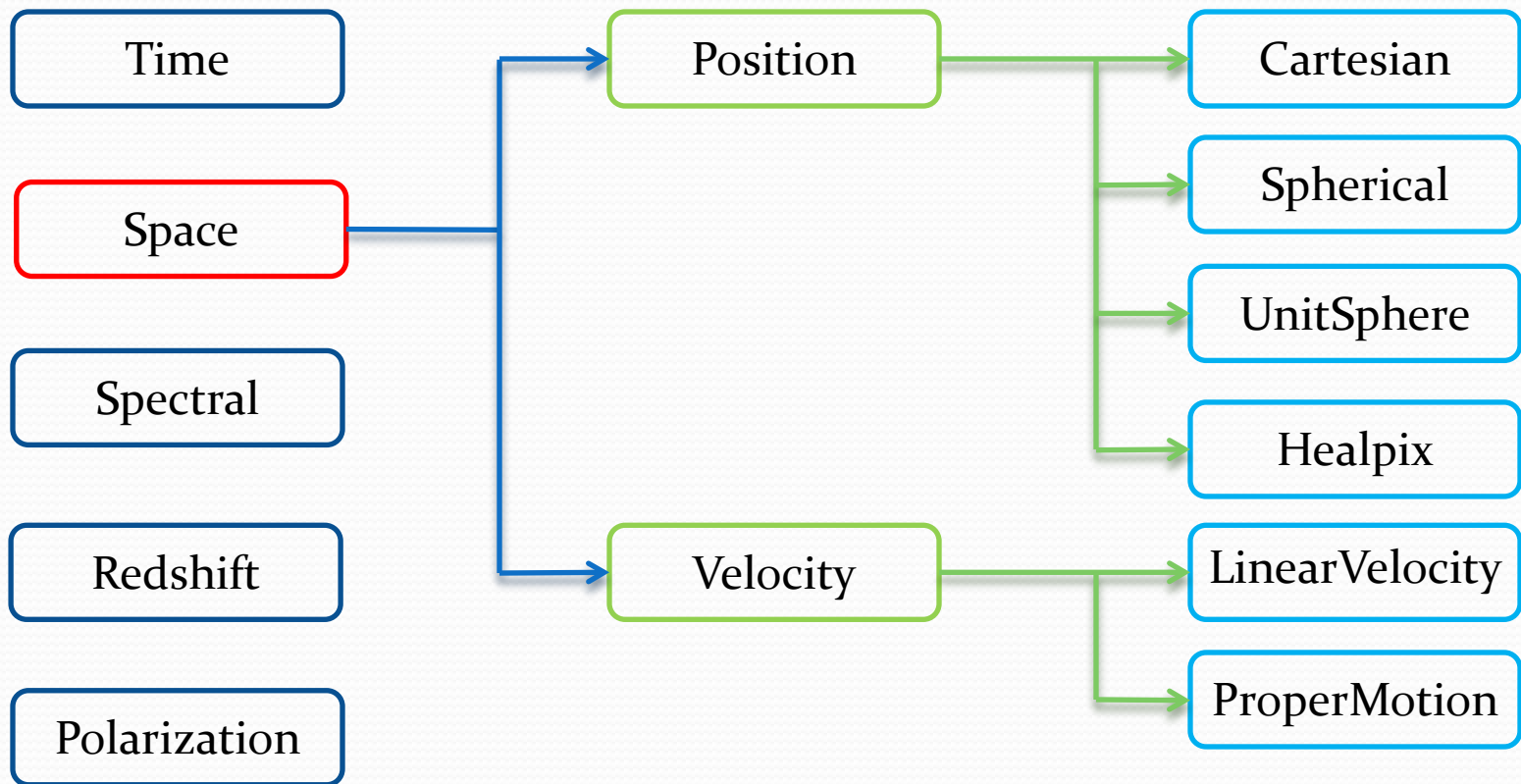- Constraining units

- Utility Data Types

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 semantic concept *Coordinate Domain*:
  - Within a *Coordinate* it sets the *top concept* allowable for units
  - *Subsetting* sets the *top concept* for each type of coordinate
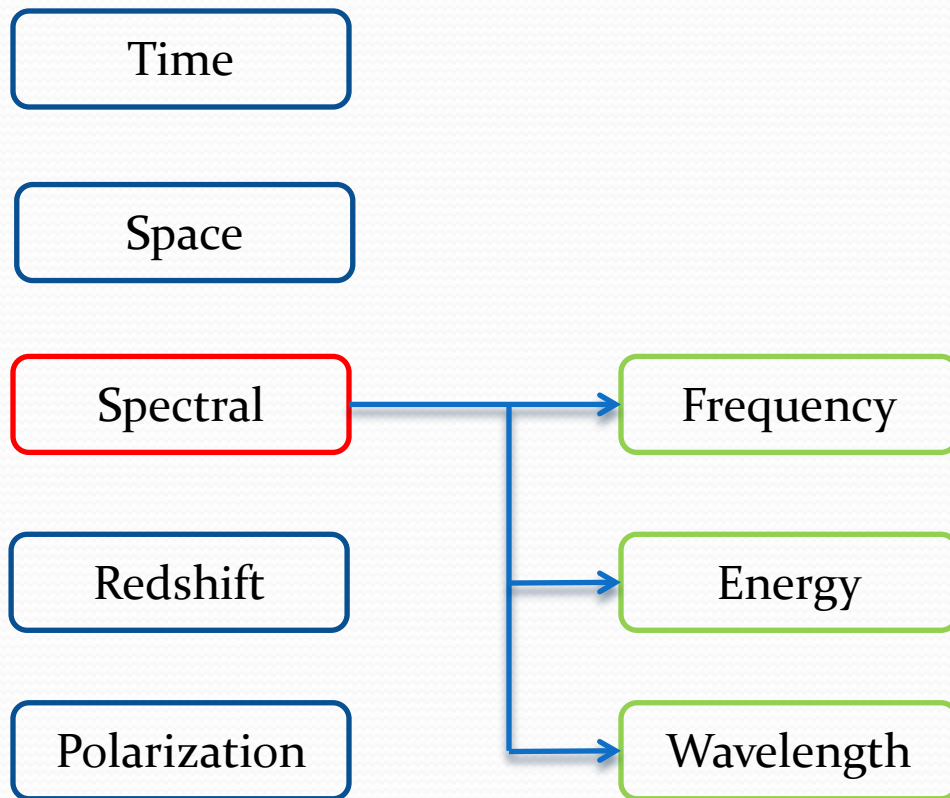 - It provides a consistent units constraint mechanism that is independent of context
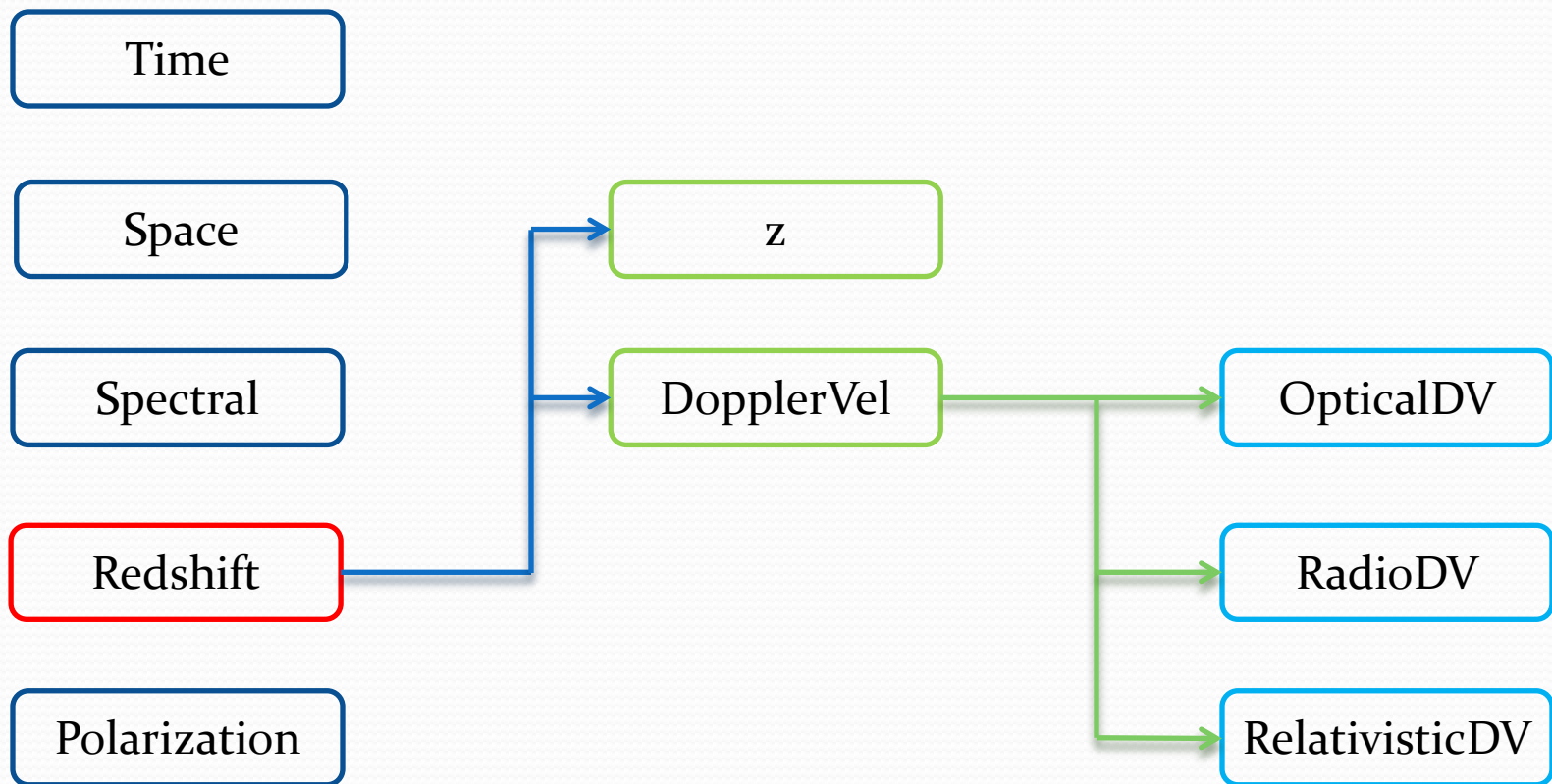
Coordinate Domain Taxonomy

```
Time ──────────────┐
                    ├──────→ ISOTime
Space               │
                    ├──────→ JD
Spectral            │
                    ├──────→ MJD
Redshift            │
                    └──────→ timeOffset
Polarization
```
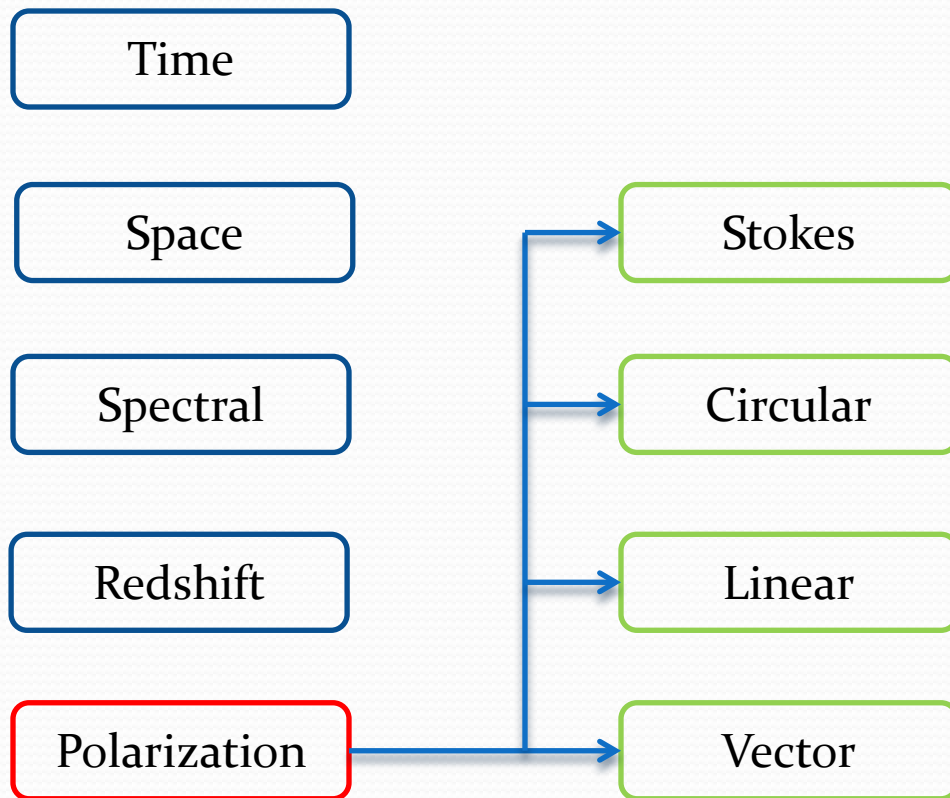
Coordinate Domain Taxonomy

Coordinate Domain Taxonomy

Coordinate Domain Taxonomy

```
Time

Space                    z

Spectral              DopplerVel          OpticalDV

Redshift                                  RadioDV

Polarization                              RelativisticDV
```

Coordinate Domain Taxonomy

Time

Space → Stokes

Spectral → Circular

Redshift → Linear

Polarization → Vector
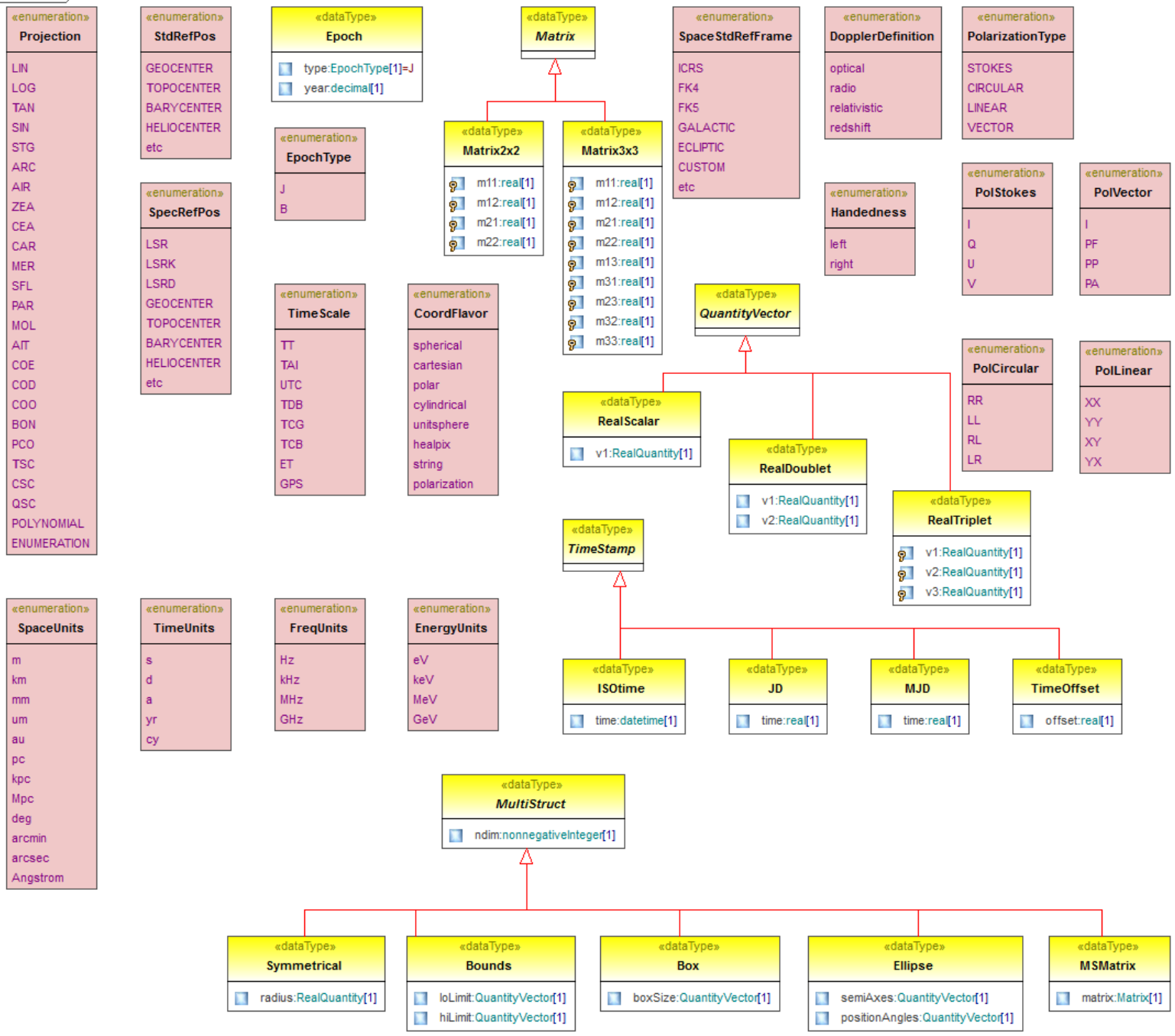
Quantities and Derived Data Types

- *Quantities* include units
- Handy derived data types:
  - Quantity vector: scalar, doublet, triplet
  - Matrix: 2x2, 3x3
- *Multistruct* (for lack of a better name; 2-D):
  - Symmetrical, Bounds, Box, Ellipse, MSMatrix
  - For error and resolution specifications
- *Timestamp*:
  - ISO-8601, JD, MJD, Time offset

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Done, Underway
& 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

- Resolve VO-DML issues

- Generate library

STC2.0 - 2015-10-30
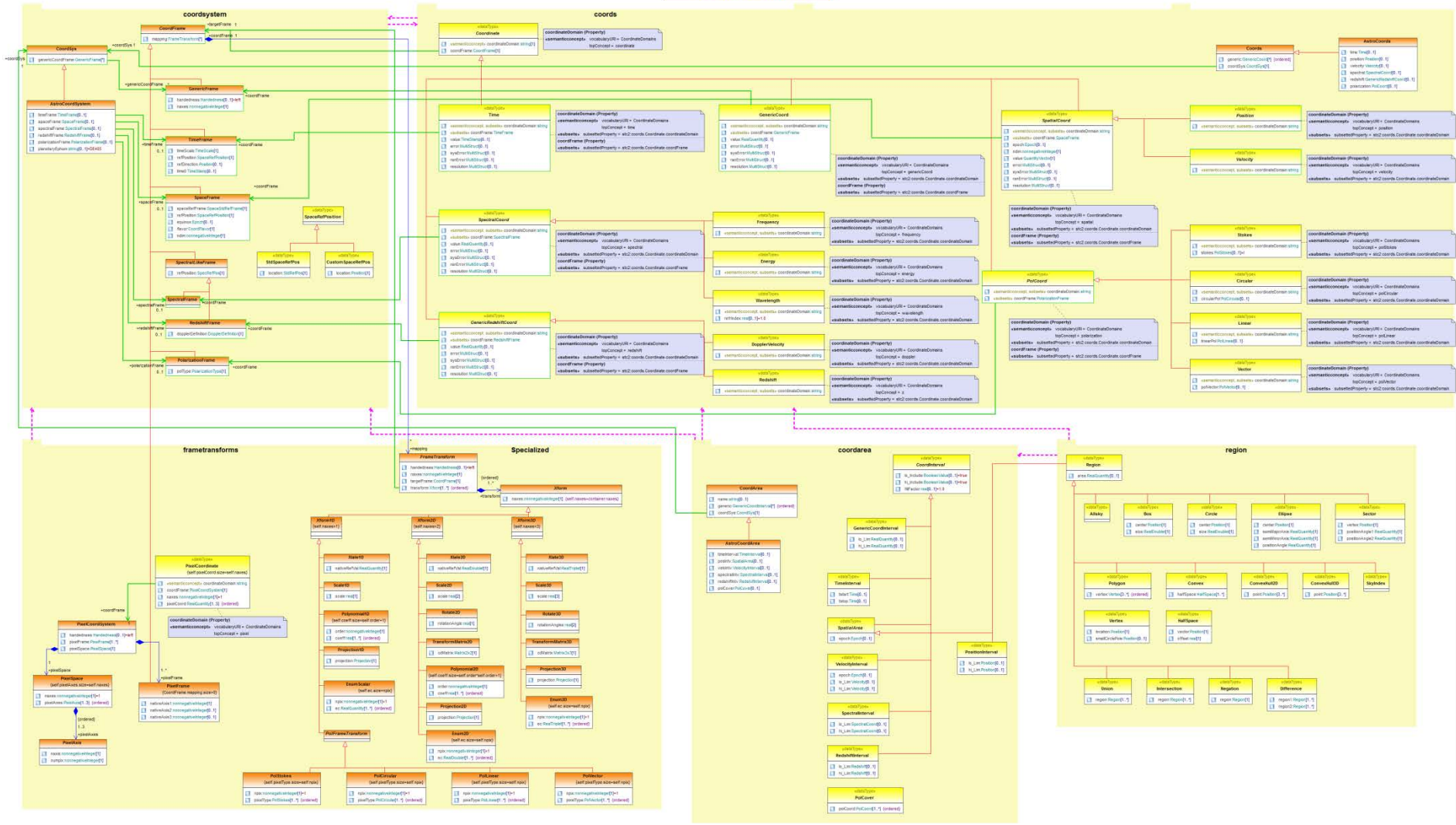
VO-DML Issues

- Constraints
  - An explicit syntax for Constraints would be helpful
- Multiplicity of Attributes
  - Attributes can only have a specific length, specified in the model; i.e., an object cannot contain a variable array of values. For example:
    - A polynomial object cannot contain an order and an array of coefficients, its length determined by the order
    - One cannot leave the dimensionality of a value (1, 2, or 3) open
    - The coordinate values of an enumerated axis cannot be specified in a vector

Arnold Rots: STC2 Status - IVOA Interop Sydney, October 2015