

Spectrum Data Model

Enhancement Request

Enhancement Request

Where is this coming from?

- Presentations by Vandana Desai
 - Nov. 2020 Interop:
 - [“Implementation of the IVOA Spectral Data Model at IPAC”](#)
 - assessment of V1.1 Recommendation
 - May 2021 Interop:
 - [“IVOA Spectral Models and Access in the Era of Big Data”](#)
 - enhancement request to support IPAC use cases

Enhancement Request

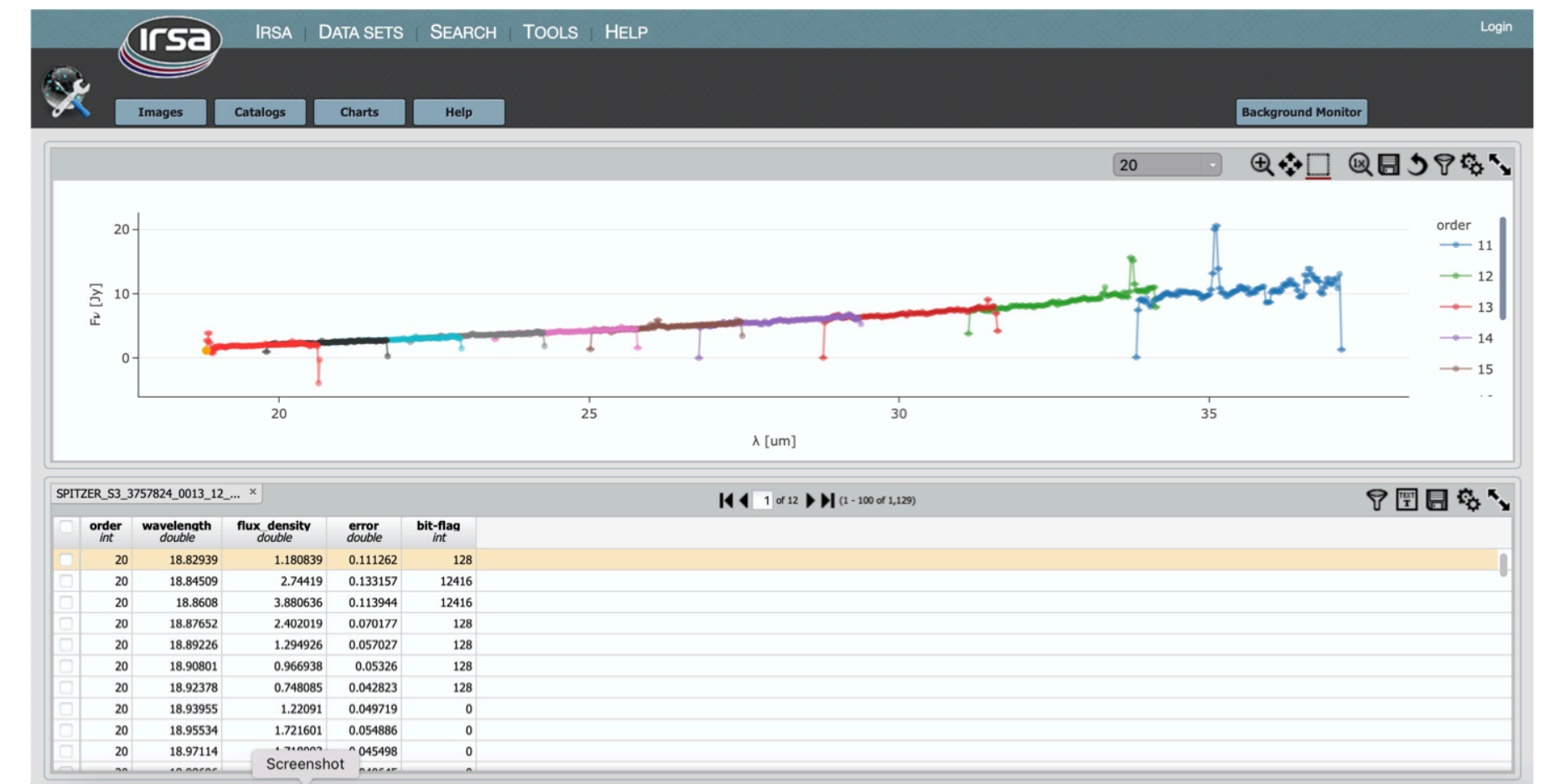
What is it?

- Support Spectral Order



Proposed Changes to SDM1.1 to Plot Spectral Orders

- 1-D spectra from Spitzer's Infrared Spectrograph have multiple spectral orders
 - Spectral orders can overlap in wavelength
 - Plotting a Spitzer spectrum without accounting for orders gives you a mess
- Option 1: Create separate tables for each order
 - Requires plotting multiple tables on one chart
 - Additional development requirement
- Option 2: Treat order as a column
 - Column-based plotting is common
 - UCD="instr.order" already exists
 - We propose column utype = spec:Spectrum.Data.SpectralAxis.Order



Firefly-based IRSA Viewer tool shows multi-order Spitzer spectrum as a chart (top) and a table (bottom). Both are interactive.

Since our proposed column utype for spectral orders has not yet been accepted by the IVOA, this implementation recognizes ipac:Spectrum.Data.SpectralAxis.Order

Enhancement Request

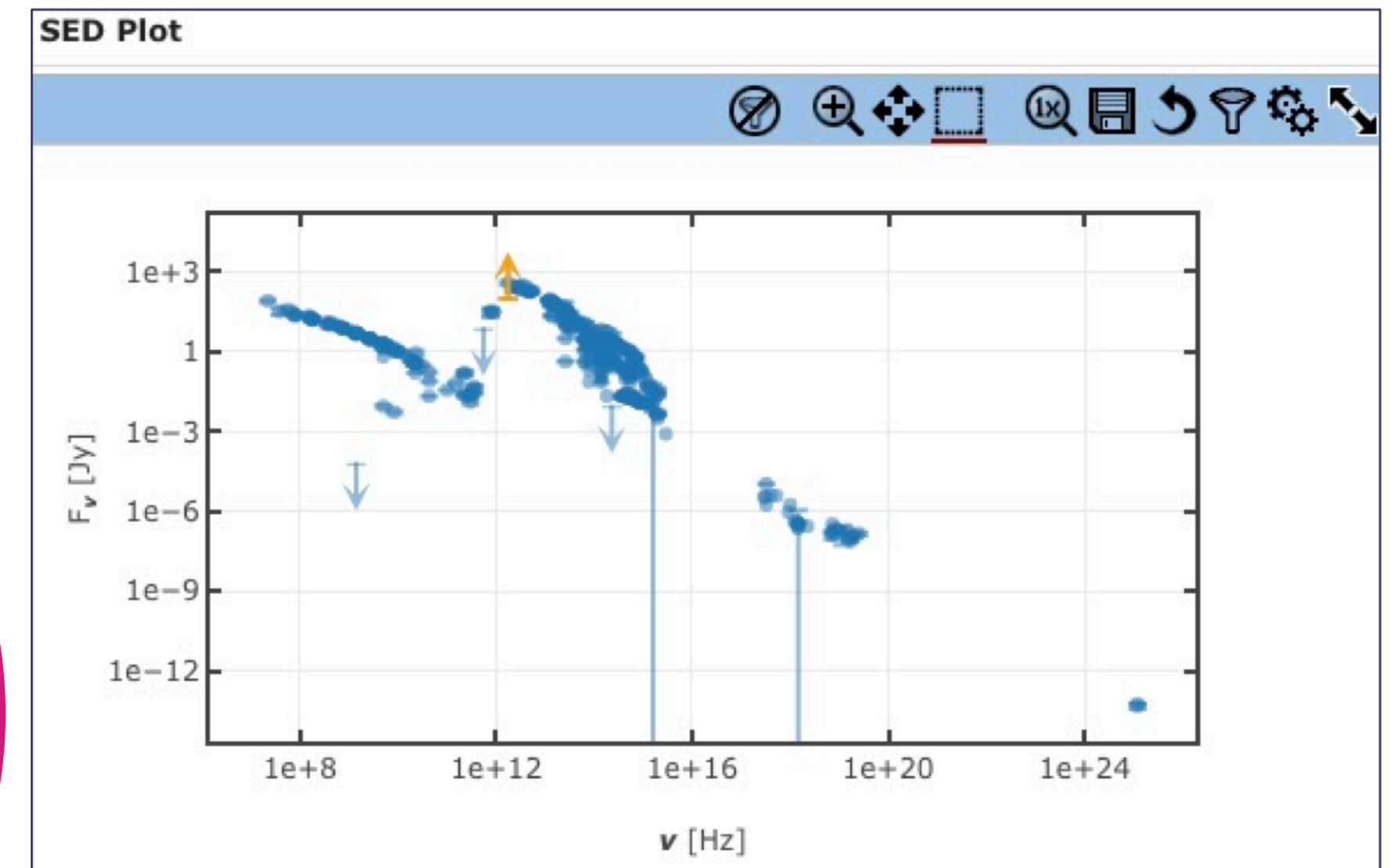
What is it?

- Upper/Lower Limits Support



Proposed changes to SDM1.1 to plot limits for SEDs (1/2)

- Spectral Energy Distributions (SEDs) often include limits on measurements.
 - These can be upper or lower limits
 - Plotters need to indicate limits clearly to avoid scientific misunderstanding
- SDM1.1 handling of upper limits is not ideal
 - Upper limits are to be represented as measurements with highly asymmetric errors
 - Example: upper limit of f
 - flux = f
 - lower statistical error = f
 - upper statistical error = 0
 - This would lead to the display of an error bar extending from 0 to the upper limit (maybe ok for our purposes)
 - Mathematically incorrect
- SpectrumDM 1.1 does not address lower limits
 - Lower limits do appear in some NED datasets
 - Saturation, edge effects




Firefly-based NED web GUI shows NED SED with upper and lower limits.

Enhancement Request

What is it?


- Update Units requirements
- Others for later consideration



Future Considerations

Visualization Capability	Considerations
Label the plot with units	<ul style="list-style-type: none"> • SDM1.1 specifies OGIP unit convention rather than VOUnit, which was established in 2014. • Is there any reason <i>not</i> to change to VOUnit?
Change units	
Download many thousands of spectra	<ul style="list-style-type: none"> • FITS representation is more efficient than VOTable for many spectra • Look to Euclid
Correct axes for redshift	<ul style="list-style-type: none"> • All of these require assembling data that may exist outside of the spectrum.
Label possible spectral features	
Label measured spectral features	
Overplot spectral response or atmospheric transmission curves	
Overplot synthetic photometry	<ul style="list-style-type: none"> • Spitzer IRS Enhanced Data Products provide synthetic photometry within the spectral file. How should this be represented? • Very important to distinguishing synthetic versus real photometry

IWOA 5/26/21 15



Enhancement Request

What is it? In a nutshell

- Looking for 3 new UTypes
 - `spec:Spectrum.Data.SpectralAxis.Order`
 - `Spec:Spectrum.Data.FluxAxis.Accuracy.UpperLimit`
 - `Spec:Spectrum.Data.FluxAxis.Accuracy.LowerLimit`
- Of course.. these represent model extensions.

Refinement

Follow-up discussion on requested items

- Follow-up DAL Telecon, and DM mail list discussion on the RFE resulted in the following refinement to the request by Petr Skoda.
 - We need two 'order's
 - An absolute order
 - A relative order - depends on processing criteria

Feasibility

- Model updates
 - Performed a pretty thorough review of Spectrum model history and content
 - Are logical extensions/migrations of the model
 - Are backward compatible (additions only)
 - I don't think there is a problem with current UpperLimit description and the UpperLimit extension requested
 - Good opportunity to prototype functionality needed in for Spectrum as Cube evolution.
- Document updates are more problematic
 - Not in Git, no ivaotex (word doc)
 - Inconsistencies of model/schema etc, opened 'can of worms' last time
 - These can be managed.. limiting changes only to what is necessary

Model Changes

Current model

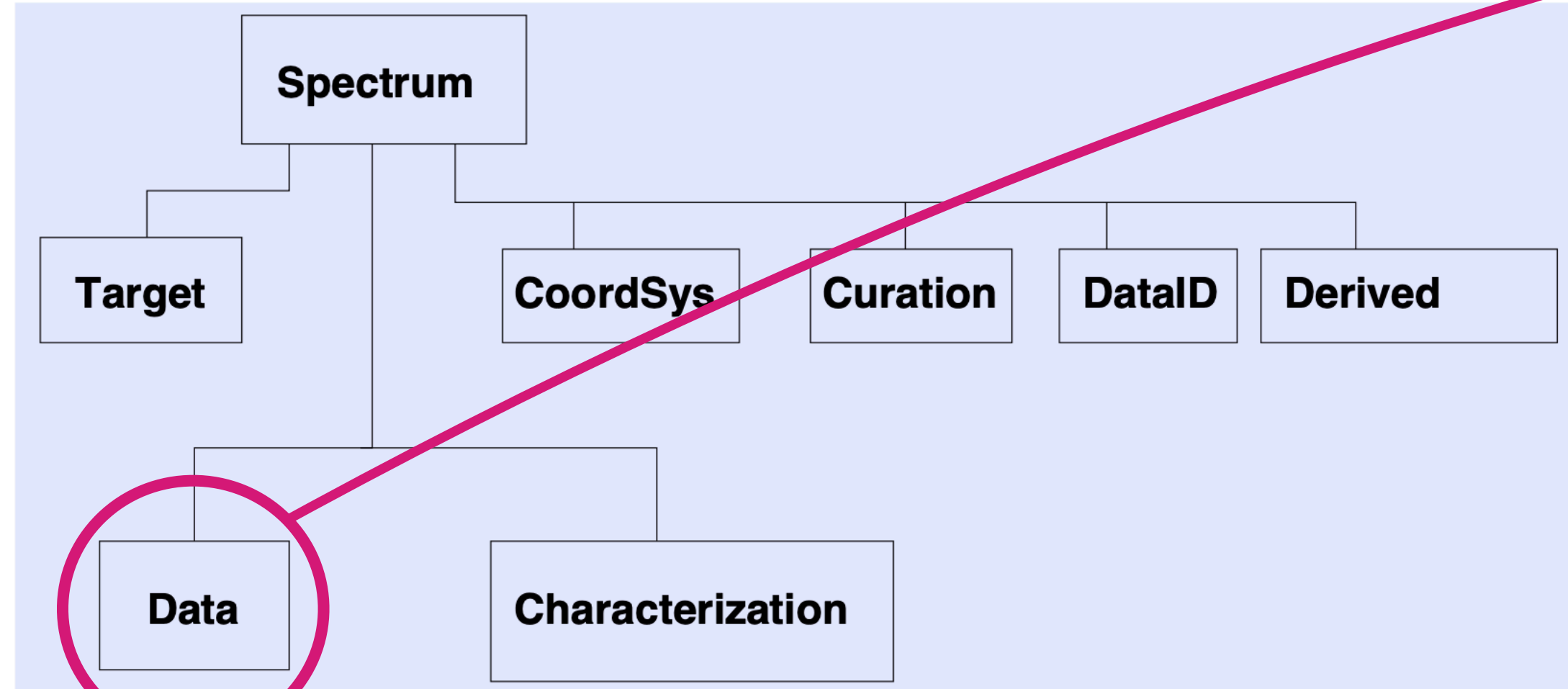


Figure 1: UML class diagram for the spectral data model. The Characterization, Curation, DataID and Derived classes are shown in detail below in diagram form and with further text description in Section 5.

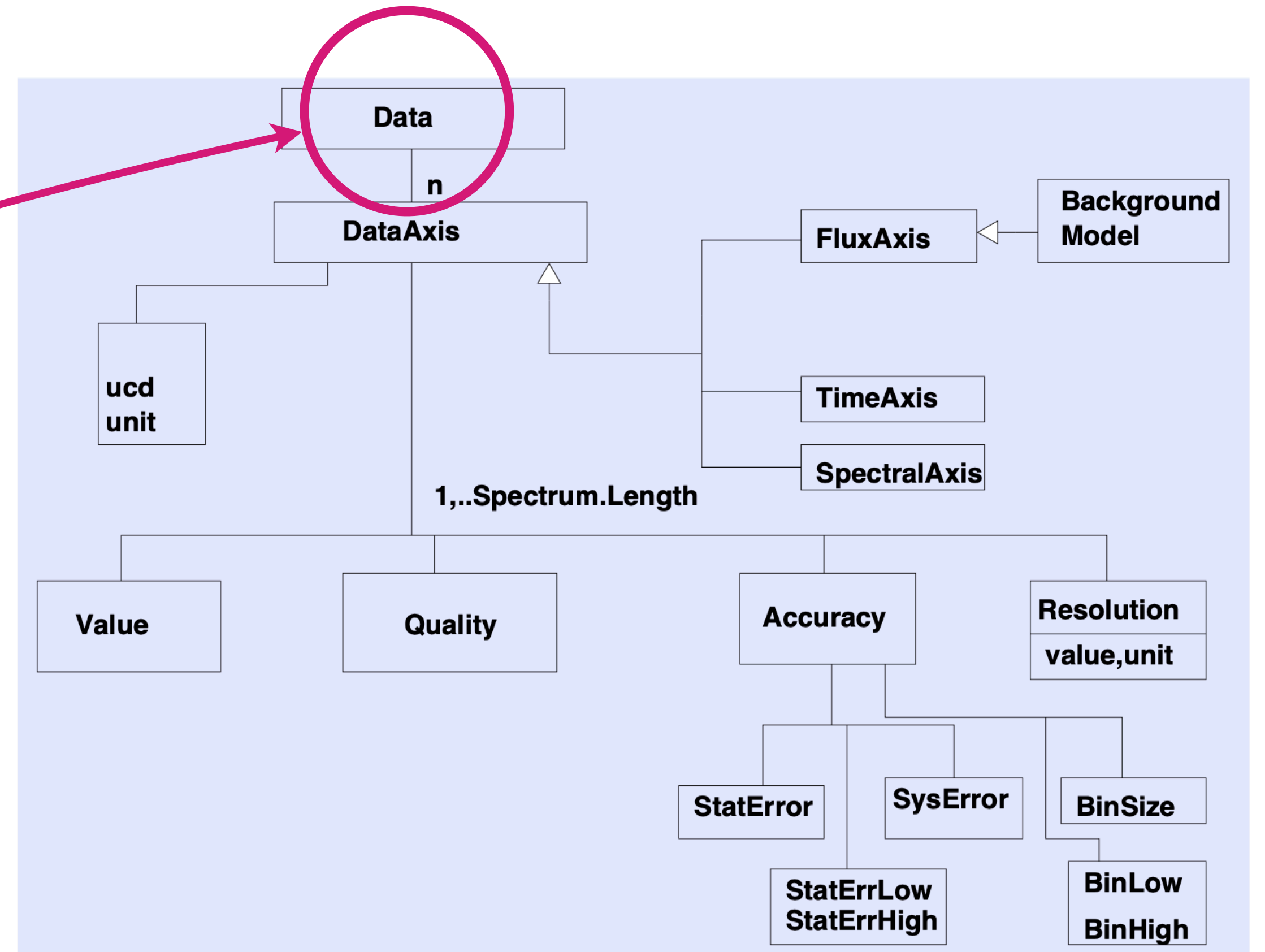
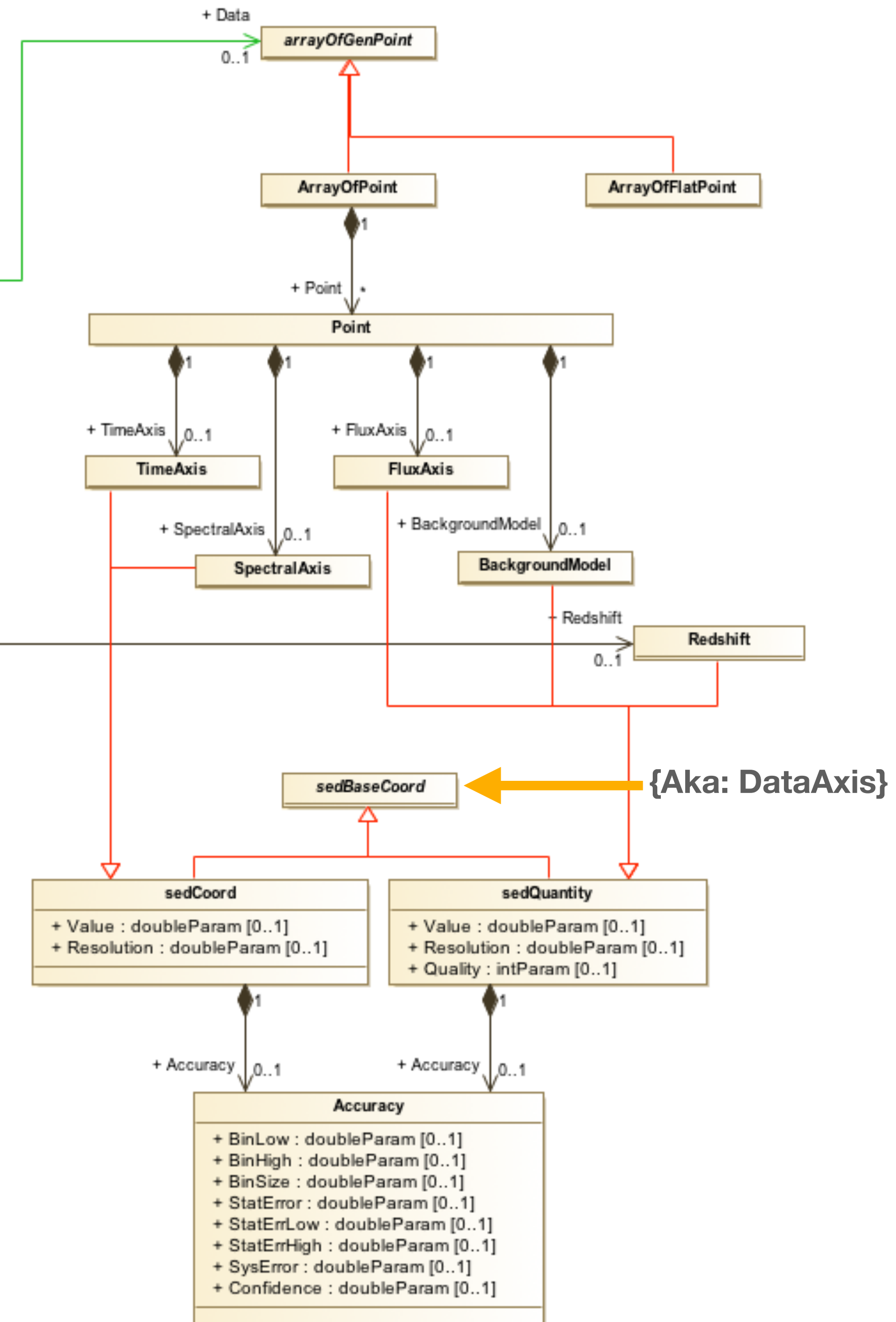
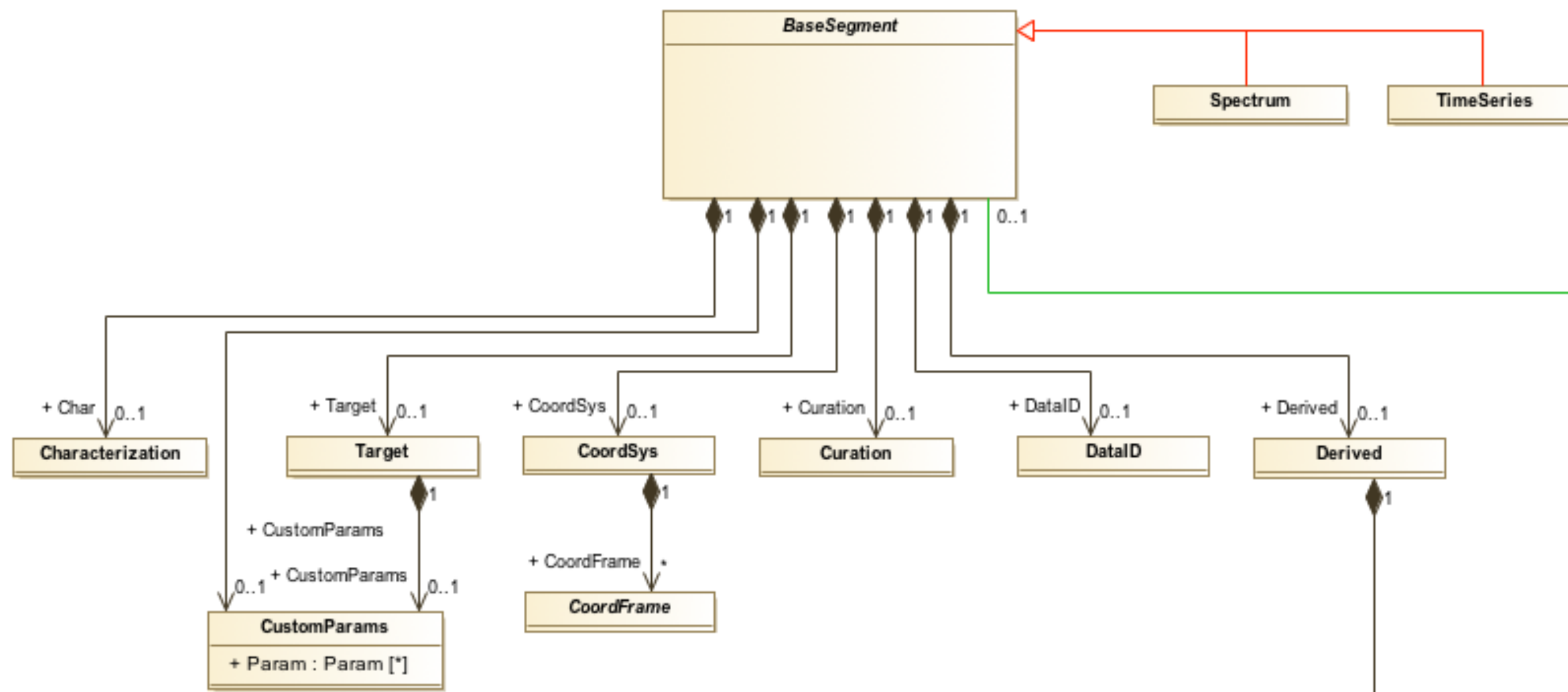


Figure 2: Diagram for Data object

Model Changes

Current model

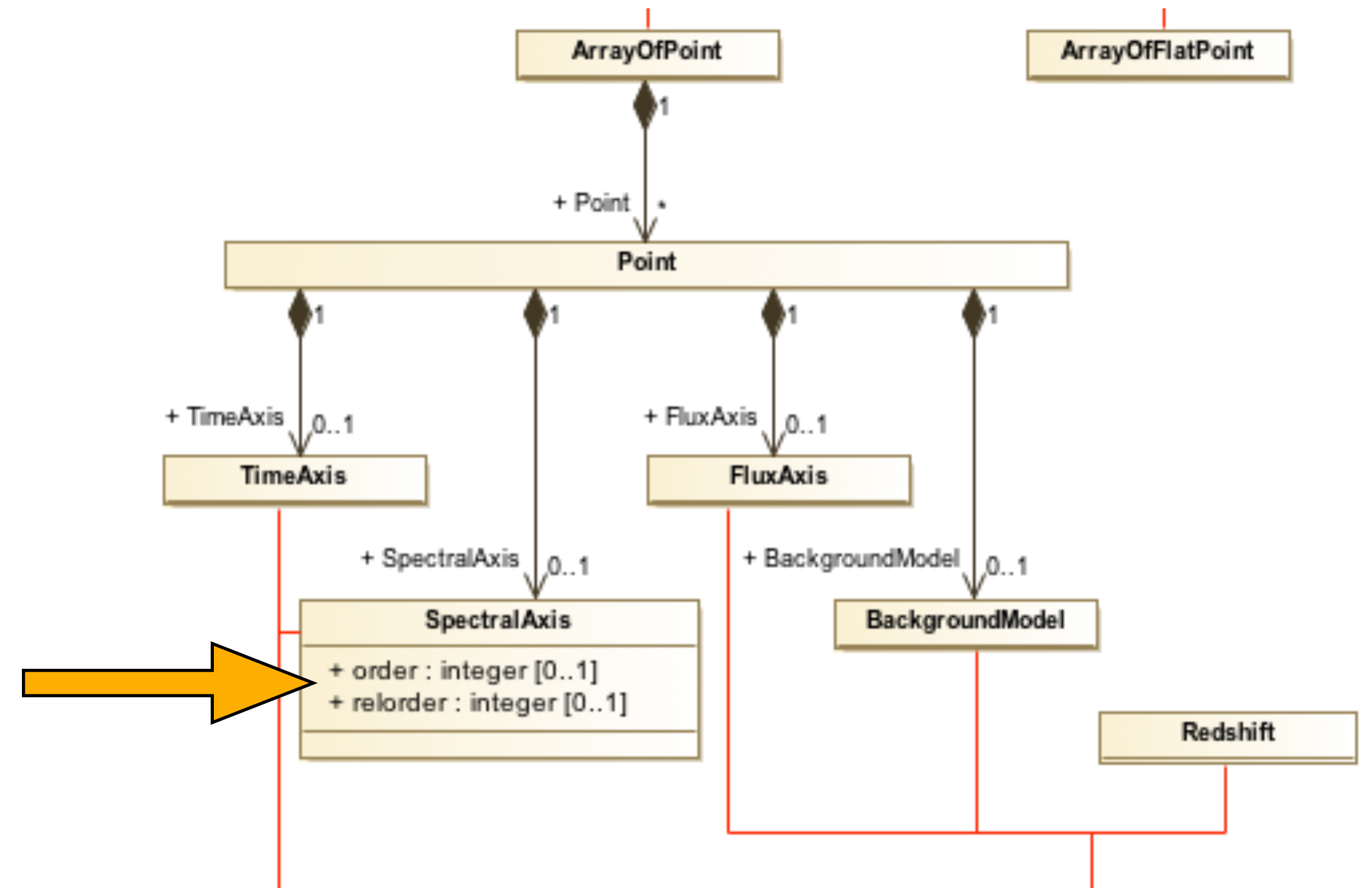
In UML - derived from schema



Options - Order Support

Option 1

- Add 'order' attributes to SpectralAxis
 - order as ancillary metadata associated with spectral axis.

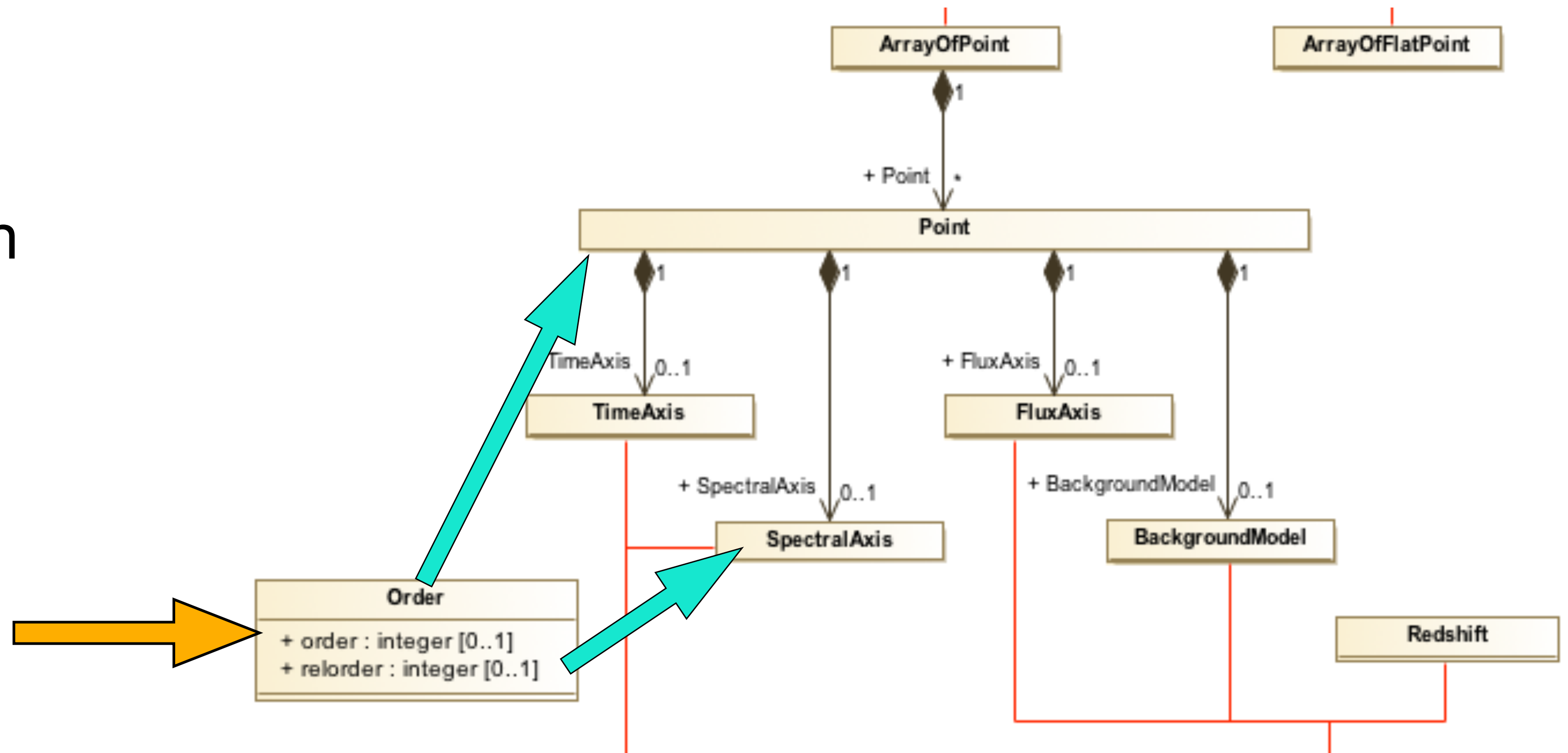


* requested change

Options - Order Support

Option 2

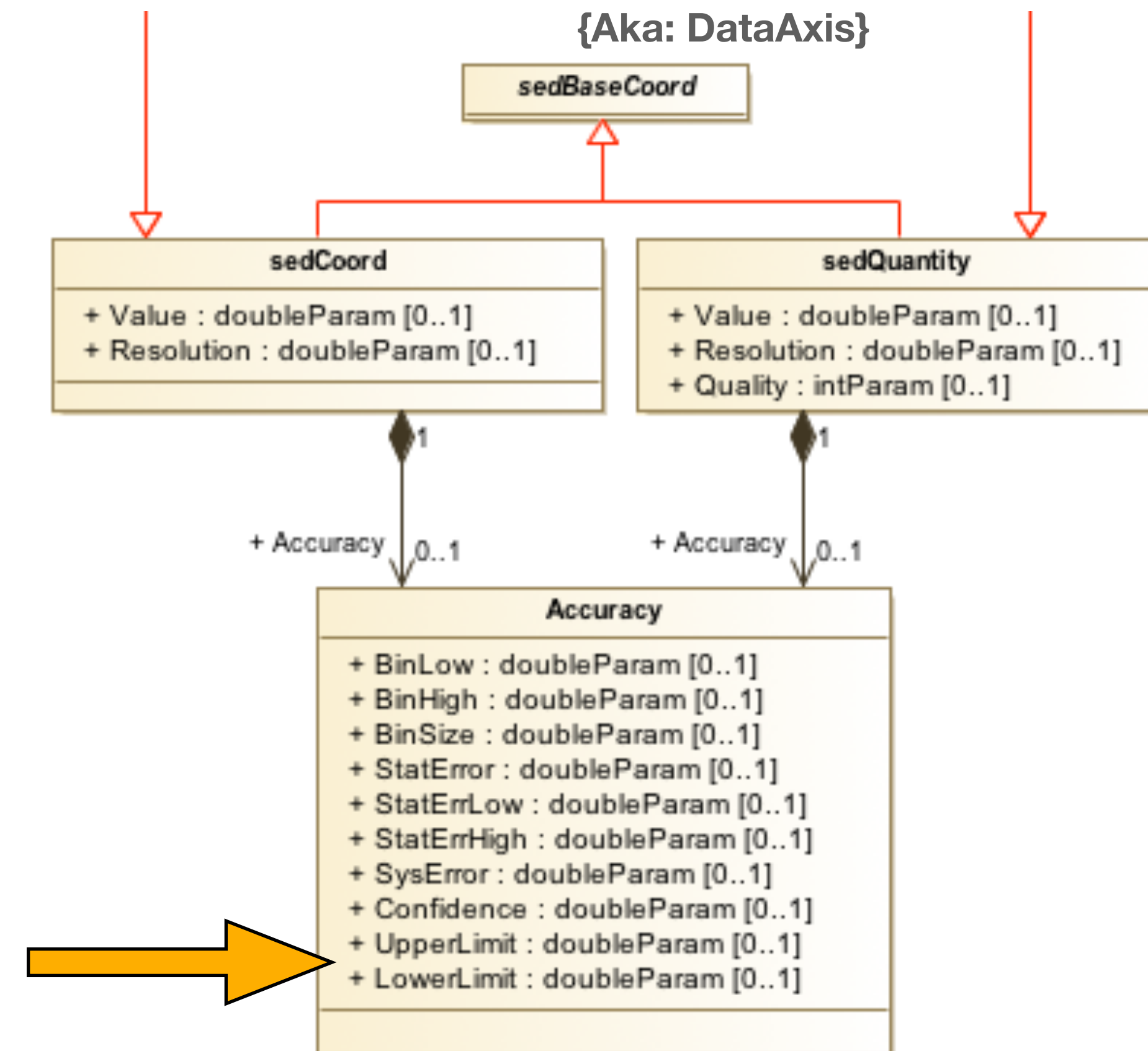
- Order as DataAxis
- or object associated with SpectralAxis



Options - Upper/Lower Limits

Option 1

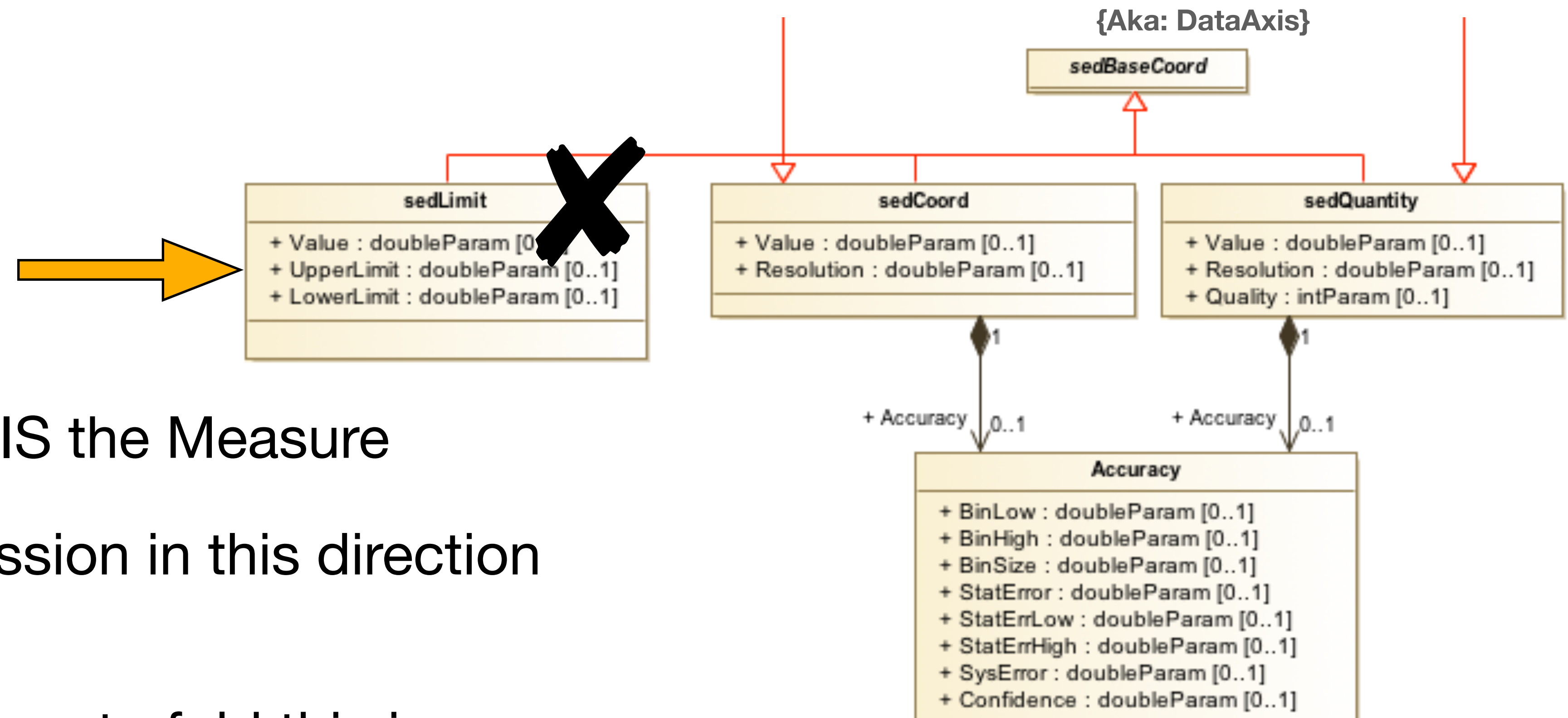
- Add to Accuracy suite



* requested change

Options - Upper/Lower Limits

Option 2



- Upper/LowerLimit IS the Measure
 - was some discussion in this direction the last time..
 - is less obvious how to fold this in

How To Proceed

- Option 1: Note/Endorsed Note: “IPAC extension to Spectrum-1.1”
 - Formalize what they already did
 - Include formal model extension + new UTypes
 - Namespace declaration: eg: “spec-ipac”
 - Does not open the Spectrum REC.
- Option 2: Update the Spectrum Model REC
 - More official
 - Higher requirements for implementation/review

Validation/Implementations

What and Who?

- Original Spectrum model implementations are “SSA”
 - Implementations to support this extension should be OK to focus only on the extended content. ie: need not exercise the full model.
- Candidates: Need commitments before proceeding too far
 - IPAC: Firefly Application
 - GAVO/DaCHS: volunteered to do an implementation of ‘absolute’ order
 - IRAP: Cassis? (uses SSA)
 - SPLAT??
 - Other ??

Follow-up Meeting

- GitHub Repository
 - Seed [SpectrumDM repository](#) (created Nov. 2020)
 - Create Issue(s) for this RFE
- Hold a focus meeting to
 - Discuss the options and make selections
 - Plan implementation threads
 - Set timetable for model and implementation delivery