

# Building up a Time Series Data Model

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# Which Time Domain Data to cover?

- Time series is considered in a large sense as a collection of data samples, taken along a sequence of time stamps.
- $F=f(t)$ , with  $F$  being
  - a simple value for a measure,
  - One structured measure with value, error, precision, etc.
  - Multiple values (e.g. multi-wavelength)
  - A dataset itself, e.g. the data product resulting of an observation: spectrum, image, cube, etc .
- $F$  is a dataset, observed in one go or compiled from various observations

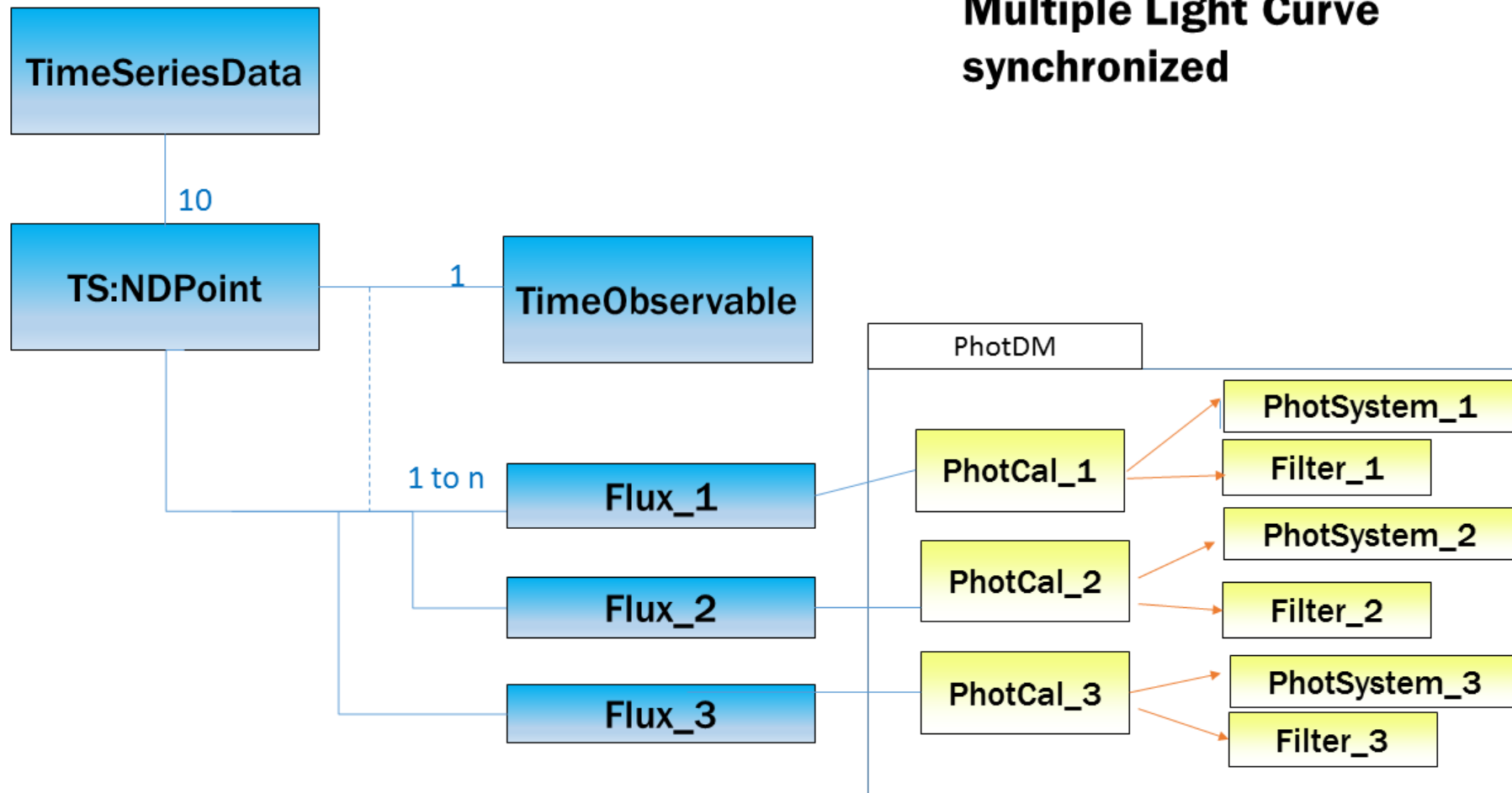


# Minimal metadata needed

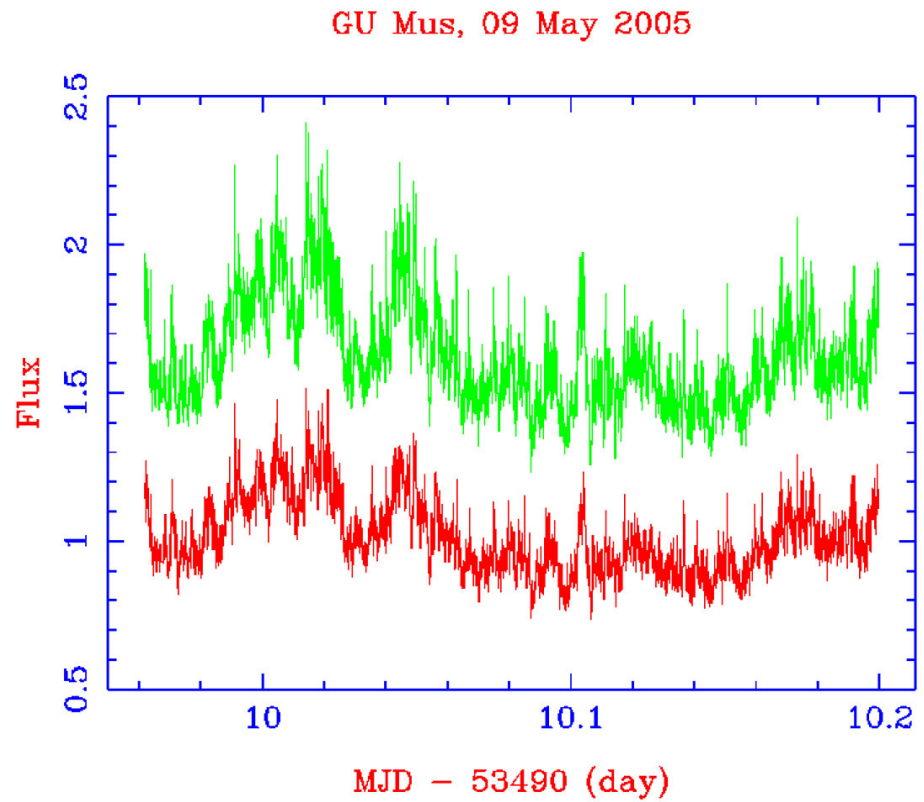
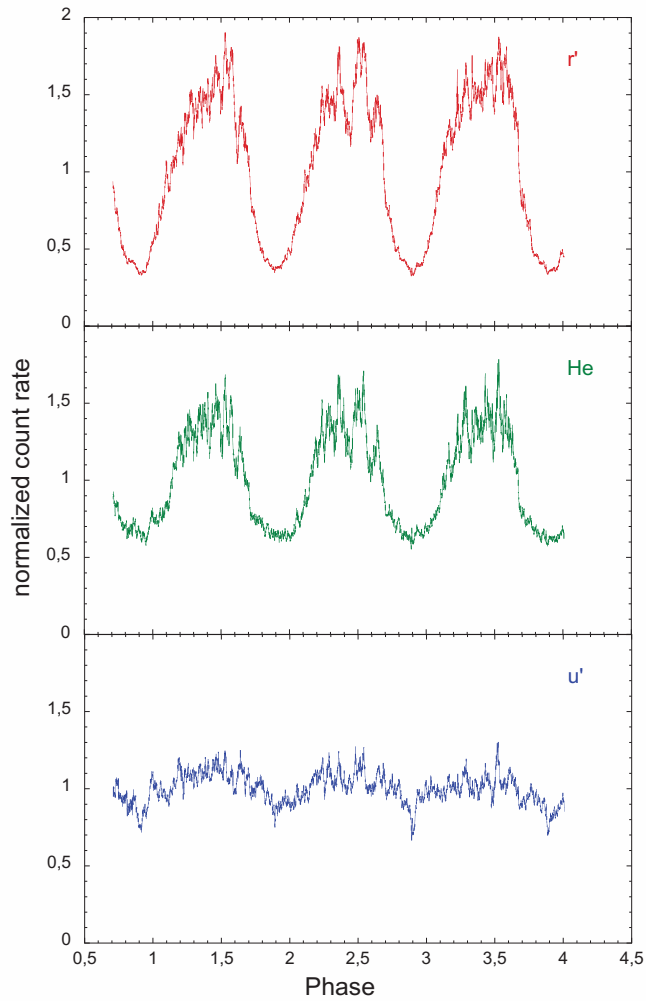
- F has a set of measures along some observed physical axes
  - Position , spectral band, polarimetry,
  - Observables varying with time : velocity, flux, mag, etc .
  - Rich description of Time axis properties
- Search for Time domain data:
  - When are the time stamps taken and how ?
  - Which observable quantities (measures) are available for a timeseries dataset?
  - Which axes together with their coordinate system?



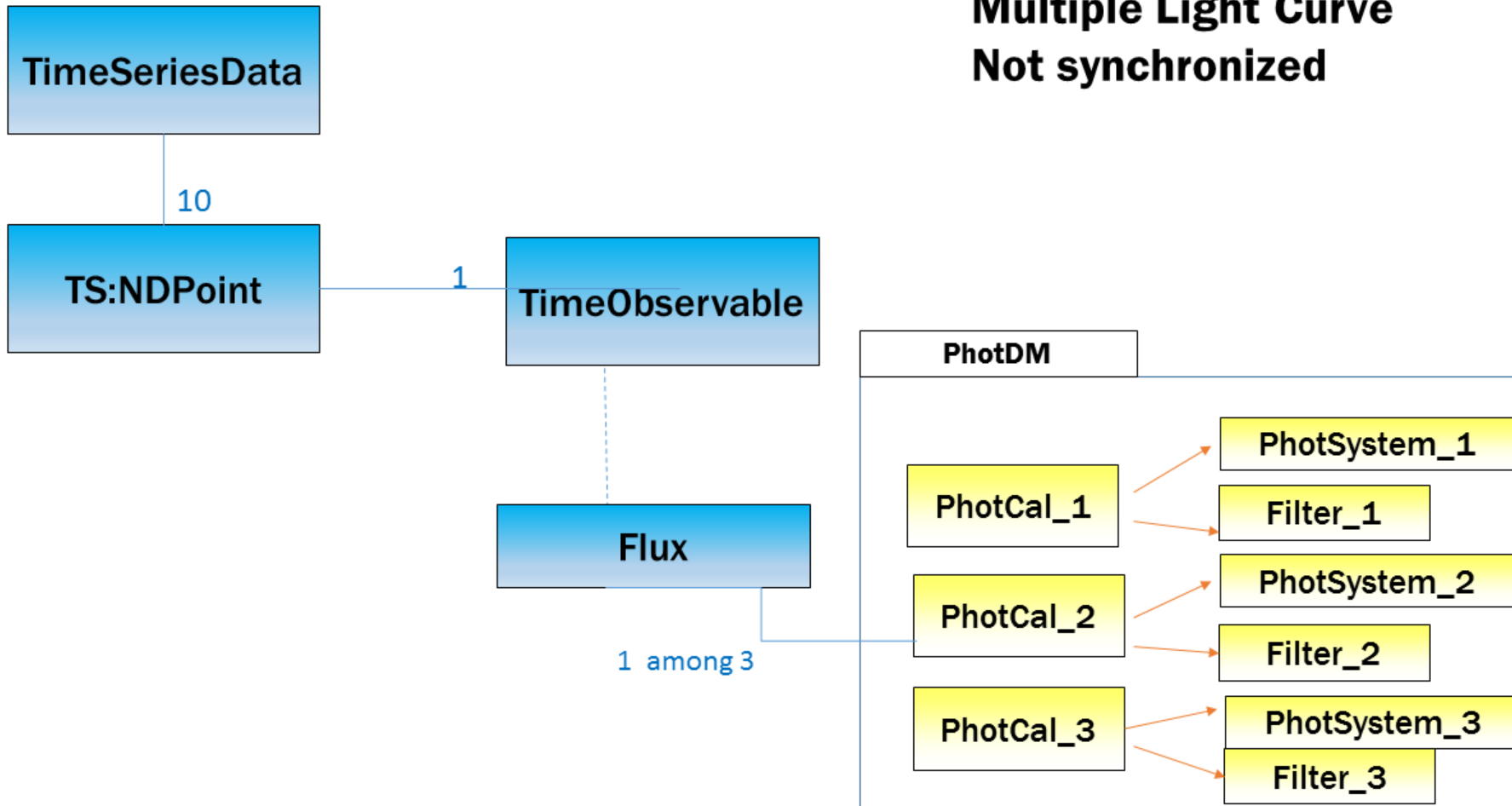
# Various combinations use cases



# □ Ultracam time series



# Various combinations use cases



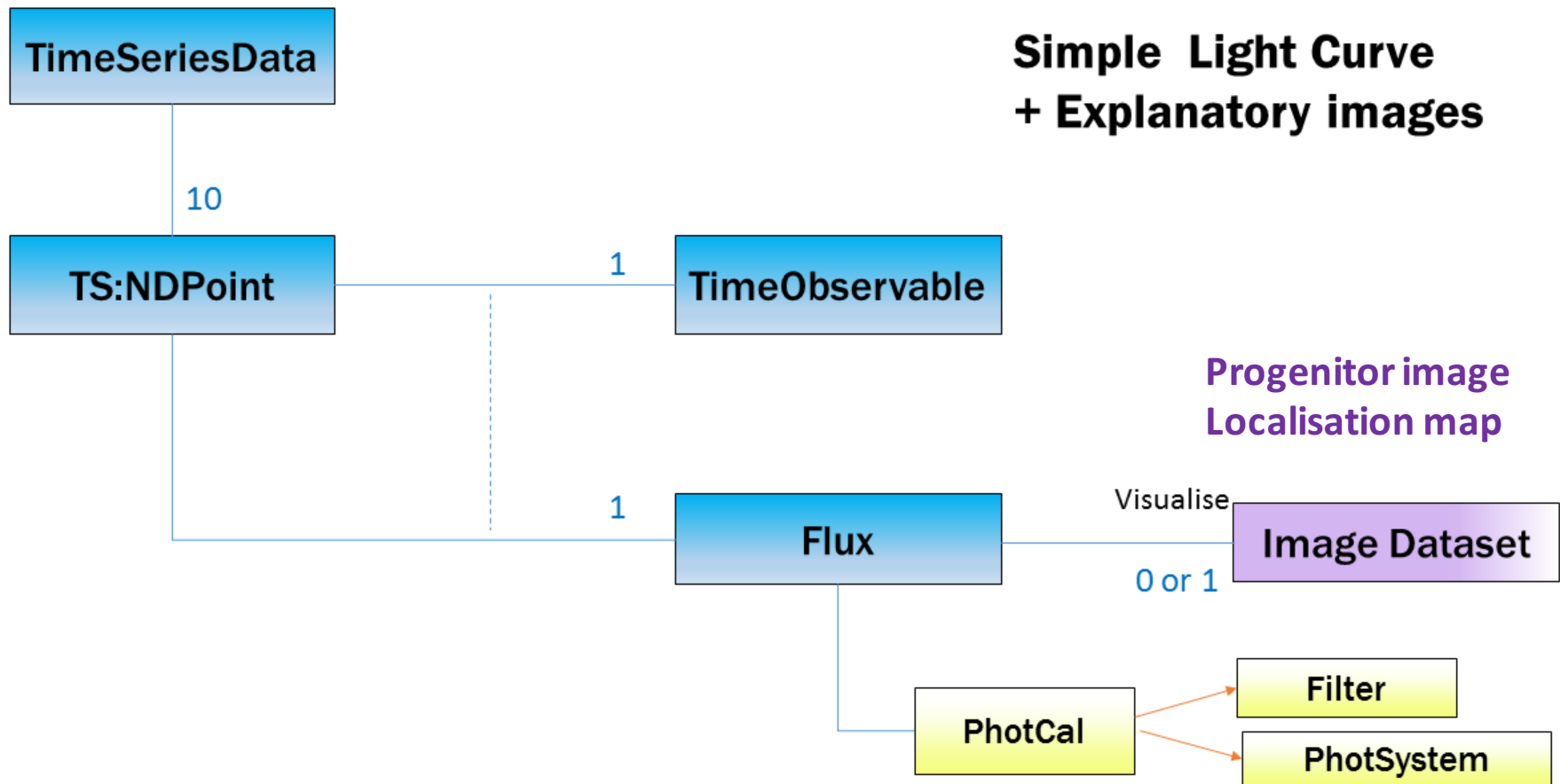
# Multiband Flux measures

Coord/ Measure	T1	T2	T3	T4	T5	T6	T7	T8	Time range	Min time period	T-xel
magB	+		+	+							3
Err_magB	+		+	+							3
magV		*		*		*		*	T8-T2	Min (t <sub>j+1</sub> -t <sub>j</sub> )	4
Err_magV		*		*		*		*			4
magU				^	^	^	^	^	T7-T4		5
Err_magU				^	^	^	^	^			5



# Measures + datasets

## Simple Light Curve + Explanatory images

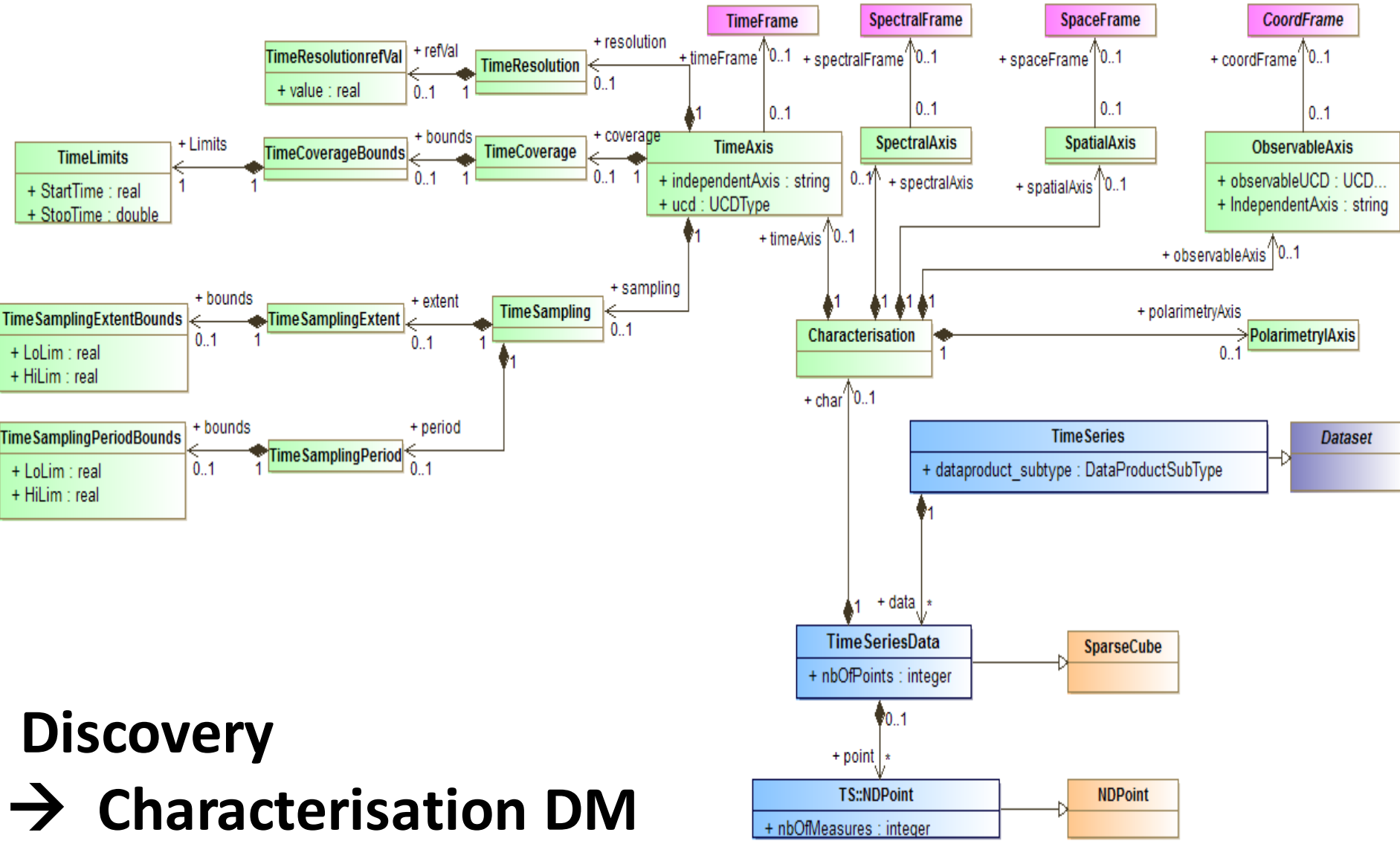




# Data Model Reuse from the IVOA

- A Time series is
  - a dataset → reuse `ObsDataset` from **DatasetMetadata DM**
  - A *multi axis dataset* → reuse *SparseCube* **Cube DM**
  - A collection of points of multiple dimensions `Cube NDPoint`
  - The principal `Cube DataAxis` is **TimeAxis**
  - Its properties can be summarized with **Characterization DM**
  - Measures/Observations **depend** on time samples
  - Simple measurement → reuse **CoordMeasure** as in **STCv2.0 DM**
  - Structured measures as data products → **ObsDataset** element from **DatasetMetadata DM**
  - Bundle of measurements on a similar physical axis → **To be modelled**

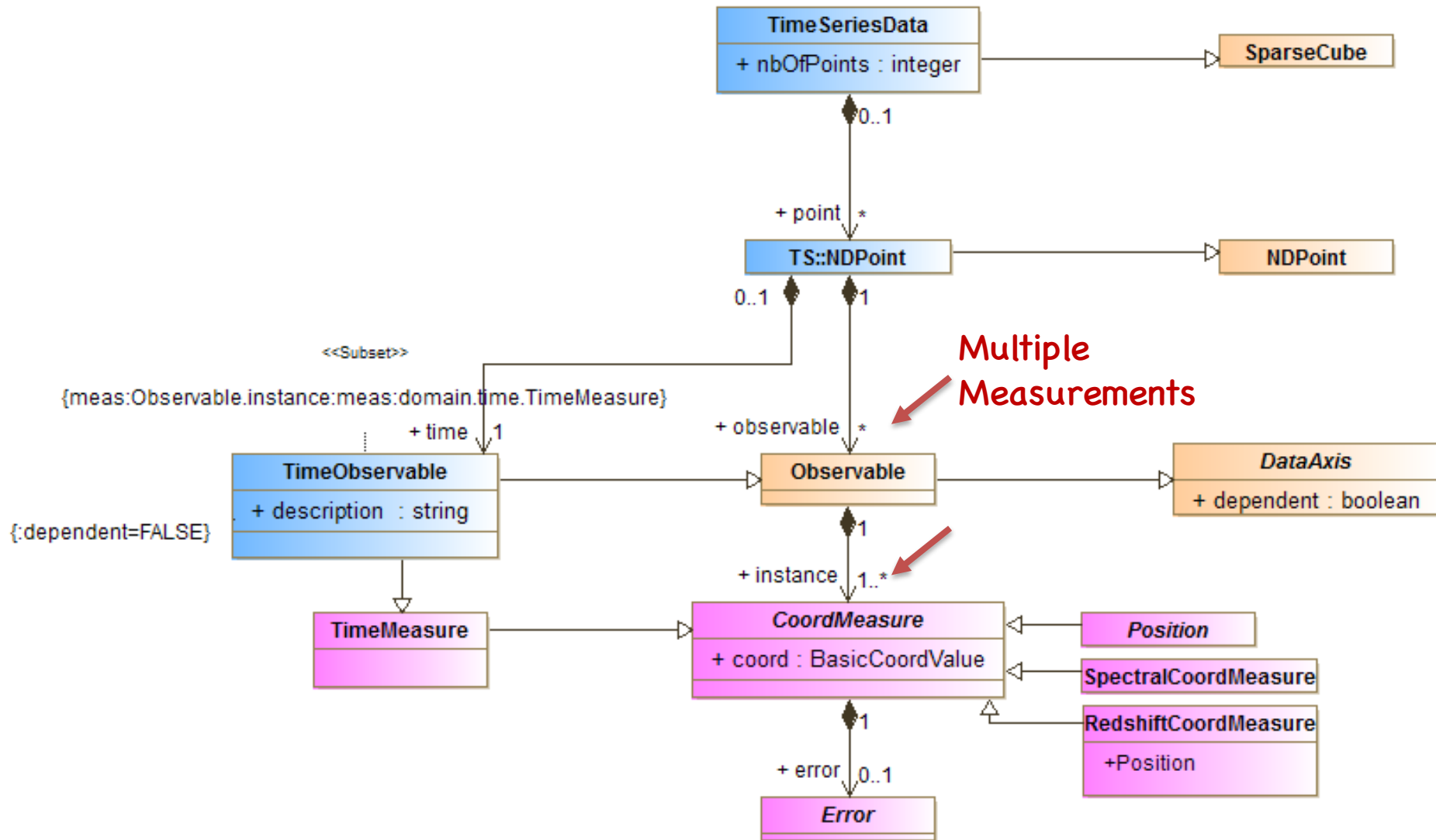




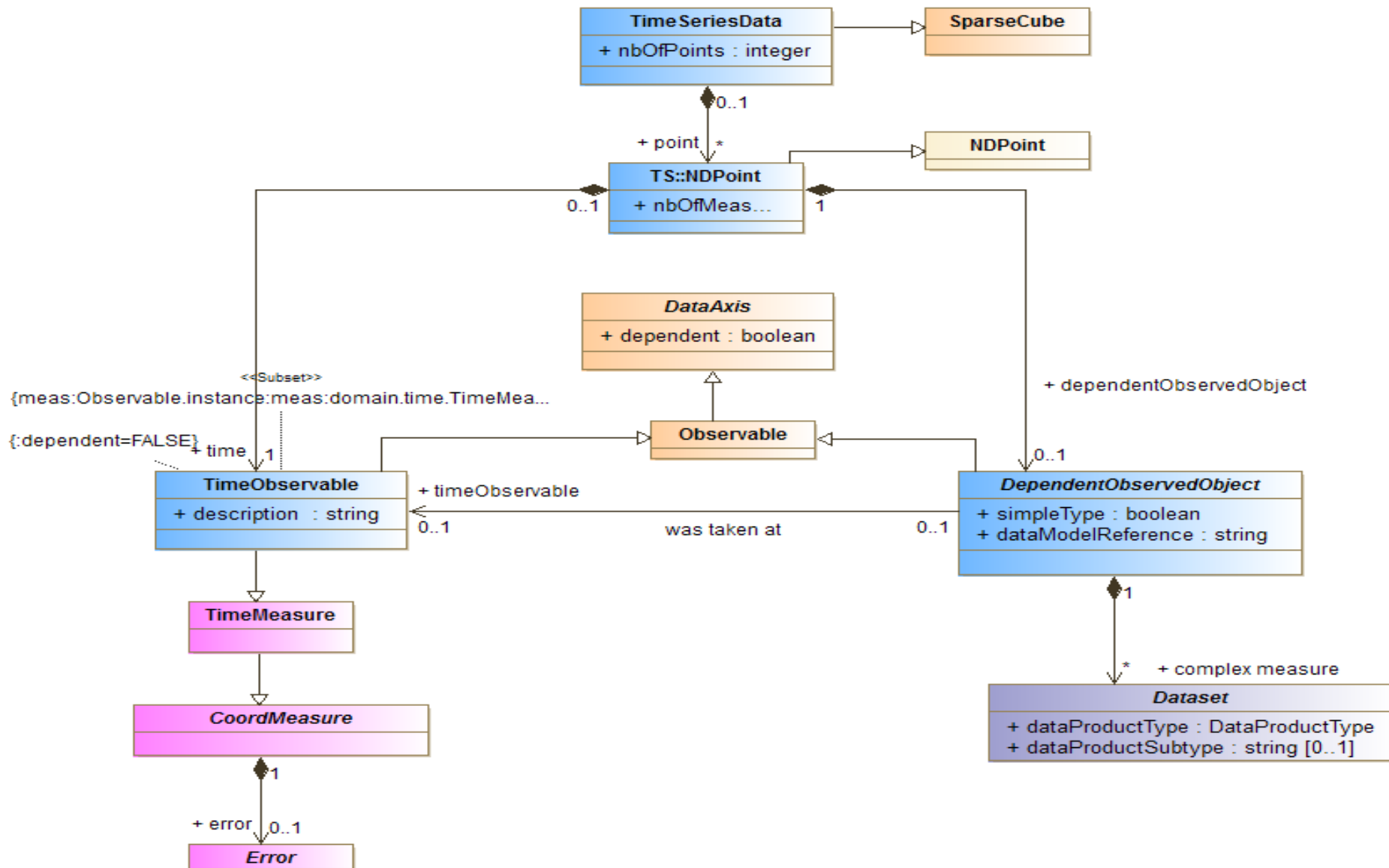
**Discovery**  
**→ Characterisation DM**



# Data selection : Simple measure



# Data selection : associated dataproducts



# How to handle multiple measures

- Simple light curve 1 Time Axis , 1 Flux axis
- Multiwavelength light curve
  - Multiple DataAxis as Flux axis = $f(\lambda)$
- Heterogeneous TS
  - Lightcurve with associated images ( or spectra?)
- TS of datasets
  - Cube TS , e.g. MUSE series of hyperspectral cubes

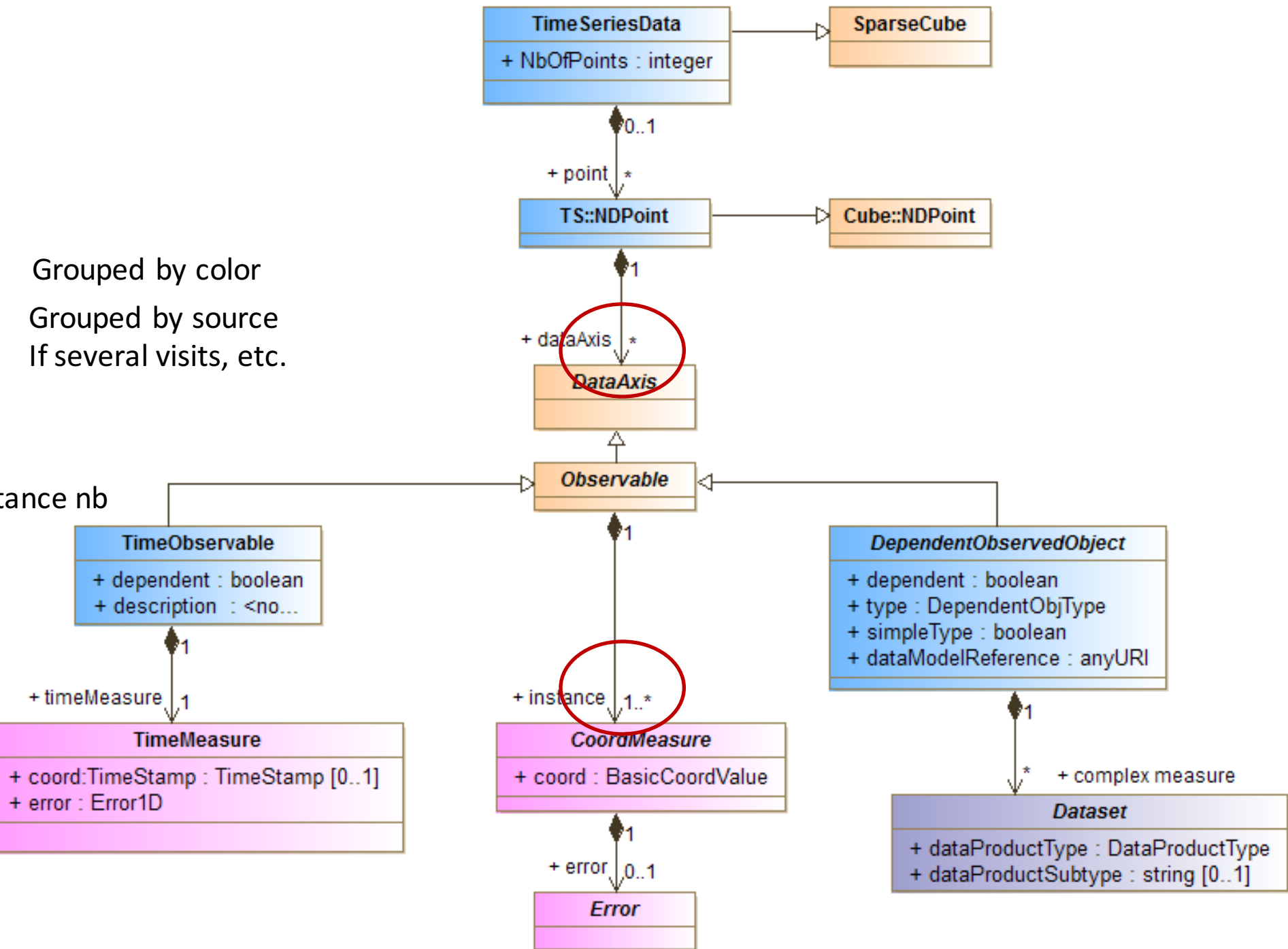


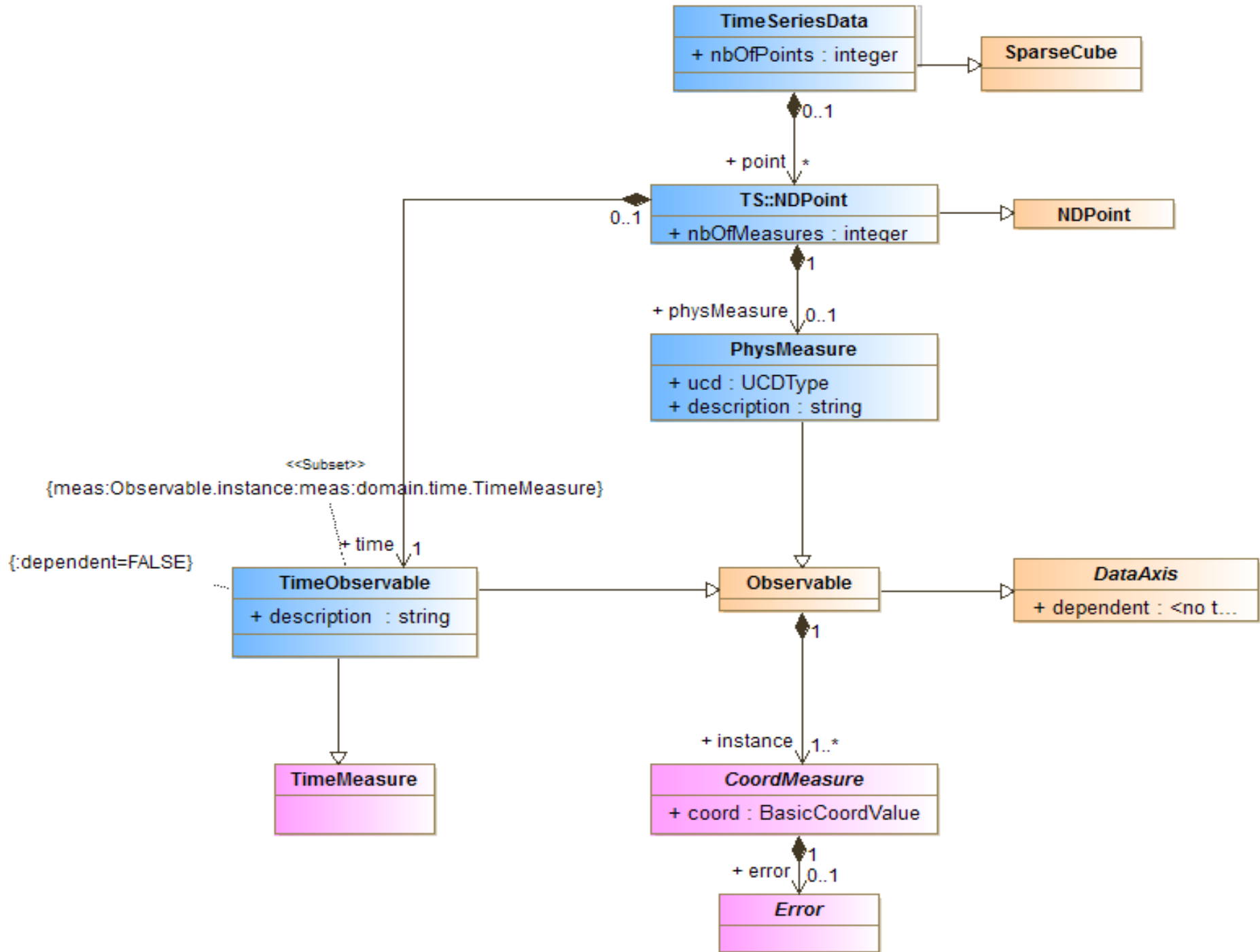
# How to bind with STC /meas and coos

- We identify the basic physical measures in TS DM
- How to describe them in STC
  - Measures , CoordMeasure, etc .
- How to bind to the Coordinate Frames
- Describe all kinds of Observables
  - Generic physical measure with UCD Tag



Grouped by color  
 Grouped by source  
 If several visits, etc.







# Multiplicity case : multiband / heterogeneous details level

t1

- magB
- errorMagB

t2

- magB
- errormagB
- magU
- errormagU

t3

- magV
- errormagV
- magU
- errormagU

t4

- magB
- errorMagB

t5

- magB
- errormagB
- magU
- errormagU

t6

- magV
- errormagV
- magU
- errormagU



# Modeling Status

- Coded in the Modelio UML modeler 3.6
- VODML Import of Cube DM and STC DM
- To do
  - Re-use CharDM and EPN-Core DM for completing the TimeAxis description
  - Resolve how to represent multiplicity of observables at a time stamp
  - Generation of the VO-DML xml description for this model
  - Generation of the html documentation via VO-DML tools
- Explore more science cases



# Lessons learned

- There are a lot of concepts already existing
- The re-use of classes from different models is more tricky than expected
  - Model complexity : many levels of abstraction in STC
  - Modeling tool
- Importing the models in Modelio is not straightforward
  - Import of xmi works
  - Cannot see the classes in Modelio
- More to experience at VODML Hackaton

