



MANGO

Model for ANnotating Generic Objects

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Theodore Ross with Pine.

Gabriel Sculp.

Theodore Ross with Pine.

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Gabriel Sculp.

MANQUIER ou MANGO.

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What MANGO Is Not

Not a model describing some kind of astronomical object

Not a model describing some kind of astronomical data set

Not a model describing some kind of astronomical data service

What MANGO Is

A **container** for **model elements** that can be used to construct **complex quantities** from **table data**.

Model elements can be

- **Classes imported** from other models
- Specified as MANGO **built-in classes**

MANGO History

- Born after a poll to get **use-cases** for a **source data-model** (Paris 2019)
- Kept dormant while the pandemic, the DM workshop and the MIVOT process

What Are Complex Quantities (or Properties)

Quantities with more than one coordinate	<ul style="list-style-type: none">● Position● proper motion● CCD position● errors
Quantity with errors	<ul style="list-style-type: none">● many
Quantity with specific coordinate systems	<ul style="list-style-type: none">● Photometry● Moving objects (space + time)
Quantity linked with other quantities	<ul style="list-style-type: none">● Photometry + time stamps● Position + quality flag
Correlated quantities	<ul style="list-style-type: none">● Position + proper motion
Mix of all above cases	

Design Guideline

Flexible enough to cover many use cases

- Applicable for legacy or mission data
- Coverage of various domains (HE, time domain...)

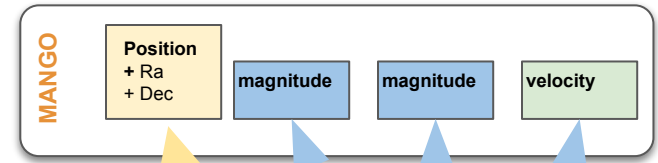
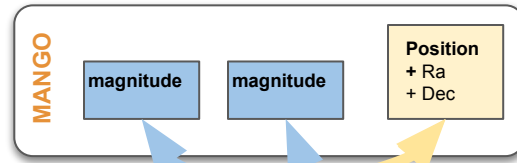
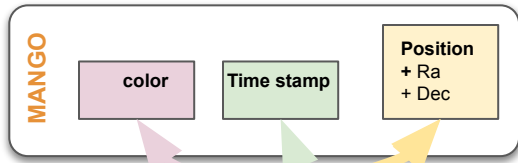
Simple Enough to be comfortable with the mapping (MIVOT)

- Mapping easy to build
- Mapping easy to consume
- Object hierarchy as shallow as possible

Accurate enough to provide significant added value

- Domains not covered before
- Property association
- Data binding
- Semantics tags

The Same Model for Different Datasets



field	field	field	field	field	field	field	field
yellow	yellow	grey	grey	pink	green	grey	grey

field	field	field	field	field	field	field	field
yellow	yellow	grey	grey	blue	blue	grey	grey

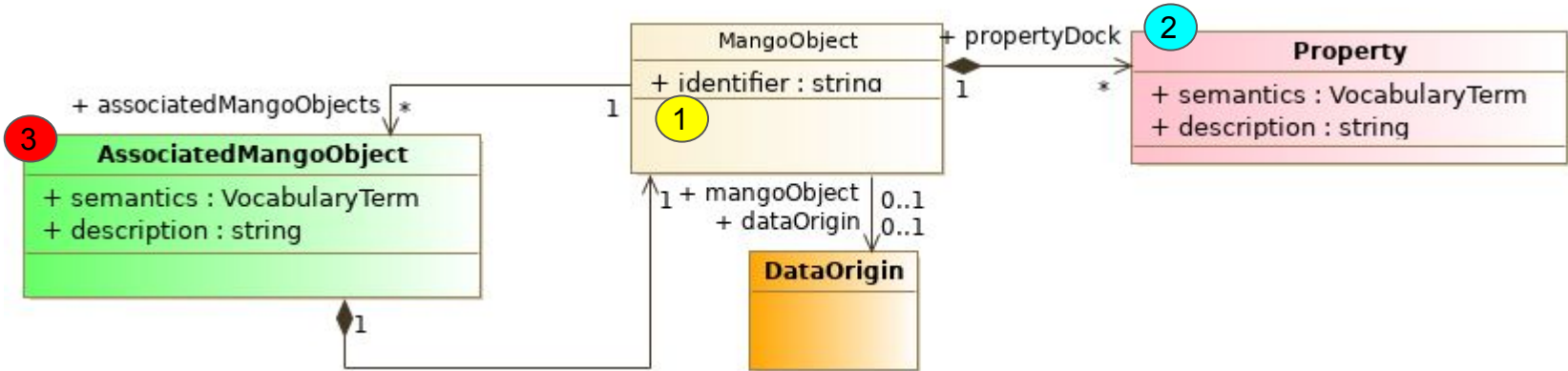
field	field	field	field	field	field	field	field
yellow	yellow	grey	grey	blue	blue	grey	green

The model describes

- Global meta data
- The quantity container
- Individual quantities
- Quantity associations

The model does not specify any pattern of expected quantities.

Model Overview



1

Model Core

- Identifier
- Data origin

2

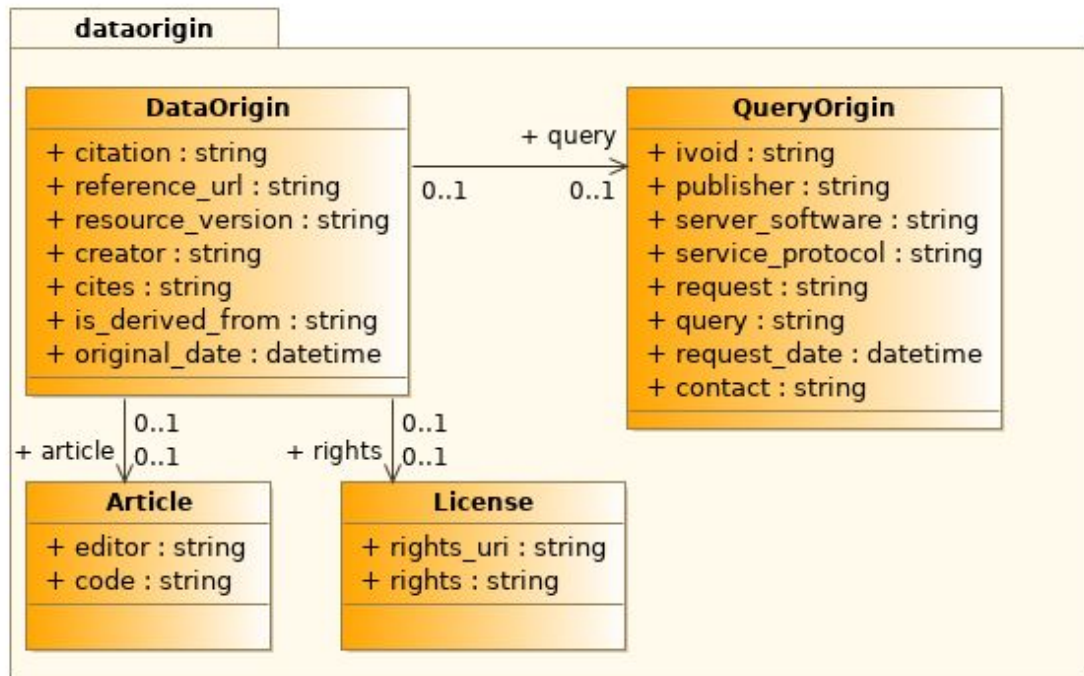
Dock for the Properties

- EpochPosition
- Magnitude
- Color
- Radial velocity
- Desired metadata

3

Mango object binding

The Data Origin (DCP IG)



Trace the dataset origin

- Article
- License
- Query
- Not the provenance

Some of this information is in <INFO>

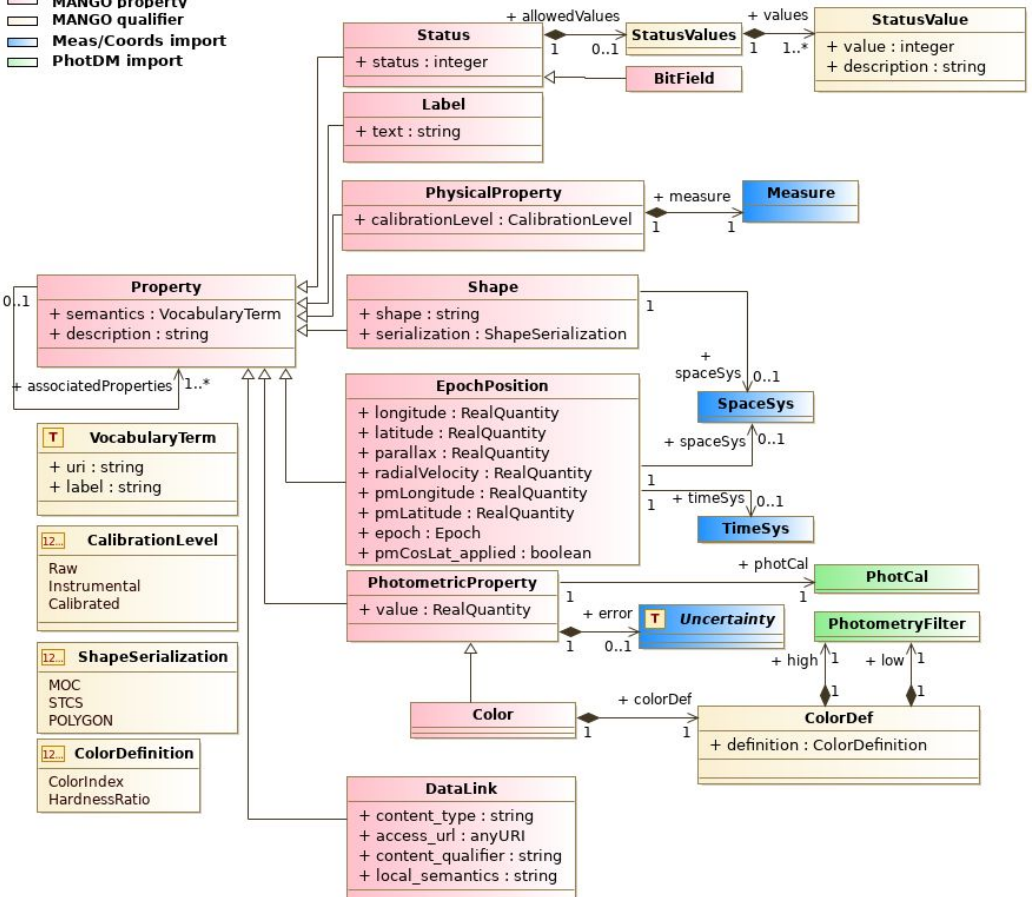
- The model provides a structured view on it

TBD - TBC

- Merge with or reuse DatasetDm

Properties Supported by the Model

- MANGO property
- MANGO qualifier
- Meas/Coords import
- PhotDM import



A mix of built-in and imported classes

- Measurement
- Coordinates
- PhotDM

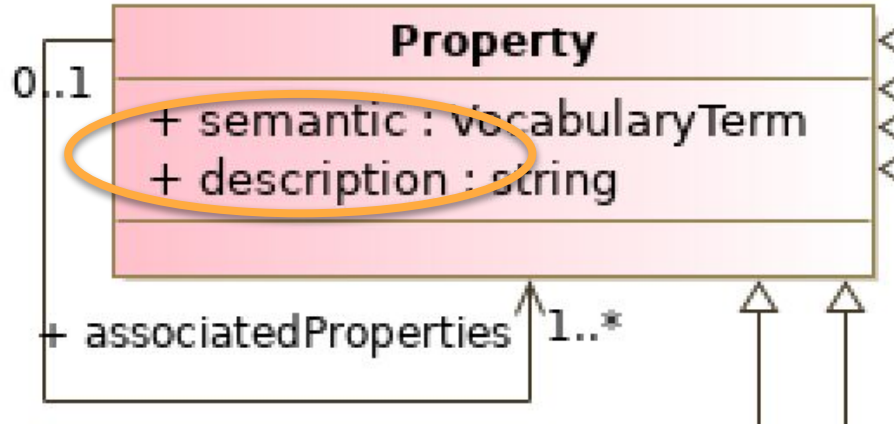
A limited number of specific classes

- Covering the most popular use-cases
- Can be still extended

Make things machine-readable

- Associations with coord. systems
- Serialization modes
- Computation mode

Property Semantic



Property role refined by semantic tags

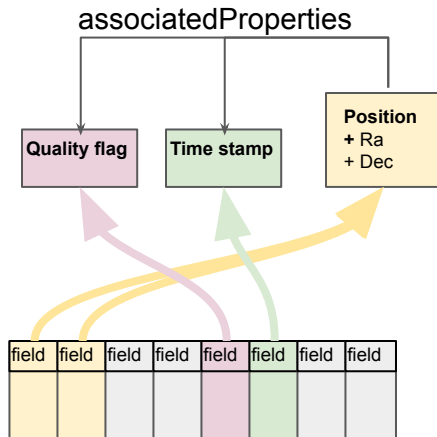
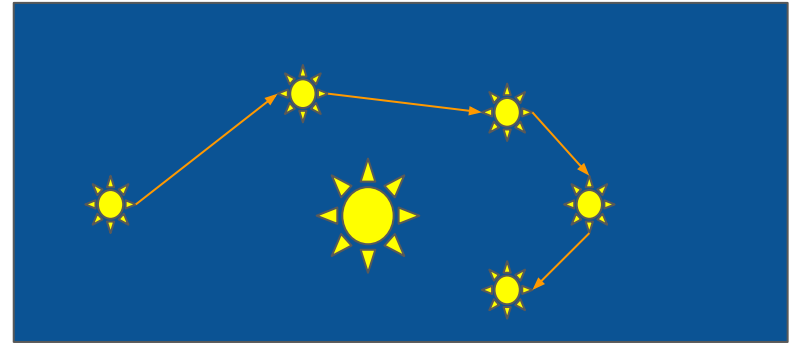
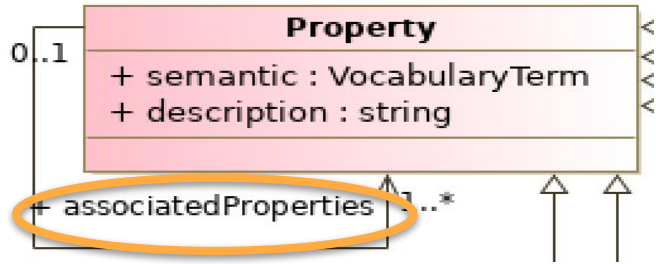
- Vocabulary
- Free text description

Semantic block can relate to

- The property itself
- The property + the associated properties

Property	Description
PhotometricProperty	This is a V magnitude
Time	This is a time stamp
PhotometricProperty + Time	This is a photometric point in V band

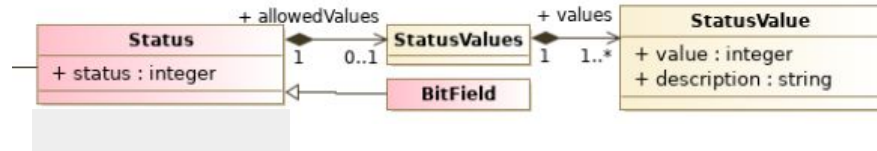
Property Association



Association purpose

- Associating a property with a time makes it easier to interpret time-domain data.
 - Moving stars
 - Orbiting system
- Associating a property with a flag makes it easier to filter data.
 - Quality flag

Status



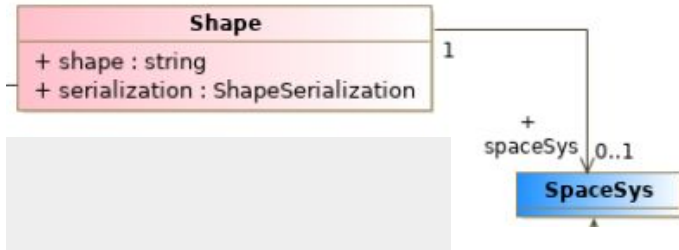
Make status values machine-readable

- Query setup
- Value understandable by the client
- Give semantics to the status

Set of allowed values

- Allowed values come with their descriptions

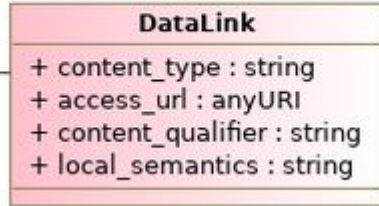
Shape



String serialization of complex shapes

- Serialization mode (MOC, STC-S...) given by the **ShapeSerialization** enum
- Space coordinate systems imported from **Coordinates** data model

DataLink



Flat DataLink serialization

- For services having URLs in data tables and not running data link services

TBD

- Is it worth it as the use of DL services is encouraged by IVOA?

Support of Classes of the Measurement Model



Measure DM sub-classe pattern

- A value (can be a vector)
- A coordinate system (frame + axis)
- An error

Placeholder for classes of the Measurements model

- Position
- Proper Motion
- Velocity
- Time
- Polarization
- Generic Measure

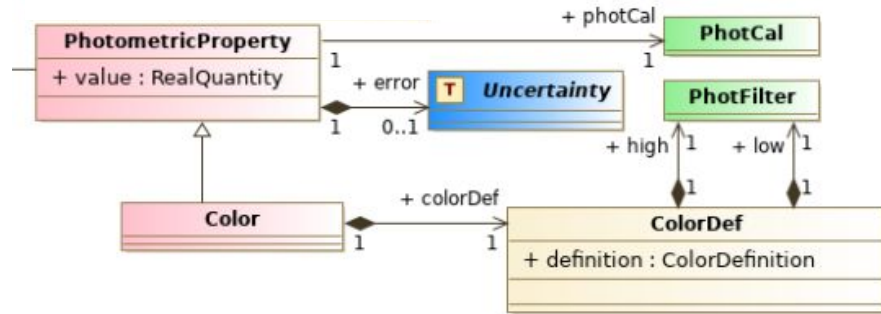
Great flexibility

- Accurate description of all axis
- Might be tricky to use due to the too many abstractions

Add a calibration level

- =borrowed from Obscore (vocabulary)

Photometry Properties



Flux/Magnitude/count rate

- A simple value with an error and a photometric calibration (imported from **PhotDM**)

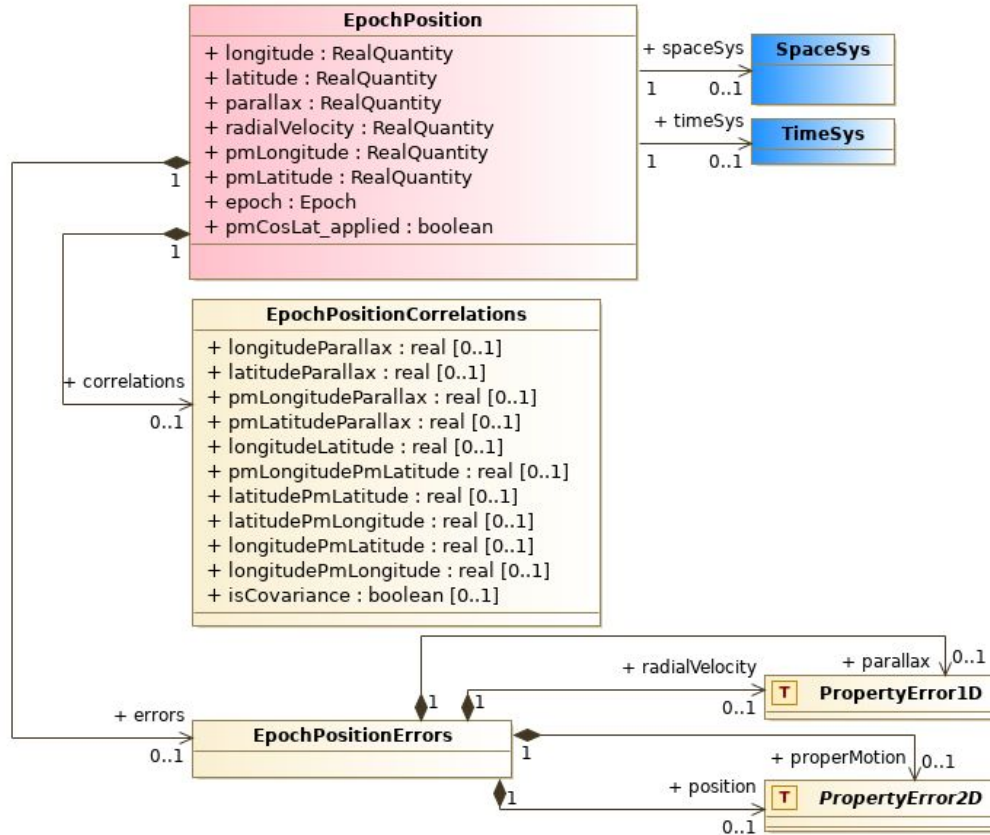
Color

- A simple value with an error and 2 photometric filters (imported from **PhotDM**)
- Distinction between Color and HR made at model level (**ColorDefinition**)

TBD - TBC

- Should we make a distinction between Fluxes and Magnitudes at model level?

The Epoch Position Class



Inspired by Gaia DR3

All components in one flat class

- Share the same coordinate systems
- Coordinate systems imported from `Coordinates` data model

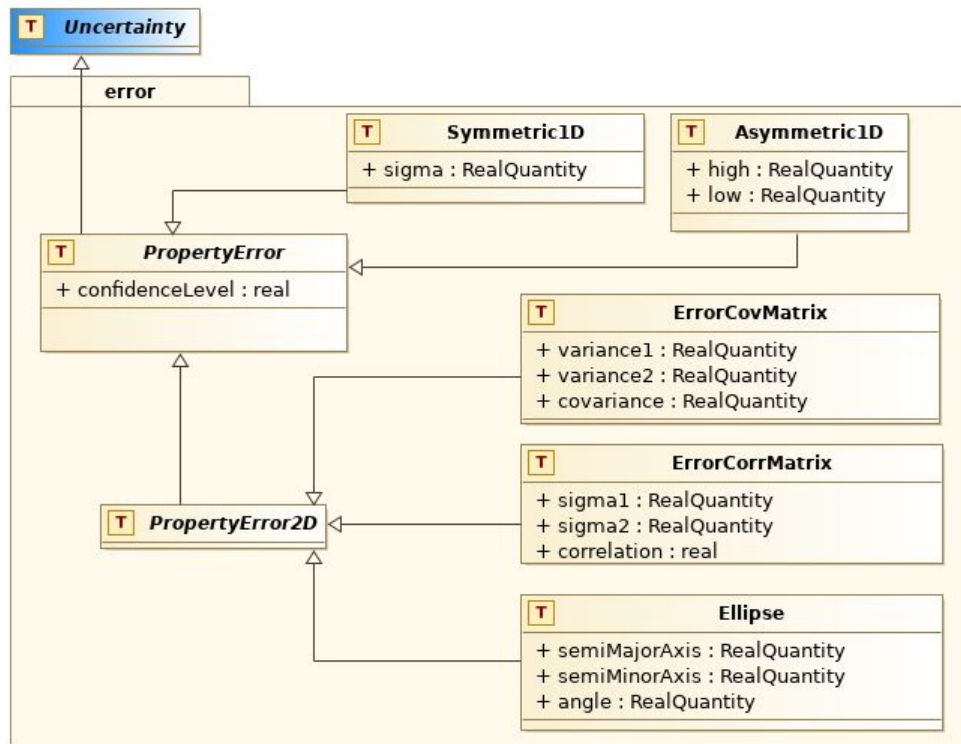
Correlation support

- Flatten correlation matrix
- A 6x6 matrix would be out of control

Implementations

- VizieR cone-search
- Xtapdb (see apps talk)
- Pyvo MIVOT package

Error Package



Currently designed for the
EpochPosition (GAIA) use-case

Main Features

- Confidence level (important for X-Match)
- Split by dimension (1D vs 2D)
- Distinction between covariance and correlation
- Derive from `meas:Uncertainty` to make them usable in the context of the physical properties

TBD - TBC

- Add an attribute giving the statistical distribution (poissonian, gaussian,...)

Issues

Vocabulary: Some classes have attribute that must be set with controlled vocabulary

- Shape serialization, calibration level (*), photometric measurement

Should we use literal enumerations or specific vocabulary?

Energy band vs filter: For now, the X-ray energy bands are considered as photometric filters with square response curve.

Is that modelling valid?

A Important Clarification

- **Why some elements present in the VOTable are duplicated in the model?**
 - Property description
 - unit
- **Several (good) Reasons**
 - a. VOTable column descriptions are column-related whereas MANGO description are quantity-related
 - b. If they are missing in a particular VOTable, we want to be able to set them in the model mapping block.
 - c. We want to be able to export self-consistent model instances
 - i. No longer dependencies with the VOTable context
 - ii. E.g. as JSON feeding a micro-service (see PyVO implementation)

Conclusions

Thanks to MIVOT and PyVO, the model can be exercised against real data.

- Data sample can be mapped on Mango by hand so that stakeholders can see whether the result match their expectations or not.

We need people input to validate the working draft

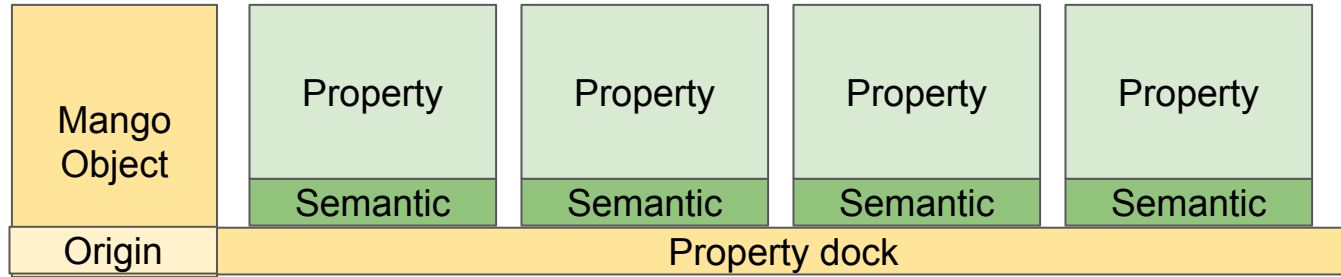
- Need data provider input to validate the model as a whole
- Need expert in orbiting system: a missing MANGO feature
- Need input for any missing property (redshift, orbiting systems..)

<https://github.com/ivoa-std/MANGO>

https://wiki.ivoa.net/twiki/bin/view/IVOA/MANGO-1_0

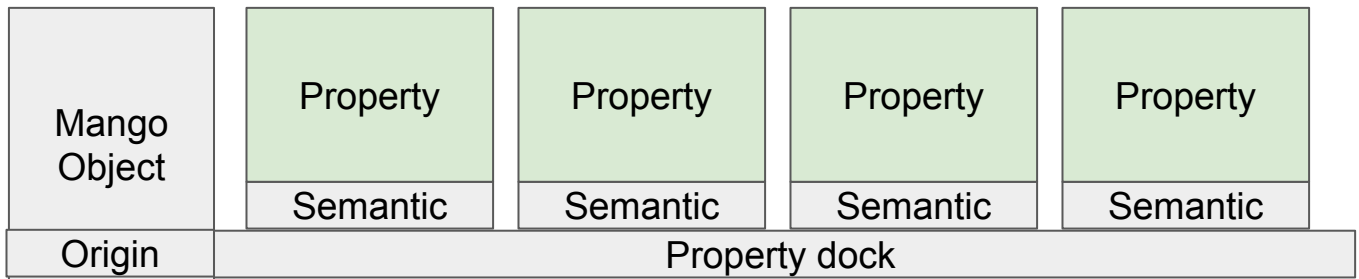
backup

Mapping the Whole Model ?



Data can be mapped as a complete MANGO instance

... or Not



Or as a bunch of elements as we are doing with the `EpochPosition`

- The parsing remain easy since any component is identified by its `@dmtype` and the `@dmrole` it plays in its context

The Purpose of MANGO

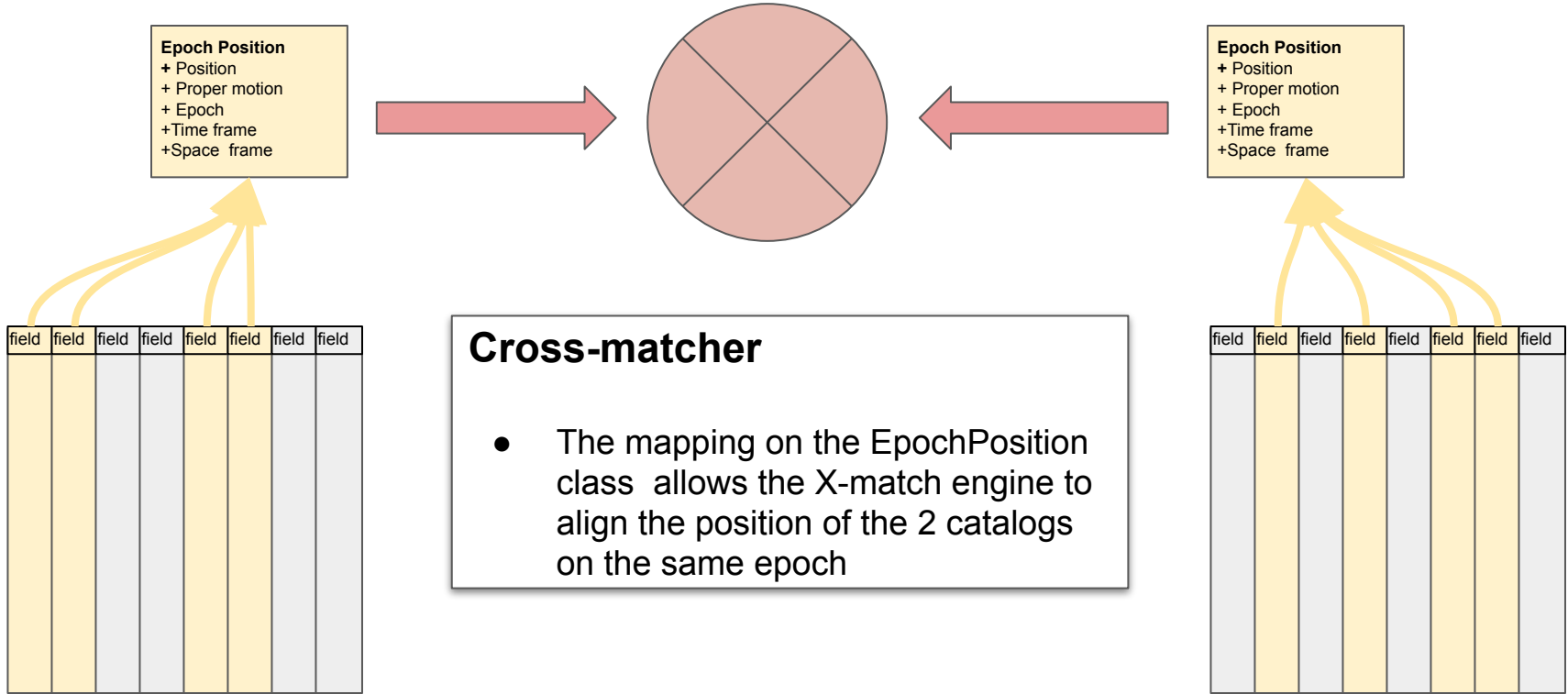
Extend the list of quantities supported by the VO models

Meta-data enhancement

(Re)construction of complex quantities

Connecting objects together

Cross-match Example



Cross-matcher

- The mapping on the EpochPosition class allows the X-match engine to align the position of the 2 catalogs on the same epoch