VODML Mapping Update

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New Mapping Syntax

- **Reminder: Mapping syntax defines how to annotate a VOTable to serialize objects of a VODML model.**

- **Previous proposed syntax minimized the number of new elements added to the VOTable spec.**
  - Low impact on the xsd, so it was easy to parse, but…
  - Very complex to document and code to because understanding the meaning of the content was very context dependent.

- **New syntax much more explicit**
  - Adds several new elements that map directly to VODML concepts.
  - Aims to remove context-dependent logic
  - Number of new elements makes it clear we're solving a complex problem
  - Impact on parsers and data providers still limited due to isolating all new elements in a single section of the VOTable.

New Developments

- **New Mapping Document**
  - Includes continuous integration paradigm and is managed in GitHub
- **Multiple people have created annotated VOTables for multiple valid VODML models**
  - Several examples embedded in mapping document.
  - Catch-all for most constructs (GL)
  - Cube model(MCD)
  - Tessellation (LM)
- **Annotation automation tools (OL)**
  - Helped to create many of the above VOTables
- **Parser prototype (TD)**
  - Web service and client for parsing and displaying annotated VOTables
  - Handles the above examples (except the FITS data)
  - Results promising. More work needed to explore all use cases.

New Developments (2)

- **At least three independent interoperable implementations**
  - Model
  - Create format-independent instances
  - Annotate VOTable
  - Parse VOTable and faithfully reconstruct instances
  - Schema validation
- **Validation is currently the weakest link**
  - You can validate against XSD with standard XML tools
  - No VO-DML specific validation of instances just yet
- **VOTable and VO-DML Mapping schemata**
  - Separated into individual schemata
  - Transparent to clients (only one namespace, as usual)
  - More sustainable development
  - Need to decide whether to “import” or “include”

Mapping Document Reboot

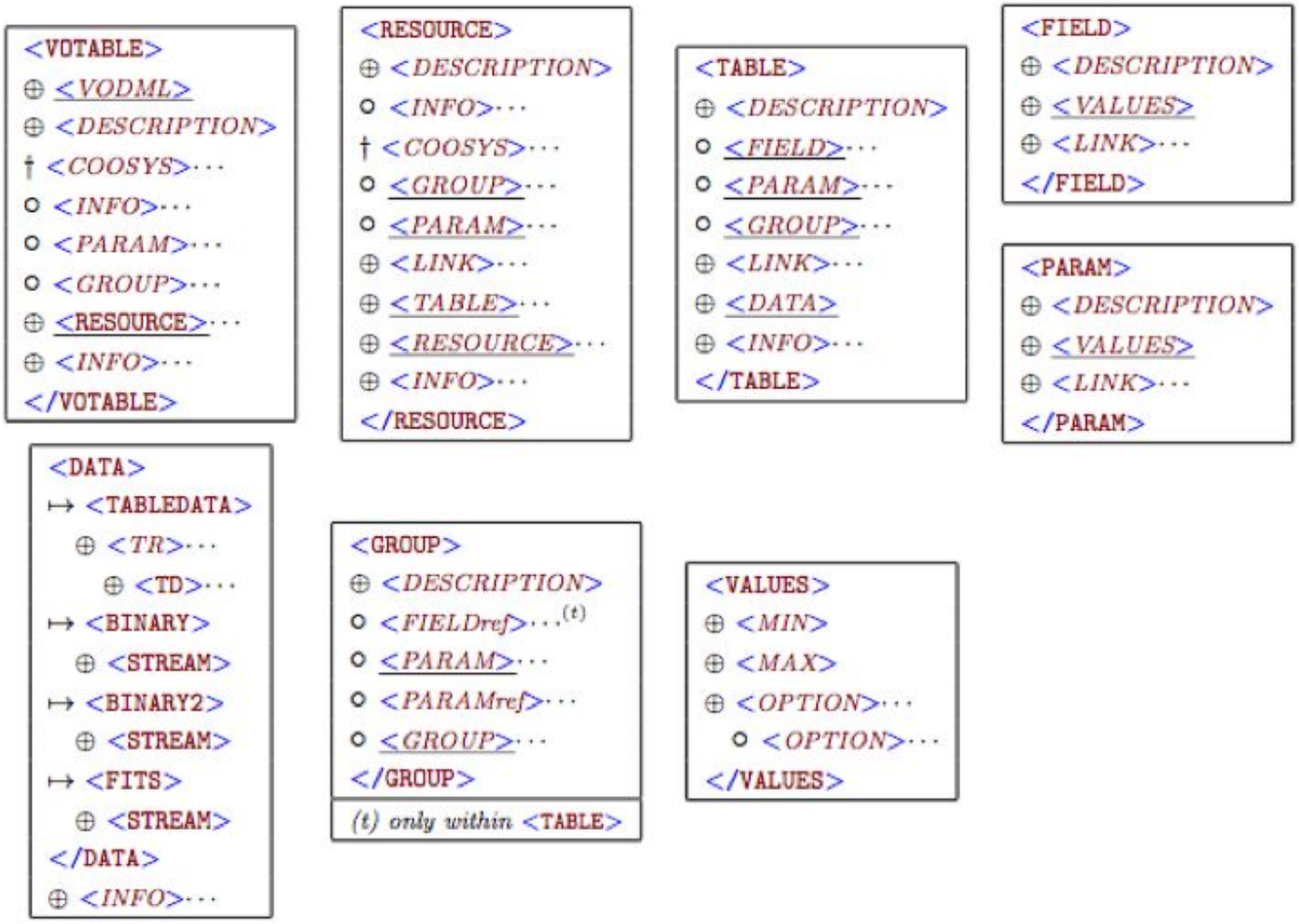
- **Rewrote from scratch with the new syntax**
- **Distributed Version Control of the source files (git/GitHub)**
- **MarkDown source with HTML and PDF outputs (like ivoatex, but w/ MD)**
- **Special integration with VO-DML:**
  - write examples in DSL
  - produce annotation during compilation
  - Include external files
- **Continuous Integration with ad-hoc cloud web application:**
  - Build HTML document upon push
  - Link to Diff
  - Keep history of changes

Mapping Document Reboot (2)

- **Extension and consolidation of use cases: many concrete and abstract use cases were added or rewritten**
- **Section 3 (The need for a mapping language) mostly unchanged**
- **Two-way mapping description:**
  - Detailed description of new XML elements
  - How to map VO-DML types to XML elements
- **Examples:**
  - Simple example with minimal annotations
  - Complex example with advanced Object Relational Mapping patterns, multiple tables

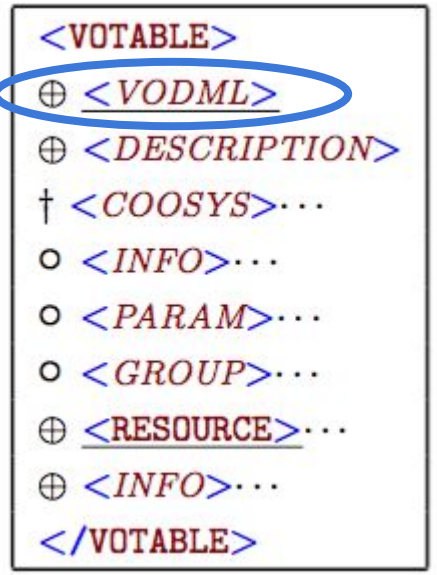
VOTable Syntax Summary

- VOTable spec summarizes syntax in section 7



VODML in VOTable Syntax

- **All new elements are under a single VODML element at the beginning of the VOTable.**
  - Other than the top level VODML element, the new elements can be defined in a separate xsd that gets included into the VOTable xsd.



- **VODML elements have all new names (no reuse from VOTable).**

- **VODML hierarchy draft at**
  https://volute.g-vo.org/svn/trunk/projects/dm/vo-dml/doc/VO-DML_mapping_syntax_summary.pdf

Syntax - New Elements

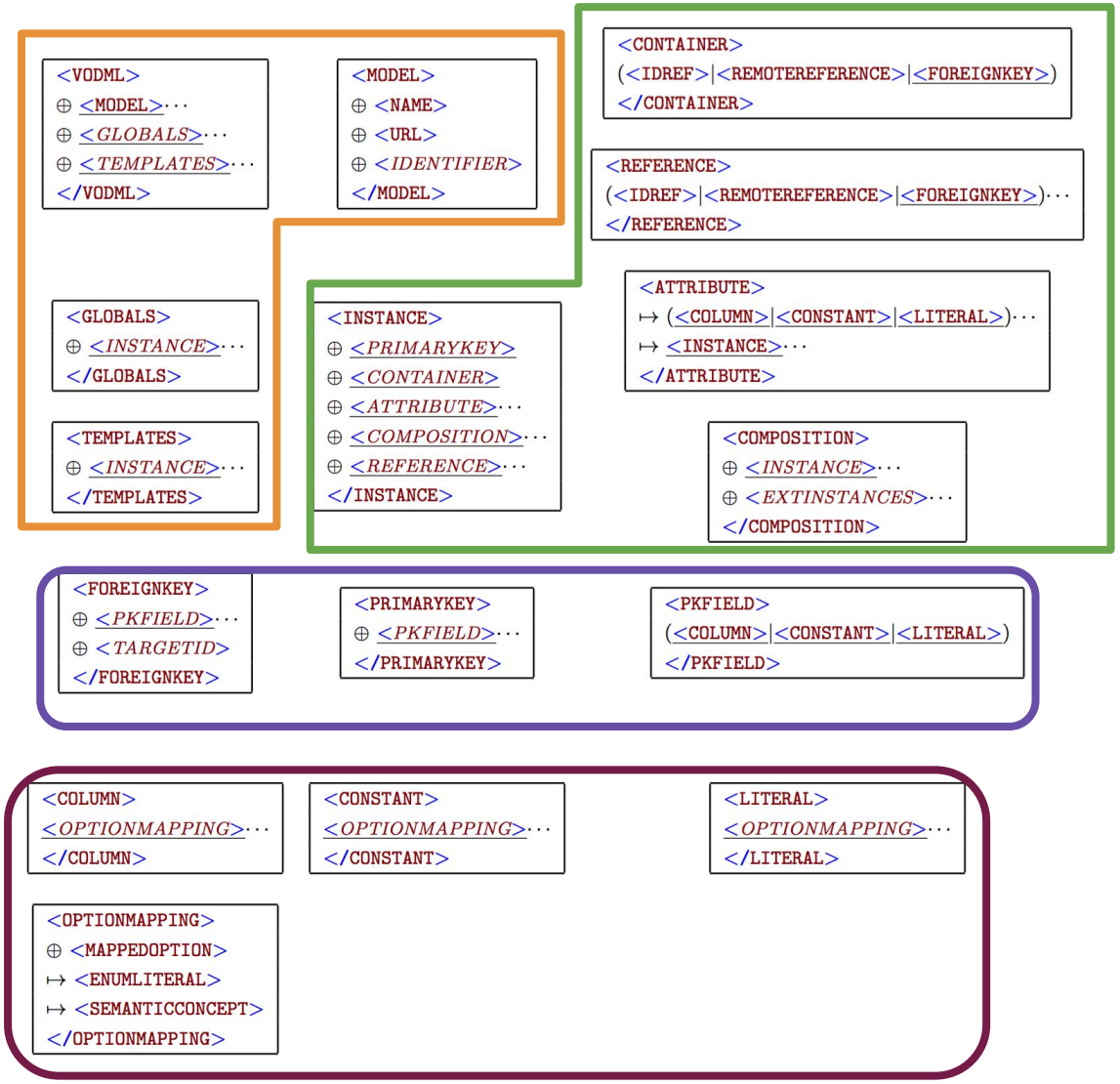
- **Structure explicitly matches VODML model concepts.**

Core elements

Instance content

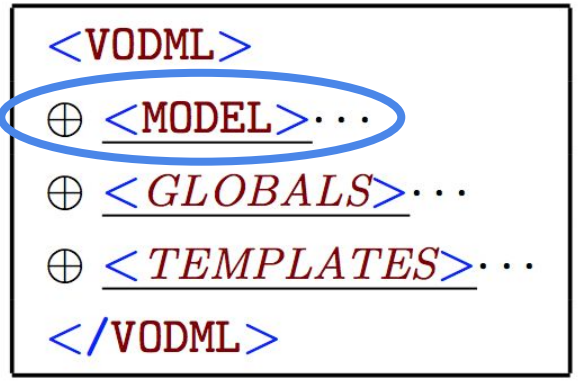
Foreign key refs

Primitive values



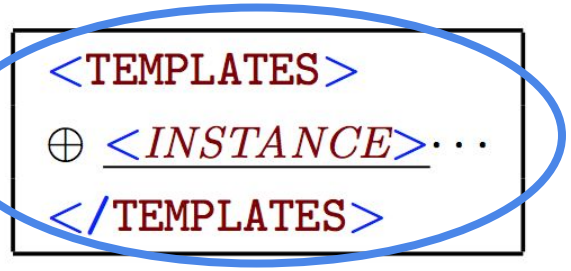
Syntax - Core Elements

- **Pointers to model definitions**



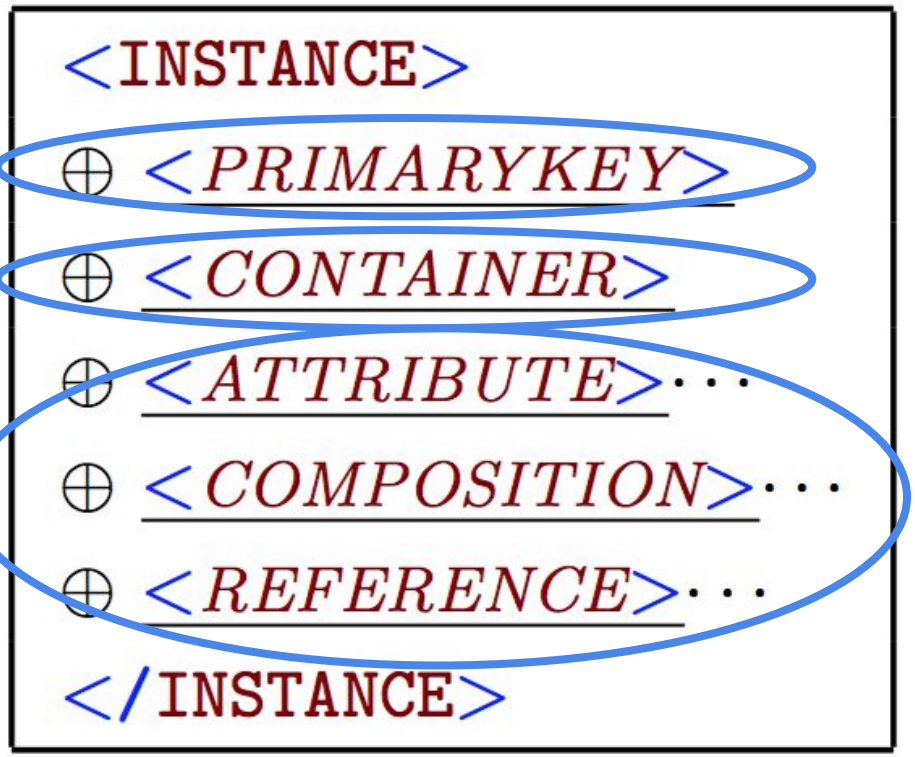
- **Model instances that do not depend on TABLE data**
  - Complete VODML instances can be conveyed here without any actual TABLEs.

- **Instance templates created once per row using data from the row**



Syntax - Instance Definition

- Used for foreign key reference
- Reference to parent
- 3 ways to specify the attributes of the instance



Annotation Experiences - Omar

Jovial:

- **Java/Groovy application and library**
- **Reference implementation for VO-DML and Mapping Document**
- **Domain Specific Language for Models and Instances**
- **Support Data Providers:**
  - Script annotations
  - Abstract from complexity of standards and syntax
- **Shield examples in mapping document from changes to syntax**
- **Target different serialization formats (VOTable, XML, JSON, YAML)**
- **Quick turnaround for end-to-end modeling efforts:**
  - Successfully applied to STC2, Cube, and TimeSeries
- **Will address more use cases as we approach PR**
  - Model-specific DSLs
  - Annotation “bootstrap”

Annotation Experiences - Omar (2)

- **End-to-end modeling of complex domains has become easier with specialized tools**
  - model (PH's VODSL, OL's Jovial, UML modeling)
  - instantiate (OL's Jovial)
  - map/serialize (OL's Jovial)
  - test against requirements and for usability/clarity
  - go back to model
- **Enables patterns like Test Driven Modeling or Rapid Model Development**

Parser Experiment - Goals

VODML (and mapping it to VOTable) is complex.

- **Assess the complexity of parsing and understanding the semantics of the new syntax.**
- **Provide alternate view(s) for human readability.**
- **Show that a client can understand mapped model instances from multiple providers (interoperability)**
- **Identify validations beyond those enforced by schema.**

Parser - Design/Plan

(Complete)

- **Adapt the MAST Portal VOTable parser**
  - Server-side C#
  - Translate annotations to JSON, but **do not** resolve references.
- **Implement Javascript client that can display instances**
  - Client will resolve references and expand templates for each data row.
  - Display multi-table VOTables.

(In Progress)

- **Handle foreign key references.**
- **Model-aware displays and validation**
  - End-to-end application of “real world” examples with models like Source and CAOM (subject to the complexities of defining the actual models).
- **Full server-side validation and dereferencing**

Parser - Server produces JSON

Server and client instructions at:

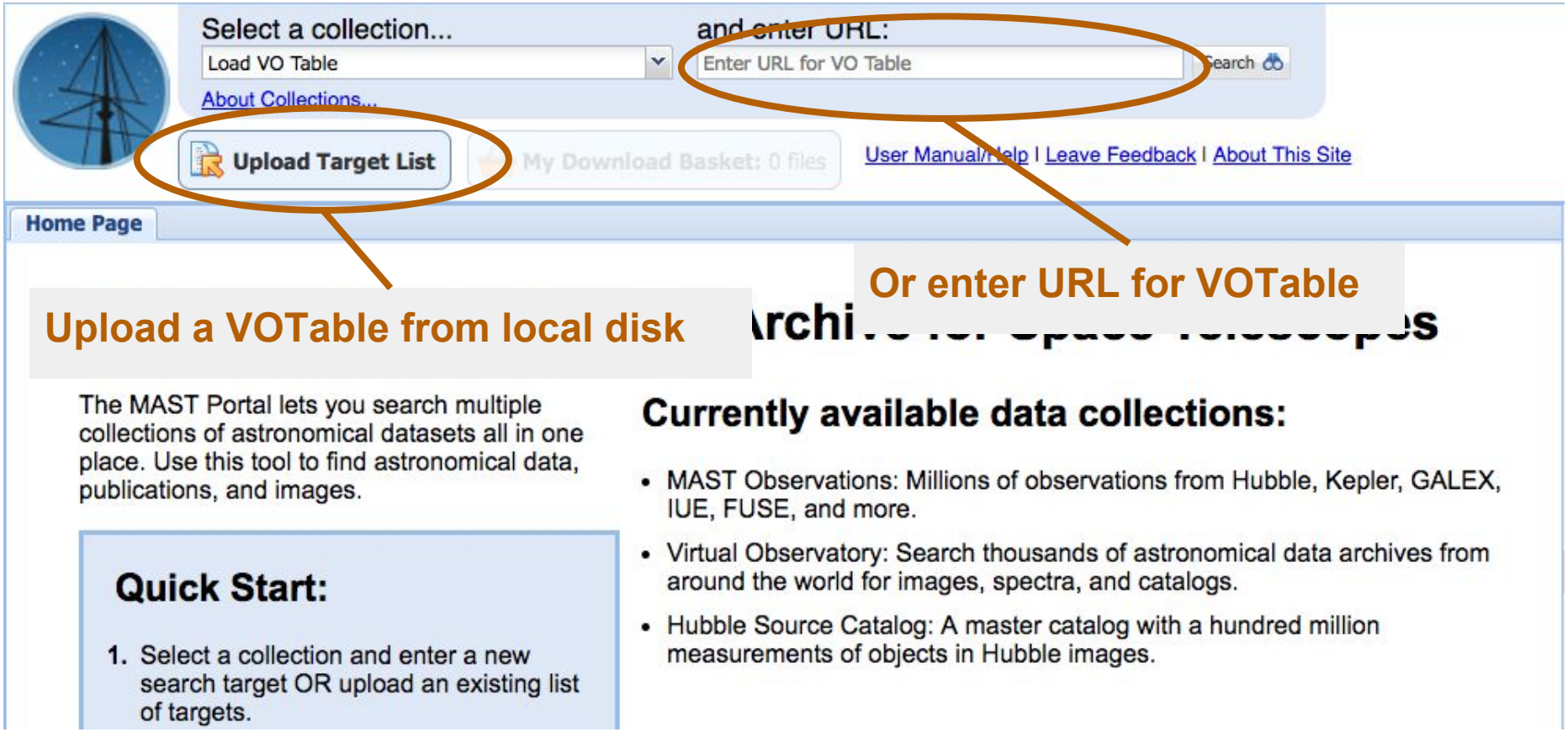
https://volute.g-vo.org/svn/trunk/projects/dm/vo-dml/mapping/MAST%20VODML%20Parser/VODML%20Parser.html

JSON for Source model instance:

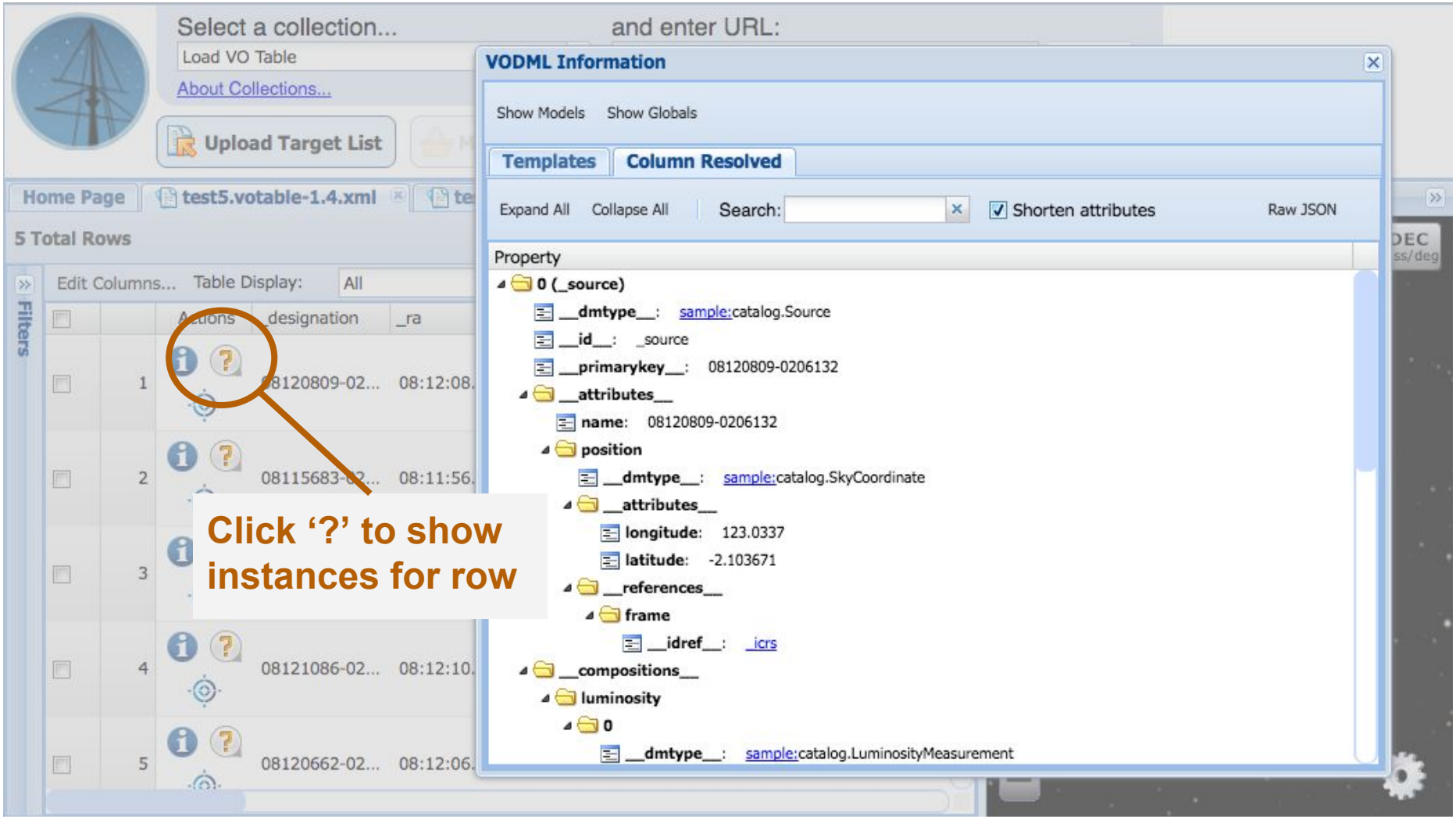

```
{
    "__dmtype__": "sample:catalog.Source",
    "__id__": "_source",
    "__primarykey__": "08120809-0206132",
    "__attributes__": {
        "sample:catalog.AbstractSource.name": "08120809-0206132",
        "sample:catalog.AbstractSource.position": {
            "__dmtype__": "sample:catalog.SkyCoordinate",
            "__attributes__": {
                "sample:catalog.SkyCoordinate.longitude": 123.0337,
                "sample:catalog.SkyCoordinate.latitude": -2.103671
            },
            "__references__": {
                "sample:catalog.SkyCoordinate.frame": {
                    "__idref__": "_icrs"
                }
            }
        }
    }
}
```

Parser - Client Based on MAST Portal

https://masttest.stsci.edu/vodml/Mashup/Clients/Mast/Portal.html



Parser - Client (cont'd)



Parser - Results So Far

New syntax is significant improvement over old.

- **Old syntax was easy to parse, but hard to understand.**
- **New syntax is tedious (but not hard) to parse**
  - Tedium is due to number of new elements.
  - Some implementations may be easier than others.
- **New syntax is much easier to understand**
  - Due to direct, explicit, mapping from new elements to VODML concepts.
  - There is still complexity.
  - Learning curve is for all aspects of VODML, not just the mapping.
  - Basic cases are not too complex.
    - E.g., substitution of FIELD values in templates is straightforward and delineates objects more clearly than UTypes.

Parser - Results So Far (2)

- **Some simplifications are possible if we decide certain features or explicit structures are not needed.**
  - E.g., ATTRIBUTE could be used instead of COMPOSITION and REFERENCE if we find the distinction is not important to clients.
- **Self-contained nature of syntax makes it easy to ignore.**
  - At least for some legacy parser implementations

What's Next?

- **Ensure all syntax constructs have clear examples.**
- **Continue implementation experiments.**
  - End-to-end (provider through client) application of "real world" cases
  - Show that client can "understand" certain models like Source, CAOM, etc.
  - Multiple providers/clients desirable
  - Curate a list of validations and continue development of validator(s)
- **Clean up volute to archive past approaches.**
- **Solicit/gather feedback.**
  - Make updates to syntax, document, examples and implementations.
- **Formalize syntax with VOTable 1.4 specification**
  - Done in time to allow review prior to next Interop
  - Are there other VOTable updates that *need* to go in at the same time?

References/Documentation

- **Mapping document working draft**
  - HTML version has scrollable examples: http://doc-ivoa.rhcloud.com/document/9458a3d669c93068f4290e0f58a3e058b18ad7ef
  - PDF: https://volute.g-vo.org/svn/trunk/projects/dm/vo-dml/doc/VO-DML_mapping_WD.pdf
- **Parser**
  - Documentation: https://volute.g-vo.org/svn/trunk/projects/dm/vo-dml/mapping/MAST%20VODML%20Parser/VODML%20Parser.html
  - Client: https://masttest.stsci.edu/vodml/Mashup/Clients/Mast/Portal.html
- **Example VOTables**
  - See several examples embedded in mapping document.
  - Catch all for most constructs (GL): https://volute.g-vo.org/svn/trunk/projects/dm/vo-dml/mapping/test5.votable-1.4.xml
  - Cube (MCD): See *_annotated.vot files in https://volute.g-vo.org/svn/trunk/projects/dm/CubeDM-1.0/examples/
  - Tesselation (LM): https://volute.g-vo.org/svn/trunk/projects/dm/vo-dml/models/tesselation/%20votable.annotatedRef.xml
- **Jovial**
  - https://github.com/olaurino/jovial

References/Documentation

Mapping project page:

http://wiki.ivoa.net/twiki/bin/view/IVOA/VODML-Mapping