

Description, Discovery, Access of Multi-Dimensional Data and Time Series in the Virtual Observatory



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acknowledges extensive collaborative work with DAL WG, DM WG, TDIG,
DADI collaborators, Strasbourg CDS and SVOM teams



Summary

- I) multi-dimensional data
 - Examples
 - Problems for interoperability
 - Discovery solutions : ObsCore, SIAV2
 - (Data)Links
 - Access Solutions
 - Representation
- II) TimeSeries
 - Data examples and need for interoperability
 - Discovery modes and possible solutions
 - Access Solutions
 - Modelling and representation



Multi-dimensional data

- Radio datacubes
- Xray cubes
- Time dimensions
- Polarisation
- Visibility data



Radio data Cubes

- ALMA
 - LOFAR, ASKAP
 - → SKA
- data discovery by selecting criteria on description attributes (metadata)
- data access : extracting usefull metadata from the datasets



DataAccess

Radio Cubes are « huge »

→ full retrieval cumbersome

→ Cutouts

→ eventually regridding, reprocessing ?

→ need for detailed data (metadata)
representation further than ObsCore....



VO Solutions

- ObsTAP : allows to select datasets on criteria such as `dataprodct_type= cube` and characterisation of axes
- SIAV2 : allows queries for images and cubes with `PARAMETERS` such as `DPTYPE = cube`
- `POS = BAND = 0.0005 0.0006 TIME = 52618 53700` etc.
- Full Data Retrieval via `access_reference` field
- Or access to DataLink and SODA (direct access to SODA also possible)
- Discovery , Representation and View via HiPS for cubes



SIAV2 parameters

POS (spatial constraints)

BAND (spectral constraints)

TIME (time constraints)

POL (polarisation constraints)

SPATRES (spatial resolution constraints)

SPECRES (spectral resolution constraints)

COLLECTION (restrict to a data collection)

FACILITY (restrict to a facility)



SIAV2/ObsTAP response (ObsCore)

Aladin v9.0 *** BETA VERSION (based on v9.039) ***

File Edit Image Catalog Overlay Coverage Tool View Interop Help

Location 344.57835 -55.91674

DSS SDSS 2MASS WISE GALEX PLANCK AKARI XMM Fermi Gaia Simbad NED +

DSS colored

Server selector

Others **CASDA**

Image servers

- Aladin images
- SkyView
- UKIDSS
- Sloan
- DSS...
- VLA...
- Archives...
- Others...

CASDA SIAv2 implementation ?

POS CIRCLE 340.4567 -64.4194 2

BAND 0.25 0.30

TIME

POL

FOV

SPATRES

EXPTIME

ID

COLLECTION

Reset Clear **SUBMIT** Close ?

Catalog servers

- All VizieR
- Surveys
- Missions
- SIMBAD
- NED
- MOC
- TAP
- SkyBot
- Gaia
- Others..



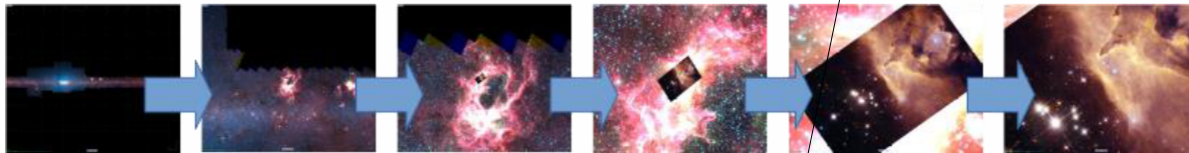
9.707' x 4.352'

grid wink north hdr multiview match

obs publ...	access url	target n...	s ra	s dec	s fov	s region	t min	Observat...	t max	Observat...	t exptime	t resolu...	em min	Spectral...	em max	Spectral...	em res p...	o ucd	pol sta
<input type="checkbox"/> cube-24	https://		344.6289...	-55.9409...	153.5149...	FoV	0.0	1858-11-...	0.0	1858-11-...	0.0	0.319074...	939,5931...	0.347154...	863,5912...	11.86275...	phot.flu...	/I/	
<input type="checkbox"/> cube-25	https://		344.6230...	-55.9411...	158.5882...	FoV	0.0	1858-11-...	0.0	1858-11-...	0.0	0.347157...	863,5854...	0.380658...	787,5834...	10.86267...	phot.flu...	/I/	
<input type="checkbox"/> cube-26	https://		344.6258...	-55.9394...	164.6950...	FoV	0.0	1858-11-...	0.0	1858-11-...	0.0	0.380660...	787,5776...	0.421318...	711,5757...	9.862602...	phot.flu...	/I/	

□ HiPS ? What is it ?

- **H**ierachical **P**rogressive **S**urvey
“The more you zoom in on a particular area, the more details show up”
- Multi-resolution **HEALPix** data structure
- for **Images**, **Catalogues**, 3-dimensional data **cubes**, ...
- **Conserves scientific** data properties alongside visualisation considerations
- No databases or dedicated servers are required, just http



3

View, Access, Discovery of DataCube



DataLink {links} resource

- Link a list of RESOURCES to a DataSet via a small votable giving url, media type, semantics, description, size of the linked resource
- Usefull for linking
 - Additional metadata (provenance, fine characterisation)
 - Auxiliary or associated files
 - Other formats
 - Previews
 - Services applied to the dataset



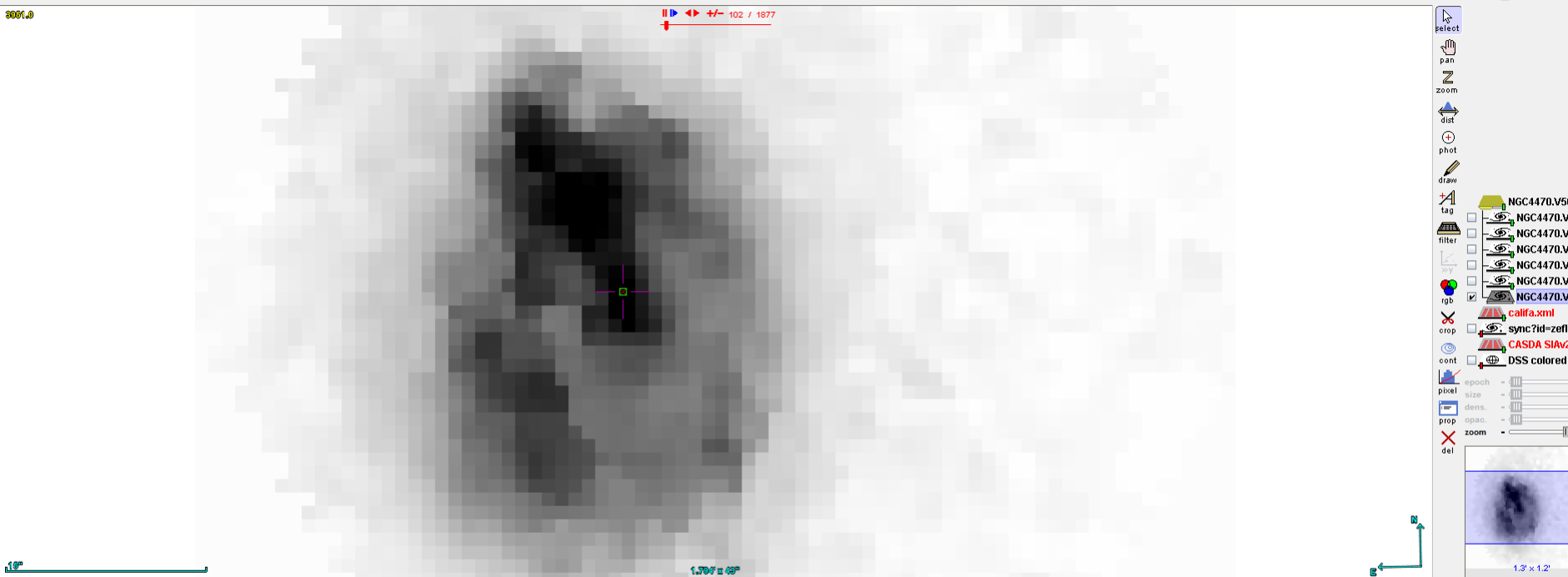
{links} response display

Aladin v9.0 *** BETA VERSION (based on v9.039) ***

File Edit Image Catalog Overlay Coverage Tool View Interop Help

Location 12:29:37.78 +07:49:27.1

DSS SDSS 2MASS WISE GALEX PLANCK AKARI XMM Fermi Gaia Simbad NED +



3001.0

102 / 1877

1.3" x 1.2"

obscore - target_name - Object a targeted observation targeted

dataproduct	obs title	obs publ...	obs crea...	access url	target n...	target c...	s ra	s dec	s fov	s region	t min	Observat...	t max	Observat...	t exptime
	CALIFA V...	1v01//02...		http://...											5400.0
	CALIFA V...	1v01//02...		http://...											2700.0

TIP: Double clic on the catalog name in the stack for selecting all its sources

2 sel / 422 src 165Mb

FR 15:30 31/10/2016

DataLink service descriptor

A resource to describe a service (included in main DAL service or {links} resource response)

```
<RESOURCE type="meta" utype="adhoc:service">
<PARAM name="standardID" datatype="char" arraysize="*" value="ivo://ivoa.net/std/SODA-1.0"/>
<PARAM name="accessURL" datatype="char" arraysize="*"
value="http://example.com/mysoda" />
  <GROUP name="inputParams">
    <PARAM name="ID" datatype="char" arraysize="*" value="" ref="primaryID"/>
    <PARAM name="POS » datatype= »char » arraysize= »* » value= » » />
    <PARAM name= »BAND » datatype= »double » arrysize= »2 » unit= »m » value= » » />
  </GROUP>
</RESOURCE>
```



SODA parameters

Similar to SIAV2, but with a different meaning

ID : ivo ID of the dataset to process

POS : spatial area to be matched

BAND : spectral range to match

TIME : time range to match

POL : selection of polarisation states



CADC example : « cutout »

The screenshot displays the ALADIN software interface. At the top, the menu bar includes File, Edit, Image, Catalog, Overlay, Coverage, Tool, View, Interop, and Help. The main window shows a star field with a central region highlighted in a light brown box. The highlighted region is labeled 'CADC SIA/2' and contains several stars, with one labeled 'BRS'. The interface also features a toolbar on the right with various icons for selection, pan, zoom, and other functions. A table at the bottom lists data for the highlighted region, including columns for em_xel, em_ucd, pol_states, pol_xel, o_ucd, access_url, access_format, access_estsize, ra_id, and lastmodified.

em_xel	em_ucd	pol_states	pol_xel	o_ucd	access_url	access_format	access_estsize	ra_id	lastmodified
1				phot.count	http://www.cad	application/x-vot	0000000-0000	0000000-0000	2013-08-21T17:4
1				phot.count	http://www.cad	application/x-vot	0000000-0000	0000000-0000	2013-08-21T17:4
1				phot.count	http://www.cad	application/x-vot	0000000-0000	0000000-0000	2013-08-21T17:4
1				phot.count	http://www.cad	application/x-vot	0000000-0000	0000000-0000	2013-08-21T17:4

CADC example : « cutout »

File Edit Image Catalog Overlay Coverage Tool View Interop Help

Data access → 2 / 19454 Location **05:22:19.18 -09:56:26.5** Frame ICRS Projection Sinus

▲ DSS ▲ SDSS ▲ ZMASS ▲ WISE ▲ GALEX ▲ PLANCK ▲ AKARI ▲ XMM ▲ Fermi ▲ Gaia ▲ Simbad ▲ TED ▲

DSS colored

Collections → 2 / 19454
 Unsupervised → 2 / 2035
 Image by SIA → 1 / 233
 cadc.nrc.ca → 1
 CADC Image Search (SIA)
 Catalog by CS, TAP → 1 / 1680
 cadc.nrc.ca → 1
 CADC Table Query (TAP) Service

select
 pan
 zoom
 fit
 phot
 crop
 tag
 filter
 cross
 crop
 cont
 plot
 crop
 del

Mouse controls:
 • Left: source selection
 • Middle: quick panning
 • Right: contrast adjustment
 • Wheel: quick zoom at the reticle.
 • Simple-ctrl: move the reticle.
 • Double-ctrl: re-center
 Let your mouse point on an object for discovering associated Simbad data.

CADC SIAv2
 cadc.nrc.ca/sia
 DSS colored

05.04° × 22.46°
 CADC SIAv2 - access_url - URL to download the data Search

sl	em_ucd	po_states	pol_sel	o_ucd	access_url	access_format	access_estsize	core_id	lastModified
1				phot.count	http://www.cadc.nrc.ca/...	application/x-csvts	00000000-0000	2013-08-21T17:...	
1				phot.count	http://www.cadc.nrc.ca/...	application/x-csvts	00000000-0000	2013-08-21T17:...	
1				phot.count	http://www.cadc.nrc.ca/...	application/x-csvts	00000000-0000	2015-07-01T19:...	
1				phot.count	http://www.cadc.nrc.ca/...	application/x-csvts	00000000-0000	2015-07-01T20:...	
1				phot.count	http://www.cadc.nrc.ca/...	application/x-csvts	00000000-0000	2015-01-07T10:...	
1				phot.count	http://www.cadc.nrc.ca/...	application/x-csvts	00000000-0000	2015-07-01T19:...	
1				phot.count	http://www.cadc.nrc.ca/...	application/x-csvts	00000000-0000	2016-01-07T10:...	
1				phot.count	http://www.cadc.nrc.ca/...	application/x-csvts	00000000-0000	2016-01-07T10:...	

select cadc.nrc
 from -- All collections --

filter coll made scan

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CADC example : « cutout »

The screenshot displays the ALadin web interface for astronomical data analysis. The main window shows a star field with a zoomed-in 'cutout' of a star. The interface includes a 'Data access' sidebar, a 'Basic controls' panel, and a 'Projection' window.

Data access sidebar:

- Collections → 19589
 - Image → 301
 - Data base → 2
 - Catalog → 17184
 - Cube → 6
 - Outreach → 1
 - Unsupervised → 2095

Location: 05:32:35.25 -11:09:55.8

Frame: ICRS **Projection:** Sinus

Basic controls:

- select: Type any object name or coordinates for moving on it.
- drag: Select catalog sources for displaying associated data measurements.
- draw: SODA sync, CADC SIAV2, 1170B4H0?runid=u2wmyfstck, CDS/P/DSS2/color
- zoom: 28.03' x 16.05'

Server selector dialog:

Cutout

• Cutout prototype for SODA sync server ?

Fill in all these fields and press the SUBMIT button

Target (ICRS, name)	05 32 57.25 -11 57 20.5	grab co...
Radius	2.904°	
Time		
Band	8.424999999999999E-5 1.1576E-4	
Pol	I Q U	
ID	adIRIS/1170B4H0	

Buttons: Reset, Clear, SUBMIT, Close, ?

Projection window:

Frame: ICRS

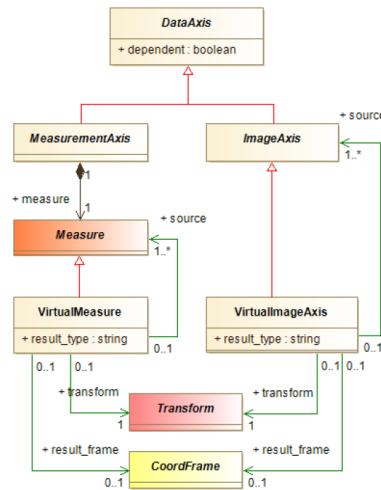
05:32:35.25 -11:09:55.8



Data representation

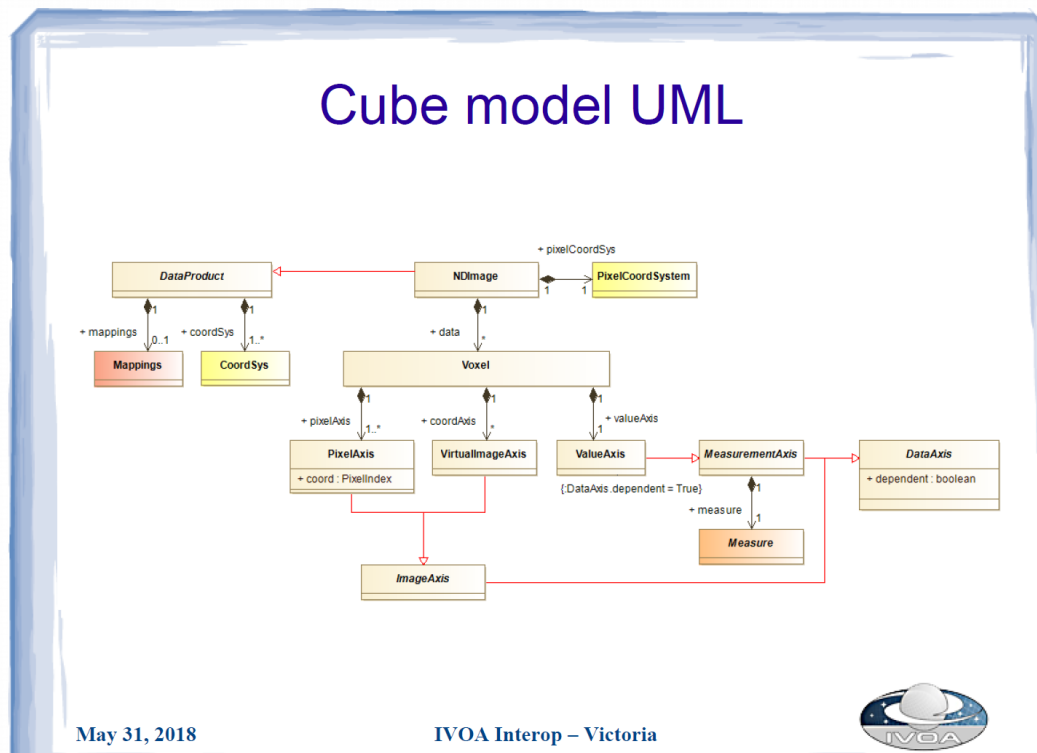
- Cube data model → serialisation : still in discussion
- in the meantime FITS or native format

Cube model UML



Data representation

- Cube data model → serialisation : still in discussion
- in the meantime FITS or native format



TimeSeries VO interoperability

- Gaia
- LSST
- Catalogues in VizieR
 - Discovery
 - Access
 - Representation and serialization (datamodel and mapping)



TimeSeries discovery

- 3 discovery modes
 - Source driven (direct or via DataLink)
 - ObsCore/SIAV2-like driven (extensions are needed ?)
 - Physical Content driven (project specific?)
 - One more in a near future ---→ TMOC ?



VO Solutions

Source driven discovery : SCS services or TAP services.

Possibility to discover a TimeSeries in the response : LINK, or DataLink access reference in the SCS or TAP service response



TimeSeries via TS-TAP/TS-S

- TimeSeries discovery requires additional parameters (see list)
- Extension of ObsTAP for TimeSeries = TsTAP
- Extension of SIAV2 with these Parameters can be called TsSAP.



TsTAP + source parameters mixed discovery

Ivoa.TsCore and a catalog describing sources
managed together

One common field for jointure (Publisher_id of
the ts, probably)

ADQL JOINS....



ObsCore extension

What should be added (if any)?

Time Support (when do we have significant observation)

Time Support summary (min/max of « parts »)

Time sampling frequency, or frequency bounds

Time sample width bounds

Extend o_* domain : what is varying with time and how much ?



Data Access

- SODA interface to retrieve a « Time Series » with a given :
 - Time range
 - Time resolution, sampling frequency
 - Representation, format



DataRepresentation: datamodel

DataModel has to represent structures and relationship for all data and metadata

Extension of Cube DataModel with specialization of TimeAxis

Has to tackle scalar observables (mag, flux, radial velocity, etc..) but also variable data products



DataRepresentation : serialisation

The Model as a formal xml representation (vo-dml-xml)

Mapping of « VO-DML » structure into VO-TABLE

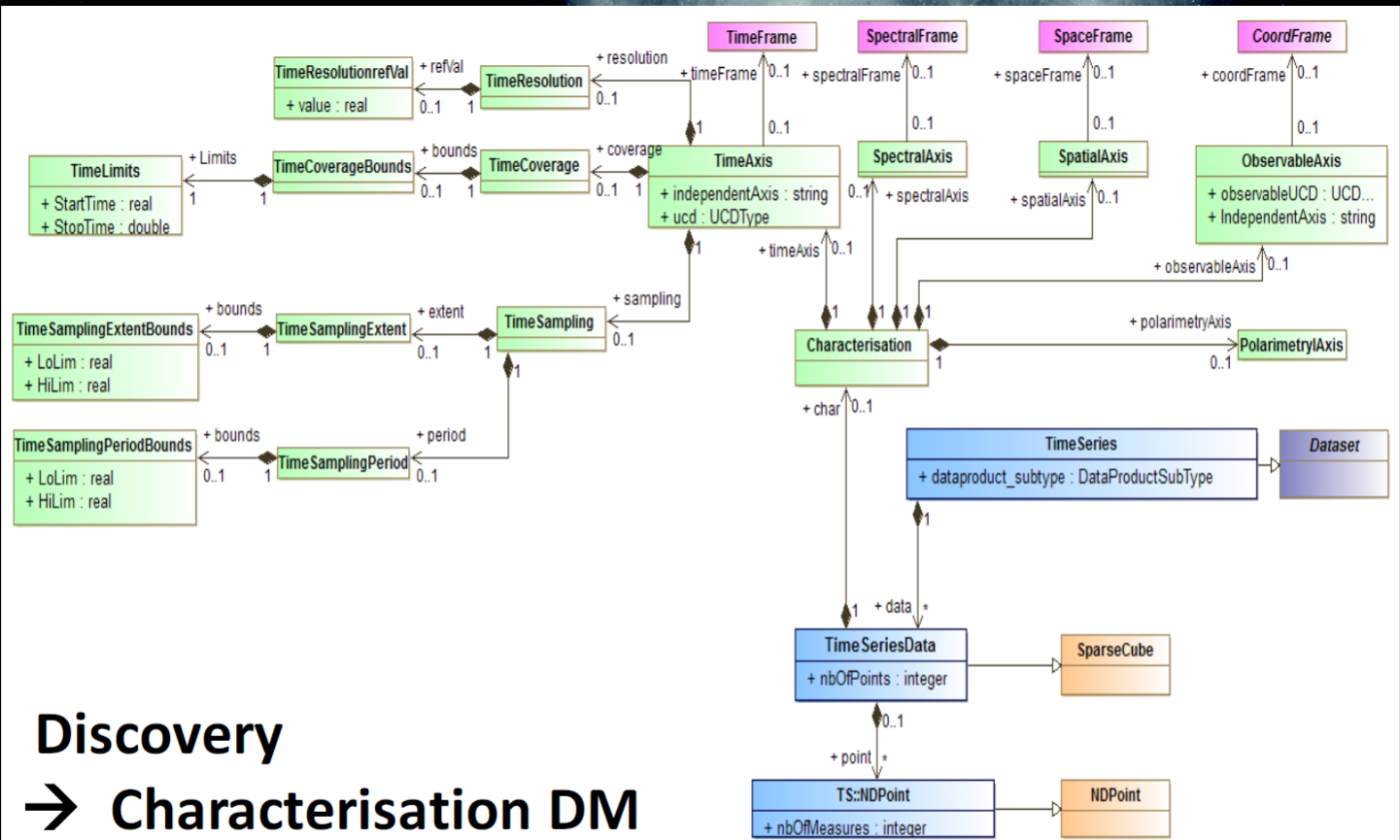
Full mapping

Lite mapping

Utypes (pointers to the model)

Need test implementation and consuming for decision (see VizieR example)



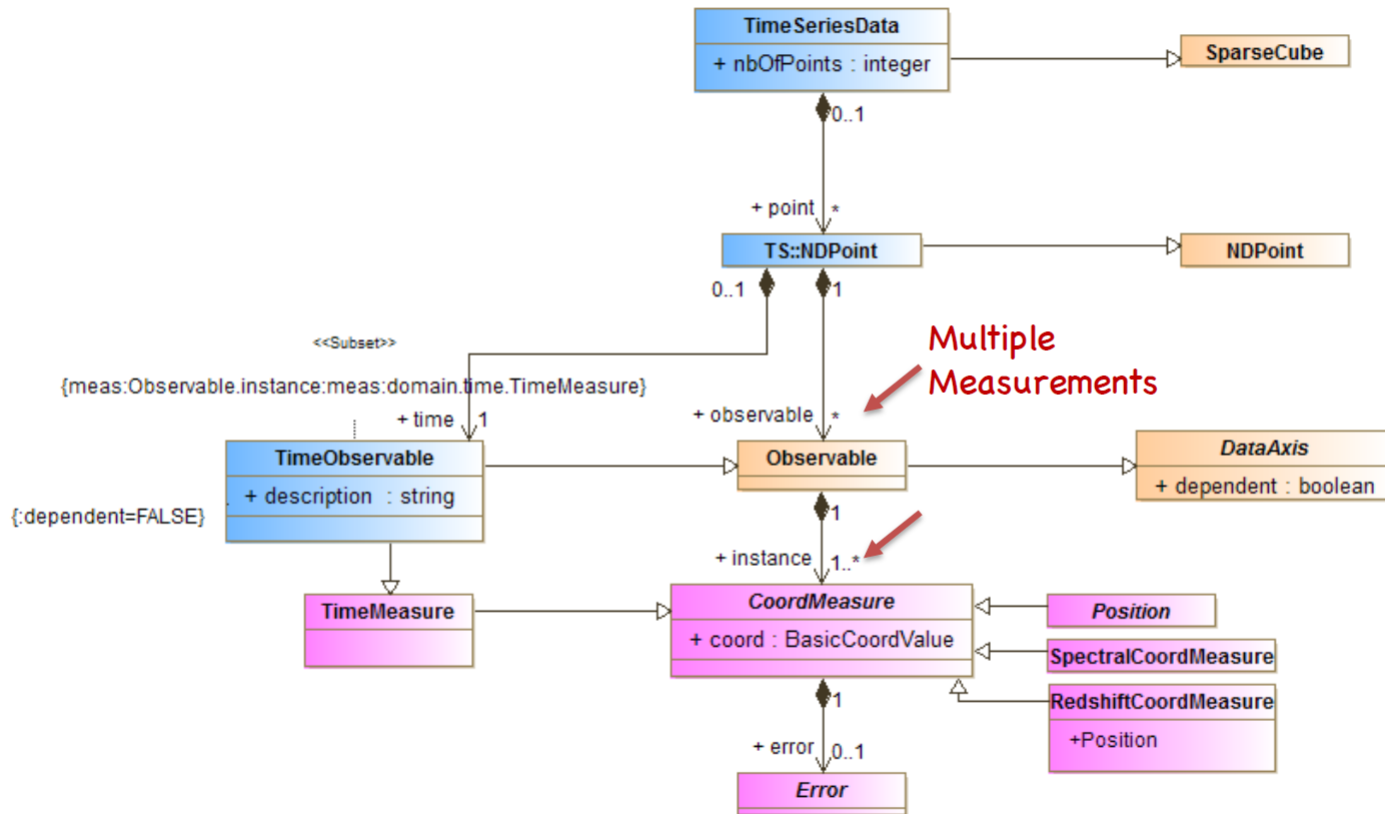


Discovery

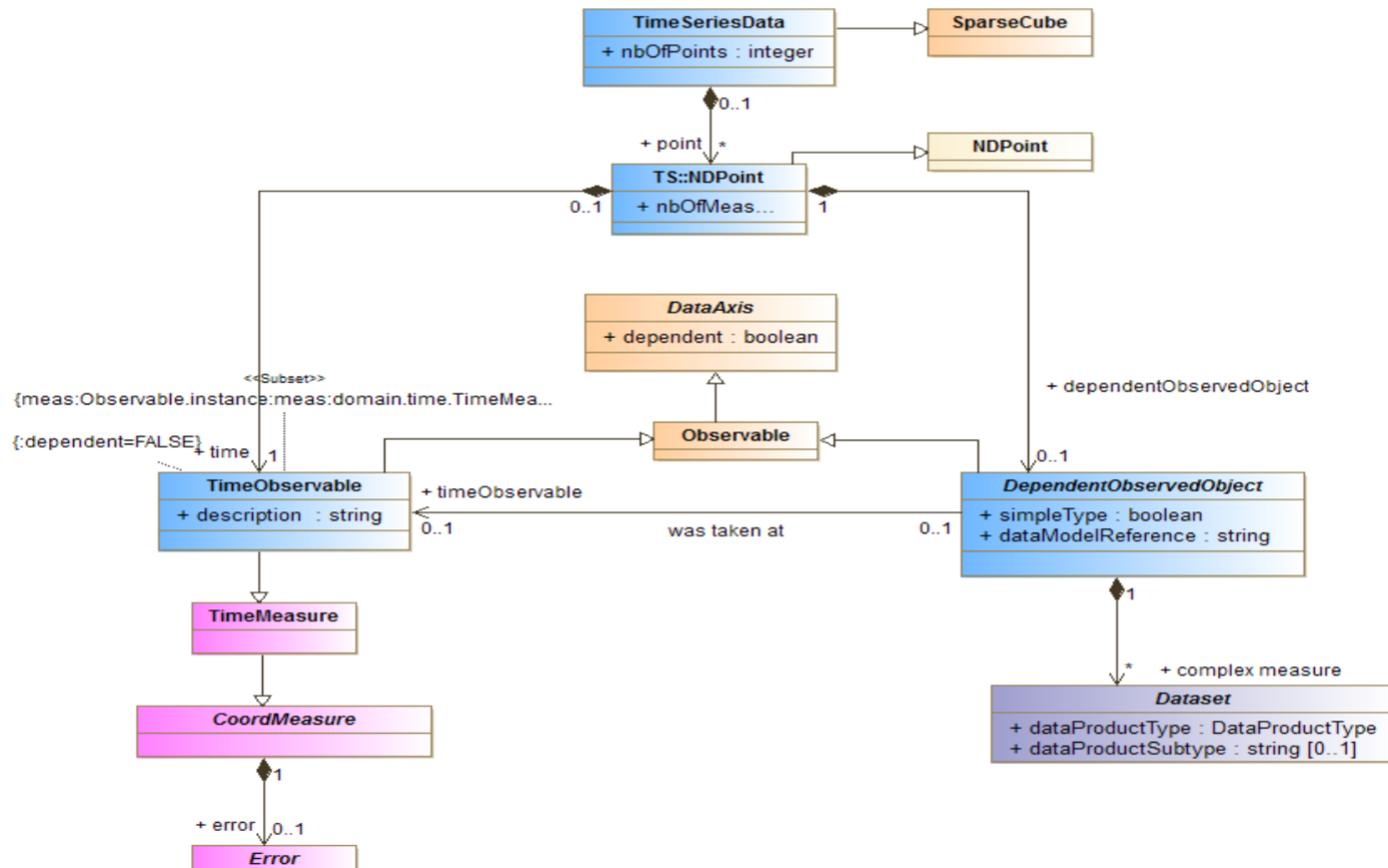
➔ Characterisation DM



Data selection : Simple measure



Data selection : associated dataproducts



Beta Lyrae case

- Characterisation an Frame Metadata [Time Frame ,
→ TimeScale, ReferencePosition, TimeRepresentation,
(TimeOrigin)
Photometric filters]
- Several colors : relationShips to « Frames » (or
Photometric filters) managed by reference.
- There are « dependant » Times. The utype says
 - It's dependant
 - It's a time

Beta Lyrae case

File Views Graphics Joins Windows VO Inter Window Columns Display Help

Table List
 5: BetaLyr_Vizier_comple...
 6: BetaLyr_Vizier_comple...
 7: BetaLyr_Vizier_comple...
 8: BetaLyr_Vizier_comple...

Current Table Properties
 Label: B
 Location: h
 Name: B
 Rows: 3
 Columns: 1
 Sort Order: A
 Row Subset: A
 Activation Action:

Table Columns for 8: BetaLyr_Vizier_comple_otypes.xml-4

Visible	Name	ID	Class	Units	Description	UCD	Utype	Datatype
<input type="checkbox"/>	0	Index	\$0	Long	Table row index			
<input checked="" type="checkbox"/>	1	Name	\$1	String	Star name (1)	meta.id:meta.main		
<input checked="" type="checkbox"/>	2	JDJ	\$2	Double	? Julian date for J band	time.epoch	ts:TimeSeriesData.NDPoint.TimeObservable.TimeMeasure_JD	char
<input checked="" type="checkbox"/>	3	Jmag	\$3	Float	? J magnitude	phot.mag:em:IR.J	ts:TimeSeriesData.NDPoint.dependantObservedObject.CoordMeasure.PhotometryPoint	double
<input checked="" type="checkbox"/>	4	e_Jmag	\$4	Float	? rms uncertainty on Mmag	stat.error:phot.mag:em:IR.J	ts:TimeSeriesData.NDPoint.dependantObservedObject.CoordMeasure.PhotometryPoint.Error	float
<input checked="" type="checkbox"/>	5	JDH	\$5	Double	? Julian date for H band	time.epoch	ts:TimeSeriesData.NDPoint.dependantObservedObject.TimeMeasure_JD	double
<input checked="" type="checkbox"/>	6	Hmag	\$6	Float	? H magnitude	phot.mag:em:IR.H	ts:TimeSeriesData.NDPoint.dependantObservedObject.CoordMeasure.PhotometryPoint	float
<input checked="" type="checkbox"/>	7	e_Hmag	\$7	Float	? rms uncertainty on Hmag	stat.error:phot.mag:em:IR.H	ts:TimeSeriesData.NDPoint.dependantObservedObject.CoordMeasure.PhotometryPoint.Error	float
<input checked="" type="checkbox"/>	8	JDK	\$8	Double	? Julian date for K band	time.epoch	ts:TimeSeriesData.NDPoint.dependantObservedObject.TimeMeasure_JD	double
<input checked="" type="checkbox"/>	9	Kmag	\$9	Float	? K magnitude	phot.mag:em:IR.K	ts:TimeSeriesData.NDPoint.dependantObservedObject.CoordMeasure.PhotometryPoint	float
<input checked="" type="checkbox"/>	10	e_Kmag	\$10	Float	? rms uncertainty on Kmag	stat.error:phot.mag:em:IR.K	ts:TimeSeriesData.NDPoint.dependantObservedObject.CoordMeasure.PhotometryPoint.error	float
<input checked="" type="checkbox"/>	11	JDL	\$11	Double	? Julian date for L band	time.epoch	ts:TimeSeriesData.NDPoint.dependantObservedObject.TimeMeasure_JD	double
<input checked="" type="checkbox"/>	12	Lmag	\$12	Float	? L magnitude	phot.mag:em:IR.3-4um	ts:TimeSeriesData.NDPoint.dependantObservedObject.CoordMeasure.PhotometryPoint	float
<input checked="" type="checkbox"/>	13	u_Lmag	\$13	Character	Uncertainty flag on Lmag	meta.code.error	ts:TimeSeriesData.NDPoint.dependantObservedObject.CoordMeasure.PhotometryPoint.errorCode	char
<input checked="" type="checkbox"/>	14	e_Lmag	\$14	Float	? rms uncertainty on Lmag	stat.error:phot.mag:em:IR.3-4um	ts:TimeSeriesData.NDPoint.dependantObservedObject.CoordMeasure.PhotometryPoint.error	float
<input checked="" type="checkbox"/>	15	JDM	\$15	Double	? Julian date for M band	time.epoch	ts:TimeSeriesData.NDPoint.dependantObservedObject.TimeMeasure_JD	double
<input checked="" type="checkbox"/>	16	Mmag	\$16	Float	? M magnitude	phot.mag:em:IR.4-8um	ts:TimeSeriesData.NDPoint.dependantObservedObject.CoordMeasure.PhotometryPoint	float
<input checked="" type="checkbox"/>	17	u_Mmag	\$17	Character	Uncertainty flag on Mmag	meta.code.error	ts:TimeSeriesData.NDPoint.dependantObservedObject.CoordMeasure.PhotometryPoint.errorCode	char

TOPCAT(5): Table Browser

Window Subsets Help

Table Browser for 5: BetaLyr_Vizier_comple_otypes.xml

productType	calibLe...	pubDID	creator	contributor	Target
1	timeSeries	1	TestTimeSeries	Shenavrin	CDS Vizier Beta Lyr

Dataset metadata

TOPCAT(6): Table Browser

Window Subsets Help

Table Browser for 6: BetaLyr_Vizier_comple_otypes.xml-2

SpatLocati...	SpatLocati...	SpatBoun...	SpatBoun...	t_min	t_max	t_mean	t_exp_time	t_resolution...
1	282, 52	33, 3627	0, 000278	0, 000278	2, 452786E	2, 453496E	0, 04	0, 002

Characterisation

TOPCAT(7): Table Browser

Window Subsets Help

Table Browser for 7: BetaLyr_Vizier_comple_otypes.xml-3

TimeSc...	refPositionT	Space...	refPositionS	wavelength	filter	wavelength	filter	wavelength	filter	wavelength	filter	wavelength	filter	
1	TT	BARYCENTER	ICRS	BARYCENTER	1250,	J_BAND	1650,	H_BAND	2200,	K_BAND	3500,	L_BAND	4800,	M_BAND

Coordinate frames + Photometry filter

TOPCAT(8): Table Browser

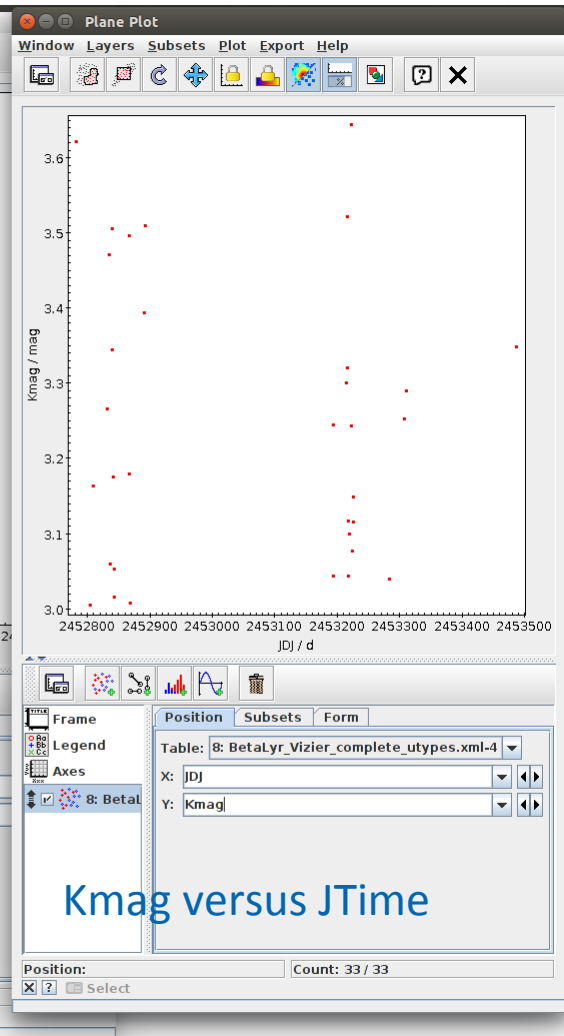
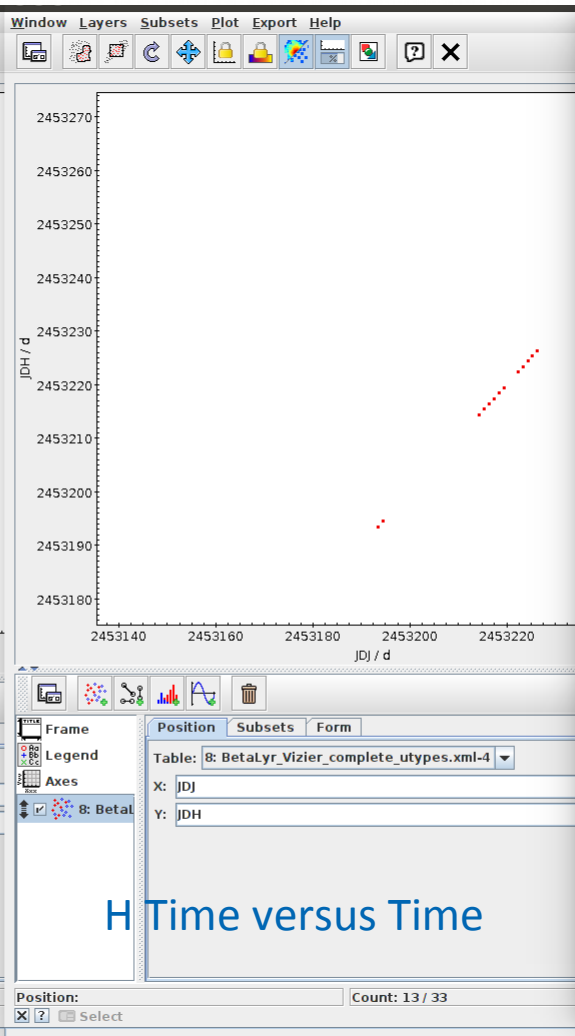
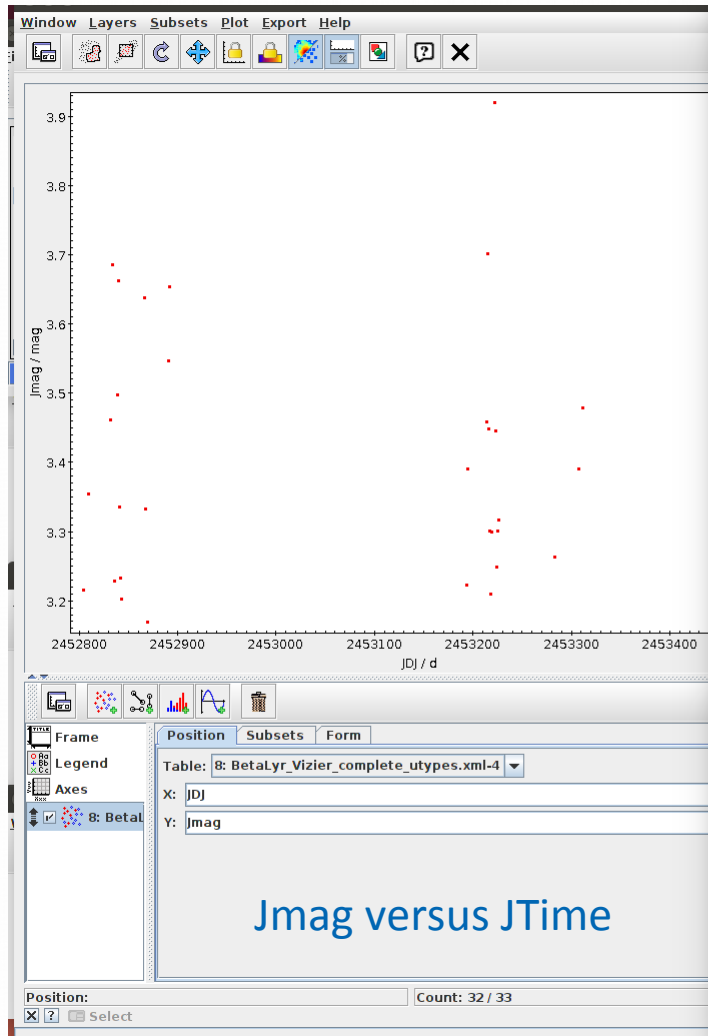
Window Subsets Help

Table Browser for 8: BetaLyr_Vizier_comple_otypes.xml-4

	JDJ	Jmag	e_Jmag	JDH	Hmag	e_Hmag	JDK	Kmag	e_Kmag	JDL	Lmag
1	2, 452782E6			2, 452782E6	3, 577	0, 012	2, 452782E6	3, 621	0, 022	2, 452782E6	3, 316
2	2, 452804E6	3, 215	0, 005	2, 452804E6	3, 145	0, 005	2, 452804E6	3, 005	0, 005	2, 452804E6	2, 747
3	2, 452809E6	3, 354	0, 008	2, 452809E6	3, 508	0, 006	2, 452809E6	3, 164	0, 005	2, 452809E6	2, 877
4	2, 452832E6	3, 461	0, 004	2, 452832E6	3, 393	0, 006	2, 452832E6	3, 266	0, 008	2, 452832E6	3, 018
5	2, 452834E6	3, 685	0, 003	2, 452834E6	3, 605	0, 006	2, 452834E6	3, 471	0, 005	2, 452834E6	3, 165
6	2, 452836E6	3, 228	0, 006	2, 452836E6	3, 168	0, 007	2, 452836E6	3, 06	0, 007	2, 452836E6	2, 785
7	2, 452839E6	3, 498	0, 004	2, 452839E6	3, 456	0, 004	2, 452839E6	3, 344	0, 003	2, 452839E6	3, 073
8	2, 452840E6	3, 663	0, 004	2, 452840E6	3, 622	0, 007	2, 452840E6	3, 506	0, 005	2, 452840E6	3, 257
9	2, 452841E6	3, 335	0, 003	2, 452841E6	3, 276	0, 004	2, 452841E6	3, 176	0, 002	2, 452841E6	2, 916
10	2, 452842E6	3, 233	0, 007	2, 452842E6	3, 144	0, 004	2, 452842E6	3, 053	0, 005	2, 452842E6	2, 769
11	2, 452843E6	3, 202	0, 005	2, 452843E6	3, 117	0, 008	2, 452843E6	3, 016	0, 003	2, 452843E6	2, 75
12	2, 452866E6	3, 638	0, 003	2, 452866E6	3, 597	0, 005	2, 452866E6	3, 496	0, 002	2, 452866E6	3, 238
13	2, 452867E6	3, 332	0, 003	2, 452867E6	3, 294	0, 005	2, 452867E6	3, 18	0, 003	2, 452867E6	2, 949
14	2, 452869E6	3, 169	0, 001	2, 452869E6	3, 11	0, 007	2, 452869E6	3, 007	0, 003	2, 452869E6	2, 763
				3, 519	0, 006	2, 452891E6	3, 394	0, 005	2, 452891E6	3, 172	
				3, 599	0, 005	2, 452892E6	3, 51	0, 002	2, 452892E6	3, 249	
				3, 152	0, 005	2, 453193E6	3, 043	0, 004	2, 453193E6	2, 81	
				3, 333	0, 01	2, 453194E6	3, 244	0, 01	2, 453194E6	3, 016	
				3, 394	0, 007	2, 453214E6	3, 3	0, 006	2, 453214E6	3, 087	
				3, 647	0, 009	2, 453215E6	3, 522	0, 01	2, 453215E6	3, 274	
				3, 383	0, 009	2, 453216E6	3, 32	0, 005	2, 453216E6	2, 973	
				3, 236	0, 005	2, 453217E6	3, 117	0, 013	2, 453217E6	2, 834	
				3, 171	0, 006	2, 453218E6	3, 043	0, 011	2, 453218E6	2, 812	
				3, 207	0, 008	2, 453219E6	3, 1	0, 009	2, 453219E6	2, 85	
				3, 822	0, 01	2, 453222E6	3, 644	0, 008	2, 453222E6	3, 322	

Data section : values and ucd/utypes

Beta Lyrae case



Full VO-DML mapping approach

```
</MODEL>
-<MODEL>
  <NAME>ivoa</NAME>
  -<URL>
    https://volute.g-vo.org/svn/trunk/projects/dm/vo-dml/models/ivoa/vo-dml/IVOA-v1.0.vo-dml.xml
  </URL>
</MODEL>
-<MODEL>
  <NAME>meas</NAME>
  -<URL>
    https://volute.g-vo.org/svn/trunk/projects/dm/STC/vo-dml/STC_meas-v2.0.vo-dml.xml
  </URL>
</MODEL>
-<GLOBALS>
  -<INSTANCE dmttype="cube:SparseCube">
    <!-- SparseCube DataProduct Instance -->
    -<COMPOSITION dmrole="cube:DataProduct.coordSys">
      -<INSTANCE dmttype="coords:AstroCoordSystem">
        -<REFERENCE dmrole="coords:AstroCoordSystem.coordFrame">
          -<FOREIGNKEY>
            -<PKFIELD>
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            -<PKFIELD>
              <LITERAL dmttype="ivoa:string" value="_PhotFrame"/>
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            </FOREIGNKEY>
          </REFERENCE>
        </INSTANCE>
      </COMPOSITION>
    -<COMPOSITION dmrole="cube:SparseCube.data">
      <EXTINSTANCES>_TimeSeriesData</EXTINSTANCES>
    </COMPOSITION>
  </INSTANCE>
</GLOBALS>
-<TEMPLATES tabref="ndgnsolidgdea">
  <!-- Dataset Metadata - ObsDataset -->
  -<INSTANCE dmttype="ds:party.Organization">
    -<PRIMARYKEY>
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```



Attributes

```
</INSTANCE>  
<INSTANCE dmtype="ds:experiment.ObsDataset">  
  <ATTRIBUTE dmrole="ds:dataset.Dataset.dataProductType">  
    <COLUMN ref="productType" dmtype="ds:dataset.DataProductType"/>  
  </ATTRIBUTE>  
  <ATTRIBUTE dmrole="ds:dataset.Dataset.dataProductSubtype">  
    <LITERAL dmtype="ivoa:string" value="Sparse Cube"/>  
  </ATTRIBUTE>  
  <ATTRIBUTE dmrole="ds:experiment.ObsDataset.calibLevel">  
    <COLUMN ref="calibLevel" dmtype="ivoa:integer"/>  
  </ATTRIBUTE>  
  <COMPOSITION dmrole="ds:dataset.Dataset.curation">  
    <INSTANCE dmtype="ds:dataset.Curation">  
      <ATTRIBUTE dmrole="ds:dataset.Curation.publisherID">  
        <COLUMN ref="pupID" dmtype="ivoa:anyURI"/>  
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    </INSTANCE>  
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</INSTANCE>
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  <VALUE dmrole='lm_timeseries:dataset.DataSet.DataProductType' ref='type' />  
  <VALUE dmrole='lm_timeseries:dataset.DataSet.dataProductSubtype' ref='subt' />  
  <VALUE dmrole='lm_timeseries:dataset.DataSet.calibLevel' ref='cal' />  
  <VALUE dmrole='lm_timeseries:dataset.DataSet.curation' ref='cur' />  
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```

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Simpler References to Instances

```
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  <INSTANCE dmtype="ds:dataset.Creator">
    <REFERENCE dmrole="ds:party.Role.party">
      <FOREIGNKEY>
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  <INSTANCE dmrole="ds:party.Role.party" ref="_002J6U7FbgCwoWQF" />
</COLLECTION>
```



VizieR prototype

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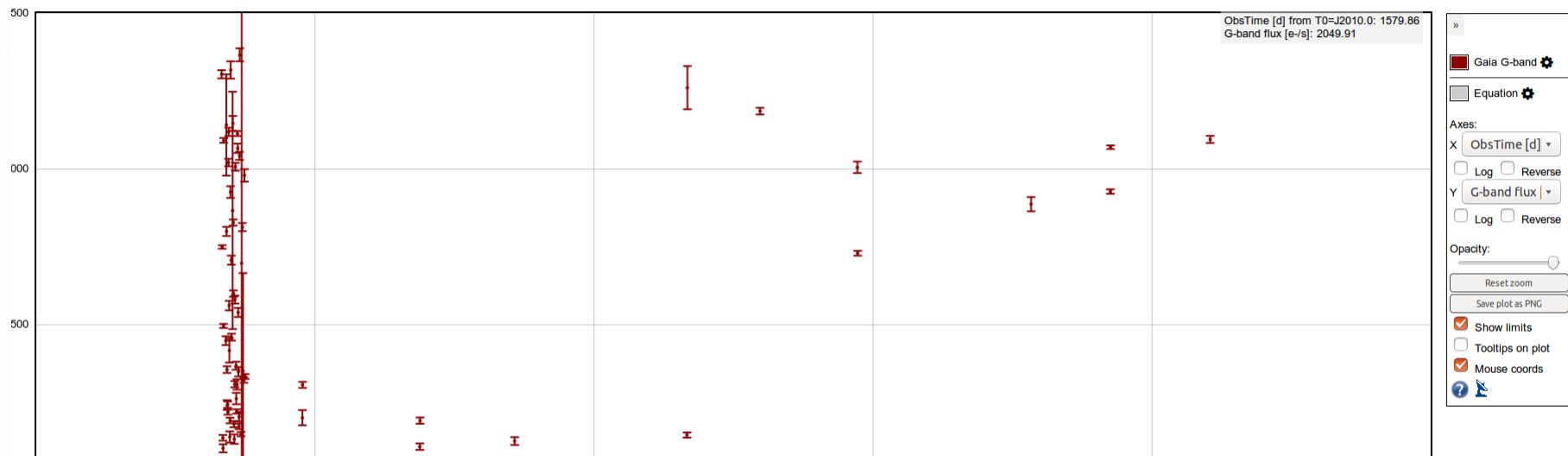
Gaia DR1 (Gaia Collaboration, 2016)
Cepheid stars identified in table VariableSummary as classification="CEP" (original column names in green) (599 rows) [\[METAtab\]](#) [\[METAcola\]](#) [\[stats\]](#)

Full	LC	fov	TBest	TBest2	Mbest	Source	P1 d	EpG d	<Gmag> mag	AmpG mag	NHP1	R21G	phi21G	RA_ICRS deg	DE_ICRS deg	RA_icsr deg	DE_icsr deg
1	LC	fov	DCEP	—	UNDEFINED	4658898497969725952	0.81104349	1664.04407304	17.0100	0.419	3	0.193	4.139	80.4417418279	-66.9861900876	80.4417418279	-66.9861900
2	LC	fov	DCEP	—	FIRST_OVERTONE	4658898738488020864	3.38448730	1658.89869278	15.0480	0.338	4	0.182	3.695	80.4115015243	-66.9476771952	80.4115015243	-66.9476771
3	LC	fov	DCEP	—	UNDEFINED	4658925092406745984	2.69331244	1659.84418704	17.3720	0.112	1			78.8871350309	-67.1440231713	78.8871350309	-67.1440231
4	LC	fov	DCEP	—	FUNDAMENTAL	4658939214286774400	3.56278072	1658.55295617	15.6500	0.344	2	0.306	4.344	79.8382641810	-67.1136249309	79.8382641810	-67.1136249
5	LC	fov	DCEP	—	FIRST_OVERTONE	4658950381175117824	2.79569245	1660.51381113	15.1510	0.174	2	0.041	4.049	79.9507863890	-66.8238448295	79.9507863890	-66.8238448
6	LC	fov	DCEP	—	FUNDAMENTAL	4658956119278242688	5.22238334	1655.10218660	15.0250	0.862	4	0.477	4.468	79.4267360254	-66.6480295442	79.4267360254	-66.6480295
7	LC	fov	DCEP	—	FIRST_OVERTONE	4658960276779885056	1.39962121	1662.74142587	16.1550	0.362	3	0.203	4.138	79.0774160047	-66.7777281836	79.0774160047	-66.7777281
8	LC	fov	DCEP	—	FIRST_OVERTONE	4658968110800455040	2.18564218	1663.21217901	15.7010	0.289	2	0.115	4.385	79.2276629254	-66.6274827232	79.2276629254	-66.6274827
9	LC	fov	DCEP	—	FIRST_OVERTONE	4658969072873169536	2.44906328	1663.77790963	15.2650	0.337	2	0.060	4.418	79.1437679628	-66.5865626749	79.1437679628	-66.5865626
10	LC	fov	DCEP	—	FUNDAMENTAL	4658970241104217472	2.90669246	1661.81108296	16.0130	0.759	4	0.432	4.283	78.8939951447	-66.6467466282	78.8939951447	-66.6467466
11	LC	fov	DCEP	—	FUNDAMENTAL	4659456740670442752	3.57527302	1658.73958036	15.4900	0.753	3	0.476	4.268	85.7639993508	-67.0764661314	85.7639993508	-67.0764661
12	LC	fov	DCEP	—	FIRST_OVERTONE	4659458527346797696	1.32562578	1663.71261361	16.1450	0.320	2	0.241	4.345	86.2315630903	-67.0800549791	86.2315630903	-67.0800549
13	LC	fov	DCEP	—	FUNDAMENTAL	4659460623290935168	5.42560958	1654.50555644	15.2020	0.413	3	0.337	4.668	86.2892914828	-67.0158001931	86.2892914828	-67.0158001
14	LC	fov	DCEP	—	FUNDAMENTAL	4659461241765373184	2.29321460	1660.71604944	16.0490	0.683	5	0.437	4.205	86.0456401016	-66.9992666985	86.0456401016	-66.9992666
15	LC	fov	DCEP	—	FIRST_OVERTONE	4659464024903476352	3.45100693	1657.81942313	15.0230	0.297	3	0.121	3.290	85.7003223028	-66.9427449711	85.7003223028	-66.9427449
16	LC	fov	DCEP	—	FIRST_OVERTONE	4659464883897843200	1.94143160	1660.88201578	15.7390	0.296	2	0.130	4.825	86.0436726396	-66.9232307845	86.0436726396	-66.9232307
17	LC	fov	DCEP	—	FIRST_OVERTONE	4659465227502800640	1.81105612	1661.77500792	15.7990	0.295	3	0.091	4.735	85.8820525670	-66.8796533252	85.8820525670	-66.8796533
18	LC	fov	DCEP	—	FIRST_OVERTONE	4659483339391441408	2.02794197	1661.46977585	15.5300	0.364	2	0.140	4.321	85.0131886781	-67.0716616361	85.0131886781	-67.0716616
19	LC	fov	DCEP	—	FUNDAMENTAL	4659494124040684032	7.47743782	1650.38164083	14.8800	0.180	2	0.143	5.660	84.6932441338	-67.0852792344	84.6932441338	-67.0852792
20	LC	fov	DCEP	—	FUNDAMENTAL	4659494879948476032	2.92545152	1660.07294073	15.7020	0.765	5	0.428	4.242	84.6697967355	-67.0349677043	84.6697967355	-67.0349677
21	LC	fov	DCEP	—	FIRST_OVERTONE	4659495154825994880	3.61472915	1657.36716036	14.9540	0.307	3	0.129	3.309	84.9383688599	-67.0564302421	84.9383688599	-67.0564302
22	LC	fov	T2CEP	W_VIR	NOT APPLICABLE	4659497285129779584	12.34489304	1632.09072772	17.2710	0.128	1			84.4995522692	-67.0530549618	84.4995522692	-67.0530549
23	LC	fov	DCEP	—	FIRST_OVERTONE	4659499759031442432	3.83869397	1655.77401254	14.7890	0.277	3	0.149	3.529	84.4736181954	-66.9468487937	84.4736181954	-66.9468487
24	LC	fov	DCEP	—	FIRST_OVERTONE	4659502061133359232	3.65107544	1656.67707148	14.8270	0.295	3	0.101	3.186	85.5126413247	-67.1186067944	85.5126413247	-67.1186067
25	LC	fov	DCEP	—	FIRST_OVERTONE	4659510170032228736	2.56262634	1661.70271521	15.1910	0.374	2	0.114	4.396	85.0264708788	-66.8730142130	85.0264708788	-66.8730142
26	LC	fov	DCEP	—	FIRST_OVERTONE	5289779853168752384	2.57602789	1666.00543643	15.4970	0.110	1			119.2865231322	-62.3245006863	119.2865231322	-62.3245006
27	LC	fov	DCEP	—	FUNDAMENTAL	4659510307501954176	2.01301613	1660.46386339	16.2580	0.687	6	0.499	4.073	84.9958673647	-66.8370151586	84.9958673647	-66.8370151
28	LC	fov	DCEP	—	FUNDAMENTAL	4659512437774965120	4.96058526	1656.23198078	14.9100	0.760	5	0.464	4.437	85.4302310976	-66.8499643471	85.4302310976	-66.8499643
29	LC	fov	DCEP	—	FUNDAMENTAL	4659518588169281920	4.01889675	1656.19077016	15.5420	0.631	4	0.476	4.323	85.0478121914	-66.6840281518	85.0478121914	-66.6840281
30	LC	fov	DCEP	—	FIRST_OVERTONE	4659523845208113280	1.81235621	1661.43937585	16.0590	0.350	2	0.127	4.546	84.5374159062	-66.8811016974	84.5374159062	-66.8811016
31	LC	fov	DCEP	—	FUNDAMENTAL	4659525597553927680	8.72307463	1647.03095256	14.4750	0.364	3	0.289	5.651	84.322320993	-66.7533061145	84.322320993	-66.7533061
32	LC	fov	T2CEP	W_VIR	NOT APPLICABLE	4659525872450052480	2.1620356951	1621.96307480	16.8770	0.157	2	0.047	5.612	84.5891433732	-66.7890195521	84.5891433732	-66.7890195
33	LC	fov	DCEP	—	FIRST_OVERTONE	4659526044231432832	1.10378136	1663.85552967	16.5870	0.318	3	0.226	3.949	84.5292603186	-66.7851409564	84.5292603186	-66.7851409

VizieR prototype

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I/337 Source 4658898497969725952 Gaia light curve



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VizieR prototype

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-<VOTABLE version="1.2" xsi:schemaLocation="http://www.ivoa.net/xml/VOTable/v1.2 http://www.ivoa.net/xml/VOTable/v1.2">
  <DESCRIPTION>
    VizieR In case of problem, please report to: cds-question@unistra.fr
  </DESCRIPTION>
  <INFO name="title" value="I/337 Source 4658898497969725952 Gaia light curve"/>
  <RESOURCE type="result" name="Gaia G-band">
    <GROUP name="widget_parameters">
      <PARAM name="option_graph_title" datatype="char" arraysizes="" value="I/337 Source 4658898497969725952 Gaia light curve"/>
      <PARAM name="y_err_0" datatype="char" arraysizes="" value="err"/>
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    </GROUP>
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      <PARAM name="SpatBoundsSizeDEC" ucd="pos.eq.dec;stat.length" unit="deg" utype="cha:Char.Coverage.SpatialAxis.Bounds.CharBox.Size2[1]" datatype="float" value=""/>
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      <GROUP ID="coosys" name="coordsys" utype="coord:coordsys.TimeFrame">
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        <!--
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        -->
        <!--
          PARAM ID='refPositions' name='refPositions' ucd='pos' utype='coord:coordsys.SpaceFrame.refPosition' datatype='char' arraysizes='' value='No se'/
        -->
        <PARAM ID="systemerror" name="systematicError" ucd="pos" utype="coord:coordsys.TimeFrame.refPosition" datatype="char" arraysizes="" value="0"/>
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      <FIELD name="G-band flux [e-/s]" ID="FG" ucd="phot.flux.em.opt" unit="e-/s" datatype="float"/>
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    </TABLE>
  <DATA>
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VizieR prototype

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-<VOTABLE xsi:schemaLocation="http://www.ivoa.net/xml/VOTable/v1.4_vodml https://volute.g-vo.org/viewvc/volute/trunk/projects/dm/vo-dml/xsd/votable_ext/VOTable-1.4_vodml.xsd?view=log ">
-<DESCRIPTION>
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</DESCRIPTION>
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      <VALUE dmrole="timeseries:dataset.DataSet.contributor" source="@cont"/>
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    <TUPLE dmrole="timeseries:TimeSeries.filter" tableref="coosys"/>
    <TUPLE dmrole="timeseries:TimeSeries.refPosition" tableref="char"/>
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