

Simple Science Use Cases with Utypes from the Core Obs DM prototype. August,1st M.Louys+F.Bonnarel.

(The style and proposed solutions are not always the same for the two authors)

Update mireille from sept 23 to oct 1: include feedback from ObsCoreDM side meeting
Update mireille from oct 1 to oct 19 remove units request: should be analysed in the query and use implicit units definitions that I recall using []

Here we describe the constraints we can build up with the ObsCoreDataModel Utypes corresponding to the UseCaseDocument provided by the IVOA TakeUp Committee.

I have attached a Utype to each metadata mentioned in the query and modelled this accordingly in the UML model. Most of the physical properties are tackled by CharacterisationDM . Spectral domain names, DataSetId, etc... are borrowed from the VOResource and VODataService definitions.

Science Use Cases, Data Query and Access:

David: When I say “show me” I expect to be given a list of datasets that satisfies the query.

Mir: I have completed the document with possible CoreObsDM Utypes that I have taken from the SSA Utype list for some part and build up from the future Observation DM for other part.

Example of Queries to be supported by most of archives

NB: all utypes to have a prefix: obs:

1 Discover imaging data of interest

1.1 Show me a list of all data that satisfies:

1.1.1 Data Type=any Observation.datatype='ANY' contentType to be discussed
Suggestion : Observation.contentType = "ANY"

1.1.2 Energy includes 5 keV Char/SpectralAxis.ucd='phys.energy'
Char/SpectralAxis.unit =[keV]
Char/SpectralAxis.Coverage.Bounds.limits.Interval.LoLim < 5 [keV]
Char/SpectralAxis.Coverage.Bounds.limits.Interval.HiLim > 5 [keV]

(Do we need quantity conversion here?)

Yes from the client side: the TAP service of an archive will provide a table with the available quantities with their units . It will be up to the client to convert the query to the proper units and send it again to the archive to retrieve the data.

1.1.3 DEC includes +10, RA includes 16.00 Char/SpatialAxis.Coverage.Support.Area contains (16.00,+10) [degrees]

1.1.4 Exposure time > 10 ks Char/TimeAxis.Coverage.support.extent > 10E4 [s]
It will be up to the archive to convert its own units into the standard ones

1.2 Let me input a list of RA and DEC coordinates and show me spatially coincident data that satisfies

1.2.1 Data type is Imaging or spectroscopy data Observation.datatype='IMAGING' or 'DATACUBE'
where Char/SpectralAxis is present.
Suggestion : Observation.contentType = "IMAGING" or "SPECTROSCOPIC"

1.2.2 Includes one or more of the RA,DEC values in the list (LIST=SERVICE REQ)
Which CoordSystem?

Char/SpatialAxis.Coverage.Support.Area;stc:AstroCoordsArea
contains (RA, DEC) for at least one position in the list

Should we translate this into STC-S representation, or ADQL region?

1.2.3 Includes both a wavelength in the range 5000-900 angstroms AND an X-ray image (AND=SERVICE REQ)

Does it mean a data set that has, for a position in the list, either a spectral coverage in the 5000-900 angstroms band or an X-ray image, or both? Probably the condition is exclusive and not inclusive?

Char/SpectralAxis.Coverage.Bounds.Limits.Interval included in [90, 500] [nm] or
Observation.contentType='IMAGING' with Char/SpectralAxis.Coverage.Bounds.Limits.Interval included in
the X wavelength domain: [0.005,10] [nm]

Here we need to relate to a coarse definition of the spectral domain of an observation.
The Observation class inherits the **waveband** attribute from the VODataService schema definition.
See <http://www.ivoa.net/Documents/latest/VODataService.html#cover>
Then the constraint becomes:
Observation.datatype="IMAGING" and Observation.waveband='X-Ray'

1.3 Show me a list of all data that satisfies

1.3.1 Datatype=Image

Observation.contentType="IMAGING"

1.3.2 Spatial resolution better than 0.3 arcseconds Char/SpatialAxis.resolution.refVal <= 0.3 [arcsec]

1.3.3 Filter = J or H or K

Band name is not defined in Characterisation package but will be in Provenance.

Provenance/Filter.bandName in ['J','H','K']

Mir: Feedback: let the user ask for J band, ask the client API to convert it into a [min,max] wavelength interval, then query on wavelength interval at the server level.

? should the query response use the filter name supported by the archives ?

1.3.4 RA between 16 hours and 17 hours

*mir: Coordsystem is not specified for the region of search? Do we assume a default Coordsys like ICRS ?
convert 16, 17 hours into decimal degrees*

Char/SpatialAxis.Coverage.Bounds.limits.Interval;stc:Coord2VecInterval.LoLim2Vec.C1 > 16*15 [deg] and
Char/SpatialAxis.Coverage.Bounds.limits.Interval;stc:Coord2VecInterval.HiLim2Vec.C1 < 17*15 [deg]

1.3.5 DEC between 10 degrees and 11 degrees

Char/SpatialAxis.Coverage.Bounds.limits.Interval;stc:Coord2VecInterval.LoLim2Vec.C2 > 10 [deg] and
Char/SpatialAxis.Coverage.Bounds.limits.Interval;stc:Coord2VecInterval.LoLim2Vec.C2 < 11 [deg]

1.4 Show me a list of all data that satisfies

1.4.1 DataType=Image

Observation.dataType='IMAGING'

1.4.2 Wavelength=Vor I or Z

Obs:Provenance/Filter.bandName in [I,V,Z]

1.4.3 Spatial Resolution < 0.7 arcseconds FWHM

Char/SpatialAxis.resolution.refVal < 0.7 [arcsec]

1.4.4 Exposure Time > 1000 Seconds

obs:char/TimeAxis.Coverage.support.extent
> 1000 [s]

1.4.5 Data Quality=Fully Calibrated

NB: discussion on the calibration status

Calibration status exists for each physical axis in the Characterisation DM. but here we need a general flag at the level of the Observation class.

Can we consider that the overall calibration status of an observation can be defined as the calibration status of the Observable axis (flux, velocity, counts, etc,...) ? Would this imply that all other axes are also calibrated?

Possible string values depend on the observation content

for spectra (see recent discussion on the list...)

ABSOLUTE, RELATIVE, UNCALIBRATED, NORMALIZED

for images

CALIBRATED: means all phys axis calibrated: spatial, spectral, time, flux

RELATIVE

NORMALIZED

UNCALIBRATED

For cubes (IFU, radio??) ???

So it seems there is no need to define a calibration flag at the observation level. ?

Examples: ObservableAxis.name='veloc'ObservableAxis.calibStatus='UNCALIBRATED'

Chandra data set: ObservableAxis.name="counts"

ObservableAxis.calibStatus="CALIBRATED"

1.5 Show me all data that satisfies

1.5.1 DataType=IFU

Observation.dataType="IFU"

FB: Is IFU a contentType ? IFU data can be spectroImaging (x, y, lambda) cubes or list of spectra according to the processing.

1.5.2 DataQuality=Fully calibrated

ObservableAxis.calibStatus="CALIBRATED"

Or suggestion

Observation.calib_level= 'SCIENCE READY'

1.5.3 ObjectClass=quasar

(SERVIC REQ + NEEDS ANOTHER SERVICE (CATALOGUE) NEED CATALOG ACCESS

1.5.4 Redshift > 3.

1.5.5 Radioflux > 1 mJy

Discussed in Trieste and addressed by Anita :

Such use-case addresses complex queries, with catalog queries producing a list of position as output and Obs-tap queries for IFU selection : can be viewed as a workflow

2 Discover Spectral data of interest

2.1 Show me a list of all data that satisfies

- 2.1.1 Data Type=Spectrum Observation.dataType="Spectrum"
- 2.2.2 Energy spans 1 to 5 keV Char/SpectralAxis.ucd='phys.energy'
Char/SpectralAxis.Coverage.Bounds.start. >1 [keV]

and Char/SpectralAxis.Coverage.Bounds.stop < 5 [keV]

- 2.4.3 Total counts in spectrum > 100
- NB: not yet in the data model should we add a total flux on the flux axis?*
- 2.4.4 Exposure time > 10000 seconds obs:Char/TimeAxis.Coverage.support.extent > 10000 [s]

- 2.4.5 Fully calibrated ObservableAxis.calibStatus="CALIBRATED"
- This second use case will be very similar.

2.2 Show me a list of all data that satisfies

- 2.2.1 Data Type=Spectrum Observation.dataType="SPECTRUM"
- 2.2.2 Wavelength includes 6500 angstroms Char/SpectralAxis.Coverage.Bounds.start. > 650 [nm]
Char/SpectralAxis.Coverage.Bounds.stop > 650 [nm]

- 2.2.3 Spectral Resolution better than 15 angstroms Char/SpectralAxis.resolution.refVal < 1.5 [nm]

- 2.2.4 Spatial Resolution better than 2 arcseconds FWHM Char/SpatialAxis.resolution.refVal < 2 [arcsec]

- 2.2.5 Exposure Time > 3600 seconds obs:Char/TimeAxis.Coverage.support.extent > 3600 [s]

- 2.2.6 Data Quality = Any [How many archive would cover this?](#)

2.3 Show me a list of all data that satisfies

- 2.3.1 Emission line width Halpha > 2000 km/sec FWHM (SERVICEREQ+NEEDS OTHER SERVICE)
- 2.3.2 Halpha/Hbeta > 3.5

Remarks : THIS REQUIRES high processing and belongs to the Workflow query category

Search from and with catalog metadata, should be translated into catalog search → list of positions

3. Discover Data cubes of interest

3.1 Show me a list of data

- 3.1.1 DataType=cube (IFU spectroscopy?)
- 3.1.2 RA,DEC includes value RA1,DEC1
- 3.1.3 Field size > 100 square arcseconds
- 3.1.3 DataSensitivity =deep
- 3.1.4 Spectral resolution better than 5 angstroms FWHM

Use case 3.1

Observation.dataType ou obs:Observation.contentType = *SPECTROIMAGING*

Suggestion : *For (x,y,lambda cubes) I propose the type SPECTROIMAGING*

- obs:char.Char/SpatialAxis.coverage.bounds.limits contains RA1,DEC1
- obs:char.Char/SpatialAxis.support.Extent > 100*100 [arcsec * arcsec]
- obs:char.FluxAxis.support.limits.LoLim < (define a value)
- obs:char.Char/SpectralAxis.resolution.refVal < 0.5 [nm]

Remarks: utype for (sensitivity) is still discussed

Mireille: from David : Sensitivity (deep , shallow, medium) would not be supported by most of the archive , so we drop this.

3.3 Show me a list of all data that satisfies

- 3.3.1 DataType=Cube with 3 dimensions
- 3.3.2 Axes includes Velocity
- 3.3.3 Axes includes RA
- 3.3.4 Axes includes DEC
- 3.3.5 Velocity Resolution better than 50 km/sec
- 3.3.6 RA includes 16.000
- 3.3.7 Dec includes +41.000

Use case 3.3

- 3.3.1 Observation.dataType ou obs:Observation.contentType = "SPECTROIMAGING"
- 3.3.3 obs:char.Char/SpectralAxis.ucd = 'phys.veloc;spect.dopplerParam '
- 3.3.4 obs:Mapping.SpatialAxis.CoordType = [RA,DEC]
- 3.3.5 obs:Char/SpectralAxis.resolution.refVal < 50 [km.s-1]
- 3.3.6 obs:Char/SpatialAxis.coverage.bounds.limits contains (16.0*15 ,+41.0*15) in [deg]
- 3.3.7

NB: "contains" means that an STC region check has to be made on limits (which is a structure built on top of STC)

3.4 Show me a list of all data that satisfies

- 3.4.1 DataType=cube
- 3.4.2 RA includes 16.00
- 3.4.3 Dec includes +41.00
- 3.4.4 Wavelength includes 6500 angstroms
- 3.4.5 Wavelength includes 4000 angstroms
- 3.4.6 Spectral resolution better than 5 angstroms
- 3.4.7 Exposure time more than 3600 seconds
- 3.4.8 Data Quality= Fully Calibrated

Use case 3.4

- Observation.dataType ou obs:Observation.contentType = 'SPECTROIMAGING'
- obs:char.Char/SpatialAxis.coverage.bounds.limits contains 16.0*15 ,+41.0*15) in [deg]
- obs:char.Char/SpectralAxis.resolution.refval < 0.5 [nm]

obs:char.Char/SpectralAxis.bounds.limits contains 400 [nm] and 650 [nm]
obs:char.Char/TimeAxis.support.extent > 3600 [sec]
obs:char.FluxAxis.calibStatus = 'CALIBRATED'

NB: contains as in 3.3

The calibrationStatus is to be discussed. It was assumed that space and lambda axes are always calibrated.
So we check only the Observable axis. Do we use FluxAxis or ObservableAxis?

4 Discover Time Series of Interest

4.1 Show me a list of all data that satisfies

- 4.1.1 DataType=TimeSeries
- 4.1.2 RA includes 16.00 hours
- 4.1.3 DEC includes +41.00
- 4.1.4 Time resolution better than 1 minute
- 4.1.5 Time interval (start of series to end of series) > 1 week
- 4.1.6 Observation data before June 10, 2008
- 4.1.7 Observation data after June 10, 2007

use case 4.1

Observation.dataType ou obs:Observation.contentType = TimeSeries ??
obs:char.Char/SpatialAxis.coverage.bounds.limits contains (16.0*15,+41.0*15)
obs:char.Char/TimeAxis.Resolution.ResRef.value < 60 [s]
obs:char.Char/TimeAxis.Bounds.limits includes June 10 2007 and June 10 2008
obs:char.Char/TimeAxis.bounds.extent > 7*24*3600 [s] 1 week
Remarks: includes is again an STC check on an Interval.

5 Discover General Data of interest

5.1 Show me a list of all data that satisfies

- 5.1.1 DataType=any
- 5.1.2 RA includes 16.00
- 5.1.3 Dec includes +41.00
- 5.1.4 Wavelength includes 6500 angstroms
- 5.1.5 Wavelength includes 4000 angstroms
- 5.1.6 Spectral resolution better than 5 angstroms
- 5.1.7 Exposure time more than 3600 seconds
- 5.1.8 Data Quality= Fully Calibrated

use case 5.1

obs:char.Char/SpatialAxis.coverage.bounds.limits contains (16.0*15,+41.0*15)
obs:char.Char/SpectralAxis.resolution.refVal < 0.5 [nm]
obs:char.Char/SpectralAxis.bounds.limits contains 400 [nm] and 650 [nm]
obs:char.Char/TimeAxis.support.extent > 3600 [s]
obs:char.FluxAxis.calibStatus = 'CALIBRATED'

5.2 Show me a list of all data that satisfies

- 5.2.1 Optical imaging
- 5.2.2 In the M81 group
- 5.2.3 With area greater than 0.5 degrees square
- 5.2.4 With sensitivity > 10sigma for point source m=25
- 5.2.5 I also want X-ray data with cutouts 5 arcmin on a side of all the detected galaxies
- 5.2.6 I also want Radio data cutouts 5 arcmin on a side around detected g

use case 5.2

Observation.dataType ou obs:Observation.contentType = 'IMAGING'
obs:Observation.waveBand = 'OPTICAL'
obs:Target.name = ? M81 group ?
obs:char.Char/SpatialAxis.support.extent > 0.5 [deg*deg]
obs:char.FluxAxis.support.limits.LowLim better than 25/square arcsec

NB : the Target name may be insufficient, because it is group.

Can be replaced by an area constraint.

The detectionLimit here is changed to a flux density one.

Isn't the criterium on magnitudes a catalog check ?

Following constraints require a previous processing , detection of galaxies, and queries around this position with constraints

obs:Observation.waveBand = 'X-RAY'

or obs:Observation.waveBand = "RADIO"

cutouts is an AccessData problem, maybe not an Obs DM problem

5.3 Show me a list of all data that satisfies

5.3.1DataType=Imaging or Spectroscopy

5.3.2RA includes 16.00 hours

5.3.3DEC includes +41.00 degrees

5.3.4SDSS images and spectra AND CFHTLS images and spectra

use case 5.3

Observation.dataType ou obs: Observation.contentType = 'IMAGING' or 'SPECTRUM'

obs:char.Char/SpatialAxis.coverage.bounds.limits contains 16.0*15,+41.0*15)

obs:DataID.collection= 'SDSS' or obs:DataID.collection = 'CFHTLS'

5.4 In Virgo cluster show me imaging and X-ray data for all galaxies that are cluster members and have $B < 21$

use case 5.4

isn't that a complex query ?

- start by querying catalog services for galaxy catalogs in Virgo cluster.

- then extract the positions and process to a table query for Images and X ray data around these positions

obs:Observation.waveBand = 'X-RAY' or obs:Observation.waveBand = 'OPTICAL'

6. Given COSMOS (or other survey) X-Ray source catalogue give me all the sources with $photoZ > X$, and spiral galaxy counterpart and produce radio - to -X-ray SEDs

Comment: Requires source/object catalogues to drive data query (for SED info which may be catalogue or data)

7. Given a list of Abell clusters, give me all their Chandra images with $texp > X$, after I select regions occupied by the diffuse emission, give me all the Chandra point sources in these regions, and find their redshift (I want to find background quasars because I am interested in lensing and I have no idea where to go to find z). For the quasars, give me high res (<0.5") optical and radio images, and build SEDs

Comment: Requires source/object catalogues and interactive image interactions (applications/interfaces), further query, and more catalogues to drive data query.

8 Find me all the variable Chandra sources with optical counterpart and redshift. If redshift is not available, give me an SED to compare with source templates (I also would like to run a tool or obtain a library of such templates from a theory database, which I expect the VO to provide). My aim is to separate stars from variable quasars.

Comment: Pretty complicated, including templates and theory as well as catalogues.

6,7,8 are also combined catalog content queries and observation queries. Beyond the scope of the sole ObsCoreComponents model

Additional Radio cases are appended below. These have recently been received.

3.2.1 Show me the names of all the objects that have moving coordinates (i.e. no RA,Dec position).

3.2 Show me a list of all data that satisfies

- 3.2.1. DataType=Cube with 3 dimensions
- 3.2.2. Axes includes FREQ
- 3.2.3. Axes includes RA
- 3.2.4. Axes includes DEC
- 3.2.5. Velocity Resolution better than 1 km/sec
- 3.2.6. RA includes 83.835000
- 3.2.7. Dec includes -5.014722
- 3.2.8. Rest Frequency = 345.795990 GHz
1VLSRK in the range [6.0, 10.0]

Use case 3.2 and following

- 3.2.1 Observation.dataType ou obs:Observation.contentType = 'SPECTROIMAGING'
- 3.2.2 obs:char.Char/SpectralAxis.ucd = 'em.freq'
- 3.2.3 obs:Mapping.SpatialAxis.CoordType = [RA,DEC]
- 3.2.5 obs:char.Char/SpectralAxis.resolution.refval < 1 km/s
- 3.2.6, 3.2.7 obs:char.Char/SpatialAxis.coverage.bounds.limits contains (83.835,-5.014722)
- 3.2.8 obs:char.Char/SpectralAxis.coverage.bounds.limits contains 345.795990 GHz and all smaller frequencies
(up to 10 time less)
Remarks : last criterium to take into account potential high redshifts. Don't know about I don't know about VLSRK ?

3.3 Show me a list of all data that satisfies

- 3.3.1. DataType=Cube with 3 dimensions
- 3.3.2. Axes includes FREQ
- 3.3.3. Axes includes RA with >100 pixels
- 3.3.4. Axes includes DEC with >100 pixels
- 3.3.5. Frequency extent > 500 MHz
- 3.2.8. Rest Frequency = 345.795990 GHz appears in band

The redshift is not specified, but should default to source for the target. .

- 3.3.1. Observation.contentType = 'SPECTROIMAGING'
- 3.3.2. obs:Char/SpectralAxis.ucd = "em.freq"
- 3.3.3. obs:Char/SpatialAxis.numbins1 > 100 and obs:Char/SpatialAxis.ucd = "pos"
- 3.3.4. obs:Char/SpatialAxis.numbins2 > 100
- 3.3.5. obs:char.Char/SpectralAxis.coverage.extent > 500 MHz
- 3.2.8. Rest Frequency = 345.795990 GHz appears in band????????????

3.4 Show me a list of all data that satisfies

- 3.4.1. DataType=Cube with 3 dimensions
- 3.4.2. Axes includes FREQ
- 3.4.3. Axes includes RA
- 3.4.4. Axes includes DEC
- 3.4.5. Frequency resolution < 10 MHz
- 3.4.8. Rest Frequency = 337.2966 GHz appears in band

Any observation that could have detected a line at this rest frequency from any target, using the nominal redshift for the target.

3.5 Show me a list of all data that satisfies

- 3.5.1. DataType=Cube with 3 dimensions

- 3.5.2. Axes includes FREQ
- 3.5.3. Axes includes RA
- 3.5.4. Axes includes DEC
- 3.5.5. Frequency resolution < 10 MHz
- 3.5.8. Rest Frequency in (213.36053, 256.0278, 298.6908925, 341.350826, 384.0066819, 426.6579505, 469.3041221, 511.944687, 554.5791355) GHz appears in band

Any observation that could have detected HCS+ (list of transition rest frequencies given above) from any target, using the nominal redshift for the target.

3.6 Show me a list of all data that satisfies

- 3.6.1. DataType=Cube with 4 dimensions
- 3.6.2. Axes includes FREQ
- 3.6.3. Axes includes RA with >100 pixels
- 3.6.4. Axes includes DEC with >100 pixels
- 3.6.5. Axes includes STOKES
- 3.6.5. Frequency resolution < 1 MHz
- 3.6.8. Rest Frequency = 345.795990 GHz appears in band