Simple Science Use Cases with Utypes from the Core Obs DM prototype.
July 24, 2009, M.Louys+F.Bonnarel.

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

Here are more uses cases with Utypes.

I have attached a Utype to each medatata mentioned in the query and modeled this accordingly in the UML model.

Most of the physical properties are tackled by CharacterisationDM .
Spectral domain names, DataSetId, etc… are borrowed from the VO:Resource description.

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.

Most of utypes will actually have the prefix: Obs:Characterisation/
Example Queries:

1 Discover imaging data of interest

Show me a list of all data that satisfies

1 DataType=any Observation.datatype='ANY'
2 Energy includes 5 keV SpectralAxis.ucd='phys.energy'
3 SpectralAxis.unit ='keV'
4 SpectralAxis.Coverage.Bounds.start. < 5 and SpectralAxis.Coverage.Bounds.stop > 5 *? Do we need quantity conversion here?*
5 DEC includes +10
6 RA includes 16.00 SpatialAxis.Coverage.Support.Area contains (16.00,+10)
7 Exposure time > 10 ks TimeAxis.Coverage.support.extent > 10
TimeAxis.Coverage.support.unit =' ks'
Convert 10 ks to the appropriate unit used in the archive.

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

1 Data type is Imaging or spectroscopy data Observation.datatype='IMAGE' or 'DATACUBE' where SpectralAxis is present.

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

3 Includes both a wavelength in the range 5000-900 angstroms AND an X-ray image (AND=SERVREQ)

Does it mean a data set that has, for a position in the list, either a spectral coverage in the5000-900 angstroms band or an X-ray image, or both? Probably the condition is exclusive and not inclusive?

SpectralAxis.Coverage.Bounds.Limits.Interval included in [900, 5000] angstroms or Observation.datatype='image' with 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='image' and Observation.waveband='X-Ray'

Show me a list of all data that satisfies

1 Datatype=Image Observation.datatype='IMAGE'

2 Spatial resolution better than 0.3 arcseconds SpatialAxis.resolution.refVal <= 0.3 and SpatialAxis.Resolution.refVal.unit='arcsec'

3 Filter = J or H or K Band name is not defined in Characterisation package but will be in Provenance. Obs:Provenance/Filter.BandName in [J,H,K]

4 RA between 16 hours and 17 hours *NB mir: Coordsystem is not specified for the region of search?*

5 *Do we assume a default Coordsys like ICRS ?* SpatialAxis.Coverage.Bounds.limits.unit = 'h' and SpatialAxis.Coverage.Bounds.limits.Interval;stc:Coord2VecInterval.LoLim2Vec.C1 > 16 and SpatialAxis.Coverage.Bounds.limits.Interval;stc:Coord2VecInterval.HiLim2Vec.C1 < 17

6 DEC between 10 degrees and 11 degrees SpatialAxis.Coverage.Bounds.limits = 'deg' and SpatialAxis.Coverage.Bounds.limits.Interval;stc:Coord2VecInterval.LoLim2Vec.C2 > 10 and SpatialAxis.Coverage.Bounds.limits.Interval;stc:Coord2VecInterval.LoLim2Vec.C2 < 11

- **Show me a list of all data that satisfies**

1 DataType=Image obs:Observation.dataType='IMAGE'

2 Wavelength=V or I or Z Obs:Provenance/Filter.bandName in [I,V,Z]

3 Spatial Resolution < 0.7 arcseconds FWHM

4 SpatialAxis.resolution.refVal < 0.7 and obs:SpatialAxis.Resolution.refVal.unit='arcsec'

5 Exposure Time > 1000 Seconds

obs:characterization/TimeAxis.Coverage.support.extent > 1000

obs:characterisation/TimeAxis.Coverage.support.unit ='s'

6 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.

- λ 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?
- λ Possible string values depend on the observation content

- λ for spectra (see recent discussion on the list...)
  - λ ABSOLUTE, RELATIVE , UNCALIBRATED, NORMALIZED
- λ for images
  - λ CALIBRATED: means all phys axis calibrated : spatial, spectral, time, flux
  - λ RELATIVE
  - λ NORMALIZED
  - λ UNCALIBRATED

λ 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"

Show me all data that satisfies

1 DataType=IFU *Observation.dataType="IFU"*
2 DataQuality=Fully calibrated *ObservableAxis.calibStatus="CALIBRATED"*
3 ObjectClass=quasar (SERVIC REQ + NEEDS ANOTHER SERVICE (CATALOGUE)
NEED CATALOG ACCESS
4 Redshift > 3.
5 Radioflux > 1 mJy

Remarks: Is IFU a contenType ? IFU data can be spectroImaging (xylambda cubes) or list of spectra according to the processing.

2 Discover Spectral data of interest

Show me a list of all data that satisfies

1 DataType=Spectrum *Observation.dataType="Spectrum"*
2 Energy spans 1 to 5 keV *SpectralAxis.ucd='phys.energy'*
3 SpectralAxis.unit ='keV'
4 SpectralAxis.Coverage.Bounds.start. >1 and SpectralAxis.Coverage.Bounds.stop < 5
5
6 Total counts in spectrum > 100 not yet in the data model should we add a total flux on the flux axis?
7 Exposure time > 10000 seconds
8 obs:characterization/TimeAxis.Coverage.support.extent > 10000
obs:characterisation/TimeAxis.Coverage.support.unit ='s'
9 Fully calibrated *ObservableAxis.calibStatus="CALIBRATED"*

This second use case will be very similar.

Show me a list of all data that satisfies

1 DataType=Spectrum
2 Wavelength includes 6500 angstroms
3 Spectral Resolution better than 15 angstroms
4 Spatial Resolution better than 2 arcseconds FWHM
5 Exposure Time > 3600 seconds
6 Data Quality = Any

Show me a list of all data that satisfies

1 Emission line width Halpha > 2000 km/sec FWHM (SERVICEREQ+NEEDS OTHER SERVICE)
2 Halpha/Hbeta > 3.5

Remarks : THIS REQUIRES high processing.

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

1 3. Discover Data cubes of interest

2 **3.1 Show me a list of data**

3 3.1.1DataType=cube (IFU spectroscopy?)
4 3.1.2RA,DEC includes value RA1,DEC1
5 3.1.3Field size > 100 square arcseconds
6 3.1.3DataSensitivity =deep
7 3.1.4Spectral resolution better than 5 angstroms FWHM

Use case 3.1

Observation.dataType ou obs:DataSet.contentType = Spectroimaging
obs:char.SpatialAxis.coverage.bounds.limits contains RA1,DEC1
obs:char.SpatialAxis.support.Extent > 100 arccsecxarcsec
obs:char.FluxAxis.support.limits.LowLim < (define a value)
obs:char.SpectralAxis.resolution.resolutionRefval < 0.5 nm

Remarks: utype 4 (sensitivity) is still discussed
For x,y,lambda cubes I propose the type SpectroImaging

1 3.3Show me a list of all data that satisfies

2 3.3.1DataType=Cube with 3 dimensions
3 3.3.2Axes includes Velocity
3 3.3Axes includes RA
1 3.3.4Axes includes DEC
2 3.3.5Velocity Resolution better than 50 km/sec
3 3.3.6RA includes 16.000
4 3.3.7Dec includes +41.000

Use case 3.3

Observation.dataType ou obs:DataSet.contentType = Spectroimaging

obs:char.SpectralAxis.ucd = spect.dopplerVeloc
obs:mapping.SpatialAxis.Coord = RA,DEC
obs:char.SpatialAxis.coverage.bounds.limits contains (16.0,+41.0)
obs:char.SpectralAxis.resolution.resolutionRefval < 50 km/s

remarks: “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

1 3.4.1DataType=cube
2 3.4.2RA includes 16.00
3 3.4.3Dec includes +41.00
4 3.4.4Wavelength includes 6500 angstroms
5 3.4.5Wavelength includes 4000 angstroms
6 3.4.6Spectral resolution better than 5 angstroms
7 3.4.7Exposure time more than 3600 seconds
I 3.4.8Data Quality= Fully Calibrated

use case 3.4

Observation.dataType ou obs:DataSet.contentType = Spectroimaging
obs:char.SpatialAxis.coverage.bounds.limits contains (16.0,+41.0)
obs:char.SpectralAxis.resolution.refval < 0.5 nm
obs:char.SpectralAxis.bounds.limits contains 400 nm and 650 nm
obs:char.TimeAxis.support.extent > 3600 sec
obs:char.FluxAxis.calibStatus = calibrated

remarks: 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

1 4.1Show me a list of all data that satisfies

2 4.1.1DataType=TimeSeries
3 4.1.2RA includes 16.00 hours
4 4.1.3DEC includes +41.00
5 4.1.4Time resolution better than 1 minute
6 4.1.5Time interval (start of series to end of series) > 1 week
7 4.1.6Observation data before June 10, 2008
8 4.1.7Observation data after June 10, 2007

use case 4.1

Observation.dataType ou obs:DataSet.contentType = TimeSeries
obs:char.SpatialAxis.coverage.bounds.limits contains (16.0,+41.0)
obs:char.TimeAxis.resolution.resolutionRefval < 1 min
obs:char.TimeAxis.bounds.limits includes June 10 2007 an June 10 2008
obs:char.TimeAxis.bounds.extent > 1 week

Remarks: includes is again an STC check on an Interval.

1 5 Discover General Data of interest

1 5.1Show me a list of all data that satisfies

2 5.1.1DataType=any
3 5.1.2RA includes 16.00
4 5.1.3Dec includes +41.00
5 5.1.4Wavelength includes 6500 angstroms
6 5.1.5Wavelength includes 4000 angstroms
7 5.1.6Spectral resolution better than 5 angstroms
8 5.1.7Exposure time more than 3600 seconds
9 5.1.8Data Quality= Fully Calibrated

use case 5.1
obs:char.SpatialAxis.coverage.bounds.limits contains (16.0,+41.0)
obs:char.SpectralAxis.resolution.resolutionRefval < 0.5 nm
obs:char.SpectralAxis.bounds.limits contains 400 nm and 650 nm
obs:char.TimeAxis.support.extent > 3600 sec
obs:char.FluxAxis.calibStatus = calibrated

1 5.2 Show me a list of all data that satisfies

2 5.2.1Optical imaging
3 5.2.2In the M81 group
4 5.2.3With area greater than 0.5 degress square
5 5.2.4With sensitivity > 10sigma for point source m=25
6 5.2.5I also want X-ray data with cutouts 5 arcmin on a side of all the detected galaxies
7 5.2.6I also want Radio data cutouts 5 arcmin on a side around detected g

use case 5.2
Observation.dataType ou obs:DataSet.contentType = Image.2D
obs:dataSet.waveBand = Optical Domain
obs:Target.name = ? M81 group ?
obs:char.SpatialAxis.support.extent > 0.5 degrees square
obs:char.FluxAxis.support.limits.LowLim better than 25/square arcsec
remarks : the Target name may be unsufficiant, 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:dataSet.waveBand = X domain

or obs:DataSet.waveBand = Radio domain
cutouts is an AccessData problem, maybe not an Obs DM problem

1 5.3 Show me a list of all data that satisfies

2 5.3.1DataType=Imaging or Spectroscopy
3 5.3.2RA includes 16.00 hours
4 5.3.3DEC includes +41.00 degress
5 5.3.4SDSS images and spectra AND CFHTLS images and spectra

use case 5.3
Observation.dataType ou obs:DataSet.contentType = image or spectra
obs:char.SpatialAxis.coverage.bounds.limits contains (1-.0,+41.0)
obs:DataID.collection = SDSS or obs:DataID.collection = CFHTLS

1 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 i n Virgo cluster.
- then extract the positions and process to a table query for Images and X ray data around these positions

obs:dataSet.waveBand = X domain
or obs:dataSet.waveBand = optical domain

1 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:Requiressource/objectcataloguestodrivedataquery(forSEDinfowhichmaybecatalogueor data)

1 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.

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1 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.

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6,7,8 are also combined catalog content queries and observation queries. Beyond the scope of the sole Obs 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
1 VLSRK in the range [6.0, 10.0]

Use case 3.2 and following
Observation.dataType ou obs:DataSet.contentType = Spectroimaging
obs:char.SpectralAxis.ucd = em.freq
obs:char.SpatialAxis.coverage.bounds.limits contains (83.835,-5.014722)
obs:char.SpectralAxis.resolution.refval < 1 km/s
obs:char.SpectralAxis.coverage.bounds.limits contains 345.795990 GHz and all smaller frequencies (up to 1à 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 zsource for the
target.

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