

ObsCore DM Proposed Extension for time series and radio visibilities

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following discussions with Time domain IG and RadiolG

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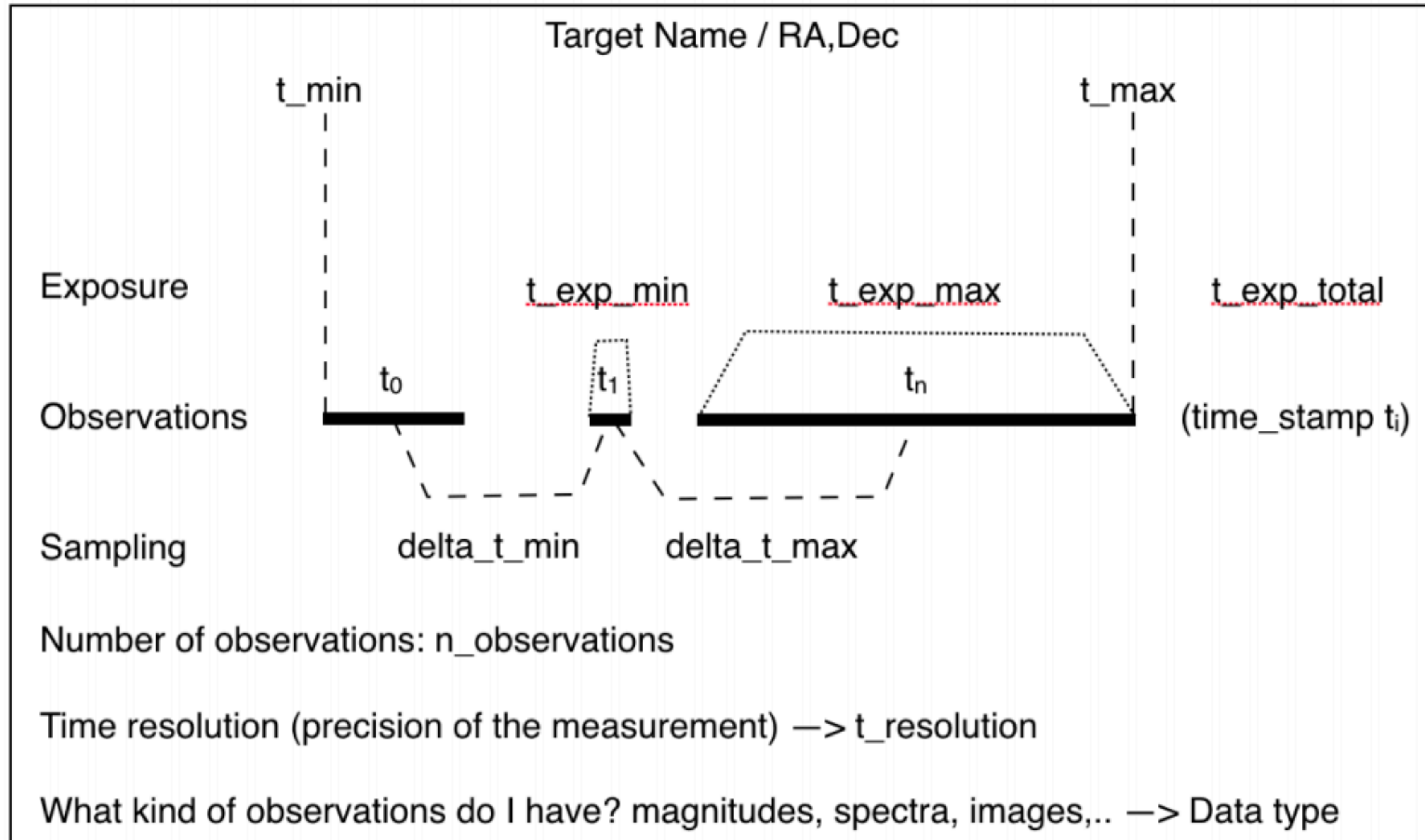


□ Context

- this work relates to the Time Domain IG charter
- what do I need in terms of time properties to query for a time series dataset?
- what is not covered by Obscore DM 1.1?
- how can I create an extra metadata table to enhance the description of the time axis for such datasets ?



□ Time series specific properties



Thanks to
Ada Nebot

Figure 1: Simple representation of Time Series data.



Time description in ObsCore

Obscore + TObs	Definition	Utype/datamodel path	UCD	Units	Mandatory/optional
t_min	Time start of the sequence	Char.TimeAxis.Coverage.Bounds.Limits.LoLim	time.start;obs.sequence	s	man
t_max	Time end of the sequence	Char.TimeAxis.Coverage.Bounds.Limits.HiLim	time.end;obs.sequence	s	man
t_exptime	Exposure time (sum of multiple exposures)	Char.TimeAxis.Support.Extent	time.duration;obs.exposure	s	man
t_exp_min	minimal length of time sample (min integration time)	Char.TimeAxis.Sampling.Extent.loLim	time.duration;obs.sequence;stat.min.	s	opt
t_exp_max	maximal length of time sample (max integration time)	Char.TimeAxis.Sampling.Extent.hiLim	time.duration;obs.sequence;stat.max	s	opt
%time space between 2 time samples / cadence					
t_delta_min	minimal length of time interval between 2 observations / cadence (min)	Char.TimeAxis.Sampling.Period.loLim	time.interval;obs.sequence;stat.min.	s	opt
t_delta_max	maximal length of time interval between 2 observations / cadence (max)	Char.TimeAxis.Sampling.Period.hiLim	time.interval;obs.sequence;stat.max	s	opt
t_resolution	minimal interpretable time difference	Char.TimeAxis.Resolution.Refval			
t_xel	nb of time stamps in the series	Char.TimeAxis.numBins	meta.number	null	man

grey cell = current Obscore keywords

add every parameter in blue cells to *ivoa.t_obs* table

Time Coordinate System



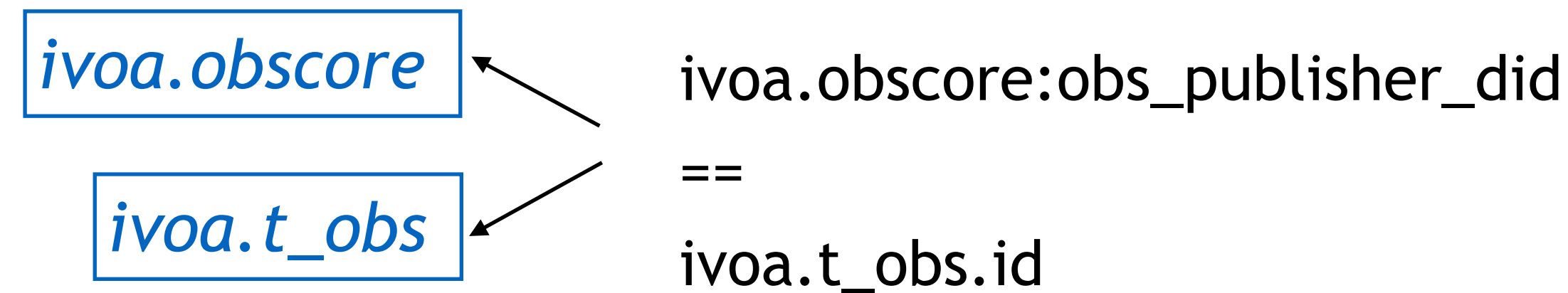
- The datasets description in Obscore 1.1 does not constrain to one specific TIME coordinate system.
- The data representation in the time series data rely on a TIMESYS element.
- Is it useful to query on it ?
- At least it is useful to get in the query response and let a client api prepare some time coordinates conversion

add every blue parameters to `ivoa.t_obs` table

Obscore + TObs	Definition	VODML-ID IN Coords DM and TIMESYS attribute	UCD	Units	Mandatory/optional	Query setup
% Time Coordinate system						
t_origin	Time(frame origin)	TimeOffset.time0 (TBC) timeorigin	time.epoch	?	opt	
t_scale	Time frame scale	TimeFrame.timeScale timescale	time.scale	?	opt	
t_refPosition (barycenter, heliocenter, ...)	Time reference position	TimeFrame.refPosition refposition	?	?	opt	
t_refDirection (e.g. for solar observations)	Time reference direction	TimeFrame.refDirection refdirection	?	?	opt	
%Time representation ISOtime , MJD, JD , ...						
t_format	Time representation	?	time;meta.code.class	null	opt	MJD

□ TAP schema extension

- An ObsTAP service can already provide metadata from *ivoa.obscore* table together from complementary tables. (cf CADC ObsTAP)



- A table join allows to search on ObsCore keywords, but also on time specific keywords
- Suggestion:
 - define a ‘time series’ ObsTAP capability when *ivoa.t_obs* is served together with *ivoa.obscore*
 - ▶ *ivoa.obscore* + *ivoa.t_obs* tables are included in the service TAP_SCHEMA
 - same mechanism can apply for a specific ‘Radio’ feature extensions
 - define a ‘radio’ ObsTAP capability when *ivoa.r_obs* is served together with *ivoa.obscore*
 - ▶ *ivoa.obscore* + *ivoa.r_obs* tables are included in the service TAP_SCHEMA



□ Refine dataproduct_type labels

- dataproduct_type='timeseries' does not state what depends on time
- proposal for several time series extensions
 - timeseries-phot for lightcurve
 - timeseries-radialVelocity
 - timeseries-image
 - timeseries-spectrum for dynamic spectrum
 - timeseries-cube
- comments and suggestions welcome on dm@ivoa.net



□ Metadata for Radio Visibility Data

- *dataprodect_type*= 'visibility'
- Spatial axis
 - *s_ra*, *s_dec*, *s_fov*, can be computed from instrument configuration and signal reconstruction.
- Observable axis :
 - Visibility data are spanned in Fourier space, along 3 axes : u,v,w
 - The value of a table element is a complex value → use 'stat.Fourier' for *o_ucd*
- Spectral axis:
 - radio data are usually given in *frequencies*
 - ▶ *f_min*, *f_max* express the limit of the spectral band **addition**
 - ▶ use 'em.freq' for *em_ucd* **by default**
 - ▶ proposed *em_unit* = MHz ?? **by default → TBD**
- Time axis
 - *t_exp_mean* : average integration time (is it needed ?)
- Polarimetry axis : keep *pol_states* enumeration



Visibilities in ObsCore + ivoa.r_obscore

Obscore and R	Definition	Utype	UCD	Units	Mandatory/ Optional	Default
dataprodct_type		ObsDataset.dataProductType	meta.code.class			visibility
% position on sky in ICRS						
s_ra	Position (within a certain area)	Char.SpatialAxis.Coverage.RefVal	pos.eq.ra	deg	man	ICRS
s_dec	Position (within a certain area)	Char.SpatialAxis.Coverage.RefVal	pos.eq.dec	deg	man	
s_resolution	Angular resolution	Char.SpatialAxis.Resolution.RefVal	pos.angResolution	arcsec	man	
% observable						
o_ucd	Physical nature attached to observable	Char.ObservableAxis.ucd	meta.ucd	null	man	stat.Fourier
stat.Fourier	Fourier coeff in visibilty as amplitude , phase depending on u,v					
% spectral coverage						
em_min	spectral interval (min)	Char.SpectralAxis.Coverage.Bounds.Limits.LoLim	em.wl;stat.min	nm	man	nm
em_max	spectral interval	Char.SpectralAxis.Coverage.Bounds.Limits.HiLim	em.wl;stat.max	nm	man	nm
em_ucd	Wavelength/ Frequency/ Energy	Char.SpectralAxis.ucd	meta.ucd	null	opt	em.freq
em_unit	Unit along spectral axis	Char.SpectralAxis.unit	meta.unit	null	opt	
f_min	spectral coverage (min) in frequency	Char.SpectralAxis.Coverage.Bounds.Limits.LoLim	em.freq;stat.min	<em_unit>	man	MHz
f_max	spectral coverage (max) in frequency	Char.SpectralAxis.Coverage.Bounds.Limits.HiLim	em.freq;stat.max	<em_unit>	man	MHz
% Polarisation states						
pol_states	Polarization state list	Char.Polarization.List	meta.class	null	opt	
%time features						
t_exp_mean	average length time interval integration time	Char.TimeAxis.Coverage.Support.Refval	time.interval;obs.sequence;stat.mean	s	opt	

add green parameters to an *ivoa.r_obs* table