GAPS
exoplanets RV time series

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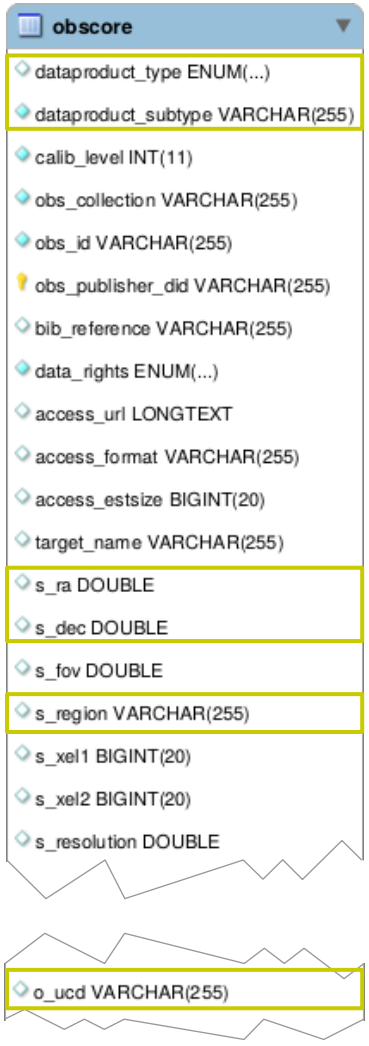
GAPS project overview

- Global Architecture of Planetary Systems
  - a long-term program for the comprehensive characterization of the architectural properties of planetary systems as a function of the hosts' characteristics (mass, metallicity, environment)
  - 340 nights at TNG/HARPS-N since August 2012
- Prepares (as one of the products) Time Series for host's radial velocity out of HARPS-N high resolution spectra
  - Not only RV, but a bunch of other observed parameters
  - Goal: follow up on most promising candidates
  - Seeking and properly characterising small exoplanets requires huge amounts of observational data

Quick summary

- Use the ObsCore solution as a start
- Customise it based on use cases
- Discuss it in the general view

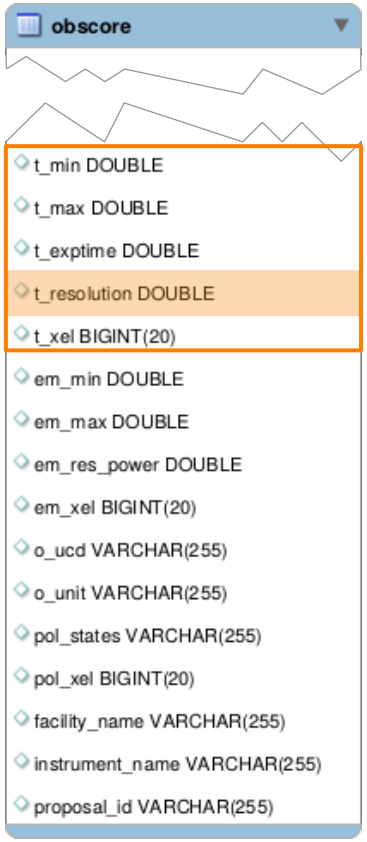
- 6(+2) use cases
- 7(5?) NULL ObsCore fields
- 2 tables added



Use Case 1 – RV Time Series

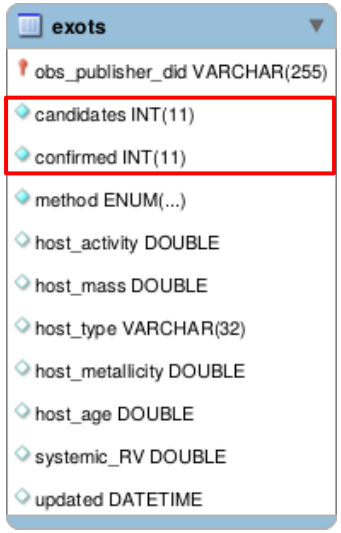
- All datasets that contain radial velocity time series
  - **dataproduct_type**='timeseries'
  - **o_ucd**='spect.dopplerVeloc.opt'
  - (plus) common ObsCore filtering (e.g. positional)
- .IR leaf to the UCD branch
  - *spect.dopplerVeloc.IR*
  - *spect.dopplerVeloc;em.IR*

Use Case 2 – Number of points



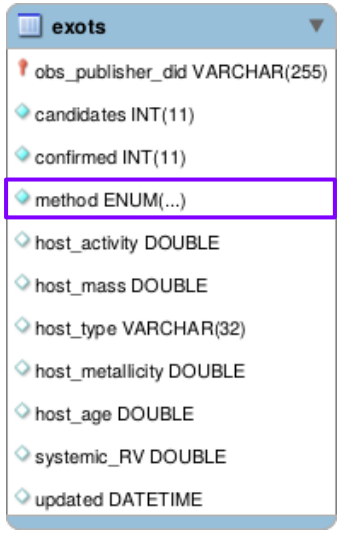
- ObsCore's use case 4.2
  - Number of points in the series: **t_xel**
  - Time span: **t_min**, **t_max**
  - Resolution: **t_resolution**
- Clarify meaning for
  - t_* fields
  - t_resolution (in particular)
- Resolution inherently uneven.

Use Case 3 – detected exoplanets



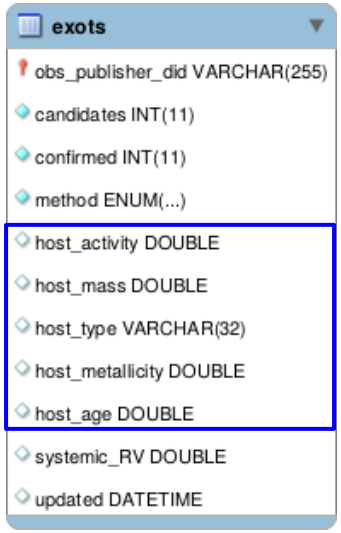
- Need to add metadata
  - external table: **exots**
  - **obs_publisher_did** foreign key to obscore
  - 1:1 relation
- 2 fields added
  - **candidates**
  - **confirmed**

Use Case 4 – discovery method



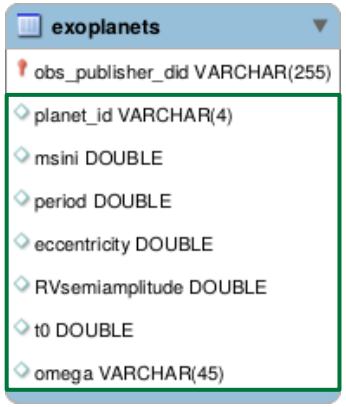
- discovery method used
  - **method** field in exots table
  - **method=**'RVspectroscopy'
  - Values should come from a controlled vocabulary
    - transit, direct-imaging, astrometry, . . .
- Alternate solution?
  - **o_ucd** to express the discovery method
  - Confusing: it would mean mapping two distinct concepts in the same field

Use Case 5 – host star



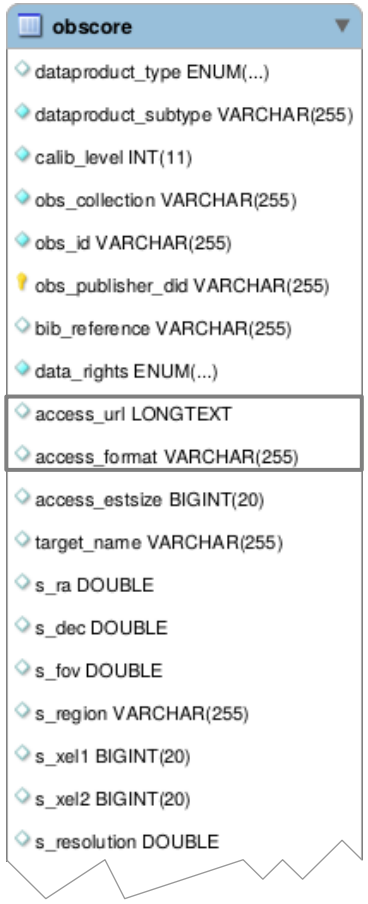
- Discovery for stars having, e.g.
  - Low stellar activity
    - Currently GAPS hosts are all low activity stars, but this may change in the future with adoption of IR spectroscopy
  - A specific spectral type
  - **host_*** fields in **exots**

Use Case 6 - exoplanets



- Filtering on planets characteristics
  - values
  - ranges
- Requires multiple values for each host system
- Added **exoplanets** table
- obs_publisher_did 1:N relation to **exots** table

Use Case 7 – spectra origin



- Not discussed here
- Linking time series points to their originating spectra
  - Provenance access the datasets used to build the time series
  - Use the Datalink on **access_url** and **access_format**

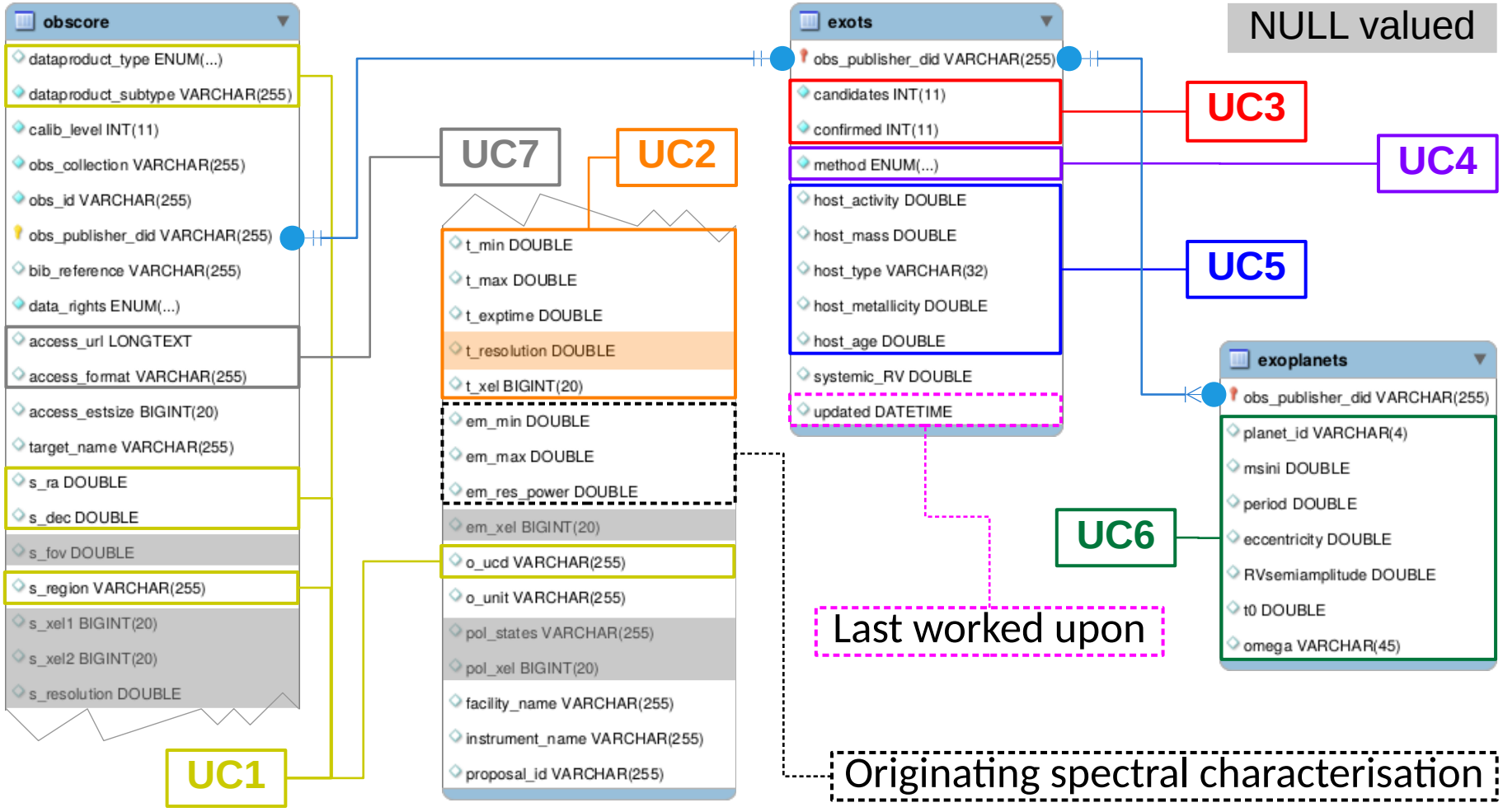
Use Case 8 – photometry

- Not discussed here
- Find time series of photometry points of the host system, to use in combination with spectral data in the exoplanets identification.
- Already solved by ObsCore

Remarks

- **s_fov** set to **NULL** rather than 1 arcsec (fiber size)
  - Suspect it could be confusing otherwise
- **em_min**, **em_max**, **em_resolution** set to spectrograph's characteristics
  - May be misleading since they refer to the spectra from which the time series originate
  - Considered harmless WRT s_fov choice
- **obs_publisher_did** relation solution
  - Enforced using **dataproduct_subtype='**RV:optical'
    - dataproduct_subtype, however is optional and free text
- An **updated** field added to report when last the time series was worked upon
  - Useful for follow up decisional process

Global view


obscore
dataproduct_type ENUM(...)
dataproduct_subtype VARCHAR(255)
calib_level INT(11)
obs_collection VARCHAR(255)
obs_id VARCHAR(255)
obs_publisher_did VARCHAR(255)
bib_reference VARCHAR(255)
data_rights ENUM(...)
access_url LONGTEXT
access_format VARCHAR(255)
access_estsize BIGINT(20)
target_name VARCHAR(255)
s_ra DOUBLE
s_dec DOUBLE
s_fov DOUBLE
s_region VARCHAR(255)
s_xel1 BIGINT(20)
s_xel2 BIGINT(20)
s_resolution DOUBLE
UC1
UC7
UC2
t_min DOUBLE
t_max DOUBLE
t_exptime DOUBLE
t_resolution DOUBLE
t_xel BIGINT(20)
em_min DOUBLE
em_max DOUBLE
em_res_power DOUBLE
em_xel BIGINT(20)
o_ucd VARCHAR(255)
o_unit VARCHAR(255)
pol_states VARCHAR(255)
pol_xel BIGINT(20)
facility_name VARCHAR(255)
instrument_name VARCHAR(255)
proposal_id VARCHAR(255)
exots
obs_publisher_did VARCHAR(255)
candidates INT(11)
confirmed INT(11)
method ENUM(...)
host_activity DOUBLE
host_mass DOUBLE
host_type VARCHAR(32)
host_metallicity DOUBLE
host_age DOUBLE
systemic_RV DOUBLE
updated DATETIME
UC3
UC4
UC5
UC6
exoplanets
obs_publisher_did VARCHAR(255)
planet_id VARCHAR(4)
msini DOUBLE
period DOUBLE
eccentricity DOUBLE
RVsemiamplitude DOUBLE
t0 DOUBLE
omega VARCHAR(45)
Last worked upon
Originating spectral characterisation
NULL valued

Conclusions

- Exoplanets time series discovery and access using ObsCore: looks feasible
- Changes may be needed if we want specific discovery scenarios to work
- Some information, useful when dealing with spectroscopic RV time series may be misleading: they refer to the spectra, not the time series
- We used 2 more tables referencing the obscore one: a simple model for time series, with tables as flat views, may be better
- This is a use case based proposal for a solution, not the solution itself