# Prototype LBT/LUCI ObsCore table


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# 1 Introduction

*The International Virtual Observatory Alliance (IVOA) is an organisation that debates and agrees the technical standard to provide interoperability among different astronomical datasets* [1]. For this purpose an Observation Data Model Core Components (ObsCoreDM) has been released defining the core components of basic queryable metadata required for global discovery of observational data through Astronomical Data Query Language (ADQL) queries (see [2]). In this document we may use the ObsCoreDM and ObsCore wording interchangeably, despite the former refers to an actual data model for observational data and the latter is the plain view of it generated for easier tabular query of the observational records described by the former.

The Large Binocular Telescope (LBT) is a pair of two identical 8.4m telescopes mounted side-by-side on a common altitude-azimuth mounting for a combined collecting area of a single 11.8m telescope mounted. It hosts three facility instruments: 1) the Large Binocular Cameras (LBCs); 2) the two Multi-Object Double Spectrograph (MODS); and 3) the two LBT Utility Cameras (LUCI), see [3] for further details on the instruments. The LBT is an international collaboration of the University of Arizona, Italy (INAF: Istituto Nazionale di Astrofisica), Germany (LBTB: LBT Beteiligungsgesellschaft), The Ohio State University, and the Tucsonbased Research Corporation representing the University of Minnesota, the University of Virginia, and the University of Notre Dame.

The archive and distribution systems of raw data between the Large Binocular Telescope Observatory (LBTO) and the partners is supported by the Italian Center for Astronomical Archives (IA2) (see [4,5,6]).

This document presents the first prototype of an IVOA compliant ObsCore table of proper raw data from LBT/LUCI to be published and shared among the astronomical community through both the Table Access Protocol (TAP-1.x) and the Simple Image Access Protocol version 2 (SIAP-2.0).

## 2 Acronyms

| | |
|---|---|
| ADQL | Astronomical Data Query Language |
| ADS | The SAO/NASA Astrophysics Data System |
| FAIR | Findable, Accessible, Interoperable, Re-usable |
| FITS | Flexible Image Transport System |
| INAF | Italian National Institute of Astrophysics |
| IVOA | International Virtual Observatory Alliance |
| LBC | Large Binocular Camera |
| LBT | Large Binocular Telescope |
| LBTB | LBT Beteiligungsgesellschaft |
| LBTO | Large Binocular Telescope Observatory |
| LUCI | LBT Utility Cameras |
| MJD | Modified Julian Date |
| MODS | Multi-Object Double Spectrograph |
| ObsCoreDM | Observation Data model Core (components) |
| PM | Person Month |
| SIA | Simple Image Access protocol |
| TAP | Table Access Protocol |
| UCD | Unified Content Descriptor |
| VO | Virtual Observatory |

## 3 Reference documents

1. http://ivoa.net/
2. "Observation Data Model Core Components, its Implementation in the Table Access Protocol", version 1.1, *Louys, M., Tody, D., Dowler, P., Durand, D., Michel, L., Bonnarel, F., Micol, A., and the IVOA DM WG*, IVOA Recommendation, https://ui.adsabs.harvard.edu/abs/2017ivoa.spec.0509L/abstract
3. Current Status of the Facility Instrumentation Suite at the Large Binocular Telescope Observatory *B. Rothberg, O. Kuhn, M. L. Edwards, J. M. Hill, D. Thompson, C. Veillet , R. M. Wagner* - Proceedings of the SPIE, Volume 9906, id. 990622 20 pp. (2016).
4. NADIR Technical Manual C. Knapic
5. NADIR: A Flexible Archiving System Current Development C. Knapic, M. De Marco, R.Smareglia, M. Molinaro - ASP Conference Series, Vol. 485
6. New Archiving Distributed InfrastructuRe (NADIR): Status and Evolution M. De Marco, C. Knapic, R. Smareglia - ASP Conference Series, Vol. 495
7. http://simbad.u-strasbg.fr/simbad/sim-fid
8."Table Access Protocol", version 1.1, *Dowler, P., Rixon, G., Tody, D., Demleitner, M.*, IVOA Recommendation, http://www.ivoa.net/documents/TAP/20190927/REC-TAP-1.1.html
9. "IVOA Simple Image Access", version 2.0, *Dowler P., Bonnarel F., Tody D.*, IVOA Recommendation, doi:10.5479/ADS/bib/2015ivoa.spec.1223D
10. http://www.ivoa.net/documents/SIA/
11. Luci User Manual https://996a4126-a-79502442-s-sites.googlegroups.com/a/lbto.org/luci/documents-and-l
LUCI_UserMan.pdf?attachauth=ANoY7cpV_Gs25sBIoOE-jOV0rjm7HXEF4rbwWyTlqHJOf-hNDlE5Zg5Yn_uPyFAZA9jxOWl8ake
PDrD1c%3D&attredirects=0

# 4 ObsCore Data Model

In this section, we briefly give an overview on the mandatory fields of the ObsCore table with their name (more precisely with their TAP column name), recommended units, data type and designation.

| Column Name | Unit | Type | Description | Constraint |
|---|---|---|---|---|
| dataproduct_type | unitless | String | Logical data product type | |
| calib_level | unitless | enum integer | Calibration level {0,1,2,3,4} | not null |
| obs_collection | unitless | String | Name of the data collection | not null |
| obs_id | unitless | String | Observation ID | not null |
| obs_publisher_did | unitless | String | Dataset identifier given by the publisher | not null |
| access_url | unitless | String | URL used to access (download dataset) | |
| access_format | unitless | String | File content format | |
| access_estsize | kbyte | integer | Estimated size of dataset in kylo bytes | |
| target_name | unitless | String | Astronomical object observed, if any | |
| s_ra | deg | double | Central right ascension, ICRS | |
| s_dec | deg | double | Central declination, ICRS | |
| s_fov | deg | double | Diameter (bounds) of the covered region | |
| s_region | unitless | String | Sky region covered by the data product, expressed in ICRS frame | |
| s_xel1 | unitless | integer | Number of elements along the first spatial axis | |
| s_xel2 | unitless | integer | Number of elements along the second spatial axis | |
| s_resolution | arcsec | double | Spatial resolution of data as FWHM | |
| t_min | d | double | Start time in MJD | |
| t_max | d | double | Stop time in MJD | |
| t_exptime | s | double | Total exosure time | |
| t_resolution | s | double | Temporal resolution FWHM | |
| t_xel | unitless | integer | Number of elements along the time axis | |
| em_min | m | double | Start in spectral coordinates | |
| em_max | m | double | Stop in spectral coordinates | |
| em_res_power | unitless | double | Spectral resolving power | |
| em_xel | unitless | integer | Number of elements along the spectral axis | |
| o_ucd | unitless | String | UCD of observable (e.g. phot.count) | |
| pol_states | unitless | String | List of polarization of NULL if not applicable | |
| facility_name | unitless | String | name of the facility used for this observation | |
| instrument_name | unitless | String | Name of the instrument used for this observation | |

The ObsCore fields for a collection of LBT raw data must be filled according to the previous requirements and under some assumptions that here we recall:

- The **dataproduct_type** field describes the scientific classification of the data product considered. Currently this classification is a controlled list of vocabulary terms such as: image, cube, spectrum, sed, timeseries, visibility, event and measurements. In the case of LBT we treat only image/cube for LBC, image/spectrum for both LUCI and MODS.
- **Calib_level**: according to IVOA standard LBT raw data are described as level 1, instrumental data in a standard format.
- **Obs_collection**: at the moment we collect LUCI data as the LBT/LUCI collection.
- **Obs_id**: at the moment we use the name of a single file as (unique) identifier.
- **Obs_publisher_did**: not delivered yet. This should/could in principle be a resolvable unique identifier for the dataset assigned by the data collection publisher.

- **Access_url**: at the moment we use the same archive URL to retrieve data.
- **Access_format**: we choose image/x-fits-gzip for both image and spectrum (being the latter treated and delivered as an image).
- **Access_estsize**: as explained in the table.
- **Target_name**: we choose to use object names as resolved by Simbad ([7]). This field is left empty when the object name provided by PI is misspelled or missing or unintentionally wrong and a coordinate query with Simbad and/or even with a query on scientific papers thorough ADS portal does not supply a unique target. These cases can be potentially solved having access to PI's proposals, even if this approach still requires a considerable human effort.
- **s_ra**, **s_dec**: as explained in the table.
- **s_fov**: we choose the diameter of a circle inscribed in a bounding box having cutted off the edges of the actual frame (in order to avoid edges effects) when a proper WCS is provided.
- **s_region**: because as archive we do not have the right algorithms to draw the footprint of each scientific frame, we use a bounding box as a precise region with which performs a positional query, when a proper WCS is provided.
- **s_xel1**, **s_xel2**: as explained in the table.
- **s_resolution** is left to NULL because we can not compute the Point Spread Function of the images.
- **t_min**, **t_max**, **t_exptime**: as explained in the table.
- **t_resolution** and **t_xel** are left to NULL, we are not working with timeseries.
- **em_min**, **em_max**: we use nominal values of the energy band of the filters as reported in [3].
- **em_res_power**: as em_min and em_max, for spectrum only.
- **em_xel** is left to NULL, there are no keywords describing this quantity in LUCI or MODS headers.
- **o_ucd**: we use phot.adu.
- **pol_states** is NULL.
- **facility_name**: LBT.
- **instrument_name**: can be LBC, LUCI or MODS.

# 5 Raw data sample

In this section are described the steps involved in selecting an appropriate (test) sample of raw datasets to turn into a prototype service.

## 5.1 Metadata

We started to investigate the feasibility of this type of activity with LUCI data because this instrument is heavily used as imager and spectrograph by the LBT community.

According to the current implementation of LUCI metadata, the combination of metadata attributes that allow the classification among images, spectra, acquisition files and darks have been carried out with the help of the Italian LBT reduction data teams. It is composed by 6 keywords: GRATNAME, MASKID, MASKSLOT, MOSPOS, FILTER1 and FILTER2, and selects files as

- dark: if FILTER1='blind' and FILTER2='blind', no matter how other keywords are filled;
- images: if GRATNAME='Mirror' and MASKID='unknown' and (MASKSLOT='unknown' or MASKSLOT='−1') and MOSPOS='no mask in use';
- acquisition files: if GRATNAME='Mirror' and MASKID>0 and MASKSLOT!='N30_FieldStop' and (MOSPOS='mask in turnout' or MOSPOS='mask in fpu');
- spectra: if MASKID>0 and MASKSLOT!='N30_FieldStop' (and GRATNAME!='Mirror' as a check); this particular condition should be enough to select all spectra except fot Adaptive Optics frames.

With acquisition files we refer to an image of the field of interest, taken with a very low exposure time, and the same image but with the slits or masks superimposed on it to verify the correctness of the alignment with the target and/or other astronomical objects (see sect. 2.1 in [11]). Since the ObsCoreDM is meant to describe only high level scientific data products, acquisition files along with dark, flat, and bias would be delivered to the final user as a set of calibration files through DataLink tool once it will be ready to use. At the moment we provide access only to the initial image/spectrum raw data via Virtual Observatory (VO) services as the aforementioned TAP and SIA.

This classification based on metadata fails when the keywords in the headers are not properly filled, e.g.:

- luci2.20160125.0045.fits.gz should be an image but due the presence of the grism the corresponding metadata are GRATNAME='G200 LoRes', MASKSLOT=-1, MASKID='unknown', MOSPOS='no mask in use'; see https://wiki.lbto.org/PartnerObserving/ObsInaf20160125
- luci2.20160130.0078.fits.gz is an acquisition file but the wrong metadata GRATNAME='G200 LoRes', MASKSLOT=12, MASKID='905822.GLASS2c', MOSPOS='mask in turnout' prevent a good classification; see https://wiki.lbto.org/PartnerObserving/ObsInaf20160130

## 5.2 Calibration and series of observations

Along with the pure scientific files the archiving system ingests all calibrations at real time. By all calibrations we mean both "technical" and "science-related" calibrations. The technical calibrations can be performed during specific periods of the observing semester, and these can be easily excluded from every kind of scientific analysis using the observing schedule, or during an observing night if some issues with instruments (related or not with bad weather) happen. The science-related calibrations are required to reduce raw data, these can be strictly related to a specific target or can be taken with a standard configuration of an instrument. During an observing semester a lot of these frames are taken also due to the peculiar location of the telescope characterized by a very varying weather conditions. In order to optimize the scientific return of an observing campaign, the scientific observer decides by time, in situ, the number of necessary calibrations, their order between different observations or some days in advance or later, as well as for any other cases. Calibrations related to specific targets can be taken more than once if, for example, scientists are obliged to reschedule that specific observation; in some cases re-observation will be performed months later. Calibrations can be repeated during the same night in case of low quality acquisition, or when the observers changes manually the instrument configuration to match the desired requirements, i.e. low counts due to an insufficient exposure time.

Actual observations (both short and long term programs) can be stopped and/or repeated if technical issues happen or due to the weather variability, i.e. increase of the seeing out of the specifications, clouds passing etc. All the scientific frames and the plethora of calibration files are archived blindly. From the metadata analysis alone it is hard to understand and recognize the relationships between good actual observations and calibrations they belong to. Some partners provide detailed public logs (see [8]) of the observation activities for each night, reporting weather condition, status of the instrument(s) during night, targets observed and almost any observative decisions taken by scientists at the telescope. Through the study of these logs it is possible to unlock the analysis of the completed observed targets, at least, using the concept of "completed program" as a first good quality hint for the raw data.

At the state-of-the-art without these logs the analysis of metadata alone is not sufficient to guarantee a reliable selection of proper datasets to be published, especially if we must take into account the different proprietary period of the data of each partner in the past. The aim of this data curation is to classify and well-form the metadata for the publishing, the drawbacks explained in these paragraphs suggest the importance of the human experience over the automation, particularly at the first stage of the data publication although it requires a lot of human effort.

# 6 Prototype LBT/LUCI ObsCore table

This prototype consists of 14 records, 5 images and 9 spectra, of the target "2MASS J05101100-0328262" taken with LUCI instrument during the 10th February 2015 night, described here: https://wiki.lbto.org/PartnerObserving/ObsInaf20150210 . The images have been taken with the filter H and 4 seconds of time exposure, while the spectra with HK and zJ filters, each of them taken with 300 seconds of exposure. The fields s_fov and s_region have been computed as described in sect. 4, treating spectra as "images" at this stage.

# 7 VO services

In the following paragraphs we describe the current VO services useful to explore the ObsCore table prototyped in this report.

The ObsCore table is the view over the test data collection. This is seen as a data resource that can be searched and accessed through the VO services seen as interfaces on top of it

## 7.1 TAP service

*The table access protocol (TAP) defines a service protocol for accessing general table data, including astronomical catalogs as well as general database tables. Access is provided for both database and table metadata as well as for actual table data* [9].

The ObsCore table can be queryable through the underlying TAP service. It can be queryable with the ADQL language using, i.e., the client TOPCAT, as shown below.

At the moment the TAP is hosted at this URL: http://archives.ia2.inaf.it/vo/tap/lbt/ and it must be inserted by hand in TOPCAT → VO → Table Access Protocol (TAP) Query → TAP URL → Use Service

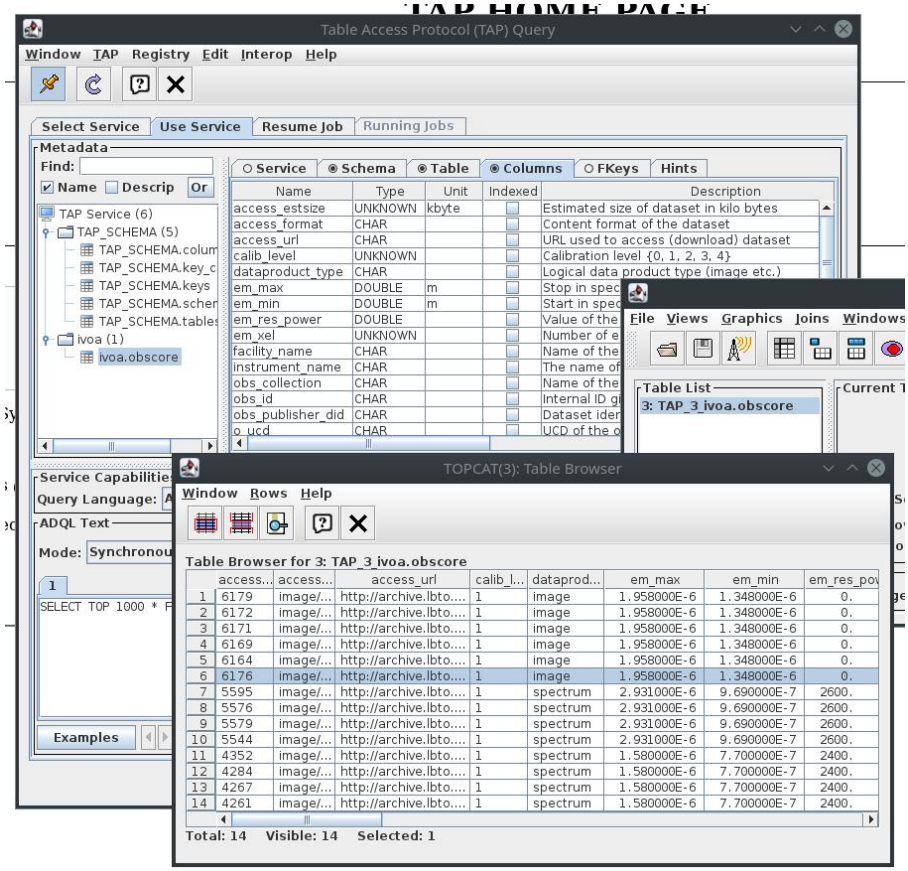


Figure 1:

## 7.2 SIA service

*The Simple Image Access protocol (SIA) provides capabilities for the discovery, description, access, and retrieval of multi-dimensional image datasets, including 2-D images as well as datacubes of three or more dimensions. SIA data discovery is based on the ObsCore Data Model (ObsCoreDM), which primarily describes data products by the physical axes (spatial, spectral, time, and polarization)* [10].

The resource described through the created ObsCore table can thus also be used as the basis for a SIA compliant service interface, temporarily hosted at http://archives.ia2.inaf.it/ivoa/siapv2/lbt/query?
.

The SIA service can be explored by the client Aladin as shown in this section. After having launched it: Aladin → File → Open server selector → VO → Generic Simple Image Access v2 query → fill the "Target field" and put the URL above in the field "Server IVOID or base URL" → SUBMIT

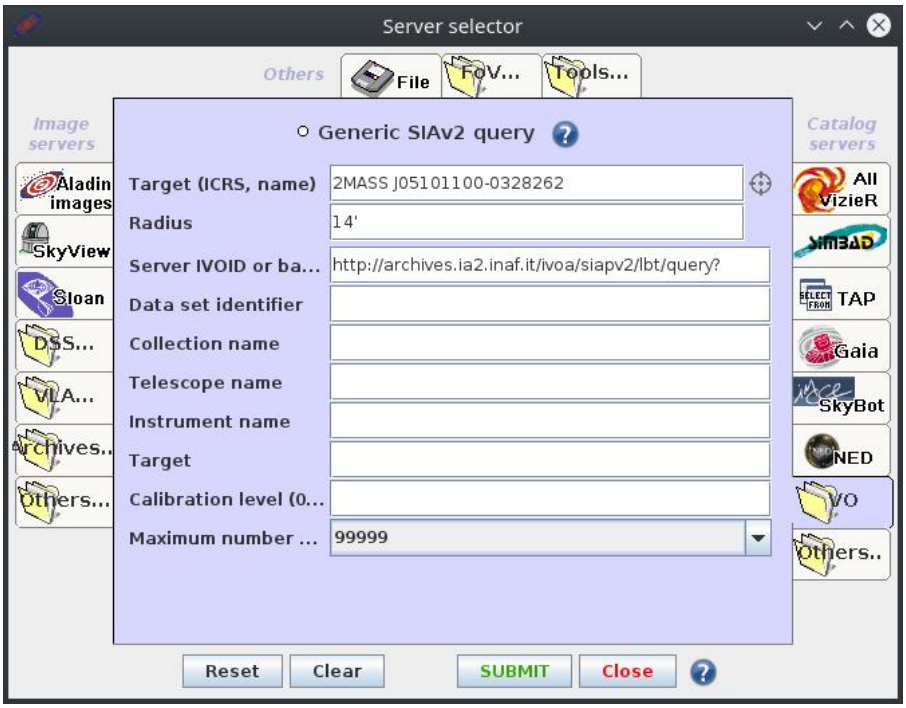


Figure 2:

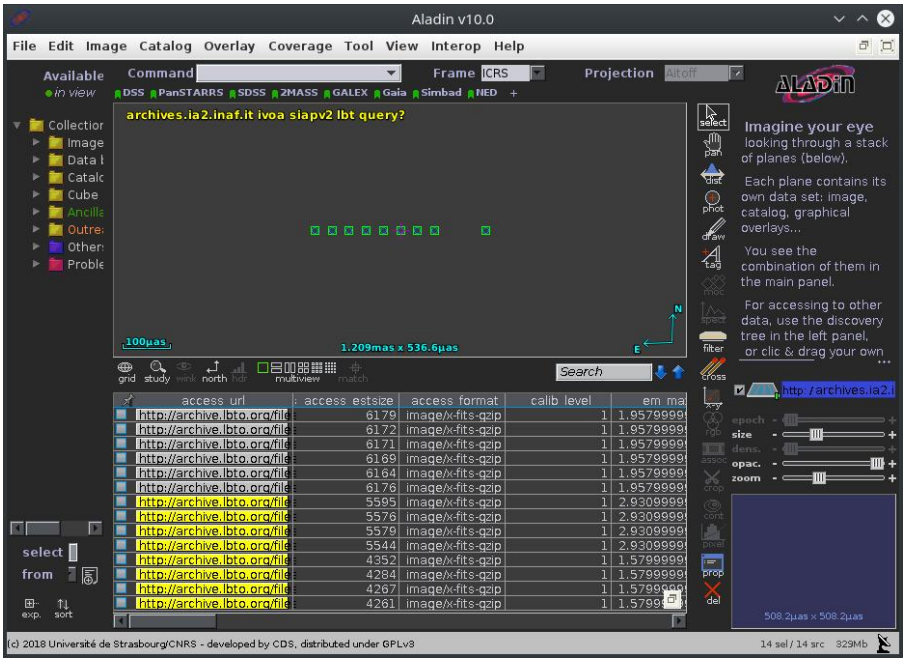


Figure 3: In this picture the ObsCore table is shown. The links to the images are colored in grey while the spectra ones are highlighted in yellow. The green small boxes in the preview window show the footprints in the sky.

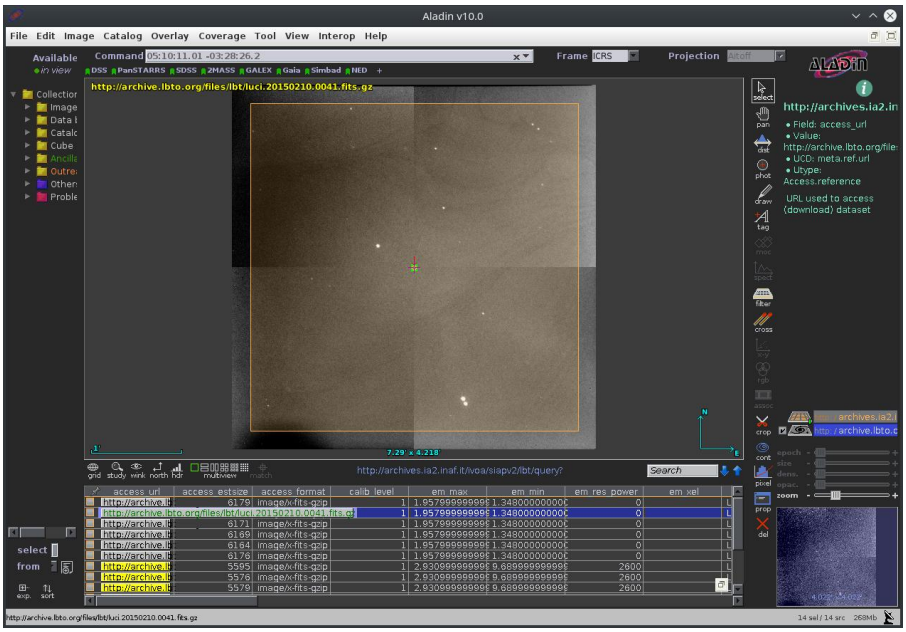


Figure 4: Here a preview of an image is shown. The orange box superimposed on the image is the representation of the s_region field of the ObsCore table

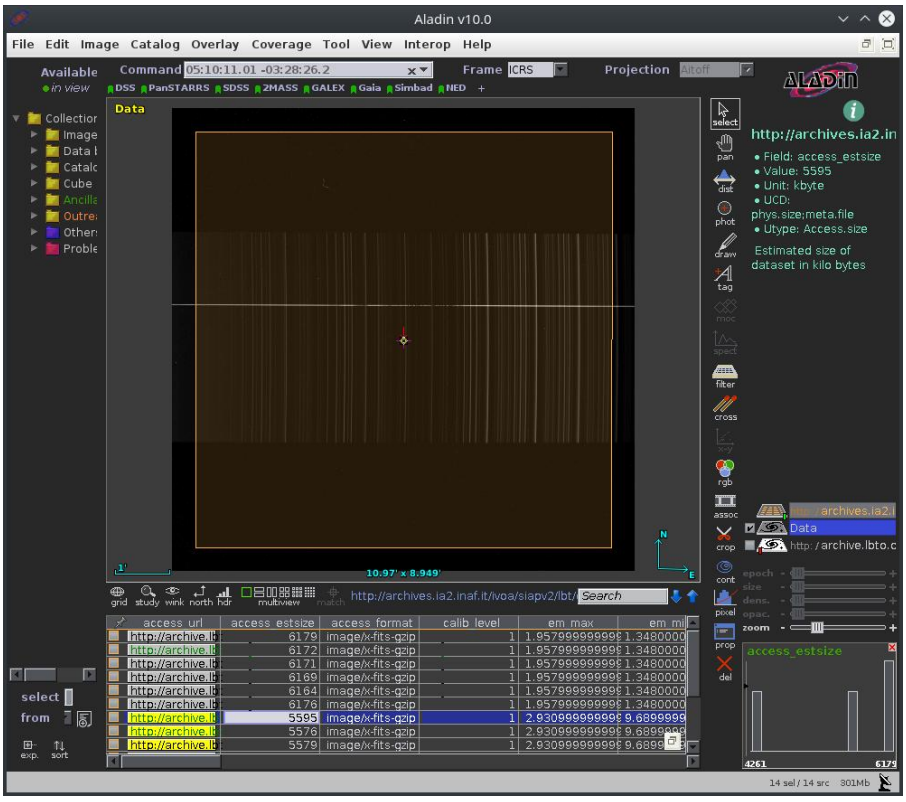


Figure 5: Same as the previous picture but for a spectrum.

# 8 Conclusions

The aim of this report is mainly to draw a possible, though arduous, strategy to collect the common metadata describing actual good raw data from a bigger collection of files. The final goal is to expose those raw observational datasets (grouped as collections) through interoperable discovery and access services using standard VO technologies.
Nevertheless, it is utterly important to highlight that the quality of this process, achieved through the analysis of the public logs of the observation activities, can not be considered at the same level as the one that can be provided by the scientists who actually performed the observations and/or reduced the raw data.
Moreover the "human" parsing of the logs comes at a high price in terms of both manpower and time dedicated resources. These could be quantified in 3.5 full-time months for 2.5 years of night logs (or about 1.5 PM per year) for only 1 partner, comprehensive of the time necessary to:

- understand the "logic" behind the observational strategy adopted (especially for a non-observative researcher starting from scratch);
- discriminating the status of short and long term programs progresses;
- keeping track of the actual calibrations related to each target (literally reading one week of logs at the same time if calibrations and science frames are acquired in different days).

Whereas this work can, in principle, help in boosting the visibility and FAIR-ness of the LBT science production, it can not be exploited only by hand by few persons as described in this document.
It is therefore recommended an agreement with the data provider to smooth out the process for acquiring and ingesting the ancillary informations here described, both in terms of the type of information needed and the technical solutions required. A suggestion could be that of finding a validated format (data domains and content) of the night logs making them parsable and then cross-checking their contents with the current metadata in archive. This will lead, finally, to a simple selection for identifying the desired files.

# A Appendix A

Here are reported all the calibrations and acquisition files related to the proper scientific data used as a prototype for the ObsCore table described in sect. 4.

```
mysql> select distinct program_tag,piname,object,objname,imagetype,obstype,date_obs
-> from luci_publication where program='PIname 1'
-> group by program_tag,piname,object,objname,imagetype,obstype order by program asc, date_obs asc;
+------------+----------+-------------+-------------------------+---------------+----------+-------------------------+
| program_tag| piname   | object      | objname                 | imagetype     | obstype  | date_obs
↪ |
+------------+----------+-------------+-------------------------+---------------+----------+-------------------------+
| PIname 1 A | PIname 1 | your object | NULL                    | FLAT          | NULL     | 2015-02-10T01:18:17.1022 |
| PIname 1 A | PIname 1 | SDSS J0510  | 2MASS J05101100-0328262 | OBJECT        | IMAGE    | 2015-02-10T02:26:43.8147 |
| PIname 1 A | PIname 1 | SDSS J0510  | 2MASS J05101100-0328262 | ACQUISITION   | NULL     | 2015-02-10T02:36:17.8256 |
| PIname 1 A | PIname 1 | SDSS J0510  | 2MASS J05101100-0328262 | OBJECT        | SPECTRUM | 2015-02-10T02:52:39.5231 |
| PIname 1 A | PIname 1 | Hip23098    | NULL                    | STANDARD STAR | NULL     | 2015-02-10T03:35:40.8054 |
| PIname 1 A | PIname 1 | NOTSPECIFIED | NULL                   | DARK          | NULL     | 2015-02-12T05:31:27.5150 |
| PIname 1 A | PIname 1 | NOTSPECIFIED | NULL                   | LAMP          | NULL     | 2015-02-12T08:37:42.6687 |
| PIname 1 A | PIname 1 | NOTSPECIFIED | NULL                   | FLAT          | NULL     | 2015-02-12T08:37:55.1345 |
+------------+----------+-------------+-------------------------+---------------+----------+-------------------------+
```

The field program_tag[1] is just an internal tag used to create a nominal link among scientific data and their calibrations. As we can see some of them, i.e. dark, flat, have been acquired two days after the actual observation.

The piname value has been anonymized in the report for privacy reasons. The value in the field objname is the corrected name of the target, it is what will appear in the ObsCore table as target_name. Fields imagetype and obstype have been corrected by hand each time to allow us to provide an easier implementation of the code generating the final ObsCore table.

# B Appendix B

In this section we list the completed targets observed analysing only INAF observing nights logs[2] from the second semester of 2014 until December 2016.

- LBT/LUCI: 50 entries that can be "safely" published.

```
mysql> select distinct program_tag,piname,object,objname,imagetype,obstype,substring(date_obs,1,10) as date_obs
    -> from luci_publication where imagetype='object'
    -> group by program_tag,piname,object,objname,imagetype,obstype order by program_tag asc, date_obs asc;
+--------------------+-----------+---------------------+-------------------------+-----------+----------+------------+
| program_tag        | piname    | object              | objname                 | imagetype | obstype  | date_obs
↪ |
+--------------------+-----------+---------------------+-------------------------+-----------+----------+------------+
| PIname 1  A        | PIname 1  | SDSS J0510          | 2MASS J05101100-0328262 | OBJECT    | IMAGE    | 2015-02-10 |
| PIname 1  A        | PIname 1  | SDSS J0510          | 2MASS J05101100-0328262 | OBJECT    | SPECTRUM | 2015-02-10 |
| PIname 1  B        | PIname 1  |                     | V* V1118 Ori            | OBJECT    | SPECTRUM | 2016-12-06 |
| PIname 1  C        | PIname 1  |                     | V* PV Cep               | OBJECT    | SPECTRUM | 2016-12-08 |
| PIname 1  C        | PIname 1  |                     | V* PV Cep               | OBJECT    | IMAGE    | 2016-12-08 |
| PIname 1  D        | PIname 1  | UZ_Tau_E            | UZ Tau E                | OBJECT    | SPECTRUM | 2016-01-25 |
| PIname 1  D        | PIname 1  | UZ_Tau_E            | UZ Tau E                | OBJECT    | IMAGE    | 2016-01-25 |
| PIname 1  E        | PIname 1  | V1118_Ori           | V* V1118 Ori            | OBJECT    | IMAGE    | 2016-01-25 |
| PIname 1  E        | PIname 1  | V1118_Ori           | V* V1118 Ori            | OBJECT    | SPECTRUM | 2016-01-25 |
| PIname 1  F        | PIname 1  | V1647_Ori           | V* V1647 Ori            | OBJECT    | IMAGE    | 2016-01-25 |
| PIname 1  F        | PIname 1  | V1647_Ori           | V* V1647 Ori            | OBJECT    | SPECTRUM | 2016-01-25 |
| PIname 1  G        | PIname 1  | V1118_Ori           | V* V1118 Ori            | OBJECT    | SPECTRUM | 2016-03-02 |
| PIname 1  H        | PIname 1  | DR_Tau              | V* DR Tau               | OBJECT    | IMAGE    | 2016-03-04 |
| PIname 1  H        | PIname 1  | DR_Tau              | V* DR Tau               | OBJECT    | SPECTRUM | 2016-03-04 |
| PIname 1  I        | PIname 1  | VY_Tau              | V* VY Tau               | OBJECT    | SPECTRUM | 2016-03-04 |
```

[1] We created other tables to store all the informations we need to publish raw data.

[2] To be safe against different proprietary period of raw data of the others partner for observations in the past (earlier than the end of 2018).

| | | | | | | |
|---|---|---|---|---|---|---|
| PIname 1 I | PIname 1 | VY_Tau | V* VY Tau | OBJECT | IMAGE | 2016-03-04 |
| PIname 1 L | PIname 1 | | V* V2492 Cyg | OBJECT | SPECTRUM | 2016-11-08 |
| PIname 2 A4-H2 | PIname 2 | G24.78+0.08 | GAL 024.78+00.08 | OBJECT | IMAGE | 2016-05-03 |
| PIname 2 A4-Ks | PIname 2 | G24.78+0.08 | GAL 024.78+00.08 | OBJECT | IMAGE | 2016-05-03 |
| PIname 2 A5-H2 | PIname 2 | G28.87+0.07 | GAL 028.86-00.07 | OBJECT | IMAGE | 2016-05-05 |
| PIname 2 A5-Ks | PIname 2 | G28.87+0.07 | GAL 028.86-00.07 | OBJECT | IMAGE | 2016-05-05 |
| PIname 3 | PIname 3 | DSF2237b_Cresci | DSF2237b | OBJECT | IMAGE | 2014-10-30 |
| PIname 4 E | PIname 4 | 2XMMJ123204.9+215254 | 2XMMJ123204.9+215254 | OBJECT | SPECTRUM | 2015-04-29 |
| PIname 4 F | PIname 4 | 2XMMJ135055.7+642857 | 2XMMJ135055.7+642857 | OBJECT | SPECTRUM | 2015-04-28 |
| PIname 4 G | PIname 4 | 2XMMJ143623.8+631726 | 2XMMJ143623.8+631726 | OBJECT | SPECTRUM | 2015-04-28 |
| PIname 5 A1 | PIname 5 | ID3605 | NULL | OBJECT | SPECTRUM | 2015-12-01 |
| PIname 5 A2 | PIname 5 | ID3605 | NULL | OBJECT | SPECTRUM | 2016-01-25 |
| PIname 5 A3 | PIname 5 | ID3605 | NULL | OBJECT | SPECTRUM | 2016-01-28 |
| PIname 5 A4 | PIname 5 | ID3605 | NULL | OBJECT | SPECTRUM | 2016-01-29 |
| PIname 6 A1-Br_Gam | PIname 6 | M0717 | MACS J0717.5+3745 | OBJECT | IMAGE | 2015-11-29 |
| PIname 6 A1-Br_Gam | PIname 6 | M0717 | MACS J0717.5+3745 | OBJECT | IMAGE | 2015-12-02 |
| PIname 6 A1-H2 | PIname 6 | M0717 | MACS J0717.5+3745 | OBJECT | IMAGE | 2015-11-25 |
| PIname 6 A1-H2 | PIname 6 | M0717 | MACS J0717.5+3745 | OBJECT | IMAGE | 2015-12-02 |
| PIname 6 A2-Br_Gam | PIname 6 | M0717 | MACS J0717.5+3745 | OBJECT | IMAGE | 2016-01-25 |
| PIname 6 A2-H2 | PIname 6 | M0717 | MACS J0717.5+3745 | OBJECT | IMAGE | 2016-01-26 |
| PIname 7 A1 | PIname 7 | 0745+4734 | QSO J0745+4734 | OBJECT | SPECTRUM | 2015-02-11 |
| PIname 7 A2 | PIname 7 | 0801+5210 | NULL | OBJECT | SPECTRUM | 2015-02-11 |
| PIname 7 A3 | PIname 7 | 0900+4215 | QSO J0900+4215 | OBJECT | SPECTRUM | 2015-02-11 |
| PIname 7 A4 | PIname 7 | 0958+2827 | 2MASS J09584122+2827291 | OBJECT | SPECTRUM | 2015-03-22 |
| PIname 7 A5 | PIname 7 | 1201+0116 | QSO J1201+0116 | OBJECT | SPECTRUM | 2015-04-28 |
| PIname 7 A6 | PIname 7 | 1535+0855 | QSO J1538+0855 | OBJECT | SPECTRUM | 2015-04-28 |
| PIname 7 B1-1 | PIname 7 | 1106+6400 | SDSS J110610.71+640010.0 | OBJECT | SPECTRUM | 2015-03-23 |
| PIname 7 B1-2 | PIname 7 | 1106+6400 | SDSS J110610.71+640010.0 | OBJECT | SPECTRUM | 2015-04-28 |
| PIname 7 B3 | PIname 7 | 2123-0050 | QSO 2123-0050 | OBJECT | SPECTRUM | 2015-06-22 |
| PIname 8 DDT | PIname 8 | LH_USS1 | [MPN2016] LH4721 | OBJECT | SPECTRUM | 2016-03-04 |
| PIname 9 A2 | PIname 9 | | NGC 2712 | OBJECT | SPECTRUM | 2016-12-08 |
| PIname 9 B1 | PIname 9 | | 2MASX J00040192+7019185 | OBJECT | SPECTRUM | 2016-11-08 |
| PIname 9 B2 | PIname 9 | | Cyg A | OBJECT | SPECTRUM | 2016-11-07 |
| PIname 10 Too | PIname 10 | GRB151027A | GRB 151027A | OBJECT | IMAGE | 2015-11-30 |
| PIname 10 Too | PIname 10 | darkgrb | GRB 151027A | OBJECT | IMAGE | 2015-11-30 |

The field date_obs (here is reported the date only for printing purpose) indicates the day in which each subset of observations has been acquired.

- LBT/MODS: 76 entries.

```
mysql> select distinct program_tag,piname,object,objname,imagetyp,obs_type,substring(date_obs,1,10) as date_obs
    -> from mods_publication where imagetyp='object' and object not like '% Acquisition'
    -> group by program_tag,piname,object,objname,imagetyp,obs_type order by program_tag asc, date_obs asc;
```

| program_tag | piname | object | objname | imagetyp | obs_type | date_obs |
|---|---|---|---|---|---|---|
| PIname 1 A | PIname 1 | DDO68 runb | UGC 5340 | OBJECT | SPECTRUM | 2016-12-06 |
| PIname 2 B | PIname 2 | v1143 Ori | V* V1143 Ori | OBJECT | IMAGE | 2014-12-21 |
| PIname 2 C | PIname 2 | VY Tau | V* VY Tau | OBJECT | SPECTRUM | 2014-12-21 |
| PIname 2 D | PIname 2 | VY Tau | V* VY Tau | OBJECT | IMAGE | 2014-12-21 |
| PIname 2 E | PIname 2 | SDSSJ0510 | SDSS J051011.01-032826.2 | OBJECT | SPECTRUM | 2014-12-21 |
| PIname 2 F | PIname 2 | SDSSJ0510 | SDSS J051011.01-032826.2 | OBJECT | IMAGE | 2014-12-21 |
| PIname 2 G | PIname 2 | XZ Tau | V* XZ Tau | OBJECT | SPECTRUM | 2014-12-21 |
| PIname 2 H | PIname 2 | XZ Tau | V* XZ Tau | OBJECT | IMAGE | 2014-12-21 |
| PIname 2 I | PIname 2 | NY Ori | V* NY Ori | OBJECT | SPECTRUM | 2014-12-21 |
| PIname 2 L | PIname 2 | NY Ori | V* NY Ori | OBJECT | IMAGE | 2014-12-21 |
| PIname 2 M | PIname 2 | v1143 Ori | V* V1143 Ori | OBJECT | SPECTRUM | 2014-12-21 |
| PIname 2 N | PIname 2 | UZ Tau E | UZ Tau E | OBJECT | SPECTRUM | 2014-12-22 |
| PIname 2 O | PIname 2 | V1118 Ori | V* V1118 Ori | OBJECT | SPECTRUM | 2014-12-22 |
| PIname 2 P | PIname 2 | V1184 Tau | V* V1184 Tau | OBJECT | SPECTRUM | 2014-12-22 |
| PIname 2 Q | PIname 2 | V1184 Tau | V* V1184 Tau | OBJECT | IMAGE | 2014-12-22 |
| PIname 2 R1 | PIname 2 | v2492 Cyg | V* V2492 Cyg | OBJECT | IMAGE | 2015-06-24 |
| PIname 2 R2 | PIname 2 | v2492 Cyg | V* V2492 Cyg | OBJECT | SPECTRUM | 2015-06-24 |
| PIname 2 R3 | PIname 2 | v2493 Cyg | V* V2493 Cyg | OBJECT | IMAGE | 2015-06-24 |
| PIname 2 R4 | PIname 2 | v2493 Cyg | V* V2493 Cyg | OBJECT | SPECTRUM | 2015-06-24 |
| PIname 2 R5 | PIname 2 | PV Cep | V* PV Cep | OBJECT | IMAGE | 2015-06-24 |
| PIname 2 R6 | PIname 2 | PV Cep | V* PV Cep | OBJECT | SPECTRUM | 2015-06-24 |
| PIname 2 S1 | PIname 2 | V1118 Ori | V* V1118 Ori | OBJECT | SPECTRUM | 2015-10-01 |
| PIname 2 S2 | PIname 2 | SDSSJ0510 | SDSS J051011.01-032826.2 | OBJECT | IMAGE | 2015-10-01 |
| PIname 2 S3 | PIname 2 | SDSSJ0510 | SDSS J051011.01-032826.2 | OBJECT | SPECTRUM | 2015-10-01 |
| PIname 2 S4 | PIname 2 | V512 Per | V* V512 Per | OBJECT | IMAGE | 2015-10-01 |
| PIname 2 S5 | PIname 2 | V512 Per | V* V512 Per | OBJECT | SPECTRUM | 2015-10-01 |
| PIname 2 S6 | PIname 2 | V1118 Ori | V* V1118 Ori | OBJECT | IMAGE | 2015-10-01 |
| PIname 2 T | PIname 2 | V1118 Ori | V* V1118 Ori | OBJECT | SPECTRUM | 2016-01-12 |
| PIname 2 U1 | PIname 2 | V1118 Ori | V* V1118 Ori | OBJECT | SPECTRUM | 2016-12-04 |
| PIname 2 U2 | PIname 2 | V1118 Ori | V* V1118 Ori | OBJECT | IMAGE | 2016-12-04 |
| PIname 3 DDT1 | PIname 3 | SECCO_C1 | [RDS2004] MGS sure 21 | OBJECT | SPECTRUM | 2016-03-03 |
| PIname 3 DDT2 | PIname 3 | SECCO_C2 | APMUKS (BJ) B114159.94-003523.7 | OBJECT | SPECTRUM | 2016-03-03 |
| PIname 4 B | PIname 4 | 2XMMJ135055.7+642857 | 2XMM J135055.7+642857 | OBJECT | SPECTRUM | 2016-07-03 |
| PIname 4 A | PIname 4 | 2XMMJ100038.9+050955 | 2XMMJ100038.9+050955 | OBJECT | SPECTRUM | 2014-12-21 |
| PIname 5 A | PIname 5 | Fiore GOODS-North Field 1 | GOODS-North Field | OBJECT | SPECTRUM | 2015-03-21 |
| PIname 6 L | PIname 6 | P04 | PA-4 | OBJECT | SPECTRUM | 2014-09-20 |
| PIname 6 M | PIname 6 | P09 | PA-9 | OBJECT | SPECTRUM | 2014-09-20 |
| PIname 6 N | PIname 6 | P46 | PA-46 | OBJECT | SPECTRUM | 2014-09-20 |
| PIname 6 O | PIname 6 | MCGC9 | [HTF2008] H24 | OBJECT | SPECTRUM | 2014-09-21 |
| PIname 6 P | PIname 6 | MCGC8 | [HTF2008] H23 | OBJECT | SPECTRUM | 2014-09-20 |
| PIname 6 Q | PIname 6 | B517 | Bol 517 | OBJECT | SPECTRUM | 2014-10-28 |
| PIname 6 R | PIname 6 | H2 | [HTF2008] H2 | OBJECT | SPECTRUM | 2014-10-28 |
| PIname 6 S | PIname 6 | H7 | [HTF2008] H7 | OBJECT | SPECTRUM | 2014-10-29 |
| PIname 6 T | PIname 6 | G002 | Mayall II | OBJECT | SPECTRUM | 2014-10-29 |
| PIname 7 VF1 | PIname 7 | Giallongo VIRGO Point 1 | VIRGO CLUSTER | OBJECT | SPECTRUM | 2016-05-03 |
| PIname 7 VF2 | PIname 7 | Giallongo VIRGO Point 2 | VIRGO CLUSTER | OBJECT | SPECTRUM | 2016-05-03 |
| PIname 8 A | PIname 8 | Grazian SDSS36 Point 1 | SDSS J014757.45+273326.7 | OBJECT | SPECTRUM | 2016-11-05 |
| PIname 9 A1 | PIname 9 | CATSJ021950 | CATSJ021950 | OBJECT | SPECTRUM | 2015-02-13 |
| PIname 9 A4 | PIname 9 | CXOUJ204734 | CXOUJ204734 | OBJECT | SPECTRUM | 2015-06-22 |
| PIname 9 A5 | PIname 9 | CXOUJ215447 | CXOUJ215447 | OBJECT | SPECTRUM | 2015-06-23 |
| PIname 9 A6 | PIname 9 | CXOUJ215544 | CXOUJ215544 | OBJECT | SPECTRUM | 2015-06-20 |
| PIname 9 A7 | PIname 9 | CATSJ193437 | CXO j193437.8+302524 | OBJECT | SPECTRUM | 2015-06-21 |
| PIname 10 M12 | PIname 10 | Messier 12 | M 12 | OBJECT | SPECTRUM | 2015-06-20 |
| PIname 10 M15 | PIname 10 | M 15 | M 15 | OBJECT | SPECTRUM | 2015-06-25 |
| PIname 10 M71 | PIname 10 | M 71 | M 71 | OBJECT | SPECTRUM | 2015-06-22 |
| PIname 11 A | PIname 11 | 3FGL_J0258.2+3555 | 3FGL J0258.2+3555 | OBJECT | SPECTRUM | 2016-12-07 |
| PIname 12 MOS 20 A | PIname 12 | SDSSJ1411 M20 | SDSS J141111.27+121737.3 | OBJECT | SPECTRUM | 2015-02-13 |
| PIname 12 MOS 20 B | PIname 12 | SDSSJ1411 M20 | SDSS J141111.27+121737.3 | OBJECT | SPECTRUM | 2015-03-22 |

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| PIname 12 MOS 21 A | PIname 12 | SDSSJ1411 M21          | SDSS J141111.27+121737.3       | OBJECT   | SPECTRUM | 2015-03-23 |
| PIname 12 MOS 21 B | PIname 12 | SDSSJ1411 M21          | SDSS J141111.27+121737.3       | OBJECT   | SPECTRUM | 2015-06-21 |
| PIname 12 MOS 21 B | PIname 12 | SDSSJ1411 M21          | SDSS J141111.27+121737.3       | OBJECT   | SPECTRUM | 2015-06-22 |
| PIname 12 MOS 22 A | PIname 12 | SDSSJ1148 M22          | SDSS J114816.64+525150.3       | OBJECT   | SPECTRUM | 2015-01-15 |
| PIname 12 MOS 22 B | PIname 12 | SDSSJ1148 M22          | SDSS J114816.64+525150.3       | OBJECT   | SPECTRUM | 2015-02-11 |
| PIname 13 GJ       | PIname 13 | GJ3470b                | GJ 3470 b                      | OBJECT   | SPECTRUM | 2016-01-14 |
| PIname 13 HAT-32   | PIname 13 | HAT-32                 | HAT-32                         | OBJECT   | SPECTRUM | 2014-10-31 |
| PIname 13 WASP-52  | PIname 13 | WASP-52                | WASP-52                        | OBJECT   | SPECTRUM | 2015-10-01 |
| PIname 14 A17      | PIname 14 | MCGC8-H23              | [HTF2008] H23                  | OBJECT   | SPECTRUM | 2016-11-05 |
| PIname 14 A5       | PIname 14 | PAndAS-17              | PAndAS-17                      | OBJECT   | SPCETRUM | 2016-11-05 |
| PIname 14 H12      | PIname 14 | H12                    | [HTF2008] H12                  | OBJECT   | SPECTRUM | 2016-12-07 |
| PIname 14 H18      | PIname 14 | H18                    | [HTF2008] H18                  | OBJECT   | SPECTRUM | 2016-12-07 |
| PIname 15 B        | PIname 15 | RDCS mask 1            | RDCS J0848+4453                | OBJECT   | SPECTRUM | 2015-02-13 |
| PIname 15 F        | PIname 15 | XLSS_mask1             | XLSS J022303.3-043621          | OBJECT   | SPECTRUM | 2014-10-28 |
| PIname 15 V        | PIname 15 | M003XLSms1             | XLSS J022303.3-043621          | OBJECT   | SPECTRUM | 2015-11-07 |
| PIname 15 W1       | PIname 15 | M004XLSms2             | XLSS J022303.3-043621          | OBJECT   | SPECTRUM | 2015-11-09 |
| PIname 15 W2       | PIname 15 | M004XLSms2             | M004XLSms2                     | OBJECT   | SPECTRUM | 2016-01-12 |
| PIname 15 Z        | PIname 15 | M003XLSms1             | XLSS J022303.3-043621          | OBJECT   | SPECTRUM | 2015-10-02 |
| PIname 16 A        | PIname 16 | M024ngc4535            | NGC 4535                       | OBJECT   | SPECTRUM | 2015-02-11 |
| PIname 17 A        | PIname 17 | J1935+1726             | PSR J1935+1726                 | OBJECT   | SPECTRUM | 2016-07-03 |
+--------------------+-----------+------------------------+--------------------------------+----------+----------+------------+
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- LBT/LBC: 81 entries.

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mysql> select distinct program_tag,piname,object,objname,obs_type,substring(date_obs,1,10) as date_obs
    -> from lbc_publication where obs_type='object'
    -> group by program_tag,piname,object,objname,obs_type order by program_tag asc, date_obs asc;
+--------------------+-----------+---------------+----------------------------------+----------+------------+
| program_tag        | piname    | object        | objname                          | obs_type | date_obs
↪ |
+--------------------+-----------+---------------+----------------------------------+----------+------------+
| PIname 1           | PIname 1  | DDO68         | UGC 5340                         | object   | 2016-01-12 |
| PIname 1 R1        | PIname 1  | UGC685        | UGC 685                          | object   | 2016-11-05 |
| PIname 1 R10       | PIname 1  | UGC3974       | UGC 3974                         | object   | 2016-11-07 |
| PIname 1 R2        | PIname 1  | UGC1249       | UGC 1249                         | object   | 2016-11-06 |
| PIname 1 R3        | PIname 1  | UGC1281       | UGC 1281                         | object   | 2016-11-07 |
| PIname 1 R8        | PIname 1  | UGC3755       | UGC 3755                         | object   | 2016-11-05 |
| PIname 2           | PIname 2  | IGR J00291+59 | IGR J00291+5934                  | object   | 2016-11-06 |
| PIname 3 A2        | PIname 3  | 063.7+33.3    | [DPP2015] 3                      | object   | 2015-11-07 |
| PIname 3 B2        | PIname 3  | 084.4+24.0    | [SPG2012] 084.4+24.0+152         | object   | 2015-11-07 |
| PIname 3 C         | PIname 3  | 086.4+31.8    | [SPG2012] 086.4+31.8+612         | object   | 2016-01-12 |
| PIname 3 C1        | PIname 3  | 086.4+31.8    | [SPG2012] 086.4+31.8+612         | object   | 2016-11-05 |
| PIname 3 C2        | PIname 3  | 086.4+31.8    | [SPG2012] 086.4+31.8+612         | object   | 2015-11-07 |
| PIname 3 D         | PIname 3  | 090.9+30.9    | [SPG2012] 090.9+30.9+266         | object   | 2016-01-13 |
| PIname 3 D2        | PIname 3  | 090.9+30.9    | [SPG2012] 090.9+30.9+266         | object   | 2015-11-07 |
| PIname 3 DDT1      | PIname 3  | SECCO_C1      | [RDS2004] MGS sure 21            | object   | 2016-03-03 |
| PIname 3 DDT2      | PIname 3  | SECCO_C2      | APMUKS (BJ) B114159.94-003523.7  | object   | 2016-03-03 |
| PIname 3 E2        | PIname 3  | 092.1+09.5    | [SPG2012] 092.1+09.5+584         | object   | 2015-11-07 |
| PIname 3 F2        | PIname 3  | 100.0+36.7    | [SPG2012] 100.0+36.7+417         | object   | 2015-11-07 |
| PIname 3 G2        | PIname 3  | 100.9+09.2    | [SPG2012] 100.9+09.2+311         | object   | 2015-11-07 |
| PIname 3 H         | PIname 3  | 104.4+04.1    | [SPG2012] 104.4+04.1-145         | object   | 2015-11-08 |
| PIname 3 I         | PIname 3  | 143.7+12.9    | [SPG2012] 143.7+12.9+223         | object   | 2016-01-12 |
| PIname 3 I2        | PIname 3  | 143.7+12.9    | [SPG2012] 143.7+12.9+223         | object   | 2016-12-05 |
| PIname 3 J         | PIname 3  | 147.0+07.1    | [SPG2012] 147.0+07.1+525         | object   | 2016-01-12 |
| PIname 3 J2        | PIname 3  | 147.0+07.1    | [SPG2012] 147.0+07.1+525         | object   | 2016-12-05 |
| PIname 3 K         | PIname 3  | 183.0+04.4    | [SPG2012] 183.0+04.4-112         | object   | 2016-01-12 |
| PIname 3 L         | PIname 3  | 195.9+06.9    | [SPG2012] 195.9+06.9-100         | object   | 2016-01-12 |
| PIname 3 M         | PIname 3  | 196.6+06.5    | [DPP2015] 11                     | object   | 2016-01-12 |
| PIname 3 N1        | PIname 3  | 331.8+21.0    | [SPG2012] 331.8+21.0+303         | object   | 2015-10-02 |
| PIname 3 O1        | PIname 3  | 339.0+09.0    | [SPG2012] 339.0+09.0-237         | object   | 2015-10-02 |
| PIname 3 O2        | PIname 3  | 339.0+09.0    | [SPG2012] 339.0+09.0-237         | object   | 2015-11-07 |
| PIname 3 P1        | PIname 3  | 341.7+07.7    | [DPP2015] 14                     | object   | 2015-10-02 |
| PIname 3 P2        | PIname 3  | 341.7+07.7    | [DPP2015] 14                     | object   | 2015-11-07 |
| PIname 3 Q1        | PIname 3  | 342.1+20.6    | [SPG2012] 342.1+20.6+208         | object   | 2015-10-02 |
| PIname 3 Q2        | PIname 3  | 342.1+20.6    | [SPG2012] 342.1+20.6+208         | object   | 2015-11-07 |
| PIname 3 R1        | PIname 3  | 345.0+07.0    | LEDA 1311801                     | object   | 2015-10-02 |
| PIname 4 A1        | PIname 4  | MACSJ0717.5   | MACS J0717.5+3745                | object   | 2015-11-08 |
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|---|---|---|---|---|---|
| PIname 4 A2 | PIname 4 | MACSJ0717.5 | MACS J0717.5+3745 | object | 2015-11-09 |
| PIname 4 A3 | PIname 4 | MACSJ0717.5 | MACS J0717.5+3745 | object | 2016-01-13 |
| PIname 4 A4 | PIname 4 | MACSJ0717.5 | MACS J0717.5+3745 | object | 2016-02-29 |
| PIname 4 A5 | PIname 4 | MACSJ0717.5 | MACS J0717.5+3745 | object | 2016-03-03 |
| PIname 4 A6 | PIname 4 | MACSJ0717.5 | MACS J0717.5+3745 | object | 2016-11-05 |
| PIname 5 P1 | PIname 5 | Pegasus_III | Pegasus III | object | 2015-10-02 |
| PIname 5 P1 | PIname 5 | Pisces_II | Pisces II | object | 2015-10-02 |
| PIname 5 P2 | PIname 5 | Pegasus_III | Pegasus III | object | 2015-11-07 |
| PIname 5 P2 | PIname 5 | Pisces_II | Pisces II | object | 2015-11-07 |
| PIname 5 P3 | PIname 5 | Pegasus_III | Pegasus III | object | 2015-11-09 |
| PIname 5 P3 | PIname 5 | Pisces_II | Pisces II | object | 2015-11-09 |
| PIname 5 P4 | PIname 5 | Pegasus_III | Pegasus III | object | 2015-12-01 |
| PIname 5 P4 | PIname 5 | Pisces_II | Pisces II | object | 2015-12-01 |
| PIname 6 A | PIname 6 | N188 | NGC 188 | object | 2015-11-30 |
| PIname 6 B | PIname 6 | Tr5 | NULL | object | 2016-01-13 |
| PIname 7 B | PIname 7 | 2014KC46 | 2014 KC46 | object | 2014-10-28 |
| PIname 7 A | PIname 7 | 426071 | NULL | object | 2016-03-01 |
| PIname 7 A | PIname 7 | 267221 | NULL | object | 2016-03-01 |
| PIname 7 A | PIname 7 | 2007VA85 | NULL | object | 2016-03-01 |
| PIname 7 A | PIname 7 | 313276 | NULL | object | 2016-03-01 |
| PIname 8 A | PIname 8 | GOODS-NORTH | GOODS-North Field | object | 2015-03-21 |
| PIname 9 VF1 | PIname 9 | VIRGO | VIRGO CLUSTER | object | 2016-05-03 |
| PIname 9 VF2 | PIname 9 | VIRGO | VIRGO CLUSTER | object | 2016-05-03 |
| PIname 10 A3 | PIname 10 | J1148+52 | NULL | object | 2016-01-28 |
| PIname 11 A1 | PIname 11 | IZw18 | I Zw 18 | object | 2016-01-12 |
| PIname 11 A2 | PIname 11 | IZw18 | I Zw 18 | object | 2016-01-27 |
| PIname 11 A3 | PIname 11 | IZw18 | I Zw 18 | object | 2016-02-29 |
| PIname 11 A4 | PIname 11 | IZw18 | I Zw 18 | object | 2016-03-02 |
| PIname 12 | PIname 12 | J2043+2740 | PSR J2043+2740 | object | 2016-07-04 |
| PIname 13 MOS 20-1 | PIname 13 | J1411+12 | NULL | object | 2015-02-13 |
| PIname 13 MOS 20-2 | PIname 13 | J1411+12 | NULL | object | 2015-02-14 |
| PIname 13 MOS 20-3 | PIname 13 | J1411+12 | NULL | object | 2015-03-22 |
| PIname 13 MOS 21-1 | PIname 13 | J1411+12 | NULL | object | 2015-03-23 |
| PIname 13 MOS 21-2 | PIname 13 | J1411+12 | NULL | object | 2015-06-21 |
| PIname 13 MOS 21-3 | PIname 13 | J1411+12 | NULL | object | 2015-06-22 |
| PIname 13 MOS 22-1 | PIname 13 | J1148+52 | NULL | object | 2015-01-15 |
| PIname 13 MOS 22-2 | PIname 13 | J1148+52 | NULL | object | 2015-01-16 |
| PIname 13 MOS 22-3 | PIname 13 | J1148+52 | NULL | object | 2015-02-10 |
| PIname 13 MOS 22-4 | PIname 13 | J1148+52 | NULL | object | 2015-02-11 |
| PIname 14 GJ | PIname 14 | GJ3470 | GJ 3470 b | object | 2016-01-14 |
| PIname 14 HAT-32 | PIname 14 | hat-p-32 | HAT-32 | object | 2014-10-31 |
| PIname 14 WASP-52 | PIname 14 | wasp52 | WASP-52 | object | 2015-10-01 |
| PIname 15 Too | PIname 15 | GRB151027A | GRB 151027A | object | 2015-11-30 |
| PIname 15 Too 2 | PIname 15 | GRB151027A | GRB 151027A | object | 2016-01-27 |
| PIname 16 F | PIname 16 | XLSSm1 | XLSS J022303.3-043621 | object | 2014-10-29 |

The main difference between the LBT/LUCI ObsCore table and the analogous tables for LBT/MODS and LBT/LBC rely on the way we can compute the s_region field.

Currently, the MODS FITS headers do not provide any World Coordinate System keywords thus the safest choices to compute the s_fov and s_region fields we adopted are: s_fov is the diameter of the circumscribed circle of the field in order to take into account all the possible orientations of the instrument with respect to the telescope pointing; s_region is, as a consequence, the box circumscribed to this circle. This "conservative" choice still allows users to perform reliable positional queries.

The lack of WCS annotation in the MODS FITS header makes it impossible to client applications (like Aladin) to visualize the footprint on top of a sky reference frame. This happens because the astrometric content provided in the obscore table is part of that table and not of the dataset.

Whilst a minimal WCS keyword set can, in principle, be added to the MODS datasets to overcome this issue, we prefer not doing so. This is to avoid providing a misleading WCS content in the FITS header that would be confusing for the final users who, when accessing the dataset alone, will use a wrong astrometric calibration without being aware of it. Therefore, we strongly suggest to the data provider to deliver final raw data with the appropriate WCS keywords in them.

The single LBC camera is equipped with four science CCDs arranged in a mosaic with three of them aligned

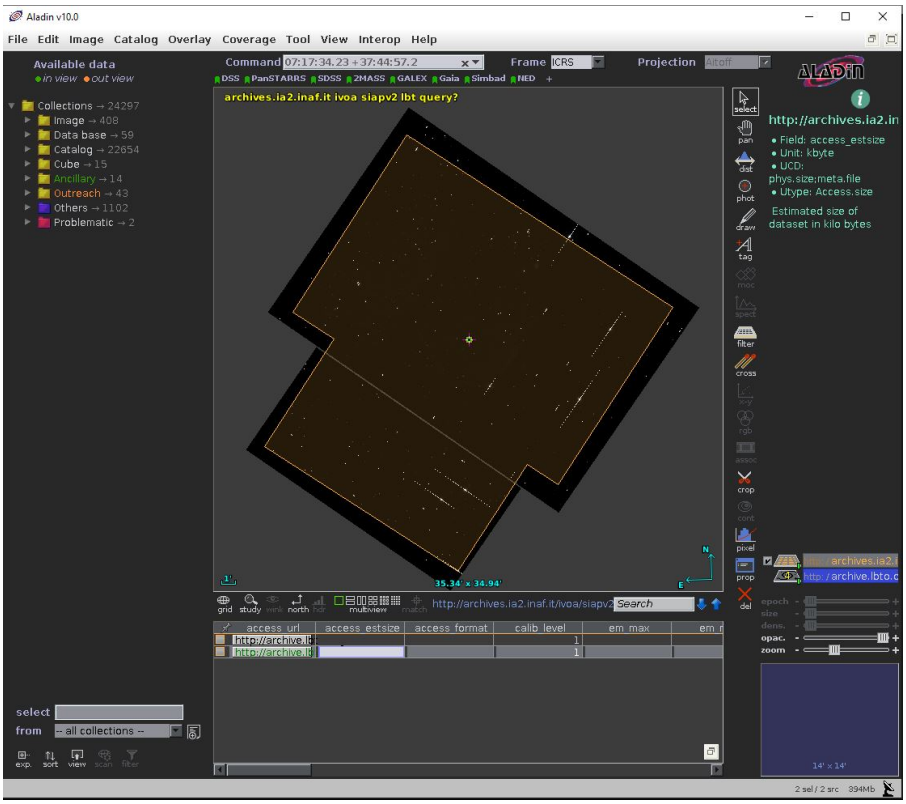


Figure 6: The proposed footprint for raw LBC images displayed in Aladin.

with each other, while the fourth CCD is rotated clockwise 90 degrees and centered along the top of the others. All the four CCDs have a gap of 70 pixels among them. A full LBC image is a mosaic of four chips stored in a multi-extension FITS, each one with its own WCS set of keywords referring to a common pointing. In this case we compute the s_region as a polygon containing the entire field of view using only the WCS of the central chip, and the s_fov as the diameter of the circle that best encompasses the s_region.