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Data Management and Operations Division

Phase 3 User Documentation

ESO Catalogue Facility User Manual

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1 Overview

The ESO Catalogue Facility provides access to the astronomical source catalogues and other scientific data in tabular format that is being ingested into the ESO science archive through the Phase 3 process. It is designed to serve the catalogue data resulting from the ESO Public Surveys and other ESO observing programmes including multi-colour photometric source catalogues, multi-epoch photometry (a.k.a. light curves), catalogues of variables, proper motion catalogues, target catalogues for spectroscopic surveys, galaxy redshift catalogues, catalogues of stellar properties and chemical abundances.

The Catalogue Facility, developed by ESO's Software Development Division, complements the existing functionalities of the ESO Science Archive Facility by adding the capability to query each catalogue by content using positional and non-positional constraints and, finally, to download the resulting data set for further scientific analysis. To this end the catalogue data is stored in a dedicated data base system from which the download data is extracted on request according to the constraints and output format specified by the user.

The typical workflow using the Catalogue Facility consists of the following steps: 1) Choose the catalogue of interest; 2) Define the query constraints; 3) Execute the query (SEARCH); 4) Review the query result; 5) Refine the query constraints and repeat the search if needed; 6) Download the catalogue data set resulting from the query (Figure 1).

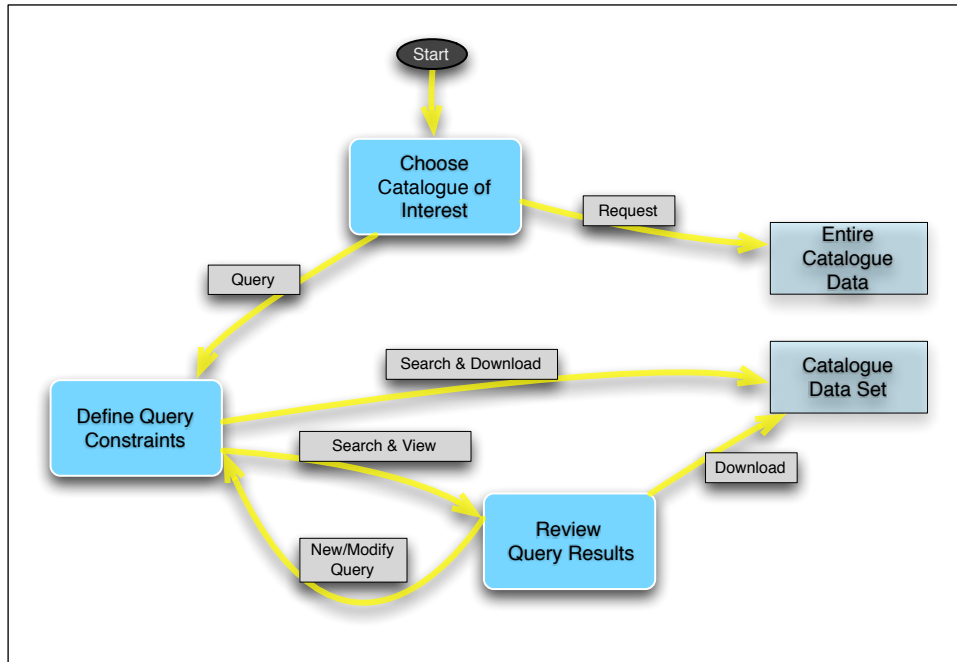


Figure 1: Illustration of the typical workflow using the Catalogue Facility.

1.1 List of Features

Release version number 1.1.6 of the ESO Catalogue Facility (Date: 02.10.2012) implements the following features:

- Browse the available list of catalogues
- Inspect the catalogue content (metadata)
- Select the catalogue of interest
- Find catalogues by name
- Find catalogues by content (employing the Unified Content Descriptor vocabulary recommended by the International Virtual Observatory Alliance)
- Search by position
 - J2000 coordinates (HMS-DMS, decimal degree)
 - Automatic target name resolution (by Sesame/CDS)
 - Support for galactic coordinates (decimal degree)
 - Multi-target search
- Constraint per column using ASU syntax for constraint qualification
- Sorting the result set (applies to the download data)
- Query results: total counts (records found).
- Tabular display (of top 1000 records).
- Pagination (displays 10, 20, 50 or 100 records per page)
- Free (re)arrangement of columns (show/hide)
- Sorting the displayed data (does not apply to the download data)
- Filter to inspect the result set¹ (ASU-like syntax, apply, clear)
- Refine (modify) the query
- Download the query result set
- Supported download formats: FITS (binary table), CSV, TSV, VOTable, HTML
- Query the catalogue and download the resulting data immediately (skipping the display stage)

¹ The user-defined filter applies to the tabular display but not to the download data.

- Request the selected catalogue in its entirety for download from the ESO archive (FITS format, no query)

2 Getting started

Being a web application, the ESO Catalogue Facility is reached by navigating the browser to the URL

<http://www.eso.org/qi>

First, you must logon using your ESO User Portal credentials, which then carries you to the main page of the ESO Catalogue Facility.

Note: the user authentication expires after some idle time, after which you may need to authenticate again.

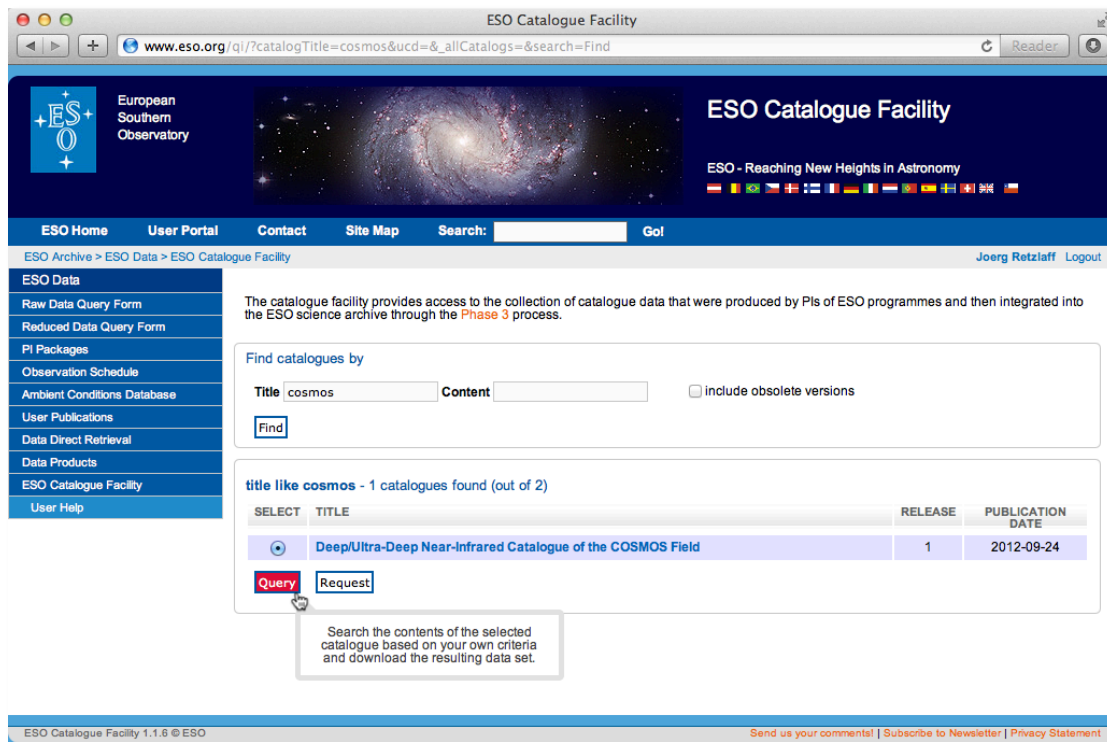


Figure 2: ESO Catalogue Facility entry page

3 Choosing the catalogue of interest

The main page (Figure 2) provides an overview of all available catalogues once successfully ingested into the ESO Archive via the Phase 3. The table displays title, release number and Phase 3 publication date for each catalogue.

3.1 Displaying information about catalogues

Click on the title to get detailed information about this catalogue and to inspect its kind of content (Figure 3). The first tab shows the information pertaining to the entire catalogue. The second tab lists

all columns belonging to this catalogue including their names, descriptions, data type, size (in bytes), Unified Content Descriptors (UCD) and physical unit. Use the browsers BACK button to return to the main page.

Details - Deep/Ultra-Deep Near-Infrared Catalogue of the COSMOS Field

Catalogue	Columns
Title	Deep/Ultra-Deep Near-Infrared Catalogue of the COSMOS Field
Data Collection	ULTRAVISTA_CAT
Release Number	1
Data Provider/P.I.	J.S. Dunlop
Phase 3 Programme	UltraVISTA
Submission Date	2012-09-05
Publication Date	2012-09-24
Description	UltraVISTA is an ultra-deep near-infrared survey which targets a sub-area of the COSMOS field. To 5-sigma limit (~23.7 AB), the Ks-selected first UltraVISTA DR1 catalogue release contains 216,298 sources observed in Y, J, H and Ks bands over the full UltraVISTA deep area (~1.8 square degree), with NB118 observations covering the "ultra-deep stripes" area.
Telescope	ESO-VISTA
Instrument	VIRCAM
Technique of Observation	IMAGE,JITTER
Start of Observations	55,170.283 (2009-12-05T19:47:34)
End of Observations	55,305.174 (2010-04-19T18:10:37)
Filter Set/bands	Y, J, H, Ks, NB118
Sky Solid Angle	1.8
Number of Records	331077
Number of Columns	48
Reference	2012A&A...544A.156M
Acknowledgment Policy	Please include the following acknowledgment in any published material that makes use of this data products: Based on observations made with ESO Telescopes at the La Silla or Paranal Observatories under programme ID(s) 179.A-2005(A), 179.A-2005(B)

Figure 3: Detailed information display for one selected catalogue

3.2 Finding catalogues

By default all catalogues are listed on the main page. The top panel allows finding catalogues by **Title** and **Content**. The list of catalogues being displayed is restricted to the subset matching the input constraints.

Enter keywords to match the catalogue title into the **Title** field or enter a word of the standard vocabulary defined by the International Virtual Observatory Alliance, the so-called Unified Content Descriptors (UCD 1+ controlled vocabulary²), into the **Content** field. Press **Find** to apply your constraint.

To find all catalogues containing near-infrared K band data, for instance, enter **EM.IR.K** into the **Content** field.

Note: the input keywords are matched against any substring of the catalogue title and UCDS respectively. The matching is independent of character case.

3.3 Accessing previous versions

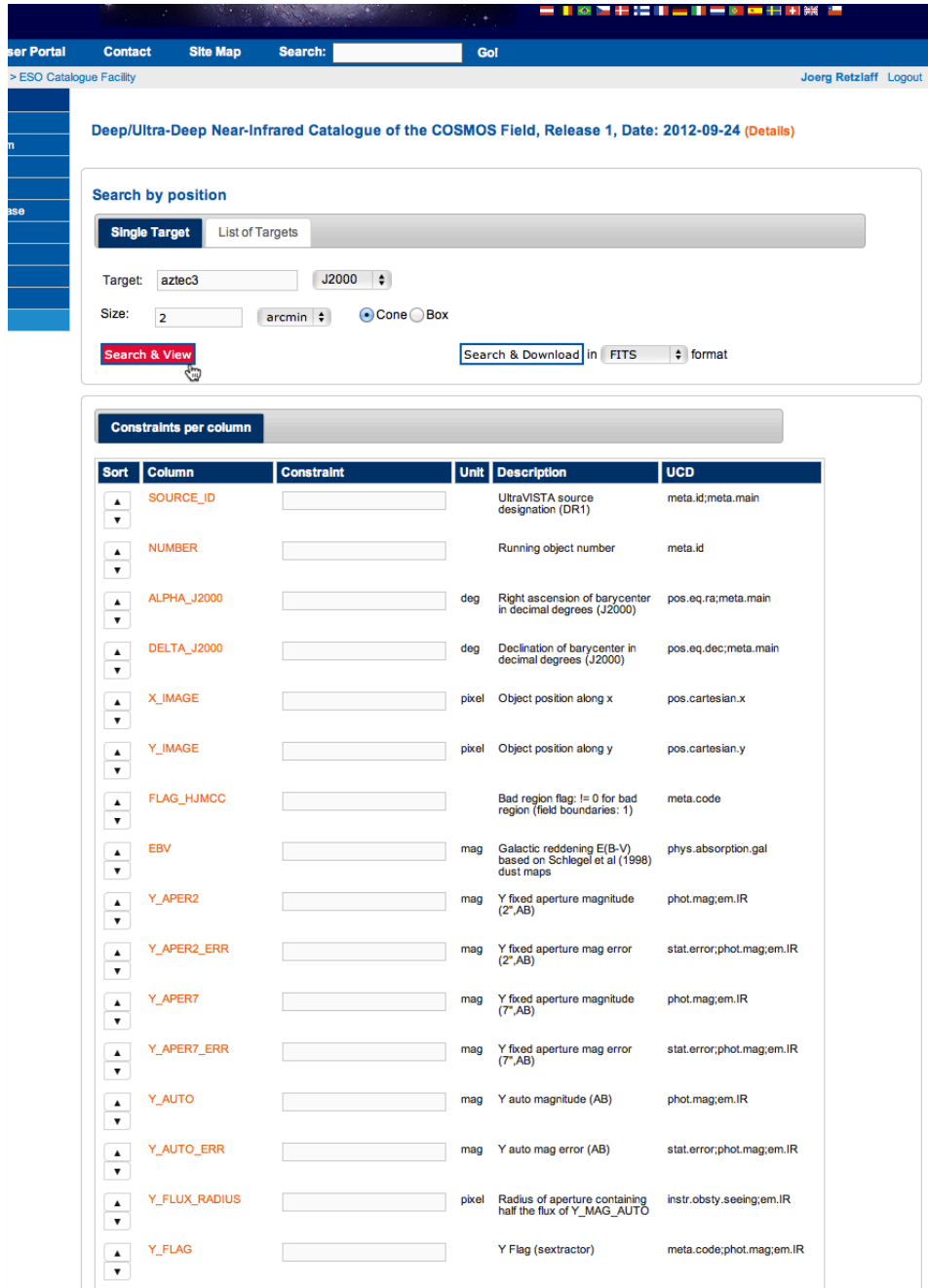
The ESO Phase 3 system supports and keeps track of the version history of data releases. You can check the tick box "**include obsolete versions**" to get access to those 'obsolete' data for which a more recent release version exists.

This function will be effective once DR2 catalogue data will have been ingested, presumably taking place in 2013 for ESO/VISTA public surveys.

After having identified the catalogue of interest by clicking the appropriate SELECT button in the left column, you continue with the next operations, either **Query** or **Request**.

² The UCD1+ controlled vocabulary, Version 1.23, IVOA Recommendation 02 April 2007, <http://www.ivoa.net/Documents/latest/UCDlist.html>

Press the **Query** button to search the catalogue based on your criteria and download the resulting data set. Or **Request** the selected catalogue in its entirety for download from the ESO archive.



Deep/Ultra-Deep Near-Infrared Catalogue of the COSMOS Field, Release 1, Date: 2012-09-24 (Details)

Search by position

Single Target List of Targets

Target: aztec3 J2000

Size: 2 arcmin Cone Box

Search & View Search & Download In FITS format

Sort	Column	Constraint	Unit	Description	UCD
▲▼	SOURCE_ID			UltraVISTA source designation (DR1)	meta.id;meta.main
▲▼	NUMBER			Running object number	meta.id
▲▼	ALPHA_J2000		deg	Right ascension of barycenter in decimal degrees (J2000)	pos.eq.ra;meta.main
▲▼	DELTA_J2000		deg	Declination of barycenter in decimal degrees (J2000)	pos.eq.dec;meta.main
▲▼	X_IMAGE		pixel	Object position along x	pos.cartesian.x
▲▼	Y_IMAGE		pixel	Object position along y	pos.cartesian.y
▲▼	FLAG_HJMCC			Bad region flag: != 0 for bad region (field boundaries: 1)	meta.code
▲▼	EBV		mag	Galactic reddening E(B-V) based on Schlegel et al (1998) dust maps	phys.absorption.gal
▲▼	Y_APER2		mag	Y fixed aperture magnitude (2",AB)	phot.mag;em.IR
▲▼	Y_APER2_ERR		mag	Y fixed aperture mag error (2",AB)	stat.error;phot.mag;em.IR
▲▼	Y_APER7		mag	Y fixed aperture magnitude (7",AB)	phot.mag;em.IR
▲▼	Y_APER7_ERR		mag	Y fixed aperture mag error (7",AB)	stat.error;phot.mag;em.IR
▲▼	Y_AUTO		mag	Y auto magnitude (AB)	phot.mag;em.IR
▲▼	Y_AUTO_ERR		mag	Y auto mag error (AB)	stat.error;phot.mag;em.IR
▲▼	Y_FLUX_RADIUS		pixel	Radius of aperture containing half the flux of Y_MAG_AUTO	instr.obsty.seeing;em.IR
▲▼	Y_FLAG			Y Flag (sextractor)	meta.code;phot.mag;em.IR

Figure 4: An example of the catalogue query form

4 Catalogue Queries

Querying the catalogue data using positional and non-positional constraints and downloading the resulting data set for further scientific analysis are key functionalities provided by the system. Having pressed the **Query** button on the main page, the query form for the selected catalogue appears (Figure 4).



4.1 Search by position

The Catalogue Facility allows searching around one (**Single Target**) or multiple target positions (**List of Targets**), using either a circular region (**Cone**) or a square (**Box**). The **Size** of the search region specifies the maximum angular distance from the target position, i.e. the radius, in case of Cone search and the side length of the square in case of Box search. You can define the **Size** in units of arcsecond, arcminute, or degree.

Note that the **Search by position** is available for all catalogues having equatorial (J2000) coordinates, otherwise the panel does not appear. The two coordinates must be identified in the FITS header by **pos.eq.ra;meta.main** and **pos.eq.dec;meta.main** set in the corresponding TUCDi keywords.

The **Target** field in case of the **Single Target** search accepts as input either a pair of coordinates or a target name. The coordinates can be either J2000 (default) or galactic. In case of J2000 coordinates either decimal degree or sexagesimal format (HMS/DMS) is possible.

Format of target coordinates (J2000)	Notes
(+)(dd)d.(ddd) (+/-)(dd)d.(ddd)	The point preceding the decimal part is mandatory, even if the decimal part is empty.
(+)HH(:)MM(:)SS(.SSS) +/-DD(:)MM(:)SS(.SSS)	The +/- sign is mandatory for the declination; seconds and arcseconds are optional for RA and Declination, respectively.

Examples of valid target coordinate input (J2000):

```
150.1 2.2
10:00:24 +02:12
10 00 24 +02 12
10 00 +02 12
11.9 -25.3
00 47 36 -25 18 00
```

Galactic coordinates (longitude/latitude) should be specified in decimal degree.

4.1.1 Target name resolution

If the target input does not represent a valid pair of coordinates (according to the format defined above), the Sesame name resolver at Centre de Données astronomiques de Strasbourg (CDS) is employed and the resulting coordinates are used.

4.1.2 List of Targets

Press the **Choose File** button to load an input file containing the list of targets having the following format. The file contains one target per line. The target can be expressed either as a name (to be resolved by Sesame) or a pair of tab-separated J2000 coordinates. Blank lines are ignored as well as lines starting with a hash ('#'). The user might use that feature to include comments into the input file. Comments may contain HTML tags.

Optionally, a hash '#' may be added after the target information followed by any text comment. These information will be propagated to the query results in the form of an additional table column (named 'comm').

Here are some examples:

```
HD 93308 # Variable Star
10 45 03.591 \tab -59 41 04.26 # eta car
```

The strings “Variable Star” and “eta car” will then get added to the query results in the first column, named 'comm'.

The queries are processed successively in the order of the input list and the results are also ordered by target, as defined in the input list.

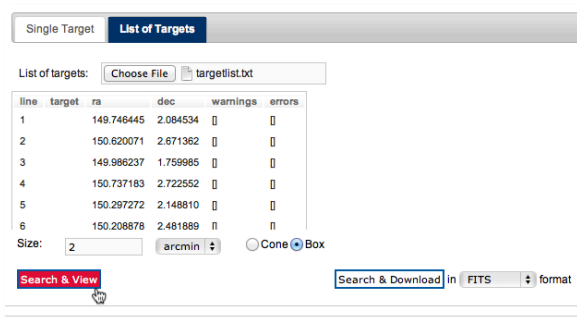


Figure 5: Example for the search by list of targets

4.2 Constraint per column

A flexible and powerful way for defining subsets of catalogue data according to your science case is provided by constraint qualification per catalogue column (Figure 6). To this end the ASU syntax (cf. Astronomical Server URL³) is employed. Within an ASU expression the parameter is implicit because it is given by the context.

Table 1: Examples of search constraint expressions

Expression	Description
5	Matches values equal to 5 (default operator for numbers)
=5	
<=5	Matches values less than or equal to 5
!=10	Matches values other than 10
1 .. 10	Range operator matches values between 1 and 10. Note the spaces around the operator!
ABC	Matches ABC (default operator for strings)
=ABC	
ABC%	Matches any string beginning with ABC. % is the wildcard character.
~AbC	Matches ABC, ABc, AbC, aBC, abC, abc (independent of character case)
!=abc%	Matches any string <i>not</i> beginning with abc (not equal)
==ABC	Matches ABC (exact string match, no wildcards)
aaa .. ccc	Range operator for strings. Note the spaces around the operator!

³ <http://vizier.u-strasbg.fr/doc/asu.html>

>aaa	Matches values greater than aaa
=abc =def	Logical OR
>1 & <10	Logical AND
!(>1 & < 10)	Logical NOT

Strings containing blank characters, e.g. source designation, should be surrounded with double quotes.

You can specify as many constraints as needed (including the possibility to combine with the **Search by position**). Multiple constraints are combined in the boolean AND sense.

When all query constraints are specified, the search can be executed by pushing one of the buttons on the query form, either **Search & View** or **Search & Download**, the difference being whether you want to review the results before downloading them or whether you want to download directly skipping the intermediate review step.

Sort	Column	Constraint	Unit	Description
▲ ▼	Y_FLAG	<input type="text" value="0"/>		Y Flag (sextractor)
▲ ▼	J_FLAG	<input type="text" value="0"/>		J Flag (sextractor)
▲ ▼	H_FLAG	<input type="text" value="0"/>		H Flag (sextractor)
▲ ▼	KS_FLAG	<input type="text" value="0"/>		Ks Flag (sextractor) [detection image]
▲ ▼	KS_AUTO	<input type="text" value="18 .. 24"/>	mag	Ks auto magnitude (AB) [detection image]
▲ ▼	SOURCE_ID	<input type="text"/>		UltraVISTA source designation (DR1)
▲ ▼	NUMBER	<input type="text"/>		Running object number

Figure 6: Specifying a range constraint on the Ks magnitude

4.2.1 Sorting and query performance

You can click on one of the UP/DOWN arrows on the left hand side of the query form to obtain a sorted result set with respect to the respective catalogue parameter in ascending or descending order (Figure 6).

The UP/DOWN arrow indicates at the same time that queries on the respective parameter are optimized for best performance.⁴ It means that queries including conditions on these parameters execute in a short time, which enables for instance colour interval selection even on very large catalogues in an efficient way. Note that any other parameter can be constraint as well, with a lower efficiency however, meaning that queries will take more time for execution and you need to wait longer until the results are returned.

Large catalogues have up to 15 indexed columns, which are set up at the time of data ingestion according to the PI/Co-I's input. Therefore, Phase 3 data providers are asked to flag the catalogue columns, which are considered most important from the scientific point of view for the purpose of searching and subset definition.

⁴ Technically, an optimized database index has been defined for this parameter.



4.3 Query Results

If you choose **Search & View** the results are displayed on the query results page for inspection once the query is executed (Figure 7). It shows the query constraints in the top panel, the number of records found (i.e. matching the constraints) with respect to the total number of catalogue records (“out of X”).

In the lower panel the data is displayed in tabular form. The viewer allows arranging the columns interactively, sorting the data according to one column, and applying a filter to display a subset of the data.

Note that the tabular view is limited to a maximum of 1000 records. It means the displayed data is truncated to the top 1000 records if the result set exceeds 1000 records but the data for download is not!


From the query results page the user may trigger one of the following operations: **New Query**, **Modify query**, or **Download**.

4.4 Data Download

The catalogue data is stored in a dedicated data base system from which the download data is extracted on request according to the user-specified constraints and output format.

Pushing the **Download** button (see Figure 7) will start the download process of the query result set to your computer. The resulting file contains as many records as listed under “records found”; it is not subject to the limit of 1000 records.

You can choose the download data format to be FITS (binary table), CSV (ASCII comma-separated values), TSV (ASCII tab-separated values), VOTABLE, or HTML.

 Note that the arrangement of columns in the tabular viewer applies to the download. Therefore, remember to pull the red bar in the Columns panel below the last line to ensure that all columns are included in the downloaded result set.

The downloaded data is sorted according to the column parameter selected for sorting in the query form if any. The filter in the tabular viewer does not apply to the downloaded data.

Portal Contact Site Map Search: Go

30 Catalogue Facility Joerg Retzlaff Logout

Deep/Ultra-Deep Near-Infrared Catalogue of the COSMOS Field, Release 1, Date: 2012-09-24 (Details)

Query constraints

Input Target aztec3

Resolved into:

RA (J2000) 150.0 (10:00:20.700)

Dec (J2000) 2.5 (+02:35:21.59)

Cone size 2 arcmin

[New Query](#) [Modify Query](#)

Query Results

759 records found (out of 331077) [Download](#) in Format

Elapsed time: 0.808 s

Results 81-90 of 759 sorted by **KS_APER2** Show results per page ◀ Previous 1 ... 6 7 8 9 10 11 12 ... 76 Next ▶

Text boxes under columns select matching rows [Apply Filter](#) [Clear Filter](#)

NUMBER	Y_APER2	J_APER2	H_APER2	KS_APER2▲	KS_AUTO	KS_FLAG	NB118_APER2	◀	▶
263814	21.99080	21.67854	21.26824	20.96337	20.78843	2	21.70204		
262158	23.00419	22.28412	21.65461	20.98373	20.73525	0	22.39588		
277914	22.59721	21.72366	21.28691	20.99398	20.75927	0	21.76913		
271353	21.99284	21.74650	21.35145	21.03029	20.74768	3	22.02411		
273505	21.60003	21.28343	21.34403	21.03989	20.78797	0	21.71654		
278664	23.02074	22.41723	21.70063	21.07186	20.86799	0	22.59346		
276282	22.20062	21.90182	21.40343	21.07984	20.81376	0	21.97119		
275669	22.68763	21.94227	21.44656	21.10656	20.92572	1	21.85518		
262428	22.22923	21.94149	21.42816	21.11421	20.88958	0	21.97642		
273578	21.93890	21.61996	21.40965	21.13888	20.98831	0	21.89375		

Results 81-90 of 759 sorted by **KS_APER2** Show results per page ◀ Previous 1 ... 6 7 8 9 10 11 12 ... 76 Next ▶

Columns [Reset column order](#)

Name	Unit	Datatype	Description
NUMBER		int	Running object number
Y_APER2	mag	float	Y fixed aperture magnitude (2",AB)
J_APER2	mag	float	J fixed aperture magnitude (2",AB)
H_APER2	mag	float	H fixed aperture magnitude (2",AB)
KS_APER2	mag	float	Ks fixed aperture magnitude (2",AB) [detection image]
KS_AUTO	mag	float	Ks auto magnitude (AB) [detection image]
KS_FLAG		int	Ks Flag (sextractor) [detection image]
NB118_APER2	mag	float	NB118 fixed aperture magnitude (2",AB)
Columns below are hidden - Drag to change			
SOURCE_ID		char[29]	UltraVISTA source designation (DR1)
ALPHA_J2000	deg	double	Right ascension of barycenter in decimal degrees (J2000)
DELTA_J2000	deg	double	Declination of barycenter in decimal degrees (J2000)

Figure 7: Display of the query results

5 Requesting the entire catalogue

This function allows direct access to the catalogue data exactly as submitted by the data provider for ingestion into the ESO archive via Phase 3.⁵

After pressing the **Request** button to download the selected catalogue in its entirety from the ESO archive, you are directed to the ESO Request Handler. Then, press the **Submit** button to confirm your

⁵ Exceptions are the FITS header keywords being updated or inserted in the course of the archiving process, namely ARCFIELD, CHECKSUM, DATASUM, ORIGFILE.



request. Thereafter, the list of files belonging to the selected catalogue is displayed, including filesize in bytes, and you can download the data to your computer.

6 Acknowledgements

The Catalogue Facility has been developed by ESO's Software Development Division. The usage of the *Spherical Geometry Toolkit* (Budavari, T., Szalay, A., & Fekete, G. 2010, Publications of the Astronomical Society of the Pacific, 122, 1375) and of the VOview package, which was originally written for the Hubble Legacy Archive, is acknowledged. The ESO Catalogue Facility employs the Sesame name resolver operated at the Centre de Données astronomiques de Strasbourg (CDS).