# TGAS for dummies

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Created using LaTeX

# Introduction

Gaia DR1 is twofold (Gaia Collaboration (Brown et al.) 2016, Summary description of Gaia DR1):

- TGAS: contains the astrometric single star solution for about 2M sources originally observed by Tycho and published in the Tycho-2 catalogue;
- position and G-magnitude of 1B sources.

The astrometric solutions are based upon the Tycho2 positions (epoch 1991.5) and the Gaia observations already available. The 5p-model (i.e. position at reference epoch, parallax and proper motion) was imposed, whether it was physically appropriate or not. Some statistical quality indicators are nevertheless present.

For processing or observational reasons, some Tycho2 stars are missing from TGAS:

- too poor astrometric solution;
- object too bright;
- too large proper motion, ...

# Application

Retrieve the parallax and its uncertainty for a list of Ba stars with known TYC identifiers (e.g. TYC 35-435-1).

Warnings:

- DR1 does not contain any spectral information yet so the selection of Ba stars has to take place outside the Gaia framework.
- TGAS supplies the parallax and its uncertainty but no guess of the extinction is provided yet.
- The observations will not be available for a long time so no processing with an alternative astrometric model is foreseen until then but other models will be considered in Gaia DR3+.

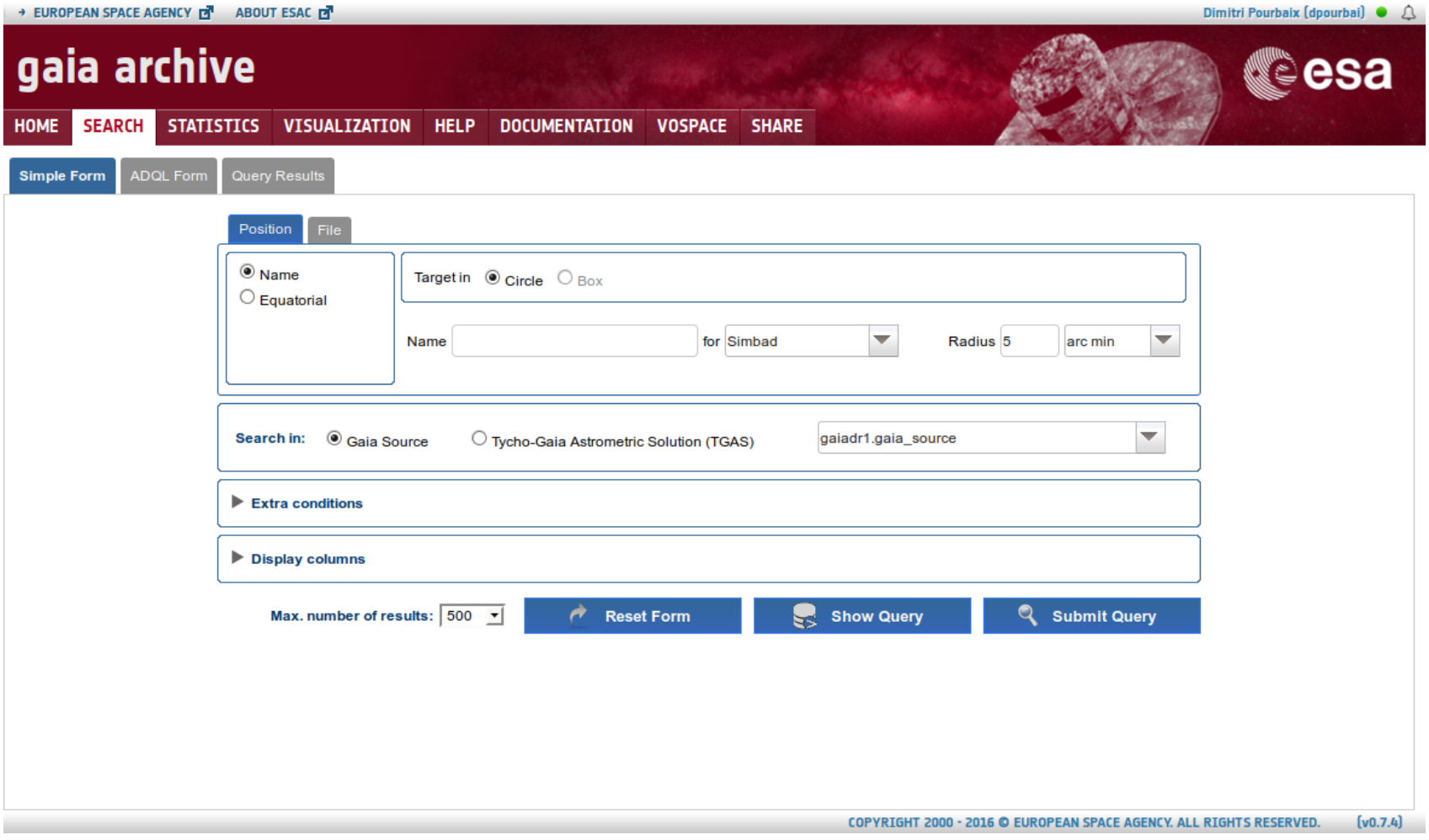
# Accessing the Gaia DR1 archive

Even though DR1 is accessible through CDS and several other mirrors, the main repository is at ESAC (Madrid):

http://archives.esac.esa.int/gaia

# Gaia Archive front end

So far, there are two ways to query the Gaia archive. The first approach offers a Simbad-like interface, convenient for one specific object or an area of the sky.




This operation can be repeated for several objects stored in a file.

# Relational DataBase Management System

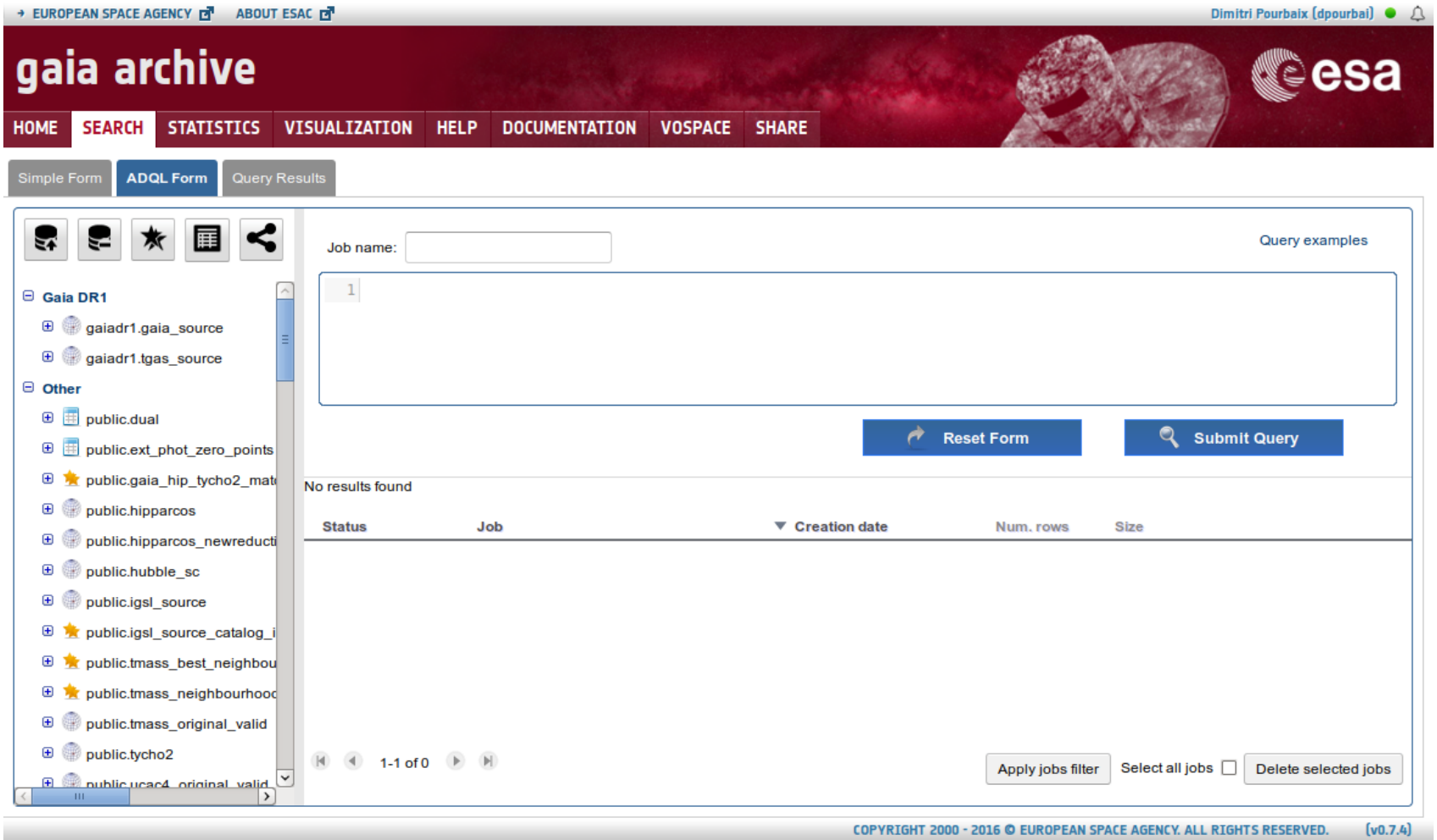
The Gaia data are stored in several rectangular tables (i.e. each row of a table has the same number of columns). A table represents a relation (in the mathematical sense) between the columns of that table. The rows of a table are independent.
Relational algebra defines 3 operations to manipulate table(s)

- Projection ($\pi$): generates a table with only a subset of the columns of the original table;
- Selection ($\sigma$): generates a table with only the rows that satisfy a relation between some columns;
- Joint ($\bowtie$): combines two tables into one where one column is common.

Our example becomes: $\pi_{\varpi,\sigma_{\varpi}}(TGAS \bowtie XmTYC \bowtie BaList)$.
The language commonly used to access such a database is Structured Query Language.
A general introduction to databases can be found in *Database System Concepts* by Silberschatz, Korth, & Sudarshan.

# Maximum power with ADQL

The Astronomical Data Query Language is a dialect of SQL-92. It makes it possible to build rather complex astronomical queries combining several tables.




Ref AQDL: http://www.ivoa.net/documents/latest/ADQL.html

# Server side versus client side

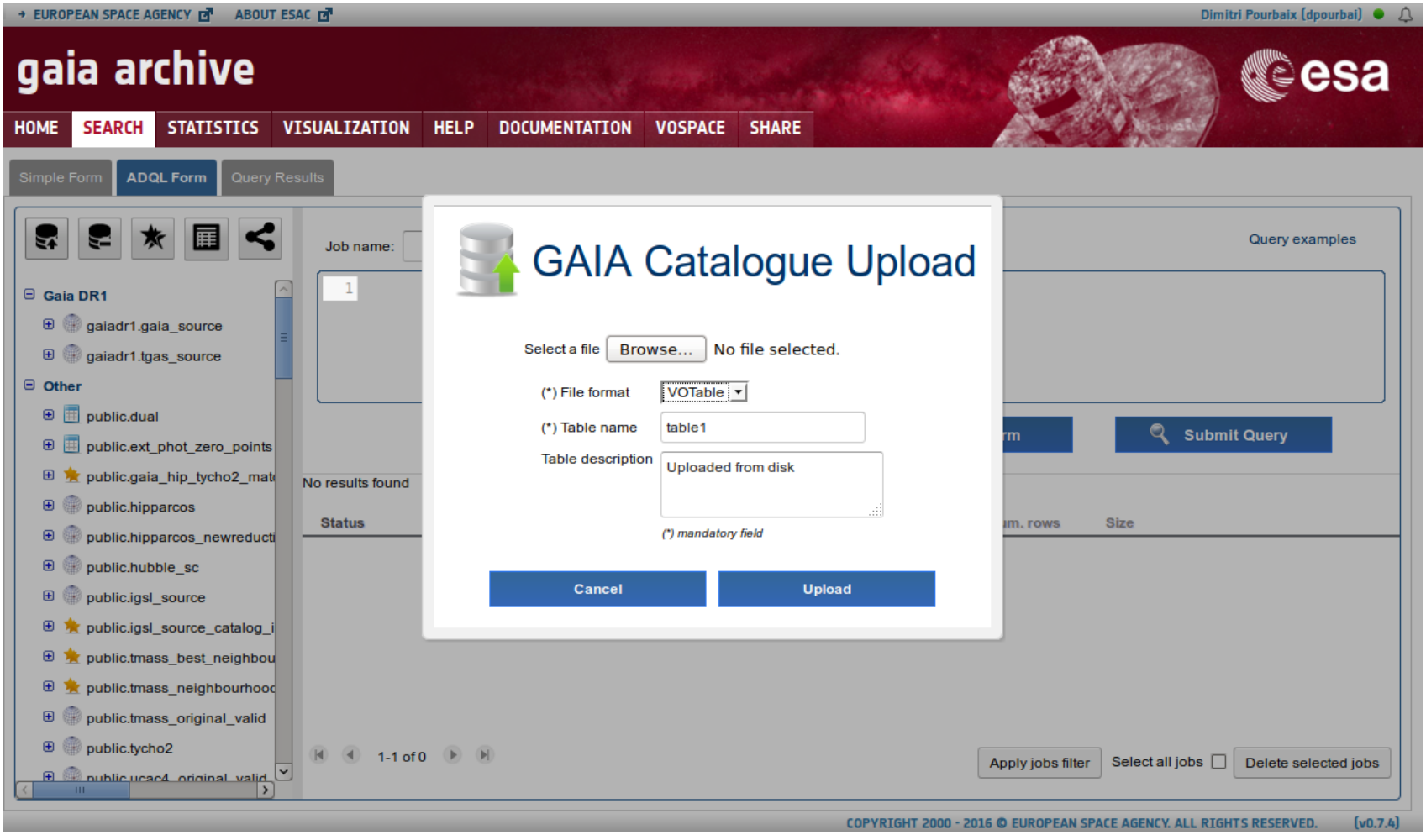
We are looking for TGAS stars with a specific TYC number. Two options are possible:

- Download the whole TGAS and take care of the cross-matching locally (client side);
- Upload the list to the server and let the server takes care of the cross-matching.

If several selections are considered, downloading TGAS once for all will be advantageous. However, in the case of TYC (as well as for HIP, GSC, UCAC, ...), cross-matching tables have been precomputed and stored on the Gaia Archive.

For TYC-like identifiers with a pattern, it is important to make use one uploads the exact same structure as the one adopted by the Gaia Archive: 'TYC 35-435-1', '0035-00435-1' and '0000 00435 1' are three distinct strings even if they might refer to the same TYC identifier.

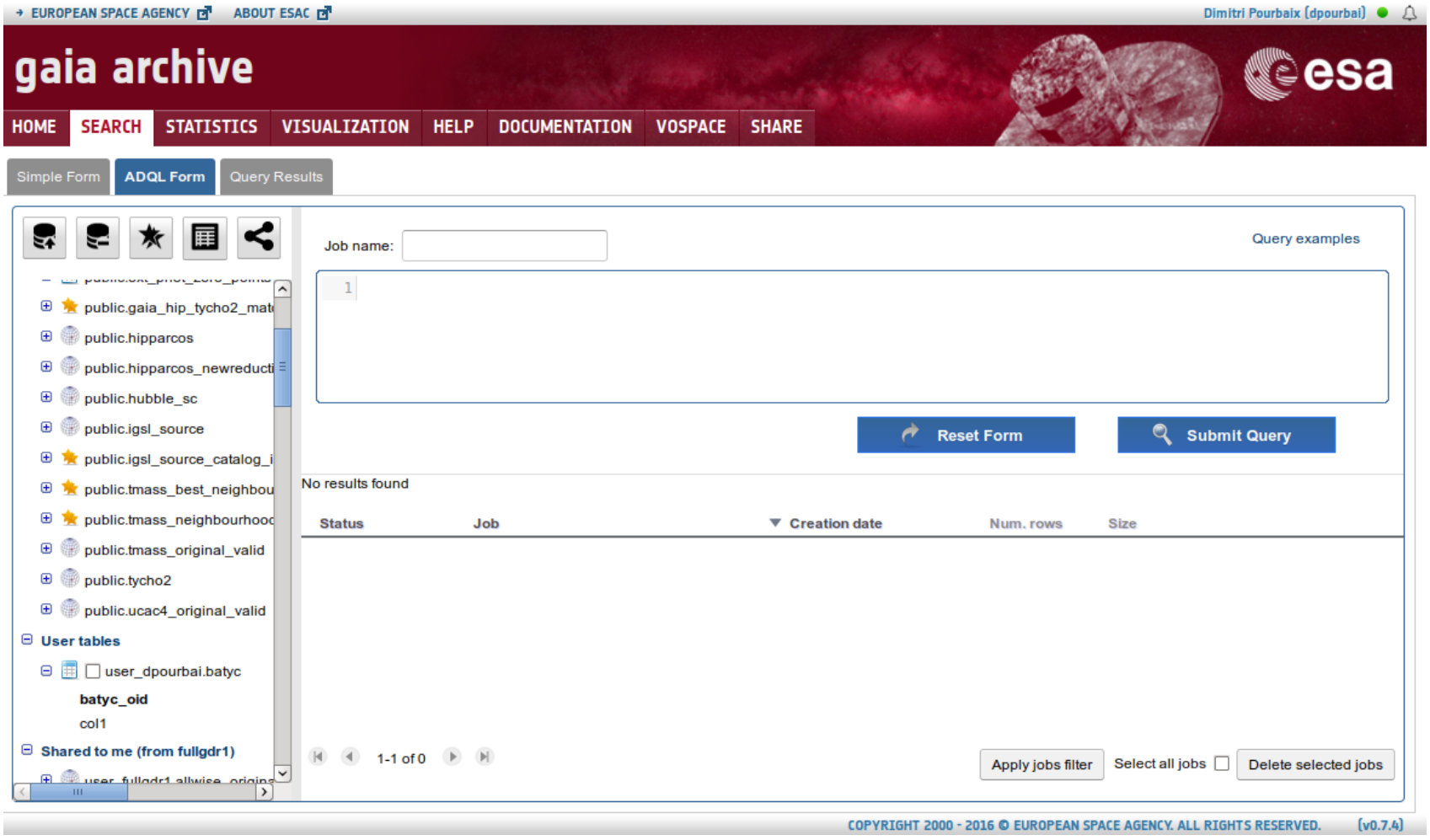
# Uploading the targets




The user can supply some new data through some new tables (VO-tables or CSV files).

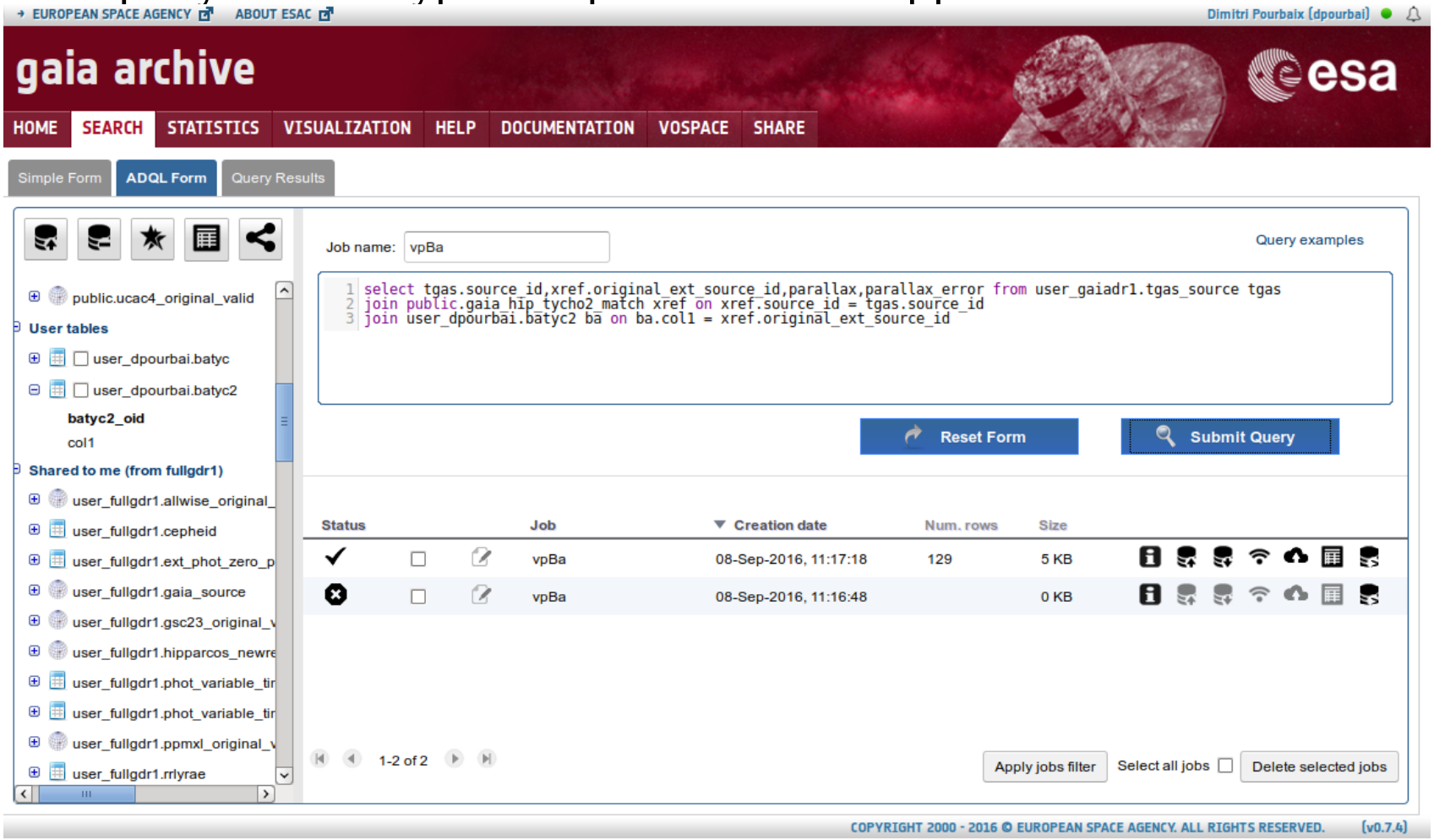
# New DBMS entries

Once these tables are uploaded, they become part of the DMBS (user's working area) and can be used in any query.



# Query

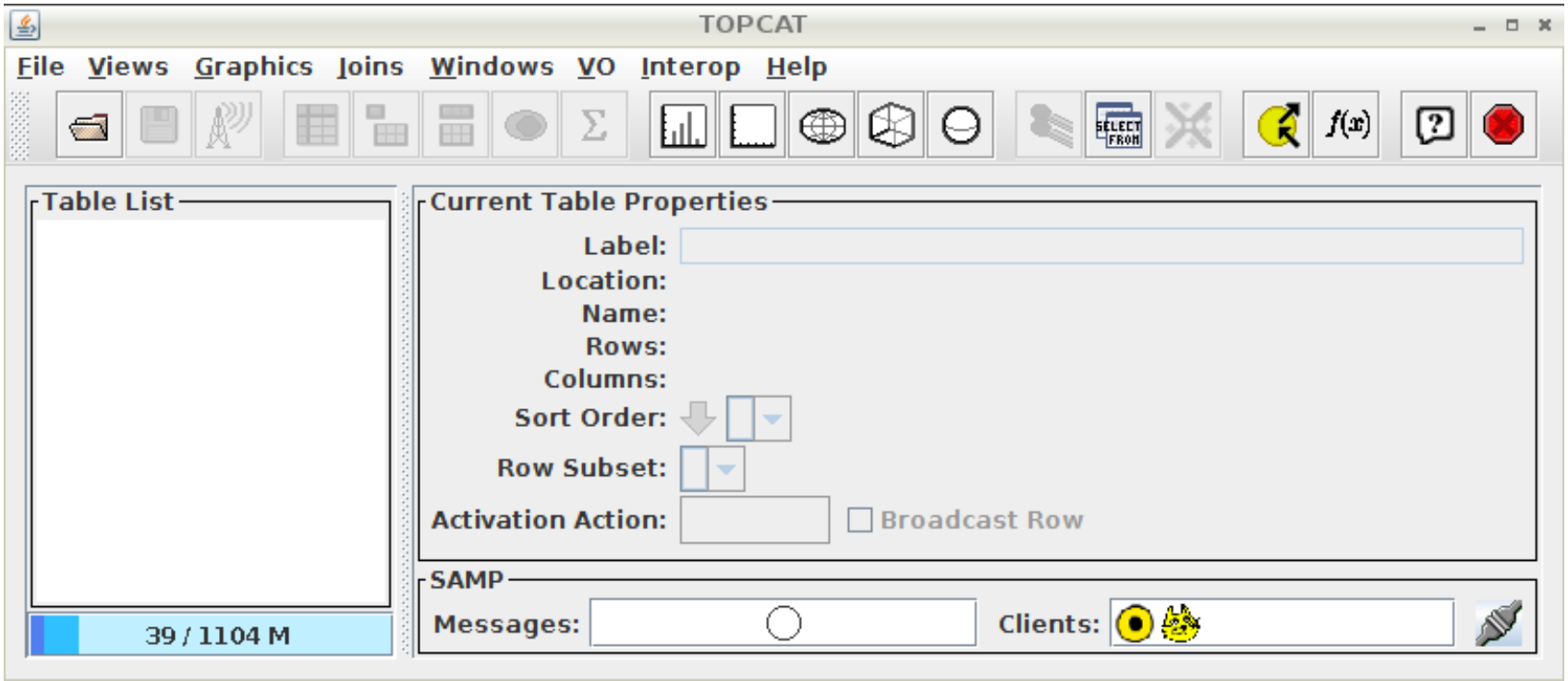
The query can be typed or pasted in the upper window.




Once the query is submitted, a new entry appears in the log. As soon as the query is completed ... or it crashes, the corresponding line of the log is updated (number of resulting rows, ...).

# TOPCAT

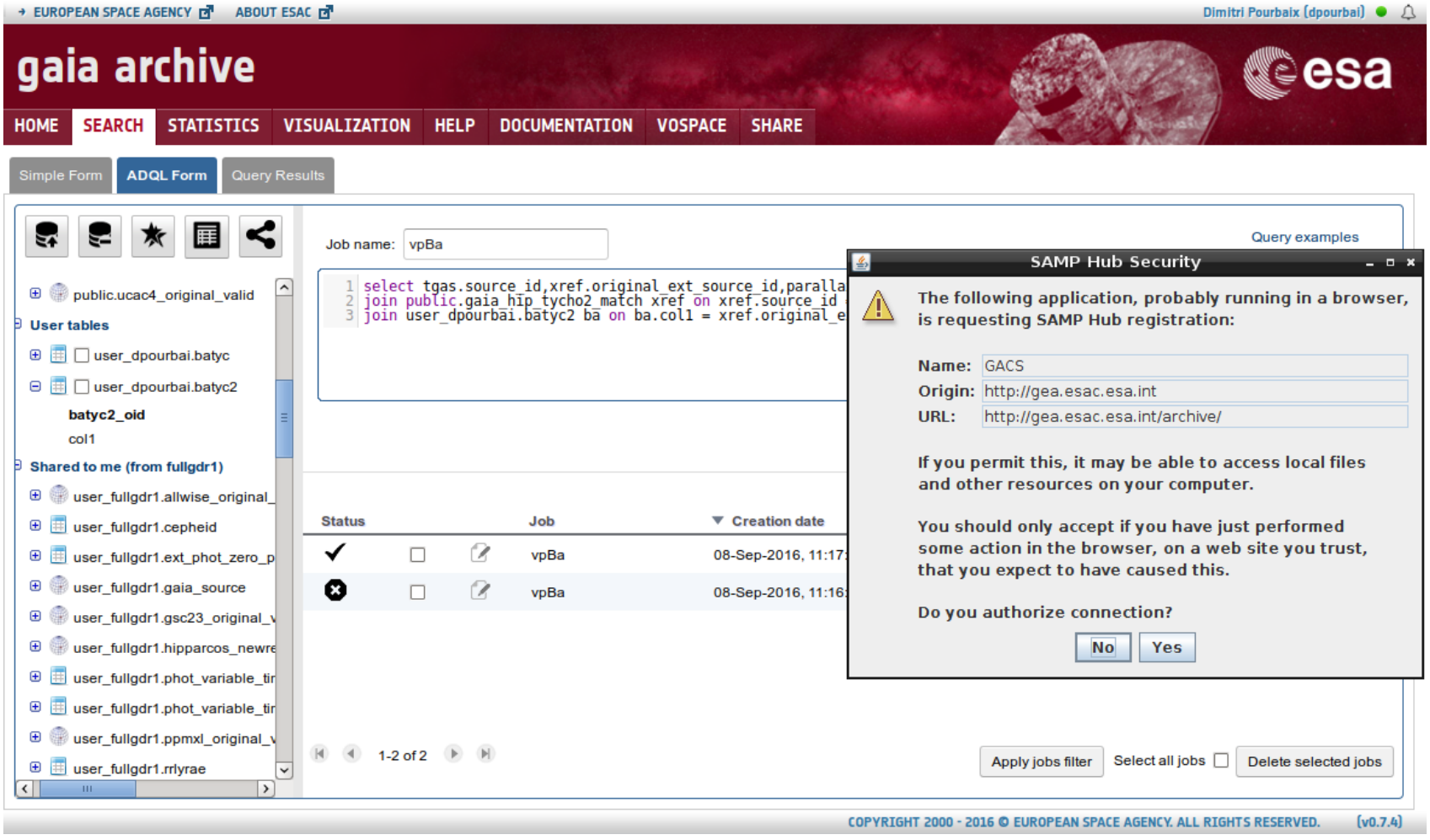
TOPCAT (http://www.star.bris.ac.uk/~mbt/topcat/) was designed to view and edit tabular data (regardless of Gaia). It was updated to communicate with the Gaia archive out of the box (4.3-3).




Make sure TOPCAT is running.

# Simple Application Messaging Protocol

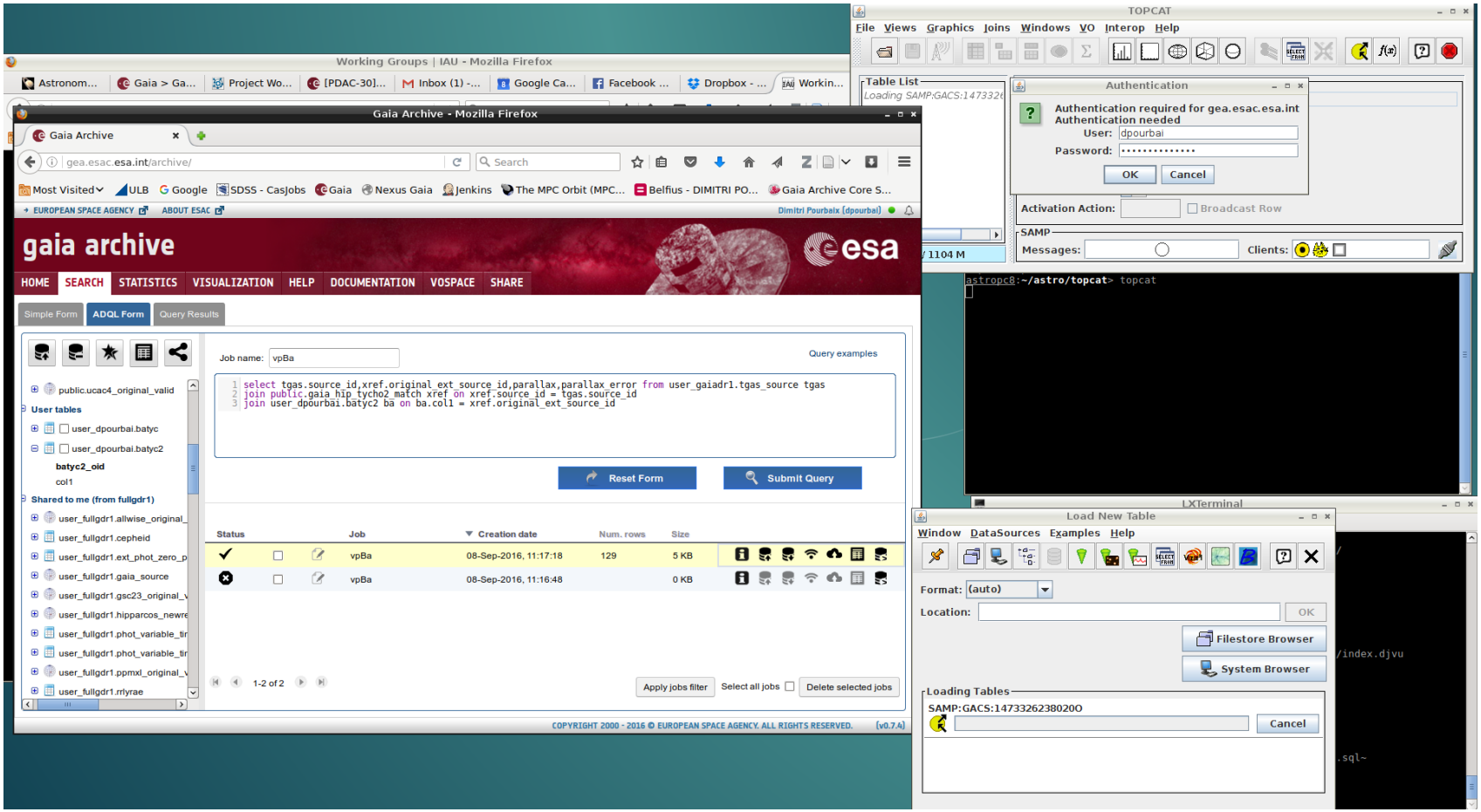
Clicking on  establishes the connection between the server, browser and TOPCAT.




SAMP can also be used to establish a connection between TOPCAT and, say, a Python code (with SAMPy package).

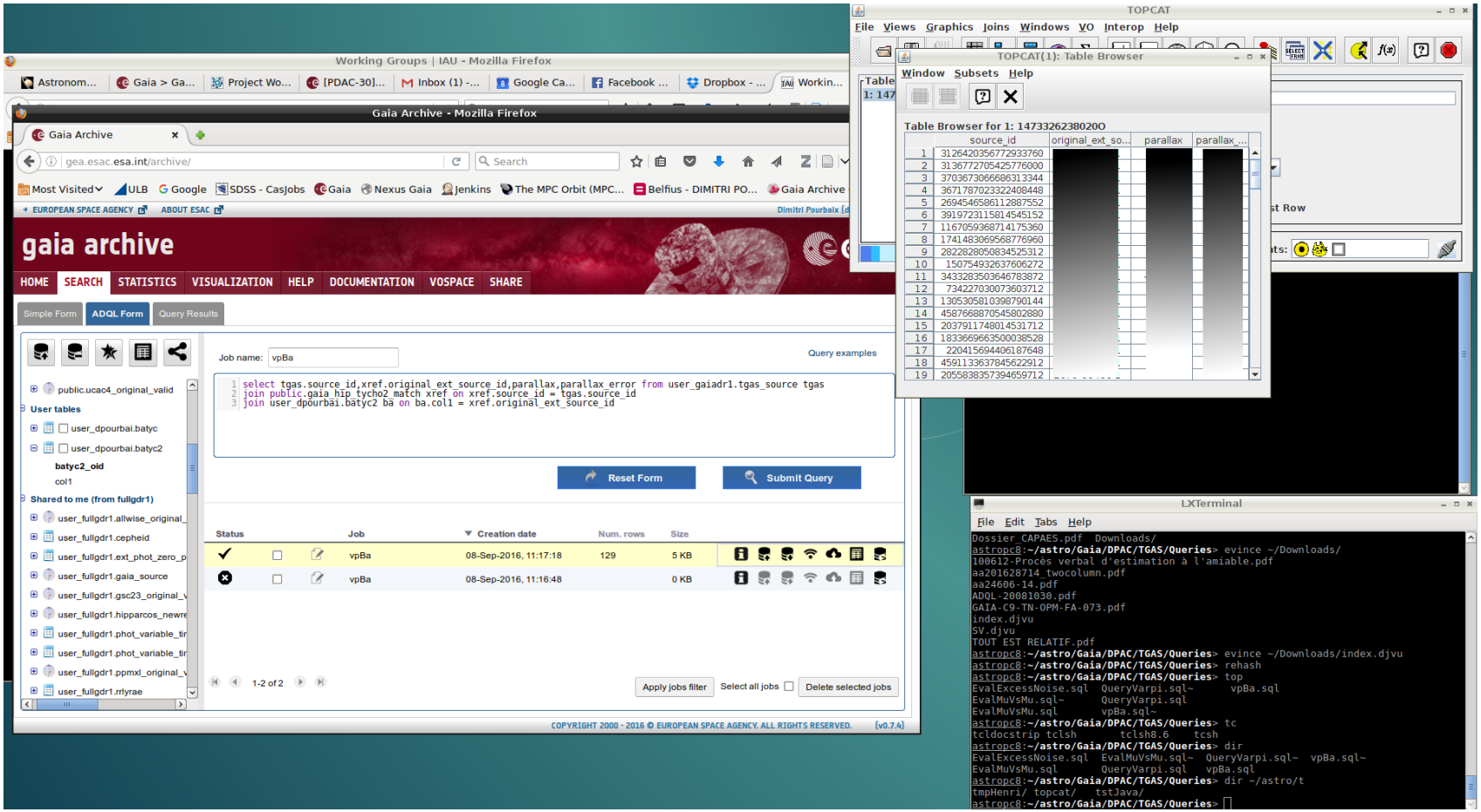
# SAMP log in

A new dialog box opens and asks for the login and password on the Gaia Archive server.



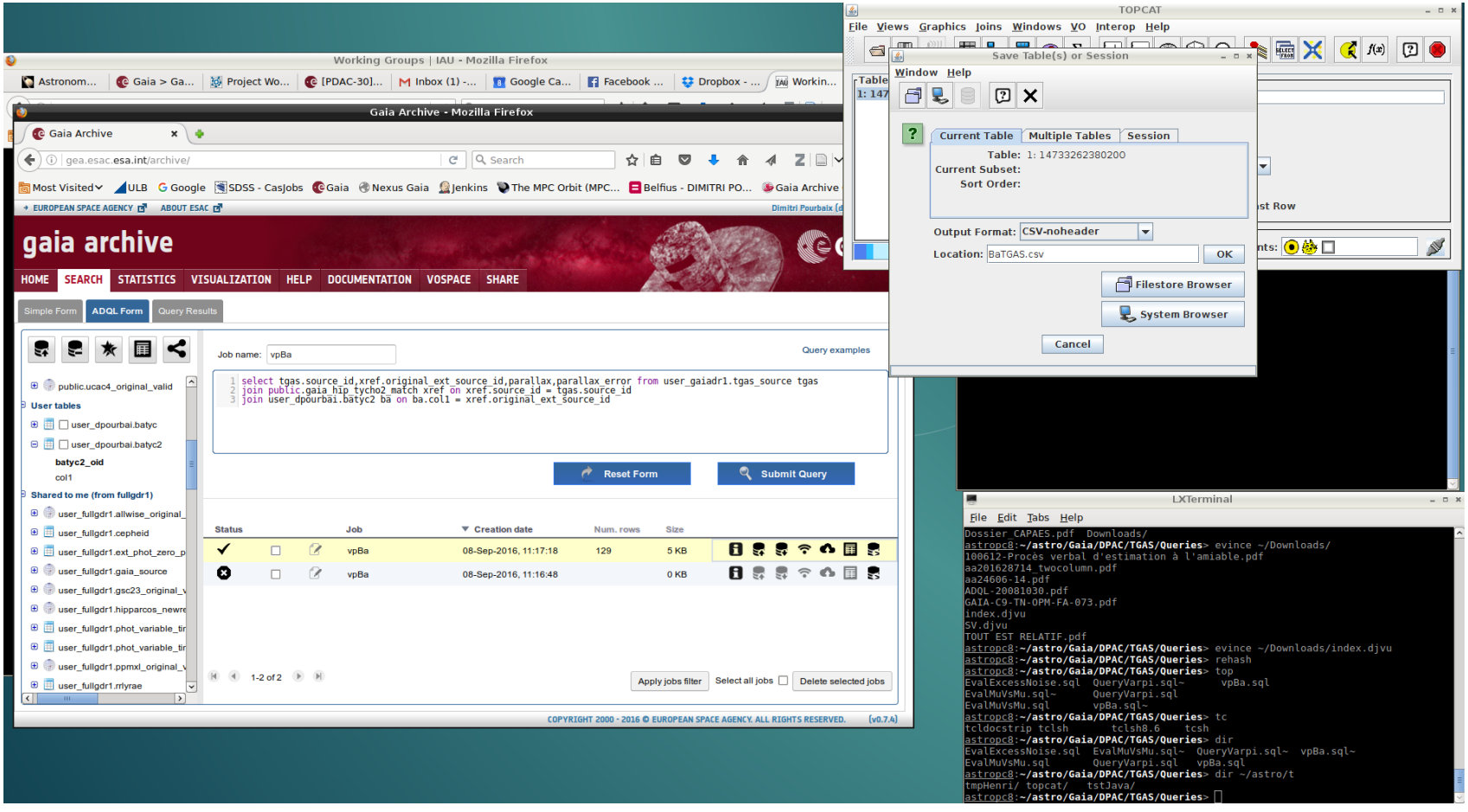
# View through TOPCAT

It is possible to directly view a sample of the table just transferred in TOPCAT.



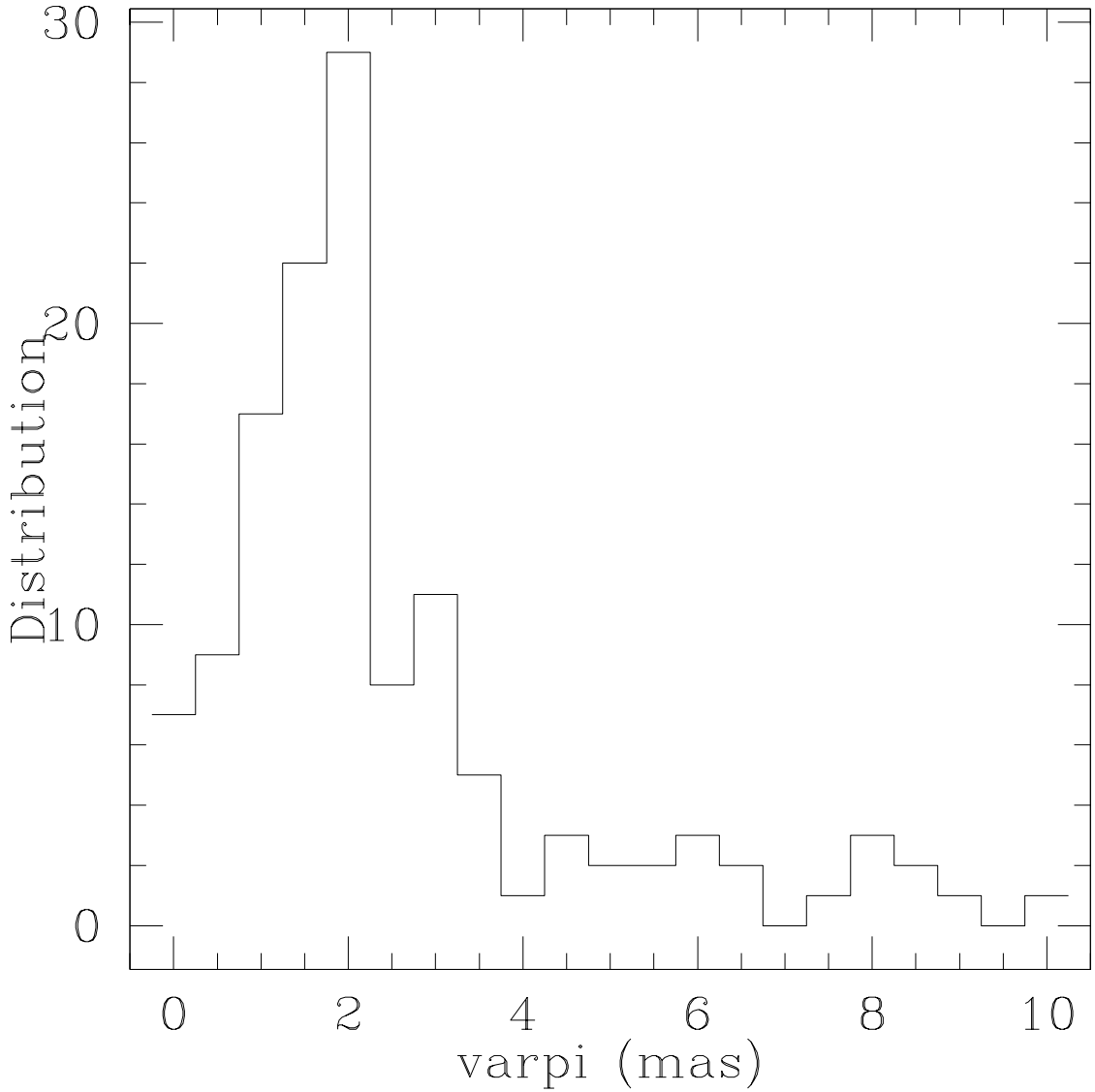
# Export to CSV

Whereas one can directly access a TOPCAT table from, say, Java or Python, exporting to CSV might offer some more flexibility.



# Results

Out of the original 557 TYC entries, only 129 turn out to hold a TGAS solution (see DR1 papers for the exact filtering criteria).



# Acknowledgement

This work has made use of data from the ESA space mission Gaia (`http://www.cosmos.esa.int/gaia`), processed by the Gaia Data Processing and Analysis Consortium (DPAC, `http://www.cosmos.esa.int/web/gaia/dpac/consortium`). Funding for the DPAC has been provided by national institutions, in particular the institutions participating in the Gaia Multilateral Agreement.