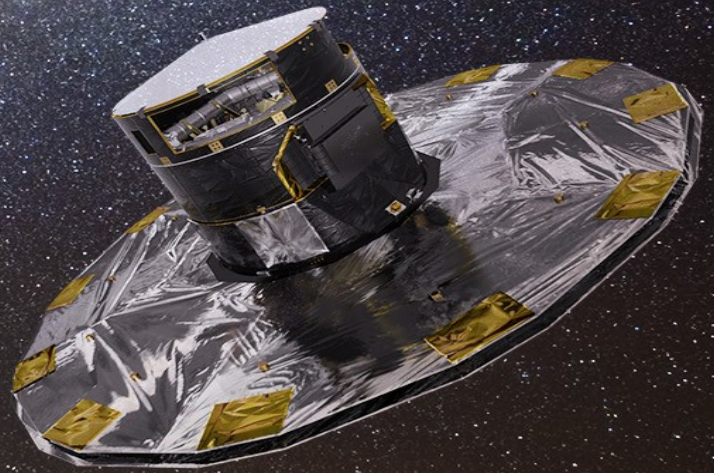
Gaia Data Release 3:

Accessing Gaia DR3 data

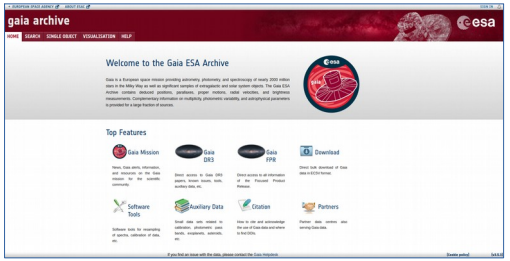
Nigel Hambly (on behalf of Nick Rowell)
University of Edinburgh



National Astronomy Meeting

15th July 2024

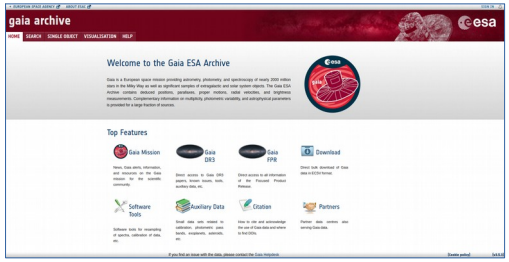
Data access points



The Gaia Archive at ESA

https://gea.esac.esa.int/archive/

Data access points



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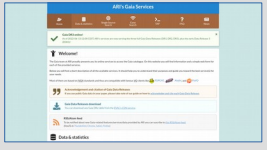
https://gea.esac.esa.int/archive/

Partner data centres:

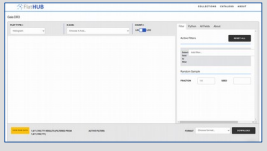
CDS
http://cdsweb.u-strasbg.fr/gaia

Space Science Data Center
http://gaiaportal.asdc.asi.it



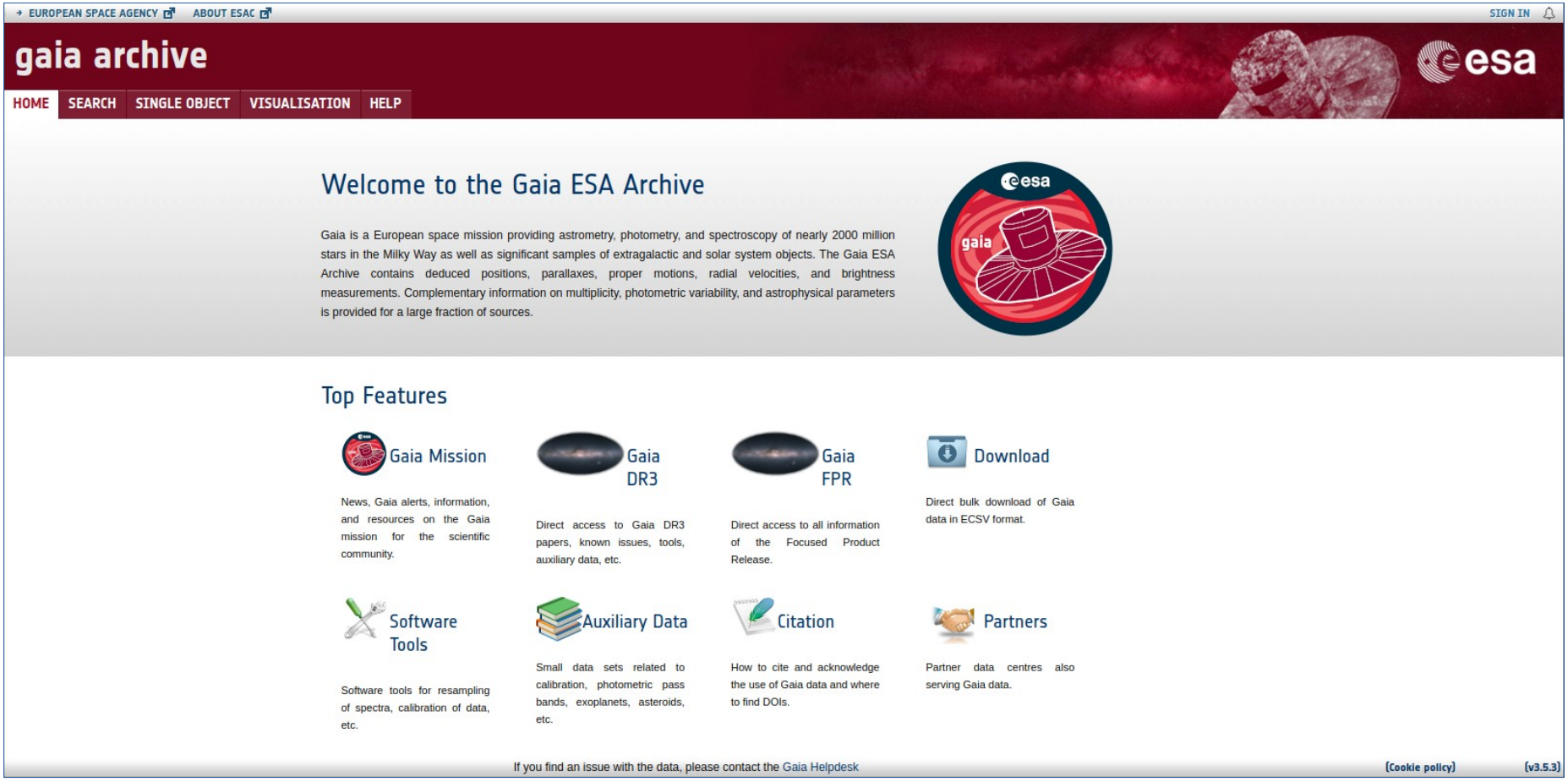
ARI (Heidelberg)
https://gaia.ari.uni-heidelberg.de

AIP (Potsdam)
https://gaia.aip.de



Flatiron
https://flathub.flatironinstitute.org/gaiadr3

The Gaia Archive at ESA



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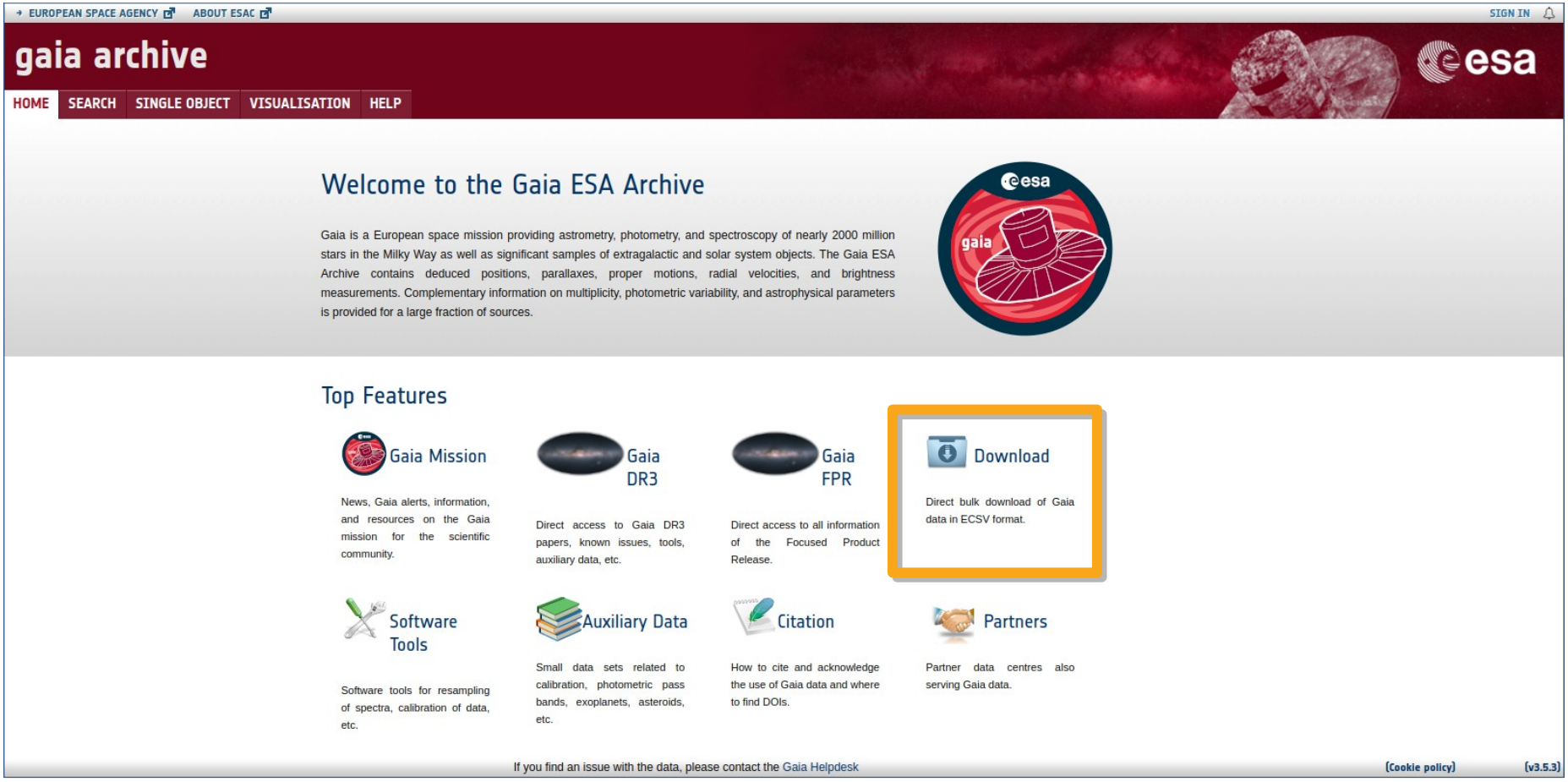

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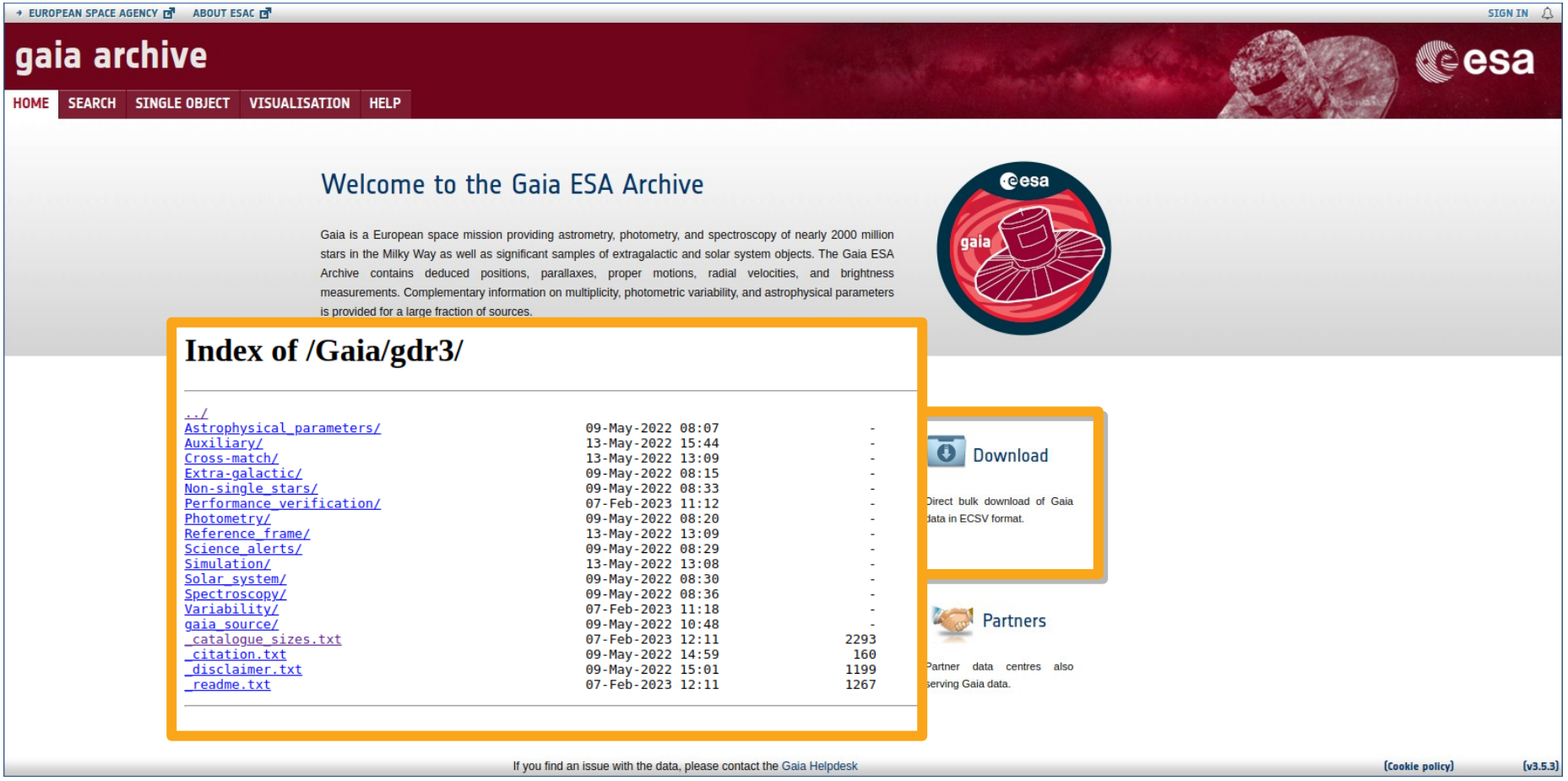

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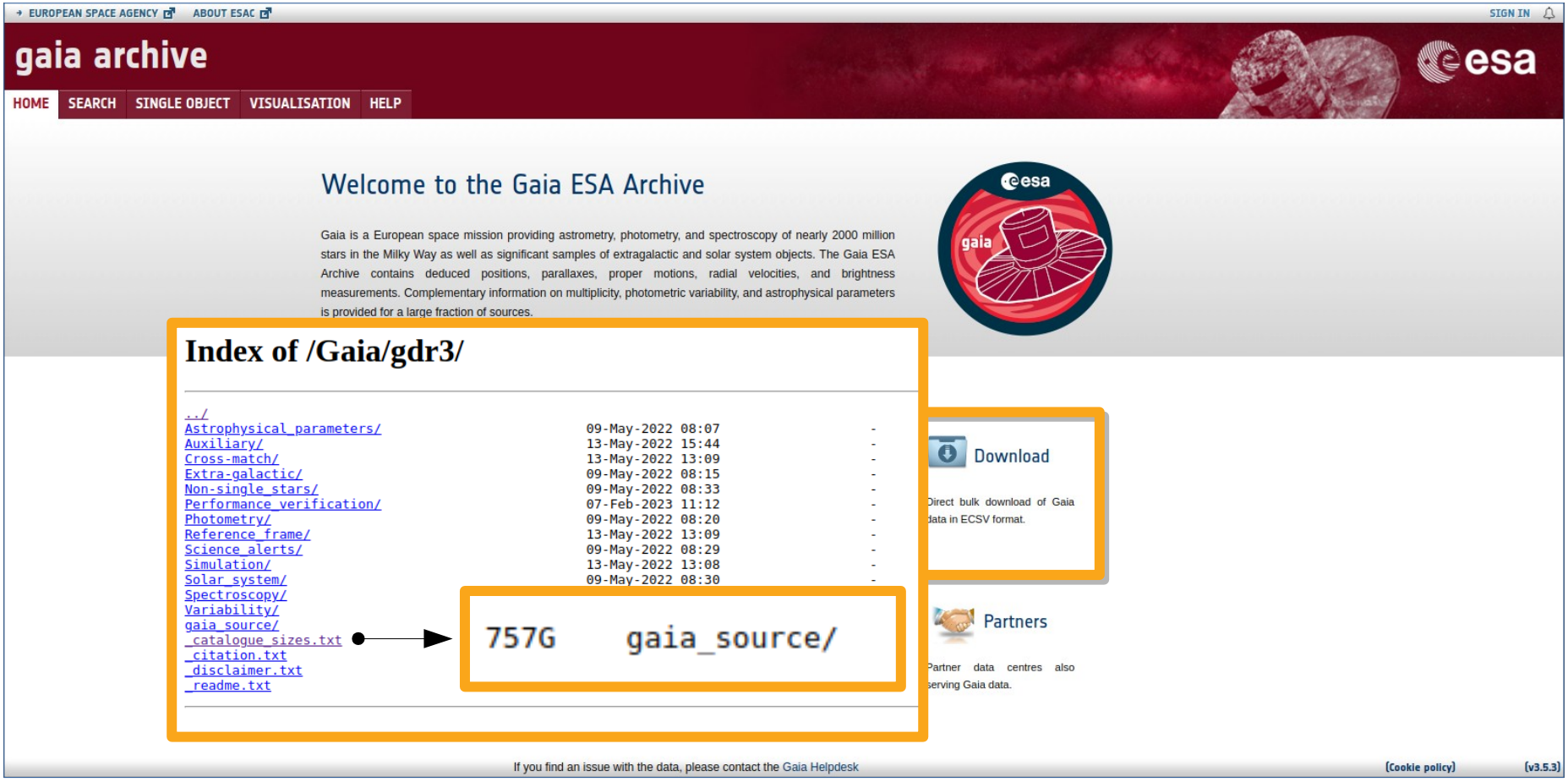

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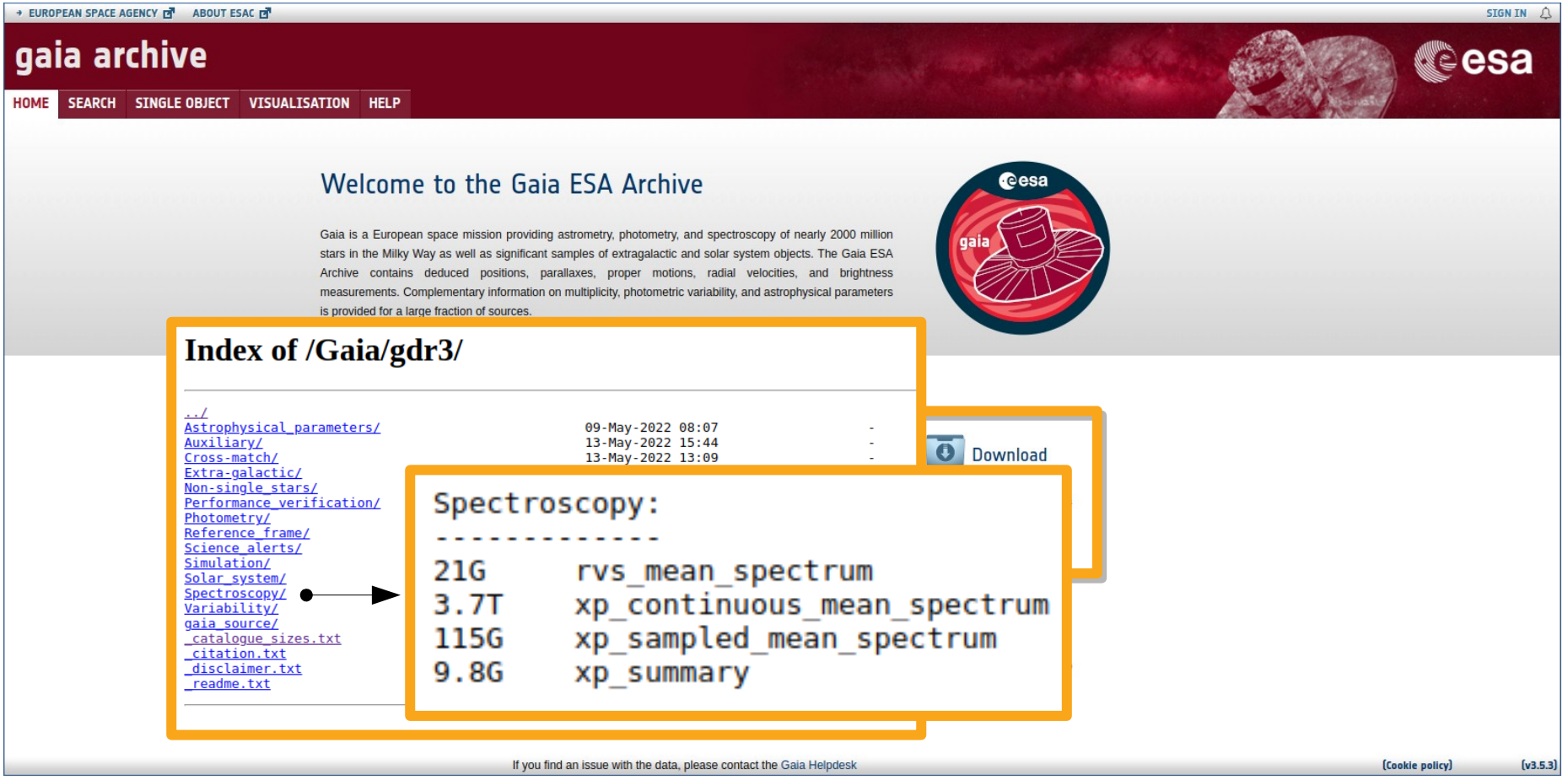

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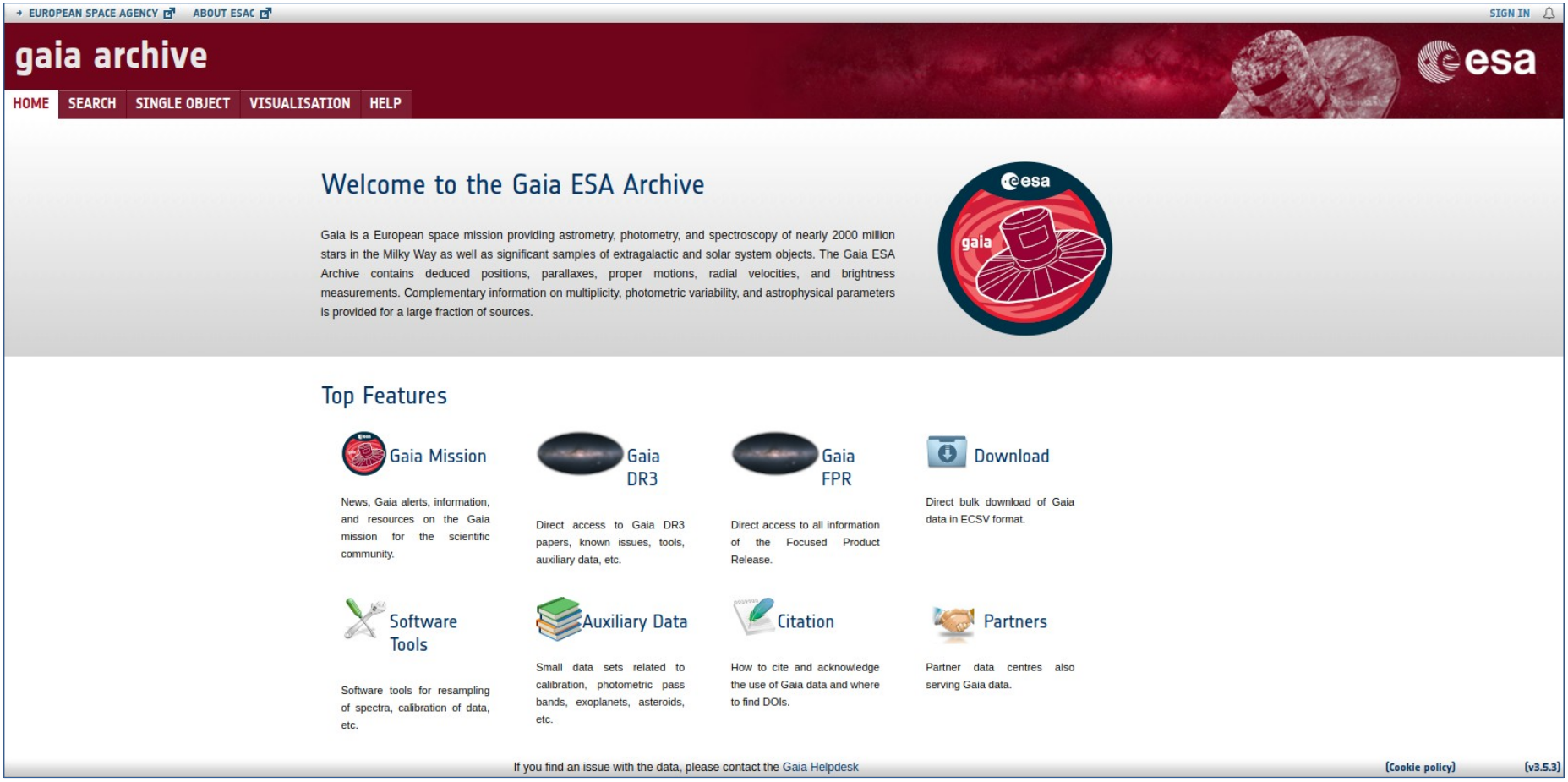

The Gaia Archive at ESA

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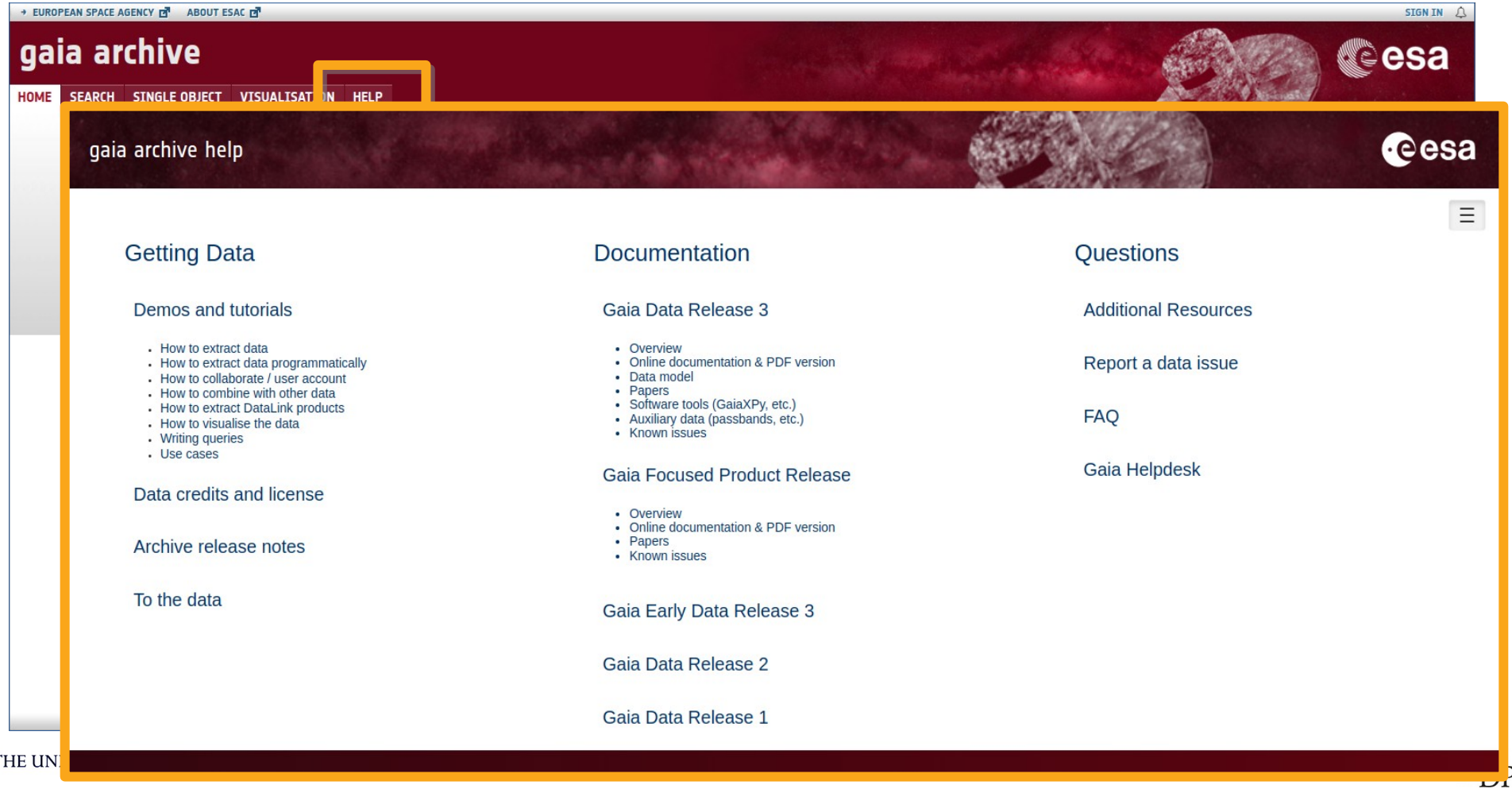

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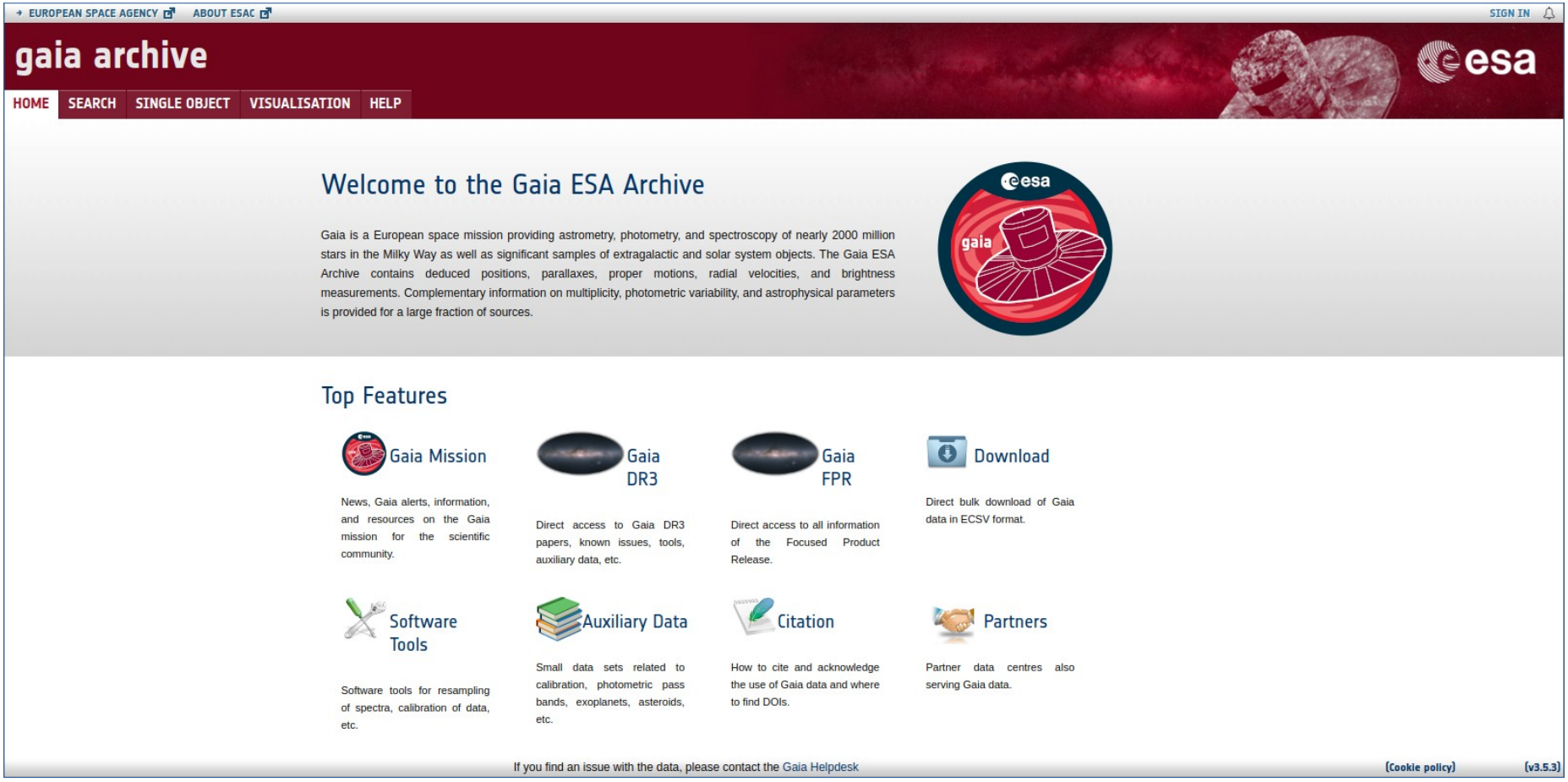

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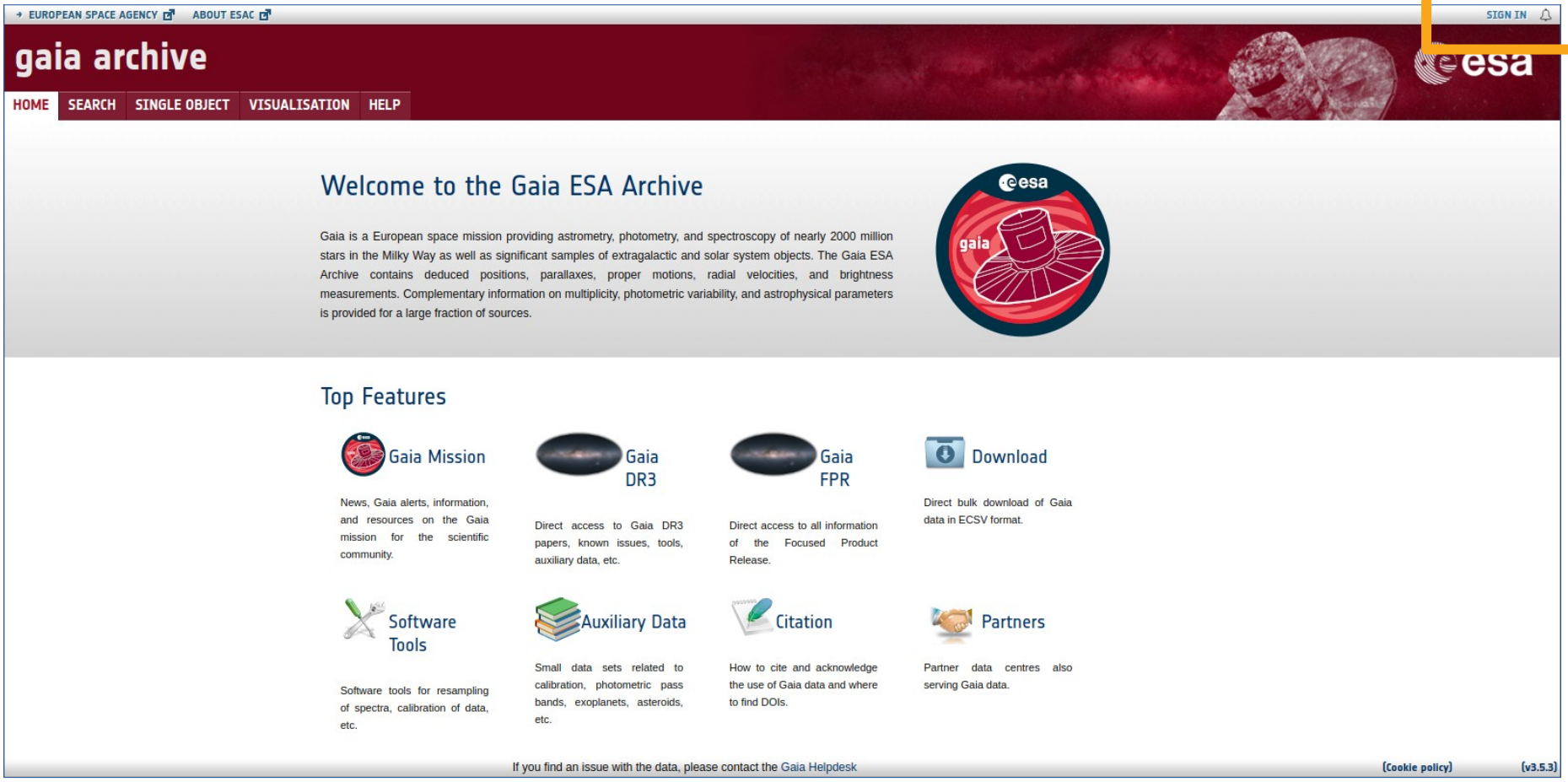

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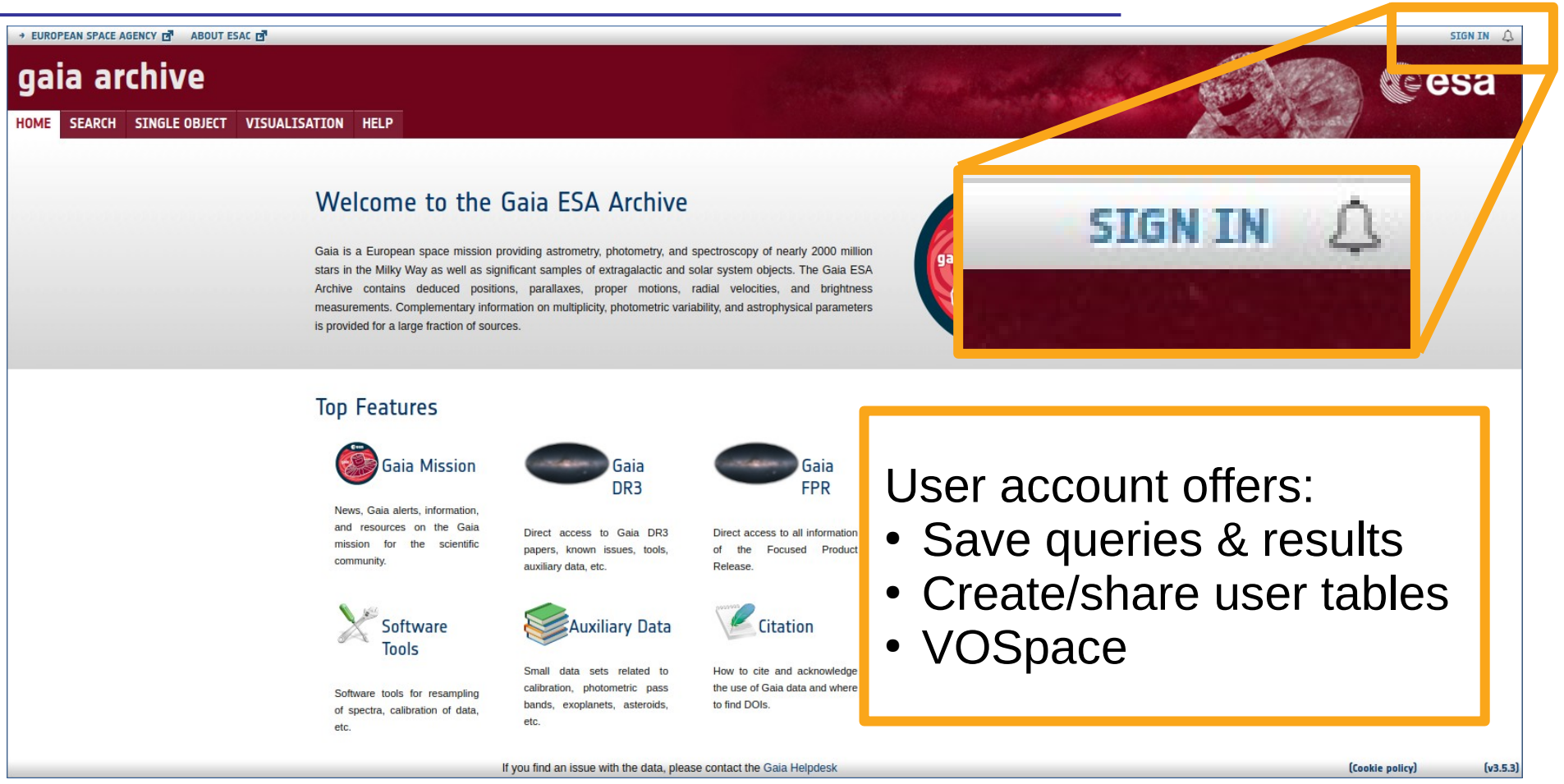
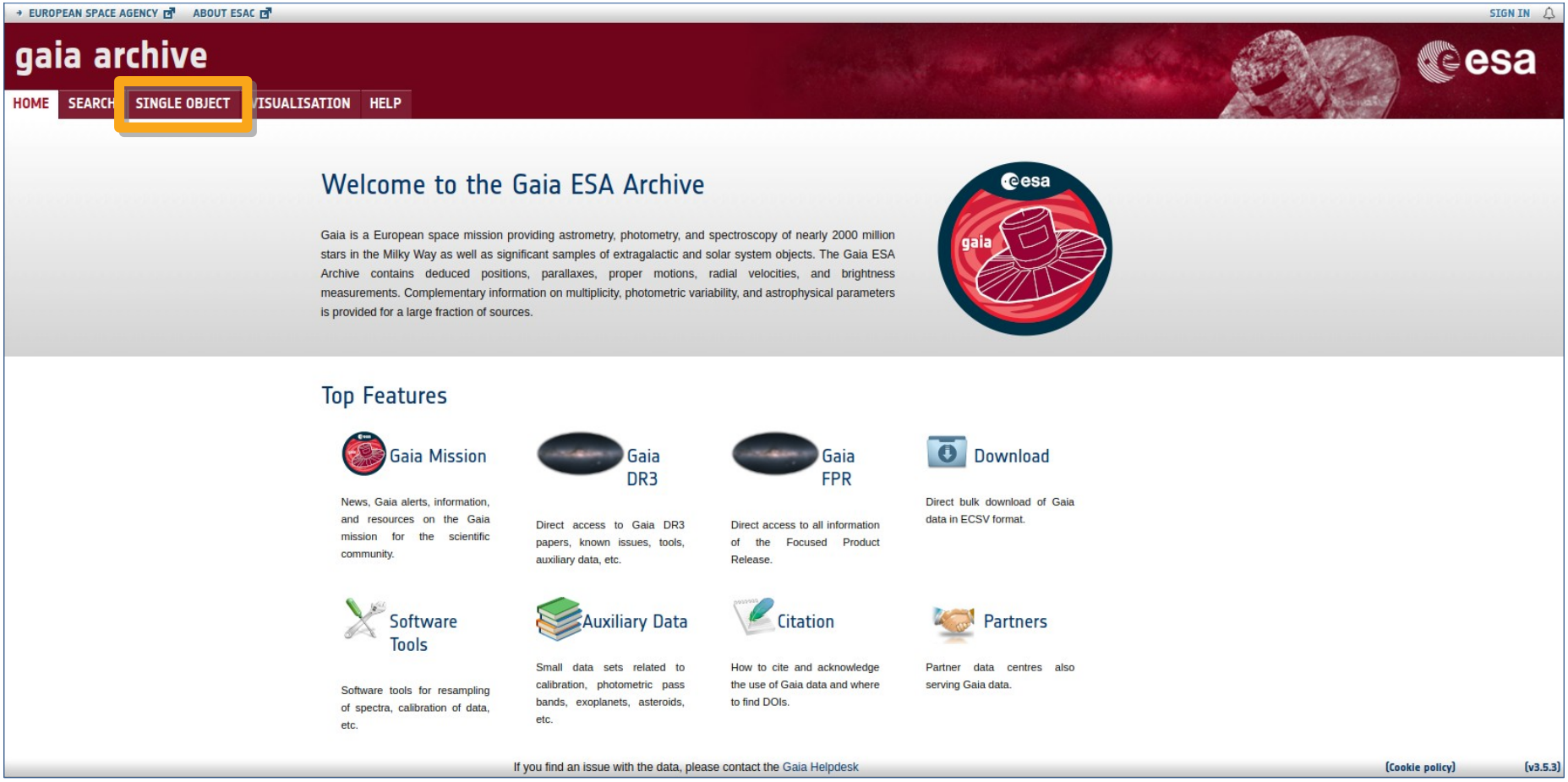


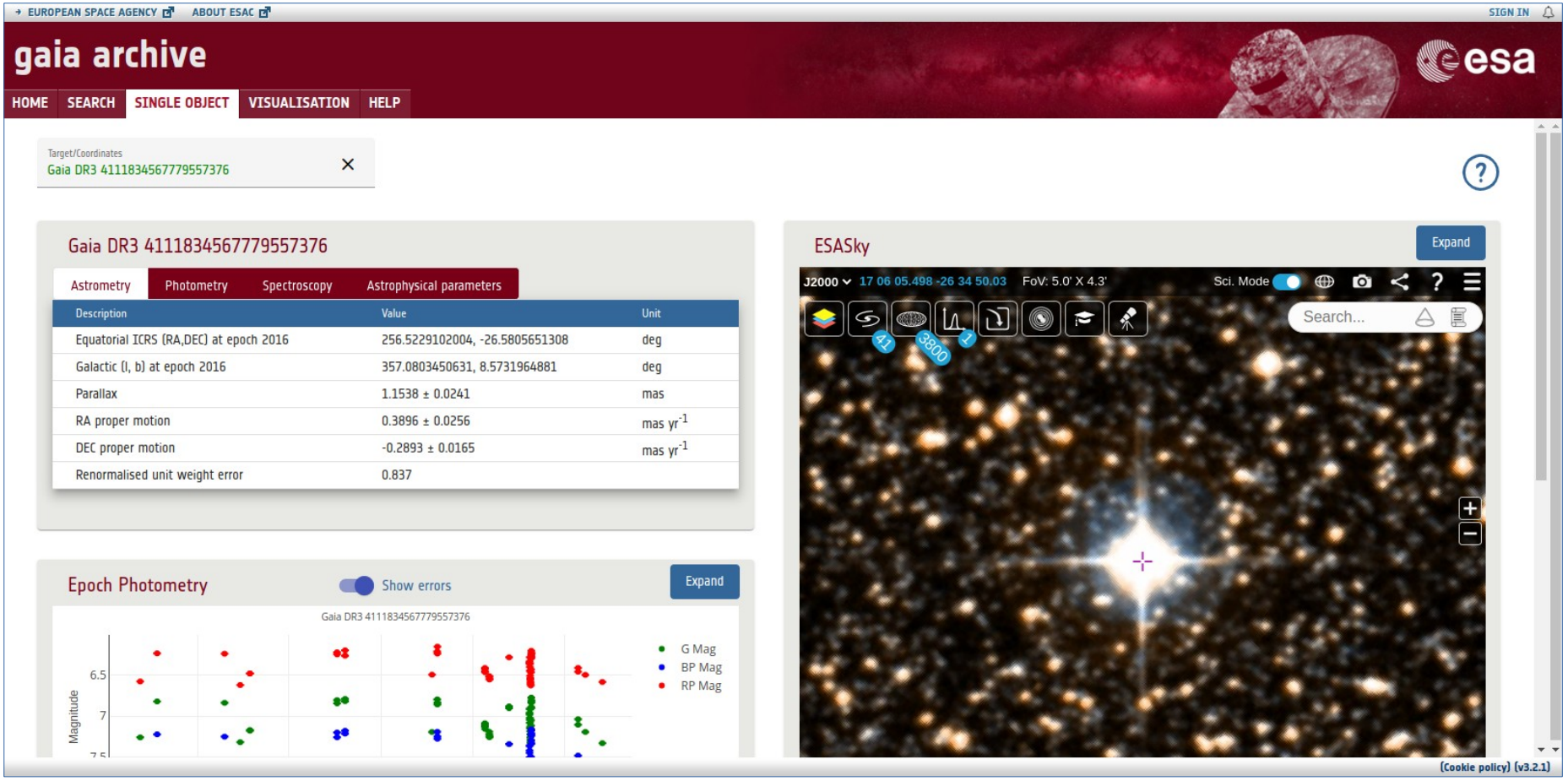
User account offers:

- Save queries & results
- Create/share user tables
- VOSpace

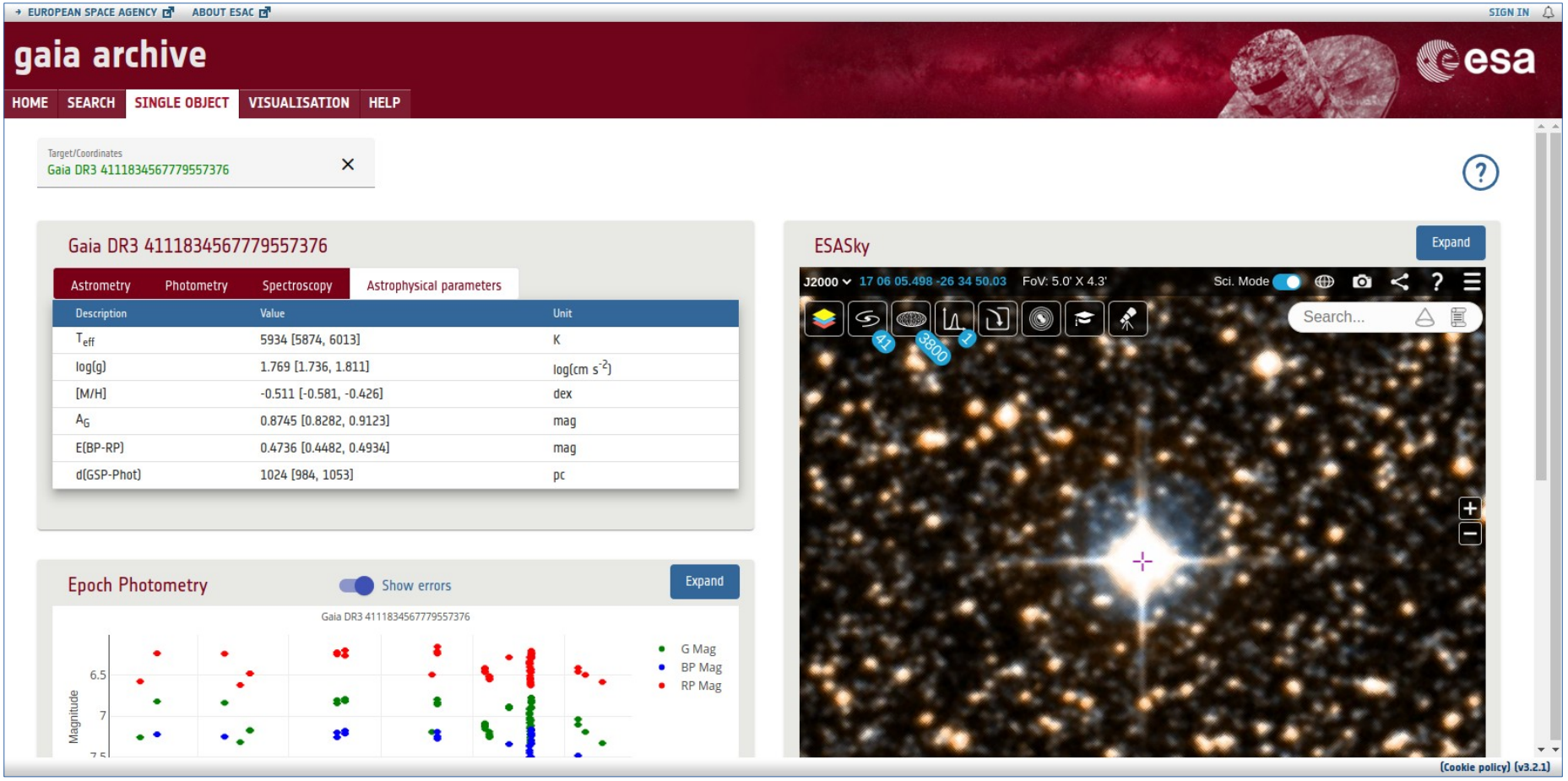
Single object search



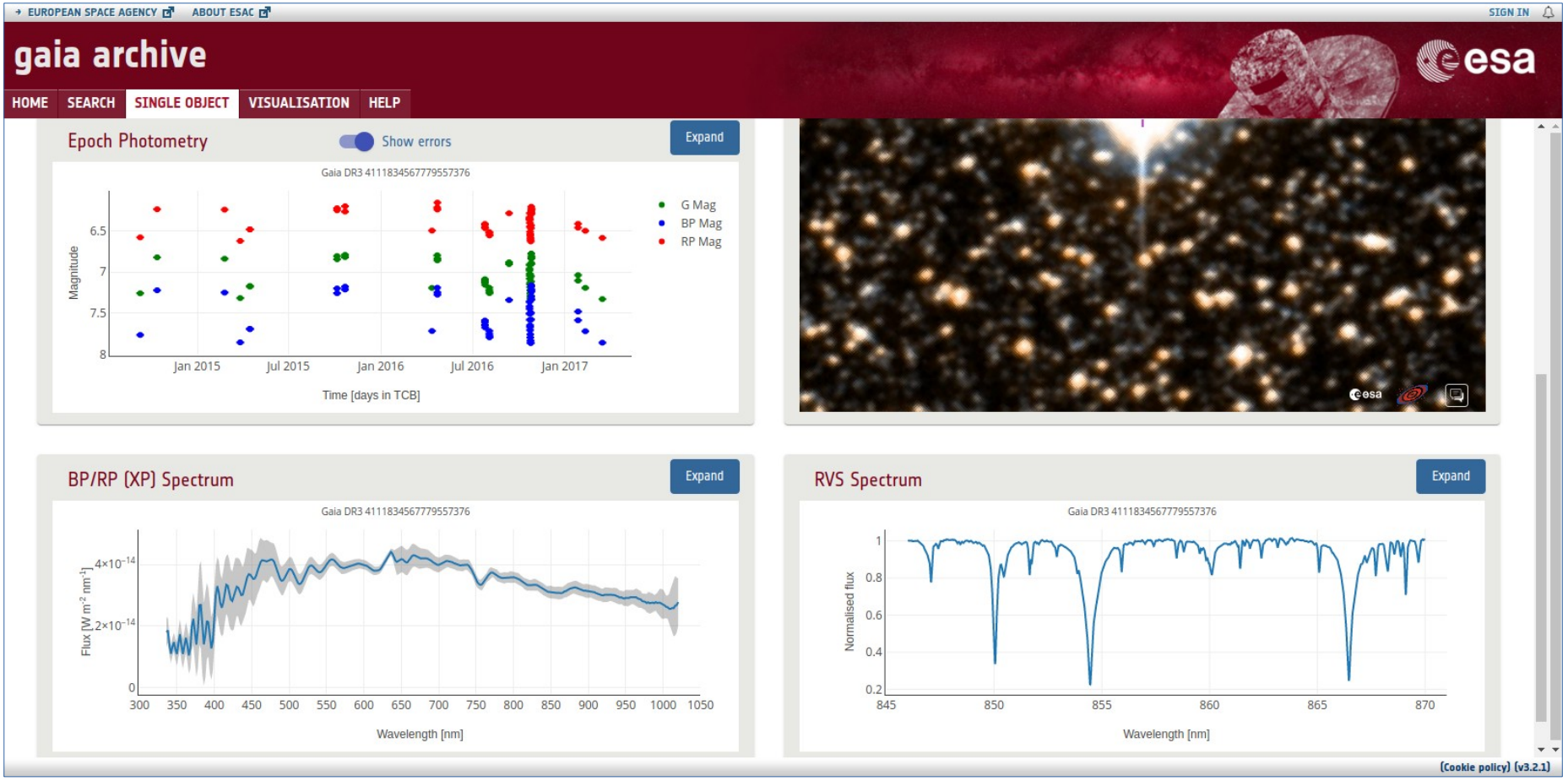
Single object search



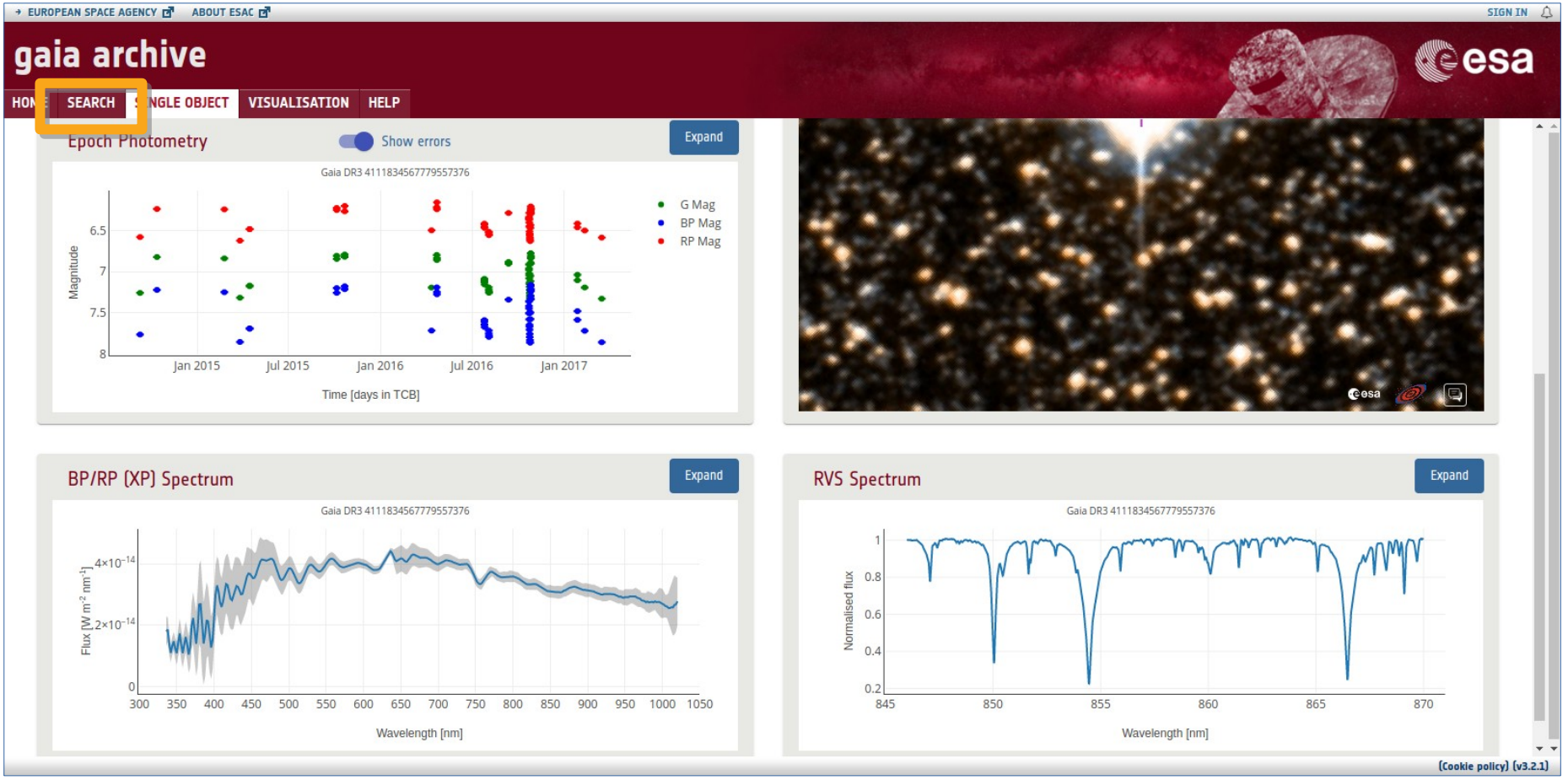
Single object search



Single object search



Single object search



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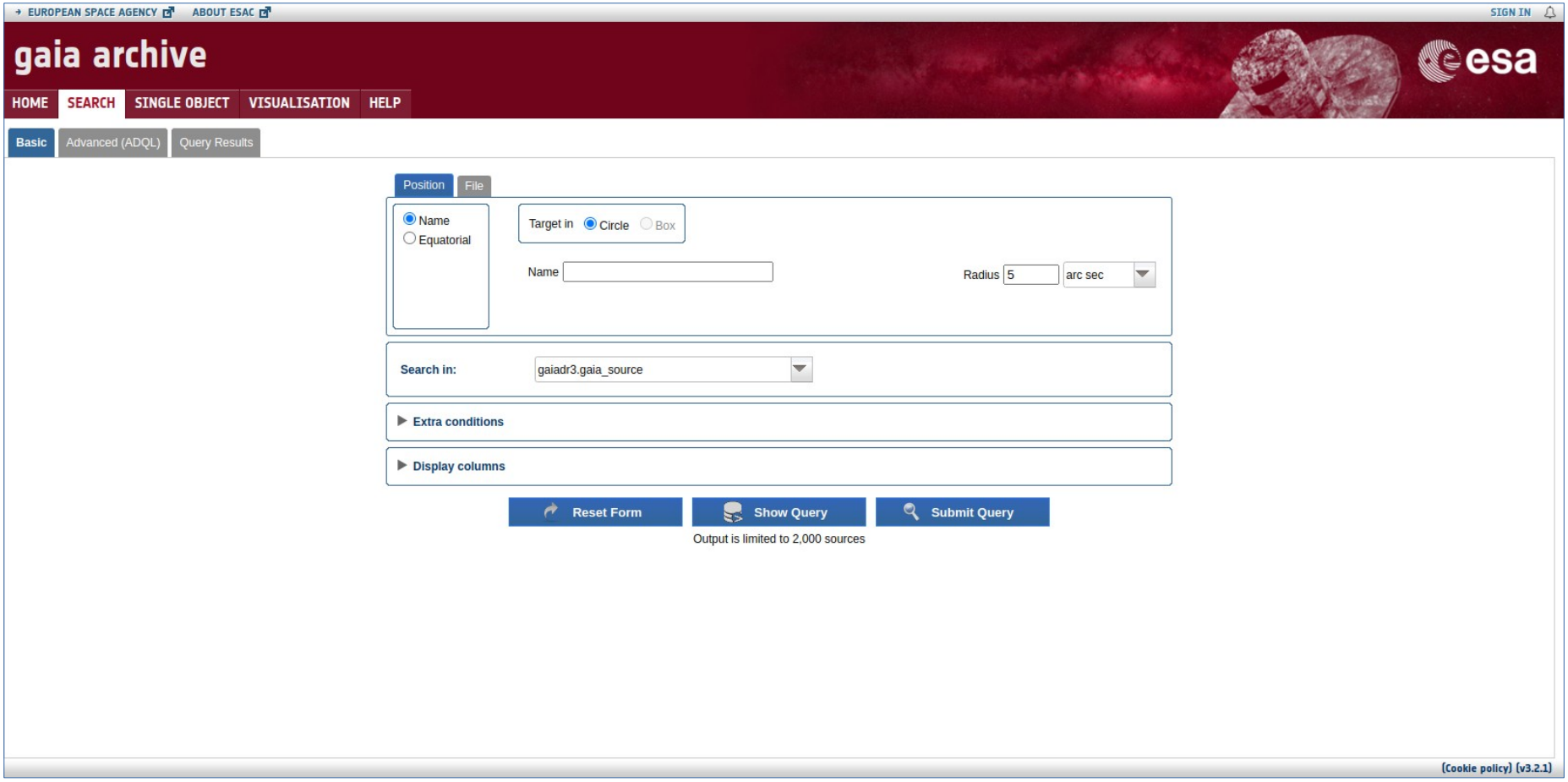

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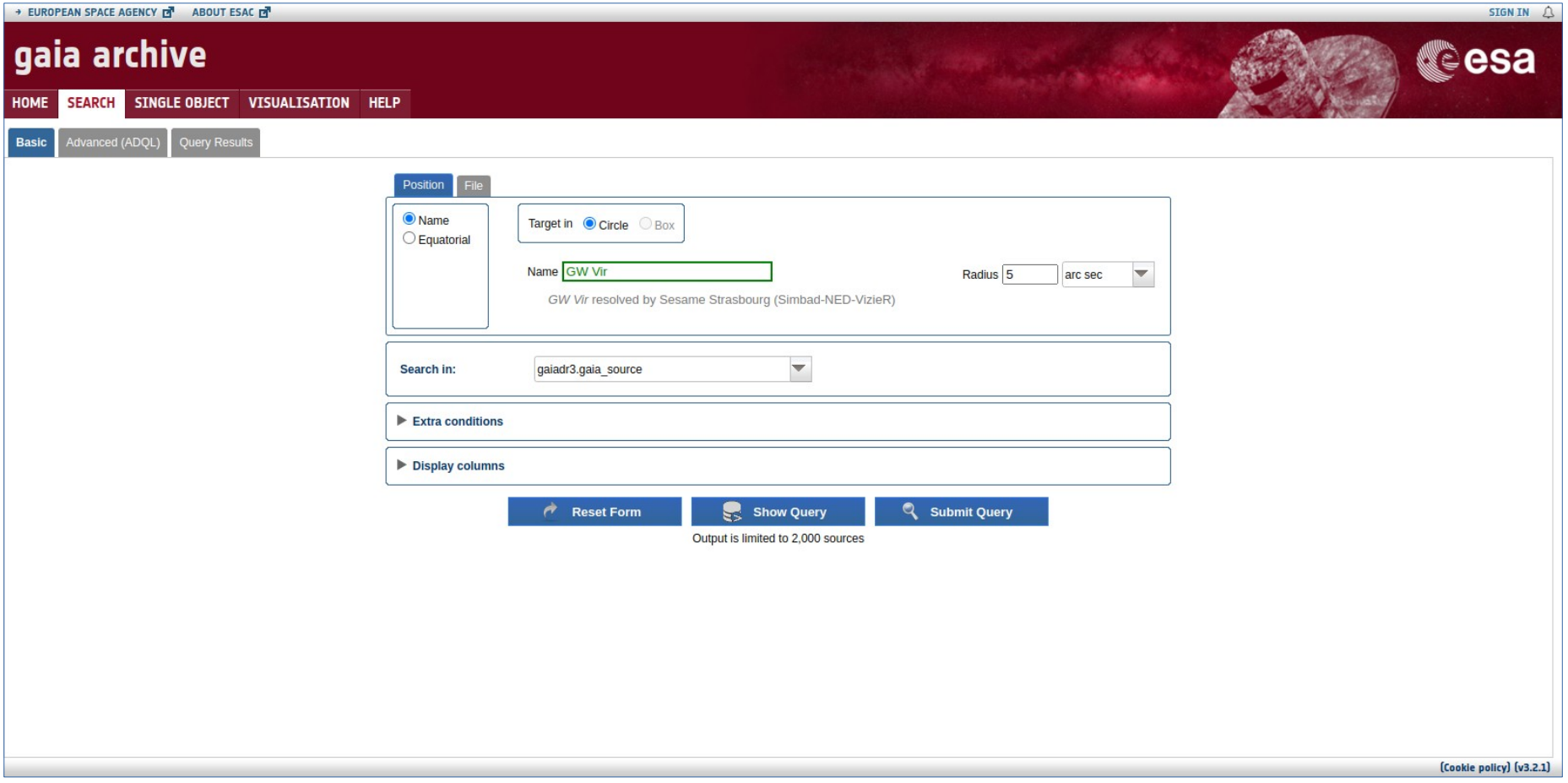

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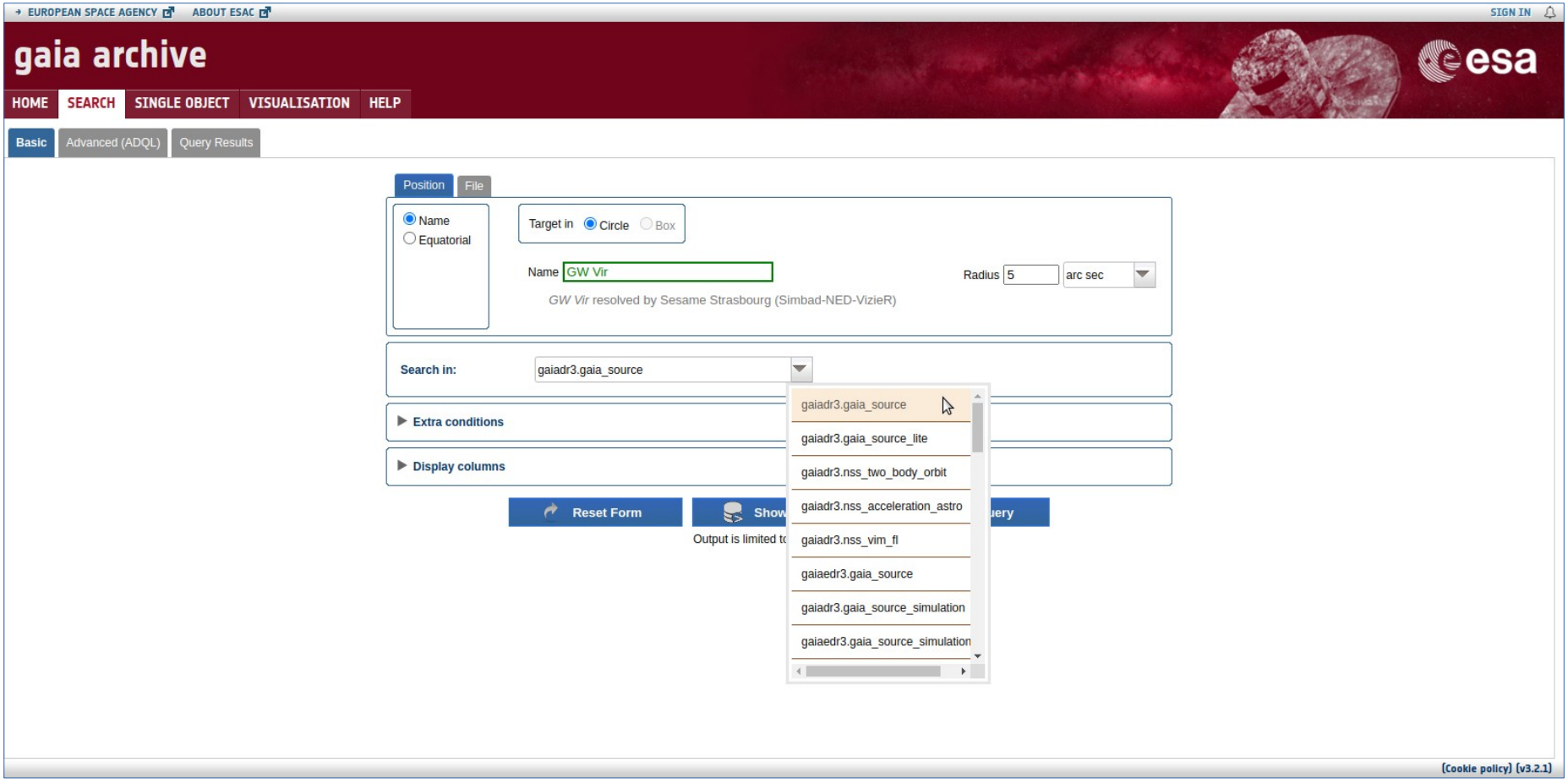

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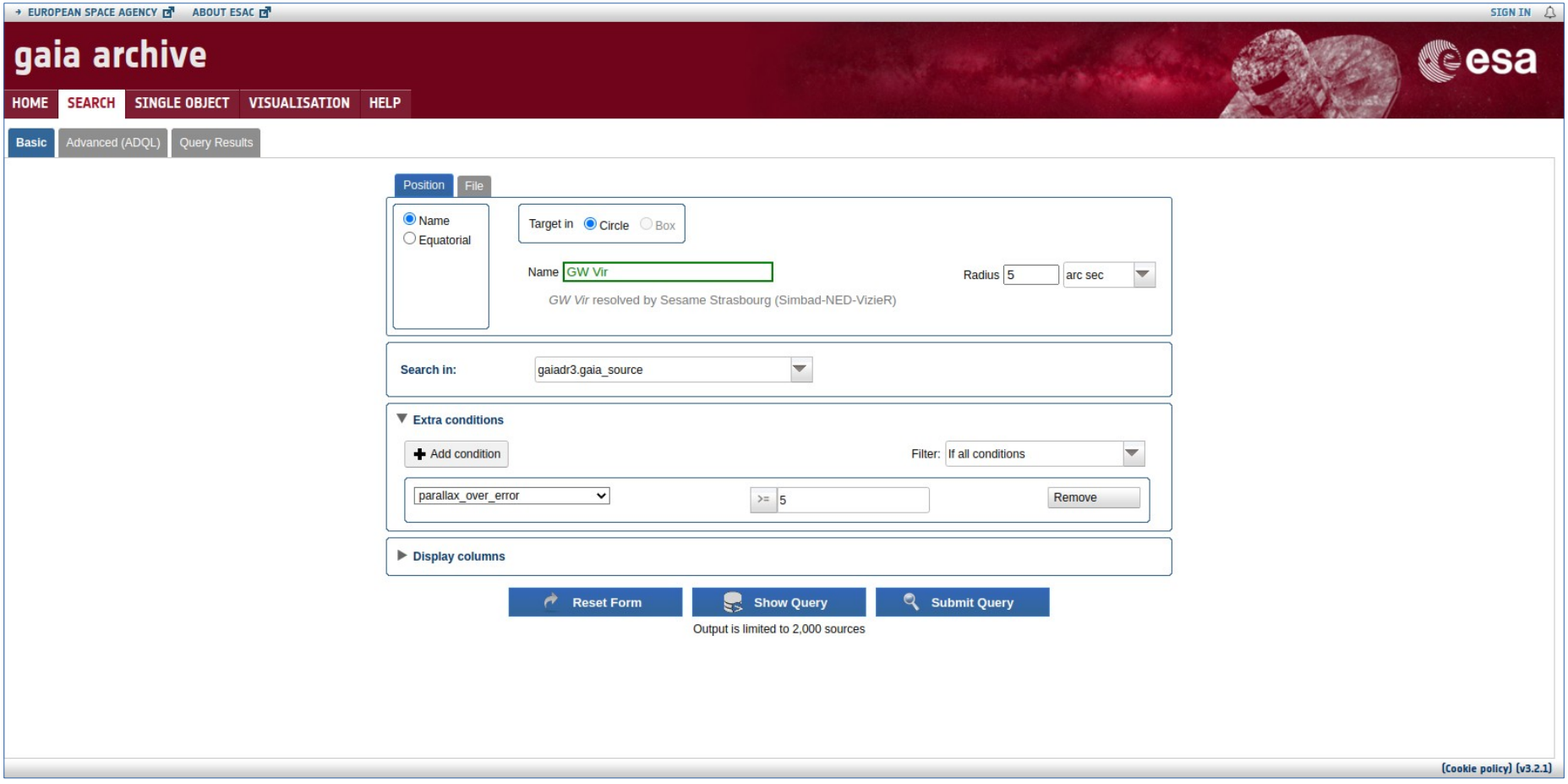

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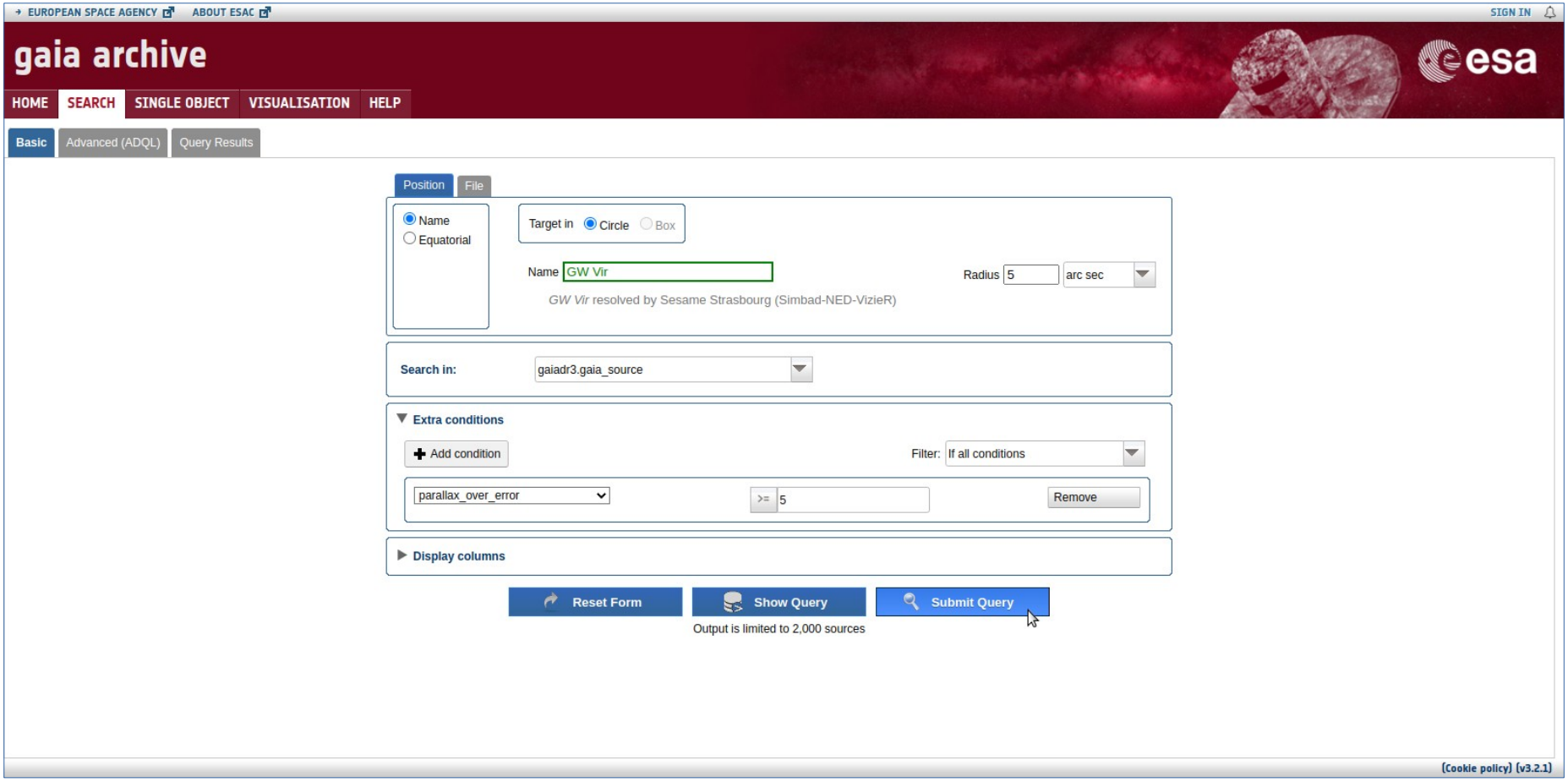

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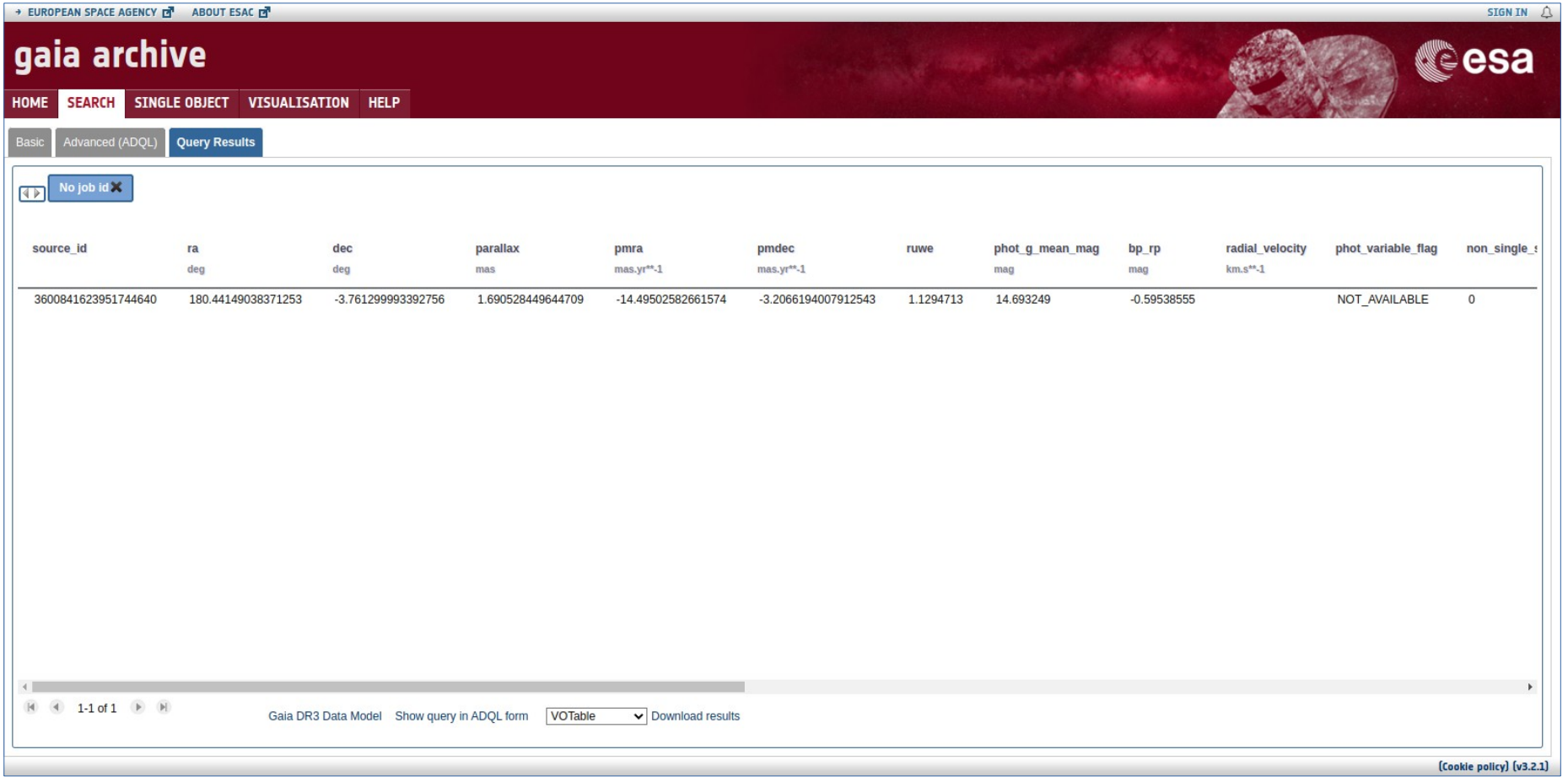
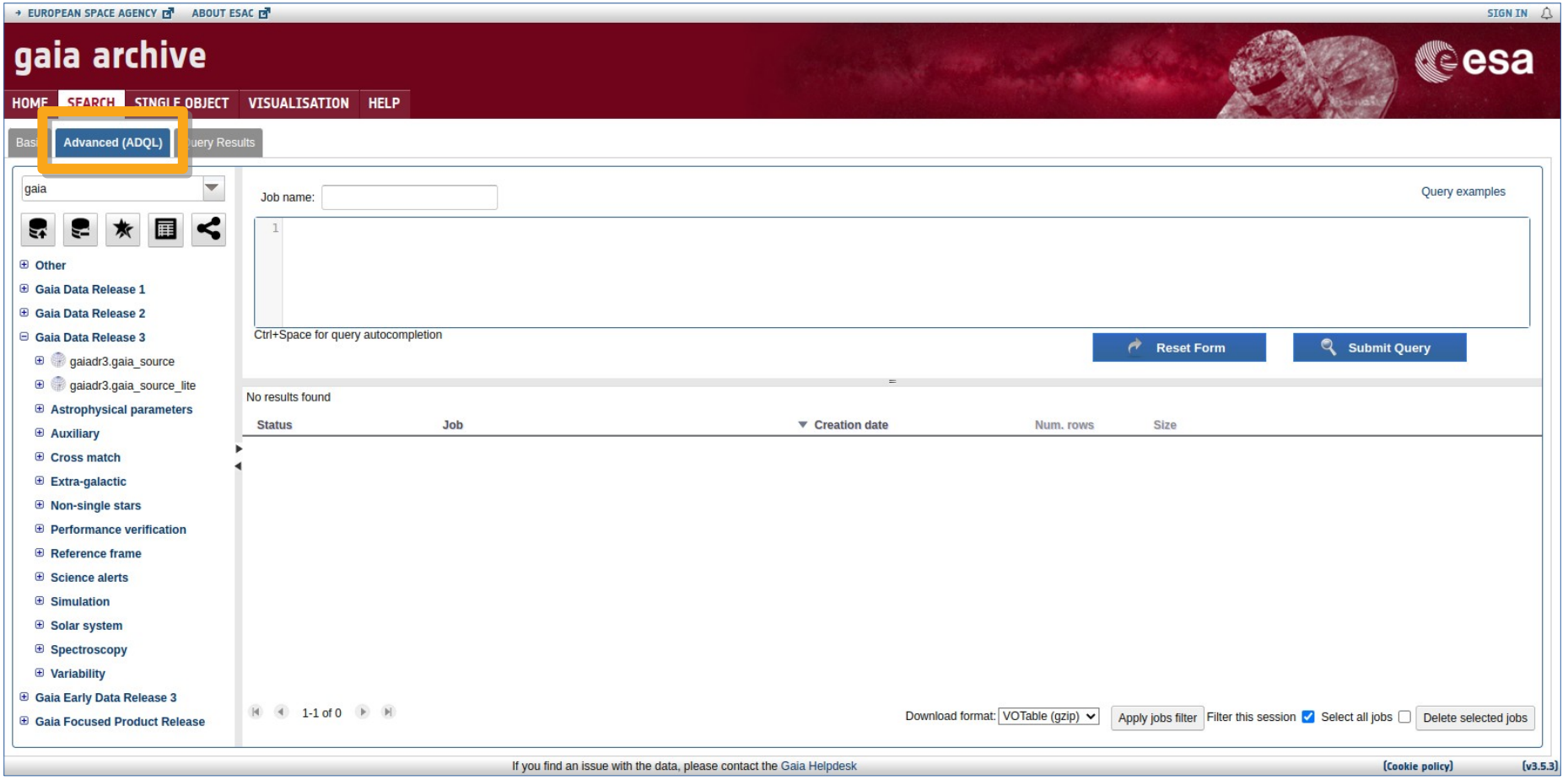


Advanced search



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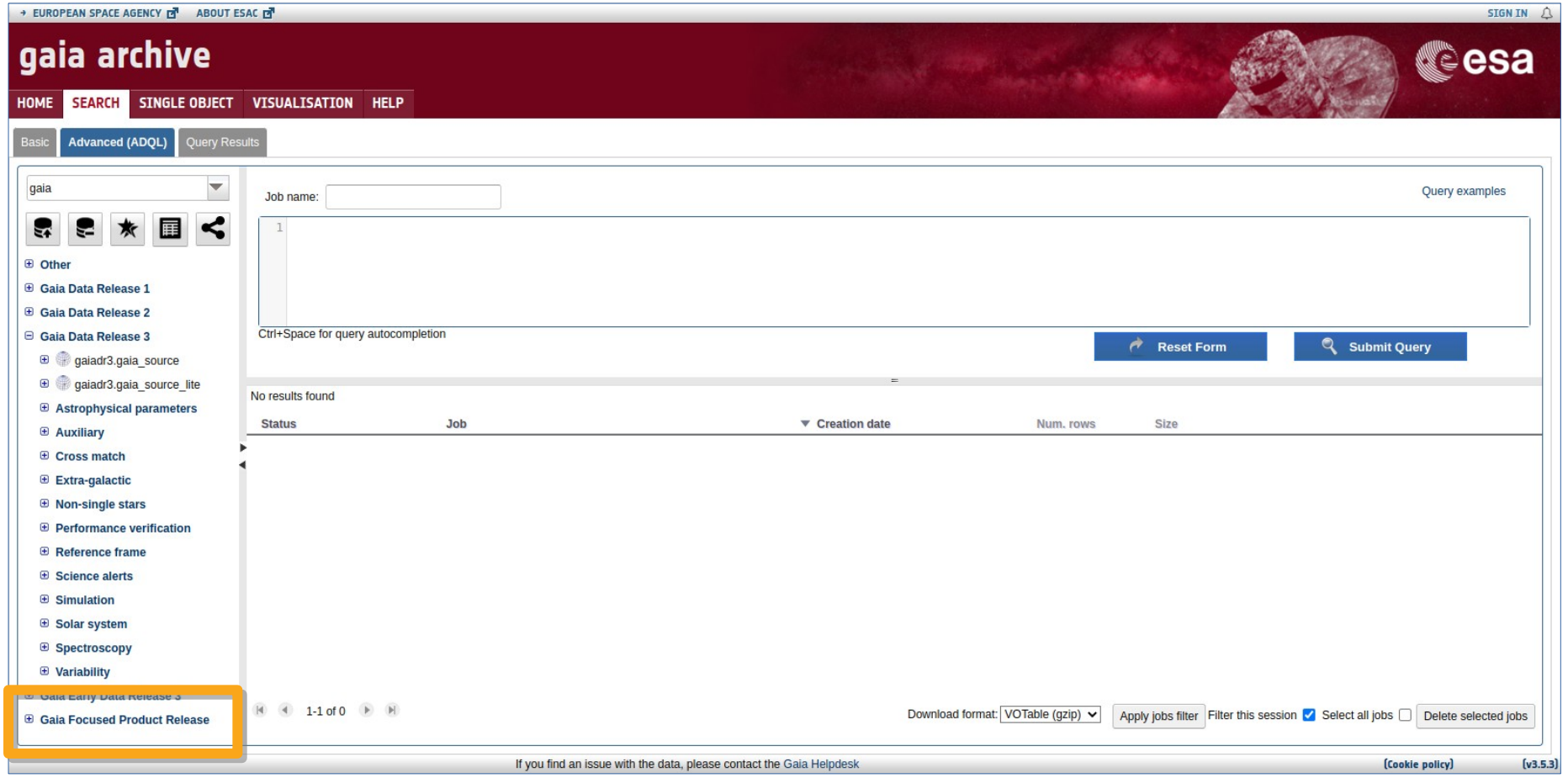

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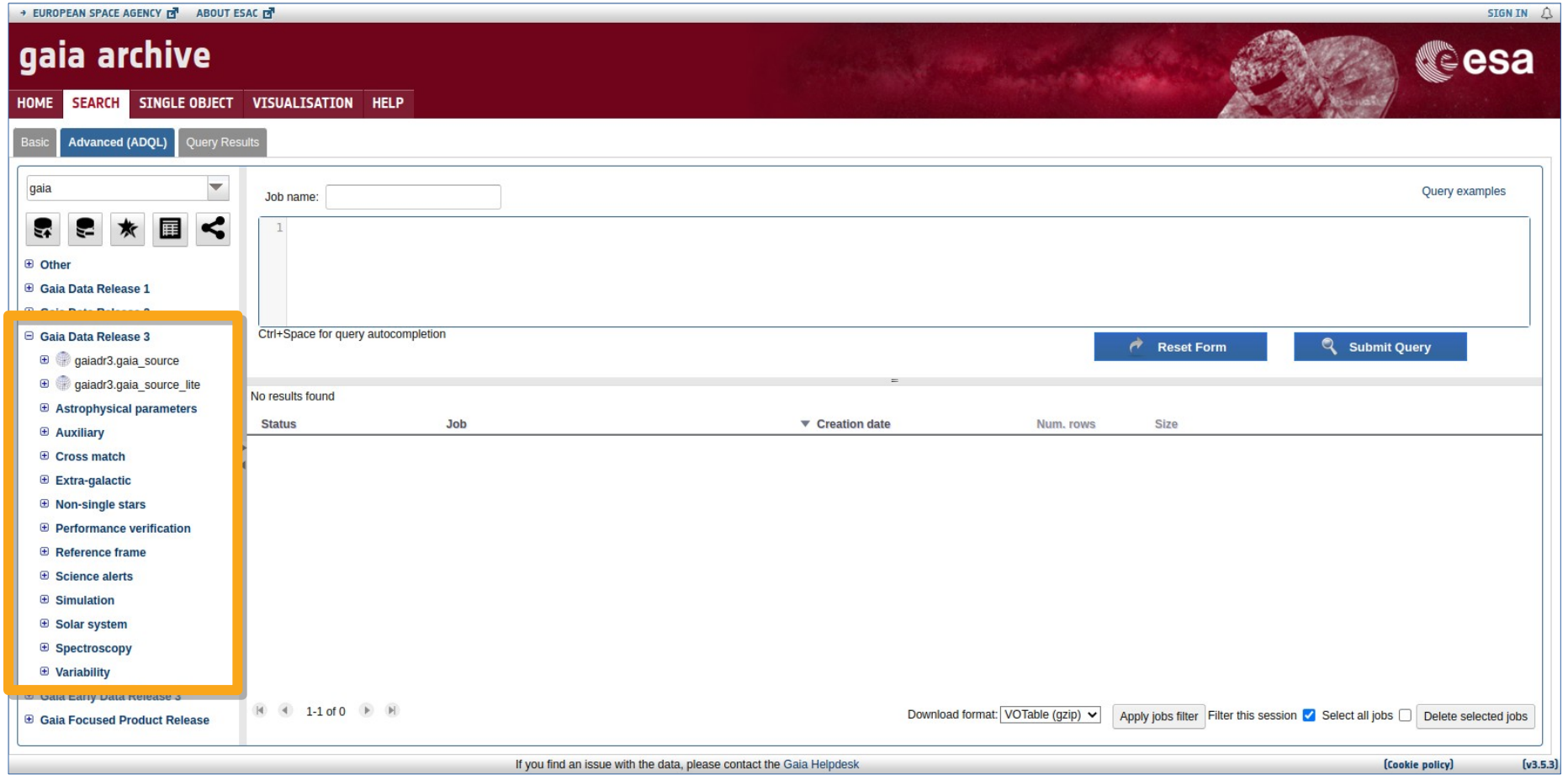

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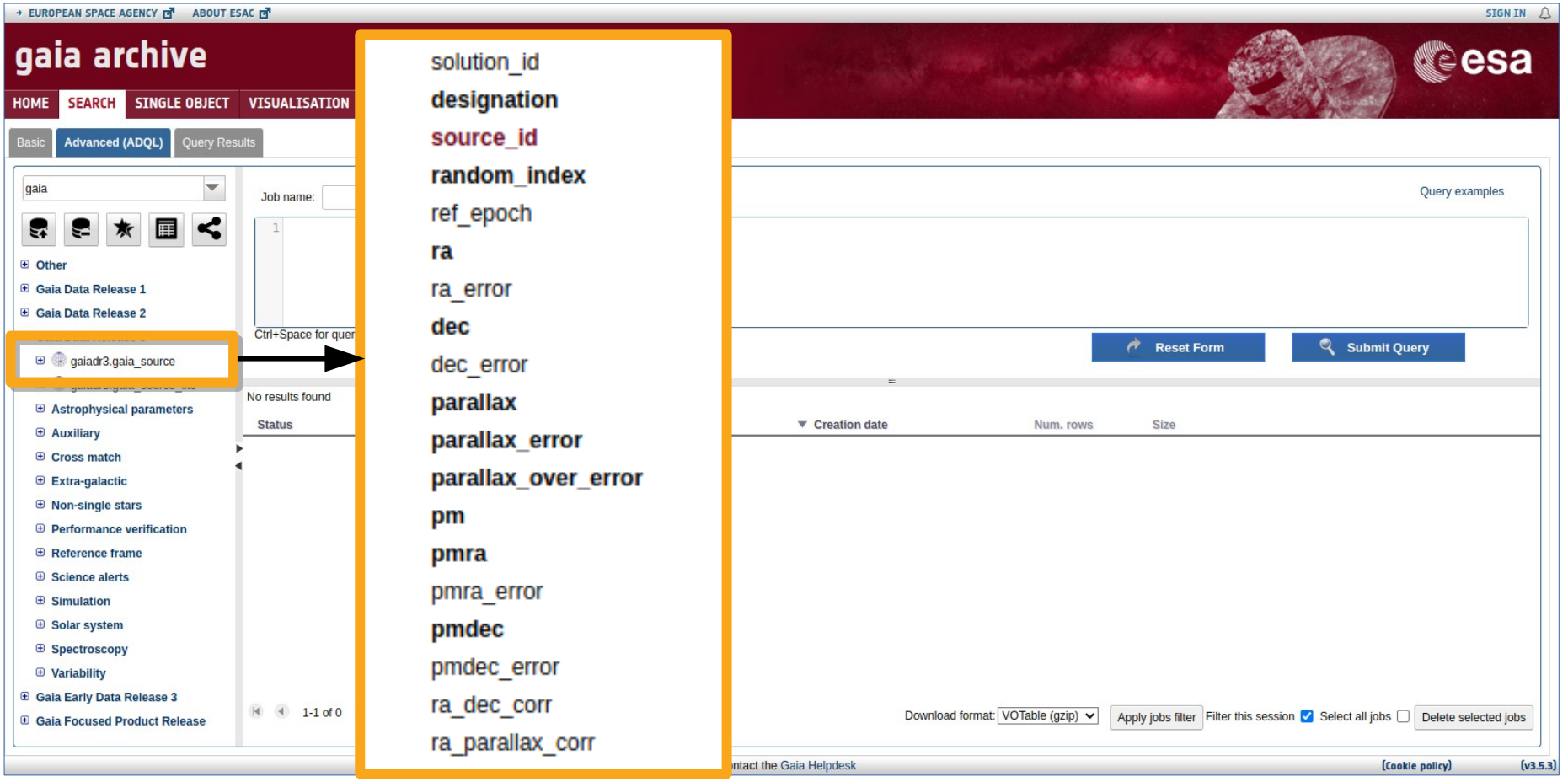

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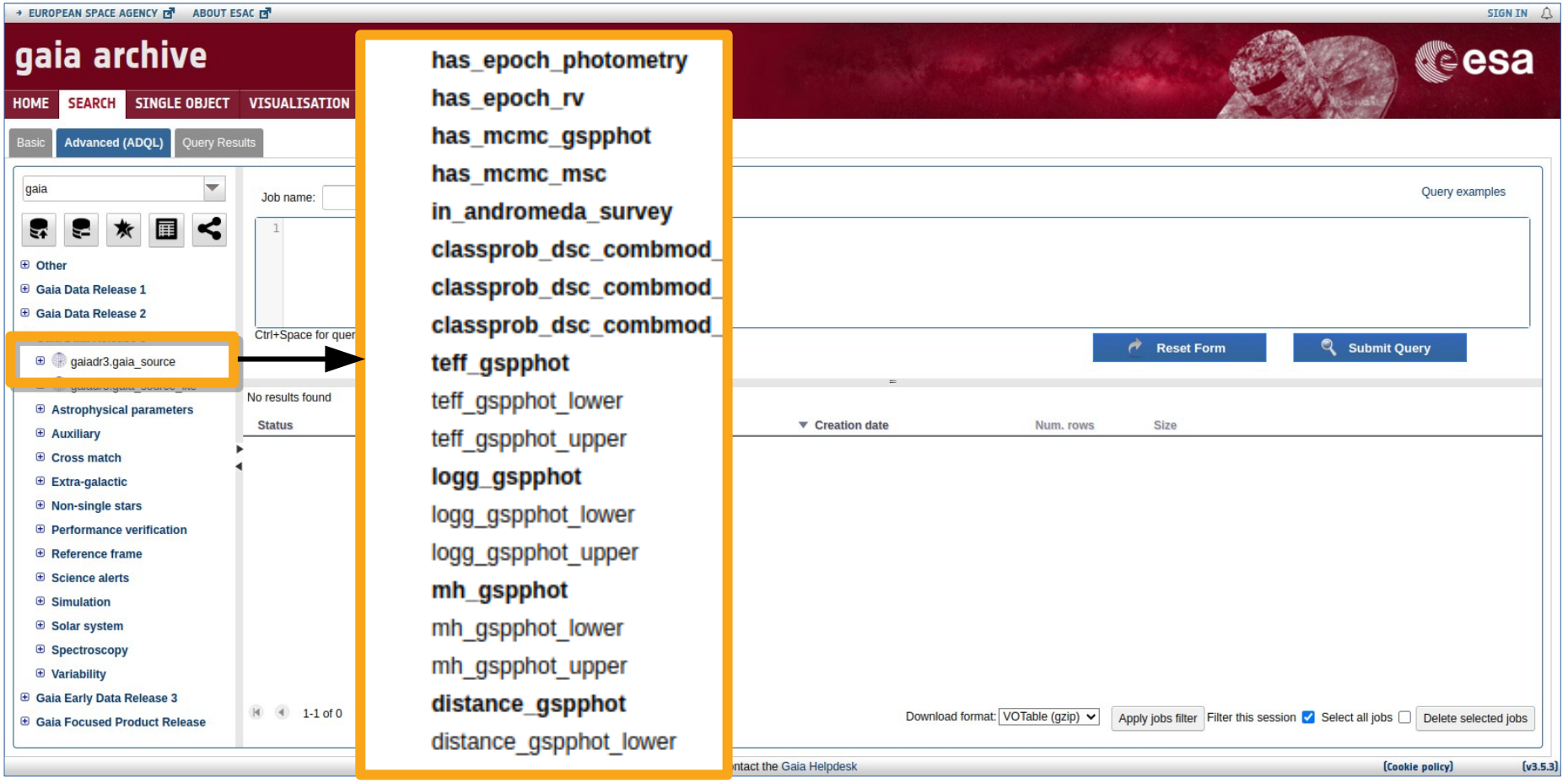

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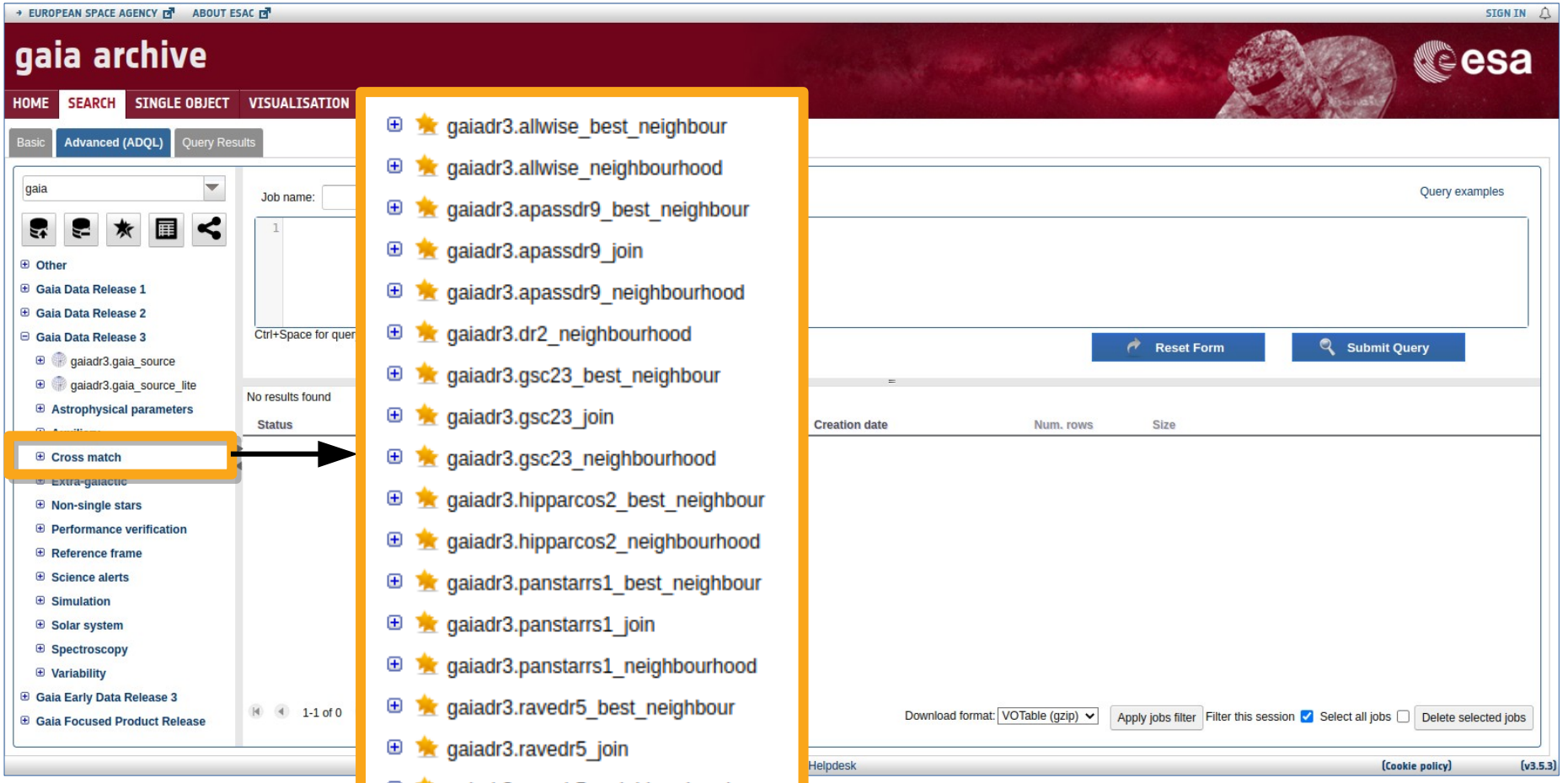

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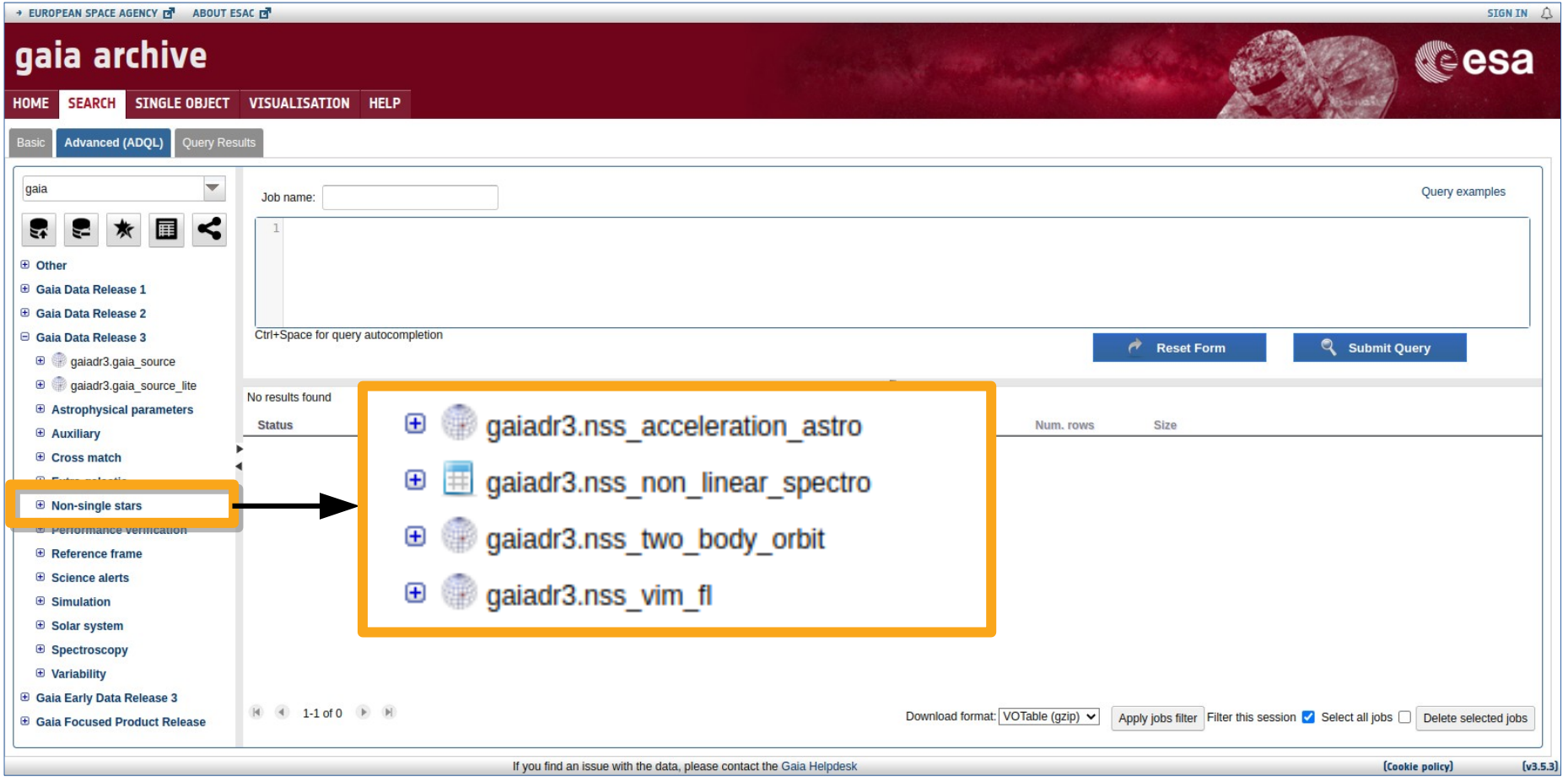

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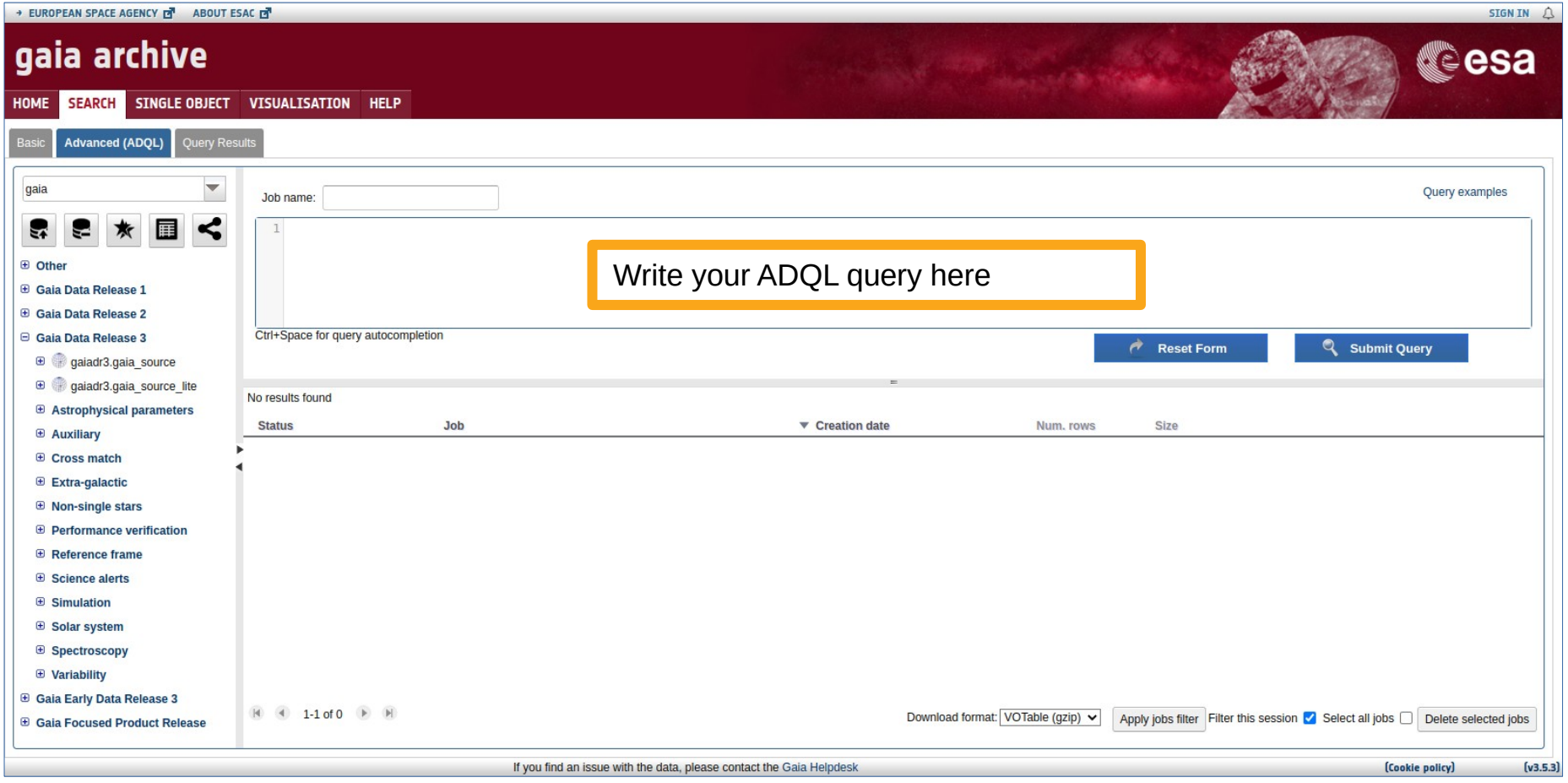

ADQL primer

- The advanced search facility allows users to perform queries on the database using Astronomical Data Query Language (ADQL)
- ADQL is a language for querying relational databases that is tailored to astronomical datasets
- It supports common astronomical operations e.g. cone searches, proper motion propagation, and it knows different reference frames
- Good references:
  - ADQL cookbook: www.gaia.ac.uk/data/gaia-data-release-1/adql-cookbook
  - Gaia Archive help pages: www.cosmos.esa.int/web/gaia-users/archive/writing-queries
- Basic query construction:

```
SELECT * FROM gaiadr3.gaia_source
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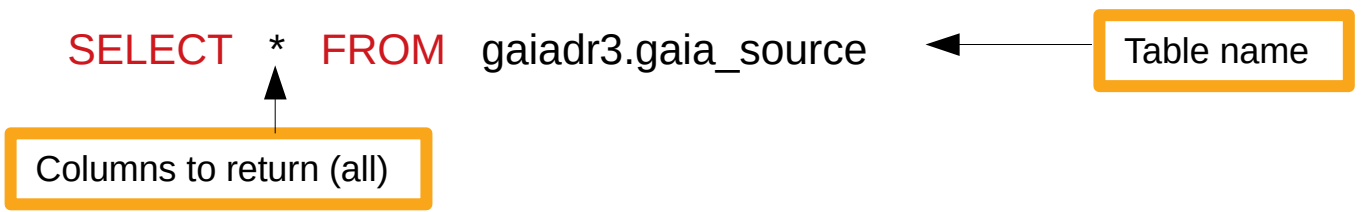

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- Basic query construction:

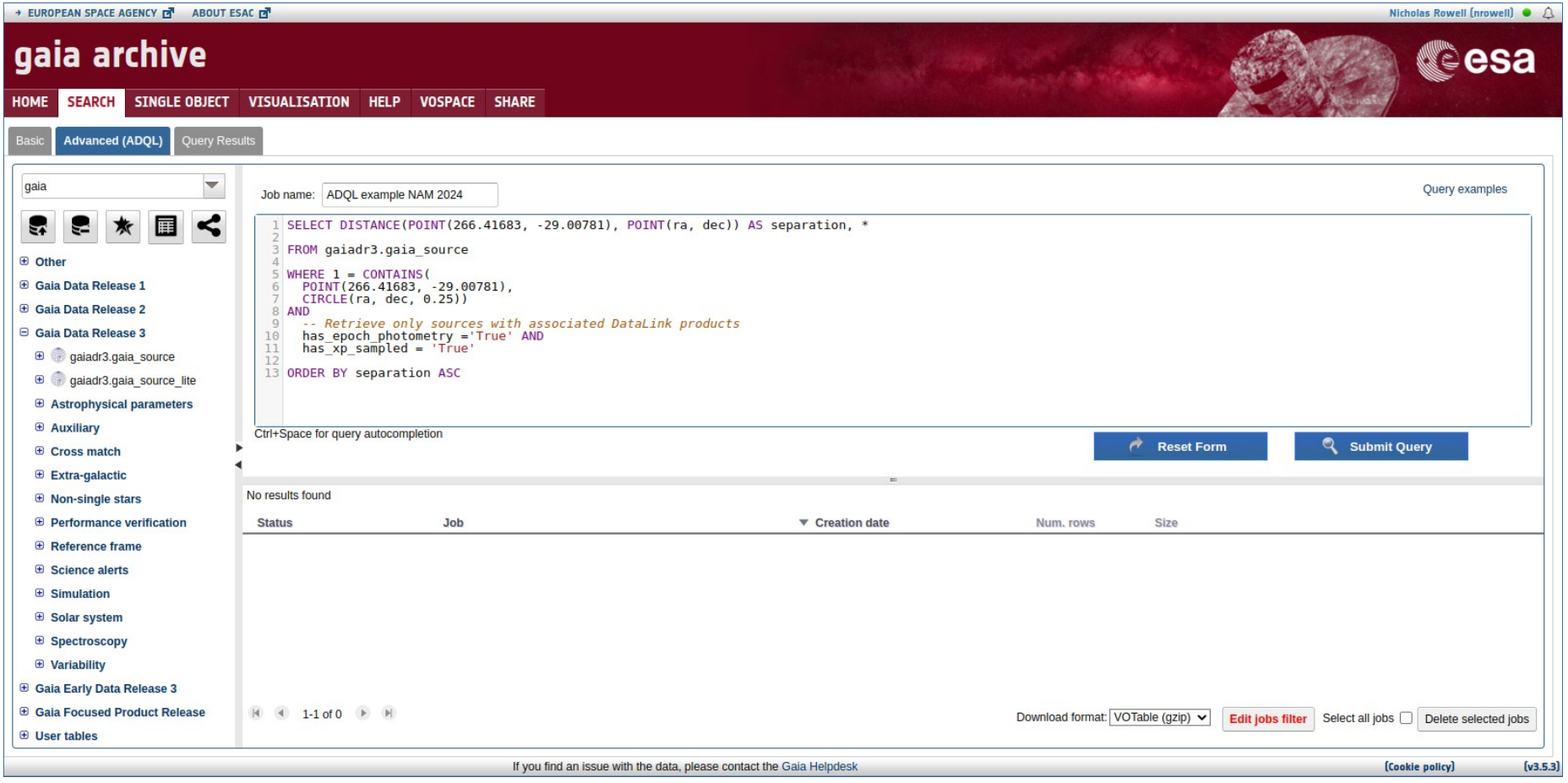
```
SELECT * FROM gaiadr3.gaia_source

SELECT ra, dec FROM gaiadr3.gaia_source WHERE phot_g_mean_mag < 10
```

Only RA & dec

Only bright stars

Advanced search



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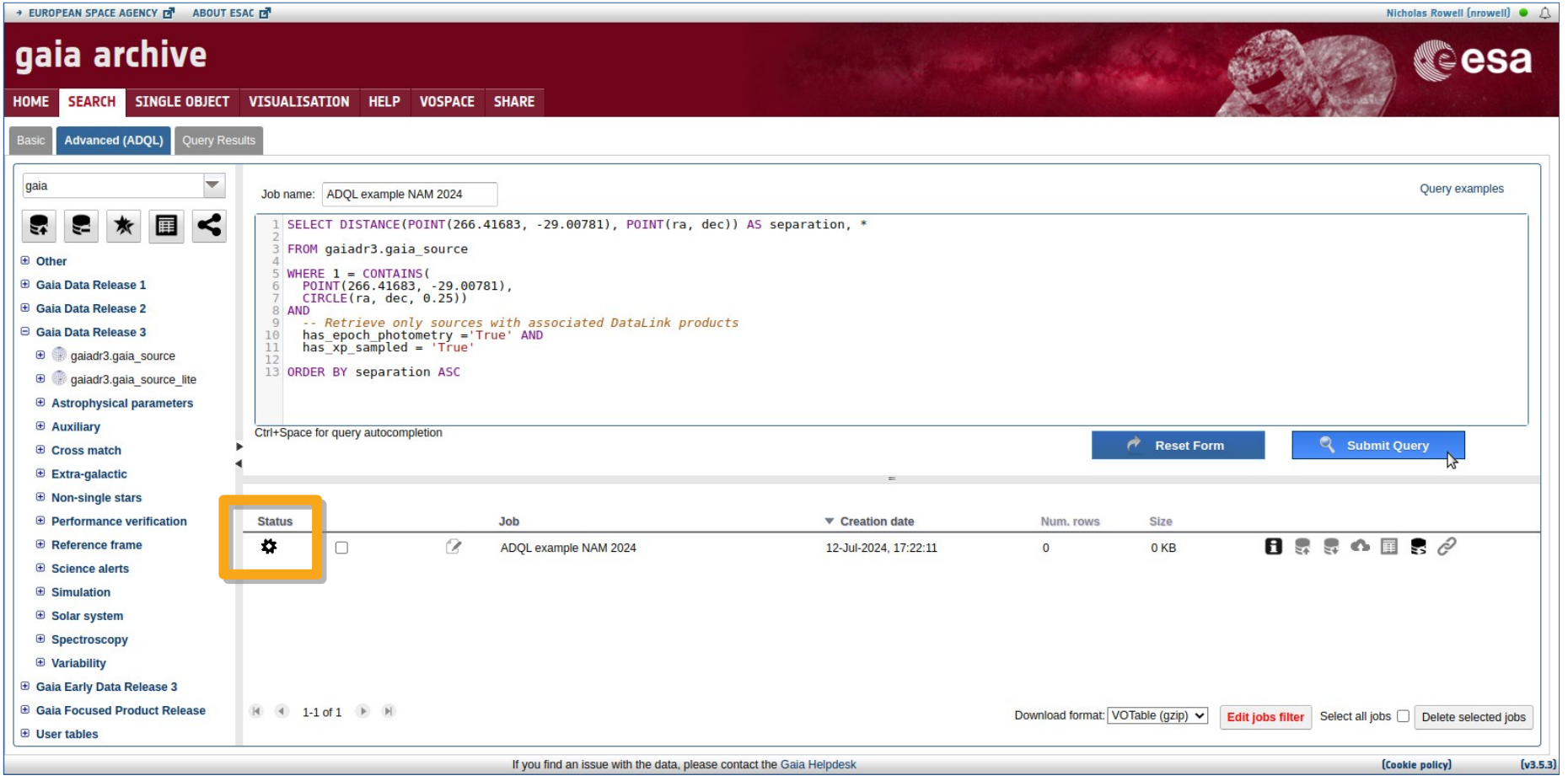
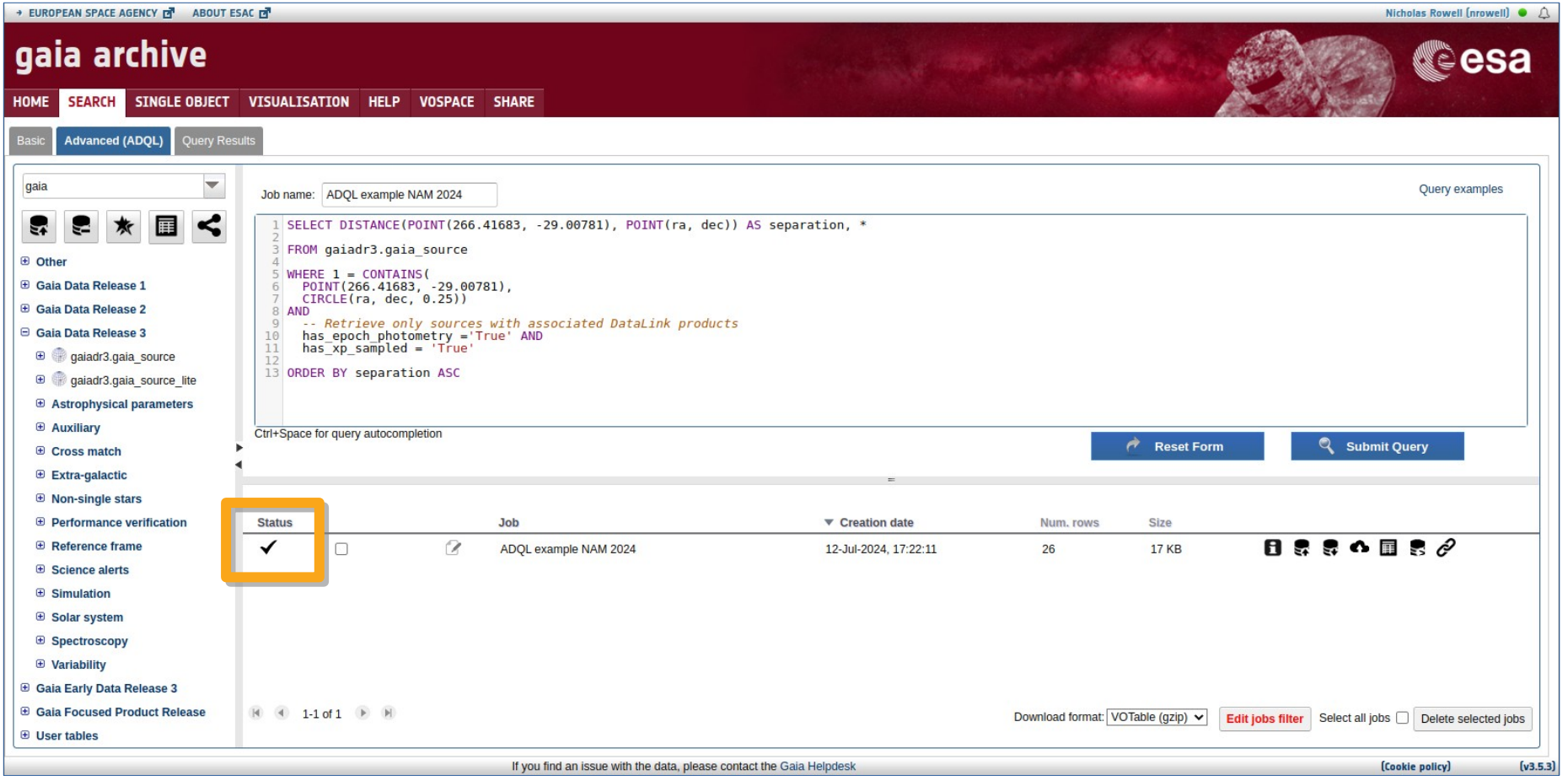


Advanced search



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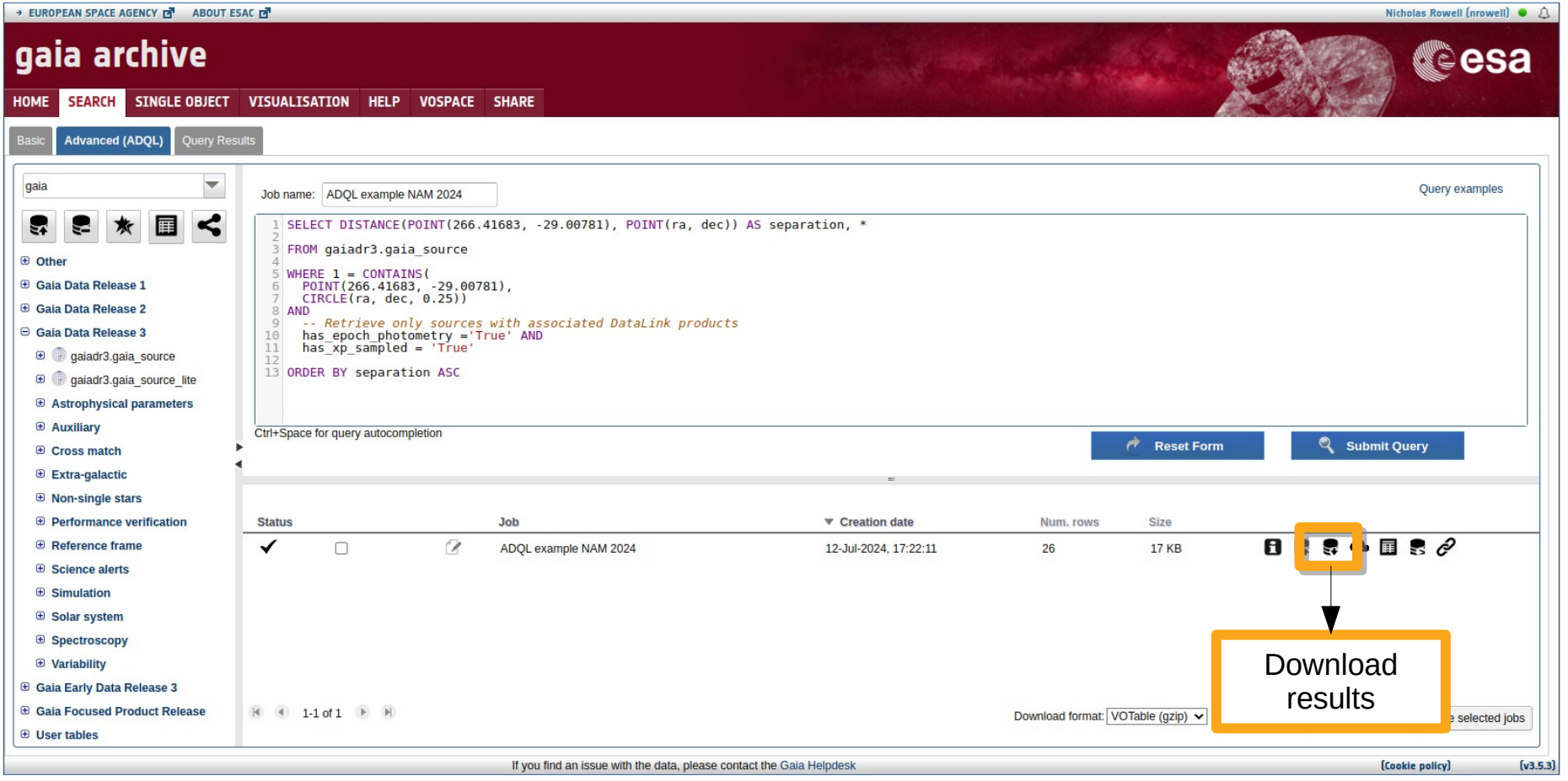

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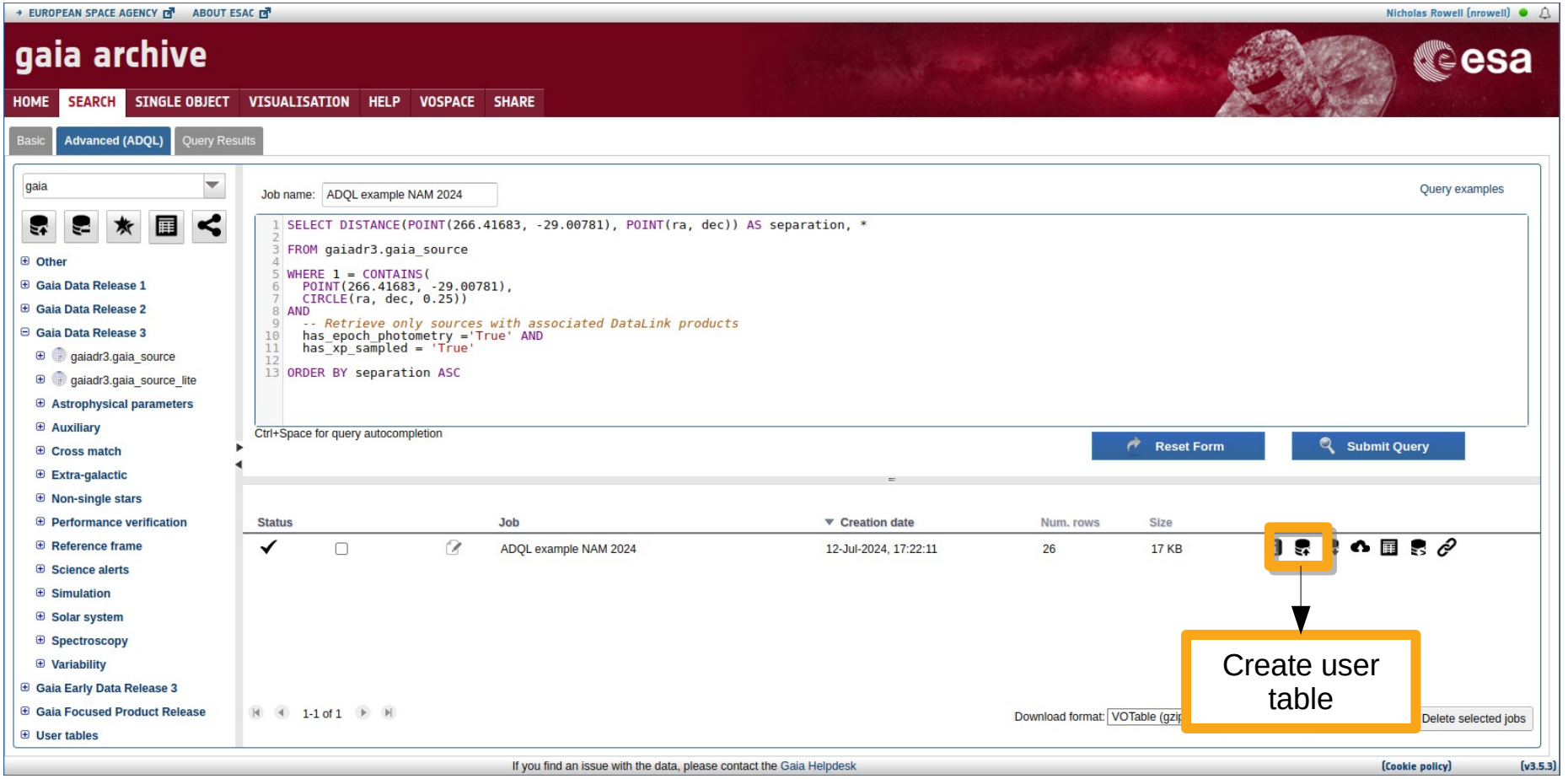

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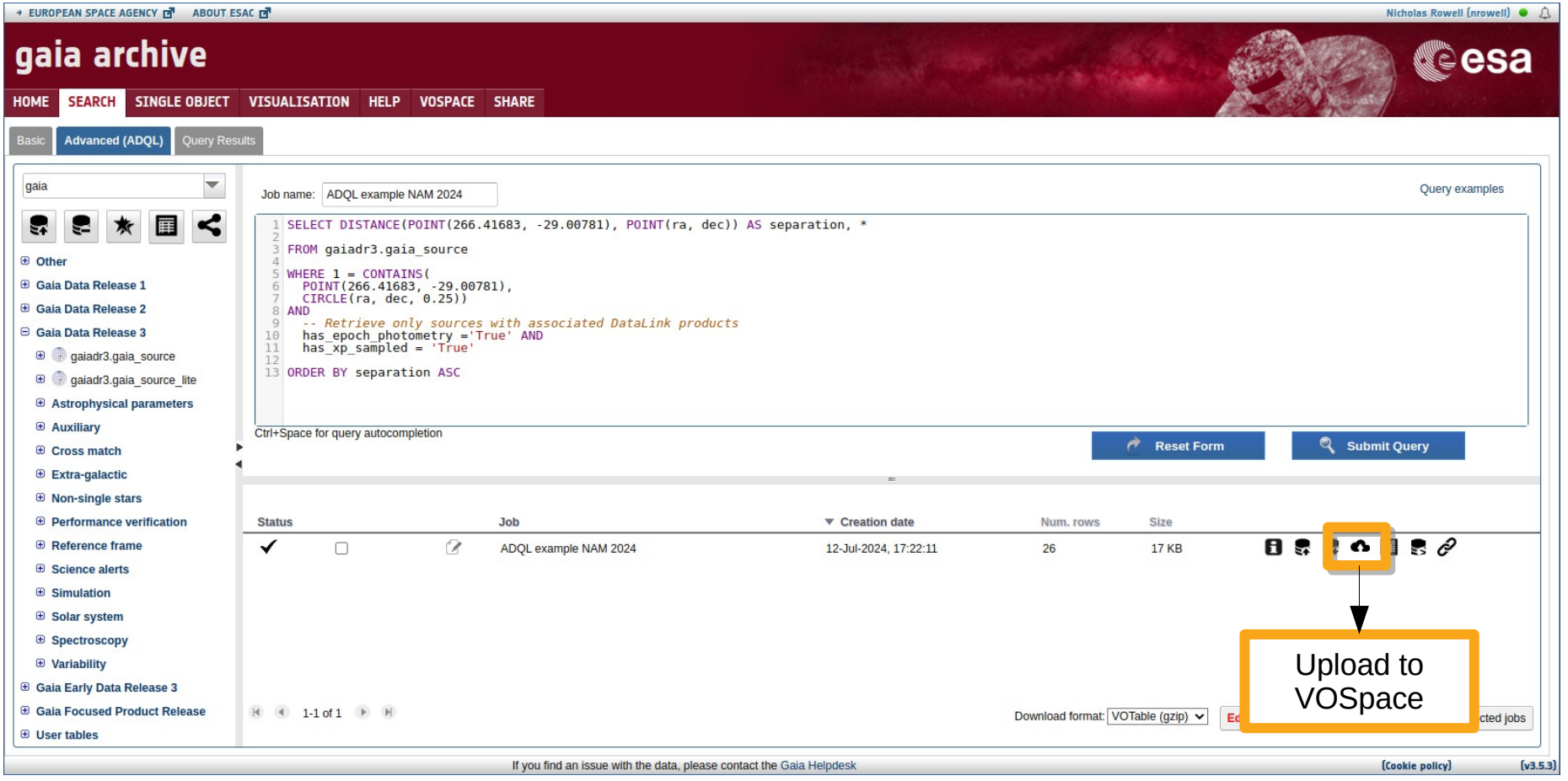

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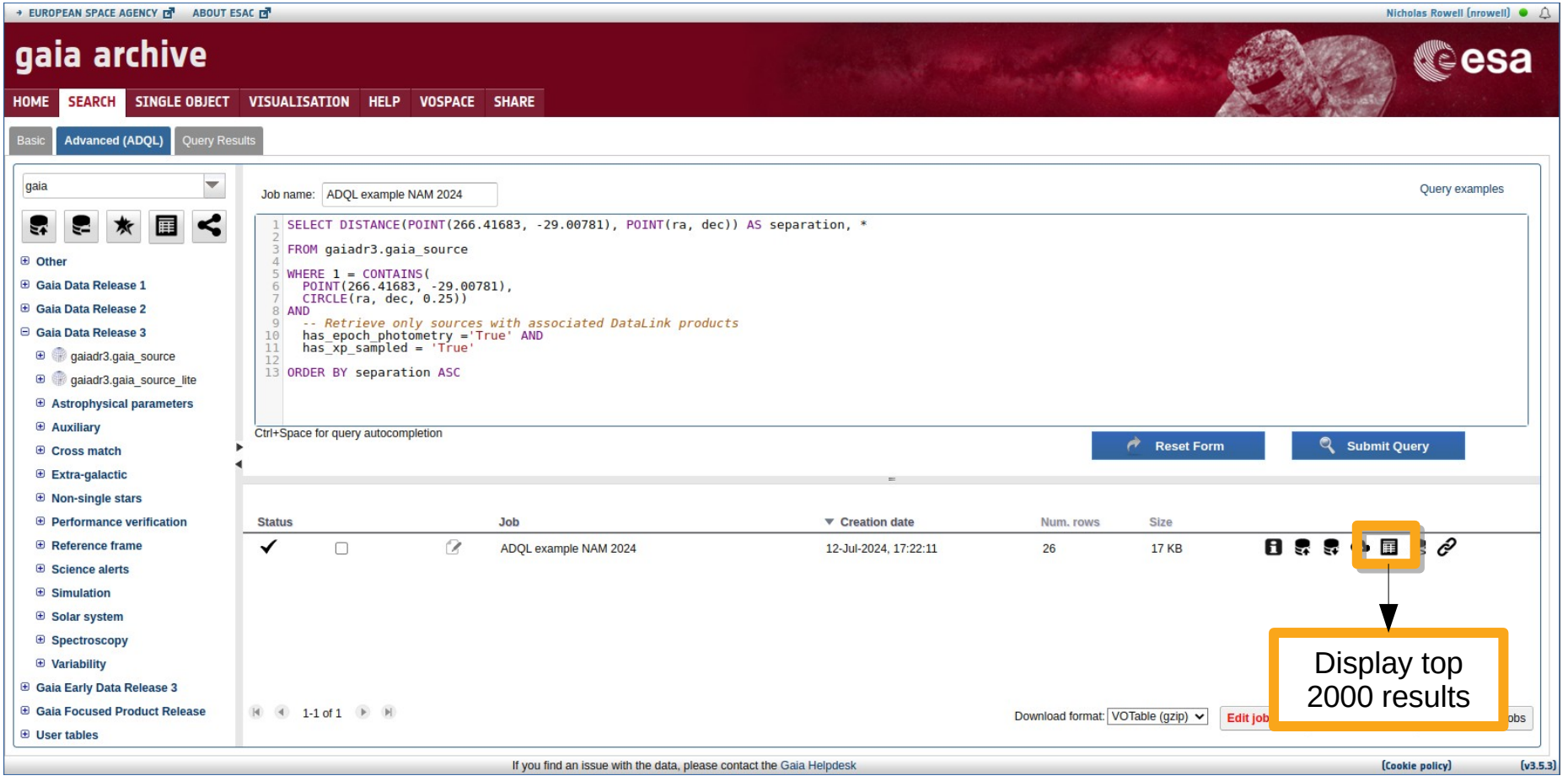

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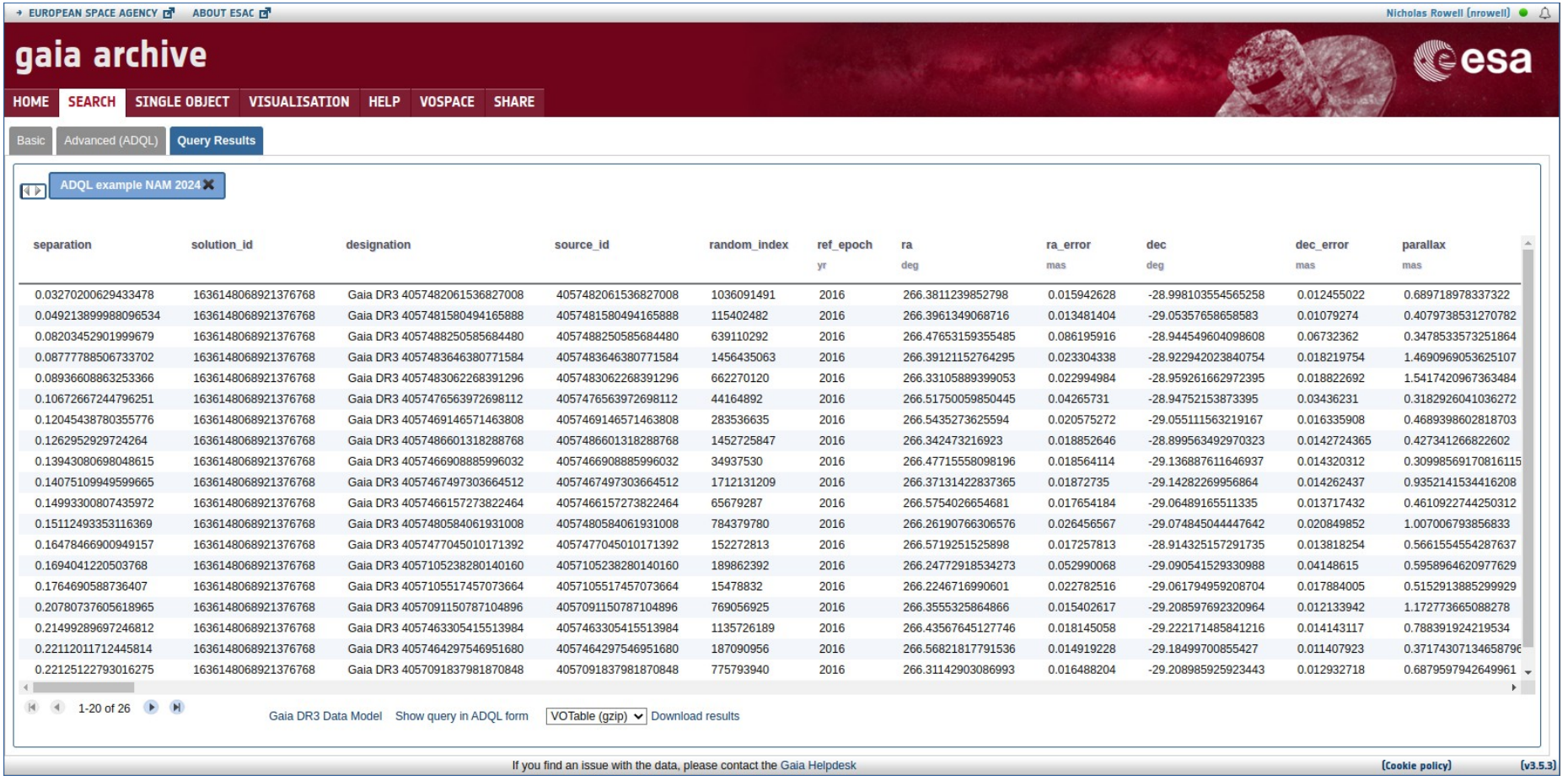

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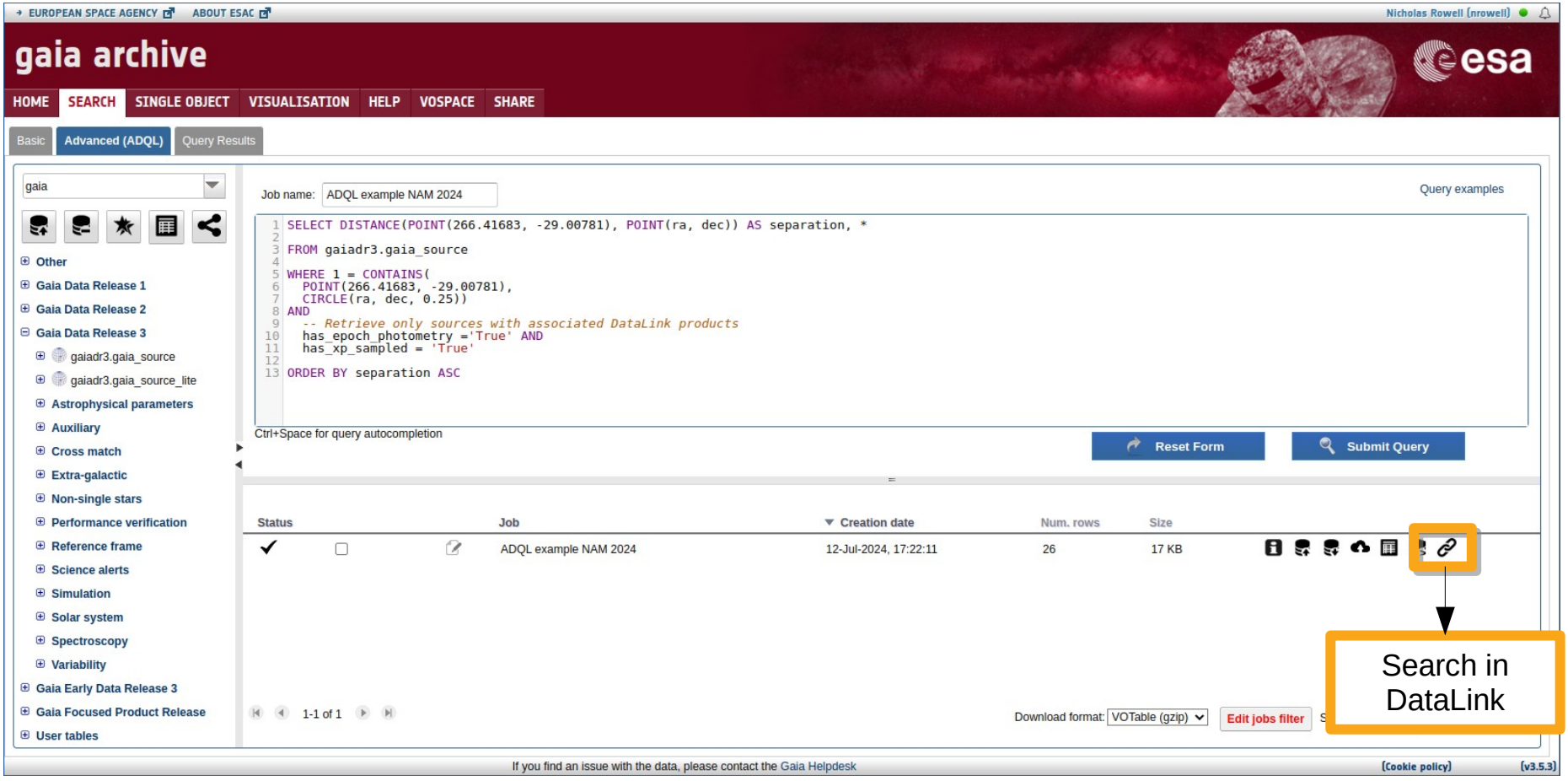
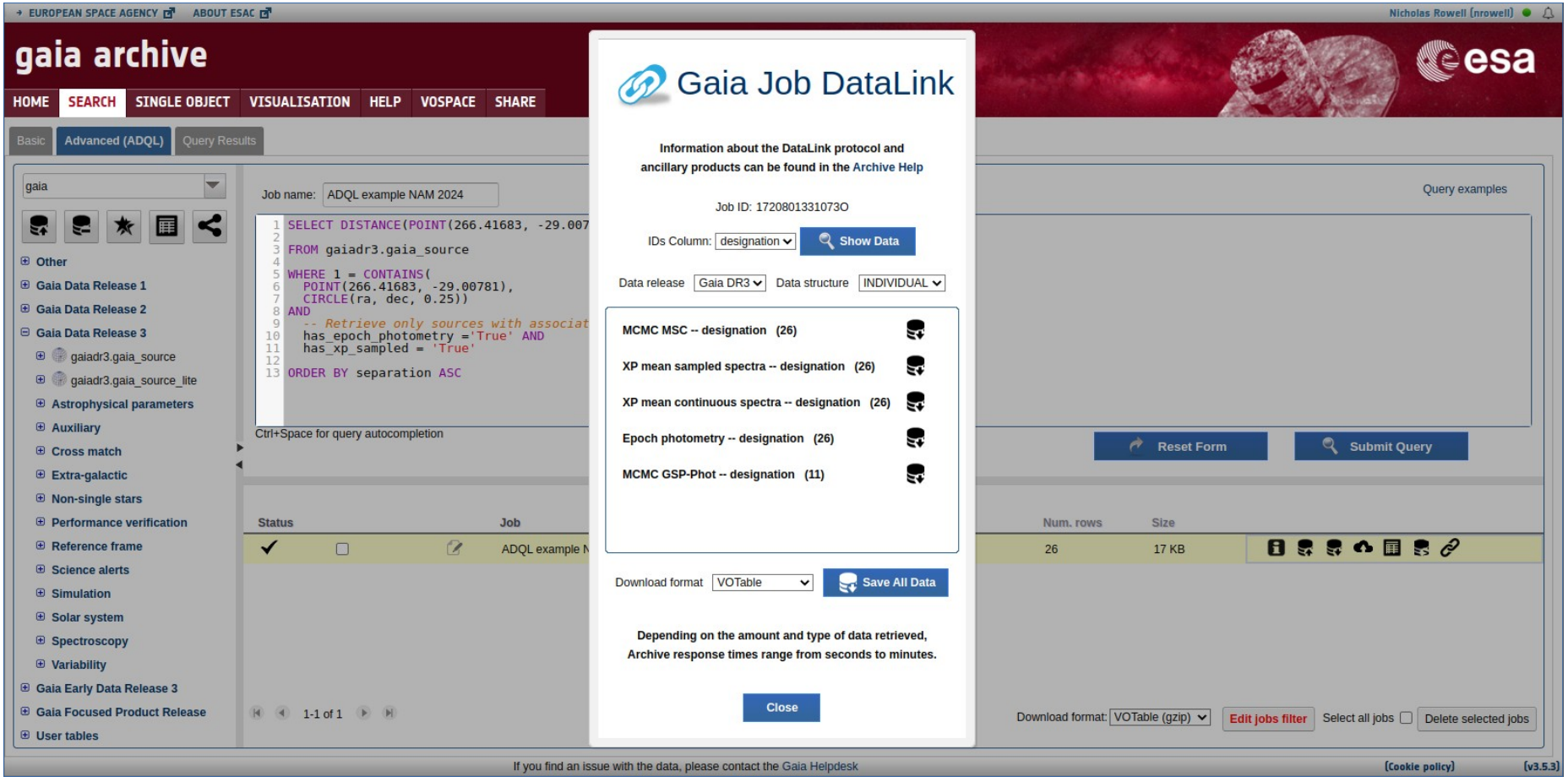
0.22112011712445814	1636148068921376768	Gaia DR3 4057464297546951680	4057464297546951680	187090956	2016	266.56821817791536	0.014919228	-29.18499700855427	0.011407923	0.3717430713465879
0.22125122793016275	1636148068921376768	Gaia DR3 4057091837981870848	4057091837981870848	775793940	2016	266.3114290308699	0.016488204	-29.208985925923443	0.012932718	0.6879597942649961

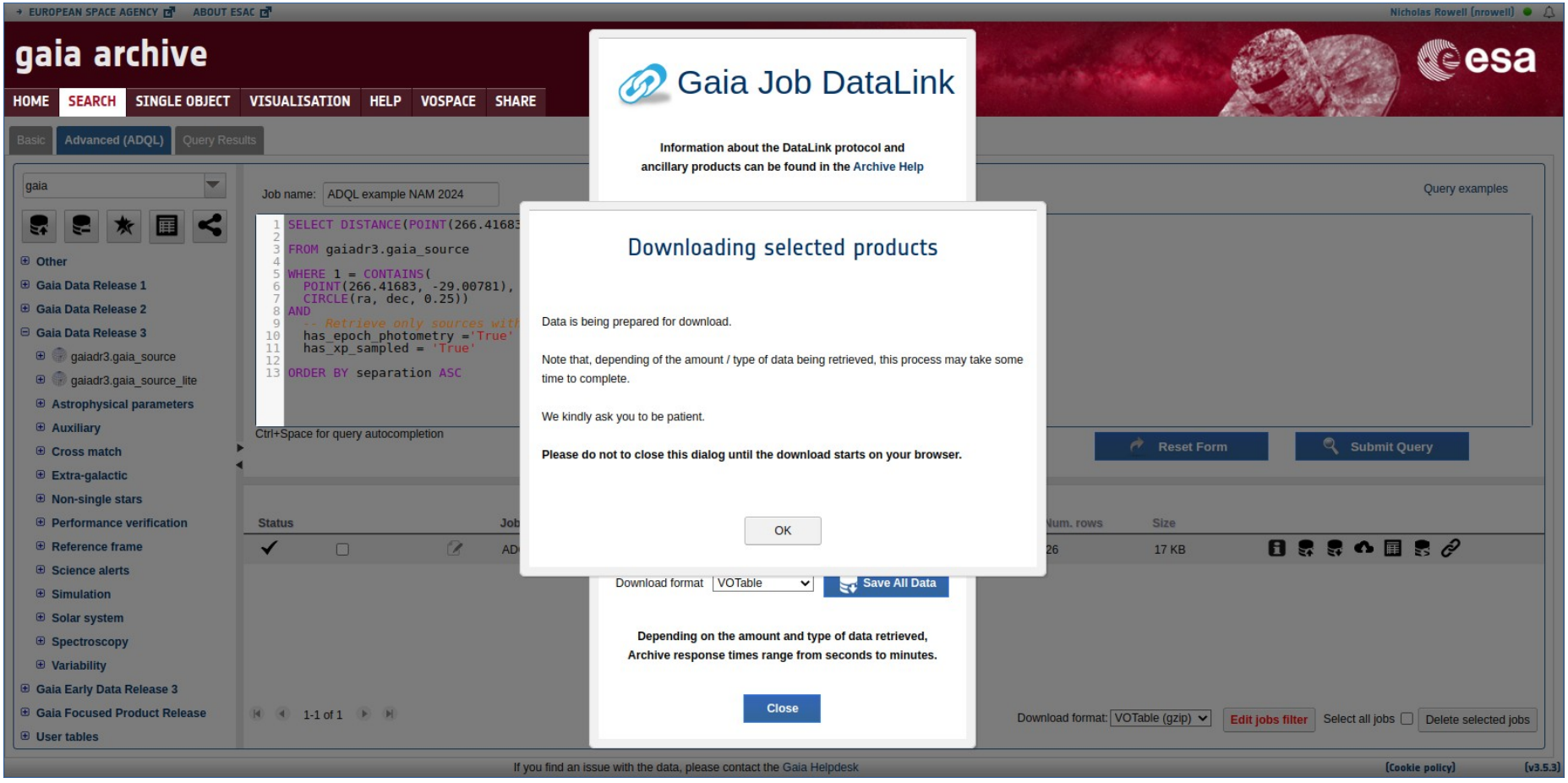
Advanced search



Advanced search



Advanced search



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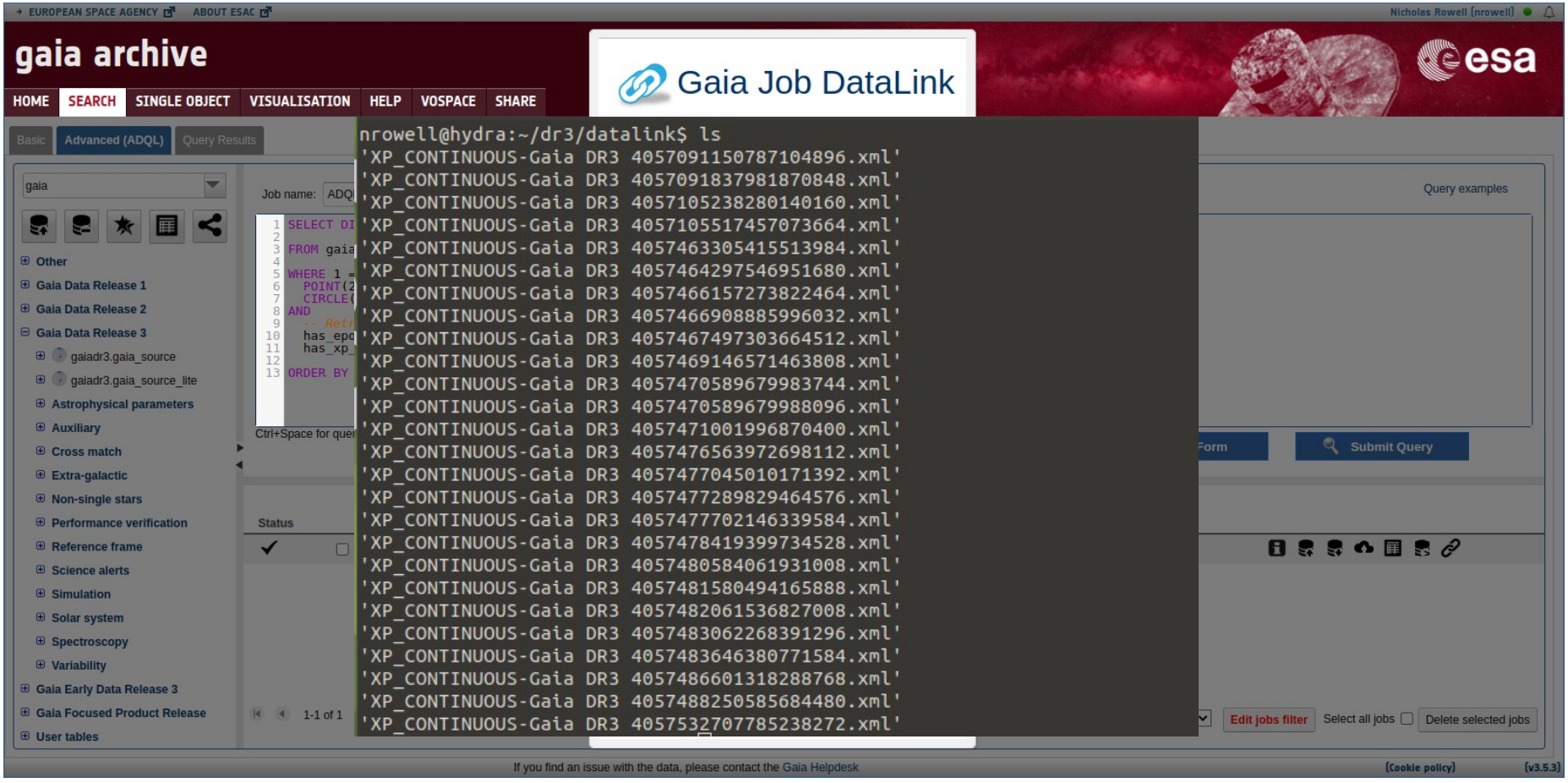

Non-tabular data in Gaia DR3

- Many of the new DR3 products are of non-tabular nature
  - BP/RP spectra, epoch photometry, MCMC samples, …
  - For practical reasons these are not stored as tables in the archive relational database
  - Not accessible using TAP+ services; fields cannot be used in ADQL queries
    - This is possible via the UK Gaia Data Mining Platform [see Nigel's talk to follow]

- These are accessed using DataLink services
  - Archive queries provide links to additional data products outside of the main catalogue
  - TOPCAT can access DataLink products (as well as tabular data via TAP+)
  - Python module astroquery.gaia provides programmatic access to DataLink products

- There are tutorials and many examples on the Gaia Archive pages
  - https://www.cosmos.esa.int/web/gaia-users/archive/datalink-products

Additional software tools

- TOPCAT
  - Accessing, visualising, manipulating tabular data (see Mark Taylor's talk)
  - www.star.bris.ac.uk/~mbt/topcat/

- astroquery.gaia
  - Python module for accessing Gaia tabular and non-tabular data
  - https://astroquery.readthedocs.io/en/latest/gaia/gaia.html

- Several software tools for working with Gaia data have been released with DR3
  - https://www.cosmos.esa.int/web/gaia/dr3-software-tools

- GaiaXPy for manipulating BP/RP spectra
  - https://gaia-dpci.github.io/GaiaXPy-website/

Summary

- The ESA Gaia Archive is the main access point for all Gaia data release products
  - https://gea.esac.esa.int/archive/

- Issues discovered since each data release are reported on the known issues pages
  - https://www.cosmos.esa.int/web/gaia/dr3-known-issues

- There are numerous ways to access the data either directly through the Archive, partner data centres or via third party applications

- There are tabular and non-tabular data
  - Tabular data can be used in selections when making queries
  - Non-tabular data must be downloaded

- Many useful tutorials are available on the Archive help pages