

The construction of the Large Quasar Astrometric Catalogue (LQAC)



Barache, C.¹, Bouquillon, S.¹, Souchay, J.¹, Andrei, A. H.², Taris, F.¹, Gontier, A.-M.¹, Lambert, S.B.¹, Arias, E. F.³ and Le Poncin-Lafitte, C.¹

¹ Observatoire de Paris, SYRTE, France, ² Observatorio Nacional and Observatorio do Valongo, MCT/UFRRJ, Rio de Janeiro, Brasil, ³ Bureau International des Poids et Mesures, Svrte, France

We gather the 12 largest quasar catalogues (4 from radio interferometry programs, 8 from optical survey) and we carry out systematic cross-identifications of the objects to obtain their best position estimates, and to provide physical information at both optical and radio wavelengths. This catalogue compilation designated the LQAC (Large Quasar Astrometric Catalogue), gives equatorial coordinates of 113666 quasars with magnitudes at 9 bandwidths, 5 radio fluxes, redshift and absolute magnitude (when the information is available). We made use of VO tools like Aladin for preliminary studies. For cross identification, data processing and validation, we made use of two different software packages with the same parameters and strategy : VO Topcat with Stilts and homemade Fortran programs .

Scientific and technical objectives for LQAC

The main scientific objective was to build an astrometric and multi-wavelength- catalogue gathering all known QSO's named Large Quasar Astrometric Catalogue (LQAC). This catalogue was also useful to help for the construction of the optical catalogue reference frame (LQRF- A.Andrei et al., 2009), to complete optical data for radio sources from the International Celestial Reference Frame (ICRF2- Gontier et al, 2009) and for the preparation of an input QSO catalogue for GAIA mission. The creation of this catalogue was also interesting for studies like the link between QSO's radio position and optical positions, the analysis of QSO neighbourhood, their distribution in space and their color magnitude diagrams.

The main technical objective was to compile the largest QSO catalogues following the astrometric precision of each catalogue in decreasing order. For each QSO, its original catalogue was kept and a specific processing was done to detect the right or wrong double identifications. To our compiled set of catalogues we added only QSO from Veron and Veron (2006) catalogue which were not identified. We added also magnitude from large star survey catalogues (2mas, GSC2.3, B1.0) to complete magnitude information whenever it was necessary. To control our procedures we worked with two different softwares (home Fortran programs and virtual observatory tools) and two different teams working on the same original catalogues taken one by one and with the same compilation strategy

Table 1. Contribution per item for each individual catalogue used to construct the LQAC.

	A	B	C	D	E	F	G	H	I	J	K	L	Total
u	0	0	0	0	74 866	20 912	0	0	570	0	0	0	96 348
b	0	0	0	0	0	22 965	866	0	836	0	69 355	2 131	96 253
v	0	0	0	0	0	0	0	0	6 949	0	41 517	0	48 466
r	0	0	0	0	74 862	0	0	0	0	0	0	0	74 862
g	0	0	0	0	74 861	20 905	413	0	0	3 502	453	0	99 537
i	0	0	0	0	74 861	0	0	0	0	7 517	3 765	0	86 143
z	0	0	0	0	74 861	0	0	0	0	0	0	0	74 861
j	0	0	0	0	0	0	0	0	0	13 647	0	0	13 647
k	0	0	0	0	0	0	0	0	0	13 647	0	0	13 647
1.4 GHz	0	0	0	0	0	0	0	0	937	144	0	0	1 081
2.3 GHz	0	3 124	0	0	0	0	0	0	0	0	0	0	3 124
5.0 GHz	0	0	0	0	0	0	0	0	0	41	0	0	41
8.4 GHz	0	3 225	46	570	0	0	0	0	17	0	0	0	3 858
24 GHz	0	0	0	0	0	0	0	0	0	0	0	0	0
redshift	0	0	0	0	74 866	20 912	413	0	5 344	0	0	0	101 535

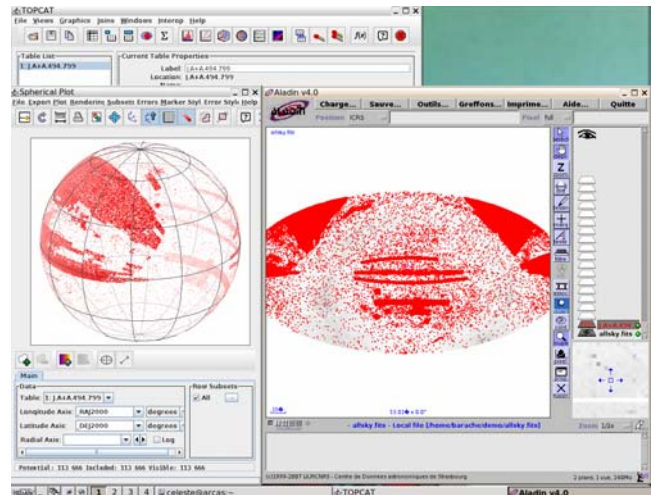
Table 1. Characteristics of the catalogues participating to the LQAC.

Catalogue	Flag	Wavelength	No. quasars	Accuracy	Search radius "
ICRF-Ext2	A	radio	717	0.001	1
VLBA	B	radio	3 357	0.001	1
VLA-015	C	radio	1 701	0.015	1
JVAS	D	radio	2 118	0.2	1
SDSS	E	optical	74 868	0.2	1
2QZ	F	optical	22 971	0.2	1
FIRST	G	radio	969	0.5	2
VLA+015	H	radio	157	0.2	2
HB	I	optical+radio	7 245	1.5	2-5-30*
2MASS	J	infrared	-	0.2	1
GSC2.3	K	optical	-	0.2	1
B1.0	L	optical	-	0.2	1
VV06	M	optical+radio	85 189	1.0	2-5-10*

*Three different search radii have been considered for the cross-identification.

VO Tools used for LQAC Construction

The Virtual Observatory Tools used to construct the LQAC were Aladin freeware from CDS (<http://aladin.u-strasbg.fr/aladin>) to visualize the catalogues origin. We used VizieR tools from CDS (<http://vizier.u-strasbg.fr/viz-bin/VizieR>) to get the different catalogue files. At last we used Topcat and Stilts (<http://www.starlin.ac.uk/stiltsandhttp://www.star.bris.ac.uk/mbt/topcat>) to make cross matching and to construct the LQAC Data Base. The LQAC is now accessible on the CDS web with the reference J/A+A/494/799 in VizieR web service.



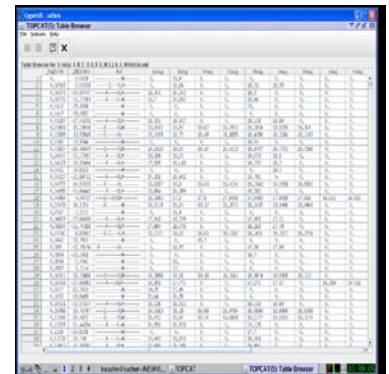
The LQAC visualised by Aladin and Topcat VO tools

LQAC Catalog

The final catalogue LQAC was constructed with the compilation of 12 large QSO catalogues (optical and radio) and includes 113666 quasars, 5 radio fluxes (1.4GHz, 2.3GHz, 5.0GHz, 8.4GHz, 24GHz), 7 photometric magnitude visible (u, b, v, g, r, i, z), 2 infrared magnitude (j, k) and the redshift value. The accuracy of the QSO sources was at the level of the milliarcsecond for sources from ICRF and not worse than 2 arc seconds for sources from Hewitt and Burbidge catalogue and Veron and Veron catalogue. The name of the catalogues and their contents are presented in Tables 1 and 2.

After the construction of this catalogue, we have written an article on it in Astronomy and Astrophysics which has been published this year (Souchay, et al. 2009, A&A 494, 799-815).

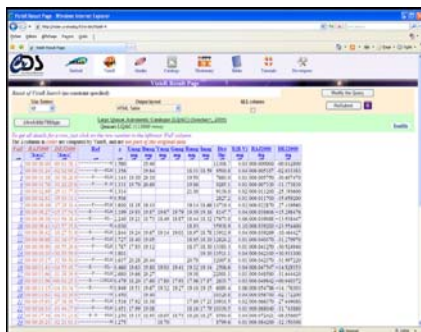
Our complete LQAC xml file visualised with Topcat using table data view



The LQAC xml file visualised by VizieR CDS Web service

References

- Souchay, et al.2009, A&A 494, 799-815
- Veron-Cetty,M.-P.,&Veron,P.2006,A&A,455,773
- Lambert, S. B.; Gontier, A.-M. 2009, A&A 493, 317-323
- A. H. Andrei et al. A&A 2009 in press



Conclusion

We are now preparing a new version of LQAC (LQAC2.0) to improve the catalogue. We will resolve the wrong double qso (300 pair of QSO's are in LQAC, their double status being doubtful). We will add some picture associated to each QSO and we will improve the homogeneity of magnitudes..We will also add a criterion of source geometry (for instance near star form than galaxy form). The VO tools used for the LQAC were useful to get and to study catalogues (Aladin,VizieR), to make cross-matching of sources (Topcat) and to manage, distribute the LQAC file catalogue easily (Topcat). However, these tools are a little limited for instance to get the data from very large catalogues, to make some complex cross-matching. Moreover we have found difficulties to get the magnitude system photometric used in the magnitude of sources in VO tables.