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Large Quasar Astrometric Catalogue 3rd release : Presentation and Application on VLBI sources

GAGNES 2015

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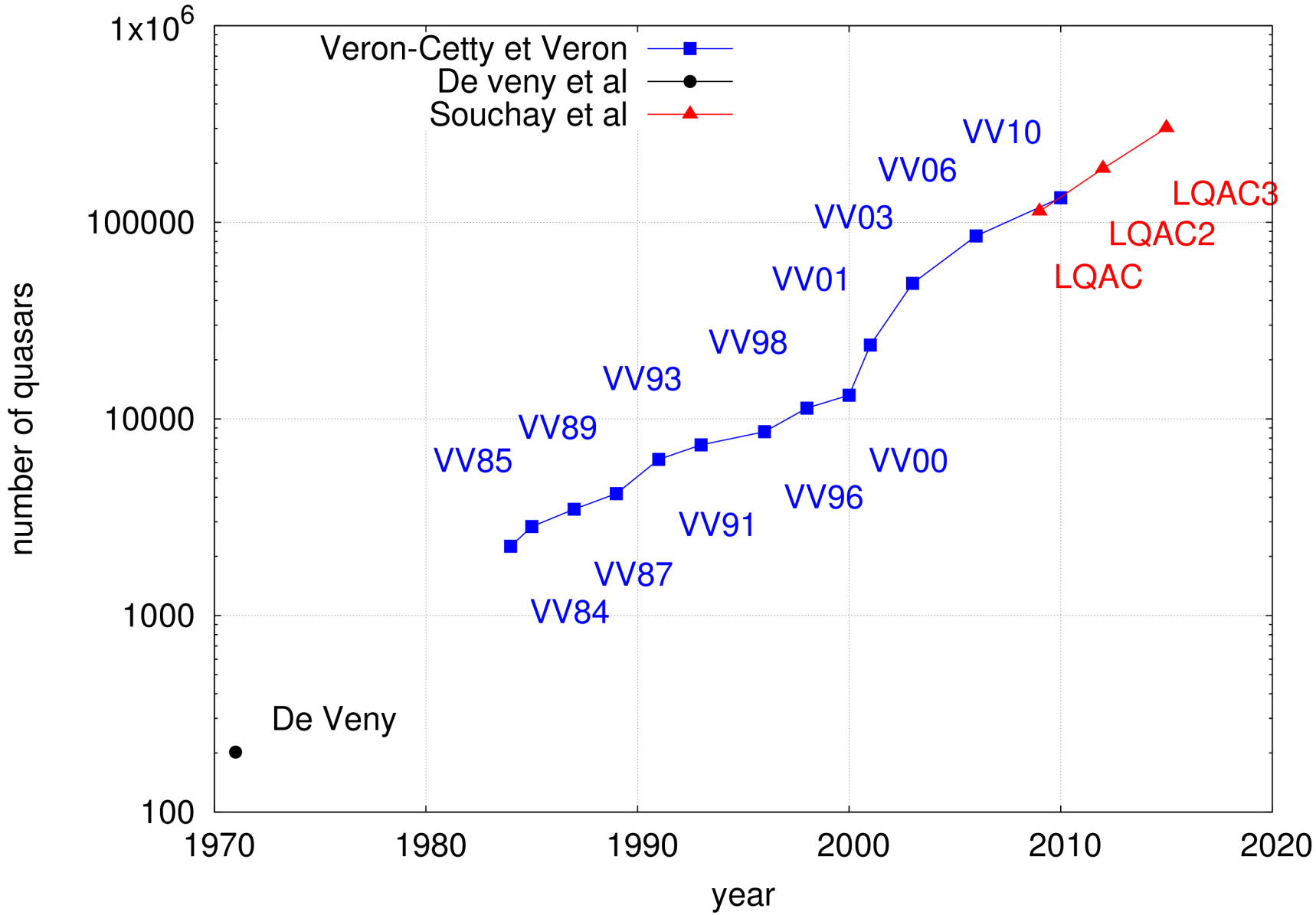
Quasars population over time



Souchay et al. 2015
Souchay et al. 2012
Souchay et al. 2009
Véron-Cetty & Véron 2010
Véron-Cetty & Véron 2006
Véron-Cetty & Véron 2003
Véron-Cetty & Véron 2001
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Véron-Cetty & Véron 1998
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Véron-Cetty & Véron 1991
Véron-Cetty & Véron 1989
Véron-Cetty & Véron 1987
Véron-Cetty & Véron 1985
Véron-Cetty & Véron 1984
De Veny et al. 1971

Motivations behind the LQAC

- To give a **compilation** of the overall known **quasars population**
- To gather the most extended **information** available per quasar **by cross-identification** between catalogues
- **To Improve the astrometry** by suitable algorithms based on LQRF (Andrei et al. 2009)
- To serve as a **reference catalogue** for Gaia
- To serve as a **basis for** several complementary **studies**

  - Statistics, density, completness
  - Multiple quasars

  (Gattano et al. 2014)

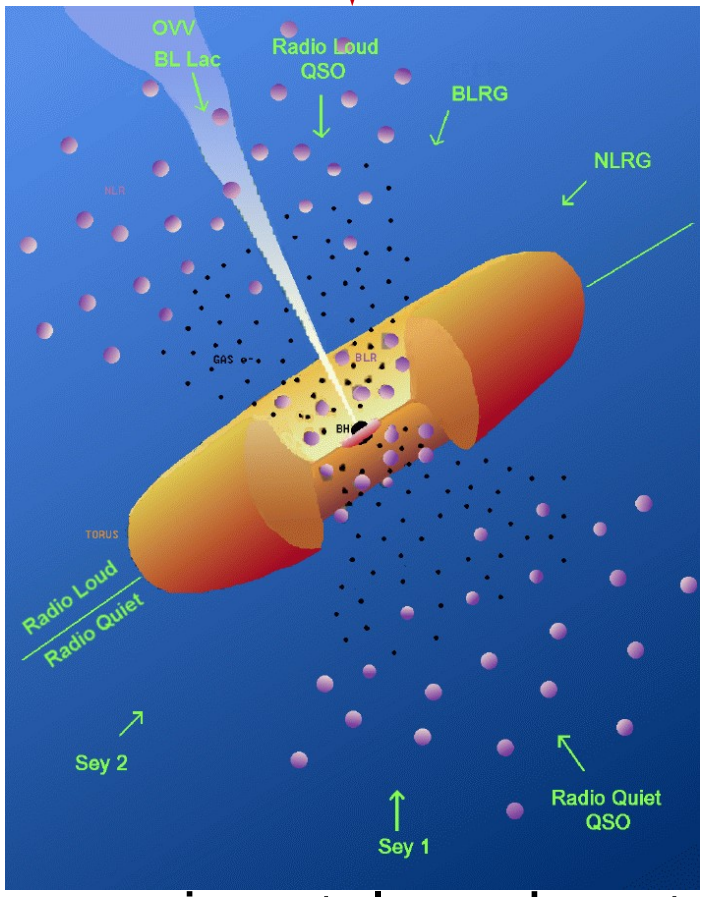
  - Quasars clustering
  - Radio-optical link
  - Etc...

Around definition of a quasar

AGNs : **compact regions at centers of galaxies strongly luminous at different wavelengths**

Unified theory : (Antonucci 1993, Urry & Padovani 1995)

➔ Different nomenclatures for the same object seen under different conditions (line of sight, age, …)



But, to identify an object with its good status, you need :

- **Optical** and/or IR fluxes **information**
- **Radio** fluxes **information**
- Luminosity **cutoff**
- **spectroscopic** information

➔ **Surveys don't have all of this information !**

! Astrophysicists should be aware that « quasars » in catalogs do not really respect the theoretical definition, because of lack of information

Around definition of a quasar

Examples of definition of quasar/QSO in the bibliography :

Véron-Cetty and Véron (A&A, 2010)

*« We have arbitrarily defined a **quasar** as a starlike object or as an object with a starlike nucleus with broad emission lines that is brighter than MB = -22.25 »*

« Clearly, some objects would move from Table_QSO to Table_AGN and vice versa if other values for H_0, q_0 and the spectral index were used …. »

SDSS-DR10Q (Pâris et al. ,A&A,2014)

« We call a **quasar** an object with a luminosity Mi [z=2] < -20.5 that either displays at least one emission line with FWHM > 500 km s-1 or, if not, has specific absorption features that can be securely identified as quasars due to the Lyman-a forest or BAL troughs »

- Definition of a quasar depends on authors
- Definition of a quasar depends on cosmological parameters which are updated over time

Construction of the LQAC

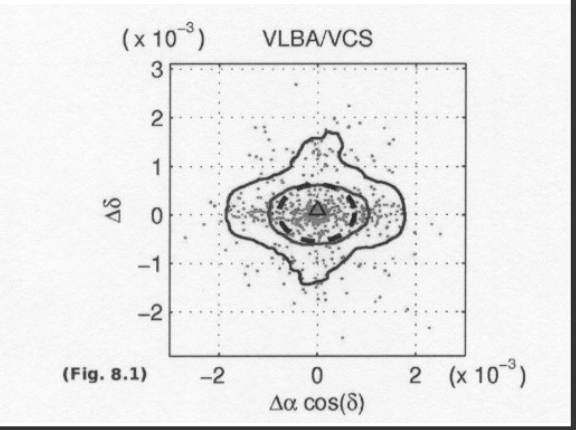
OBJECTIVES :

- **Compilation of all** the recorded **quasars**
- Strategy insisting on **astrometric quality**
- Recalculation of equatorial coordinates
- Catalogue **flag (A → M)** for cross-identifications
- **Extended** photometry & redshift
- Calculation of **absolute magnitudes** M_I & M_B
- **Morphological indexes**
- Basis for regular up-dates (→ Gaia)
- Final ASCII file with V.O. tools in parallel
- Comparisons / statistics / coherence

Astrometric comparisons

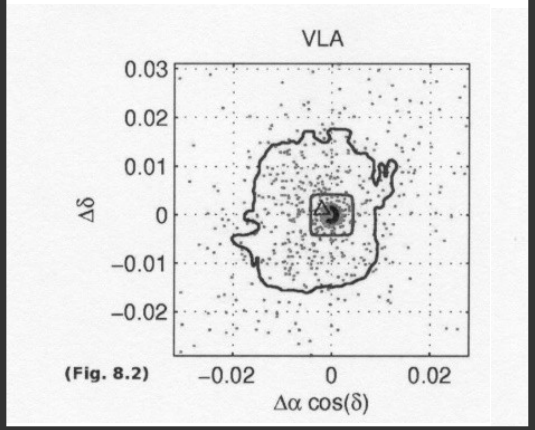
VLBA (B) – ICRF (A)

0,002 arcsec



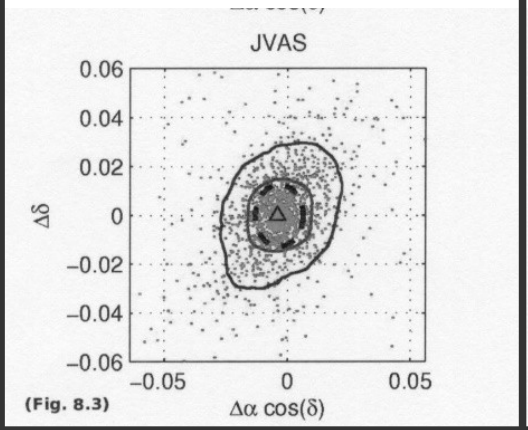
VLA (C) - AB

0,02 arcsec



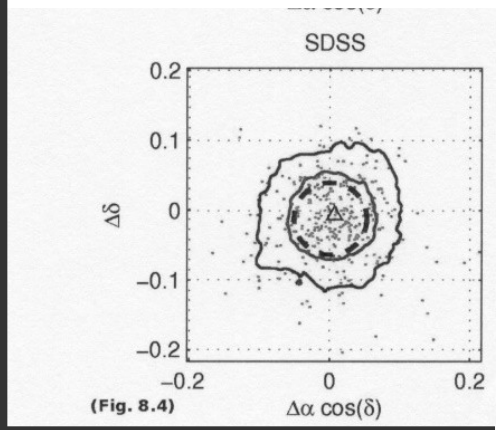
JVAS (D) - ABC

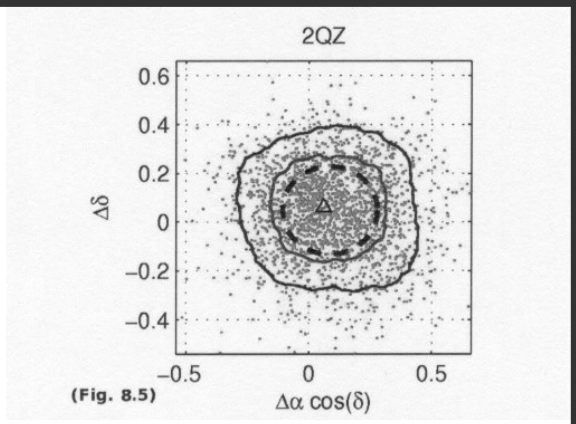
0,05 arcsec



SDSS (E) - ABCD

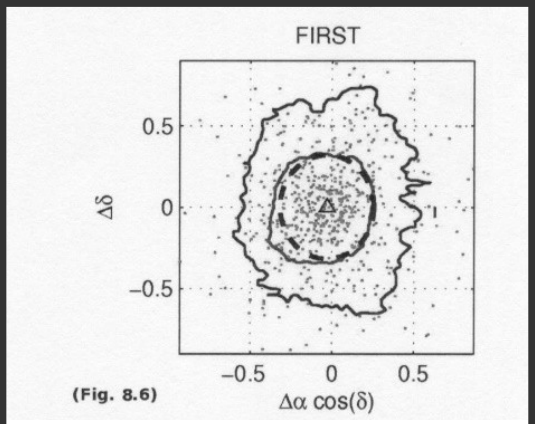
0,1 arcsec





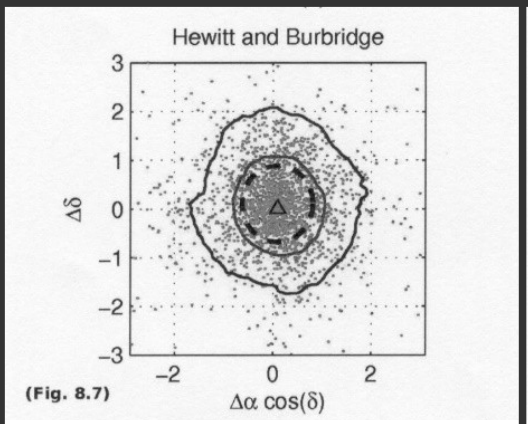
2QZ (F) - ABCDE

0,5 arcsec



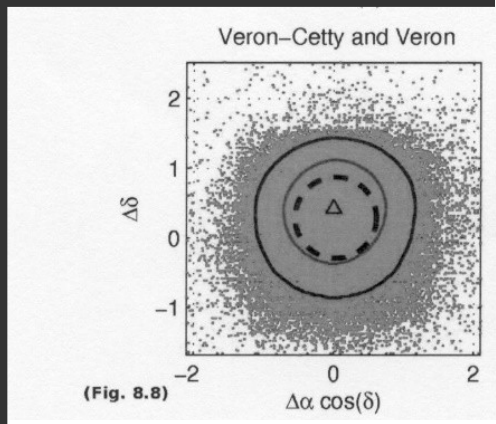
FIRST (H) - ABCDEF

0,5 arcsec



HB (I) - ABCDEFGH

2 arcsec



VV (M) - ABCDEFGHI

>2 arcsec

Quasars catalogues participating in the LQAC-3

			LQAC-3	LQAC-2	LQAC
Catalogue Name	**Flag**	**Nature**	**N(AGN)**	**N(AGN)**	**N(AGN)**
Large **Q**uasar **A**strometric **C**atalogue			321 957	187 504	113 666
ICRF	A	radio	3 414	3 414	717
RFC/**V**LBA **C**alibrator **S**urvey	B	radio	??? 7 213	rfc2010d 5 198	VCS cat. 3 357
VLA quasar catalogue	C	radio	1 858	1 858	1 701
JVAS Astrometric Survey	D	radio	2 118	2 118	2 118
Sloan **D**igital **S**ky **S**urvey	E	optical	DR10Q+DR7Q 262 535	DR8Q 126 577	DR5Q 74 868
2dF Quasar Redshift Survey **2QZ**	F	optical	23 660	23 660	22 971
2dF-SDSS LRG and QSO (2SLAQ) Survey	G	optical	9 058	9 058	-
FIRST catalogue	H	radio	969	969	969
Hewitt and **B**urbidge catalogue	I	Opt. & radio	6 720	6 721	7 145
Véron-Cetty and **V**éron catalogue	M	Opt. & radio	VV10 14 742(*)	VV10 22 440(*)	VV06 8 722(*)
2MASS	J	infrared	21 883	25 252	13 647
GSC2.3	K	optical	144 507	154 900	91 061
US Naval **O**bservatory **B1.0**	L	optical	139 190	148 894	81 662

Quasars catalogues participating in the LQAC-3

Catalogue Name	Flag	Nature	LQAC-3 N(AGN)	LQAC-2 N(AGN)	LQAC N(AGN)
Large Quasar Astrometric Catalogue			321 957	187 504	113 666
ICRF	A	radio	3 414	3 414	717
RFC/VLBA Calibrator Survey	B	radio	??? 7 213	rfc2010d 5 198	VCS cat. 3 357
VLA quasar catalogue	C	radio	1 858	1 858	1 701
JVAS Astrometric Survey	D	radio	2 118	2 118	2 118
Sloan Digital Sky Survey	E	optical	DR10Q+DR7Q 262 535	DR8Q 126 577	DR5Q 74 868
2dF Quasar Redshift Survey 2QZ	F	optical	23 660	23 660	22 971
2dF-SDSS LRG and QSO (2SLAQ) Survey	G	optical	9 058	9 058	-
FIRST catalogue	H	radio	969	969	969
Hewitt and Burbidge catalogue	I	Opt. & radio	6 720	6 721	7 145
Véron-Cetty and Véron catalogue	M	Opt. & radio	VV10 14 742(*)	VV10 22 440(*)	VV06 8 722(*)
2MASS	J	infrared	21 883	25 252	13 647
GSC2.3	K	optical	144 507	154 900	91 061
US Naval Observatory B1.0	L	optical	139 190	148 894	81 662

Quasars catalogues participating in the LQAC-3

Catalogue Name	Flag	Nature	LQAC-3 N(AGN)	LQAC-2 N(AGN)	LQAC N(AGN)
Large **Q**uasar **A**strometric **C**atalogue			**321 957**	**187 504**	**113 666**
ICRF	A	radio	3 414	3 414	717
RFC/**V**LBA **C**alibrator **S**urvey	B	radio	??? 7 213	rfc2010d 5 198	VCS cat. 3 357
VLA quasar catalogue	C	radio	1 858	1 858	1 701
JVAS Astrometric Survey	D	radio	2 118	2 118	2 118
Sloan **D**igital **S**ky **S**urvey	E	optical	DR10Q+DR7Q 262 535	DR8Q 126 577	DR5Q 74 868
2dF Quasar Redshift Survey **2QZ**	F	optical	23 660	23 660	22 971
2dF-SDSS LRG and QSO (2SLAQ) Survey	G	optical	9 058	9 058	-
FIRST catalogue	H	radio	969	969	969
Hewitt and **B**urbidge catalogue	I	Opt. & radio	6 720	6 721	7 145
Véron-Cetty and **V**éron catalogue	M	Opt. & radio	VV10 14 742(*)	VV10 22 440(*)	VV06 8 722(*)
2MASS	J	infrared	21 883	25 252	13 647
GSC2.3	K	optical	144 507	154 900	91 061
US Naval **O**bservatory **B1.0**	L	optical	139 190	148 894	81 662

Quasars catalogues participating in the LQAC-3

			LQAC-3	LQAC-2	LQAC
Catalogue Name	**Flag**	**Nature**	**N(AGN)**	**N(AGN)**	**N(AGN)**
Large **Q**uasar **A**strometric **C**atalogue			321 957	187 504	113 666
ICRF	A	radio	3 414	3 414	717
RFC/**V**LBA **C**alibrator **S**urvey	B	radio	??? 7 213	rfc2010d 5 198	VCS cat. 3 357
VLA quasar catalogue	C	radio	1 858	1 858	1 701
JVAS Astrometric Survey	D	radio	2 118	2 118	2 118
Sloan **D**igital **S**ky **S**urvey	E	optical	**DR10Q+DR7Q 262 535**	**DR8Q 126 577**	**DR5Q 74 868**
2dF Quasar Redshift Survey **2QZ**	F	optical	23 660	23 660	22 971
2dF-SDSS LRG and QSO (2SLAQ) Survey	G	optical	9 058	9 058	-
FIRST catalogue	H	radio	969	969	969
Hewitt and **B**urbidge catalogue	I	Opt. & radio	6 720	6 721	7 145
Véron-Cetty and **V**éron catalogue	M	Opt. & radio	VV10 14 742(*)	VV10 22 440(*)	VV06 8 722(*)
2MASS	J	infrared	21 883	25 252	13 647
GSC2.3	K	optical	144 507	154 900	91 061
US Naval **O**bservatory **B1.0**	L	optical	139 190	148 894	81 662

Quasars catalogues participating in the LQAC-3

			LQAC-3	LQAC-2	LQAC
Catalogue Name	**Flag**	**Nature**	**N(AGN)**	**N(AGN)**	**N(AGN)**
Large **Q**uasar **A**strometric **C**atalogue			100 %	100 %	100 %
ICRF	A	radio	1 %	2 %	1 %
RFC/**V**LBA **C**alibrator **S**urvey	B	radio	??? 2 %	rfc2010d 3 %	VCS cat. 3 %
VLA quasar catalogue	C	radio	1 %	1 %	1 %
JVAS Astrometric Survey	D	radio	1 %	1 %	2 %
Sloan **D**igital **S**ky **S**urvey	E	optical	DR10Q+DR7Q 82 %	DR8Q 68 %	DR5Q 66 %
2dF Quasar Redshift Survey **2QZ**	F	optical	7 %	13 %	20 %
2dF-SDSS LRG and QSO (2SLAQ) Survey	G	optical	3 %	5 %	-
FIRST catalogue	H	radio	0 %	1 %	1 %
Hewitt and **B**urbidge catalogue	I	Opt. & radio	2 %	4 %	6 %
Véron-Cetty and **V**éron catalogue	M	Opt. & radio	VV10 5 %(*)	VV10 12 %(*)	VV06 8 %(*)
2MASS	J	infrared	7 %	13 %	12 %
GSC2.3	K	optical	45 %	83 %	80 %
US Naval **O**bservatory **B1.0**	L	optical	43 %	79 %	72 %

Quasars catalogues participating in the LQAC-3

			LQAC-3	LQAC-2	LQAC
Catalogue Name	**Flag**	**Nature**	**N(AGN)**	**N(AGN)**	**N(AGN)**
Large **Q**uasar **A**strometric **C**atalogue			100 %	100 %	100 %
ICRF	A	**radio**	**1 %**	**2 %**	**1 %**
RFC/**V**LBA **C**alibrator **S**urvey	B	**radio**	**???** **2 %**	**rfc2010d** **3 %**	**VCS cat.** **3 %**
VLA quasar catalogue	C	**radio**	**1 %**	**1 %**	**1 %**
JVAS Astrometric Survey	D	**radio**	**1 %**	**1 %**	**2 %**
Sloan **D**igital **S**ky **S**urvey	E	optical	DR10Q+DR7Q 82 %	DR8Q 68 %	DR5Q 66 %
2dF Quasar Redshift Survey **2QZ**	F	optical	7 %	13 %	20 %
2dF-SDSS LRG and QSO (2SLAQ) Survey	G	optical	3 %	5 %	-
FIRST catalogue	H	radio	0 %	1 %	1 %
Hewitt and **B**urbidge catalogue	I	Opt. & radio	2 %	4 %	6 %
Véron-Cetty and **V**éron catalogue	M	Opt. & radio	VV10 5 %(*)	VV10 12 %(*)	VV06 8 %(*)
2MASS	J	infrared	7 %	13 %	12 %
GSC2.3	K	optical	45 %	83 %	80 %
US Naval **O**bservatory **B1.0**	L	optical	43 %	79 %	72 %

Quasars catalogues participating in the LQAC-3

			LQAC-3	LQAC-2	LQAC
Catalogue Name	**Flag**	**Nature**	**N(AGN)**	**N(AGN)**	**N(AGN)**
Large **Q**uasar **A**strometric **C**atalogue			100 %	100 %	100 %
ICRF	A	radio	1 %	2 %	1 %
RFC/**V**LBA **C**alibrator **S**urvey	B	radio	??? 2 %	rfc2010d 3 %	VCS cat. 3 %
VLA quasar catalogue	C	radio	1 %	1 %	1 %
JVAS Astrometric Survey	D	radio	1 %	1 %	2 %
Sloan **D**igital **S**ky **S**urvey	E	optical	**DR10Q+DR7Q** **82 %**	**DR8Q** **68 %**	**DR5Q** **66 %**
2dF Quasar Redshift Survey **2QZ**	F	optical	7 %	13 %	20 %
2dF-SDSS LRG and QSO (2SLAQ) Survey	G	optical	3 %	5 %	-
FIRST catalogue	H	radio	0 %	1 %	1 %
Hewitt and **B**urbidge catalogue	I	Opt. & radio	2 %	4 %	6 %
Véron-Cetty and **V**éron catalogue	M	Opt. & radio	VV10 5 %(*)	VV10 12 %(*)	VV06 8 %(*)
2MASS	J	infrared	7 %	13 %	12 %
GSC2.3	K	optical	45 %	83 %	80 %
US Naval **O**bservatory **B1.0**	L	optical	43 %	79 %	72 %

Quasars catalogues participating in the LQAC-3

			LQAC-3	LQAC-2	LQAC
Catalogue Name	**Flag**	**Nature**	**N(AGN)**	**N(AGN)**	**N(AGN)**
Large **Q**uasar **A**strometric **C**atalogue			100 %	100 %	100 %
ICRF	A	radio	1 %	2 %	1 %
RFC/**V**LBA **C**alibrator **S**urvey	B	radio	??? 2 %	rfc2010d 3 %	VCS cat. 3 %
VLA quasar catalogue	C	radio	1 %	1 %	1 %
JVAS Astrometric Survey	D	radio	1 %	1 %	2 %
Sloan **D**igital **S**ky **S**urvey	E	optical	DR10Q+DR7Q 82 %	DR8Q 68 %	DR5Q 66 %
2dF Quasar Redshift Survey **2QZ**	F	optical	7 %	13 %	20 %
2dF-SDSS LRG and QSO (2SLAQ) Survey	G	optical	3 %	5 %	-
FIRST catalogue	H	radio	0 %	1 %	1 %
Hewitt and **B**urbidge catalogue	I	Opt. & radio	2 %	4 %	6 %
Véron-Cetty and **V**éron catalogue	M	Opt. & radio	**VV10** **5 %(*)**	**VV10** **12 %(*)**	**VV06** **8 %(*)**
2MASS	J	infrared	7 %	13 %	12 %
GSC2.3	K	optical	45 %	83 %	80 %
US Naval **O**bservatory **B1.0**	L	optical	43 %	79 %	72 %

Quasars catalogues participating in the LQAC-3

Catalogue Name	Références
Large **Q**uasar **A**strometric **C**atalogue	LQAC3(Souchay et al. To be published) ; LQAC2(Souchay et al 2012) ; LQAC(Souchay et al. 2009)
ICRF	ICRF2 (Ma et. al. 2009)
RFC/**V**LBA **C**alibrator **S**urvey	RFC (Astrogeo.org/rfc) ; VLBA (Beasley et al. 2007)
VLA quasar catalogue	https://science.nrao.edu/facilities/vla/docs/manuals/cal)
JVAS Astrometric Survey	Patnaik et al. 1992, Browne et al. 1998, Wilkinson et al. 1998
Sloan **D**igital **S**ky **S**urvey	DR7Q (Schneider et al. 2010) ; DR10Q (Pâris et al. 2014)
2dF Quasar Redshift Survey **2QZ**	Croom et al. 2001, Croom et al. 2004
2dF-SDSS LRG and QSO (2SLAQ) Survey	Croom et al. 2009
FIRST catalogue	Gregg et al. 1996 ; White et al. 2000 ; Becker et al. 2001
Hewitt and **B**urbidge catalogue	Hewitt and Burbidge, 1993
Véron-Cetty and **V**éron catalogue	Véron-Cetty & Véron, 2010
2MASS	Cutri et al. 2003
GSC2.3	Lasker et al. 2008
US Naval **O**bservatory **B1.0**	Monet et al. 2003

Contribution from catalog with respect to SDSS

Catalog Name	Flag	Nature	Nbs of quasars (LQAC-3)	Nb. of quasars common with SDSS
ICRF2	A	radio	3 414	506
VLBA	B	radio	7 213	951
VLA	C	radio	1 858	356
JVAS	D	radio	2 118	451
2QZ	F	optical	23 660	3 271
2df-SDSS LRG	G	optical	9 058	1 923
FIRST	H	radio	969	801
HB	I	opt. & radio	6 720	2 102
2MASS	J	infrared	21 884	18 433
GSC2.3	K	optical	144 508	113 213
B1.0	L	optical	139 192	111 121
V&V	M	optic. & radio	79 692	25 191

quasars not in SDSS : 59 422

that is **18 %** of the LQAC

But do not forget :

- Accuracy on positions
- Radio fluxes
- Magnitudes in 9 different bandwidths

Provide by the LQAC-3

LQAC Name	Original Name	Category	Ra (orig.)	Dec. (orig.)	Ra (LQRF)	Dec. (LQRF)	Catalog	Flag		Z
LQAC_000-000_001	Q 2357-003A	QUASAR	0.0000000000	-0.0328000000	359.9998660000	-0.0328680000	----------M-------	-	0	1.56000
LQAC_000-000_002	SDSS J00000-0027	QUASAR	0.0019783170	-0.4510882950	0.0019831179	-0.4510868988	----E-----KLM-------	-	0	0.24998
LQAC_000+004_002	SDSS 1237678777404358776	QUASAR	0.0040523890	4.8297805750	0.0040518603	4.8297817777	----E----------	-	0	1.61883
LQAC_000-002_001	FIRST J00000-0202	QUASAR	0.0053169740	-2.0332732890	0.0053195960	-2.0332663974	----E--H--KLM-------	-	0	1.36031
LQAC_000-001_013	SDSS 1237678882094383164	QUASAR	0.0057462150	-1.3250087920	0.0057516319	-1.3250036320	----E----------	-	0	2.33259
LQAC_000-030_001	2QZ J000001-3036	QUASAR	0.0057500000	-30.6074722220	0.0056940000	-30.6074290000	-----F----KLM-------	-	0	1.14340
LQAC_000-031_001	2QZ J000001-3122	QUASAR	0.0073333330	-31.3738333330	0.0072330000	-31.3736930000	-----F----K-M-------	-	0	1.33120
LQAC_000-000_058	SDSS 1237663783660552482	QUASAR	0.0080666910	-0.2409707850	0.0080714470	-0.2409692064	----E----------	-	0	2.16445
LQAC_000-025_001	XMM J00000-2511	QUASAR	0.0112000000	-25.1936000000	0.0111330000	-25.1935080000	----------M-------	-	0	1.31400
LQAC_000-035_001	MS 23574-3520	QUASAR	0.0117000000	-35.0592000000	0.0000000000	0.0000000000	----------M-------	-	0	0.50800
LQAC_000+001_018	SDSS 1237678617417810395	QUASAR	0.0132289990	1.2529671120	0.0132309431	1.2529665537	----E----------	-	0	2.35445
LQAC_000+006_002	SDSS 1237678779014971808	QUASAR	0.0159555710	6.1797883900	0.0159514431	6.1797879001	----E----------	-	0	2.27147
LQAC_000+003_004	SDSS 1237678660350247162	QUASAR	0.0192231840	3.8562314970	0.0192223311	3.8562312349	----E----------	-	0	2.79494
LQAC_000+006_003	SDSS 1237669516368085369	QUASAR	0.0202226820	6.3010453150	0.0202185518	6.3010448251	----E----------	-	0	2.38374
LQAC_000-000_059	SDSS 1237663783660552224	QUASAR	0.0206958530	-0.2783433190	0.0207006087	-0.2783417405	----E----------	-	0	2.87944
LQAC_000-000_060	SDSS 1237663783123681495	QUASAR	0.0209285610	-0.6413930230	0.0209337407	-0.6413915019	----E----------	-	0	2.66196
LQAC_000-027_001	2QZ J000005-2725	QUASAR	0.0228750000	-27.4195555560	0.0227550000	-27.4195250000	-----F----KLM-------	-	0	1.93040
LQAC_000-001_014	SDSS 1237679436129108222	QUASAR	0.0229765500	-1.4575530150	0.0229826706	-1.4575477257	----E----------	-	0	2.27372
LQAC_000+000_001	SDSS 1237663277927760239	QUASAR	0.0272349470	0.5153320050	0.0272348784	0.5153313516	----E-----KL--------	-	0	1.82337
LQAC_000+008_002	J0000+0816	RADIO	0.0292964000	8.2791810360	0.0000000000	0.0000000000	-B----------	-	0	0.03870
LQAC_000+006_004	SDSS 1237678779015037100	QUASAR	0.0294144220	6.0593981880	0.0294102958	6.0593976988	----E----------	-	0	1.54601
LQAC_000+000_044	SDSS 1237663277927760243	QUASAR	0.0316175510	0.4953544530	0.0316174822	0.4953537996	----E----------	-	0	2.25979
LQAC_000-063_001	MS 23575-6352	AGN	0.0333000000	-63.5933000000	0.0000000000	0.0000000000	----------M-------	-	0	0.13600
LQAC_000+000_002	SDSS 1237666408442429705	QUASAR	0.0338913630	0.2762976840	0.0338919551	0.2762976909	----E-----KL--------	-	0	1.83908
LQAC_000+007_003	SDSS 1237669518515634615	QUASAR	0.0339942940	7.9781487930	0.0339910894	7.9781467102	----E----------	-	0	2.39650
LQAC_000+015_001	SDSS 1237652943712223408	QUASAR	0.0386083320	15.2984772810	0.0386109919	15.2984718558	----E-----KL--------	-	0	1.20413
LQAC_000+002_011	SDSS 1237678618491617421	QUASAR	0.0386573640	2.1061119260	0.0386584344	2.1061103677	----E----------	-	0	1.43557
LQAC_000+013_001	SDSS 1237652942101545092	QUASAR	0.0390858430	13.9384516500	0.0390909717	13.9384474502	----E-----KL--------	-	0	2.22480
LQAC_000+023_001	PSS J0000+2357	QUASAR	0.0392000000	23.9544000000	0.0000000000	0.0000000000	----------M-------	-	0	4.03000
LQAC_000-010_001	SDSS 1237652946915033257	QUASAR	0.0392718390	-10.4644269430	0.0392790916	-10.4644222727	----E-----KL--------	-	0	1.85411
LQAC_000-031_002	2QZ J000009-3116	QUASAR	0.0403750000	-31.2799722220	0.0403780000	-31.2799450000	-----F----KLM-------	-	0	1.72660
LQAC_000-030_002	2QZ J000009-3055	QUASAR	0.0412500000	-30.9249444440	0.0412790000	-30.9248570000	-----F----KLM-------	-	0	1.78720
LQAC_000+030_001	GB6 23576+3039	QUASAR	0.0421000000	30.9333000000	0.0420760000	30.9331550000	----------M-------	-	0	1.80100
LQAC_000-031_003	2QZ J000010-3159	QUASAR	0.0423750000	-31.9972222220	0.0423410000	-31.9971400000	-----F----KLM-------	-	0	1.63730
LQAC_000-002_010	SDSS 1237679434518495618	QUASAR	0.0434283900	-2.7944255610	0.0434326772	-2.7944175428	----E----------	-	0	2.25143
LQAC_000-001_017	SDSS 1237678881557512487	QUASAR	0.0465126530	-1.7428198010	0.0465172866	-1.7428142742	----E----------	-	0	2.17237
LQAC_000+014_002	SDSS J00001+1455	QUASAR	0.0475530580	14.9293573330	0.0475557179	14.9293519073	----E-----KLM-------	-	0	0.45983
LQAC_000+001_001	SDSS J00001+0101	AGN	0.0483000000	1.0306000000	0.0483680000	1.0307250000	----------m-------	-	0	0.10200
LQAC_000-031_004	2QZ J000011-3138	QUASAR	0.0485833330	-31.6444166670	0.0485590000	-31.6443790000	-----F----KLM-------	-	0	2.68030
LQAC_000+005_001	RXS J00001+0523	AGN	0.0487000000	5.3881000000	0.0488640000	5.3881690000	----------M-------	-	0	0.04000
LQAC_000+000_003	PB 5669	QUASAR	0.0498392210	0.0403505280	0.0498410010	0.0403510696	----E---IJKLM-------	-	0	0.47967
LQAC_000-002_011	SDSS 1237679435592237458	QUASAR	0.0502398020	-2.0039299330	0.0502424237	-2.0039230414	----E----------	-	0	2.34203
LQAC_000-000_003	SDSS 1237657190368346393	QUASAR	0.0510843510	-0.5390343450	0.0510898740	-0.5390338754	----E-----K---------	-	0	1.43576
LQAC_000-001_018	SDSS 1237678881557512491	QUASAR	0.0524933190	-1.7046433020	0.0524979527	-1.7046377753	----E----------	-	0	2.38620
LQAC_000+004_003	SDSS 1237678661424054566	QUASAR	0.0543102200	4.7343228770	0.0543096918	4.7343240799	----E----------	-	0	2.62491
LQAC_000+014_003	SDSS 1237656494576828664	QUASAR	0.0547837520	14.1763055240	0.0547864117	14.1763000990	----E-----KL--------	-	0	0.94861
LQAC_000-002_002	Q 2357-024	QUASAR	0.0567000000	-2.1722000000	0.0568390000	-2.1720740000	----------M-------	-	0	1.45000
LQAC_000-000_004	SDSS 1237656906355114201	QUASAR	0.0575060590	-0.9129991480	0.0575114211	-0.9129983348	----E-----KL--------	-	0	1.84678
LQAC_000+001_019	SDSS 1237678595943039313	QUASAR	0.0586536990	1.4976644810	0.0586559457	1.4976622170	----E----------	-	0	3.22838
LQAC_000+005_003	SDSS 1237678778478166080	QUASAR	0.0594540720	5.8174607240	0.0594514472	5.8174631140	----E----------	-	0	2.28641
LQAC_000-001_001	SDSS 1237663275780276444	QUASAR	0.0617783190	-1.1752155490	0.0617827211	-1.1752115110	----E-----KL--------	-	0	1.89429
LQAC_000+006_005	SDSS 1237669516905021597	QUASAR	0.0626617960	6.7493981330	0.0626552072	6.7493978192	----E----------	-	0	2.33447
LQAC_000+000_045	SDSS 1237657191978959176	QUASAR	0.0632144610	0.8092482880	0.0632155510	0.8092470928	----E----------	-	0	3.02764
LQAC_000+000_004	SDSS 1237663278464631008	QUASAR	0.0645082650	0.8796827290	0.0645093547	0.8796815339	----E-----KL--------	-	0	1.85611
LQAC_000-027_002	2QZ J000015-2738	QUASAR	0.0663750000	-27.6490833330	0.0663900000	-27.6490020000	-----F----KLM-------	-	0	1.51650
LQAC_000-031_005	2QZ J000016-3144	QUASAR	0.0680416670	-31.7438611110	0.0680360000	-31.7438690000	-----F----KLM-------	-	0	1.45110

...

Provide by the LQAC-3

u	b	v	g	r	i	z	J	K	F(1.4)	F(2.0)	F(5.0)	F(8.4)	F(23)
0.00000	19.40000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21.68728	21.08000	20.09000	21.18773	20.49993	20.13815	19.85104	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20.44316	0.00000	0.00000	19.94631	19.62401	19.39688	19.25113	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20.59702	19.64000	0.00000	19.97943	19.21778	18.94612	18.84114	0.00000	0.00000	0.00145	0.00000	0.00000	0.00000	0.00000
20.68617	0.00000	0.00000	20.13501	20.15773	20.05710	19.88642	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19.30300	20.10200	0.00000	0.00000	19.50000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19.70000	20.69200	0.00000	0.00000	19.86000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20.42290	0.00000	0.00000	20.10458	19.92739	19.87472	19.68056	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	21.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	16.89000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21.61185	0.00000	0.00000	20.93620	20.74246	20.82811	20.45969	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22.41749	0.00000	0.00000	21.45212	21.39687	21.12431	21.34713	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21.72315	0.00000	0.00000	21.31515	21.19180	21.18595	20.90603	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22.14127	0.00000	0.00000	21.65465	21.63809	21.55773	21.41859	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
23.17227	0.00000	0.00000	22.35085	21.88857	22.30125	22.26955	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22.01318	0.00000	0.00000	21.27323	21.06413	21.06447	20.87829	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
18.35200	19.42700	0.00000	0.00000	19.13800	18.69000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21.97332	0.00000	0.00000	21.37717	21.49466	21.39718	20.84167	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20.57606	20.42000	0.00000	20.58818	20.49464	20.17307	20.19127	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.02000	0.00000
21.38616	0.00000	0.00000	20.96643	20.74793	20.57870	20.77958	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20.84498	0.00000	0.00000	20.31850	20.37709	20.20643	19.92218	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	17.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20.30463	20.41000	0.00000	20.36418	20.01676	19.53222	19.31342	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22.72119	0.00000	0.00000	21.97436	22.07314	21.93141	21.51647	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19.89790	19.87000	0.00000	19.77119	19.37600	19.14767	19.30842	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20.50868	0.00000	0.00000	19.91026	19.45782	19.22480	19.09906	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19.24564	18.74000	18.49000	18.88533	18.42655	18.30446	18.08445	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	18.93000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19.21223	19.67000	0.00000	19.00441	18.97029	18.77564	18.69605	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
18.39800	19.05000	0.00000	0.00000	18.65300	18.10000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
17.92900	19.11600	0.00000	0.00000	18.37200	18.30000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	19.30000	0.00000	0.00000	0.00000	0.08600	0.00000	0.04900	0.00000	0.00000
20.28100	20.44200	0.00000	0.00000	20.78100	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22.52408	0.00000	0.00000	21.76627	21.73441	21.79678	21.02539	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20.86670	0.00000	0.00000	20.52914	20.43332	20.37974	20.12330	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19.64317	19.80000	19.03000	19.46836	19.35669	19.18064	19.02319	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20.43000	0.00000	19.37000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19.66400	20.26900	0.00000	0.00000	19.38200	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	16.40000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
17.99275	17.60000	17.80000	17.77682	17.85312	17.79358	17.70732	16.65100	14.82100	0.00000	0.00000	0.00000	0.00000	0.00000
22.53193	0.00000	0.00000	21.17492	21.31511	21.18690	20.52400	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20.68523	20.99000	0.00000	20.61202	20.32632	20.18603	20.25951	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21.50048	0.00000	0.00000	20.92362	20.85428	20.81639	20.76495	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21.81759	0.00000	0.00000	21.15749	20.88827	21.01626	20.40666	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19.52612	18.94000	18.86000	19.29925	19.11957	19.14941	19.08169	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	19.40000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00200	0.00000	0.00000	0.00000	0.00000
20.50137	20.13000	0.00000	20.22209	20.06256	19.58522	19.44920	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22.59146	0.00000	0.00000	20.45520	20.01341	19.68581	19.65000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20.27501	0.00000	0.00000	19.78023	19.80273	19.70772	19.42150	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19.47851	19.49000	0.00000	19.42363	19.41574	19.20553	19.12852	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20.04830	0.00000	0.00000	19.32162	19.04707	18.90365	18.62646	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22.35713	0.00000	0.00000	19.85191	19.23959	19.12856	18.89764	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19.60102	20.30000	0.00000	19.41323	19.32573	19.03280	19.13601	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
17.91800	18.37900	0.00000	0.00000	17.69200	17.21000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
17.99400	19.07600	0.00000	0.00000	18.16300	17.79000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

+ **Morphological indexes**
  - Skewness
  - Roundness
  - Normalness

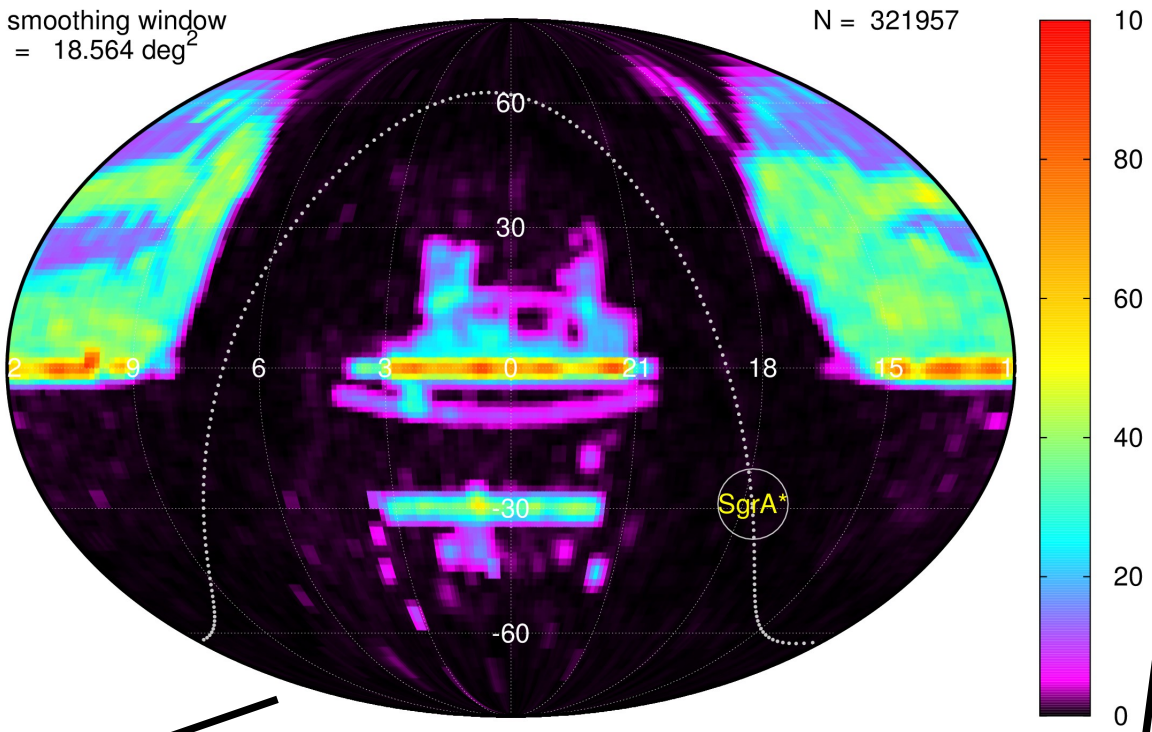
  In B, R and I band

+ **Absolute magnitudes**

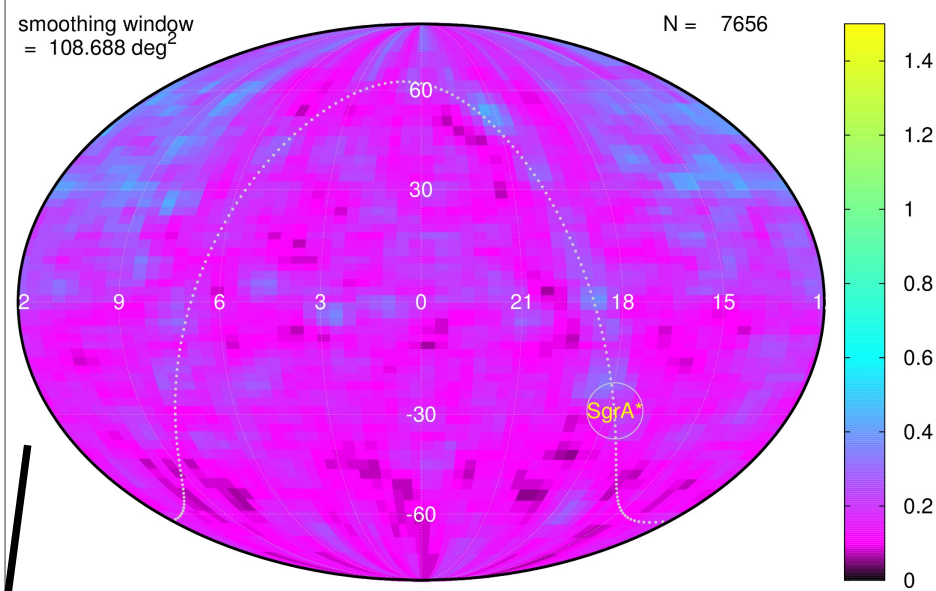
  In B and I Band

Sky coverage & quasars' density by square degree

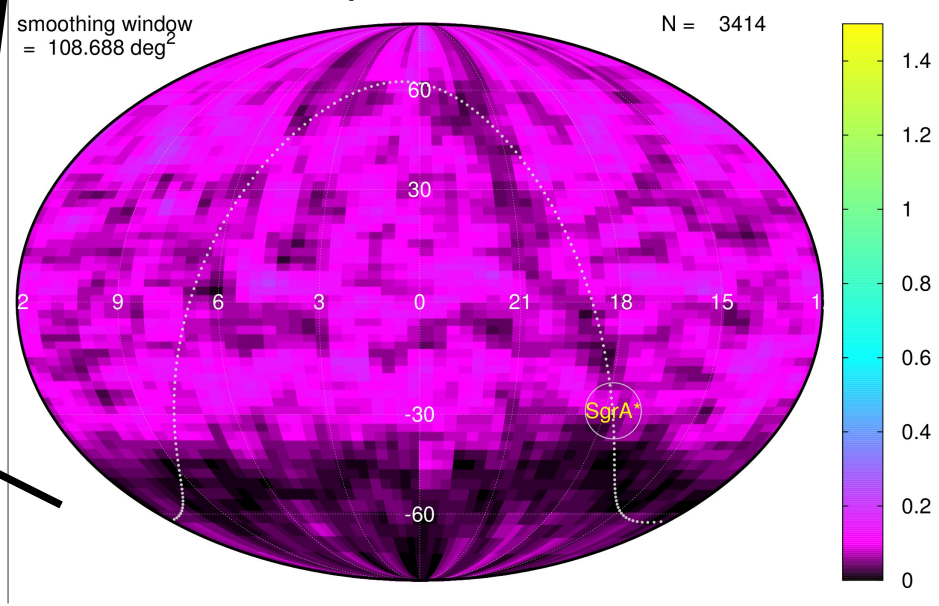
Large Quasar Astrometric Catalogue 3rd version



LQAC/RFC quasars distribution



ICRF2 quasars distribution



LQAC : 7,8 qso/deg² ↔ 1 quasar per 432 '²

LQAC/RFC : 0,18 qso/deg² ↔ 1 quasar per 5 deg²

ICRF2 : 0,08 qso/deg² ↔ 1 quasar per 12 deg²

Units = number of quasars per square degree

Redshift distribution

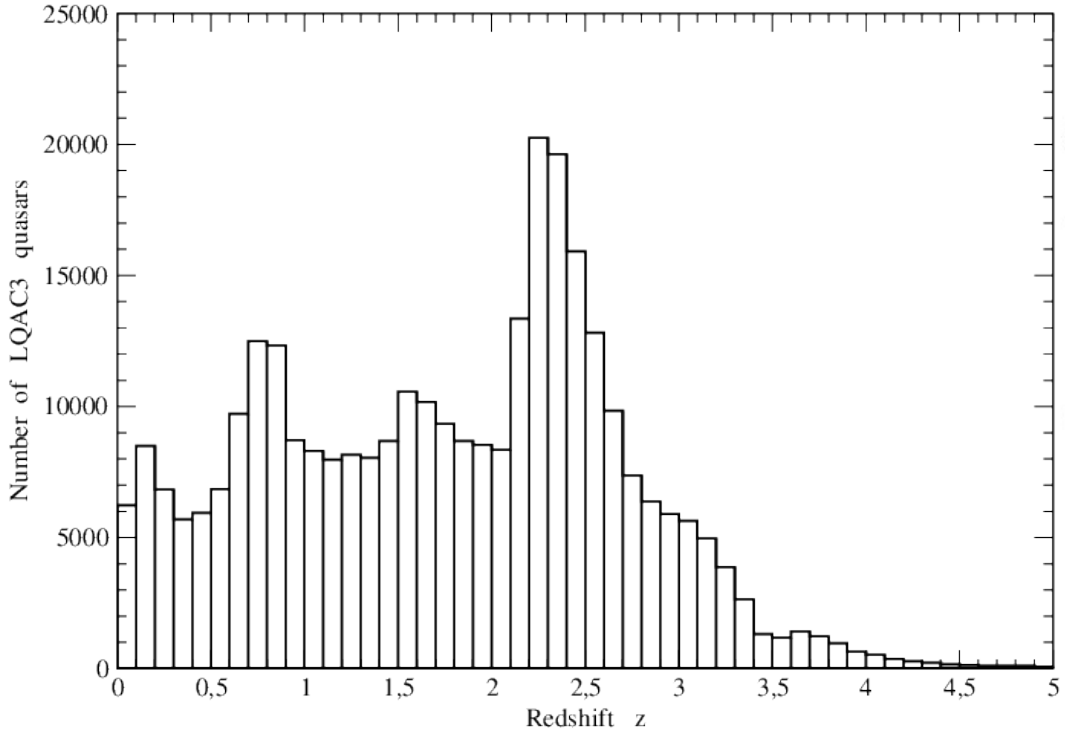


Fig. Redshift distribution from all LQAC sources

(Souchay et al. 2014)

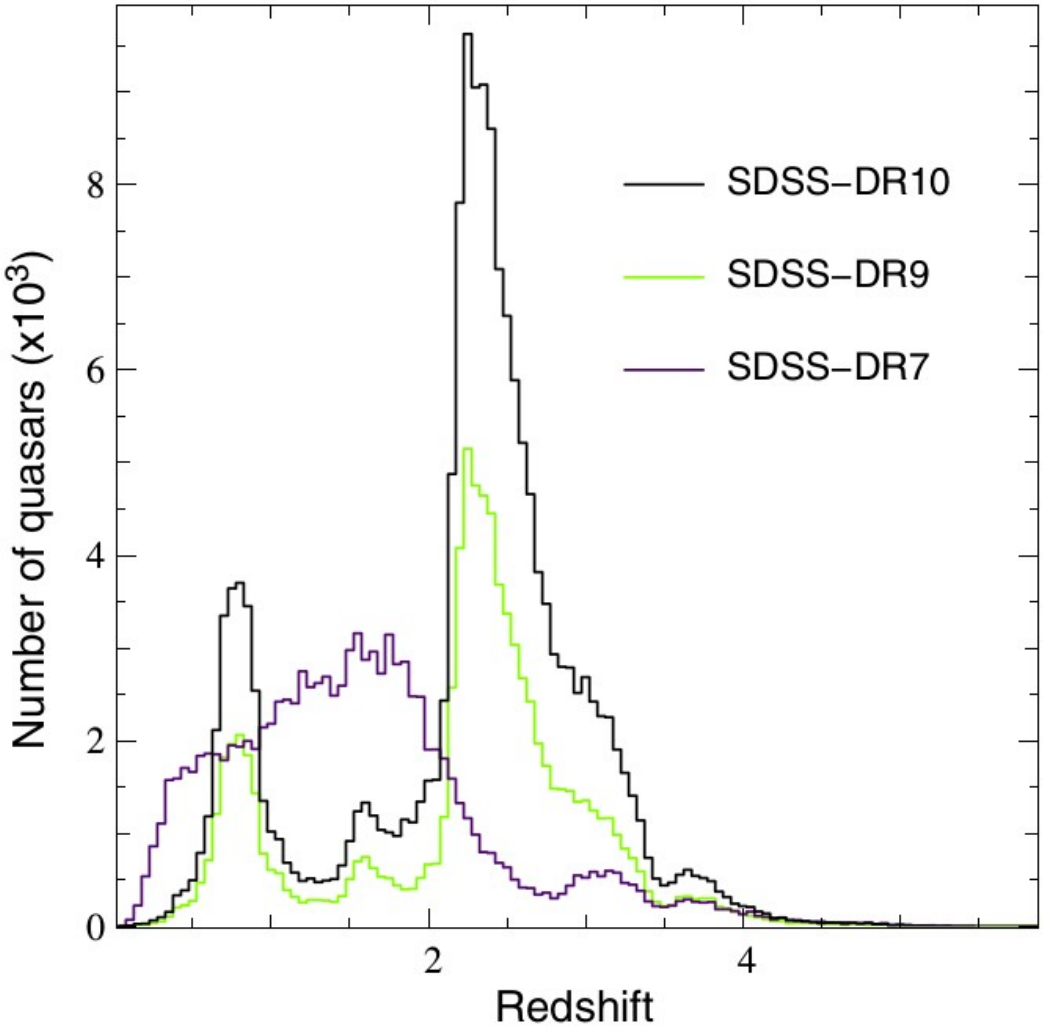


Fig. Redshift distribution from several SDSS Data Release

(Pâris et al. 2014)

Redshift distribution

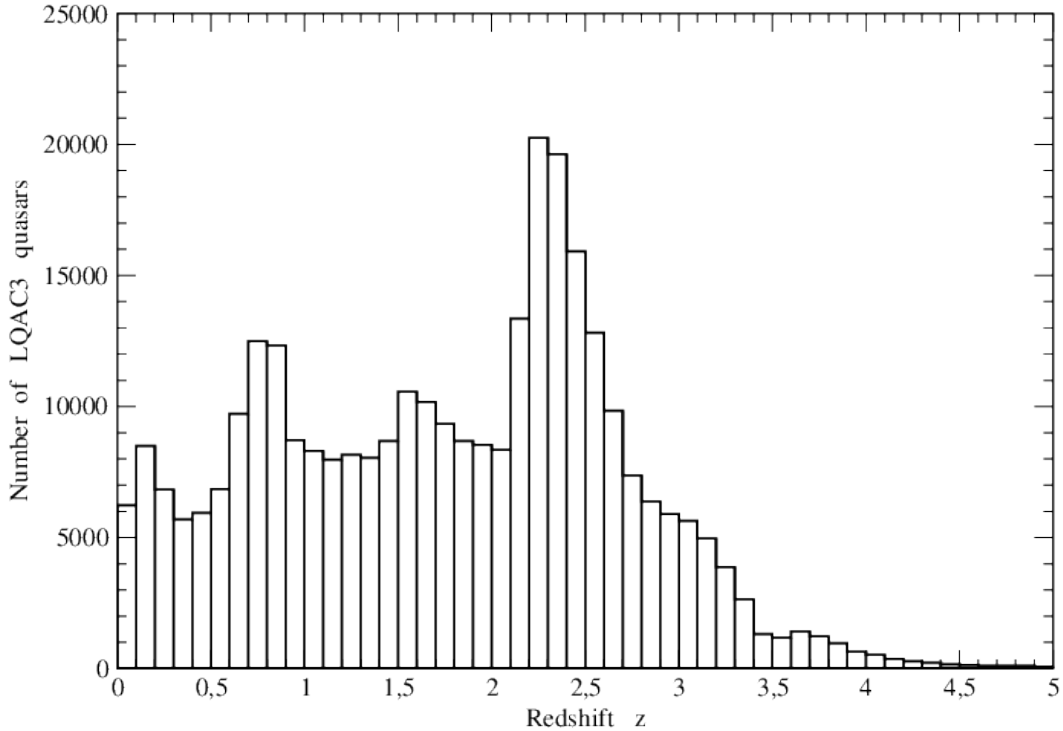


Fig. Redshift distribution from all LQAC sources

(Souchay et al. 2014)

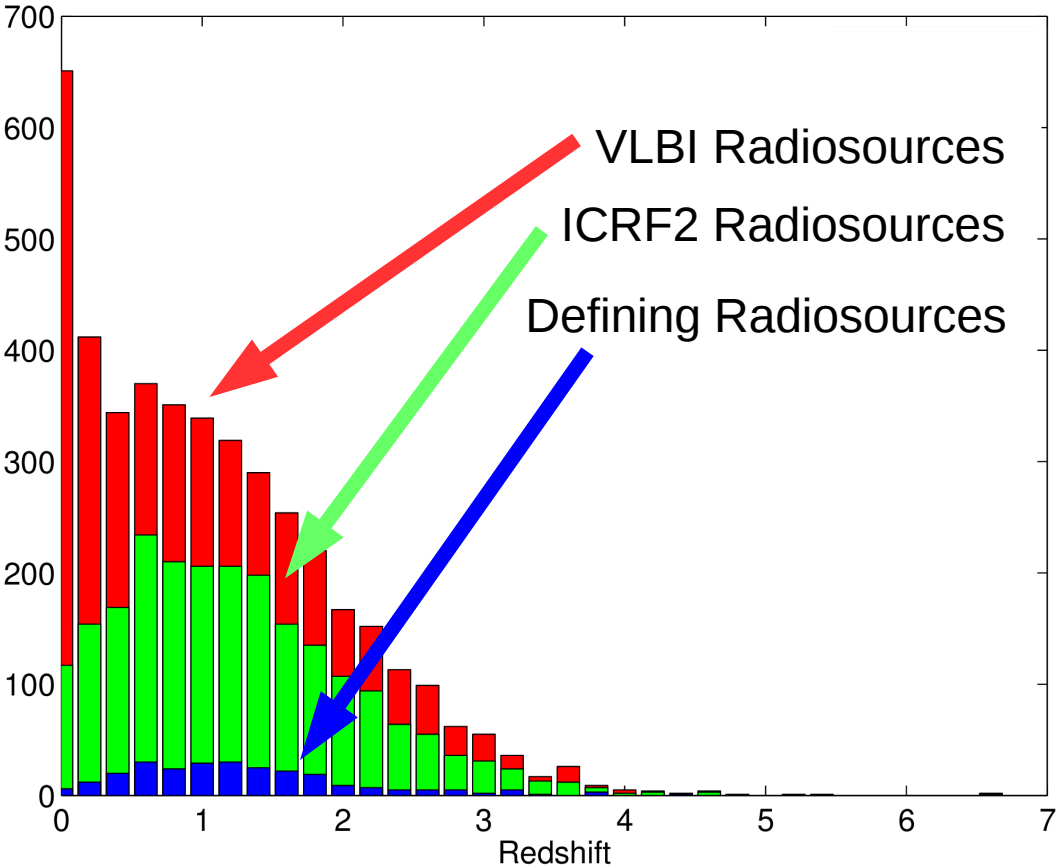


Fig. Redshift distribution for VLBI radiosources from LQAC-RFC cross identification

Link Radio-optical : coordinates offsets

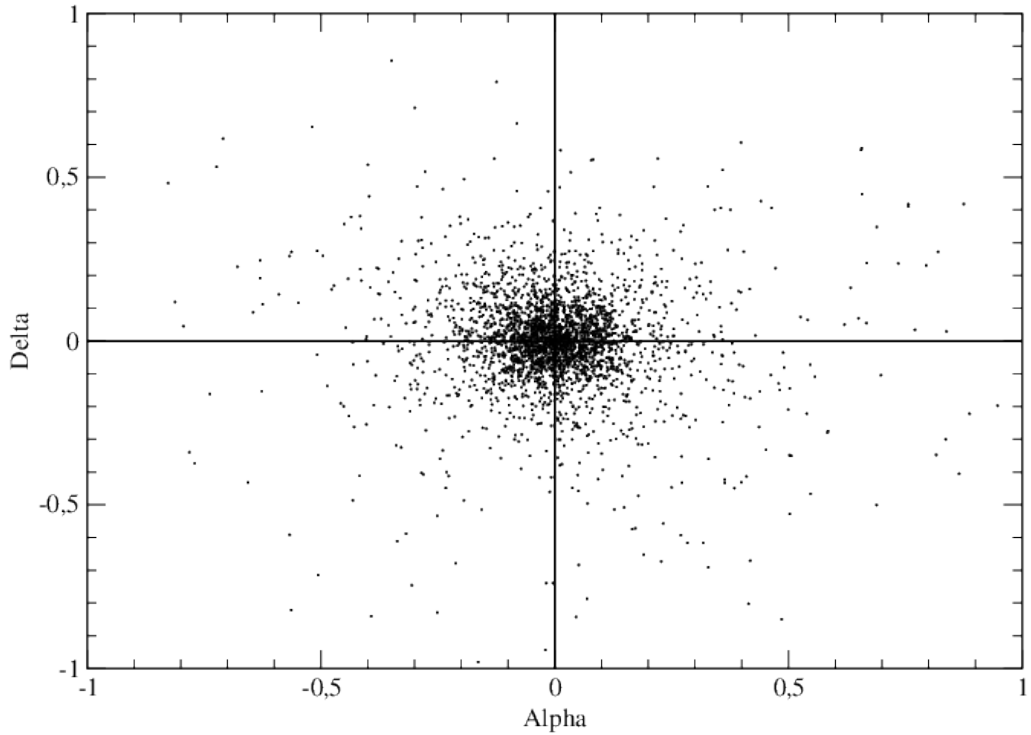


Fig. Coordinates offset between ICRF and LQRF (unit : arcsec)

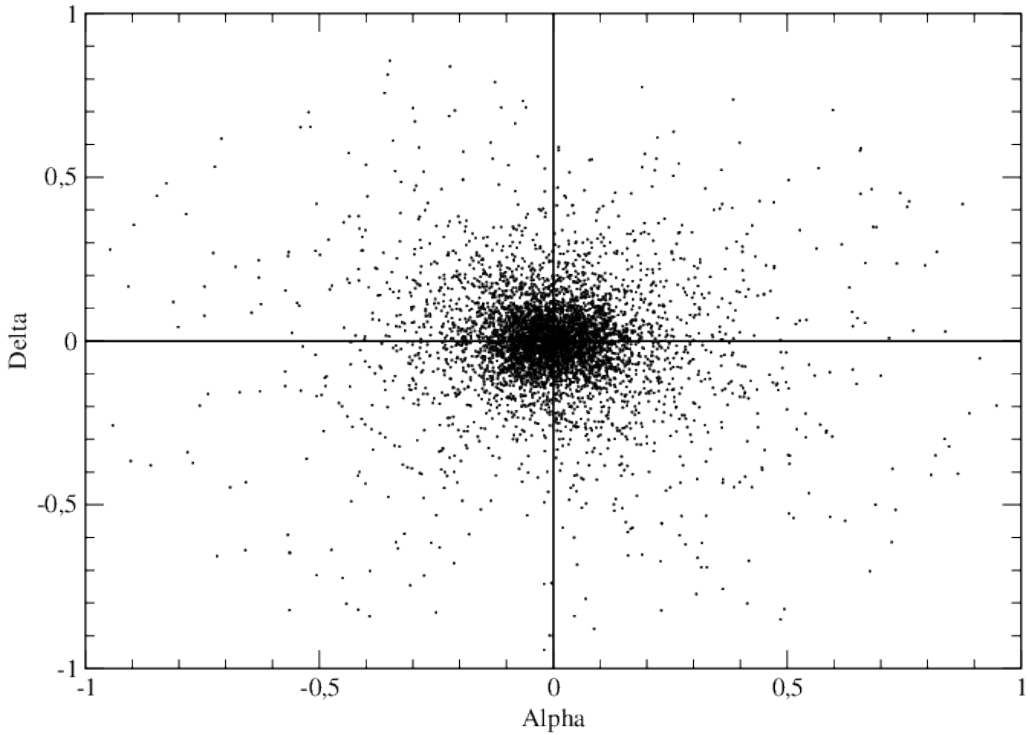
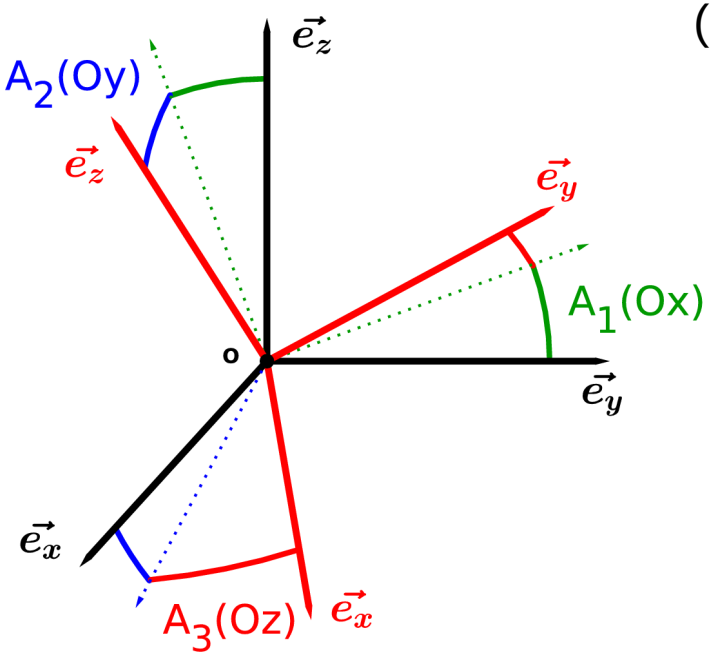


Fig. Coordinates offset between RFC and LQRF (unit arcsec)

What is the contribution to offsets ?

- Bad astrometry ?
- Source structure ?
- Physical process ?
- Combinaison of those 3 effects ?

Statistical difference between radio and oprical catalogs



Radio Reference Frame & **Optical Reference Frame**
(from LQAC → A, B, C, D) (from LQRF coordinates)

are slightly **rotated** with rotation angles of the **order of 5 mas** (ten sigmas).

$$A_1 = +4{,}8 \pm 0{,}6\,[mas]$$
$$A_2 = -4{,}7 \pm 0{,}6\,[mas]$$
$$A_3 = +2{,}6 \pm 0{,}7\,[mas]$$

	σ(")		Distance(")	
	α.cos(δ)	δ	α.cos(δ)	δ
All VLBI sources	0,174	0,172	0,178	0,123
ICRF-2	0,169	0,164	0,174	0,124
Defining sources	0,126	0,119	0,134	0,110
QSO	0,224	0,239	0,241	0,174
BL Lac	0,126	0,125	0,132	0,100
AGN	0,219	0,216	0,237	0,175

Access to the LQAC

LQAC and LQAC2 are available on Vizier :

http://vizier.u-strasbg.fr/viz-bin/VizieR

LQAC3 (Souchay et al., 2015, in press)
coming very soon

LQAC4 scheduled for 2016

THANK YOU
FOR YOUR ATTENTION