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Optical monitoring of extragalactic sources for the link between the ICRF and the future Gaia celestial reference frame

I. Variability of ICRF sources

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ABSTRACT

Context. The astrometric mission Gaia of the European Space Agency is scheduled to be launched in 2013. It will provide an astrometric catalogue of 500000 extragalactic sources that could be the basis of a new optical reference frame after the one of the Hipparcos satellite. On the other hand, the current International Celestial Reference Frame (ICRF), is based on the observation of extragalactic sources observed in the radio wavelength. The sources in these two reference systems will have roughly the same uncertainty in their astrometric coordinates. It is then mandatory to observe a set of common targets both in the optical and in the radio wavelength to achieve the link between the ICRF and what could be called GCRF (Gaia Celestial Reference Frame).

Aims. The goal of this work is to observe a first set of 70 extragalactic sources in the optical wavelength that could achieve the link with the ICRF. Variations in the light curves of these targets are linked with astrophysical processes that could produce displacements of the optical photocenter. Such displacements, if they exist, would be of criticism importance in the framework of the link of reference systems.

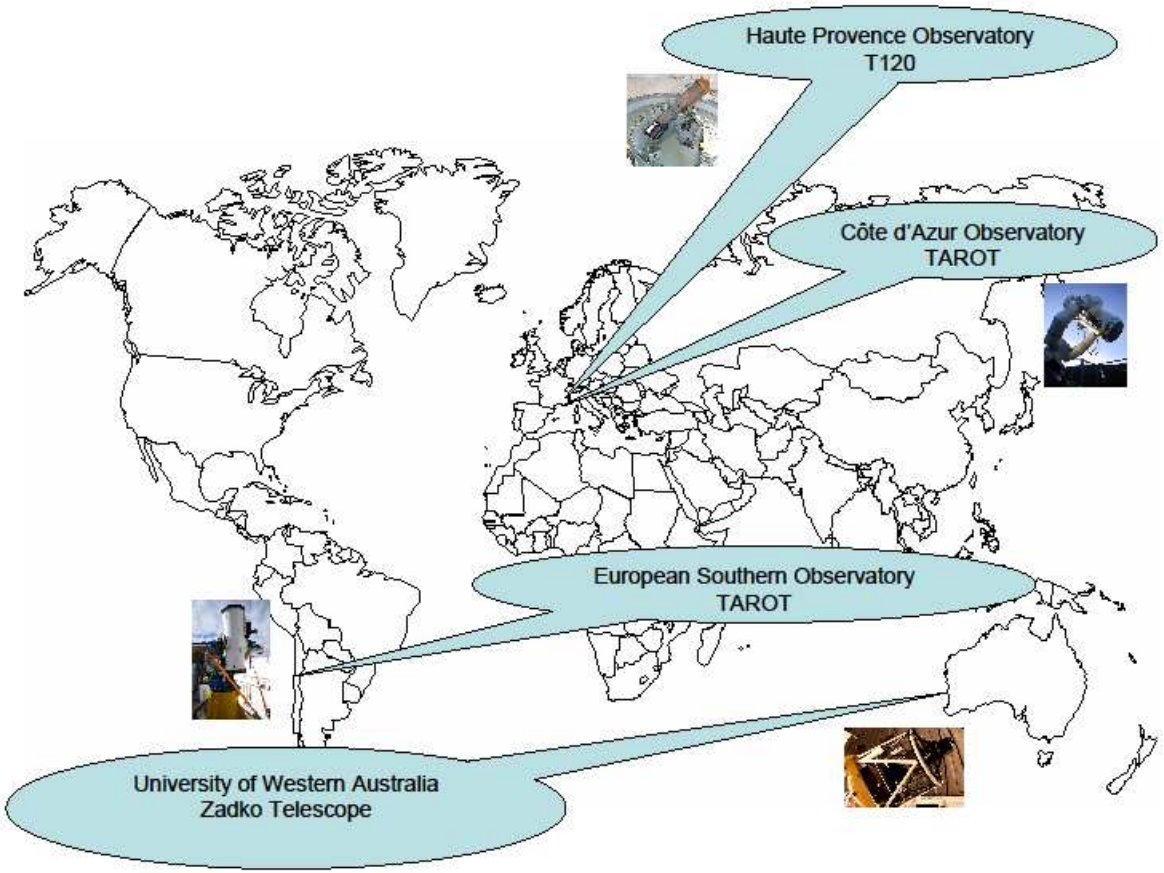
Methods. Four telescopes have been used to observe the targets in the optical wavelength. Two of them are located in France, one in Chile and the last one in Australia. First observations were carried out during 1.5 year in R and V bands. A new caracterisation method of the compacity of the targets has been applied to the images obtained.

Results. This paper present results of optical monitoring of axtragalactic sources suitable for the link of reference systems. We show that a great number of targets in our set are variable in the two wavelength of observation. A short presentation of each object is given together with some reference to earlier photometric studies. A morphological index is defined and applied to the 5000 images obtained during the observation campaign.

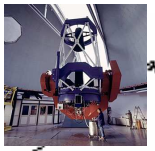
Conclusions. This work fits into a more general work about astro-photometric and astrophysical studies of extragalactic radiosources in the framework of the reference systems. It brings to the astrometrists community some informations in the optical wavelength about a set of targets that could be used for the link between the radio ICRF and the future Gaia celestial reference frame.

Key words. Reference systems – Astrometry – Gaia – Quasars: General

Optical Telescopes (variability aspects)



Optical Telescopes (morphology aspects)



ESO 2p2, La Silla
2007 - 2010

LT(2013A) – NOT(2012B), La Palma





CFHT, Hawaii
2008B, 2012A



Data mining ESO, HST, SDSS…

Summary of the observations 2010 - 2011

Telescope	Nb images
Tarot OCA (France)	1691
Tarot ESO (Chile)	2191
OHP (France)	463
Zadko (Australia)	159
	4504

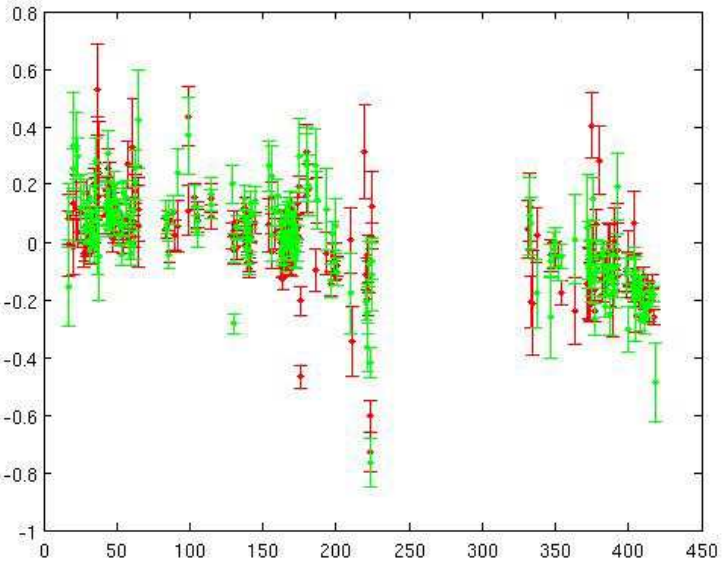
All the data will be stored in a database under construction in the frame of the ICRS-PC

Summary about variability and morphology in referred papers

Type	Host galaxy	Variability
21% Seyfert	Yes 19% (+16%)	Yes 36% (+9%)
36% BL Lac.	No 21%	No (54%)
43% QSO	Unknown 43%	Unknown (1%)

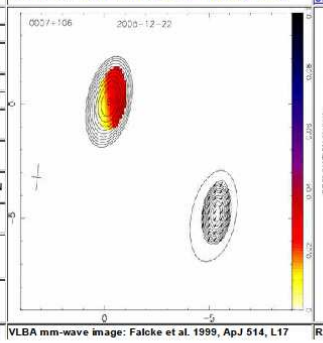
- 67/70 sources: 3 targets (M81, M84, Mk421) are not point-like sources
- 7 targets remain unobserved in the frame of this work
- For 36 targets (54%), new informations about variability

0007+106

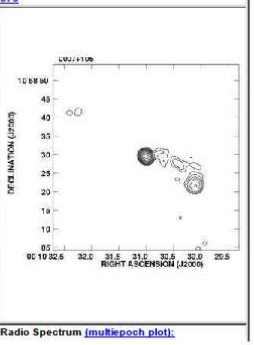


Common Name:	III Zw 2
B1950 Name:	0007+106
J2000 Name:	J0010+1058
R.A. and Dec. (J2000):	0h10m31.006s +10d58'29.504"
Optical Class:	G
Redshift:	0.0893
Luminosity Distance:	403 Mpc ; 1.65 pc/mas
Radio Spectrum:	Flat
Gamma-ray Association	LAT: N, EGRET: N, TeV: N
Kpc-scale morphology:	Two-sided
Max. Jet Speed:	166 ± 16 μas/y ; 0.97 c Lister et al. 2009, AJ, 138,1874
Separation Versus Time Plot:	GIF PS

MOJAVE 2cm [Total intensity movie] | [Polariz. movie]



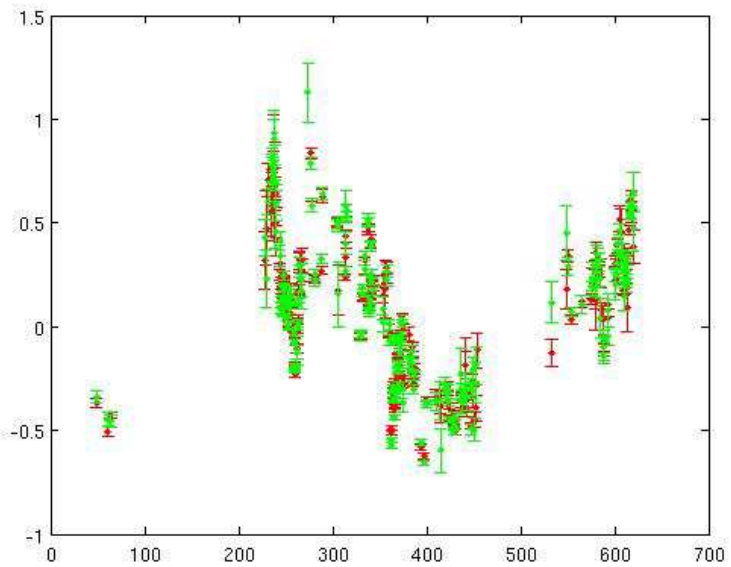
Kpc-scale: Cooper et al. 2007, ApJ Supl 171, 376



Stacked epoch 15 GHz VLBA images: VLBA mm-wave image: Falcke et al. 1999, ApJ 514, L17 Radio Spectrum (multiepoch plot):

Mojave

0109+224



Common Name:	S2 0109+22
B1950 Name:	0109+224
J2000 Name:	J0112+2244
R.A. and Dec. (J2000):	1h12m5.825s +22d44'38.786"
Optical Class:	BL Lac
Redshift:	0.265
Luminosity Distance:	1335 Mpc ; 4.04 pc/mas
Radio Spectrum:	Flat
Gamma-ray Association	LAT: Y, EGRET: N, TeV: N
Kpc-scale morphology:	Core
Max. Jet Speed:	
Separation Versus Time Plot:	GIF PS

MOJAVE 2cm [Total intensity movie] | [Polariz. movie]

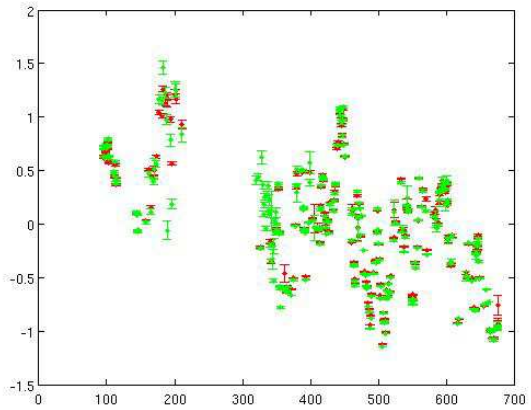
Kpc-scale: Cooper et al. 2007, ApJ Supl 171, 376

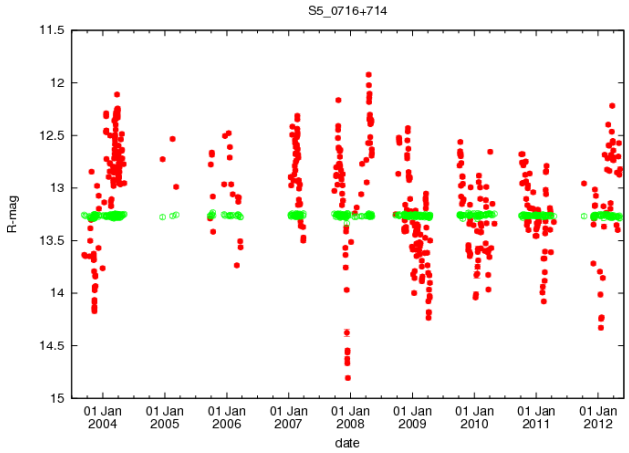
Stacked epoch 15 GHz VLBA images: VLBA mm-wave image: Radio Spectrum (multiepoch plot):

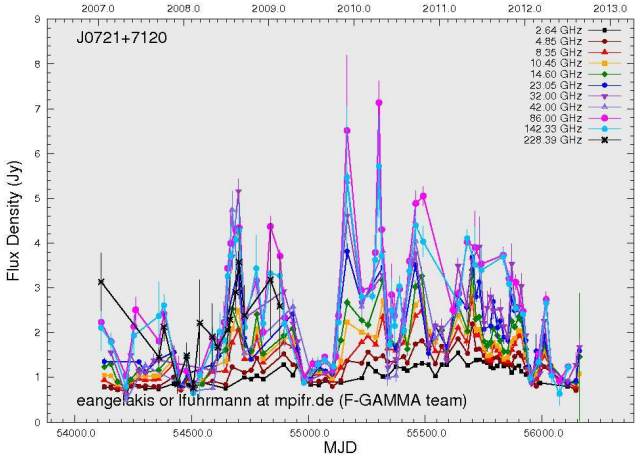
Mojave

0716+714

Tuorla Obs.







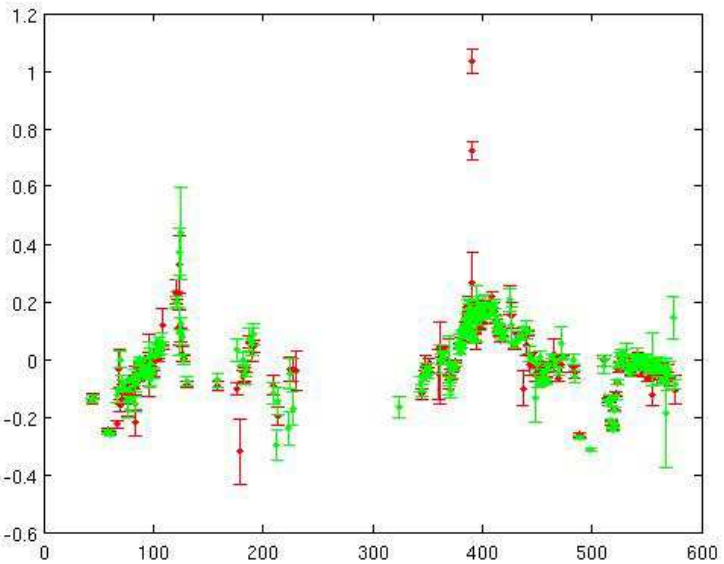
F-gamma

MOJAVE Sample: 0716+714 http://www.physics.purdue.edu/astro/MOJAVE/sourcepages/0716+714.shtml

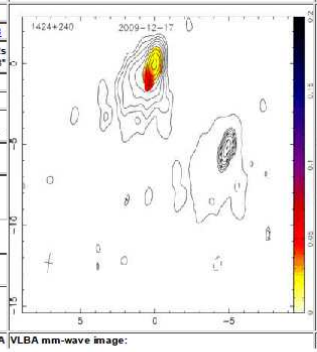
Common Name:	S5 0716+71	MOJAVE 2cm [Total intensity movie] [Polariz. movie]	Kpc-scale: Antonucci et al. 1986, AJ 92, 1
B1950 Name:	0716+714		
J2000 Name:	J0721+7120		
R.A. and Dec. (J2000):	7h21m53.448s +71d20'36.363"		
Optical Class:	BL Lac		
Redshift:	0.31		
Luminosity Distance:	1600 Mpc ; 4.52 pc/mas		
Radio Spectrum:	Flat		
Gamma-ray Association	LAT: Y, EGRET: Y, TeV: Y		
Kpc-scale morphology:	Two-sided Halo		
Max. Jet Speed:	521 ± 18 μas/y ; 10.06 c Lister et al. 2009, AJ, 138,1874		
Separation Versus Time Plot:	GIF PS		
Stacked epoch 15 GHz		VLBA mm-wave image: Boston U. Blazar Monitoring	Radio Spectrum (multiepoch plot):

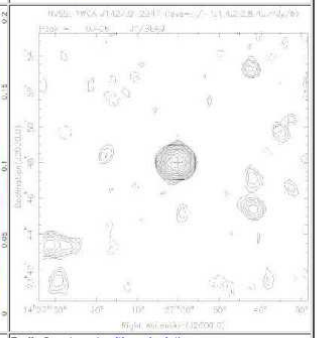
Mojave

1424+240



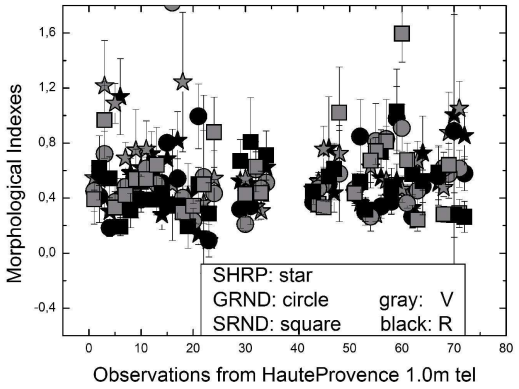
Common Name:	OQ +240	MOJAVE 2cm [Total intensity movie] | [Polariz. movie]	Kpc-scale: NVSS
B1950 Name:	1424+240		
J2000 Name:	J1427+2348		
R.A. and Dec. (J2000):	14h27m0.392s +23d48'0.038"		
Optical Class:	BL Lac		
Redshift:	0.26		
Luminosity Distance:	1306 Mpc ; 3.99 pc/mas		
Radio Spectrum:	Flat		
Gamma-ray Association	LAT: Y, EGRET: N, TeV: Y		
Kpc-scale morphology:			
Max. Jet Speed:			
Separation Versus Time Plot:			
Stacked epoch 15 GHz VLBA		VLBA mm-wave image:	Radio Spectrum (multiepoch plot):

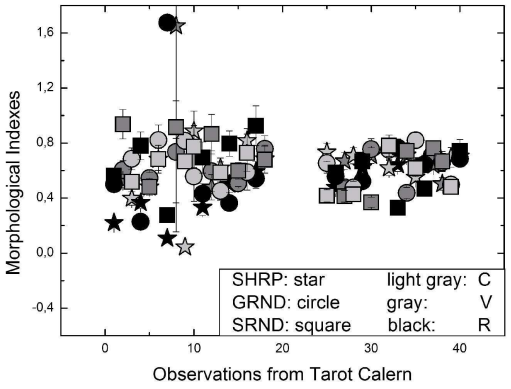


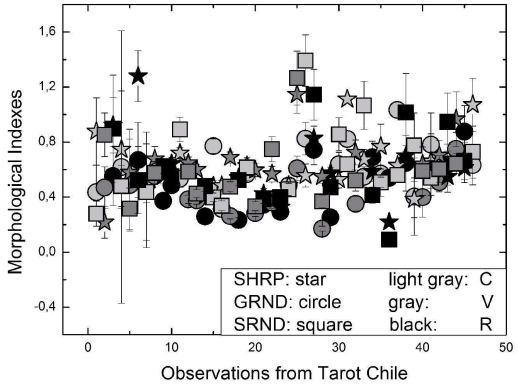


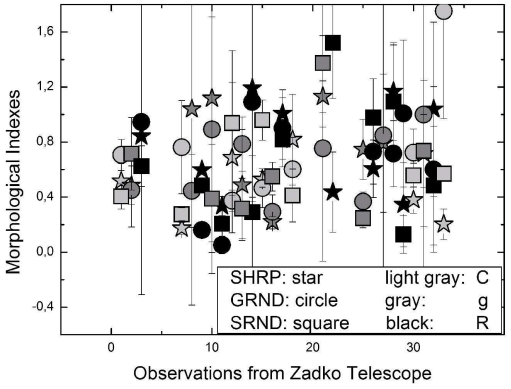
Mojave

Compacity index

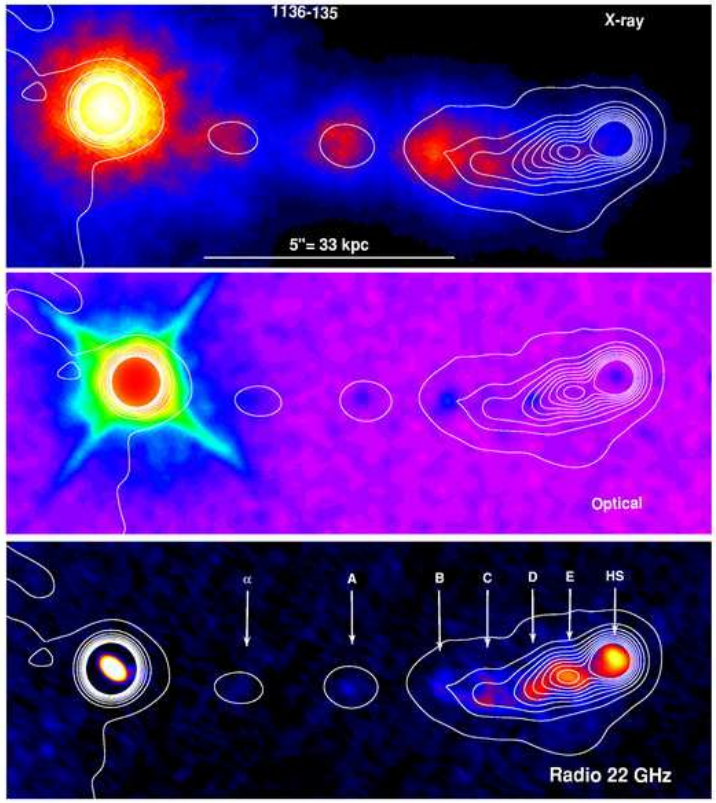


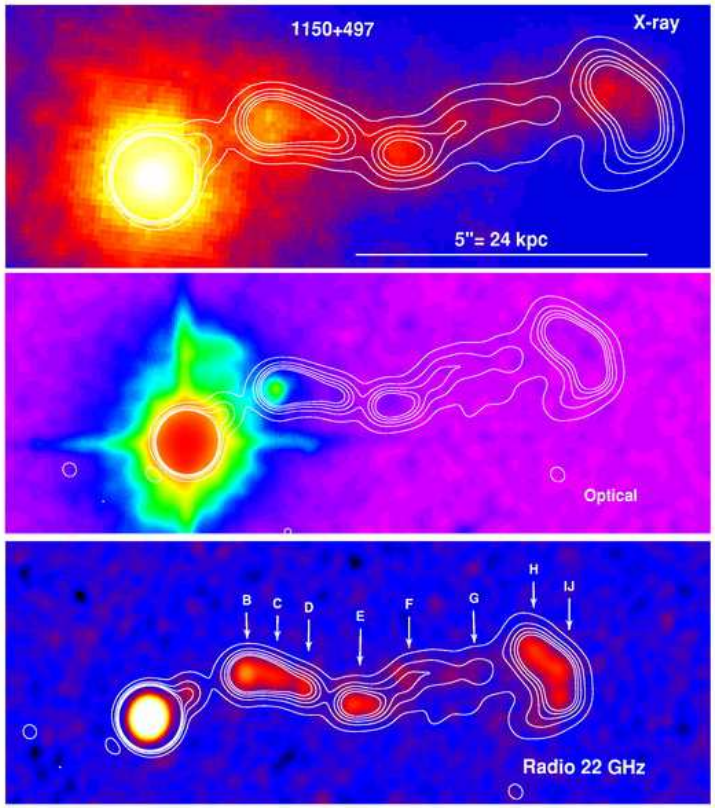






Multi-wavelength observations





1136-135

1150+497