OPTICAL MONITORING OF QSO IN THE FRAMEWORK OF THE GAIA MISSION

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ABSTRACT. The Gaia astrometric mission of the European Space Agency has been launched the 19th December 2013. It will provide an astrometric catalogue of 500.000 extragalactic sources that could be the basis of a new optical reference frame. On the other hand, the current International Celestial Reference Frame (ICRF) is based on the observations of extragalactic sources at radio wavelength. The astrometric coordinates of sources in these two reference systems will have roughly the same uncertainty. It is then mandatory to observe a set of common targets at both optical and radio wavelength to link the ICRF with what could be called the GCRF (Gaia Celestial Reference Frame). We will show in this paper some results obtained with the TJO, Telescopi Juan Oro, from Observatori Astronomic del Montsec in Spain. It also presents some results obtained with the Lomb-Scargle and CLEAN algoritm methods applied to optical magnitude obtained with the TAROT telescopes.

1. THE TELESCOPES USED

A set of optical telescopes is currently used both for morphology (large facilities) and for photometry (robotic/manual and small/medium telescopes). This paper is more particularly dedicated to the photometry aspect, the morphology being currently under study and will be presented elsewhere. The photometric program (magnitude monitoring) has begun in 2010 and is currently under progress. Among all the telescopes used, three of them, The Telescopi Joan Oró (TJO)[1] from the Observatori Astronòmic del Montsec (OAdM, Spain) and the two twin TAROT telescopes from Observatoire de la Côte d'Azur (OCA, France)[2] and European Southern Observatory (ESO, Chile), provide light curves that are presented and used in the frame of this work (Fig. 1). The data obtained with the TJO are differential magnitudes against two reference stars while the data obtained with the TAROT telescope are direct magnitudes. Both of them are shown here in R Cousins filter.

2. LOMB-SCARGLE AND CLEAN PERIODOGRAMS

The Lomb-Scargle periodogram is a very common tool for spectral analysis of time series with unequally spaced data (Scargle, 1982; Press & Rybicky, 1989). It is equivalent to the least-squares fitting of sine wave. An independent method has been chosen to confirm the frequencies obtained by the Lomb-Scargle method (to avoid misinterpretation of frequency peaks). This method, the CLEAN algorithm, has been described by Roberts et al. (1987) and, in our case, implemented by Jablonski (1991). The Table 1 gives the comparison of the detected periods obtained by the two previously mentioned methods in the case of the TAROT light curves.

[1] see http://www.oadm.cat/en/home.htm
[2] see http://tarot.obs-hp.fr/tarot

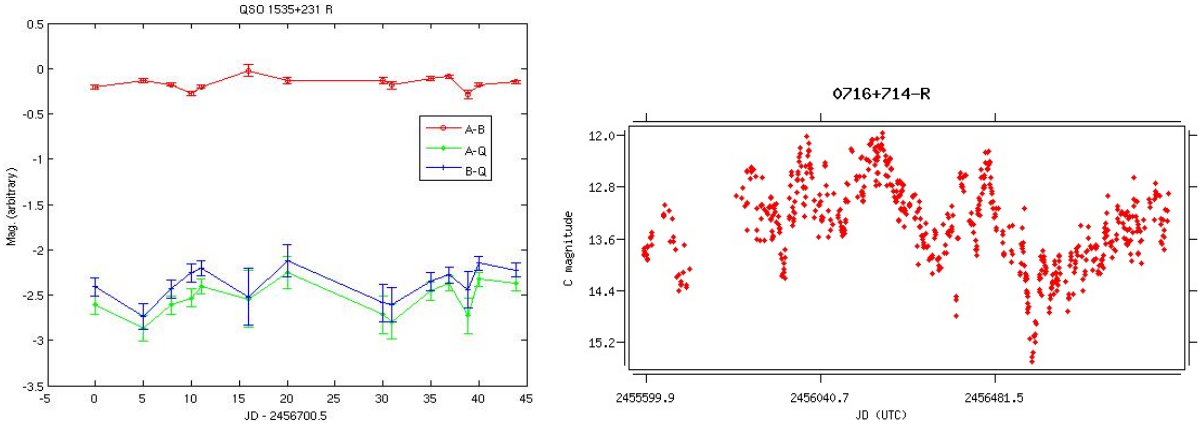

Figure 1: On the left panel, R light curve for QSO 1535+231 obtained with the TJO. On the right panel IERS B0716+714 R light curve obtained with TAROT telescope (OCA).

IERS Name	Lomb-Scargle	CLEAN	IERS Name	Lomb-Scargle	CLEAN
B0405-123	1228	1169	B1101-325	1759	2050
	277			262	
	84	87		655	603
	201			359	366
B0716+714	1000	1055	B1424+240	423	442
	316	310		816	847
	235	215		214	216
	163			99	
	68	68		151	159
				76	76

Table 1: Comparison of the detected periods (in days) by the Lomb-Scargle and CLEAN methods.

3. CONCLUSION

Binary central compact objects are not part of the current unified model of AGN. But it must be noted that supermassive binary black holes are predicted to be at an inevitable late stage in the evolution of the galaxy mergers (Beckmann & Shrader, 2012). Despite this fact, one could reasonably suspect that the rotation of the accretion disk and the dynamic of the accretion flow produce some periodic or quasi-periodic phenomena. Many objects are well known to exhibit one or more (quasi-)periodicity, such as for example B0109+224 (Ciprini et al., 2003), B0716+714 (Zhang, et al., 2009), B0735+178 (Qian & Tao, 2004), B1253-055 (Li et al., 2009). This work confirms some periods already known for B0716+714. These periods are the signature of some underlying astrophysical phenomena that could modify the photocenter of this target. This could be an issue for the link of reference systems.

4. REFERENCES

Beckmann, V., Shrader, C., 2012, "Active Galactic Nuclei", Wiley-VCH Verlag GmbH & Co.
Ciprini, S., Tosti, G., Raiteri, C., et al., 2003, A&A, 400, 487.
Jablonski, F., 1991, Private communication.
Li, H., Xie, G., Chen, L., et al., 2009, PASP, 121, 1172.
Press, W., Rybicki, G., 1989, ApJ., 338, 277.
Qian, B., Tao, J., 2004, PASP, 116, 161.
Roberts, D.H., Lehar, J., Dreher, J.W., 1987, AJ, 93, 968.
Scargle, J.D., 1982, ApJ, 263, 835.
Zhang, H., Zhang, X., Dong, F., et al., 2009, ChA&A, 33, 373.