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GI Aqr Is RRab Type Star

PETR SOBOTKA
Astronomical Institute, Academy of Sciences of the Czech Republic,
251 65 Ondřejov, Czech Republic; sobotka(at)astro.cz

Abstract: Observations by INTEGRAL Optical Monitoring Camera (OMC) showed, that the GI Aqr is not an eclipsing binary of EB type as given by GCVS. Based on CCD V-filtered observations, **GI Aqr is pulsating RRab type star**. To determine new light elements also ROTSE and ASAS-3 data were used. **P=0.6097 ± 0.0003 days, $T_{0(max)}$ = 2451314.7593.**

GI Aqr was discovered by Kurochkin (**Kurochkin 1986**) on photographic plates. His paper in Peremennye Zvezdy was used as a source for the 68th Name-List of Variable Stars (**Kholopov et. al 1987**). GI Aqr was classified as possible eclipsing binary star of the EB type. No other observations or paper can be found via NASA ADS service since the discovery.

This study uses data provided by the Optical Monitoring Camera (OMC) onboard the ESA INTEGRAL satellite (The International Gamma-Ray Astrophysics Laboratory). (**Winkler et al., 2003**). While the main goal of the INTEGRAL is to provide simultaneous observations of high-energy sources in all data bands, also the OMC data alone can provide important inputs for various analyses of astrophysical objects.

GI Aqr was observed by OMC in two seasons (Fig. 1), the first on December 2002 and the second on November 2003. Continuous data with total time span 3.5 days were collected during the first season. Total amount of observations in the first season is 382. Data obtained during the second season cover 0.8 d. The number of points is 87. Standard deviation of the measurements is 0.23 mag.

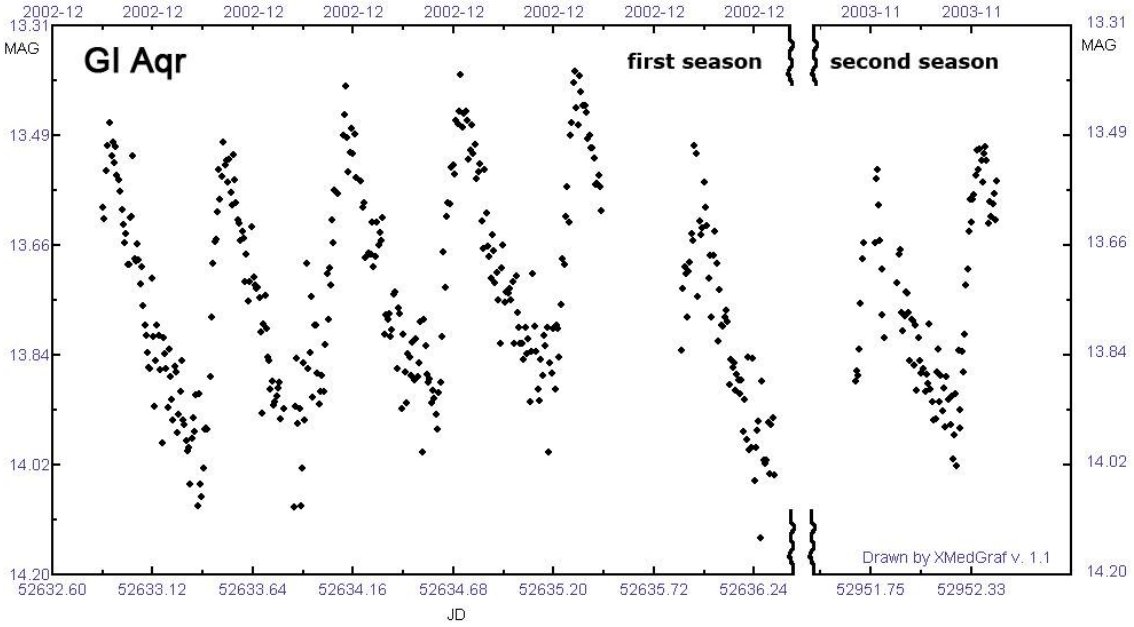

Figure 1: Light curve of GI Aqr in two seasons. V-filtered CCD data by OMC.

Light curve shows clearly that **GI Aqr is RR Lyrae type star** and it was misclassified in the GCVS.

For further analysis, observations with exposure shorter than 20 sec were rejected and 630 seconds sampling time was used. It was necessary because the GI Aqr magnitude range 13.5 to 14.1 is on the lower boundary for the OMC instrument.

Photometric data were obtained through Johnson V filter. Data processing was done by Off-line Scientific Analysis package (OSA 6.0) on Laboratory for Space Astrophysics and Theoretical Physics (LAEFF) near Madrid, Spain. I am not authorized to attach the data to this paper, but the observations are accessible via https://sdc.laeff.esa.es/omc.

To find new light elements, I looked through another photometric data. I have found observations of robotic telescopes ROTSE (**Wozniak et al. 2004**) and ASAS-3 (**Pojmanski 2002**). I put the data together with OMC with systematic shift 0.11 mag for ASAS-3 and 0.38 mag for ROTSE. The whole set of available observations covers time span from JD 2451312 to 2453896, which is roughly 7 years. The resultant light curve is presented in Figure 2.

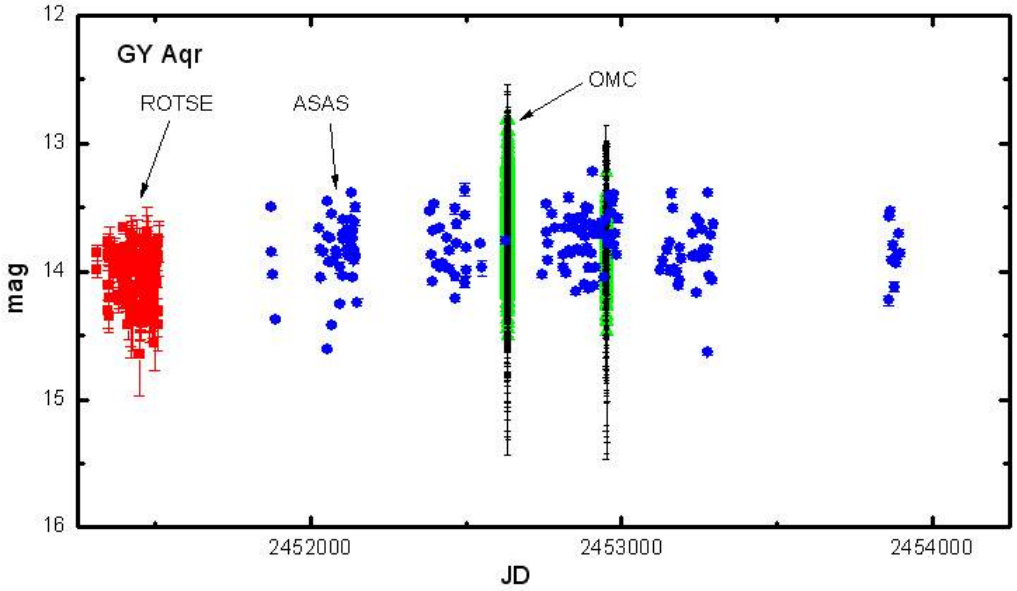

Figure 2: Light curve of GI Aqr based on the CCD observations of ROTSE, ASAS-3 and OMC.

I have analyzed merged data with software PerSea v2.01 developed by Maciejewski (**Maciejewski 2004**). This software is based on fast and statistically optimal period search in uneven sampled observations method by A.Schwarzenberg-Czerny. For more information on software, please contact its author.

New light elements determined by PerSea are:

$$\mathbf{P = 0.6097 \pm 0.0003 \text{ days}, T_{0(max)} = 2451314.7593}$$

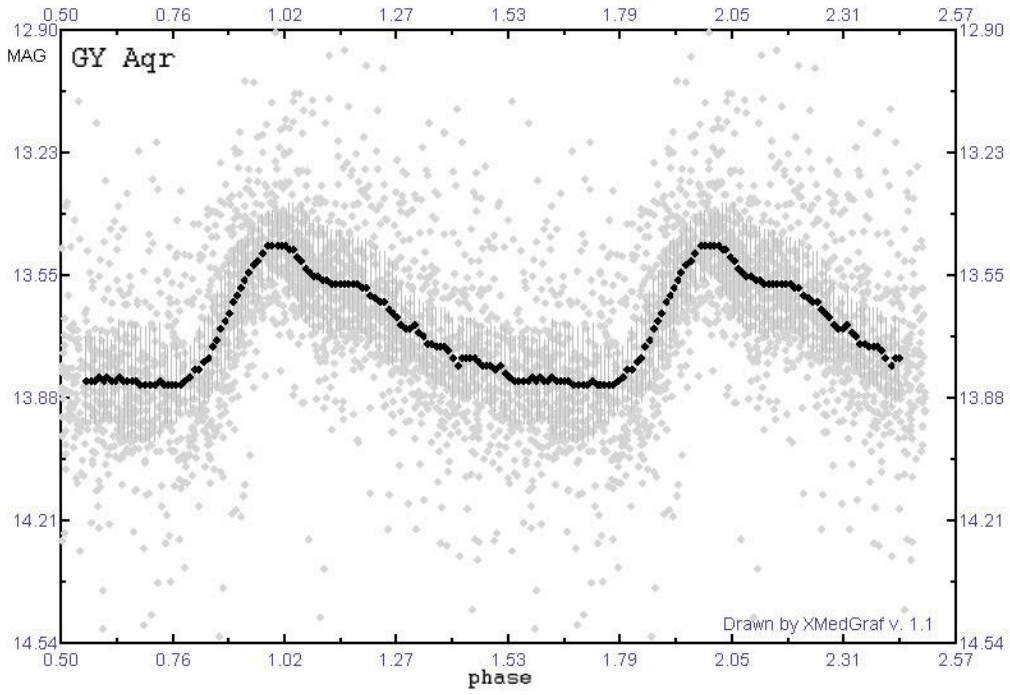

Figure 3: Smoothed phased light curve of GI Aqr based on the new elements.

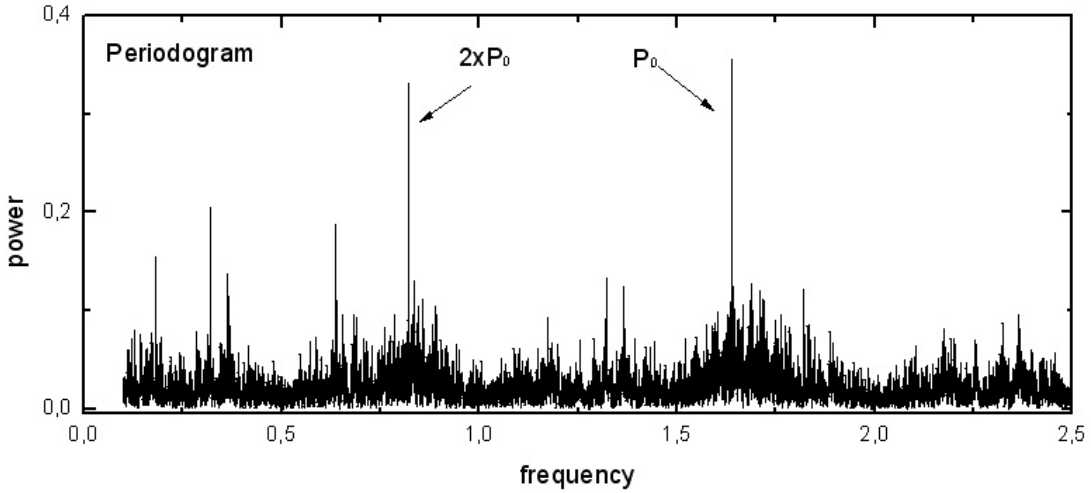

Figure 4: Periodogram for GI Aqr based on ROTSE, ASAS-3 and OMC data shows period 0.6097 d.

Smoothed phased light curve is presented in Figure 3 and the periodogram in Figure 4. Highest peak corresponds with the period P_0= 0.6097 d and the peak near the frequency 0.8 is double of the main period. More interesting results can be obtained when only the OMC data are analyzed. These data covers 3.5 days with no gap and exhibits variations from cycle to cycle as showed in Fig. 1 in season one.

Periodogram based only on these data is shown in Fig. 5. Peaks marked as P_0 are the same as in Figure 4. Peak marked as P_1 corresponds with period 2.8952, which is 4.7 times longer then P_0. It is probably not an alias, but represents mean magnitude variations from cycle to cycle showed in Fig. 1. More data needed to prove cycle to cycle variations.

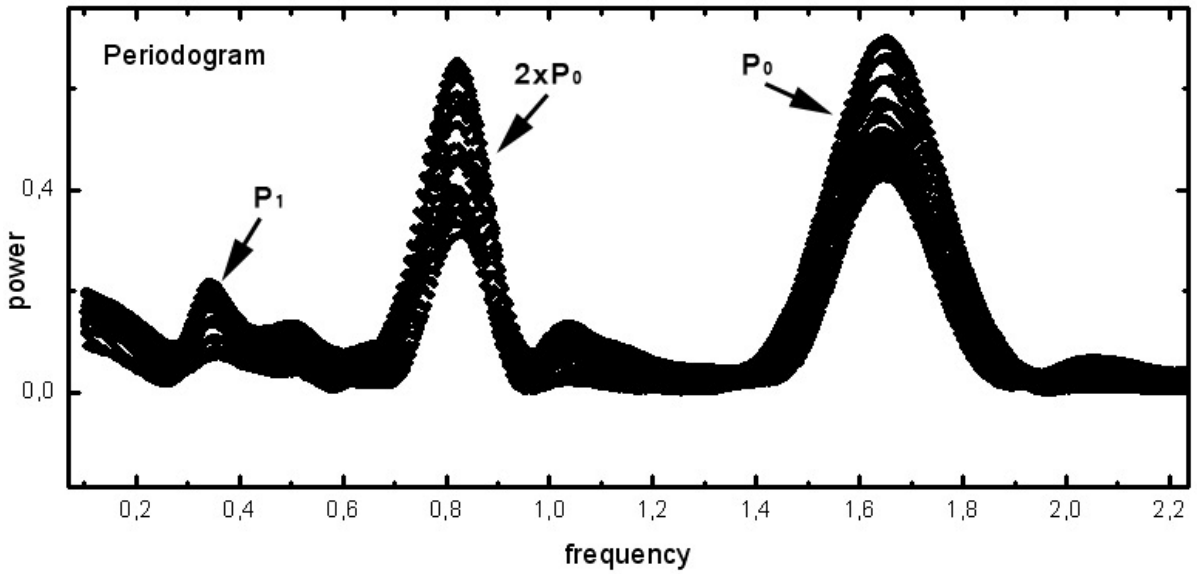

Figure 5: Periodogram for GI Aqr based only on the OMC data from the first season.

Maxima timings of GI Aqr:

JDhel	*instrument*	*author*
2451520.150	ROTSE	A. Paschke
2452385.344	ASAS-3	A. Paschke
2452632.898	OMC	this paper
2452633.494	OMC	this paper
2452634.120	OMC	this paper

2452634.717	OMC	this paper
2452635.318	OMC	this paper
2452951.782	OMC	this paper
2452952.391	OMC	this paper

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