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# Photometric observations of asteroids – in support of the Gaia Mission

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## Abstract

Photometric observations of four asteroids are presented. They were performed simultaneously with the Gaia spacecraft, within the Gaia-GOSA programme.

## 1. Introduction

Asteroid photometry gives clues about asteroid surface physical properties and compositions since more than 100 years. The most significant progress in the last decade was driven by spacecraft observations [1]. Huge contribution is delivered by Gaia mission due to its accurate photometry, astrometry and low-resolution spectra [2]. It opens new perspectives for improvement of ground-based observations: first, observers got much more dense set of calibration stars with precision of few millimag [3], second – ground based observations can be calibrated by Gaia observations executed at the same time.

In my amateur work I focus on asteroid astrometry and photometry contributing to the Gaia-GOSA (Gaia-Groundbased Observational Service for Asteroids) programme. According to authors of the tool, "the data collected by the GOSA community will be exploited to enhance the reliability of the Gaia's Solar system science" [4].

## 2. Telescopes

### 2.1 Nerpio (Spain)

In Nerpio a remote Corrected Dall-Kirkham (PlanWave) 12.5" (f/8) telescope with Finger Lakes Instrumentation ProLine 16803 cooled camera (front-iluminated KAF-16803, diam. 52.1 mm, 9.0 µm pixel) and Astrodon L, Ha, SLOAN i', r', g' filters is used.

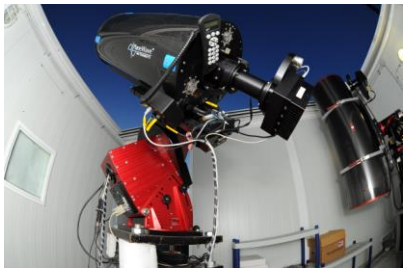

Figure 1: The Nerpio telescope.

### 2.2 Lusowko (Poland)

In Lusowko a Celestron Rowe-Ackermann-Schmidt Astrograph 11" (f/2.2) with high sensitive ZWO ASI290MM (2.9 µm pixel) and ZWO ASI1600MM (3.8 µm pixel) cooled CMOS mono cameras with the 12bit A/D converter are used. This system takes advantage of speed, sensitivity and low read-noise of the CMOS cameras to collect high frequency frames for better astrometry and photometry reduction. The site is registered in IAU as K80 "Lusowko Platanus Observatory".

## 3. Observations

In 2017 the following observations were submitted to Gaia-GOSA:

Table 1: Asteroids observed in 2017

| Object | Date | Vmag |
|---|---|---|
| 774 Armor | 22/23.05.2017 | 13.90 |
| 409 Aspasia | 23/24.05.2017 | 11.64 |
| 409 Aspasia | 24/25.05.2017 | 11.66 |
| 387 Aquitania | 05/06.06.2017 | 11.78 |
| 387 Aquitania | 06/07.06.2017 | 11.79 |
| 387 Aquitania | 07/08.06.2017 | 11.80 |
| 704 Interamnia | 23/24.07.2017 | 10.99 |

## 4. Reduction

All observations have been performed in the observatory in Nerpio. All frames have been calibrated with the bias, dark and flat field frames. In Gaia-GOSA programme full photometry reduction is performed by professional astronomers and final result comes from observations received from many observers around the world. This cooperative work produces quality lightcurve of an asteroid and hence its period.

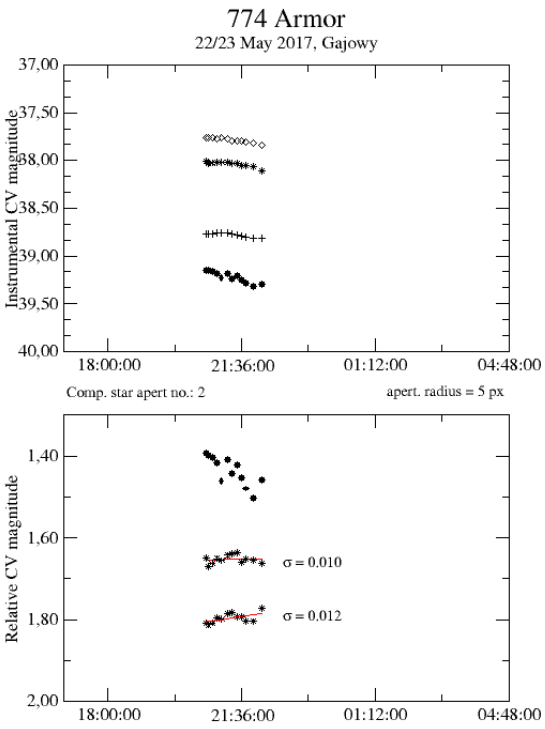


Figure 2: Lightcurve of 774 Armor observed at Nerpio and reduced by the Gaia-GOSA operators. The observations were done through the Astrodon Cousins-V filter. The upper plot shows the instrumental magnitudes which are used to trace weather conditions. The lower plot presents differential magnitudes of the asteroid and comparison stars. It is assumed that the latter should be constant so the scatter of their magnitudes is a measure of the photometric accuracy.

## 5. Summary and Conclusions

Cooperation between amateur astronomers and professionals in Gaia-GOSA program brings added values for both: professional astronomers got much more quality observations done and amateurs can improve observation skills and have significant input in science. Technological progress increases availability of quality equipment for amateurs and opens areas reserved for professionals so far. It can be assumed that cooperation between both groups will intensify in coming years with benefit to science.

## 6. Future work

The involvement in Gaia-GOSA is not my only activity in asteroids. In May 2018 I observed 1627 Ivar from Lusowko Platanus Observatory. The goal was to check if CMOS cameras are suitable to obtain a quality lightcurve and if frequent sampling would improve the quality. Approximately 28k frames have been taken on 3 successive nights covering 3 full periods. The reduction is ongoing and results will be presented during the Congress.

Additionally, in the future work I will check how short-exposure photometry can be used for fast-movers (NEOs) and fast rotators.

## Acknowledgements

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I am also grateful to Dr. Dagmara Oszkiewicz for encouraging me to publish some results of my observations.

## References

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