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Small telescope stellar object light curve measurements

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Abstract

Taurus Hill Observatory (THO), observatory code A95, is an amateur observatory located in Varkaus, Finland. The observatory is maintained by the local astronomical association Warkauden Kassiopeia.

THO research team has observed and measured various stellar objects and phenomena. Observatory has mainly focused to asteroid and exoplanet light curve measurements, observing the gamma rays burst, supernova discoveries and monitoring and long term monitoring projects.

2. Light curve measurements of asteroids

In every night there are visible many asteroids which can be easily detected with amateur devices. If a telescope has been equipped with a CCD camera, variation of brightness can be measured. The brightness variation of one rotation period can be presented as a light curve. When the variation of brightness is observed in some different sections of an asteroid orbit the shape of the asteroid can be calculated.

THO research team has measured 15 light curves of the different asteroid at THO during the last a couple of years. Because the rotation period is often 5 - 10 hours this will usually means the doing of the measurements for all night long. Because of the quite fast relative move of asteroids the exposure time must be short, this means about one minute. However this is generally enough when using photometric R filter because the brightness of targeting objects have been between 11 and 13 magnitudes.

Our observations were submitted to the SAPC supported by the University of Helsinki. These results were analyzed by researcher *Johanna Torppa*. Her doctoral thesis "Light curve inversion for asteroid spins and shapes" [1], were accepted in December 2007.

3. The observing measurements of OJ287 at THO

OJ287 has been perceived at THO since December 2006 to October 2008 about 50 times. The measurements have been normally made once a week according to the prevailing weather conditions. The target has usually been imaged with the exposures of 300 or 600 seconds through the photometric R filter and on each observation night 3 - 6 times. In our photometric measurements we have used the finding chart and the brightness list of the check stars which are read on the project pages of OJ287: *www.astro.utu.fi/OJ287MMVI/*. The observation results have been submitted Dr. *Kari Nilsson* from Tuorla Observatory. We usually have achieved brightness precision of 0.01 magnitudes. Our results have been in harmony with the measurements done by others around the world. At the moment OJ287 can be perceived very down over the horizon on the eastern sky about at four o'clock in the morning. Because of this the measurements have been difficult to do in previous months. THO OJ287 measurements were used in the publication that was published in Nature, April 2008 [2].

4. The gamma ray bursts observations

Swift satellite can observe very short gamma ray burst of distant galactic objects. From these detections also amateurs can get quick messages via GCN circulars by e-mail. While working at THO we are possible to change our observing target to GRB position in few minutes after getting a new GCN message. Optical afterglows of these phenomena are seen only some hours after GRB detection. But they are often so bright that many amateur telescopes can detect them. At THO was imaged GRB afterglow first time in October 2007. The object got a code name GRB071020. This was in same time one of the most distant objects ever observed in Finland. Its red shift was z ~ 2.145. The second GRB afterglow was

GRB080319B which we were able to image at 19th of March in 2008. That object was possible the most distant object which could be seen by naked eye. Its visual brightness was so high as 5.7 magnitudes though the distance was even 7.5 billion lys. The latest, the seventh one, GRB afterglow observed at THO was 2009 October 24th, GRB091024. Some GRBs can counterpart with peculiar supernovae. This kind of afterglow of GRB060218 was observed at THO many weeks after the detection of gamma ray burst. The object was classified as type I b/c supernova

5. Supernova discoveries and observations

THO has been the most active supernovae observer in Finland. The observatory research team has discovered nine new supernovae from the northern part of the sky. Observatory has also monitored few interesting supernovae. For example the measurements from the supernova SN 2008ha were used in the Nature article [3] published June 2009.

6. Exoplanet light curve measurements

Exoplanets have been one of the specialties of the THO research team. The team has been made now some years light curve measurements about the exoplanets. To this date the team has measured 20 different exoplanet light curves and some of them many times. The measurements have been added to AXA-database that is maintained by *Bruce L. Gary*. Our highlights in the exoplanet research are the measurements made from the GJ436b and HAT-P-13. THO research team presented its exoplanet research results in the EPSC 2009, Potsdam, Germany [4].

7. Summary and Conclusions

Taurus Hill Observatory has a good record in field of astronomy and especially in light curve measurements and long term photometric monitoring. The research team of the observatory has possibility and knowledge for making a good and high quality photometric light curve measurements. The publication record is one of the good examples from this knowledge. In the future the THO research team aims for more challenging astronomical research projects.

As a conclusion it can be stated that it is possible to do high quality astronomical research with amateur astronomy equipment if you just have the enthusiasm and knowledge to use your equipment in the right way.

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