## VIDOJEVICA PROGRESS REPORT 2012

### M. BOGOSAVLJEVIĆ

### Astronomical observatory, Volgina 7, 11060 Belgrade, Serbia E-mail mbogosavljevic@aob.rs

**Abstract.** We present an overview of our results on the development of the Astronomical Station Vidojevica (ASV) site in 2012. After a period of infrastructure development, instrument installation and testing, the 60 cm telescope is now regularly performing science observations for three projects from Astronomical observatory in Belgrade. We describe our other scientific activities, student training sessions and educational seminars held in 2011 and 2012. We also present the status of design and acquisition of the new 1.5 m-class robotic telescope "Milanković".

### 1. INTRODUCTION

The Astronomical Observatory of Belgrade (AOB) has performed preliminary investigations towards identifying a new observatory site, away from its current location in Belgrade, since the early 1980's. One complete issue of the Publications of the Astronomical Observatory of Belgrade, entitled "Astroclimatic explorations for site selection of the high altitude station of the Belgrade Observatory" has been devoted to investigations of the candidate sites (see Arsenijević et al., 1981 and other references in the same volume). The peak of Mt. Vidojevica (elevation 1155 m asl.) near Prokuplje has been considered favorable for a new astronomical station based on these works. The interest in the site gained momentum around the year 2000 with an initiative at the Department of Astronomy, Faculty of Mathematics, University of Belgrade, which led to the start of construction of the Astronomical Station Vidojevica (ASV) in 2003 (Ninković et al., 2007). Some basic local climate investigations have been attempted in Mijajlović, 2006 and Jovanović, 2012.

However, the installation of the first telescope at the ASV site, the 60 cm Cassegrain, started only in the Fall of 2010. In the past two years, supporting infrastructure at the site has been completed, including Internet connection, installation of an automated meteorological station, all-sky camera and a seeing monitor. A number of upgrades to the original design of the dome and building were also proven necessary. For example a separate warm observing room (prefabricated container) has been added in the Fall of 2011 and it now contains all the computer and supporting electronic equipment necessary for the operations of the telescope. The dome rotation motors and controls were redesigned in 2012 in order to allow for integration in with the telescope control system. Finally, a system containing temperature sensors, humidity sensors and

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hardware limit switches for the telescope itself was designed and installed in 2012 as well.

Figure 1: The infrastructure at Astronomical Station Vidojevica and the 60 cm telescope. Top left: the dome building for the 60 cm telescope. Bottom left: the lodging building. Right: the 60 cm telescope, manufactured by Astro Optik.

## 2. ASV SCIENCE OBSERVATIONS IN 2011 AND 2012

Since the second half of 2011 the 60 cm telescope at ASV has been operational in a "shared-risk" mode, during which the telescope has been tested and supporting infrastructure, software and hardware for the instruments and automated dome operation were still in some development. Some results of the telescope and instruments testing have been published during 2012 (Cvetković et al. 2012, Vince and Jurković 2012, Stojanović et al. 2012, Vince 2012).

First astrometric observations of asteroids in the Solar system from ASV have been performed in November 2011 (Bogosavljević and Smolić, 2011). After verification of the precision achieved, Minor Planet Center (MPC) of the IAU has included ASV in its list of observatories that are eligible to report measurements for positions of moving bodies. The observatory code assigned by MPC for ASV is C89. To our knowledge this is only the second permanent observatory facility (of any size) in Serbia registered with the MPC, the first one being the AOB itself with code 057.

The winter of 2011/2012 was exceptionally severe in Serbia. As a result of unusually heavy snowfall, the site itself was inaccessible for a period of more than two months. Regular activities at ASV resumed only in March 2012.

In 2012, three science projects from AOB were assigned regular observing time slots and corresponding observations were performed at ASV:

• Photometric light curves of close binary systems (PI Gojko Djurašević),

- Orbits of visual binary star systems (PI Rade Pavlović),
- Optical observations of reference extragalactic radio sources (PI Goran Damljanović).

In addition, ASV has participated in its first international collaborative observing campaign in June 2012. Christopher Mauche from Lawrence Livermore National Laboratory and colleagues from Spain and Oman have requested observations in support of a multiwavelength observational campaign<sup>1</sup> of object AE Aqr, and intermediate polar cataclysmic variable. The 60 cm telescope at ASV took part by providing optical B-band photometry taken during nights of June 14 - 18 (Figure 2.) in synchronization with observations taken by Swift satellite, MAGIC Cherenkov telescope on La Palma and 0.6 m KVA (La Palma) and 1.3 m Skinakas (Crete) optical telescopes (Ioannou, these proceedings).



Figure 2: An example of AE Aqr photometry in B-band, taken with 60 cm telescope at ASV. The brightness of the object was measured at roughly 14 second intervals using Alta Apogee U42 CCD camera.

Due to two very long interruptions caused by the technical problems we have experienced with the telescope and dome in summer of 2012, the total time spent observing on-source in 2012 was only about 40 nights. However, after overcoming these initial difficulties, we expect that in 2013 we will be able to utilize most of clear nights at ASV. At the time of writing of this contribution, the 60 cm telescope is capable of operating in a remote observer mode, with the observer controlling the telescope in real-time via the Internet. The telescope dome tracks the position of the telescope automatically, though the opening and closing of the dome still must be performed manually. We will continue the upgrade of the telescope dome to enable

<sup>&</sup>lt;sup>1</sup>http://www.aavso.org/aavso-alert-notice-458

a full remote and robotic operation (e.g. scheduled observations) with the 60 cm telescope in the near future. This will drastically increase the effective on-source time we can achieve with the 60 cm telescope.

# 3. EDUCATION AT ASV IN 2011 AND 2012

Educational activities in astronomy are considered an integral part of the role of ASV in Serbia. The observatory site does not yet have the resources and staff to handle interested visitors on a daily basis, however, special seminars for groups of up to 50 people can be organized with the help of AOB staff and University lecturers. Below we will describe our educational activities in the past year, presented in chronological order.

While still in the early phase of testing operations with the 60 cm telescope, the ASV has taken part in the SEENET-MTP seminar series of lectures, during the Balkan Summer Institute 2011 (BSI<sup>2</sup>). The part of the BSI seminar at ASV (August 19-21, 2011), was jointly organized by SEENET-MTP Network and its Office at the Faculty of Science and Mathematics Niš, Physical Society Nis in cooperation with UNESCO Venice Office, Faculty of Physics University of Craiova and Astronomical Observatory Belgrade (Project BELISSIMA). Two lectures were presented during the course of a half-day visit to the ASV site: one about ASV in general and the other about Astronomy via the Internet (lecturers O. Vince and M. Bogosavljević). The audience of about 50 participants, comprised for the most part of physics teachers and university faculty, also made a brief visit to the 60 cm telescope where a presentation about its operations was given.

In October 2011 the ASV took an active part in the course of a science project for high-school students. The project was named MONECOM and a poster about the project was presented during the course of the "Future science with metre-class telescopes" conference (Bogdanović et al., these proceedings). The aim of the projects was to perform photometric observations of several Main Belt Comets with the 1.2 m MONET North telescope (Hessman 2007, Bischoff et al 2006). A collaboration of schools from Croatia, Greece and Serbia was created for the six nights of the observational campaign and latter data analysis. The students were supervised by their teachers and local astronomers. The group of students from Serbia received preliminary training in observational techniques at the ASV 60 cm telescope, and performed remote observations with MONET/North from ASV site on October 28<sup>th</sup> and 30<sup>th</sup>, 2011. For more information and the results, we refer the reader to the poster Bogdanović et al. in these proceedings.

Lastly, the first training session for undergraduate students of astronomy and astrophysics from University of Belgrade and University of Novi Sad was held at ASV (June 16-18, 2012). The students at ASV have attended several presentations on topics of importance for observing with optical telescopes and CCD cameras. The lecturers were Tijana Prodanović from the Physics Department, University of Novi Sad, Dragana Ilić from Department of Astronomy, University of Belgrade and Milan Bogosavljević from AOB. With the ASV 60 cm telescope the students performed CCD photometry of optical transient sources reported by the Astronomer's Telegram (Rutledge, 1998) and Skyalert.org (Williams et al, 2009). This observing session was

<sup>&</sup>lt;sup>2</sup>http://bsw2011.seenet-mtp.info/



the first in what is to become a yearly event of student practice sessions with the 60 cm telescope at Vidojevica.

Figure 3: Undergraduate students during a training session at ASV in June 2012.

# 4. MOVING ON TO PHASE II: THE 1.5 m-class TELESCOPE

The plans for Phase II of the site development include a construction of what would be the main instrument of ASV site, a 1.5 m-class optical telescope "Milanković". The purchase of the new telescope has been supported by grants from the European Commission (project BELISSIMA) and Ministry of Education, Science and Technological development of the Republic of Serbia.

The purpose of the new telescope is to bring back AOB to the forefront of observational astronomy in the region of Western Balkans. The cost constraints have set constraints to proceed with a common and simple telescope design for photometry and low-resolution spectroscopy, but with capability of full autonomous robotic operation.

Some key features of the telescope are:

- Primary mirror diameter 1.5 m-class (depending on cost),
- Field of View 30 arcmin,
- Focal length f/8 (12 meters),
- Nasmyth and/or Cassegrain foci,
- One CCD and one low-res spectrograph permanently mounted.

The time allocation strategy for the telescope "Milanković" has been envisioned to include the following applications, with provisional percentages of allocated time given here:

- AOB key science projects (about 50% of time),
- Collaborative long-term campaign (about 30% of time),
- Training of students (10%),
- Follow-up of optical transients (Targets of opportunity) (5%),
- Instrument development / testing (5%).

The envisioned modes of operation of the telescope include direct on-site observing, full remote control in real time over the Internet and fully robotic queue-scheduled observations. The real-time status of the telescope would be available on-line to the community for short-response observation requests. Our long-term goal is to integrate the 1.5 m telescope (and its instruments, with automated data reduction) within a large network of robotic telescopes.

Currently the instruments at ASV are maintained by AOB staff (traveling to site). As the project develops with the construction of the 1.5 m telescope, our staff will eventually have to include a local technical daytime crew and public relations personnel for organized visits and lectures for the public.

The process of the telescope design, purchase and installation has experienced significant delays due to the local political instability in Serbia in 2011 and 2012. Eventually the co-financing by the government of Serbia has been secured for the new instrument, whereas the financing for the infrastructure is still not resolved. The initial plan was for the telescope to be installed by the end of 2013, however, our current best estimate envisions the telescope on site by the mid-2015.

### 5. CONCLUSIONS

The activities at Astronomical Station at Vidojevica since the Fall of 2011 have been described. After a period of work on improving the infrastructure at ASV and installing and testing of the instrument, three science projects from AOB have been regularly using the 60 cm telescope for their science observations. The 60 cm telescope has been registered with Minor Planet Center as observatory C89. In June 2012, the ASV took part in its first international observing campaign in June 2012, providing observations of cataclysmic variable AE Aqr in synchronization with other optical observatories, Swift satellite and MAGIC Cherenkov telescope on La Palma.

Due to a number of interruptions in operations and technical problems, all projects have been able to observe on only about 40 nights in total in 2012. However, a lot of effort has been invested in improving the infrastructure at ASV in order to enable remote observing sessions with the 60 cm telescope, which should increase the observing time which is efficiently used.

There have been a number of activities at ASV related to education and student training. The ASV took part in Balkan Summer Institute 2011, MONECOM project

for high-school students and hosted the first training session in observational astronomy for undergraduate students from University of Belgrade and University of Novi Sad.

The next phase of the development of ASV is the construction of what is to become its main instrument, a 1.5 m class robotic telescope. We describe the plans for the telescope design, modes of operation and time allocation strategy. After experiencing significant delays, due to the problems with co-financing by the government of Serbia, the current best estimate is that the telescope "Milanković" will be installed on site by the mid-2015.

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#### References

- Arsenijević, J., Kubičela A., Vince I., Djurašević G., Ivanović Z.: 1981, *Publ. Astron. Obs. Belgrade*, **31**, 89.
- Bogdanović, T., Smolić, I., Milić, I., Bogosavljević, M., this proceedings
- Bogosavljević, M., Smolić, I.: 2011, Minor Planet Circular, 76875, 10
- Hessman, F., 2007, Astronomische Nachrichten, Vol.328, Issue 7, pp. 681
- Bischoff, K., Tuparev, G., Hessman F.V., Nikolova, I.: 2006, Observatory Operations: Strategies, Processes, and Systems, Proceedings of the SPIE, 6270, 62701Q.
- Cvetković, Z., Damljanović, G., Pavlović, R., Vince, O., Milić, I. S., Stojanović, M. 2012, Serb. Astron. J., 184, 97.
- Jovanović, M., Stojanović, M., Martinović, N., Bogosavljević, M., Smolić, I., Acković, B.: 2012, Publ. Astron. Obs. Belgrade, 91, 83.
- Mijajlović, Z., Valjarević, A., Simonović, A.: 2006, Publ. Astron. Obs. Belgrade, 80, 361.
- Ninković, S., Pejović, N., Mijajlović, Ž.: 2007, Astronomical Society of the Pacific, Solar and Stellar Physics Through Eclipses ASP Conference Series, **370**, 308.
- Rutledge, E.R., 1998, *PASP*, **110**, 754.
- Stojanović, M., Pavlović, R., Cvetković, Z., Vince, O.: 2012, Publ. Astron. Obs. Belgrade, 91, 169.
- Vince, O., Jurković, M.: 2012, Publ. Astron. Obs. Belgrade, 91, 77.
- Vince, O.: 2012, Serb. Astron. J., 185, 65
- Williams, R. D., Djorgovski, S. G., Drake, A. J., Graham, M. J., Mahabal, A.: 2009, Astronomical Society of the Pacific, Astronomical Data Analysis Software and Systems XVIII ASP Conference Series, 411, 115.

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